The current issue and full text archive of this journal is available at
www.emeraldinsight.com/1469-1930.htm

Analysing value added as an indicator of intellectual capital and its consequences on company performance

Daniel Zéghal and Anis Maaloul
CGA – Accounting Research Centre, Telfer School of Management, University of Ottawa, Ottawa, Canada

Abstract

Purpose – The purpose of this paper is to analyse the role of value added (VA) as an indicator of intellectual capital (IC), and its impact on the firm's economic, financial and stock market performance.

Design/methodology/approach – The value added intellectual coefficient (VAIC™) method is used on 300 UK companies divided into three groups of industries: high-tech, traditional and services. Data require to calculate VAIC™ method are obtained from the "Value Added Scoreboard" provided by the UK Department of Trade and Industry (DTI). Empirical analysis is conducted using correlation and linear multiple regression analysis.

Findings – The results show that companies' IC has a positive impact on economic and financial performance. However, the association between IC and stock market performance is only significant for high-tech industries. The results also indicate that capital employed remains a major determinant of financial and stock market performance although it has a negative impact on economic performance.

Practical implications – The VAIC™ method could be an important tool for many decision makers to integrate IC in their decision process.

Originality/value – This is the first research which has used the data on VA recently calculated and published by the UK DTI in the "Value Added Scoreboard". This paper constitutes therefore a kind of validation of the ministry data.

Keywords Intellectual capital, Value added, Company performance, United Kingdom

Paper type Research paper

I. Introduction

Intellectual capital (IC), innovation and value creation (or value added (VA)) are nowadays the object of particular attention by managers, investors, economic institutions and governments; as they are also the object of several studies recently realised in academic and professional environments.

According to the Organisation for Economic Cooperation and Development (OECD) (2008), many companies invest nowadays in employee training, research and development (R&D), customer relations, computer and administrative systems, etc. These investments, often referred to as IC, are growing and they are competing with physical and financial capital investments in some countries[1]. Several authors, such as Stewart (1997) and Zéghal (2000), ascribed this change in investment structure to the

The authors gratefully acknowledge the support of the CGA – Accounting Research Centre at the University of Ottawa.

Journal of Intellectual Capital
Vol. 11 No. 1, 2010
pp. 39-60

1469-1930
DOI 10.1108/14691931011013325

advent of a new knowledge-based economy. Other authors, such as Edvinsson (1997), Sveiby (1997) and Lynn (1998) emphasised the importance of IC which they consider to be the main source of value creation in the new economy.

However, it is difficult to measure IC since it is intangible and non-physical in nature. The traditional accounting model, which is conceived for companies operating in an industrial economy, remains focussed on physical and financial assets and ignores most IC assets. Interestingly, even the International Accounting Standards/International Financial Reporting Standards (IAS/IFRS)[2], including the ones recently modified by the International Accounting Standards Board, did not contribute to redefining many of the concepts, principles and valuation methods of IC assets. The relative lack of IC accounting recognition and its growing role in the value creation process, imply that financial statements have lost some of their value for shareholders and many other users (Canibano *et al.*, 2000; Ashton, 2005; OECD, 2006, 2007).

Many studies, often conducted within a resource-based theory framework, have tried to analyse the problem of accounting for IC. The first studies began with the identification, representation, and classification of IC components (Edvinsson and Malone, 1997; Zéghal, 2000; Guthrie *et al.*, 2004). Other studies were interested rather in the practices of IC reporting in companies' annual reports (Williams, 2001; Abdolmohammadi, 2005; Kristandl and Bontis, 2007). Some studies also focussed on the problem of IC measurement not being recorded in financial statements (Stewart, 1997; Pulic, 1998, 2004; Gu and Lev, 2003; Chen *et al.*, 2004). Finally, a number of studies were related to the validation of IC in a decision-making context, notably in terms of its usefulness to investors on a capital market (Lev and Sougiannis, 1996; Cazavan-Jeny, 2004; Casta *et al.*, 2005; Lev *et al.*, 2007).

In this study, we aim to extend the efforts made by researchers and practitioners to find an appropriate measure of IC. We propose therefore the concept of "value added" as an indicator of IC measurement in a company. This idea is based on the "value added intellectual coefficient – VAIC™" method developed by Pulic (1998, 2004). This method is still in the early stages of its application in management accounting practices and needs to be empirically validated with a large number of companies in a decision-making context. This is precisely the objective of our study according to which we attempt:

- to empirically analyse the role of VA as an indicator of IC; and
- to empirically validate the method of VAIC™ to assess the impact of IC on economic, financial and stock market performance.

Our study is motivated by the conceptual link which could exist between IC and VA. Indeed, a recent survey carried out by the UK Department of Trade and Industry (DTI) (2004)[3] shows that successful UK companies recognise that investing in IC is essential to their ability to create world-class VA products and services. Other reports edited by the OECD (2006, 2007) considered IC as the main important source of value creation in a company. More recently, the UK DTI (2007) also reported that, on average, UK companies create much more VA than other European companies. In fact, UK companies' ability to compete in the global economy largely and increasingly depends on creating higher levels of VA through investments in IC.

The concept of "value added" used in the present study for measuring IC has a strong historical past in the UK (Morley, 1979; Pong and Mitchell, 2005). For many years, UK companies have revealed information about their VA in the "Value Added Statement". At present, information on the VA of UK companies is also revealed by the UK DTI in the "Value Added Scoreboard". All this explains our choice to carry out our study in a UK context through the analysis of a sample of 300 companies listed on the London Stock Exchange (LSE) during 2005.

We also chose, in this study, to divide our sample into three groups of sectors representing high-tech industries, traditional industries and services. Our expectation is that the contribution of IC to a company's performance differs from sector to sector.

The remainder of the present paper is organised as follows: Section 2 briefly describes the theoretical and conceptual framework for both IC and VA and outlines related prior research. Section 3 presents our research objective and the different research hypotheses. Section 4 describes the methodology used in this study and the results of the data analysis are detailed in Section 5. The final section summarises and concludes with suggestions for future research.

II. Intellectual capital and value added

1. Intellectual capital

Until now, there has been no generally accepted definition or classification of IC (Canibano *et al.*, 2000; Bhartesh and Bandyopadhyay, 2005; OECD, 2006). It was only in the late 1990s that professionals and researchers in management began to attempt to define and to classify the IC components.

Stewart (1997, p. 67) defined IC simply as "packaged useful knowledge". Edvinsson and Malone (1997, p. 358) broadened the definition of IC to "knowledge that can be converted into value". Following these authors we define IC, in this study, as being "the sum of all knowledge a company is able to use in the process of conducting business to create value – a VA for the company".

The studies conducted by Stewart (1997) and Edvinsson and Malone (1997) led to a similar classification of IC components. According to their classification, the company's IC, in a broad sense, comprises human capital (HC) and structural capital (SC). HC is defined as the knowledge, qualifications and skills of employees and the fact that companies cannot own or prevent those employees from going home at night; SC refers to the knowledge that remains with the company after the employees go home at night. It includes production processes, information technology, customer relations, R&D, etc. This classification of IC components is, according to Ashton (2005), the one most used in literature up until the present time. There are also other classifications which subdivide the SC into organisational capital and customer capital (Sveiby, 1997; Guthrie *et al.*, 2004; Youndt *et al.*, 2004).

