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Does Intellectual Capital Affect Business Performance?

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The aim of this paper is to assess the impact of intellectual capital (IC) on firms' financial performance with reference to a sample of companies operating in the European Union (EU) area during the period from 2006 to 2013. The analyses are further differentiated by country of domicile, industry sector, and historical period (pre-crisis and crisis). We investigate whether the value of the components of IC is a relevant factor that influences firms' performance, proposing and testing a modified version of the value added intellectual capital (VAIC^{TM}) model which also considers country-specific differences in terms of default risk. The empirical results evidence the relevance of the information on IC disclosed by companies. Differences arise depending on the reference country, industry, and historical period examined. The main limitations of the research are the unbalanced structure of the sample among countries and industries and the specificity of the examined sample (listed firms applying IAS/IFRS system). The main implication of the study is that, since we demonstrate the value relevance of IC, our findings could be of interest for standard setters for defining a standard (qualitative and quantitative) level of information on human resources to be disclosed by companies in their financial statements. Our contribution to the literature is the proposal of some relevant modifications to the original VAIC^{TM} model and providing new evidence on the influence that IC had in recent years on business performance in the EU.

Keywords: accounting standards, business performance, country-specific factors, financial accounting, human capital (HC), intellectual capital (IC), IAS/IFRS

Introduction

One of the main groups of stakeholders that interact on a daily basis with firms is constituted by employees, also known as "human resources" of a company. In the last few decades, the importance of research on human resources has grown in the accounting literature, and an increasing number of scholars and practitioners in this field have proposed a variety of evaluation approaches and methods for estimating the value of this asset (Chan, 2009a; 2009b; Chen, Cheng, & Hwang, 2005; Luthy, 1998; Nazari & Herremans, 2007; Pulic, 1998; 2000; Sveiby, 2002; Tan, Plowman, & Hancock, 2008; Williams, 2001).

From an empirical point of view, the practical importance of this issue has increased due to the growth of services businesses. This change in the structure of advanced economies has contributed to the establishment of the opinion that the value of human resources is, substantially, the whole or, at least a majority, of the value of a firm.

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From an accounting perspective, human resources play a relevant role in the determination of both cash flows and balance sheet values. In fact, since the 1980s, as a consequence of the dematerialization of services, which are characterized by a greater quantity of knowledge and information, a large part of firms' value has shifted from the tangible to the intangible group of assets. In particular, for many businesses (e.g., high-tech sector) that are based on intellectual property (brands, patents, copyright, etc.) and, in general, on know-how that is connected with the organization and quality of employees, these elements are able to generate an amount of value that can be greater than that generated by tangible or financial assets.

In the light of the above considerations, it is evident that human resources should be investigated from an accounting perspective in order to define principles and methods for correctly measuring and reporting their value in companies' financial statements. However, although the economic relevance of human capital (HC) and intellectual capital (IC) has been widely acknowledged, currently, the disclosure of the related information is not mandatory under the IAS-IFRS system. In fact, this information is captured within goodwill. However, goodwill can be recognized only when a business combination occurs and this fact results in a limitation for the recognition of HC and IC in financial statements.

The objective of this study is to assess the impact of IC and HC on firms' financial performance by using a modified version of the value added intellectual capital (VAIC^{TM}) model, which includes an additional explanatory variable aimed at considering also country-specific differences. The model is tested with reference to a sample of companies operating in the European Union (EU) area during the period from 2006 to 2013 and to further sub-samples differentiated in terms of country of domicile, industry sector, and reference year. The empirical results show that the whole model and the single explanatory variables are statistically significant for the whole sample and for most of the sub-samples analyzed, hence supporting the hypothesis of relevance of the information on IC disclosed by companies. The relevance of each variable varies across countries and industries, with a higher significance for the countries where the recent financial crisis has had a lower impact. The model is significant for both the pre-crisis and the crisis periods, with higher coefficient values observed in the pre-crisis case. Furthermore, the signs of the coefficients are consistent with logic-economic expectations.

This work contributes to the existing literature using a widely known model, with some changes, to investigate whether the information on human resources is a relevant factor that influences the economic and financial performance of companies and the investment decisions of market operators. In addition, the empirical results of this study could be of interest for standard setters if they decide to develop a standard capable of representing in financial reporting the information related to human resources.

The paper is organized as follows. Section 2 is devoted to a theoretical background on the concepts of HC and IC. This section thus provides the necessary background to interpret the empirical results of the methodologies. Section 3 provides an overview on the current accounting treatment of HC and IC under the IAS-IFRS system, together with some considerations on the adequacy of the current accounting principles in representing these resources. Section 4 describes the proposed model used to run the analyses. Section 5 presents the empirical data and the methodologies used to assess the impact of IC and HC on firms' financial performance. Section 6 reports the empirical results of the analyses based on the application of the proposed model. Section 7 concludes.

Theoretical Background and Literature Review

Over the last few decades, a plurality of definitions on HC and IC have been proposed by accounting experts (Leon, 2002). In all likelihood, this is attributable to the circumstance that the term "IC" may be interpreted as a synonym of intangible assets, invisible assets, knowledge assets, knowledge capital, information assets, HC, and the hidden value of companies (Bontis, 2001; Tseng & James Goo, 2005). HC, in synthesis, could be defined as the potential for employees themselves to generate more economic value for organizations in the future, which becomes surplus value over the returns of the other tangible and financial assets of the firm. On the other hand, IC is a more general concept, which indicates all the intellectual material (knowledge, information, intellectual property, and experience) that could be used in order to generate economic value.

