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Capital efficiency and market value in knowledge and capital-intensive firms: an empirical study

Abstract

The increasing gap between market and book value allows us to understand that firms' value is based not only on physical but also on intangible assets. Intellectual capital resources are very important, especially in knowledge-intensive but also in capital-intensive industries.

The main aims of this work are: (1) to propose a methodology based on the value added components, starting from Pulic's point of view (Pulic, 1998; 2000; 2008), which is able to discriminate between knowledge-intensive and capital-intensive industries; (2) to investigate the relationship between intellectual capital efficiency and market value (and between physical capital efficiency and market value) for firms belonging to both knowledge and capital-intensive sectors.

Keywords: knowledge-intensive firms, capital-intensive firms, intellectual capital efficiency, physical capital efficiency, market value, value added.
JEL Classification: C01, G32, M12, M41.

Introduction

Many scholars have studied the asymmetry between the market and the book value: one of the main elements that influence firms' market value is the intellectual capital (Edvinsson, 1997; Sveiby, 1997; and Lynn, 1998). Therefore, it has become interesting to study the relationship between intellectual capital and market value.

In this age, intellectual capital often "replaces" traditional resources such as land, capital and work (Sveiby, 1997; Bontis, 1999; O'Donnell et al., 2006). The actual accounting systems are able to show only physical assets without considering intangibles.

Another interesting topic is the difference between capital-intensive Firms (CIFs) and knowledge-intensive firms (KIFs). Even if the concept is rather clear and accepted, in the literature there are few proposals of criteria able to distinguish whether a sector (or a firm) has to be considered as knowledge-intensive or capital-intensive.

The aim of the paper is threefold: (1) starting from Pulic's point of view (Pulic, 1998; 2000; 2008), we propose a methodology based on the value added components that is able to discriminate between knowledge-intensive and capital-intensive industries; (2) we propose two new indicators useful for measuring the intellectual capital and the physical capital efficiency, extending the concept of VAIC (value added intellectual coefficient) proposed by Pulic (1998; 2000; 2008); (3) we analyze the relationship between Intellectual capital efficiency and market value (and between physical capital efficiency and market value) for firms belonging to both knowledge and capital intensive sectors.

The paper is organized as follows. Section 1 describes the literature review and the hypothesis development; section 2 illustrates the methodology of research; section 3 describes the analysis carried out; the discussion is included in section 4. The final section concludes the paper.

1. Literature review and hypothesis development

1.1. Literature review. Many scholars have studied the gap existing between firms' market value and book value and observed that there is an undetectable value unmentioned in financial statements (Chen et al., 2005; Campisi and Costa, 2008; Iazzolino and Fortino, 2012; Iazzolino and Pietrantonio, 2005). Market value is made up of a combination of tangible and intangible value (Tseng and Goo, 2005; O'Donnell et al., 2000).

The topic of firm performance evaluation has been studied from different point of view (Iazzolino et al., 2012). Intellectual capital is becoming a fundamental part of correctly estimating firms' market value. Several studies were carried out that tried to evaluate the impact of intellectual capital on market value and firms' performance (Rahman, 2012; Maditinos et al., 2011; Gan and Saleh, 2008; Chen et al., 2005; Tseng et al., 2005; Cabrita and Bontis, 2008; Firer and Williams, 2003; Schiuma et al., 2008; Iazzolino et al., 2013).

In the new knowledge-based economy, many firms belonging to several industries emphasize knowledge intensity and innovation as tools of competition (Hsiung and Wang, 2012; Pantano et al., 2013; Corvello et al., 2013; Corvello and Iazzolino, 2013). Many scholars have attempted to classify both capital intensive (CIFs) and knowledge-intensive firms (KIFs).

Despite the widespread use and apparent acceptance of the concept of KIF, there is no shared definition in

the literature. The concept of knowledge-intensive firms does not have a unique and universal meaning (Robertson and O'Malley Hammersley, 2000).

With the purpose of defining and distinguishing knowledge-intensive firms, researchers used two different perspectives: (1) the input-based perspective; and (2) the output-based perspective.