The IC (both human and structural) is viewed by resource-based theory (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993) as being a strategic resource in the same way as capital employed (physical and financial) is viewed as a strategic resource. This theory considers that companies gain competitive advantage and superior financial performance through the acquisition, holding and efficient use of strategic resources.

However, many authors such as Riahi-Belkaoui (2003) and Youndt *et al.* (2004) underline that capital employed (physical and financial) is not strategic because it simply constitutes a generic resource. It is precisely IC that is viewed as being a strategic resource allowing the company to create VA. For these authors, a resource is considered to be strategic when it distinguishes itself from others by the difficulty of imitation, substitution and by its imperfect mobility.

This point of view is consistent with Reed *et al.* (2006) who recently developed an IC-based theory. Reed and her colleagues view their theory as a mid-range one because it represents one specific aspect of the more general resource-based theory. Although they have the same objective, to explain corporate performance by the effective and efficient use of a company's resources, the IC-based theory considers IC as being the only strategic resource to allow a company to create VA. This theory does not break away from its origins and is always analysed along with resource-based theory.

2. Value added as an indicator of IC (the VAIC™ method)

Taking into consideration the increasing importance of the role played by IC in value creation, Pulic (1998, 2004), with colleagues at the Austrian IC Research Centre, developed a new method to measure companies' IC which they called the "value added intellectual coefficient" (VAIC™). This method is very important since it allows us to measure the contribution of every resource – human, structural, physical and financial – to create VA by the company.

The calculation of the VAIC™ method follows a number of different steps. The first step is to calculate the company's ability to create VA. In accordance with the stakeholder theory[4] (Meek and Gray, 1988; Donaldson and Preston, 1995; Riahi-Belkaoui, 2003; DTI, 2006), the VA is calculated as follows:

$$\mathrm{VA} = \mathrm{OUT} - \mathrm{IN} \quad (1)$$

Outputs (OUT) represent the revenue and comprise all products and services sold on the market; inputs (IN) include all expenses for operating a company, exclusive of employee costs which are not regarded as costs.

The second step is to assess the relation between VA and HC. The value added human capital coefficient (VAHU) indicates how much VA has been created by one financial unit invested in employees. For Pulic (2004), employee costs are considered as an indicator of HC. These expenses are no longer part of the inputs. This means that expenses related to employees are not treated as a cost but as an investment. Thus, the relation between VA and HC indicates the ability of HC to create value in a company[5]:

$$\mathrm{VAHU} = \mathrm{VA}/\mathrm{HC} \quad (2)$$

The third step is to find the relation between VA and SC. The value added structural capital coefficient (STVA) shows the contribution of SC in value creation. According to Pulic (2004), SC is obtained when HC is deducted from VA. As this equation indicates, this form of capital is not an independent indicator. Indeed, it is dependent on the created VA and is in reverse proportion to HC.

This means that the greater the share of HC in the created VA, the smaller the share of SC. Thus, the relation between VA and SC is calculated as:

$$\mathrm{STVA} = \mathrm{SC}/\mathrm{VA} \quad (3)$$

The fourth step is to calculate the value added intellectual capital coefficient (VAIN), which shows the contribution of IC in value creation. Given that IC is composed of HC and SC, the VAIN is obtained by adding up VAHU and STVA:

$$\text{VAIN} = \text{VAHU} + \text{STVA} \tag{4}$$

Then, the fifth step is to assess the relation between VA and physical and financial capital employed (CA). For Pulic (2004), IC cannot create value on its own. Therefore, it is necessary to take financial and physical capital into account in order to have a full insight into the totality of VA created by a company's resources. The value added capital employed coefficient (VACA) reveals how much new value has been created by one monetary unit invested in capital employed. Thus, the relation between VA and CA indicates the ability of capital employed to create value in a company:

$$\text{VACA} = \text{VA}/\text{CA} \tag{5}$$

Finally, the sixth step is to assess each resource that helps to create or produce VA. Therefore, VAIC™ measures how much new value has been created per invested monetary unit in each resource. A high coefficient indicates a higher value creation using a company's resources, including its IC. Thus, VAIC™ is calculated as follows:

$$\text{VAIC}^{\text{TM}} = \text{VAIN} + \text{VACA} \tag{6}$$

There has been some criticism of the VAIC™ method, mainly by Andriessen (2004) who suggested that the method's basic assumptions are problematic and thus it produces dissatisfying results. However, an increasingly large number of researchers (such as Chen *et al.*, 2005; Shiu, 2006; Kujansivu and Lonnqvist, 2007; Tan *et al.*, 2007; Yalama and Coskun, 2007; Kamath, 2007, 2008; Chan, 2009) adopted the VAIC™ method which remains, in their view, the most attractive among the suggested methods to measure IC. For instance, Chan (2009, p. 10) mentions at least a dozen favourable arguments for the VAIC™ method, and concludes that the VAIC™ is the most appropriate method to measure IC. Also, according to Kamath (2007, 2008), the VAIC™ method has compellingly proved its suitability as a tool for the measurement of IC. Finally, the fact that the UK DTI makes data available to facilitate the use of the VAIC™ method contributes significantly, in our opinion, to the practical and empirical validity of this method.

3. Prior research

Recent empirical studies have attempted to show that IC significantly contributes to VA created by the company, and therefore is positively associated with its performance. In this context, Pulic (1998), using data from Austrian companies, found that VA is very highly correlated with IC, whereas the correlation between VA and capital employed (physical and financial) is low. These results suggest that IC has become the main source of value creation in the new knowledge-based economy. Furthermore, Stewart (1997, 2002), showed that a company's performance depends on the ability of its resources to create VA. Similarly, Riahi-Belkaoui (2003), using a sample of US multinational firms, discovered a significantly positive association between IC and future performance. He considers IC as a strategic resource, able to create VA for the company.

In a study based on 4,254 Taiwanese listed companies during the period 1992-2002, Chen *et al.* (2005) found that IC and capital employed have a positive impact on market value, as well as on current and future financial performance. In other words, the results indicated that investors place higher value on firms with greater IC which are considered more competitive than other firms. More recently, Tan *et al.* (2007) confirmed these results. Using data from 150 publicly traded companies in Singapore, their findings showed that IC is positively associated with current and future financial performance. They also found that the contribution of IC to a company's performance differs by industry.

However, the studies of Firer and Williams (2003) and Shiu (2006) provided generally limited and mixed results. Using data from 75 publicly traded companies in South Africa, Firer and Williams demonstrated that IC is negatively associated with traditional measures of corporate performance, while the association between these measures of performance and capital employed (physical and financial) is positive. In other words, the empirical results suggested that capital employed remains the most significant underlying resource of corporate performance in South Africa. Similar results were found by Shiu who examined the same model using data from 80 Taiwanese technology firms.

III. Research objective and hypotheses

The objective of this study is to empirically analyse the role of VA as an indicator of IC. We attempt also to empirically validate the method of VAIC™ to assess the impact of IC under the following triptych: economic performance (Model 1), financial performance (Model 2), and stock market performance (Model 3). Our assumption is that if the company is economically successful, it is going to exhibit a healthy and profitable financial state of affairs, which is going to reverberate on its stock market performance.