The concept of IC could be further broadened to include all value creation activities performed by humans relating to the company (Chan, 2009a; 2009b). More in particular, scholars have been advocating the inclusion of HC and structural capital (SC) as part of IC (Andriessen, 2006; Bontis, 2004; Edvinsson, 1997; Guthrie, Petty, & Johanson, 2001). In other words, a significant number of scholars identify three main components of IC: HC, customer (relation) capital (CC), and SC (Edvinsson & Malone, 1997; Mavridis & Kyrmizoglou, 2005; Wall, 2005; Ruta, 2009; Maditinos, Chatzoudes, Tsairidis, & Theriou, 2011).

Similarly, J. Roos, G. Roos, Dragonetti, and Edvinsson (1997) classified IC into HC and SC, which represent "thinking" and "non-thinking" assets respectively. In other words, HC refers to knowledge, skills, and experiences that employees take with them when they leave the organization, while SC includes all non-human knowledge-based resources available in the organization (such as databases, organizational charts, procedures and administrative processes, strategies), that is everything that creates a higher value for the organization rather than its physical essence.

Consistently with Roos et al. (1997), Meritum Project (2002, pp. 10-11) gave the following definitions for the components of IC:

> Human capital is defined as the knowledge that employees take with them when they leave the firm. It includes the knowledge, skills, experiences and abilities of people. Some of this knowledge is unique to the individual, some may be generic (…).
>
> Structural capital is defined as the knowledge that stays within the firm at the end of the working day. It comprises the organizational routines, procedures, systems, cultures, databases, etc. (…). Some of them may be legally protected and become Intellectual Property Rights, legally owned by the firm under separate title.
>
> Relational capital is defined as all resources linked to the external relationships of the firm, with customers, suppliers or R&D partners. It comprises that part of Human and Structural Capital involved with the company's relations with stakeholders (investors, creditors, customers, suppliers, etc.), plus the perceptions that they hold about the company (…).

Therefore, in summary, two components of IC can be identified: (1) one referring to patents, intellectual property, brands, and trademarks; and (2) one referring to knowledge, information, and experience. On this point, it should be noted that nowadays the second component represents the greatest part of IC (Chan, 2009a; 2009b; Gan & Saleh, 2008; Gavious & Russ, 2009).

The Accounting Treatment for IC Under the IAS-IFRS System

Considering the above considerations, it is evident that while IC is becoming increasingly important, accounting for it is a controversial issue, with particular reference to the HC component. In fact, to date, traditional financial statements are usually unable to reflect the value created by intangibles (Canibano, Garcia-Ayuso, & Sanchez, 2000; Chen et al., 2005).

In spite of it being accepted among scholars (Flamholtz, 2005) that "accounting for the worth of employees has implications for both managers and investors" (Roslender & Dyson, 1992, p. 319), a relevant part of researchers (Edvinsson & Malone, 1997; Stewart, 2001; Pulic, 1998; 2000; Sveiby, 2000) have underlined that traditional measures of firms' performance, which are based on accounting principles (i.e., IAS-IFRS, US GAAP), may not represent human resources adequately in the financial statements.

Under the IAS-IFRS system, intangibles are treated within IFRS 3 on "Business Combinations" and IAS 38 on "Intangible Assets", with the latter defining intangible assets as "identifiable non-monetary assets without physical substance" (IAS 38, Para. 8). It is relevant to note that IAS 38 never refers to IC, including HC, in a way that is consistent with the concepts described above[1]. In other words, IAS 38 does not consider HC as an asset.

According to International Accounting Standards Board (IASB, 2004, p. 4), IC consists of "non-financial fixed assets that do not have financial substance but are identifiable and controlled by the entity through custody and legal rights".

In addition, Para. 69 of IAS 38 (IASB, 2013) provides that, "Other examples of expenditure that is recognised as an expense when it is incurred include: (…) (b) expenditure on training activities" (IAS 38, Para. 69, p. A1048). Furthermore, under IFRS 3 requirements, although in a business combination there could be items that present characteristics similar to the other identifiable intangible assets (e.g., trademarks, patents, etc.), some intangible assets cannot be recognized separately from goodwill. In particular, this situation may occur with a higher frequency when employees are highly specialized; in fact, in that case, the buyer may assign a value to the existence of highly specialized employees that allows the firm's activity to continue without interruptions during the business combination process. However, the IAS-IFRS system, due to fact that these skills cannot be separately identified among other assets, requires that they should be recognized within goodwill. Therefore, a recurrent item in goodwill is the HC or workforce (Giuliani & Brännström, 2011). In fact, this is a typical intangible that cannot be recognized separately in view of the lack of control over the expected future economic benefits (Eckstein, 2004).

Clearly, the IAS-IFRS requirements cannot fit both the concepts underlying IC and HC. Although the IAS-IFRS system treats the cost related to IC as a current expense, there are many studies demonstrating that these amounts provide useful information about an unrecorded intangible asset (Bell, Landsman, Miller, & Yeh, 2002; Brännström, Catasús, Giuliani, & Gröjer, 2009). It is relevant to note that some academics argued that spending on employees should not be treated as an expense incurred during the year because expenditure on some employees may generate returns over a period of time that exceeds a single year (Brummet, Flamholtz, & Pyle, 1968; Flamholtz, 1972; Lev & Schwartz, 1972). However, the failure to achieve, from an accounting perspective, a shared method for the accounting treatment of HC has led researchers to change their view (Roslender & Dyson, 1992; Roslender, 1997).

[1] Para. 9 of IAS 38 explains that: "Entities frequently expend resources, or incur liabilities, on the acquisition, development, maintenance or enhancement of intangible resources such as scientific or technical knowledge, design and implementation of new processes or systems, licences, intellectual property, market knowledge and trademarks (including brand names and publishing titles). Common examples of items encompassed by these broad headings are computer software, patents, copyrights, motion picture films, customer lists, mortgage servicing rights, fishing licences, import quotas, franchises, customer or supplier relationships, customer loyalty, market share and marketing rights" (p. A1037).

