

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

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## **Abstract**

*Intellectual Capital (IC), the knowledge based equity of corporations, receives a significant growing acceptance as a worthy topic of serious academic investigation and practical implication. The purpose of the present study is to examine the impact of intellectual capital on firms' market value and financial performance. The efficiency of the value added by corporate intellectual ability (Value Added Intellectual Coefficient) is incorporated to measure the intellectual capital construct. 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. 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 intellectual capital is increasingly recognized as an important strategic asset for sustainable corporate competitive advantages, the results of the present study give raise to various arguments, criticism and further research on the subject.*

**Keywords:** intellectual capital, market value, book value, financial performance

JEL Classification: D83, J24

## **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, 2000b) 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, 2000b).

The main objective of the present study is to examine the relationship between intellectual capital, market value and financial performance. The methodology for the measurement of intellectual capital 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 4, 5, 6 and 7 respectively.

## **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 formalized, 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 characterized as "hidden assets", since it is difficult to identify their contribution to a firm and quantify them in a financial statement (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 intellectual capital assets that are not recognized 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), scholars and practitioners unanimously identify three basic components of IC; human capital, structural capital and customer (relational) capital (Bontis, 1998; 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 categorization, 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 organisational 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 utilized 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 (Value Added Intellectual Coefficient) 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 utilization 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).

Firer and Williams (2003) used 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 intellectual capital 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 utilized Pulic's (2000a, b) Value Added Intellectual Coefficient (VAIC). Their study underlined the importance of IC in the enhancement of firm profitability and revenue growth. The empirical results proved that (a) investors value higher companies with better IC efficiency, (b) 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 Conceptual Framework**

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

### **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 fail to account one of the most important intangible assets of every organization: intellectual capital (Sveiby, 2000, 2001). 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 significantly higher than the calculated book value (Chen *et al.*, 2005; Firer and Williams, 2003; Riahi-Belkaoui, 2003). Therefore, it is hypothesized that the greater the IC, the higher the ratio of market-to-book value:

Hypothesis 1: 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 hypothesized:

Hypothesis 1a: Companies with greater capital employed efficiency have higher ratios of market-to-book value.

Hypothesis 1b: Companies with greater human capital efficiency have higher ratios of market-to-book value.

Hypothesis 1c: Companies with greater structural capital efficiency have higher ratios of market-to-book value.

### **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 sold 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 an significant impact on profitability. The present paper makes an attempt to enrich the IC literature, thus, hypothesizing:

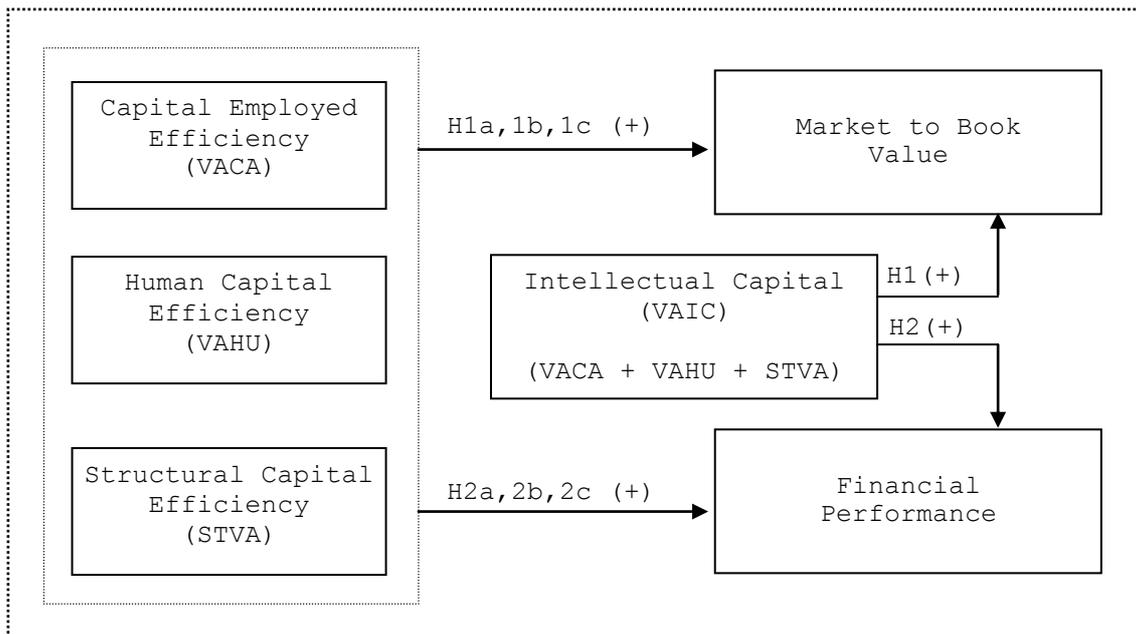
Hypothesis 2: Companies with greater IC have better financial performance.