1. Economic performance model

Many authors suggest that IC investment allows the company to enhance its economic performance (Lev and Sougiannis, 1996; Lev and Zarowin, 1998; Casta *et al.*, 2005; Bismuth and Tojo, 2008). This performance is defined by the operating profitability which represents an economic surplus or an economic margin acquired by the difference between income and production costs (Cappelletti and Khouatra, 2004).

For instance, Nakamura (2001) suggested that if companies invest in IC, the success of these investments should permit companies on average to reduce their production costs and/or increase any kind of operational margins (or mark-ups). In this sense, highly skilled HC can enhance department store sales, and an efficient process of R&D can cut a factory's production costs.

In their model of IC valuation, Gu and Lev (2003) propose a new methodology based on the economic notion of "production function". This methodology considers that a company's economic performance is generated by three kinds of resources: physical, financial and intellectual.

However, the UK DTI (2006) considers that, in a value creation context, the company's economic performance depends not only on amounts invested in physical, financial and intellectual resources, but rather on the ability of these resources to create VA.

Using the VAIC™ method measures, we will test the following hypothesis:

H1a. There is a positive association between "value added intellectual capital coefficient" and economic performance.

H1b. There is a positive association between "value added capital employed (physical and financial) coefficient" and economic performance.

2. Financial performance model

Many authors believed strongly that IC could have a positive effect on the company's financial performance (Riahi-Belkaoui, 2003; Youndt *et al.*, 2004; Chen *et al.*, 2005; Tan *et al.*, 2007). This performance was defined by profitability, an expression of the ability of invested capital to earn a certain level of profit.

Following resource-based theory, Chen *et al.* (2005) suggested that if IC is a valuable resource for a company's competitive advantages, it will contribute to the company's financial performance. This assumption is also shared by Youndt *et al.* (2004) who stated that IC intensive companies are more competitive than other companies and are, therefore, more successful.

However, in order to constitute a sustained competitive advantage, and therefore a determinant of financial performance, Riahi-Belkaoui (2003) and Firer and Williams (2003) assumed that IC, as well as the physical and financial capital employed, is used in an effective and efficient way. This efficiency is assessed, according to Pulic (2004), in terms of the resources' ability to create VA for the company.

Using the VAIC™ method measures, we will investigate the following hypothesis:

H2a. There is a positive association between "value added intellectual capital coefficient" and financial performance.

H2b. There is a positive association between "value added capital employed (physical and financial) coefficient" and financial performance.

3. Stock market performance model

Some authors considered that the increasing gap between a company's market and book value can be a consequence of not taking IC into account in financial statements (Edvinsson and Malone, 1997; Lev and Sougiannis, 1996; Lev, 2001; Skinner, 2008). This gap, generally exhibited in market-to-book (MB) ratio, indicates that investors perceive IC as a source of value for a company, even though it is not present in the company's book value.

In this context, Firer and Williams (2003) and Chen *et al.* (2005) suggested that if the market is efficient, investors will place higher value on companies with greater IC. This assumption is also shared with Youndt *et al.* (2004) and Skinner (2008) who stated that IC intensive companies are valued more in the stock market than are other companies.

However, Zéghal (2000) and the UK DTI (2006) considered that, in a value creation context, investors do not limit their investments to companies with greater IC. Rather they will try to select for their portfolios those companies that have a track record of continuous creation of VA in an efficient and sustainable way.

Using the VAIC™ method measures, we will test the following hypothesis:

H3a. There is a positive association between "value added intellectual capital coefficient" and stock market performance.

H3b. There is a positive association between "value added capital employed (physical and financial) coefficient" and stock market performance.

IV. Methodology

1. Data and sample selection

The sample of companies used in this study was based on all UK companies which were listed on the LSE and which were available on the "Value Added Scoreboard" database provided by the UK DTI. The original data sample consisted of about 342 companies[6] that had realised the biggest contribution to the VA in the UK during 2005.

The following selection criteria were then applied to the original data sample:

- Following Firer and Williams (2003) and Shiu (2006), companies with negative book value of equity, or companies with negative HC or SC values were excluded from the sample.
- Companies for which some data were missing (unavailability of annual reports in consequence of merger, repurchase, suspension, delisting) were also excluded.
- Finally, in order to control for the presence of extreme observations or "outliers" in our sample, companies with selected variables situated at the extremities of every distribution were eliminated.

This sample selection process led us to a final sample composed of 300 UK companies (Table I).

In contrast with previous studies which examined only a single sector (Firer and Williams, 2003; Pulic, 2004; Shiu, 2006), the originality of our study consists in the examination of all sectors. In fact, the "new economy" literature shows that every sector of the economy has felt the impact of increased IC in value creation (Lynn, 1998; Bhartesh and Bandyopadhyay, 2005; Ashton, 2005). However, it is likely that the contribution of IC to a company's performance differs by industry (Abdolmohammadi, 2005; Tan *et al.*, 2007). For instance, the OECD (2006) suggested the application of industry-specific standards to accommodate the very different role of IC from sector to sector. Considering these suggestions, we chose in this study to divide our sample into different sub-samples to allow a cross-sectional analysis. After a review of classification criteria of sectors used in the literature, we opted to follow the rigorous classification provided by the UK DTI (2006, p. 49). This classification consists in organising the 39 industry classification benchmark (ICB)[7] sectors into three groups: high-tech industries, traditional industries and services (see the classification criteria in Table AI).

Table II shows the sample distribution by sector group and stock index. As can be seen, our sample is dominated by the group of services (53.67 per cent of the whole sample). The two other groups, i.e. traditional industries and high-tech industries, respectively, represent 30 and 16.33 per cent of the whole sample.

Table I.
Sample selection procedures

Initial sample	342
Companies with negative book value	− 15
Companies missing data on selected variables	− 14
Extreme observations or "outliers"	− 9
Companies with negative human capital or structural capital values	− 4
Final sample	300

Table II also shows that our sample of companies represents the different levels of market capitalization. The largest component of the sample (51.33 per cent of whole sample) belongs to the Financial Times Stock Exchange (FTSE) 250 index which is characterised by medium market capitalization. The two other components of the sample (29 and 19.67 per cent of whole sample) belong, respectively, to the FTSE 100 index which is characterised by large market capitalization and other stock indexes which are characterised by small market capitalization (such as, for example, the FTSE small cap index).

2. Definition of variables

2.1 Dependent variables. To conduct the relevant analysis in the present study, three dependent variables of operating income/sales (OI/S), return on assets (ROA) and MB were used as proxy measures for economic, financial and stock market performance, respectively. These variables were defined as:

- *OI/S*. Ratio of the operating income divided by total sales, used as a proxy for economic performance (Lev and Sougiannis, 1996; Nakamura, 2001; Lev, 2004).
- *ROA*. Ratio of the earnings before interest and taxes divided by book value of total assets, used as a proxy for financial performance (Firer and Williams, 2003; Chen *et al.*, 2005; Shiu, 2006).
- *MB*. Ratio of the total market capitalization (share price times number of outstanding common shares) to book value of net assets, used as a proxy for stock market performance (Sougiannis, 1994; Firer and Williams, 2003; Cazavan-Jeny, 2004).

