



The impact of intellectual capital on firms' market value and financial performance

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Abstract

Purpose – Intellectual capital (IC) shows a significant growing acceptance as a worthy topic of academic investigation and practical implication. The purpose of this study is to examine the impact of IC on firms' market value and financial performance.

Design/methodology/approach – The empirical data were drawn from a panel consisting of 96 Greek companies listed in the Athens Stock Exchange (ASE), from four different economic sectors, observed over the three-year period of 2006 to 2008. Various regression models were examined in order to test the hypotheses included in the proposed conceptual framework.

Findings – Results failed to support most of the hypotheses; only concluding that there is a statistically significant relationship between human capital efficiency and financial performance. Despite the fact that IC is increasingly recognised as an important strategic asset for sustainable corporate competitive advantage, the results of the present study give rise to various arguments, criticism and further research on the subject.

Research limitations/implications – The lack of available data for the appropriate analysis, the investigation of four sectors of economic activity and the relatively narrow three-year period for data collection are the main limitations of the present study.

Practical implications – Results proved that, in the Greek business context, the development of human resources seems to be one of the most significant factors of economic success. Focusing on human capital should, therefore, be at the centre of the companies' attention.

Originality/value – The present study combines previous methodologies in order to investigate certain causal relationships considering the IC of Greek listed companies. The value of the paper is the empirical investigation of these relationships in the context of the Greek economy and the enrichment of the literature with another paper that follows the value-added intellectual coefficient methodology for the measurement of IC.

Keywords Intellectual capital, Market value, Financial performance, Organizations, Greece

Paper type Research paper



1. Introduction

Intellectual capital (IC) can be briefly defined as the knowledge-based equity of organizations and has attracted, during the last decade, a significant amount of practical interest (Campisi and Costa, 2008; Petty and Guthrie, 2000). Although the importance of IC is constantly increasing, many organizations face problems with its management, mostly due to measurement difficulties (Andrikopoulos, 2005; Kim *et al.* 2009, Nazari and Herremans, 2007).

The increasing gap observed between market value and book value of many companies has drawn attention towards investigating the value missing from financial statements. According to various scholars, IC is considered to be the hidden value that escapes financial statements and the one that leads organizations to obtain a competitive advantage (Chen *et al.*, 2005; Edvinsson and Malone, 1997; Lev and Radhakrishnan, 2003; Lev and Zarowin, 1999; Lev, 2001; Ruta, 2009; Yang and Lin, 2009). Additionally, it is believed that the limitations of financial statements in precisely explaining firm value reveal the fact that, nowadays, the source of economic value is the creation of IC and no longer the production of material goods (Chen *et al.*, 2005).

The widespread acceptance of IC as a source of competitive advantage led to the development of appropriate methods of measurement, since traditional financial tools are not able to capture all of its aspects (Campisi and Costa, 2008; Nazari and Herremans, 2007). Pulic (2000a, b) developed the most popular method that measures the efficiency of value added by corporate intellectual ability (value added intellectual coefficient (VAIC)). VAIC measures the efficiency of three types of inputs: physical and financial capital, human capital, and structural capital (Firer and Williams, 2003; Montequin *et al.* 2006; Public, 2000a, b).

The main objective of the present study is to examine the relationship between IC, market value and financial performance. The methodology for the measurement of IC was based on the studies of Firer and Williams (2003) and Chen *et al.* (2005). The empirical investigation was conducted using data drawn from a panel consisting of 96 Greek companies listed in the Athens Stock Exchange (ASE), from four different economic sectors (period 2006 to 2008). Moreover, based on the aforementioned VAIC methodology, the study, analytically examines the separate effects of capital employed efficiency, human capital efficiency, and structural capital efficiency on market value and financial performance.

The following section includes a short literature review concerning the main variables of the study. In the third and fourth section, the proposed conceptual framework and the research methodology are being presented. The results, conclusions, study limitations and future research are discussed in the sections 5, 6 and 7 respectively.

2. Literature review

Various attempts have been made towards developing a widely accepted definition of IC, until most authors finally agreed on its basic parameters. Klein and Prusak (1994) contributed to the creation of a universal definition by defining IC as the intellectual material that can be formalised, captured and leveraged to produce a higher value asset. In the same vain, Edvinsson and Malone (1997) defined IC as the knowledge that can be converted into value. Stewart (1997) argued that intellectual resources such as knowledge, information and experience, are the tools for creating wealth and defined IC

as the new wealth of organizations. Sullivan (2000, p. 17) defined IC as “knowledge that can be converted into profits”.

According to Edvinsson and Malone (1997) IC can be also defined as the gap that is observed between a firm’s book and market value. Also, Kok (2007) argued that a method for determining the intellectual (intangible) assets of a company is to compare market to book value. These arguments are based on the nature of IC. The intellectual assets of a company are intangible in nature and, thus, do not have a certain shape or an appropriate financial value. They are characterised as “hidden assets”, since it is difficult to identify their contribution to a firm and quantify them in a financial statement (Edvinsson, 1997; Fincham and Roslender, 2003).

The observed gap between market and book value that has been highlighted in the bibliography (Andrikopoulos, 2005; Chaminade and Roberts, 2003; Fincham and Roslender, 2003; Lev and Radhakrishnan, 2003; Lev and Zarowin, 1999; Lev, 2001; Tseng and Goo, 2005; Zerenler and Gozlu, 2008) can be, therefore, attributed to the IC assets that are not recognised in balance sheets (Chaharbaghi and Cripps, 2006; Brennan and Connell, 2000). The role of IC in filling the gap between book and market value has brought even wider research attention towards the investigation of its nature (Chen *et al.*, 2005).

Although there is a variety of IC definitions, mostly due to the fact that both knowledge-based and economic-based approaches exist (Burr and Girardi, 2002; Walsh *et al.*, 2008), a considerable number of scholars and practitioners identify three basic components of IC; human capital, structural capital and customer (relational) capital (Bontis, 1998; Edvinsson, 1997; Holton and Yamkovenko, 2008; Mavridis and Kyrmizoglou, 2005; Ruta, 2009; Tayles *et al.*, 2007; Yang and Lin, 2009; Zerenler and Gozlu, 2008; Wall, 2007; Walsh *et al.*, 2008).