Hypothesis 2a: Companies with greater capital employed efficiency have better financial performance.

Hypothesis 2b: Companies with greater human capital efficiency have better financial performance.

Hypothesis 2c: Companies with greater structural capital efficiency have better financial performance.

Figure 1 (see next page) summarizes all the above hypotheses, thus, presenting the proposed Conceptual Framework of the study.



**Figure 1: The Conceptual Framework of the study**

## Research Methodology

### Sample and data selection

The final sample of the present study consists of 96 Greek companies listed in the Athens Stock Exchange (ASE). These companies belong to four economic sectors (according to official sector classification); Construction & Materials (20 companies), Industrial Goods & Services (23), Food & Beverage (19) and Personal & 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 3 year examination period). However, the first screening of data availability demonstrated that such an endeavor 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 reflect 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% of the total number of listed companies in the ASE for the year 2010.

### Variable definition

#### Independent Variables

The present study includes four independent variables (Pulic 2000a, 2000b):

- 1 Capital Employed Efficiency (VACA), indicator of value added efficiency of capital employed.
- 2 Human Capital Efficiency (VAHU), indicator of value added efficiency of human capital.
- 3 Structural Capital Efficiency (STVA), indicator of value added efficiency of structural capital.
- 4 Value Added Intellectual Coefficient (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).

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

CE = Total assets - intangible assets

HU = Total investment on employees (salary, wages, etc)

SC = VA - HU

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 standardized 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.

#### **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 = Number of shares × Stock price at the end of the year.

BV = Stockholders' equity - Paid in capital of preferred stocks.

The financial performance is measured with the use of 3 indicators:

A Return On Equity (ROE)

ROE = Net Income / Shareholder's Equity

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

B Return On Assets (ROA)

ROA = Net Income / 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.

C Growth revenues (GR)

$$GR = [(Current\ year's\ revenues / Last\ year's\ revenues) - 1] \times 100\%$$

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

### 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 (a) VAIC and market-to-book value ratio, and (b) VACA, VAHU and STVA and market-to-book value ratio:

$$\text{Hypothesis 1: } M/B = a_0 + a_1VAIC + e \quad (1)$$

$$\text{Hypotheses 1a, 1b and 1c: } M/B = a_0 + a_1VACA + a_2VAHU + a_3STVA + e \quad (2)$$

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

$$\text{Hypothesis 2: } ROE = a_0 + a_1VAIC + e \quad (3a)$$

$$\text{Hypothesis 2: } ROA = b_0 + b_1VAIC + e \quad (3b)$$

$$\text{Hypothesis 2: } GR = c_0 + c_1VAIC + e \quad (3c)$$

$$\text{Hypothesis 2a, 2b and 2c: } ROE = a_0 + a_1VACA + a_2VAHU + a_3STVA + e \quad (4a)$$

$$\text{Hypothesis 2a, 2b and 2c: } ROA = b_0 + b_1VACA + b_2VAHU + b_3STVA + e \quad (4b)$$

$$\text{Hypothesis 2a, 2b and 2c: } GR = c_0 + c_1VACA + c_2VAHU + c_3STVA + e \quad (4c)$$

## Results

### Descriptive statistics and Correlation analysis

Table 1 presents the descriptive statistics for all study variables. The Market-to-Book value ratio (1,694) indicates that 40,96% of the firms' market value is not reflected on financial statements:

$$\text{Hidden Value} = [(1,694-1,000) / 1,694] * 100 = 40,96\%$$

This finding supports previous 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% of corporate market value is omitted from financial statements, while this percentage seems to be on an upward trend.