According to the input perspective, the term "knowledge-intensive" imitates the economists' labelling of firms as "capital-intensive" or "labor-intensive" (Starbuck, 1992). These labels describe the relative importance of both/either capital and/or labor as inputs to the production process. In a capital-intensive firm, capital (intended as physical capital such as plants, tools, etc.) is more important than labor (intended as human effort); in a labor-intensive firm, labor has the greater importance. By analogy, labelling a firm as knowledge-intensive implies that knowledge has more importance than other inputs (i.e. capital and labor); in fact, it can be considered as the raw material for developing these types of firm.

On the other hand, the output-based perspective emphasizes the role of knowledge in the output of the production process, reflecting the tradition industrial classification schemes, where organizations are grouped in industries by their outputs.

1.2. Hypothesis development. In order to evaluate the efficiency of intellectual and physical capital, we rely on the concept of value added, as introduced by Pulic (1998; 2000; 2008). We propose an extension of Pulic's methodology that considers also the other components of value added than the cost of employees (human capital).

The bridge that Pulic created between the notion of value added and that of value creation in a knowledge economy context constitutes the principal strong point of his proposal. For a detailed analysis of the concept of VAIC (value added intellectual coefficient) see Iazzolino and Laise (2013). The main strong point of Pulic was to recover the notion of value added, as intended in the Value Added Income Statement. The VAIC provides a cumulative measure of the changes in value added produced by efficiency gains related to the use of both physical/financial capital and intellectual capital.

Pulic defines the VAIC as:

$$VAIC = HCE + SCE + CEE,$$

where, HCE = Human capital efficiency = $\frac{VA}{HC}$, (HC = Human capital = Cost of employees); SCE = Structural capital efficiency = $\frac{SC}{VA}$, (SC = Structural capital = $VA - HC$); CEE = Capital employed efficiency = $\frac{VA}{CE}$, (CE = Capital employed = Book value of invested capital).

The term CE refers to the value of physical and financial (or traditional) assets while the terms HC and SC respectively refer to the components of the intellectual capital or (i.e.) human capital and structural capital.

We propose a different approach to measure the physical capital efficiency from Pulic. We measure the efficiency of physical and financial capital as the ratio of VA to the change occurred in physical and financial assets, rather than the ratio of VA to a stock of assets. Furthermore, we propose to introduce one more indicator to measure the intellectual capital efficiency.

Besides the human capital (cost of employees), we propose to extend the analysis to the other components of the Value Added, in order to consider the efficiency of the different inputs and the contribution to the value creation of all the production process inputs. In the following section a more detailed explanation of our methodology is provided.

2. Methodology of research

The aim of the paper is threefold: (1) at first, starting from Pulic's point of view (Pulic, 1998; 2000; 2008), we propose a methodology based on the value added components that is able to discriminate between KIFs and CIFs; (2) secondly, we propose two new indicators useful for measuring the intellectual capital efficiency (ICE) and the physical capital efficiency (PCE), extending the concept of VAIC proposed by Pulic (1998; 2000; 2008); (3) third, we analyze the relationship between ICE and market value (and between PCE and market value) for both KIFs and CIFs.

2.1. A criterion to discriminate between KIFs and CIFs. In order to make a distinction between KIFs and CIFs (and then also between knowledge-intensive industries and capital-intensive industries) we refer to the concept of value added and its components. By extending Pulic's work, we propose to consider also the other components of value added rather than human capital (HC).

Value added is made up of several sub-components that contribute in a different way to value creation. According to the formulation based on factors of production, value added could be written as:

$$VA = Cost\ of\ employees + Depreciation\ and\ amortization + Interests\ expenses + Taxation + Net\ Income,$$

where VA = *Value Added.*

Furthermore, in this formula *Depreciation and amortization* is considered as a whole component. We

have partitioned depreciation and amortization into three components: Tangible, Intangible and Others. Tangible amortizations regard physical capital (physical assets) such as plants, machineries, etc.; intangible amortization are linked to intellectual capital; other amortization regard other funds/ provisions (Figure 1).

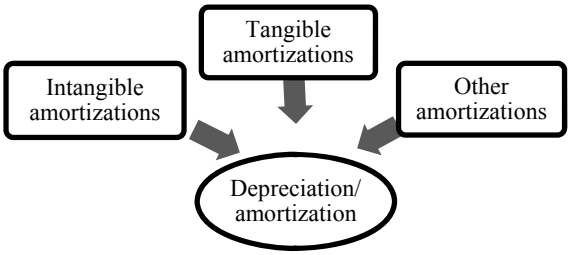

Fig. 1. Composition of depreciation and amortization

The overall decomposition of value added is illustrated in Table 1.