From a practical point of view, while a number of studies have attempted to develop an accounting system for human resources, the involvement of firms in this practice is mostly limited to qualitative disclosures of this information (Hussain, Khan, & Yasmin, 2004; Subbarao & Zeghal, 1997; Ax & Marton, 2008). Consistent with that, Abeysekera and Guthrie (2004) and Abeysekera (2006; 2008) showed that many firms do not even use the term HC or IC in their annual reports, as they merely provide a qualitative description on the human resources whenever necessary.

Background: The VAIC™ Model

The assessment of the impact of IC on business performance requires the definition of a measure of performance to be used as the dependent variable of the model. According to Chu, Chan, Yu, Ng, and Wong (2011) and Hofer (1983), financial performance measures represent the dominant model for measuring firms' performance. In prior research (Chan, 2009a; 2009b; Firer & Stainbank, 2003; Firer & Williams, 2003), the productivity and the profitability of companies have been measured using both accounting-based and market-based measures.

The new economy is a knowledge-based economy and the forces of globalization have highlighted the fact that knowledge, communication and, in general, intangibles have become the most critical resources for an organization (Edvinsson & Malone, 1997; Lev, 2001; Stewart, 2001). However, nowadays, there is no generally accepted methodology for valuing intangible assets, including IC and HC. One of the best known models for assessing the impact of IC on business performance is the VAIC™ model as defined by Pulic (2008). The VAIC™ model is a method aimed at measuring and managing the efficiency of a company in the creation of value based on intellectual (capital) efficiency or intellectual resources (Pulic, 2000). Employees are considered as valuable contributors to a company's performance, and the objective of the model is to measure their productivity in terms of impact on business performance. In particular, especially for knowledge-based companies characterized by a high incidence of HC in the total value of the organization, Pulic's (2008) objective is to measure the intellectual work efficiency similar to what Taylor did with physical work. The VAIC™ model has been widely applied in a large number of research studies as a universal indicator of the efficiency of each component of IC based on the concept of added value. Some studies aimed at assessing the impact of HC on firms' financial performance and capital market performance can be found in Chan (2009a; 2009b), Chen et al. (2005), Nazari and Herremans (2007), and Tan et al. (2008).

The calculations of the VAIC™ model are based on the following figures:

(1) Human capital (HC), which is often estimated by using employee-related expenditures;

(2) Structural capital (SC), which is determined as the difference between the added value produced by the firm (VA) and the HC, thus representing the share of VA after deducting investments in HC;

(3) Capital employed (CE), which is interpreted as financial capital, that is, the book value of net assets.

The VA is the value added by all the resources of the company during the period, and it is calculated as the difference between the income and the expenditures that it generates. According to the formula proposed by Pulic (2005), for each reference company i and year t, the VA equals (Equation (1)):

$$VA = P + C + D + A \tag{1}$$

where P is the operating profit, C represents the personnel costs (salaries and social costs), D represents the depreciation expenses, and A represents the amortization expenses of the company. Alternatively, VA can be determined as follows (Muhammad & Ismail, 2009) (Equation (2)):

$$VA = OUTPUT - INPUT \tag{2}$$

where, for each reference company i and year t, $OUTPUT$ represents the total income from all the products and services sold during the relevant period, and $INPUT$ is the aggregate value of all the expenses (except labor, taxation, interests, dividends, and depreciation) incurred by the company during the relevant period.

Based on this formulation, Riahi-Belkaoui (2003) proposed an additional formula for calculating VA, which can be derived from the following relation (Equation (3)):

$$R = S - B - DP - W - I - D - T \tag{3}$$

where, for each reference company i and year t, R is the (annual) change in retained earnings, S is the net sales revenue, B represents the bought-in materials and services (cost of goods sold plus all expenses, except labor, taxation, interests, dividends, and depreciation), DP is depreciation, W represents the employees' salaries and wages, I represents the interest expenses, D represents the dividends paid to shareholders, and T represents the corporate taxes. According to Equation (3), the (annual) change in retained earnings is determined as the difference between sales revenue, on one hand, and costs and dividends, on the other hand. Therefore, Equation (3) can be rearranged to calculate the value added by the firm (Equation (4)):

$$VA = S - B = DP + W + I + D + T + R \tag{4}$$

where, for each reference company i and year t, each variable assumes the same meaning considered for Equation (3).

On the basis of these definitions and assumptions, $VAIC$ is calculated as the sum of the following three efficiency indicators:

(1) Capital employed efficiency (CEE) = VA/CE. This ratio measures the amount of added value generated by the company per one monetary unit invested in financial or tangible capital;

(2) Human capital efficiency (HCE) = VA/HC. This ratio measures the amount of added value generated by the company per one monetary unit invested in its human resources. It can be interpreted also as the reciprocal of the value of its human capital per one monetary unit of added value created by the firm;

(3) Structural capital efficiency (SCE) = SC/VA. This ratio measures the amount of added value (net of human resources expenditure) generated by the company per one monetary unit of the total added value. Therefore, it indicates the quote of added value that is generated by SC.

Hence (Equation (5)):

$$VAIC = CEE + HCE + SCE = \frac{VA}{CE} + \frac{VA}{HC} + \frac{SC}{VA} \tag{5}$$

As an intermediate result, the intellectual capital efficiency (ICE) can be calculated as the sum of HCE and SCE, hence $VAIC = CEE + ICE$.

In practice, the application of the VAIC^{TM} model requires the determination of its variables for each firm examined. To this aim, HC is usually set equal to human resources costs, that is the overall expenditure on wages and salaries, VA is determined as specified in Equation (1), i.e., as a sum of the earnings before interest, taxes, depreciation, and amortization (EBITDA) and HC, and SC is calculated as the difference between VA and HC.