2.2 Independent variables. Using the VAIC™ method measures, two coefficients were selected to measure both independent variables under consideration:

(1) VAIN: the value added intellectual capital coefficient.
where:

$$\mathrm{VAIN} = \mathrm{VAHU} + \mathrm{STVA}$$

$$\mathrm{VAHU} = \mathrm{VA}/\mathrm{HC}; \quad \text{Value added human capital coefficient}$$

$$\mathrm{VA} = \mathrm{OUT} - \mathrm{IN}$$

$$\mathrm{HC} = \text{employee costs} - \text{R\&D costs (principally costs of employees working in R\&D)}$$

$$\mathrm{STVA} = \mathrm{SC}/\mathrm{VA}; \quad \text{Value added structural capital coefficient}$$

$$\mathrm{SC} = \mathrm{VA} - \mathrm{HC}; \quad \text{structural capital}$$

Sector group	Sector group Vol.	Percentage	Index	Stock index Vol.	Percentage
High-tech industries	49	16.33	FTSE 100	87	29.00
Traditional industries	90	30.00	FTSE 250	154	51.33
Services	161	53.67	Others	59	19.67
Total	300	100	Total	300	100

Table II. Sample distribution by sector group and stock index

(2) VACA: the value added capital employed coefficient., where:

$$VACA = VA/CA$$

$$CA = \text{book value of the net assets}$$

2.3 Control variables. Two control variables were used in this study to control for their effect on company performance:

(1) Size of the company (Size): measured by the natural log of book value of total assets (Riahi-Belkaoui, 2003).
(2) Leverage (Lev): measured by the ratio of book value of total assets to book value of common equity (Lev and Sougiannis, 1996).

3. Research models

In order to respond to our research objective, we propose to empirically test the following three equations relating to the economic (Model 1), financial (Model 2) and stock market (Model 3) performance models:

$$OI/S = \beta_0 + \beta_1 \, VAIN + \beta_2 \, VACA + \beta_3 \, Size + \beta_4 \, Lev + \mu \quad \text{(Model 1)}$$

$$ROA = \beta_0 + \beta_1 \, VAIN + \beta_2 \, VACA + \beta_3 \, Size + \beta_4 \, Lev + \mu \quad \text{(Model 2)}$$

$$MB = \beta_0 + \beta_1 \, VAIN + \beta_2 \, VACA + \beta_3 \, Size + \beta_4 \, Lev + \mu \quad \text{(Model 3)}$$

V. Empirical results

1. Descriptive statistics

Table III presents the means, standard deviations, medians, minimum and maximum values of all the variables. The mean MB is about 3.5, indicating that investors generally valued the sample companies in excess of the book value of net assets as reported in financial statements. Consequently, nearly 70 per cent of a company's market value is not reflected on financial statements. The comparison between VAIN and VACA values suggests that during 2005 the sample companies were generally more effective in creating VA from their IC (VAIN = 2.946) than from physical and financial capital employed (VACA = 1.402). This finding is consistent with prior literature (Zéghal, 2000; Pulic, 2004) suggesting that, in the new economic era, we accord much more value to wealth created by intellectual resources than that created by physical and financial resources. The mean of aggregate VAIC™ which is 4.348 indicates that UK companies studied in this paper created £4.348 for every £ employed.

To compare between groups of sectors, a one-way ANOVA was conducted on the three groups. Results from this test are shown in Table IV. These results again suggest that each group (high-tech industries, traditional industries and services) was generally more effective in creating VA from its IC than from physical and financial capital employed (VAIN > VACA). This finding is consistent with the "new economy" literature showing that every sector of the economy has felt the impact of increased IC in value creation and economic wealth, and that value creation applies to any sector (Lynn, 1998; Bhartesh and Bandyopadhyay, 2005; Ashton, 2005). It is also consistent

Variable	n	Mean	SD	Median	Minimum	Maximum
OI/S	300	0.132	0.149	0.086	− 0.126	0.976
ROA	300	0.077	0.065	0.068	− 0.143	0.348
MB	300	3.504	2.815	2.703	0.580	17.643
VAHU	300	2.496	2.349	1.745	1.059	18.735
STVA	300	0.450	0.215	0.427	0.056	0.947
VAIN	300	2.946	2.511	2.172	1.115	19.681
VACA	300	1.402	1.967	0.883	0.059	26.330
VAIC™	300	4.348	2.811	3.508	1.637	27.560
Size	300	7.421	1.752	7.170	4.398	13.737
Lev	300	4.807	5.918	2.848	0.308	38.870

Notes: Variables are defined as follows: OI/S is the ratio of the operating income divided by total sales, used as proxy for economic performance; ROA is the ratio of the earnings before interest and taxes divided by book value of total assets, used as proxy for financial performance; and MB is the ratio of the total market capitalization (share price times number of outstanding common shares) to book value of net assets, used as proxy for stock market performance; VAHU is the value added human capital coefficient; STVA is the value added structural capital coefficient; VAIN is the value added intellectual capital coefficient (sum of HC and SC); VACA is the value added capital employed coefficient (physical and financial) and VAIC™ is the value added intellectual coefficient (sum of IC and capital employed). Size of the company (Size) is measured by natural log of book value of total assets, and leverage (Lev) is measured by the ratio of book value of total assets to book value of common equity

Table III. Descriptive statistics for selected variables

	High-tech industry ($n = 49$)		Traditional industry ($n = 90$)		Services ($n = 161$)			
Variable	Mean	SD	Mean	SD	Mean	SD	F	Significance
VAHU	1.871	1.139	3.104	3.331	2.345	1.842	5.227	0.006*
STVA	0.382	0.172	0.498	0.233	0.444	0.210	4.834	0.009*
VAIN	2.254	1.282	3.602	3.505	2.790	2.011	5.399	0.005*
VACA	1.430	0.843	1.590	2.998	1.288	1.409	0.683	0.506
VAIC™	3.684	1.367	5.192	4.138	4.078	2.017	6.390	0.002*

Note: Significant at *1 per cent level

Table IV. A one-way between groups ANOVA

with prior studies (Zéghal, 2000; Firer and Williams, 2003) suggesting that, even within traditional industry sectors, the conventional underlying factors of production such as physical and financial capital lost much of their importance in favour of IC.

Table IV also shows that traditional industry sectors were generally more effective in creating VA from their intellectual, physical and financial resources (VAIC™ = 5.192) than other groups of sectors (high-tech industry VAIC™ = 3.684, and services VAIC™ = 4.078). This mean difference is statistically significant at a 1 per cent level ($p = 0.002$). Although the results are surprising, they widely confirm, nevertheless, the statistics presented by the UK DTI (2006, p. 51) in the "Value Added Scoreboard". Indeed, contrary to other European countries such as Germany and

Switzerland which in the high-tech and services sectors, respectively, are very much involved in the creation of VA, the UK[8] mainly leans on its traditional sectors to create VA. These sectors are much modernised, innovative and competitive (DTI, 2006).

2. Correlation analysis

Correlation analysis is the initial statistical technique used to analyse the association between the dependent and the independent variables. Table V shows the findings from Pearson pair wise analysis which indicate that the value added intellectual capital coefficient (VAIN) is significantly positively associated ($p < 0.01$) with economic performance (OI/S), on the one hand, and with financial performance (ROA), on the other. Nevertheless, the association between the value added intellectual capital coefficient (VAIN) and stock market performance (MB) is not significant[9]. Consequently, these results entirely support *H1a* and *H2a*, while rejecting, at least partially, the *H3a*.