Table 1. Value added and its components

Components	Types of capital	%
Cost of employees (human capital)	Intellectual capital (human capital)	%
Depreciation/Amortization		
Intangible amortizations	Intellectual capital	%
Tangible amortizations	Physical capital	%
Other amortizations	(Not included in intellectual or phisical capital)	%
Interest expenses	Financial capital	%
Taxation	"External" capital (Government)	%
Net income	Financial capital	%
Value added (VA)		100%

In the literature there are no methodologies for classifying KIFs and CIFs. We propose a classification of firms based on the weight of value added components (on the whole value added), emphasizing: (1) cost of employees and intangible amortization for KIFs; and (2) Tangible amortization for CIFs. In particular, a KIF is characterized by a high weight of human capital (cost of employees) and Intangible amortization on value added; whereas, a CIF is identified by a high weight of Tangible amortization on value added.

We elaborated a formal rule for defining if a sector (and then a firm) can be considered as a KIF or a CIF:

1. Considering a specific sector *i*:

$$Sector_i \in KIF \underset{iff}{\Leftrightarrow} \begin{cases} \dfrac{HC_i}{VA_i} \geq Median\left(\dfrac{HC_{all\ sectors}}{VA_{all\ sectors}}\right) \\ \text{and} \\ \dfrac{HC_i}{VA_i} \geq \dfrac{TA_i}{VA_i} \end{cases}$$

where $i = 1,.., n$

2. Considering a specific sector *i*:

$$Sector_i \in CIF \underset{iff}{\Leftrightarrow} \left\{ \frac{TA_i}{VA_i} \geq Median \frac{TA_{all\ sectors}}{VA_{all\ sectors}} \right\}$$

where $i = 1,.., n$

2.2. Two new indicators for measuring IC efficiency and physical capital efficiency. After the classification, we proposed two new efficiency indicators for intellectual and physical capital. Pulic (1998, 2000, 2008) proposed VA/HC as efficiency indicator of intellectual capital; in fact, he used it to measure the knowledge workers' productivity. HC is the amount of investment in human resources, thus VA/HC is an efficiency indicator of human capital. As a matter of fact, a high value of VA/HC means that the firm is making the best use of its employees. This indicator shows how new value is created for each monetary unit invested in human capital.

We introduce two new indicators: VA/Intangible amortizations for measuring the intellectual capital efficiency and VA/Tangible amortizations for measuring the physical capital efficiency. Therefore, the efficiency indicators we used in our analysis are:

1. $\dfrac{VA}{Cost\ of\ employees}$: efficiency of intellectual capital (human capital) (already proposed by Pulic);
2. $\dfrac{VA}{Intangible\ amortizations}$: efficiency of intellectual capital (intangible assets) (new);
3. $\dfrac{VA}{Tangible\ amortizations}$: efficiency of physical capital (new).

2.3. Analysis of the relationship between IC efficiency and market value (and between physical capital efficiency and market value). The third aim of our research is to investigate the relationship between IC efficiency and market value (and between physical capital efficiency and market value) in: (1) KIFs and (2) CIFs.

In order to achieve this goal the following hypotheses were tested:

H1: In knowledge-intensive industries, intellectual capital efficiency (average value in the time range 2005-2009) positively influences market value (average value in 2009-2011).

H2: In capital-intensive industries, physical capital efficiency (average value in the time range 2005-2009) positively influences market value (average value in 2009-2011).

H3: In knowledge-intensive industries, intellectual capital efficiency (average value in the time range 2002-2009) positively influences market value (average value in 2009-2011).

H4: In capital-intensive industries, physical capital efficiency (average value in the time range 2002-2009) positively influences market value (average value in 2009-2011).