**Table 1: 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 |

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 2: 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 |

\* correlation significant at the 0,01 level (two-tailed)

### Hypotheses verification

Table 3 presents the results considering Hypothesis 1 (Model 1) and Table 4 the results considering Hypotheses 1a, 1b and 1c (Model 2). As seen in Table 3, 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 Hypothesis 1. Moreover, results depicted on Table 4 give only support to Hypothesis 1b, since the significance indexes for the other two independent variables are also inadequate ( $p > 0,05$ ).

Therefore, the empirical investigation failed to support the hypothesis that investors place higher value on firms with greater intellectual capital (VAIC). Nevertheless, it seems that investors take the human capital of a company into consideration when they estimate its real value.

Moreover, results 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).

**Table 3: 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        |
| Adjusted R <sup>2</sup> = 0,000<br>F-value = 99,36 (p-value > 0,05) |             |             |              |

**Table 4: Regression results - Model 2: M/B and VAICs components**

| Independent Variables   | Coefficient | t-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        |
| Adjusted R <sup>2</sup> = 0,114<br>F-value = 63,14 (p-value < 0,05) |             |             |              |

Table 5 presents the results considering Hypothesis 2 (Model 3) and Table 6 the results considering Hypotheses 2a, 2b and 2c (Model 4). Results in Table 5 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, Hypothesis 2 is not supported by the empirical data. Moreover, results depicted in Table 6 indicate that the only statistically significant relationship is the one between human capital efficiency (VAHU) and Return on Equity (ROE). All other investigated models are statistically insignificant. Therefore, Hypotheses 2b and 2c are not supported by the empirical data, while Hypothesis 2a is partially supported.

**Table 5: Regression results - Model 3: Financial Performance and VAIC**

| Independent Variable    | Dependent Variables |             |             |             |             |             |
|-------------------------|---------------------|-------------|-------------|-------------|-------------|-------------|
|                         | ROE                 |             | ROA         |             | GR          |             |
|                         | Coefficient         | t-statistic | Coefficient | t-statistic | Coefficient | t-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 <sup>2</sup> | 0,095               |             | 0,004       |             | 0,000       |             |
| F-Value                 | 2,653               |             | 3,698       |             | 34,652      |             |

\* significant at the 0,05 level

**Table 6: Regression results - Model 4: Financial Performance and VAICs components**

| Independent Variables   | Dependent Variables |             |             |             |             |             |
|-------------------------|---------------------|-------------|-------------|-------------|-------------|-------------|
|                         | ROE                 |             | ROA         |             | GR          |             |
|                         | Coefficient         | t-statistic | Coefficient | t-statistic | Coefficient | t-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 <sup>2</sup> | 0,189               |             | 0,009       |             | 0,002       |             |
| F-Value                 | 4,698*              |             | 21,448      |             | 9,367       |             |

\* significant at the 0,05 level

## Conclusions

The present study attempted to investigate the relationship between intellectual capital (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 "Value Added Intellectual Coefficient" (VAIC) that has been previously utilized 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 present 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.

The results of the study present the bibliography with another paper that fails to fully support the importance of IC (measured under the VAIC methodology). Firer and Williams (2003), in a study conducted on South Africa, also failed to identify such an argument, while Chen *et al.* (2005), succeeded in identifying a relationship between IC, market value and financial performance in the Taiwanese economy.

Moreover, the most recent study that has been conducted in the Greek banking sector using data from the period 1996-1996 (Mavridis and Kymizoglou, 2005), concluded that there is a positive correlation between value added and physical capital, but especially between value added and human or intellectual capital. Although, 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 (Mavridis and Kymizoglou, 2005). Using the same way of thinking, it could be said that the results of the present study were negatively influenced by the bad economical climate of the period 2006 to 2008, thus failing to underline the importance of IC.

Nevertheless, the results of the present study may be in direct correlation with certain characteristics of the Greek economy. The huge public sector (accounting for about 40% of the GDP), the low level of inward Foreign Direct Investments (FDI), the low entrepreneurship indexes, 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 intellectual capital.

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.

### **Limitations and future research**

A major limitation of the present study was 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.

Since results of the present study and results found in similar studies that were conducted in other countries and/or time periods (Chen *et al.*, 2005; Firer and Williams, 2003; Mavridis and Kyrmizoglou, 2005) are quite contradictory, it appears that the effect of IC on business success is not yet fully explained. Thus, the replication of the present study and methodology in different countries and time periods may provide with solid conclusions as to the nature of the relationship between IC and financial performance.

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