Table V also shows that the VACA is significantly negatively correlated with economic performance (OI/S). Contrary to expectations, this finding leads us to reject the *H1b*, namely that there is a positive association between VACA and OI/S. The *H2b* also seems to be rejected – at least partially –since the association between the "value added capital employed coefficient" (VACA) and financial performance (ROA) is not significant[10]. However, the results indicate a significant positive association between the VACA and stock market performance (MB). In accordance with our expectations, this finding appears to support *H3b*.

Finally, it is interesting to note that the VAIC™ index is significantly positively correlated ($p < 0.01$) with economic performance (OI/S), financial performance (ROA), and stock market performance (MB).

Variable	OI/S	ROA	MB
VAHU	0.702*	0.161*	−0.105
STVA	0.712*	0.264*	−0.086
VAIN	0.717*	0.173*	−0.106
VACA	−0.244*	0.076	0.578*
VAIC™	0.470*	0.208*	0.310*
Size	0.325*	−0.208*	−0.172*
Lev	0.167*	−0.281*	0.148**

Notes: Significant at *1 and ** 5 per cent level, respectively; variables are defined as follows: OI/S is the ratio of the operating income divided by total sales, used as proxy for economic performance; ROA is the ratio of the earnings before interests and taxes divided by book value of total assets, used as proxy for financial performance and MB is the ratio of the total market capitalization (share price times number of outstanding common shares) to book value of net assets, used as proxy for stock market performance; VAHU is the value added human capital coefficient; STVA is the value added structural capital coefficient; VAIN is the value added intellectual capital coefficient (sum of HC and SC); VACA is the value added capital employed coefficient (physical and financial) and VAIC™ is the value added intellectual coefficient (sum of IC and capital employed). Size of the company (Size) is measured by natural log of book value of total assets, and Lev (leverage) is measured by the ratio of book value of total assets to book value of common equity

Table V.
Correlation analysis of selected variables ($n = 300$)

3. Linear multiple regression results

The correlation analysis results constitute a first approach to test our hypotheses. We now continue to test these hypotheses through our linear multiple regression Models (1-3). Two control factors (Size and leverage) which can have an effect on company performance are also included. To check for the absence of multicollinearity problems, the Pearson's correlation coefficients between explanatory variables were analysed. The Pearson pair wise correlation matrix is shown on Panel A of Table VI for the whole sample and Panels B-D for the three sector groups, respectively.

Kennedy (1985) suggested that multicollinearity be viewed as a serious problem only if the correlation between explanatory variables exceeds 0.8. As can be seen from Table VI (Panels A-D), the correlation coefficients between explanatory variables are not high. They range from a low of 0.003 to a high of 0.780. Consequently, we can presume the absence of any multicollinearity problems.

Economic performance model. Table VII exhibits the results of the regression coefficients for all explanatory variables, using economic performance (OI/S) as the dependent variable. Panel A presents the results for the whole sample while Panel B presents the results for the three groups of sectors, respectively. The adjusted R^2 is 0.550 for the whole sample, 0.446 for the high-tech industry sub-sample, 0.506 for the traditional industry sub-sample and 0.705 for the services sub-sample. These numbers indicate that the model is able to explain about 55 per cent of the variance in the dependent variable for the whole sample, 45 per cent for the high-tech industry sub-sample, 51 per cent for the traditional industry sub-sample and 71 per cent for the services sub-sample.

Variables	VAIN	VACA	Size	Lev
Panel A: whole sample ($n = 300$)				
VAIN	1	−0.230*	0.302*	0.003
VACA		1	−0.240*	0.221*
Size			1	0.526*
Lev				1
Panel B: high-tech industry sectors ($n = 49$)				
VAIN	1	−0.224	0.558*	−0.126
VACA		1	−0.266	0.639*
Size			1	0.175
Lev				1
Panel C: traditional industry sectors ($n = 90$)				
VAIN	1	−0.197	0.316*	−0.125
VACA		1	−0.203	0.780*
Size			1	−0.059
Lev				1
Panel D: services sectors ($n = 161$)				
VAIN	1	−0.347*	0.259*	0.080
VACA		1	−0.357*	−0.029
Size			1	0.696*
Lev				1

Note: Significant at *1 per cent level

Table VI. Pearson correlation matrices for the explanatory variables

Table VII. Linear multiple regression results for economic performance

$$\text{Model 1}: \text{OI/S} = \beta_0 + \beta_1\,\text{VAIN} + \beta_2\,\text{VACA} + \beta_3\,\text{Size} + \beta_4\,\text{Lev} + \mu$$

	Panel A		Panel B					
	Whole sample		High-tech industry		Traditional industry		Services	
Variable	β	t	β	t	β	t	β	t
Intercept	N/A	0.518	N/A	1.272	N/A	1.051	N/A	−1.691***
VAIN	0.693	16.629*	0.633	4.647*	0.715	9.008*	0.800	17.254*
VACA	−0.137	−3.094*	−0.154	−0.942	−0.148	−1.179	−0.021	−0.413
Size	−0.026	−0.500	−0.092	−0.590	−0.043	−0.535	0.030	0.444
Lev	0.209	4.120*	−0.160	−0.964	0.079	0.643	0.147	2.318**
n	300		49		90		161	
Adj. R^2	0.550		0.446		0.506		0.705	
F	92.471*		10.644*		23.803*		96.799*	

Note: Significant at *1, **5 and ***10 per cent levels, respectively

Panels A and B of Table VII show that the value added intellectual capital coefficient (VAIN) has a significantly positive association with economic performance (OI/S). This result supports the *H1a* and confirms that IC plays a major role in reducing production costs (Nakamura, 2001; Gu and Lev, 2003). Moreover, this finding agrees with previous studies conducted by Lev and Sougiannis (1996), Lev and Zarowin (1998) and Casta *et al.* (2005) who found a positive effect of IC on economic performance in American, French and Spanish companies, respectively. However, contrary to theoretical expectations, the results exhibited in Panel A of Table VII indicate a negative association between the VACA and economic performance (OI/S). Although it is contrary to findings from prior literature (Lev and Sougiannis, 1996; Gu and Lev, 2003), this result partially confirms the findings of Casta *et al.* (2005) and appears to reject the *H1b*. The negative sign on VACA may be due to the fact that capital employed (physical and financial) may generate additional expenses for companies, such as, for example, the electricity expenses for operating machines which are part of capital employed. Another explanation is that measurements used in various studies to measure capital employed are not homogeneous.

Financial performance model. Table VIII (Panels A and B) shows the results of regression coefficients for all explanatory variables, using financial performance (ROA) as the dependent variable. Panel A presents the results for the whole sample while Panel B presents the results for the three groups of sectors individually. Adjusted R^2 is 0.139 for the whole sample, which indicates that the model is able to explain nearly 14 per cent of the variance in the dependent variable. As for sector groups, adjusted R^2 is 0.394 for the high-tech industry sub-sample, 0.113 for the traditional industry sub-sample, and 0.207 for the services sub-sample. This indicates that the model is able to explain more than 39 per cent for the high-tech industry sub-sample, 11 per cent for the traditional industry sub-sample and 20 per cent for the services sub-sample, respectively.