The above categorisation, early manifested itself into the IC literature, led to the development of a method of indirect IC measurement. More specifically, Bornemann *et al.* (1999) argued that IC can be measured by the accumulate value of three categories of indicators; human capital (knowledge, skills), structural capital (databases and organizational structure) and customer capital (supplier and customer relations). The usefulness and importance of IC indicators was, moreover, highlighted by Brennan and Connell (2000). Moreover, Sullivan (2000) supported that the various difficulties that are inherent to the direct measurement of IC can be resolved by using individual indicators. The same approach has been supported and utilised by various researchers (Andriessen, 2007; Andrikopoulos, 2005; Chaminade and Roberts, 2003; Montequin *et al.*, 2006; Tseng and Goo, 2005; Wall, 2007).

Pulic (2000a, b) developed a convenient method of measuring IC. He argued that the market value of organizations is created by capital employed and IC, the latter consisting of human and structural capital. The method Pulic (2000a, b) proposed aims to provide information about the value creation efficiency of both tangible (capital employed) and intangible (human and structural capital) assets of an organization. This method is named VAIC and is distinguishable because it indirectly measures IC via the measurement of capital employed efficiency (VACA), human capital efficiency (VAHU), and structural capital efficiency (STVA). The higher the VAIC, the better the utilisation of the value creation potential of a firm. The VAIC approach is being adopted in the present study, following the methodological framework of Firer and Williams (2003) and Chen *et al.* (2005).

Despite the inherent limitations of VAIC as a method of measuring IC (discussed in a following section of the paper), its simplicity, subjectivity, reliability and comparability make it an ideal measure for the context of the present study. More specifically, according to Andriessen (2004), the use of VAIC as an indicator of IC is justified by the sufficient availability of the financial data that the model uses as inputs. Additionally, according to Schneider (1998), the danger of losing track of the main objective of a study arises when the procedures to collect and process the appropriate data become exceedingly sophisticated. Taking that into consideration, the simplicity of VAIC offers good services to researchers and, furthermore, enables cross-sectional comparisons (Schneider, 1998). Firer and Williams (2003), moreover, support the use of VAIC, mentioning that other developed models of IC measurement are, mostly, customised to fit the profile of a specific company and, therefore, lack generalisation opportunities and have limited comparability. Finally, according to Firer and Williams (2003), VAIC is argued to be an appropriate IC measurement tool due to the fact that all data applied in its calculation are based on audited information, which is objective and verifiable.

On the field of empirical research, many studies have empirically utilised VAIC as a measure of IC. Firer and Williams (2003) utilised the VAIC approach to measure the relationship between IC and traditional measures of corporate performance. They used a sample of 75 South African public traded companies, but the empirical results failed to support any relationship between the three value added efficiency components and the three dependent variables (profitability, productivity and market value). Their findings revealed that South African companies depend mostly on their tangible resources, pay the least importance to structural capital, while on the other hand, the market seems to react negatively to firms that concentrate solely on the enhancement of human assets. Overall, the findings of Firer and Williams (2003) suggest that physical capital in South Africa remains the most significant underlying resource of corporate performance, despite efforts to increase the IC base of the country.

Chen *et al.* (2005) conducted an empirical investigation on the relationship between IC, market value and financial performance. They used a large sample of Taiwanese listed companies and utilised Pulic's (2000a, b) VAIC. Their study underlined the importance of IC in the enhancement of firm profitability and revenue growth. The empirical results proved that:

- investors value higher companies with better IC efficiency; and
- companies with better IC efficiency obtain a higher degree of profitability and revenue growth in the current and following years.

Chen *et al.* (2005) concluded that IC is indeed a significant strategic asset, since it is positively related to the firm's market value and financial performance.

The VAIC approach, developed by Pulic (2000a, b), has been, moreover, adopted in various other studies, mostly in those conducted in emerging and developing countries. Muhammad and Ismail (2009) tried to investigate the efficiency of IC and its performance in Malaysian financial sectors, based on data from 18 companies for the year 2007. It was found that the banking sector was the one relying the most on IC, followed by companies of the insurance sector and the brokerage sector. It was also found that IC has a positive relationship with company performance (measured by profitability and ROA), but, on the other hand, it was discovered that in Malaysian

financial sectors, market value is created more by capital employed (physical and financial) rather than IC. This last finding of Muhammad and Ismail (2009) was consistent with a previous study conducted in the same country over the period 2001 to 2003 (Goh, 2005), where it was found that Malaysian banks with satisfactory financial performance (measured by traditional economic measures) had low IC coefficients.

On another study conducted in the banking sector of Turkey, Samiloglu (2006) tried to determine whether a significant relationship between VAIC and market to book value ratio really exists. The author used data from the financial statements of banks listed in the Istanbul Stock Market over the years 1998 to 2001. The results demonstrated that there was no significant relationship between the dependent variable (MV/BV) and the independent variables (VAIC and its three components).

Gan and Saleh (2008), moreover, examined the relationship between IC and corporate performance of technology-intensive firms listed on Bursa (Malaysia), by investigating whether value creation efficiency (measured by VAIC), can be explained by market valuation, profitability, and productivity. Overall, the study of Gan and Saleh (2008) concluded that VAIC can explain profitability and productivity, but fails to explain market valuation. On a similar study in Taiwan, Shiu (2006) found a significant positive correlation between VAIC, profitability and market valuation and a negative correlation with productivity. Tseng and Goo (2005), in an empirical study of Taiwanese manufacturers, found a positive relationship between IC and corporate value.

Tan *et al.* (2007) used the VAIC methodology to examine data from 150 listed companies on the Singapore Stock Exchange, and conclude that:

- IC and company performance are positively related;
- IC is correlated to future company performance;
- the rate of growth of a company's IC is positively related to the company's performance; and
- the contribution of IC to company performance differs by industry.

Appuhami (2007) investigated the impact of the value creation efficiency on investors' capital gains on shares. The author used data collected from listed companies in Thailand's stock market and utilised the VAIC approach. The empirical research found that firms' IC has a significant positive relationship with its investors' capital gains on shares.