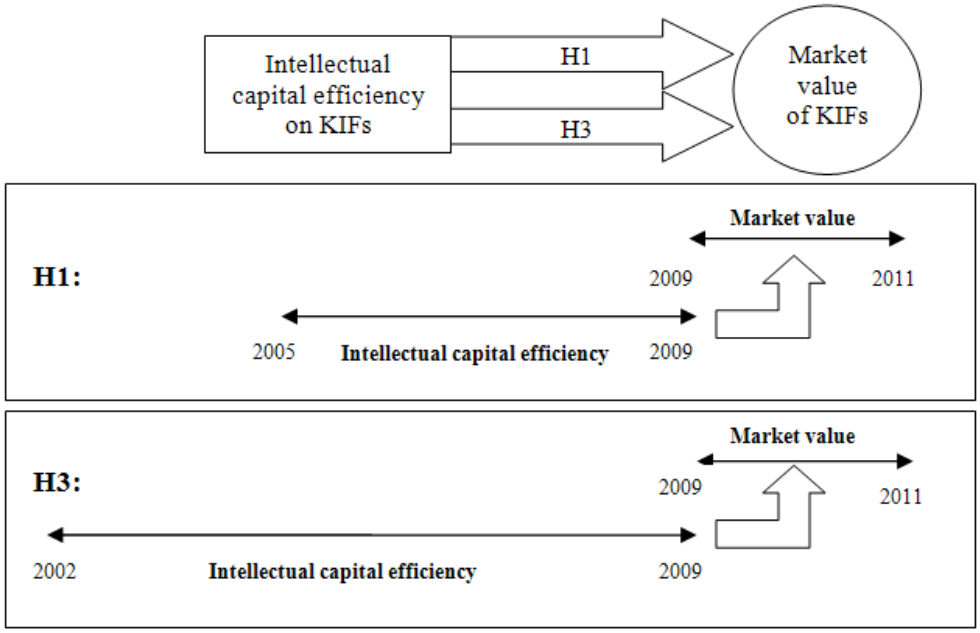

Fig. 2. Hypotheses 1 and 3

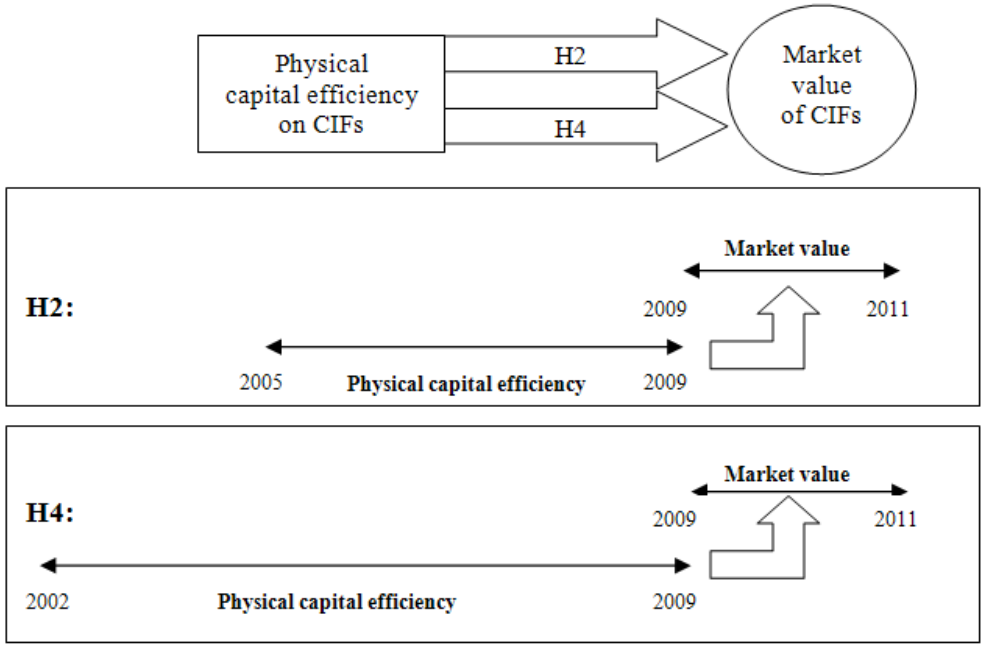

Fig. 3. Hypotheses 2 and 4

These hypotheses are based on the following considerations: investments in Intangibles provide benefits in the long term. Investments regarding intellectual capital consider expenditures on patents and brands but also in human resources and organization development. Thus, it is reasonable to assume that in order to obtain a return from these expenditures a long time period will be necessary. We considered two wide time ranges: the first from 2005 to 2009 and the second from 2002 to 2009. Similarly we considered the physical capital efficiency and then hypotheses 2 and 4.