Within the ambit of the VAIC^{TM} model, some of the dependent variables which can be used for measuring the performance of firms are the market-to-book value (M/B), that is, the ratio of the total market capitalization to the book value of equity; the return on assets (ROA), that is, the ratio of the net income to the book value of total company assets; the asset turnover (ATO), calculated as the ratio between total revenues and the total book value of assets; and the return on equity (*ROE*), that is, the ratio of net income to the book value of equity. On the other hand, the independent variables, which can be considered, are the aggregate value of *VAIC* (Models 1, 2, 3, and 4 shown in Table 1) and its individual components *CEE*, *HCE*, and *SCE* (Models 5, 6, 7, and 8 shown in Table 1).

Table 1
Possible VAIC^{TM} Models

Model number	Model structure
1	$M / B_t^i = \beta_0 + \beta_1 VAIC_t^i + \varepsilon_t^i$
2	$ROA_t^i = \beta_0 + \beta_1 VAIC_t^i + \varepsilon_t^i$
3	$ATO_t^i = \beta_0 + \beta_1 VAIC_t^i + \varepsilon_t^i$
4	$ROE_t^i = \beta_0 + \beta_1 VAIC_t^i + \varepsilon_t^i$
5	$M / B_t^i = \beta_0 + \beta_1 CEE_t^i + \beta_2 HCE_t^i + \beta_3 SCE_t^i + \varepsilon_t^i$
6	$ROA_t^i = \beta_0 + \beta_1 CEE_t^i + \beta_2 HCE_t^i + \beta_3 SCE_t^i + \varepsilon_t^i$
7	$ATO_t^i = \beta_0 + \beta_1 CEE_t^i + \beta_2 HCE_t^i + \beta_3 SCE_t^i + \varepsilon_t^i$
8	$ROE_t^i = \beta_0 + \beta_1 CEE_t^i + \beta_2 HCE_t^i + \beta_3 SCE_t^i + \varepsilon_t^i$

Note. This table provides the structure of some VAIC^{TM} models which can be used for assessing the impact of IC on business performance, namely, on *M*/*B*, *ROA*, *ATO*, and *ROE* ratios, for each reference company *i* and year *t*.

In our work, we focused on the model where the dependent variable is the *M*/*B* and the independent variables are the individual components of VAIC, that is, *CEE*, *HCE*, and *SCE* (Model 5 in Table 1).

Methodology

Data

The model that we present in this paper is tested using a sample of listed companies that operated in the EU area during the eight-year period from 2006 to 2013 (the "Period"). The sample was determined by selecting all the companies domiciled in EU member countries that were included in the world equity index "Market World" (mnemonic: "G#LTOTMKWD") published by Thomson Reuters Datastream during the Period. At the date of the research, throughout the entire Period, the Market World index was composed of 7,030 companies.

In addition to the general sample, we also identify sub-samples according to the following criteria: (1) the country of domicile of each firm; (2) the industry sector of each firm; and (3) the reference historical period. With reference to the first criterion, the analyses are conducted only for those countries which are both the most relevant from an economic point of view and characterized by a sufficient number of empirical observations. With reference to the second criterion, we consider the industry classification available in the Thomson Reuters Datastream database (the Industry Classification Benchmark, coded "ICBIN") provided for each element of the Sample, identifying 10 sectors. Finally, with reference to the third criterion, we analyze separately the pre-crisis (from 2006 to 2007) and the crisis (from 2008 to 2013) periods.

Both market and accounting data were collected on an annual basis on December 31 of each year of the Period using the Bloomberg and Thomson Datastream databases, with all economic values expressed in Euros. For each variable of the model (excluding the last one, that is, the nations' CDS (credit default swap) price), extreme values are excluded from the group of observations through a trimming procedure, eliminating the values that are below the 5% percentile and above the 95% percentile. Finally, the observations that do not have the necessary data to apply the model are excluded.

Table 2 presents the structure of the selected sample (the "Sample") organized by year and by country, showing the number of selected companies with available data for developing the analyses.

Table 2

Sample Structure by Country and by Industry (Number of Observations)

Country/industry	BM	CG	CS	FI	HC	IND	OG	TECH	TEL	UTI	Total
Austria	5	0	0	18	0	33	8	0	6	4	74
Belgium	10	8	9	25	7	17	0	0	8	6	90
Czech Republic	0	0	0	0	0	0	0	0	5	6	11
Denmark	0	16	0	7	15	38	3	0	3	0	82
Finland	22	10	0	6	0	36	2	3	6	6	91
France	23	71	79	41	16	115	28	14	5	29	421
Germany	57	77	26	31	23	68	0	12	10	19	323
Greece	0	0	1	16	0	8	2	0	3	4	34
Hungary	0	0	0	5	0	0	5	0	4	0	14
Ireland	2	10	6	0	0	5	1	0	0	0	24
Italy	0	23	28	51	0	30	17	0	13	42	204
Luxembourg	6	0	9	0	0	0	0	0	4	0	19
The Netherlands	16	14	5	9	2	32	12	9	5	0	104
Poland	2	1	0	14	0	0	8	1	1	10	37
Portugal	0	0	18	16	0	8	5	0	4	8	59
Spain	6	10	21	36	11	37	22	5	8	40	196
Sweden	23	22	3	26	10	43	2	6	10	0	145
United Kingdom	58	60	91	119	18	139	42	13	15	35	590
Total	230	322	296	420	102	609	157	63	110	209	2,518

Notes. This table provides the structure of the Sample organized by country and by industry, showing the number of selected companies which during the Period were included in the Market Europe equity index and for which the data needed for developing the analyses are available. Industry (ICBIN) categories are indicated as follows: BM = Basic materials; CG = Consumer goods; CS = Consumer services; FI = Financials; HC = Health care; IND = Industrials; OG = Oil and gas; TECH = Technology; TEL = Telecommunications; UTI = Utilities.