In a VAIC study that was conducted in a traditional Western economy, Puntillo (2009) examined the relationship between value creation efficiency, firms' market valuation and financial performance, by using data drawn from 21 banks enlisted in the Milan Stock Exchange, Italy. Results failed to show any positive significant association between the studied variables, except from the relation between capital employed efficiency (a component of VAIC) and different measures of firm's performance.

Finally, in an exploratory study, Mohiuddin *et al.* (2006) used VAIC to measure the IC performance of 17 commercial banks in Bangladesh for the period 2002 to 2004. According to their findings, all 17 banks of the sample had relatively higher human capital efficiency than other capital efficiencies.

In one of the very few IC studies that have been conducted in Greece, Mavridis and Kyrmizoglou (2005) used data from the banking sector for the period 1996-1999 and

concluded that there is a positive correlation between value added and physical capital, but especially between value added and human or IC. Authors make a note implying that results may be over over-positive, due to the fact that the Greek banking sector was on a significant upward trend for the period under investigation.

3. The conceptual framework

The present study introduces a conceptual framework that expands on previews methodologies (Bontis 1998; Bontis *et al.*, 2000; Chen *et al.*, 2005; Firer and Williams, 2003; Mavridis, 2004; Pulic 2000a, b) and investigates the relationship between IC, market value and financial performance. The hypotheses of the study are presented below.

3.1 IC and market value

According to the traditional accounting practices the book value of an organization is solely calculated from its financial statements. The simplistic method of such a calculation includes subtracting liabilities from the firm's total assets. As a result, conservative accounting practices failed to account one the most important intangible assets of every organization: IC (Sveiby, 2000, 2001). The gradual introduction of the International Accounting Standards (IAS) in nearly every developed and developing country (except from the USA which is expected to implement the IAS in the next five years) forced companies to calculate assets at their real market value, while giving full definition and credit to all intangibles (International Financial Reporting Standards, 2008). Despite that, the inability of most companies to comply with the IAS and the significant cost of such an implementation, still deteriorate the recognition of the intangible assets of every organization (Judge *et al.*, 2010).

The result of such a short seeing is a growing divergence between the market and book value of organizations. In other words, the market estimates the value of companies with high intangible assets (IC) to be significant higher than the calculated book value (Chen *et al.*, 2005; Firer and Williams, 2003; Riahi-Belkaoui, 2003). Therefore, it is hypothesised that the greater the IC, the higher the ratio of market-to-book value:

H1. Companies with greater IC have higher ratios of market-to-book value.

The above hypothesis uses VAIC as an aggregate measure for corporate intellectual ability (IC). As stated earlier in the paper, VAIC includes three component measures: capital employed efficiency (VACA), human capital efficiency (VAHU) and structural capital efficiency (STVA). Since different significance may be put on each of the three components of VAIC, it would be interesting to examine the separate effect of each on market-to-book value ratio. Such an investigation would increase the explanatory power of the conceptual framework and give raise to interesting observations. Thus, it is hypothesised:

H1a. Companies with greater capital employed efficiency have higher ratios of market-to-book value.

H1b. Companies with greater human capital efficiency have higher ratios of market-to-book value.

H1c. Companies with greater structural capital efficiency have higher ratios of market-to-book value.

3.2 IC and financial performance

The impact of IC on financial performance has not been investigated thoroughly on an empirical level, either it has led researchers to solid and unanimous conclusions. On a theoretical level, distinguished authors argue that IC is the value driver of all companies (Stewart, 1997), that knowledge management is a core organizational issue (Nonaka and Takeuchi, 1995) and that organizational knowledge is at the crux of every sustainable competitive advantage (Bontis, 1999). On the other hand, empirical evidence are inconclusive and far from achieving a solid scientific consensus. The study of Riahi-Belkaoui (2003) found a positive relationship between IC and financial performance, while Bontis *et al.* (2000) concluded that, regardless of industry, the development of structural capital has a positive impact on business performance. On the other hand Firer and Williams (2003) examined the relationship between IC and traditional measures of firm performance (ROA, ROE) and failed to find any relationship, while Chen *et al.* (2005), using the same methodology, concluded that IC has a significant impact on profitability. The present paper makes an attempt to enrich the IC literature, thus, hypothesising:

H2. Companies with greater IC have better financial performance.

H2a. Companies with greater capital employed efficiency have better financial performance.

H2b. Companies with greater human capital efficiency have better financial performance.

H2c. Companies with greater structural capital efficiency have better financial performance.

Figure 1 summarises all the above hypotheses, thus, presenting the proposed conceptual framework of the study.

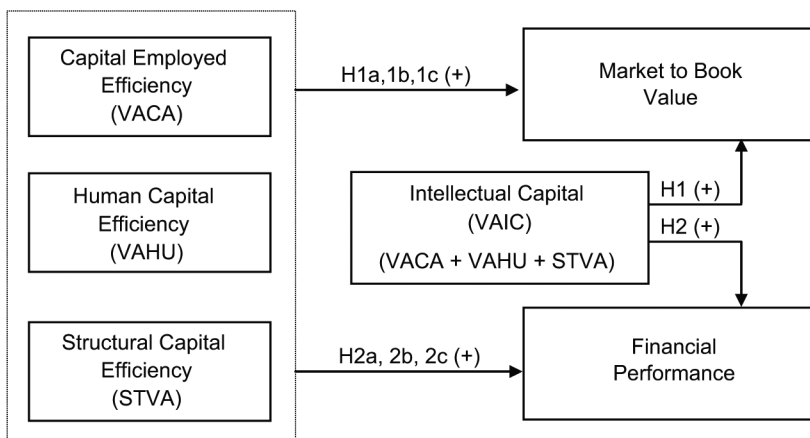


Figure 1.
The conceptual
framework of the study

4. Research methodology

4.1 Sample and data selection

The final sample of the present study consists of 96 Greek companies listed in the ASE. These companies belong to four economic sectors (according to official sector classification): Construction and Materials (20 companies), Industrial Goods and Services (23), Food and Beverage (19) and Personal and Household Goods (34 companies). The selected data cover a period of three years, from 2006 to 2008. All four sectors are knowledge based and have a significant importance to the Greek economy.