3. Analysis

3.1. Dataset. The data were extracted from the AMADEUS Bureau Van Dijk database. In particular, we selected six industries:

- Computer programming and consultancy.
- Manufacture of chemicals.
- Manufacture of basic metals.

- Travel agency and tour operator reservation service.
- Advertising and market research.
- Manufacture of paper.

Initially, we analyzed 2280 Italian SMEs belonging to the above-mentioned sectors; subsequently, the sample was reduced, by considering the data availability from 2002 to 2011. A wide number of firms were removed, owing to the presence of null value or unavailable data. Furthermore, abnormal observations or outliers were removed, in order to improve both indexes of symmetry and kurtosis and then to guarantee a greater effectiveness of multiple linear regressions.

Therefore, the final sample was made up of 534 firms, as shown in Table 2.

Table 2. The sample

Sectors	No. of firms
Computer programming and consultancy	58
Manufacture of chemicals	25
Manufacture of basic metals	20
Travel agency and tour operator reservation service	105
Advertising and market research	170
Manufacture of paper	156
Total	534

3.2. Knowledge- and capital-intensive industries. In order to distinguish knowledge and capital-intensive sectors we carried out the analysis of the industries; the percentage of the value added components (on the whole value added) for each firm was calculated. Average values for every sector are shown in Table 3.

Table 3. Percentage of value added components for each industry

	Computer programming and consultancy	Travel agency	Advertising and market research	Manufacture of chemicals	Manufacture of basic metals	Manufacture of papers
Cost of employees	70%	58%	46%	41%	40%	41%
Tangible amortizations	3%	2%	1%	11%	10%	12%
Intangible amortizations	9%	8%	4%	8%	5%	7%
Other amortizations	2%	3%	1%	3%	2%	3%
Total depreciation and amortization	14%	13%	6%	22%	17%	22%
Interest expenses	2%	4%	4%	6%	9%	6%
Taxations	7%	13%	1%	5%	2%	5%
Net income	6%	12%	34%	26%	31%	26%
Value added	100%	100%	100%	100%	100%	100%

Observing the percentage of each component of value added a classification can be obtained for distinguishing between knowledge- and capital-intensive industries. Therefore, we adopted the rules cited beforehand in the methodology for establishing which firms could be classified as KIFs and which as CIFs. The results are shown in the Table 4 below.

Table 4. Classification of industries

	Computer programming and consultancy	Travel agency	Advertising and market research	Manufacture of chemicals	Manufacture of basic metals	Manufacture of papers
Cost of employees	70%	58%	46%	41%	40%	41%
Tangible amortizations (TA)	3%	2%	1%	11%	10%	12%
Intangible amortizations (IA)	9%	8%	4%	8%	5%	7%
Median HC/VA	44%	44%	44%	44%	44%	44%
Median TA/VA	7%	7%	7%	7%	7%	7%
Rules calculus	70% > 44% and 9% > 3%	58% > 44% and 7% > 2%	46% > 44% and 4% > 1%	11% > 8%	10% > 5%	12 % > 7%
Kind of sector	Knowledge-intensive	Knowledge-intensive	Knowledge-intensive	Capital-intensive	Capital-intensive	Capital-intensive

In Table 5 the resulting classification is reported.

Table 5. Knowledge- and capital-intensive sectors

Knowledge-intensive	Capital-intensive
Computer programming and consultancy	Manufacture of chemicals
Advertising and market research	Manufacture of basic metals
Travel agency	Manufacture of paper

3.3. The impact of intellectual and physical capital on market value. A multiple linear regression analysis was carried out that allowed us to evaluate the impact of Intellectual and physical capital on firm's market value. To build solid regression models we considered not only the Cost of employees and the Depreciation/Amortization, but all the components of value added. Before proceeding with the multiple linear regressions, a correlation analysis was carried out (by SPSS Statistics 19), for each sector, among the independent variables used in the models. We developed four multiple regression models.