The Modified VAIC™ Model

As said, in this study, we applied a modified version of the VAIC™ model described in Section 4 (see Equation (5)), focusing on the model where the dependent variable is the *M*/*B* and the independent variables are the individual components of VAIC, that is *CEE*, *HCE*, and *SCE* (Model 5 in Table 1). To this end, we use the sample observations described in Section 5.1 organized as unstructured panel data.

The choice of this model was motivated by the broad consensus found in literature on its significance – both in statistical and economic terms – as well as by the fact that a relevant part of scholars on this topic conclude that IC significantly influences firms' performance, which is the object of our assessment for the EU context. In particular, this model is aimed at verifying the validity of the capital market theory for IC, since, in general, it presumes that capital market participants use all relevant available information to make their investment decisions, hence including the disclosed information on firms' human resources (Beaver, 1981; Fama, 1970; 1991; Fama, Fisher, Jensen, & Roll, 1969). Since our objective is to verify whether or not IC has a significant influence on business performance, we chose the model version where the dependent variable is a function (also) of a market variable, i.e., market capitalization.

In order to do so, the use of multivariate ordinary least squares (OLS) regressions has two advantages: first, since it is a method widely known in literature, it requires brief technical explanations, thus leaving space for a conceptual analysis of statistical results; moreover, it allows extensive testing to be performed to assess the statistical significance and the explanatory power of the model, with numerical or graphical test outputs that are easy to interpret. The main limitation of the model is the assumption that the relation between the dependent variable and the group of independent variables is linear, as well as the other technical assumptions underlying the OLS method. However, even though it is not possible to infer whether the hypothesized econometric structure is the best one to study the phenomenon under examination, the significance tests allow us to determine, in absolute terms, whether those technical assumptions are verified or not, that is, whether the proposed model is valid or not.

The changes that we made to the original version of the VAIC™ model are the following.

First of all, considering that annual financial reports for a given year (*t*) are usually published at the beginning of the second quarter of the following year (*t*+1), for the *M* variable, i.e., the numerator of the dependent variable, we took as a reference the values as at April 30 of year (*t*+1). The rationale for this modification is that the value of the market capitalization at December 31 cannot take into account the information published usually three or four months after that date through the publication of financial reports. However, the time lag we propose for *M* allows us to correct the model taking into account the average temporal misalignment between companies' balance sheet information and market prices, thus allowing us to observe, on average, the impact of the release of accounting information on stock prices during the period in which financial statements are usually published.

A second modification to the original model is the addition of a further explanatory variable. In particular, we have introduced a measure of the default risk of the country where each company operates (Laghi, Mattei, & Di Marcantonio, 2013). We expect that, *ceteris paribus*, an increase (decrease) in a country's default risk as perceived by financial market operators determines a decrease (increase) in national stock prices, as a higher credit risk is perceived also with reference to the companies that operate in the same country. In order to quantify the sovereign credit risk perceived by financial market operators, we consider the price of 5-year-maturity CDS of each reference country as at April 30 of year (*t*+1) (the explanatory variable *CDSN*). In fact, since *CDSN* is a market price (as *M*), the reference date must be set equal to the one chosen for the numerator of the dependent variable, that is, April 30 of year (*t*+1).

The final modified version of the VAIC™ model that we used in our work is the following (Equation (6)):

$$\begin{aligned} M / B_t^i &= \beta_0 + \beta_1 CEE_t^i + \beta_2 HCE_t^i + \beta_3 SCE_t^i + \beta_4 CDSN_t^i + \varepsilon_t^i \\ &= \beta_0 + \beta_1 \frac{VA_t^i}{CE_t^i} + \beta_2 \frac{VA_t^i}{HC_t^i} + \beta_3 \frac{SC_t^i}{VA_t^i} + \beta_4 CDSN_t^i + \varepsilon_t^i \end{aligned} \tag{6}$$

where, for each reference year (*t*), $CDSN^i$ is the market price as at April 30 of year (*t*+1) of the 5-year-maturity CDS of the country where company *i* operates, ε_i is the error term, with $\varepsilon_i \sim N(0; \sigma^2)$ and $\sigma(\varepsilon_i; \varepsilon_m) = 0 \ \forall \ i \neq m$ and the other variables are defined as for Equation (5), except for the reference date of M^i, that is, April 30 of year (*t*+1).

We perform a multivariate OLS regression analysis for each selected sample, correcting the model for heteroscedasticity using White's heteroscedasticity-corrected variances and standard errors. We perform in-depth econometric analyses in order to test the OLS assumptions for each sub-sample, as well as to assess their significance and explanatory power across countries, sectors, and historical periods.

In the light of the above definitions, we expect the following signs for the coefficients. For *CEE* and *SCE* respectively, a higher (lower) efficiency of the financial/tangible capital and the SC should have a positive (negative) impact on stock prices; hence, we expect a positive sign. For *CDSN*, as said, we expect a negative sign. The hypothesis on the sign of the coefficient for *HCE* depends on how market operators interpret HC: if the efficiency of HC is preferred, the sign of the coefficient should be positive; on the other hand, if in line with the general tendency observed in the last few decades, firms that are more human capital-intensive are preferred, the sign of the coefficient should be negative.

Empirical Results

Descriptive Statistics

Table 3 shows the descriptive statistics for the variables included in the model for the total Sample. We observe that the total number of empirical observations is 2,518 and, consistently with their definition, all the variables show only positive values.