The initial target of the study was to draw data from all companies listed in the Athens Stock Exchange (approximately 280 companies with constant participation in the ASE for the three-year examination period). However, the first screening of data availability demonstrated that such an endeavour was too ambitious. The second data screening led in the exclusion of many companies, leaving the sample with only 119 companies with sufficient available data. Finally, 23 more companies were excluded from the sample after the third and most detail data screening. The high degree of excluded companies reflects the poor level of reporting of Greek listed companies. More precisely, the majority of the excluded companies provided insufficient data in more than two variables. Overall, the final sample (96 companies) represents the 34.2 per cent of the total number of listed companies in the ASE for the year 2010.

4.2 Variable definition

4.2.1 *Independent variables.* The present study includes four independent variables (Pulic 2000a, b):

- (1) VACA, indicator of value added efficiency of capital employed.
- (2) VAHU, indicator of value added efficiency of human capital.
- (3) STVA, indicator of value added efficiency of structural capital.
- (4) VAIC, the composite sum of the three separate indicators.

The first step towards the calculation of the above variables is to calculate value added (VA). VA is calculated according to the methodology proposed by Riahi-Belkaoui (2003).

Second, capital employed (CE), human capital (HU) and structural capital (SC) are being calculated:

$$CE = \text{Total assets}^* - \text{intangible assets}$$

$$HU = \text{Total investment on employees (salary, wages, etc.)}$$

$$SC = VA - HU.$$

(* In Greece, salaries are calculated in the profit and loss (P&L) statement, therefore, are already included in total assets.)

Finally, VAIC and its three components are being calculated:

$$VACA = VA/CE$$

$$VAHU = VA/HU$$

$$STVA = SC/VA$$

$$VAIC = VACA + VAHU + STVA.$$

The use of the above measurement methodology is argued to provide certain advantages (Bontis, 1999; Chen *et al.* 2005; Firer and Williams, 2003; Pulic and Bornemann, 1999; Roos *et al.*, 1997; Sullivan, 2000):

- It is easy to calculate.
- It is consistent.
- It provides standardised measures, thus, allowing comparison between industries and countries.
- Data are provided by financial statements that are more reliable than questionnaires, since they are usually audited by professional public accountants.

4.2.2 Dependent variables. The present study includes two dependent variables:

- (1) Market-to-book value ratios.
- (2) Financial performance.

The market-to-book value ratio is simply calculated by dividing the market value (MV) with the book value (BV) of common stocks:

$$MV = \text{Number of shares} \times \text{Stock price at the end of the year.}$$

$$BV^* = \text{Stockholders' equity} - \text{Paid in capital of preferred stocks.}$$

(*In all cases that goodwill was included in the book value of a company of the sample, the required subtraction was conducted.)

The financial performance is measured with the use of three indicators:

- (1) *Return on equity (ROE)*:

$$ROE = \text{Net Income} / \text{Shareholder's Equity.}$$

ROE measures an organizations profitability by revealing how much profit a company generates with the money shareholders have invested.

- (2) *Return on assets (ROA)*:

$$ROA = \text{Net Income} / \text{Total Assets.}$$

ROA is an indicator of how profitable a company is in relation to its total assets. It gives an idea as to how efficient the management uses assets to generate earnings.

(3) *Growth revenues (GR):*

$$GR = [(Currentyear's revenues / Lastyear's revenues) - 1] \\ \times 100\%.$$

GR is the most traditional measure that indicates the growth of an organization.

4.3 Regression models

In order to examine the hypotheses of the study, various regression models have been evaluated.

Models 1 and 2 examine the relationship between VAIC and market-to-book value ratio, and VACA, VAHU and STVA and market-to-book value ratio:

$$H1 : M/B = a_0 + a_1 VAIC + e \quad (1)$$

$$H1a, H1b \text{ and } H1c : M/B = a_0 + a_1 VACA + a_2 VAHU + a_3 STVA + e. \quad (2)$$

Regression models 3a to 4c examine the relationship between VAIC and financial performance (ROE, ROA, GR), and VACA, VAHU and STVA and financial performance (ROE, ROA, GR):

$$H2 : ROE = a_0 + a_1 VAIC + e \quad (3a)$$

$$H2 : ROA = b_0 + b_1 VAIC + e \quad (3b)$$

$$H2 : GR = c_0 + c_1 VAIC + e \quad (3c)$$

$$H2a, H2b \text{ and } H2c : ROE = a_0 + a_1 VACA + a_2 VAHU + a_3 STVA + e \quad (4a)$$

$$H2a, H2b \text{ and } H2c : ROA = b_0 + b_1 VACA + b_2 VAHU + b_3 STVA + e \quad (4b)$$

$$H2a, H2b \text{ and } H2c : GR = c_0 + c_1 VACA + c_2 VAHU + c_3 STVA + e. \quad (4c)$$

5. Results

5.1 Descriptive statistics and correlation analysis

Table I presents the descriptive statistics for all study variables. The market-to-book value ratio (1.694) indicates that 40.96 per cent of the firms' market value is not reflected on financial statements:

$$\text{Hidden Value} = [(1.694 - 1.000) / 1.694] * 100 = 40.96 \text{ per cent.}$$

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This finding supports previews empirical research that has underlined the existence of an increasing gap between market and book value of organizations (Lev and Radhakrishnan, 2003; Lev and Zarowin, 1999; Lev, 2001). More specifically, Lev (2001) conducted a longitudinal research in the US market (1977-2001) and concluded that about 80 per cent of corporate market value is omitted from financial statements, while this percentage seems to be on an upward trend.

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The correlation analysis provides an initial preview of the results, concluding that market-to-book value is significantly related only with one of the three components of VAIC; human capital efficiency. All other correlation indexes (M/B correlated with VAIC, VACA STVA) were not found to be statistically significant (Table II).

5.2 Hypotheses verification

Table III presents the results considering *H1* (Model 1) and Table IV the results considering *H1a-H1c* (Model 2). As seen in Table III, the explanatory power of Model 1 is minimal and, moreover, all statistical indexes fail to comply with the usual standards. Therefore, the empirical results fail to support *H1*. Moreover, results depicted on Table IV give only support to *H1b*, since the significance indices for the other two independent variables are also inadequate ($p > 0.05$).