Model 1 (Hypoteses H1 and H2)

$$FCFO_{2009-2011} = \beta_0 + \beta_1 \times \frac{VA_{2005-2009}}{Cost\ of\ employees_{2005-2009}} + \beta_2 \times \frac{VA_{2005-2009}}{Intangible\ amortizations_{2005-2009}} +$$
$$+ \beta_3 \times \frac{VA_{2005-2009}}{Tangible\ amortizations_{2005-2009}} + \beta_4 \times \frac{VA_{2005-2009}}{Others\ amortizations_{2005-2009}} + \beta_5 \times \frac{VA_{2005-2009}}{Taxations_{2005-2009}} + \quad (1.1)$$
$$+ \beta_6 \times \frac{VA_{2005-2009}}{Interest\ expenses_{2005-2009}} + \beta_7 \times \frac{VA_{2005-2009}}{Net\ income_{2005-2009}} + \varepsilon;$$

$$FCFO/Sales_{2009-2011} = \beta_0 + \beta_1 \times \frac{VA_{2005-2009}}{Cost\ of\ employees_{2005-2009}} + \beta_2 \times \frac{VA_{2005-2009}}{Intangible\ amortizations_{2005-2009}} +$$
$$+ \beta_3 \times \frac{VA_{2005-2009}}{Tangible\ amortizations_{2005-2009}} + \beta_4 \times \frac{VA_{2005-2009}}{Others\ amortizations_{2005-2009}} + \beta_5 \times \frac{VA_{2005-2009}}{Taxations_{2005-2009}} + \quad (1.2)$$
$$+ \beta_6 \times \frac{VA_{2005-2009}}{Interest\ expenses_{2005-2009}} + \beta_7 \times \frac{VA_{2005-2009}}{Net\ income_{2005-2009}} + \varepsilon.$$

Model 2 (Hypoteses H3 and H4)

$$FCFO_{2009-2011} = \beta_0 + \beta_1 \times \frac{VA_{2002-2009}}{Cost\ of\ employees_{2002-2009}} + \beta_2 \times \frac{VA_{2002-2009}}{Intangible\ amortizations_{2002-2009}} +$$
$$+ \beta_3 \times \frac{VA_{2002-2009}}{Tangible\ amortizations_{2002-2009}} + \beta_4 \times \frac{VA_{2002-2009}}{Others\ amortizations_{2002-2009}} + \beta_5 \times \frac{VA_{2002-2009}}{Taxations_{2002-2009}} + ; \quad (2.1)$$
$$+ \beta_6 \times \frac{VA_{2002-2009}}{Interest\ expenses_{2002-2009}} + \beta_7 \times \frac{VA_{2002-2009}}{Net\ income_{2002-2009}} + \varepsilon;$$

$$FCFO/Sales_{2009-2011} = \beta_0 + \beta_1 \times \frac{VA_{2002-2009}}{Cost\ of\ employees_{2002-2009}} + \beta_2 \times \frac{VA_{2002-2009}}{Intangible\ amortizations_{2002-2009}} +$$
$$+ \beta_3 \times \frac{VA_{2002-2009}}{Tangible\ amortizations_{2002-2009}} + \beta_4 \times \frac{VA_{2002-2009}}{Others\ amortizations_{2002-2009}} + \beta_5 \times \frac{VA_{2002-2009}}{Taxations_{2002-2009}} + \quad (2.2)$$
$$+ \beta_6 \times \frac{VA_{2002-2009}}{Interest\ expenses_{2002-2009}} + \beta_7 \times \frac{VA_{2002-2009}}{Net\ income_{2002-2009}} + \varepsilon.$$

The regression models were developed using the average of dependent and independent variables in order to take into account the value of variables for the years considered.

Firms included in the sample are not listed on a stock market; thus we used a "proxy" of market value (because this is not available for non-listed firms): FCFO (free cash flow from operations). It could be used as a proxy of firm's market value as FCFO is the basic item for calculating the market value[1].

The other dependent variable considered in our analysis is FCFO/Sales. It allowed us to take into account the dimensional factors of firms.

The independent variables of models concern the efficiency of the value added components, as written previously. In particular we considered VA/Cost of employees (or VA/HC) and VA/Intangible Amortizations as indicators of intellectual capital efficiency; we considered VA/Tangible amortizations as an indicator of physical capital efficiency.

3.3.1. Model 1 (Data from 2005 to 2009). This model was developed to test hypotheses H1 and H2; hence, independent variables were drawn by the average of efficiency indicators mentioned beforehand considering the period of 2005-2009, while the average firm's market value from 2009 to 2011 was measured through FCFO and FCFO/Sales (dependent variables). The results of the application of Model 1 are shown in Table 6.