Table 3

Descriptive Statistics of the Main Sample

Variable	No. of observations	Mean	Std. deviation	Minimum	Maximum
M/B	2,518	2.0198	1.2335	0.4496	7.2860
CEE	2,518	0.3767	0.2428	0.0236	1.0533
HCE	2,518	2.9524	3.0637	1.1492	21.8371
SCE	2,518	0.4887	0.2210	0.1298	0.9542
CDSN	2,518	87.5416	125.6872	1.7500	1,350.3820

Notes. This table presents the descriptive statistics for the main Sample of the variables used to measure the impact of IC on business performances. For each company of the sample, data were collected from 2006 to 2013 on an annual basis, taking as a reference the date of December 31 of year (t) for accounting items and April 30 of year (t+1) for market quotes (i.e., *M* and *CDSN*). *M/B* (market-to-book value) is the dependent variable and *CEE* (capital employed efficiency), *HCE* (human capital efficiency), *SCE* (structural capital efficiency), and *CDSN* (the 5-year CDS spread of firms' respective domicile countries) are the explanatory variables of the multivariate regression model shown in Equation (6).

Table 4 shows Pearson correlation coefficients and their statistical significance (the p-value, in parenthesis) for the variables included in the regression model specified in Equation (6) for the main Sample of observations.

Table 4

Pearson Correlation Coefficients for the Main Sample

Variable	*M/B*	*CEE*	*HCE*	*SCE*
CEE	0.3209 (0.000)			
HCE	-0.0209 (0.294)	-0.3269 (0.000)		
SCE	0.0298 (0.135)	-0.5121 (0.000)	0.7531 (0.000)	
CDSN	-0.1431 (0.000)	-0.1279 (0.000)	0.0132 (0.508)	0.0796 (0.000)

Notes. This table shows the Pearson correlation coefficients for the main Sample for the variables used to examine the impact of IC on business performances. The p-value of each correlation is shown in parenthesis. See Table 3 for variables' definitions.

As we expected, *CEE* and *CDSN* are characterized by a highly significant Pearson correlation coefficient with the dependent variable *M*/*B*, while for *HCE* and *SCE*, the coefficient is near to zero and not significant. It should be noted that, as we expected, the new variable *CDSN* shows a negative (significant) correlation with the dependent variable.

Multivariate Regression Analysis Results

As said, the regressions are performed using the model defined in Equation (6), on the basis of data calculated as specified in Section 5.1. Besides the basic tests (*F*-statistic, adjusted R^2, and *T*-statistics), for each regression we run the following additional analyses: variance inflation factor (VIF), as an indicator of multicollinearity; White's test for heteroscedasticity; Shapiro-Wilk test for the normality of residuals; and the Ramsey RESET test using powers of the fitted values to assess the correct specification of the model.

Table 5 provides the results of the OLS regression estimates and significance tests for the main Sample and the sub-samples identified according to criterion No. 1 (country of domicile of each firm).

Table 5

Multivariate OLS Regression (Equation (6)) for the Main Sample and Sub-samples by Country of Domicile

Country of domicile	Whole sample	France	Germany	Italy	Spain	UK
N	2,518	421	323	204	196	590
F	122.49^{***}	27.14^{***}	23.57^{***}	11.38^{***}	24.81^{***}	45.27^{***}
Adj. R^2	17.71%	19.93%	28.98%	11.66%	33.11%	20.80%
β_0	0.35^{***}	0.46^{*}	0.72^{***}	0.99^{***}	1.04^{***}	0.82^{***}
	(3.75)	(1.84)	(2.70)	(3.73)	(2.87)	(3.41)
CEE	2.32^{***}	2.08^{***}	2.47^{***}	0.90^{***}	4.36^{***}	2.37^{***}
	(19.82)	(7.27)	(7.25)	(3.86)	(8.57)	(11.21)
HCE	-0.07^{***}	-0.04^{**}	-0.08^{***}	0.05	0.02	-0.13^{***}
	(-6.70)	(-2.11)	(-2.67)	(0.94)	(0.30)	(-5.08)
SCE	2.25^{***}	2.19^{***}	2.05^{***}	0.93	0.93	3.31^{***}
	(13.15)	(5.39)	(4.17)	(1.61)	(1.30)	(9.20)
CDSN (× 1,000)	-1.12^{***}	-4.54^{***}	-11.72^{***}	-2.05^{***}	-3.01^{***}	-10.95^{***}
	(-6.20)	(-5.96)	(-5.99)	(-3.57)	(-5.58)	(-4.72)
Multicollinearity (VIF)	1.90	2.00	1.87	2.34	2.28	2.01
White's test	81.53^{***}	26.77^{**}	49.13^{***}	11.98	17.23	34.89^{***}
Shapiro-Wilk test	12.33^{***}	12.76^{***}	15.02^{***}	12.32^{***}	9.27^{***}	14.80^{***}
Ramsey RESET test	7.89^{***}	2.31^{*}	11.31^{***}	0.57	3.99^{***}	4.58^{***}

Notes. ***: Significant at the 0.99 level; **: Significant at the 0.95 level; and *: Significant at the 0.90 level. For each explanatory variable *k* the value of the coefficient β_k and its *T*-statistic (below, in parenthesis) is shown. We specify that the value shown in the table for *CDSN* is the coefficient value multiplied by 1,000. See Table 3 for variables' definitions.

Consistent with prior studies (Chu et al., 2011; Gan & Saleh, 2008; Muhammad & Ismail, 2009; Shiu, 2006), the empirical results show that for the whole Sample of observations, the model (*F*-statistic) and each component of the VAIC coefficient (*T*-statistics) are statistically significant at a level of confidence of 99%; furthermore, also the new variable *CDSN* is significant at 99%. Similar results are also obtained for the single sub-samples by country of domicile, for which all the explanatory variables are always significant, mostly at 99%, except *HCE* and *SCE* for Italy and Spain. Furthermore, all the variables (when significant) are characterized by a constant sign of the coefficient that is in line with our expectations. For all the samples, while there are no problems of multicollinearity (VIF $\leq$ 2.34) and the heteroscedasticity in some cases is present but corrected using White's corrected variance and standard errors, the model shows problems of non-normality of residuals and, in some cases, possible misspecification. The analysis of influential observations (Cook's distance, Dfits, Dfbetas and leverage vs. residual squared plot) confirms the overall significance of the proposed models, as we observe a relatively small number of influential observations on both coefficients and estimates.