Table I.
Descriptive statistics for
all study variables

Variable	Mean	Standard deviation	Minimum	Maximum
M/B	1.694	1.862	0.123	7.365
VAIC	4.052	2.555	-15.631	25.148
VACA	0.069	0.042	-0.092	0.236
VAHU	3.364	2.364	-16.369	24.342
STVA	0.619	0.341	-0.837	2.496
ROE	1.211	3.148	-15.689	9.361
ROA	1.123	2.333	-4.361	5.314
GR	8.311	37.318	-36.145	269.329

Table II.
Correlation analysis for
selected study variables

Variable	M/B	VAIC	VACA	VAHU	STVA
M/B	1.000				
VAIC	0.136	1.000			
VACA	0.369	0.514 *	1.000		
VAHU	0.269 *	0.789 *	0.369 *	1.000	
STVA	0.029	-0.013 *	-0.129	-0.236	1.000

Note: *Correlation significant at the 0.01 level (two-tailed)

Table III.
Regression results –
Model 1: M/B and VAIC

Independent variable	Coefficient	t-statistic	Significance
Constant	-1,971.535	-0.495	0.622
VAIC	-0.021	-0.164	0.870

Notes: Adjusted $R^2 = 0.000$; F -value = 99.36 (p -value > 0.05)

The empirical investigation failed to support the hypothesis that investors place higher value on firms with greater IC (VAIC). Nevertheless, it seems that investors take only the human capital of a company into consideration when they estimate its real value. Therefore, results clearly indicate that investors place different value on each of the three components of VAIC, since human capital efficiency is treated differently than the other two components (capital employed efficiency and structural capital efficiency). Finally, it should be pointed out that the statistical analysis produced the same results, even when each of the four sectors was separately analysed.

Table V presents the results considering *H2* (Model 3) and Table VI the results considering *H2a-H2c* (Model 4). Results in Table V demonstrate that there is no significant relationship between IC (measured with VAIC) and the three financial performance measures (ROE, ROA, GR), since all coefficients or model solutions are statistically insignificant. Therefore, *H2* is not supported by the empirical data. Moreover, results depicted in Table VI indicate that the only statistically significant

Independent variables	Coefficient	<i>t</i> -statistic	Significance
Constant	-3,457.817	-0.706	0.483
VACA	0.003	0.025	0.369
VAHU	0.126	0.325	0.032
STVA	-0.022	-0.165	0.645

Notes: Adjusted $R^2 = 0.114$; F -value = 63.14 (p -value > 0.05)

Table IV.
Regression results –
Model 2: M/B and VAICs
components

Independent variable	ROE		ROA		GR	
	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic
Constant	1,907.369	2,948*	2,253.304	2.423*	7,124.459	1.005
VAIC	0.095	0.743	0.062	0.498	0.019	0.153
Adjusted R^2	0.095		0.004		0.000	
F -value	2.653		3.698		34.652	

Note: *Significant at the 0.05 level

Table V.
Regression results –
Model 3: financial
performance and VAIC

Independent variables	ROE		ROA		GR	
	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic
Constant	3,392.369	4.689*	2,555.276	2.276*	6,881.598	0.890
VACA	0.009	0.077	0.056	0.439	0.021	0.161
VAHU	0.432	3.627*	0.054	0.416	-0.025	-0.190
STVA	0.085	0.726	0.041	0.322	0.022	0.171
Adjusted R^2	0.189		0.009		0.002	
F -value	4.698*		21.448		9.367	

Note: *Significant at the 0.05 level

Table VI.
Regression results –
Model 4: Financial
Performance and VAICs
components

relationship is the one between human capital efficiency (VAHU) and ROE. All other investigated models are statistically insignificant. Therefore, *H2b* and *H2c* are not supported by the empirical data, while *H2a* is partially supported. The above results did not dramatically changed, even after each of the four sectors included in the study was separately analysed.

The results of the present study offer the bibliography another paper that fails to fully support the importance of IC (measured under the VAIC methodology). In general, the empirical studies that have used the VAIC approach in order to investigate the impact of IC on various business variables have concluded on contradictory results.

For example, Firer and Williams (2003), in a study conducted on South Africa, failed to identify a relationship between VAIC and profitability, productivity and market value, while Chen *et al.* (2005), succeeded in identifying a relationship between IC, market value and financial performance in the Taiwanese economy. On two studies conducted in Malaysia, Gan and Saleh (2008) found that VAIC can explain profitability and productivity, but fails to explain market valuation, while Shiu (2006) found a positive correlation between VAIC, profitability and market valuation and a negative correlation with productivity.

The failure of the VAIC methodology to provide coherent results raises the criticism on its effectiveness and gives room for questions regarding its reliability: "Does the VAIC methodology properly describes the business reality (therefore, IC has no impact on market value, financial performance, etc.), or does it need improvements/adjustments in order to better mirror the business landscape?"

In order to address the question above, one has to take under consideration the context in which most VAIC studies have been made. Either by replication trend or because the VAIC methodology better fits such a context, most of the empirical studies have been conducted in emerging and developing countries (South Africa, Taiwan, Malaysia, Turkey, Singapore, Thailand, Bangladesh), rather than on already advanced economies (France, Germany, UK). The reasons for the widespread use of VAIC on emerging and developing economies seem to be its easy implementation, the fact that is based on fundamental accounting measures and has limited reporting requirements (compared with other methods of IC measurement). Therefore, it seems that the lack of advanced accounting practices and mature financial structures on emerging and developing countries fit with the requirements of VAIC, thus, making it an ideal IC methodology.

Therefore, the question about the reliability of VAIC is strongly connected with the context of previous researches. Since emerging and developing countries have yet to explore their knowledge potential, one could assume that the failure of VAIC to verify significant relationships between IC and various business variables (market value, profitability, productivity financial, etc.) is attributed, not on the inefficiency of VAIC itself, but on the disregard of the intellectual assets on behalf of the companies of the emerging and developing countries and the imperfect functioning of the capital market in these economies (the latter having an impact on the relationship between IC and market valuation). Emerging and developing countries are mostly based on tangible assets and tend to neglect the intangible ones (Malhotra, 2003), thus, it seems logical for VAIC studies to fail to establish a positive relationship between IC and company value.