Panels A and B of Table VIII show that the value added intellectual capital coefficient (VAIN) has a significantly positive correlation with financial performance (ROA). This result supports our *H2a*, stating that IC plays a major role in creating value for stockholders as well as for other stakeholders. Moreover, this finding

Table VIII. Linear multiple regression results for financial performance

$$\text{Model 2}: \text{ROA} = \beta_0 + \beta_1\,\text{VAIN} + \beta_2\,\text{VACA} + \beta_3\,\text{Size} + \beta_4\,\text{Lev} + \mu$$

	Panel A		Panel B					
	Whole sample		High-tech industry		Traditional industry		Services	
Variable	β	t	β	t	β	t	β	t
Intercept	N/A	4.880*	N/A	1.340	N/A	1.396	N/A	4.036*
VAIN	0.243	4.219*	0.629	4.413*	0.371	3.491*	0.149	1.953***
VACA	0.166	2.712*	0.081	0.473	0.201	1.921***	0.227	2.760*
Size	−0.102	−1.402	−0.117	−0.720	0.050	0.467	−0.208	−1.850***
Lev	−0.264	−3.766**	−0.314	−1.814***	−0.186	−1.132	−0.228	−2.190**
n	300		49		90		161	
Adj. R^2	0.139		0.394		0.113		0.207	
F	13.042*		8.795*		3.839*		11.419*	

Note: Significant at *1, **5 and ***10 per cent levels, respectively

confirms prior studies conducted by Sougiannis (1994), Riahi-Belkaoui (2003), Chen *et al.* (2005) and Tan *et al.* (2007) who all found a significant positive association between IC and financial performance. The data in Table VIII also show that VACA has significant positive correlation with financial performance (ROA). This result appears to support *H2b*, and corroborates prior studies conducted by Sougiannis (1994) and Chen *et al.* (2005) who found a positive effect of capital employed (physical and financial) on the profitability of American and Taiwanese companies, respectively. However, Panel B of Table VIII shows that the association between VACA and ROA within high-tech industry sectors is not significant. This finding may imply that high-tech companies' financial performance is mainly due to IC.

Stock market performance model. Table IX (Panels A and B) shows the results of regression coefficients for all explanatory variables, using stock market performance (MB) as the dependent variable. As reported in Panel A, the adjusted R^2 is 0.331 for the whole sample, indicating that the model is able to explain more than 33 per cent of the variance in the dependent variable. Across the three linear regressions reported in Panel B, adjusted R^2 varies from a high of 61 per cent for traditional industry to a low of 39.9 per cent for services.

Table IX. Linear multiple regression results for stock market performance

$$\text{Model 3}: \text{MB} = \beta_0 + \beta_1\,\text{VAIN} + \beta_2\,\text{VACA} + \beta_3\,\text{Size} + \beta_4\,\text{Lev} + \mu$$

	Panel A		Panel B					
	Whole sample		High-tech industry		Traditional industry		Services	
Variable	β	t	β	t	β	t	β	t
Intercept	N/A	4.437*	N/A	−0.581	N/A	2.324**	N/A	1.587
VAIN	0.049	0.971	0.557	4.315*	0.057	0.802	0.036	0.544
VACA	0.550	10.193*	0.499	3.226*	0.157	1.401	0.644	8.987*
Size	−0.094	−1.470	0.013	0.090	−0.077	−1.080	−0.031	−0.321
Lev	0.076	1.223	0.159	1.013	0.660	6.044*	0.033	0.370
n	300		49		90		161	
Adj. R^2	0.331		0.503		0.610		0.399	
F	38.019*		13.126*		35.763*		27.553*	

Note: Significant at *1 and **5 percent level, respectively

Similar to the results of correlation analysis, the results reported in Panel B of Table IX show that the *H3a*, where we expect a positive association between the value added intellectual capital coefficient (VAIN) and stock market performance (MB), is only verified for high-tech industry sectors. This unexpected finding implies that UK investors do not appreciate the importance of IC within traditional industry and services sectors though they are highly creative of VA. The data in Panel A of Table IX also show that the VACA has a significantly positive association with stock market performance (MB). This result appears to support *H3b*, and corroborates prior studies conducted by Firer and Williams (2003), Chen *et al.* (2005) and Shiu (2006) who found a positive association between capital employed (physical and financial) and MB ratio. However, the association between VACA and MB within traditional industry sectors is not significant. This result may be due to the high dominance of the leverage effect ($\beta_4 = 0.660$ and $p < 0.01$) on stock market performance in estimating the regression equation for this group of sectors. Indeed, the association between VACA and MB within traditional industry sectors becomes significantly positive when we subtract the leverage variable from the regression equation (results not tabulated).

VI. Conclusions

Given that the traditional accounting model imperfectly and partially measures the IC assets, we tried in this study to extend the efforts made by researchers and practitioners to find an appropriate measure of IC. Using the "value added intellectual coefficient – VAIC™" method, we attempted to empirically analyse the role of VA as an indicator of IC. We also attempted to empirically validate the method of VAIC™ to assess the impact of IC on company performance.

The following associations which constitute the basic hypotheses of our study were tested:

- There is a positive association between "value added intellectual capital coefficient" and economic performance, financial performance and stock market performance.
- There is a positive association between "value added capital employed coefficient" and economic performance, financial performance and stock market performance.

By using data from UK listed companies during 2005, our findings have important implications. First, our results show a significantly positive association between the value added intellectual capital coefficient and a company's economic performance. This indicates that IC plays a major role in reducing a company's production costs. In addition, our results show that the value added intellectual capital coefficient has a significantly positive association with a company's financial performance. This finding supports the significant role of IC in creating value for stockholders as well as for other stakeholders. However, the association between the value added intellectual capital coefficient and a company's stock market performance is only significant for high-tech industry sectors. This indicates that UK investors perceive IC as a source of "value creation" only for this kind of sector. Finally, our results show that the VACA has a significantly positive association with a company's financial and stock market performance. These findings indicate that capital employed (physical and financial) remains important for stockholders and stakeholders through its significant role in value creation. Nevertheless, our results seem to indicate a negative association between the VACA and a company's economic performance.

The results of this research have several practical implications. Primarily, they allow managers to apply the VAIC™ method to better harness and manage their IC and to benchmark against the best competitors in their sectors. Accountants can also adopt the VAIC™ method as a potential measure to report on IC. In addition, investors can use the VAIC™ method to help them select companies for their portfolios that have a track record for continuous creation of VA in an efficient and sustainable way. Finally, governments can use the VAIC™ method to assess different companies and different sectors in the economy in terms of VA of their IC. This may result in better economic policies and an improvement in the management of the new economy. In fact, our findings will support the UK DTI in their decision to compile and disclose the data on VA in the Value Added Scoreboard. Also, our results are coherent with the OECD's new approach on the role of IC in value creation.

This research is not without its limitations. First, the results related to the impact of control factors on dependent variables are mixed and not significant in most cases. Additional research should give more attention to control factors and could eventually introduce other control factors and provide clearer results, if the necessary data were to be available. Second, given that findings from the present study are cross-sectional, future research should be undertaken to examine the associations studied in this paper across time. Finally, future research could revisit some of the basic assumptions of the VAIC™ method and assess their potential consequences for the validity of empirical testing and results.