Once we have analyzed the impact of IC on business performance across the main European countries, we examine the statistical significance of the model for the sub-samples identified according to criterion No. 2 (industry sector of each firm). Table 6 shows the results of our analyses.

Table 6
Multivariate OLS Regression (Equation 6) for the Main Sample and Sub-samples by Industry

Industry	BM	CG	CS	FI	HC	IND	OG	TECH	TEL	UTI
N	230	322	296	420	102	609	157	63	110	209
F	20.26***	22.27***	19.64***	28.28***	1.88	31.35***	2.78**	26.21***	9.59***	13.49***
Adj. R^2	24.93%	24.92%	20.20%	29.31%	1.09%	18.76%	1.41%	51.66%	18.18%	18.82%
β_0	-0.62**	-0.33	0.61**	1.21***	1.65	0.43**	1.86***	-2.90***	-1.42**	0.88*
	(-2.30)	(-1.27)	(2.48)	(6.86)	(1.32)	(2.14)	(3.99)	(-4.90)	(-2.08)	(1.73)
CEE	3.63***	2.49***	0.90***	3.47***	0.77	2.21***	0.87*	6.00***	4.06***	1.19
	(6.03)	(7.92)	(2.77)	(6.98)	(0.67)	(9.23)	(1.96)	(7.86)	(5.08)	(0.86)
HCE	-0.08**	-0.15***	0.08	-0.07***	-0.16**	0.00	0.09*	-0.27***	0.27	-0.02
	(-2.44)	(-3.42)	(0.87)	(-4.83)	(-2.18)	(-0.13)	(1.69)	(-4.77)	(0.71)	(-0.47)
SCE	2.93***	3.98***	2.34***	0.68**	3.32**	1.81***	-0.78	8.17***	1.19	2.00***
	(6.00)	(7.14)	(3.22)	(2.00)	(2.11)	(4.84)	(-0.97)	(8.78)	(0.51)	(2.97)
CDSN (× 1,000)	0.78	-1.01**	-0.81**	-1.51***	-0.09	-1.75***	-0.22	-4.00**	0.66	-3.34***
	(1.02)	(-2.02)	(-2.05)	(-4.30)	(-0.04)	(-4.50)	(-0.34)	(-2.16)	(1.27)	(-5.99)
Multicollinearity (VIF)	1.92	1.62	2.12	2.09	2.58	1.72	2.21	2.60	4.95	2.09
White's test	16.34	19.68	25.98**	45.29***	5.65	28.30***	2.52	12.47	11.87	27.44**
Shapiro-Wilk test	10.82***	11.60***	10.12***	9.94***	12.03***	12.26***	12.59***	7.77***	9.80***	12.54***
Ramsey RESET test	0.87	5.18***	2.03	4.47***	0.97	7.98***	1.08	1.89	1.22	3.75**

Notes. ***: Significant at the 0.99 level; **: Significant at the 0.95 level; and *: Significant at the 0.90 level. For each explanatory variable *k* the value of the coefficient β_k and its *T*-statistic (below, in parenthesis) is shown. We specify that the value shown in the table for *CDSN* is the coefficient value multiplied by 1,000. Industry (ICBIN) categories are indicated as follows: BM = Basic materials; CG = Consumer goods; CS = Consumer services; FI = Financials; HC = Health care; IND = Industrials; OG = Oil and gas; TECH = Technology; TEL = Telecommunications; UTI = Utilities. See Table 3 for variables' definitions.

The model shows good results in terms of basic tests and VIF, but the impact of VAIC components *CEE*, *HCE*, and *SCE* on business performance is not consistent among industries in terms of both significance and sign of coefficients. Furthermore, the same inconsistencies can also be detected for *CDSN*. In general, the variables which show the highest levels of significance and sign constancy are *CEE* and *SCE*. It should be noted that the model and all its explanatory variables are highly significant for the financial and technology sectors.

With reference to the last criterion (the reference historical period), Table 7 shows the results of the multivariate OLS regression output for the whole Sample with time dummy variables where D_y is equal to 1 when year = y and 0 if otherwise, with $y \in \{2006, 2007, \ldots, 2013\}$, for the pre-crisis period (2006-2007) and for the crisis period (2008-2013).

Table 7

Multivariate OLS Regression (Equation (6)) for the Main Sample and Sub-samples by Country of Domicile

Historical period	Whole sample	Pre-crisis period (2006-2007)	Crisis period (2008-2013)
N	2,518	401	2,117
F	796.93***	14.46***	123.78***
Adj. R^2	79.14%	11.87%	18.84%
β_0	-	1.15***	0.20**
	-	(4.19)	(1.97)
CEE	2.38***	1.78***	2.44***
	(22.76)	(6.20)	(21.30)
HCE	-0.07***	-0.13***	-0.05***
	(-6.15)	(-4.23)	(-4.61)
SCE	2.20***	2.54***	2.11***
	(13.36)	(5.33)	(11.80)
CDSN (× 1,000)	-0.42**	-15.09**	-0.63***
	(-2.23)	(-2.49)	(-3.43)
D_{2006}	0.94***	-	-
	(8.07)	-	-
D_{2007}	0.59***	-	-
	(4.95)	-	-
D_{2008}	-0.18*	-	-
	(-1.70)	-	-
D_{2009}	0.36***	-	-
	(3.57)	-	-
D_{2010}	0.30***	-	-
	(2.89)	-	-
D_{2011}	-0.07	-	-
	(-0.58)	-	-
D_{2012}	0.23**	-	-
	(2.04)	-	-
D_{2013}	0.48***	-	-
	(4.27)	-	-
Multicollinearity (VIF)	-	1.96	1.90
White's test	114.59***	9.56	91.94***
Shapiro-Wilk test	12.47***	7.28***	12.01***
Ramsey RESET test	-	0.72	4.91***

Notes. ***: Significant at the 0.99 level; **: Significant at the 0.95 level; and *: Significant at the 0.90 level. For each explanatory variable k the value of the coefficient β_k and its T-statistic (below, in parenthesis) is shown. We specify that the value shown in the table for *CDSN* is the coefficient value multiplied by 1,000. See Table 3 for variables' definitions.