Nevertheless, VAIC, as a method of measurement, suffers from inefficiencies, as most tools of measurement do. In order to draw a positive conclusion about its

efficiency and, therefore, be able to fully support or criticise it, the present paper proposes:

- The application of a number of adjustments to the VAIC methodology, so as to “heal” some of its most profound limitations (these adjustments are discussed on the last section of the paper).
- The replication of the VAIC methodology in developed countries, so as to verify its efficiency in measuring intellectual assets. In case VAIC fails to fully recognise the impact of IC on business performance in knowledge-based economies, its critique would be unavoidable. In a difference case, it would be strongly supported.
- The implementation of other IC methodologies (Economic value added (EVA), value-based management (VBM), Tobin’s *Q* ratio) on contexts that have already been investigated under the VAIC approach. For example, an empirical investigation in the context of Greece using EVA, would help verify the results of the present study and shed more light on the efficiency of VAIC: a possible rejection of the same hypotheses would strengthen the certainty about the present results and offer additional support on the VAIC methodology.

6. Conclusions

The present study attempted to investigate the relationship between IC, market value and financial performance of Greek listed companies that belong to four major industries of the country. The methodology adopted is the one of VAIC that has been previously utilised to other similar studies (Chen *et al.*, 2005; Firer and Williams, 2003; Williams, 2001).

Despite the fact that IC is increasingly recognised as an important strategic asset for sustainable competitive advantage, the results of the study fail to support such a claim. Empirical results failed to support most of the proposed hypotheses, only verifying the relationship between human capital efficiency (VAHU) and ROE, one of the three indicators of financial performance used in the study.

However distant from theory, the results of the present study seem to be in direct correlation with certain characteristics of the Greek economy. The huge public sector (accounting for about 40 per cent of the gross domestic product (GDP)), the low level of inward foreign direct investments (FDI), the imperfect function of the capital market, the relatively small size of most of the Greek companies and the general lack of modern management practices may not form the best surroundings for the development of the idea of IC. Moreover, innovation, competitiveness and entrepreneurship indexes in Greece (three variables that indirectly measure the intellectual capacity of an economy), are in very unsatisfactory levels (steadily in the last positions of the countries of the European Union). Therefore, the findings of the study should not sound as a surprise, but should act as a warning sign towards taking certain actions.

Overall, the empirical findings suggest that the Greek market is placing greater faith and value in physical capital assets than intellectual ones. Despite efforts towards improving its IC base, the Greek business environment appears to place greater weight on corporate performance based on physical capital assets. Policy makers should intensify their initiatives in order to encourage greater acceptance and understanding

of the concept of IC and the development of its related assets. Only by such actions would the country be able to improve in vital indexes as the ones mentioned above. Moreover, on a microeconomic level, organizations should understand that only by nurturing their intellectual assets they will be able to remain competitive, fight against the severe competition (domestic and foreign) and create sustainable competitive advantages.

Finally, it must be, moreover, underlined that the empirical results indicate the existence of a significant relationship between one of the three components of IC (human capital efficiency) and one of the three indicators of financial performance (ROE). Thus, it is concluded that in the Greek business context, the development of human resources seems to be one of the most significant factors of economic success. Stewart (1997) and Roos *et al.* (1997) argued that human capital can be defined as the employee's abilities to act in different situations and that it includes skills, education, experience and motivation. Hence, nurturing such human employee characteristics seems to be of vital importance for Greek companies.

7. Limitations and future research

The limitations of the present study can be separated into two categories: those that are inherent to the research methodology of the research and those that are connected with the inefficiencies of the VAIC methodology.

A limitation of the first category is the difficulty in finding complete data for the three-year period under investigation. Therefore, the sample was limited to 96 companies, while the average number of listed companies during 2006-2008 was approximately 280. Moreover, certain data needed for the analysis were not able to be retrieved, especially figures like expenses for staff and advertising. Another limitation may be considered to be the investigation of only four sectors of economic activity and the relatively narrow three year period for data collection (2006-2008). Presumably, expanding the panel with more industries (sectors) would yield results supported by the theory (hypotheses verification). Moreover, a sample consisting of data from a ten-year period would possibly offer different results, since longitudinal data will no longer be affected by the early stages of the current financial crisis that affected financial statements of the listed companies in the period under investigation (especially in 2008).

The second category of limitations is the one that concern the implementation of the VAIC methodology itself. The following "problematic areas" are recognised:

- The use of market value in IC calculations may have a negative impact on the verification of the hypotheses, since market value is highly influenced by the sentiments of the market and tends to ignore the financial reality of the company. By linking IC with market value (stock price of the company), it is suggested that IC depends solely on the market sentiments. For example, when it comes to the present study, the market sentiments changed dramatically during the research period (2006-2008): the first two years of bull market were followed by a year of bear market. In 2008, with the beginning of the economic crisis, many companies faced decreasing market value, even though they had improved their financial results. This decrease in market value happened due to external factors, such as increased investors risk avoidance, and most probably not due to the decrease in the IC of companies under examination.

- The calculation of market value with the use of the stock price at the end of the year may lead in obtaining a market value price that is not representative of the whole year under examination. Such a calculation may have a negative effect on the verification of the hypotheses, since the stock prices at the end of the year, usually, reflect investor's perceived value of the company for the coming year instead of the past one. If a given company had a great year, but the expectations for the next one are not optimistic (or vice versa), the correlation between VAIC and market value would be disrupted.
- The use of net earnings in the calculation of ROA may influence the correlation between VAIC and financial performance, since net earnings are highly influenced by the degree of the financial leverage. In general, the VAIC methodology disregards the level of company risk, which is one of the most important factor determining company and IC value.

The above limitations may be considerably "healed" by applying slight modifications to the traditional VAIC model (Pulic, 2000a, b; Williams, 2001). In that direction, the following proposals are being made:

- Replacement of "market value" with "intrinsic value": such a modification would protect from temporary market sentiments ("intrinsic value" is influenced by these sentiments to the lesser extent).
- Calculation of the average price of stocks in a more representative way: for example, it is proposed to use the average stock prices at the end of each month (sum of stock prices at the end of each month/12). In the present study, the above modification failed to produce any different results.
- Use EBITDA returns (operating profit) instead of net earnings: such a modification would help taking under consideration the net business performance, irrespective of financial leverage.