Notes

1. For example, in 2002, the investment in IC was larger than the investment in physical and financial capital in the USA and Finland (OECD, 2007).
2. The accounting for IC assets is henceforth regulated by the IAS 38 (intangible assets), IAS 36 (impairment of assets), and IFRS 3 (business combinations).
3. The DTI was recently divided into two separate units: the Department for Business, Enterprise and Regulatory Reform and the Department for Innovation, Universities and Skills.
4. The stakeholder theory designates the concept of VA as the best indicator of the company's ability to create value. This VA is created by the stakeholders and then distributed to the same stakeholders.
5. According to OECD (2006), HC and SC tend to be complementary and can overlap significantly. For example, the bulk of R&D expenditures, in fact, covers wages for highly skilled labour. In consideration of this point, we subtracted the R&D expenditures (part of SC) from employee costs to measure HC.
6. Other companies treated in this database (DTI, 2006) are unlisted. It is therefore difficult to obtain their annual reports to complete the information needed for the analysis, and, as a result, it is impossible to include them in our sample. The annual reports of listed companies used in this study were extracted from the financial web site www.northcote.co.uk. In order to check their conformity, the data obtained from the "Value Added Scoreboard" database were compared with those contained in annual reports.
7. The ICB sectors has been agreed by the FTSE and Dow Jones and was implemented on 3 January 2006.

8. The UK has 47.2 per cent of its VA in the traditional industry sectors, 42.8 per cent in the services sectors, and only 10 per cent in the high-tech industry sectors. Germany on the other hand has 47 per cent of VA in the high-tech industry sectors, 31.9 per cent in the traditional industry sectors and 21.1 per cent in the services sectors (DTI, 2006).
9. The association between VAIN and MB became significantly positive ($p < 0.01$) within high-tech industry sectors. Consequently, it seems that UK investors perceive IC as a source of "value creation" only for this kind of sector.
10. The association between VACA and ROA became significantly positive ($p < 0.01$) within the services sectors.

References

Abdolmohammadi, M.J. (2005), "Intellectual capital disclosure and market capitalization", *Journal of Intellectual Capital*, Vol. 6 No. 3, pp. 397-416.

Andriessen, D. (2004), *Making Sense of Intellectual Capital: Designing a Method for the Valuation of Intangibles*, Elsevier Butterworth-Heinemann, Oxford.

Ashton, R.H. (2005), "Intellectual capital and value creation: a review", *Journal of Accounting Literature*, Vol. 24, pp. 53-134.

Barney, J.-B. (1991), "Firm resources and sustainable competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.

Bhartesh, K.R. and Bandyopadhyay, A.K. (2005), "Intellectual capital: concept and its measurement", *Finance India*, Vol. 19 No. 4, pp. 1365-674.

Bismuth, A. and Tojo, Y. (2008), "Creating value from intellectual assets", *Journal of Intellectual Capital*, Vol. 9 No. 2, pp. 228-45.

Canibano, L., Garcia-Ayuso, M. and Sanchez, P. (2000), "Accounting for intangibles: a literature review", *Journal of Accounting Literature*, Vol. 19, pp. 102-30.

Cappelletti, L. and Khouatra, D. (2004), "Concepts et mesure de la création de valeur organisationnelle", *Comptabilité-Contrôle-Audit*, Vol. 10 No. 1, pp. 127-46.

Casta, J.-F., Escaffre, L. and Ramond, O. (2005), "Intangible investments and accounting numbers: usefulness, informativeness and relevance, on the European stock markets", working paper, available at: www.ssrn.com

Cazavan-Jeny, A. (2004), "Le ratio market-to-book et la reconnaissance des immatériels – une étude du marché français", *Comptabilité-Contrôle-Audit*, Vol. 10 No. 2, pp. 99-124.

Chan, K.H. (2009), "Impact of intellectual capital on organisational performance: an empirical study of companies in the Hang Seng Index (part 1)", *The Learning Organization*, Vol. 16 No. 1, pp. 4-21.

Chen, J., Zhu, Z. and Xie, H.Y. (2004), "Measuring intellectual capital: a new model and empirical study", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 195-212.

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.

Donaldson, T. and Preston, L.E. (1995), "The stakeholder theory of the corporation: concepts, evidence", *The Academy of Management Review*, Vol. 20 No. 1, p. 65.

DTI (2004), *Creating Value from Your Intangibles*, Critical Success Factors, Department of Trade and Industry, London.

DTI (2006), *The Value Added Scoreboard*, Commentary and Analysis (Volume 1), Company Data (Volume 2), Department of Trade and Industry, London.

DTI (2007), *The Value Added Scoreboard*, Commentary and Analysis (Volume 1), Company Data (Volume 2), Department of Trade and Industry, London.

Edvinsson, L. (1997), "Developing intellectual capital at Skandia", *Long Range Planning*, Vol. 30 No. 3, pp. 266-373.

Edvinsson, L. and Malone, M. (1997), *Intellectual Capital: Realizing your Company's True Value by Finding its Hidden Brainpower*, Harper Collins, New York, NY.

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.

Gu, F. and Lev, B. (2003), "Intangible assets: measurement, drivers, usefulness", working paper, Boston University, Boston, MA.

Guthrie, J., Petty, R., Yongvanich, K. and Ricceri, F. (2004), "Using content analysis as a research method to inquire into intellectual capital reporting", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 282-93.

Kamath, G.B. (2007), "The intellectual capital performance of Indian banking sector", *Journal of Intellectual Capital*, Vol. 8 No. 1, pp. 96-123.

Kamath, G.B. (2008), "Intellectual capital and corporate performance in Indian pharmaceutical industry", *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 684-704.

Kennedy, P. (1985), *A Guide to Econometrics*, 2nd ed., MIT Press, Cambridge, MA.

Kristandl, G. and Bontis, N. (2007), "The impact of voluntary disclosure on cost of equity capital estimates in a temporal setting", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 577-94.

Kujansivu, P. and Lonnqvist, A. (2007), "Investigating the value and efficiency of intellectual capital", *Journal of Intellectual Capital*, Vol. 8 No. 2, pp. 272-87.

Lev, B. (2001), *Intangibles: Management, Measurement and Reporting*, Brookings Institution Press, Washington, DC.

Lev, B. (2004), "Sharpening the intangibles edge", *Harvard Business Review*, Vol. 82 No. 6, pp. 109-16.

Lev, B. and Sougiannis, T. (1996), "The capitalization, amortization, and value-relevance of R&D", *Journal of Accounting and Economics*, Vol. 21, pp. 107-38.

Lev, B. and Zarowin, P. (1998), "The market valuation of R&D expenditures", working paper, New York University, Leonard N. Stern School of Business, New York, NY.

Lev, B., Thomas, J. and Nissim, D. (2007), "On the informational usefulness of R&D capitalization and amortization", working paper, available at: www.ssrn.com

Lynn, B. (1998), "Intellectual capital", *CMA Magazine*, Vol. 72 No. 1, pp. 10-15.

Meek, G. and Gray, S. (1988), "The value added statement: an innovation for US companies?", *Accounting Horizons*, Vol. 2 No. 2, pp. 73-81.