The results evidence that, also with reference to both pre-crisis and the crisis periods, the model is characterized by a high statistical significance, a good level of explanatory power, and coefficient signs that are constant and consistent with logic-economic expectations. With reference to the first regression, we notice that dummy variables are significant mostly at 99% significance level, and when they are significant, their sign is always positive, despite characterized by different values among years; this means that most of the examined years are characterized by a positive (and significant) intercept, that is, a positive mean value of the *M*/*B* ratio which varied during the 2006-2013 period. As is reasonable to expect, this mean value is higher in the pre-crisis period than in the crisis period.

It is interesting to note that in the crisis period, the impact of *CEE* on business performance increased, while the importance of *HCE* and *SCE* decreased. Similarly, the value of the coefficient of *CDSN* significantly decreased. This could have been due to the following reasons: (1) During the crisis, the information on CDS quotes became less relevant (but still significant) for market operators, probably because that they were influenced in great part by a general status of temporary, irrational chaos which dominated the financial markets in that period, hence other types of information were preferred for estimating the probabilities of default of firms and governments; and/or (2) During the crisis, the information on CDS quotes maintained the same level of relevance for market operators, but the average increase in CDS spreads determined a decrease in the *CDSN* estimated coefficient, assuming that the *M*/*B* ratio varied (decreased) relatively less.

Finally, in Table 8, we show the results of the cluster analyses (Cameron, Gelbach, & Miller, 2011) performed considering both the two-dimension case (firm and year) and the one-dimension case (firm, year, industry, and country of domicile).

All the sub-samples are characterized by the same values of the main Sample in terms of sample size, adjusted R^2, and coefficient estimates, while differences arise for *F*-statistics and *T*-statistics. In particular, the results show that, independently from the cluster dimension(s) considered, the joint significance of the set of explanatory variables is always confirmed at a level of confidence of 99%. Furthermore, in each case – with one exception for the intercept – all the independent variables are statistically significant, mostly at a level of confidence of 99% and never below the 90% level.

Table 8

Cluster Analysis of the Model (Equation (6)) (Dimension(s): Firm and Year; Firm; Year, Industry; Country of Domicile)

Dimension(s)	Whole sample	Firm and year	Firm	Year	Industry	Country
N	2,518	2,518	2,518	2,518	2,518	2,518
F	122.49***	120.99***	53.76***	150.33***	36.22***	64.58***
Adj. R^2	17.71%	17.71%	17.71%	17.71%	17.71%	17.71%
β_0	0.35***	0.35**	0.35**	0.35**	0.35	0.35**
	(3.75)	(1.97)	(2.27)	(2.71)	(1.63)	(2.47)
CEE	2.32***	2.32***	2.32***	2.32***	2.32***	2.32***
	(19.82)	(9.19)	(12.41)	(11.25)	(11.63)	(12.83)
HCE	-0.07***	-0.07***	-0.07***	-0.07***	-0.07***	-0.07***
	(-6.70)	(-3.78)	(-4.40)	(-4.91)	(-3.28)	(-3.60)
SCE	2.25***	2.25***	2.25***	2.25***	2.25***	2.25***
	(13.15)	(8.49)	(7.86)	(16.89)	(5.48)	(5.96)
CDSN (× 1,000)	-1.12***	-1.12**	-1.12***	-1.12*	-1.12***	-1.12**
	(-6.20)	(-2.21)	(-4.48)	(-2.34)	(-3.67)	(-2.65)

Notes. ***: Significant at the 0.99 level; **: Significant at the 0.95 level; and *: Significant at the 0.90 level. For each explanatory variable *k* the value of the coefficient β_k and its *T*-statistic (below, in parenthesis) is shown. We specify that the value shown in the table for *CDSN* is the coefficient value multiplied by 1,000. See Table 3 for variables' definitions.

Conclusions

In this study, we assess the impact of IC and HC on firms' financial performance by using a modified version of the VAIC^{TM} model, which includes an additional explanatory variable aimed at considering also country-specific differences. The model is tested with reference to a sample of companies operating in the EU area during the period from 2006 to 2013 and to further sub-samples differentiated in terms of country of domicile, industry sector, and reference year.

The empirical results evidence that the whole model and the single explanatory variables, including the one relating to the sovereign default risk of each country, are statistically significant for the whole sample and for most of the sub-samples analyzed, the main exceptions being for the industry-specific regressions. The relevance of each variable varies across countries and industries, with a higher significance for the countries where the recent financial crisis has had a lower impact. The model is significant for both the pre-crisis and crisis periods, with higher coefficient values observed in the pre-crisis case. Furthermore, coefficient signs are consistent with logic-economic expectations. Our evidence is consistent with the findings of previous studies, which assessed the significance of the influence that IC components have on the business performance of firms.

This work contributes to the existing literature by proposing and testing an innovative model for investigating whether the information on human resources is a relevant factor that influences the economic and financial performance of companies and the investment decisions of market operators, taking into account also country-specific factors. Furthermore, the empirical results of this study could be of interest to standard setters for the purposes of defining a standard (qualitative and quantitative) level of information, i.e., the accounting treatment and disclosure, on human resources which should be disclosed by companies in their financial statements.

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