Moreover, future research should focus on the following directions:

- Comparing other measures of IC efficiency (e.g. EVA, VBM) with the VAIC model, so as to generate more valuable conclusions.
- Using the structural equation modelling technique in order to better understand the interrelationships between different components of IC and their cumulative impact on various dependent variables (financial performance, market valuation, productivity, etc.).
- Working towards the development of an IC model that will be in compliance with the International Accounting Standard Board (IASB) for financial reporting and, moreover, being able to be used by both from external stakeholders and internal management.

References

- Andriessen, D. (2004), *Making Sense of Intellectual Capital: Designing a Method for the Valuation of Intangibles*, Elsevier Butterworth-Heinemann, Burlington, MA.
- Andriessen, D. (2007), "Designing and testing an OD intervention: reporting intellectual capital to develop organizations", *The Journal of Applied Behavioral Science*, Vol. 43 No. 1, pp. 89-107.

- Andrikopoulos, A. (2005), "The real-options approach to intellectual capital analysis: a critique", *Knowledge & Process Management*, Vol. 12 No. 3, pp. 217-24.
- Appuhami, B.A.R. (2007), "The impact of intellectual capital on investors' capital gains on shares: an empirical investigation of Thai banking, finance and insurance sector", *International Management Review*, Vol. 3 No. 2, pp. 14-25.
- Bontis, N. (1998), "Intellectual capital: an exploratory study that develops measures and models", *Management Decision*, Vol. 36 No. 2, pp. 63-76.
- Bontis, N. (1999), "Managing organizational knowledge by diagnosing intellectual capital: framing and advancing the state of the field", *Intellectual Journal of Technology Management*, Vol. 18 Nos 5-8, pp. 433-62.
- Bontis, N., Chua, W. and Richardson, S. (2000), "Intellectual capital and business performance in Malaysian industries", *Journal of Intellectual Capital*, Vol. 1 No. 1, pp. 85-100.
- Bornemann, M., Knapp, A., Schneider, U. and Sixl, K.I. (1999), "Holistic measurement of intellectual capital", *International Symposium: Measuring and Reporting Intellectual Capital: Experiences, Issues and Prospects*, available at: www.oecd.org/dataoecd/16/20/1947871.pdf (accessed 4 April 2010).
- Brennan, N. and Connell, B. (2000), "Intellectual capital: current issues and policy implications", *Journal of Intellectual Capital*, Vol. 1 No. 3, pp. 206-40.
- Burr, R. and Girardi, A. (2002), "Intellectual capital: more than the interaction of competence $\times$ commitment", *Australian Journal of Management*, Vol. 27, special issue, pp. 77-87.
- Campisi, D. and Costa, R. (2008), "A DEA-based method to enhance intellectual capital management", *Knowledge and Process Management*, Vol. 15 No. 3, pp. 170-83.
- Chaharbaghi, K. and Cripps, S. (2006), "Intellectual capital: direction, not blind faith", *Journal of Intellectual Capital*, Vol. 7 No. 1, pp. 29-32.
- Chaminade, C. and Roberts, H. (2003), "What it means is what it does: a comparative analysis of implementing intellectual capital in Norway and Spain", *European Accounting Review*, Vol. 12 No. 4, pp. 733-51.
- Chen, M.C., Cheng, S.J. and Hwang, Y. (2005), "An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance", *Journal of Intellectual Capital*, Vol. 6 No. 2, pp. 159-76.
- Edvinsson, L. (1997), "Developing intellectual capital at Skandia", *Long Range Planning*, Vol. 30 No. 3, pp. 366-73.
- Edvinsson, L. and Malone, M.S. (1997), *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*, Harper Business, New York, NY.
- Fincham, R. and Roslender, R. (2003), "Intellectual capital accounting as management fashion: a review and critique", *European Accounting Review*, Vol. 12 No. 4, pp. 781-95.
- Firer, S. and Williams, S.M. (2003), "Intellectual capital and traditional measures of corporate performance", *Journal of Intellectual Capital*, Vol. 4 No. 3, pp. 348-60.
- Gan, K. and Saleh, Z. (2008), "Intellectual capital and corporate performance of technology-intensive companies: Malaysia evidence", *Asian Journal of Business and Accounting*, Vol. 1 No. 1, pp. 113-30.
- Goh, P.C. (2005), "Intellectual capital performance of commercial banks in Malaysia", *Journal of Intellectual Capital*, Vol. 6 No. 3, pp. 385-96.
- Holton, E.E. and Yamkovenko, B. (2008), "Strategic intellectual capital development: a defining paradigm for HRD?", *Human Resource Development Review*, Vol. 7 No. 3, pp. 270-91.