Morley, M.F. (1979), "The value added statement in Britain", *The Accounting Review*, May, pp. 618-89.

Nakamura, L.I. (2001), "What is the US gross investment in intangibles? (At least) one trillion a year!", working paper, Federal Reserve Bank of Philadelphia, Philadelphia, PA.

OECD (2006), "Creating value from intellectual assets", paper presented at Meeting of the OECD Council at Ministerial Level, Paris.

OECD (2007), "Policy brief: creating value from intellectual assets", OECD Observer, Paris, February.

OECD (2008), *Intellectual Assets and Value Creation – Synthesis Report*, OECD, Paris.

Peteraf, M.A. (1993), "The cornerstones of competitive advantage: a resource based view", *Strategic Management Journal*, Vol. 14 No. 3, pp. 179-91.

Pong, C. and Mitchell, F. (2005), "Accounting for a disappearance: a contribution to the history of the value added statement in the UK", *The Accounting Historians Journal*, Vol. 32 No. 2, pp. 173-99.

Pulic, A. (1998), "Measuring the performance of intellectual potential in a knowledge economy", paper presented at 2nd McMaster World Congress, available at: www.vaic-on.net (accessed 2 January 2007).

Pulic, A. (2004), "Intellectual capital-does it create or destroy value?", *Measuring Business Excellence*, Vol. 8 No. 1, pp. 62-8.

Reed, K.K., Lubatkin, M. and Srinivasan, N. (2006), "Proposing and testing an intellectual capital-based view of the firm", *Journal of Management Studies*, Vol. 43 No. 4, pp. 867-93.

Riahi-Belkaoui, A. (2003), "Intellectual capital and firm performance of US multinational firms", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 215-26.

Shiu, H.-J. (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.

Skinner, D.J. (2008), "Accounting for intangibles – a critical review of policy recommendations", *Accounting and Business Research*, Vol. 38 No. 3, pp. 191-204.

Sougiannis, T. (1994), "The accounting based valuation of corporate R&D", *The Accounting Review*, Vol. 69 No. 1, pp. 44-68.

Stewart, T.A. (1997), *Intellectual Capital: The New Wealth of Organisation*, Nicholas Brealey, London.

Stewart, T.A. (2002), "The case against knowledge management", *Business 2.0*, Vol. 3 No. 2, pp. 80-3.

Sveiby, K. (1997), *The New Organisational Wealth: Managing and Measuring Knowledge Based Assets*, Berrett-Koehler, San Francisco, CA.

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. 76-95.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5 No. 2, pp. 171-4.

Williams, S.M. (2001), "Is intellectual capital performance and disclosure practice related?", *Journal of Intellectual Capital*, Vol. 2 No. 3, pp. 192-203.

Yalama, A. and Coskun, M. (2007), "Intellectual capital performance of quoted banks on the Istanbul stock exchange market", *Journal of Intellectual Capital*, Vol. 8 No. 2, pp. 256-71.

Youndt, M.A., Subramaniam, M. and Snell, S.A. (2004), "Intellectual capital profiles: an examination of investments and returns", *Journal of Management Studies*, Vol. 41 No. 2, pp. 335-61.

Zéghal, D. (2000), "New assets for the new economy", *FMI Journal*, Vol. 11 No. 2, pp. 35-40 (Financial Management Institute of Canada).

Appendix

1. High-tech industry sectors (R&D > 2.5% of sales)	2. Traditional industry sectors (capex[a] > 4.3% of sales but R&D < 2.5% of sales)	3. Services sectors other sectors with (R&D < 2.5% of sales and capex[a] < 4.3% of sales)
1. Aerospace and defence	10. Beverages	24. Banks
2. Automotive	11. Construction and materials	25. Equity investment
3. Chemicals	12. Electricity	26. Food and drug retailers
4. Electronic and electrical	13. Fixed line telecomms	27. Food producers[b]
5. Health care	14. Forestry and paper	28. General financial
6. Industrial engineering	15. Gas, water and multi-utilities	29. General retailers
7. Pharmaceuticals and biotechnology	16. General industrials	30. Household goods
	17. Industrial metals	31. Leisure goods
8. Technology hardware and equipment	18. Industrial transport	32. Life insurance
	19. Mining	33. Media
9. Software and computer services	20. Mobile telecomms	34. Non-equity investments
	21. Oil and gas producers	35. Non-life insurance
	22. Oil equipment and services	36. Personal goods
	23. Travel and leisure	37. Real estate
		38. Support services
		39. Tobacco

Notes: [a]Capex: capital expenditure; [b]food producers are sometimes considered to be a traditional industry or even a high-tech industry sector. However, capex at 3.2 per cent of sales is well below 4.3 per cent and R&D is below 1.5 per cent for all but one company (DTI, 2006); the names of the sample companies can be obtained from the authors upon request
Source: UK DTI (2006)

Table AI. The three sector groups – assignment of the 39 sectors to the three sector groups

About the authors

Daniel Zéghal's research interests deal with a great number of subjects related to the communication and use of accounting and financial information. His most recent work deals with the topics of international disclosure, performance evaluation and corporate governance, environmental management reporting and auditing, enterprise risk management, accounting and reporting of intangible and non-traditional assets. He has published books and research monographs and numerous articles in accounting and finance in academic and professional journals such as *International Journal Management*, *Accounting and Business Research*, *Financial Management Journal*, *La Revue internationale de gestion*, *Journal of International Accounting Auditing and Taxation*, *Comptabilité Contrôle Audit*, *Contemporary Accounting Research*, *Accounting Auditing and Accountability Journal*, *Canadian Journal of Administrative Sciences*, *Journal of Accounting & Public Policy*, *International Review of Accounting*, *Journal of Business Finance and Accounting*, *Journal of Financial and Quantitative Analysis*, *Économie et comptabilité*, *The Canadian Journal of Economics*, *La Revue française de comptabilité*, *The Journal of Human Resources Costing and Accounting*, *Analyse financière*, *Finance Economie et comptabilité*, *Camagazine*, *CGA Magazine*, *Cost and Management* and *Gestion 2000*. He teaches accounting theory, management control, cost accounting and international accounting at both graduate and under graduate levels. He is the Executive Director of the CGA – Accounting Research Centre and is an active member of the Canadian Academic Accounting Association, the European Accounting Association, the Certified General Accountants' Association of Ontario and CGA Canada. In 2004, he joined the CGA – Canada Research Foundation Board of Directors. He has been a member of the editorial Board of a number of academic journals for many years. He is an Associate Editor for Canadian Accounting Perspective. In recognition for his work and

leadership in both research and education in accounting and his contribution to the profession, he has won many prizes including the following: Fellow of the Certified General Accountants of Canada in 1996, Life membership of CGA-Ontario, member of the year 2000 edition of the International Who's Who of Professionals, winner of the 2000 Alan G. Ross Award for Writing Excellence and was listed in the 22nd edition of Who's Who in Canadian Business 2001. He was also named to "100 CGA's who have made a difference". He was selected for having contributed to the excellent reputation of the profession and having given his time, energy and commitment to benefit the community at large. Daniel Zéghal is the corresponding author and can be contacted at: zeghal@telfer.uOttawa.ca

Anis Maaloul is a Research Associate at the CGA – Accounting Research Centre, Telfer School of Management, Ottawa, Canada.