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- International Financial Reporting Standards (2008), "IAS 38 Intangible assets", available at: www.cpaaustralia.com.au/cps/rde/xbcr/cpa-site/IAS-38-fact-sheet.pdf (accessed 15 September 2010).
- Judge, W., Li, S. and Pinsker, R. (2010), "National adoption of international accounting standards: an institutional perspective", *Corporate Governance: An International Review*, Vol. 18 No. 3, pp. 161-74.
- Kim, D., Kumar, V. and Kumar, U. (2009), "A framework of intellectual capital management based on ISO 9001 quality management system: the case study of ISO 9001 certified Public R&D Institute", *Knowledge and Process Management*, Vol. 16 No. 4, pp. 162-73.
- Klein, D.A. and Prusak, L. (1994), *Characterising Intellectual Capital*, Ernst & Young, Cambridge.
- Kok, A. (2007), "Intellectual capital management as part of knowledge management initiatives at institutions of higher learning", *The Electronic Journal of Knowledge Management*, Vol. 5 No. 2, pp. 181-92.
- Lev, B. (2001), *Intangibles: Management, and Reporting*, Brookings Institution Press, Washington, DC.
- Lev, B. and Radhakrishnan, S. (2003), "The measurement of firm-specific organization capital", NBER Working Paper Series No. 9581, available at: www.cib.espol.edu.ec/Digipath/D_Papers/47205.pdf (accessed 4 April 2010).
- Lev, B. and Zarowin, P. (1999), "The boundaries of financial reporting and how to extend them", *Journal of Accounting Research*, Vol. 37, Autumn, pp. 353-85.
- Malhotra, Y. (2003), "Measuring knowledge assets of a nation: knowledge systems for development", *Ad Hoc Group of Experts Meeting – Knowledge Systems for Development, New York*, available at: www.kmnetwork.com/KnowledgeManagementMeasurementResearch.pdf (accessed 15 September 2010).
- Mavridis, D.G. (2004), "The intellectual capital performance of the Japanese banking sector", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 92-115.
- Mavridis, D.G. and Kyrmizoglou, P. (2005), "Intellectual capital performance drivers in the Greek banking sector", *Management Research News*, Vol. 28 No. 5, pp. 43-62.
- Mohiuddin, M., Najibullah, S. and Shahid, A.I. (2006), "An exploratory study on intellectual capital performance of the commercial banks in Bangladesh", *The Cost and Management*, Vol. 34 No. 6, pp. 40-54.
- Montequin, V.R., Fernandez, F.O., Cabal, V.A. and Gutierrez, N.R. (2006), "An integrated framework for intellectual capital measurement and knowledge management implementation in small and medium-sized enterprises", *Journal of Information Science*, Vol. 32 No. 6, pp. 525-38.
- Muhammad, N.M.N. and Ismail, M.K.A. (2009), "Intellectual capital efficiency and firms' performance: study on Malaysian financial sectors", *International Journal of Economics and Finance*, Vol. 1 No. 2, pp. 206-12.
- Nazari, A. and Herremans, I.M. (2007), "Extended VAIC model: measuring intellectual capital components", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 595-609.
- Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, NY.
- Petty, R. and Guthrie, J. (2000), "Intellectual capital literature review: measurement, reporting and management", *Journal of Intellectual Capital*, Vol. 1 No. 2, pp. 155-76.
- Pulic, A. (2000a), "VAIC – an accounting tool for IC management", *International Journal of Technology Management*, Vol. 20 Nos 5-7, pp. 702-14.
- Pulic, A. (2000b), "MVA and VAIC analysis of randomly selected companies from FTSE 250", available at: www.vaic-on.net/download/ftse30.pdf (accessed 4 April 2010).

- Pulic, A. and Bornemann, M. (1999), "The physical and intellectual capital of Austrian banks", available at: www.vaic-on.net/download/Papers/Physical%20and%20intellectual%20Capital%20of%20Austrian%20Banks.htm (accessed 4 April 2010).
- Puntillo, P. (2009), "Intellectual capital and business performance. Evidence from Italian banking industry", *Electronic Journal of Corporate Finance*, Vol. 4 No. 12, pp. 97-115.
- Riahi-Belkaoui, A. (2003), "Intellectual capital and firm performance of US multinational firms: a study of the resource-based and stakeholder views", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 215-26.
- Roos, G., Roos, J., Edvinsson, L. and Dragonetti, N.C. (1997), *Intellectual Capital Navigating in the New Business Landscape*, New York University Press, New York, NY.
- Ruta, C.D. (2009), "HR portal alignment for the creation and development of intellectual capital", *International Journal of Human Resource Management*, Vol. 20 No. 3, pp. 562-77.
- Samiloglu, A.T. (2006), "The performance analysis of the Turkish banks through VAIC and MV/MB ratio", *Journal of Administrative Sciences*, Vol. 4 No. 1, pp. 207-26.
- Schneider, U. (1998), "The Austrian approach to the measurement of intellectual potential", paper presented at the National Business Conference, Hamilton.
- Shiu, H. (2006), "The application of the value added intellectual coefficient to measure corporate performance: evidence from technological firms", *International Journal of Management*, Vol. 23 No. 2, pp. 356-65.
- Stewart, T. (1997), *The New Wealth of Organizations*, Doubleday, New York, NY.
- Sullivan, P.H. (2000), *Value-driven Intellectual Capital: How to Convert Intangible Corporate Assets into Market Value*, John Wiley & Sons, Toronto.
- Sveiby, K. (2000), "Intellectual capital and knowledge management", available at: www.sveiby.com.au/BookContents.html (accessed 2 June 2009).
- Sveiby, K. (2001), "Methods for measuring intangible assets", available at: www.sveiby.com.au/BookContents.html (accessed 2 June 2009).
- Tan, H.P., Plowman, D. and Hancock, P. (2007), "Intellectual capital and financial returns of companies", *Journal of Intellectual Capital*, Vol. 8 No. 1, pp. 76-94.
- Tayles, M., Pike, R. and Sofian, S. (2007), "Intellectual capital, management accounting practices and corporate performance", *Accounting, Auditing & Accountability Journal*, Vol. 20 No. 4, pp. 522-48.
- Tseng, C. and Goo, Y.J. (2005), "Intellectual capital and corporate value in an emerging economy: empirical studies of Taiwanese manufacturers", *R&D Management*, Vol. 35 No. 2, pp. 187-201.
- Wall, A. (2007), "The measurement and management of intellectual capital in the public sector", *Public Management Review*, Vol. 7 No. 2, pp. 289-303.
- Walsh, K., Enz, C. and Canina, L. (2008), "The impact of strategic orientation on intellectual capital investments in customer service firms", *Journal of Service Research*, Vol. 10 No. 4, pp. 300-17.
- Williams, M. (2001), "Are intellectual capital performance and disclosure practice related?", *Journal of Intellectual Capital*, Vol. 2 No. 3, pp. 192-203.
- Yang, C.C. and Lin, C.Y.Y. (2009), "Does intellectual capital mediate the relationship between HRM and organizational performance? Perspective of a healthcare industry in Taiwan", *International Journal of Human Resource Management*, Vol. 20 No. 9, pp. 1965-84.
- Zerenler, M. and Gozlu, S. (2008), "Impact of intellectual capital on exportation performance: research on the Turkish automotive supplier", *Journal of Transnational Management*, Vol. 13 No. 4, pp. 318-41.

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