In order to test the hypotheses, we have observed the *t*-tests (shown in Table 8 and Table 9 the Appendix). Through the β coefficient and its significance it is possible to identify which sectors satisfy H1 and H2.

3.3.2. Model 2 (2.1 and 2.2). Model 2 was developed to test H3 and H4; thus, independent variables were drawn by the average of efficiency indicators as done

[1] According to the financial method for evaluating firm market value. FCFO is calculated as: *FCFO = EBITDA − ΔWorking capital − ΔGross fixed assets − ΔOperating taxation*, where: *FCFO = Free cash flow from operations*; *EBITDA = Earnings before interest, Taxes, Depreciation and amortization*.

in Model 1 considering the period from 2002 to 2009 as time horizon, while the average firm's Market Value from 2009 to 2011 was measured through FCFO and FCFO/Sales (dependent variables). The following Table 9 shows the results of the application of this model.

Table 6. Application of Model 1 (1.1 and 1.2)

Model 1				
Independent variables: Average of ratios 2005-2009				
	Dependent variable: FCFO/Sales (average)		Dependent variable: FCFO (average)	
Sectors	R^2	*F*	R^2	*F*
Computer programming and consultancy	0.3	2.01*	0.27	1.72
Travel agency and tour operator reservation services	0.97	97.93***	0.68	5.31**
Advertising and market research	0.71	4.35**	0.58	2.41*
Manufacture of paper	0.17	2.74**	0.28	5.24***
Manufacture of chemicals	0.16	4.46*	0.53	25.48***
Manufacture of basic metals	0.18	4.51***	0.06	1.45

Notes: *Significance level of 10%; **significance level of 5%; ***significance level of 1%.

Table 7. Application of Model 2

Model 2				
Independent variables: average of ratios from 2002-2009				
	Dependent variable: FCFO/Sales (average)		Dependent variable: FCFO (average)	
Sectors	R^2	*F*	R^2	*F*
Computer programing and consultancy	0.17	1.53	0.01	0.07
Travel agency and tour operator reservation services	0.24	0.79	0.65	4.45**
Advertising and market research	0.77	5.97**	0.64	3.17**
Manufacture of paper	0.17	2.74**	0.26	4.71***
Manufacture of chemicals	0.19	0.44	0.11	2.35**
Manufacture of basic metals	0.08	1.89	0.10	2.35**

Notes: *Significance level of 10%; **significance level of 5%; ***significance level of 1%.

As done for the previous model, *t*-tests have been observed in order to test both hypotheses H3 and H4. The results are shown in Table 10 and 11 (see Appendix).

4. Discussion

4.1. KIFs and CIFs. The results demonstrate that, in general, the HC% value (percentage on VA) is the highest in all sectors with respect to the other VA components. However, considering the different sectors, knowledgeiintensive firms (KIFs) have a higher value of HC% than the capital-intensive firms (CIFs). Furthermore, KIFs have a value of Intangible amortization (%) higher than Tangible amortization (%). In fact, in knowledge-intensive industries there is a greater use of intellectual resources and consequently there are not many tangible assets. Through the results, it can be noted that, in the computer programming and consultancy sector, there are the greatest values of HC% and Intangible amortizations %. In fact, in this industry there are companies that base their business on an intensive use of their staff competences. In CIFs there are higher values of tangible than Intangible amortization, owing to the use of expensive production plants. As can be noticed, there are intangible assets also in capital-intensive sectors but they are lower than tangible assets.

The validity of these criteria is guaranteed by the objectivity of the assessment, since financial data were used.

4.2. Model 1 (1.1 and 1.2). In Model 1, the analyses considering the FCFO as dependent variable point out that H2 is never satisfied in any capital-intensive industries. The results prove that there are no significant relationships between FCFO and the efficiency of physical capital. Owing to the fact that *t*-value is lower than the critical threshold, it can be said that the ratio VA/Tangible amortizations is not significant for determining firm's market value (measured by FCFO).

Hypothesis H1 (considering the same variables) is satisfied in the Travel agency sector (Table 7) in which the intellectual capital efficiency ratios are significant for determining firm's market value (FCFO).

In contrast, measuring firm's market value by FCFO/Sales, the previously mentioned hypotheses find a more empirical confirmation. H1 is satisfied for two knowledge-intensive sectors: Computer programming consultancy and Travel agency (Table 8). In capital-intensive sectors, H2 is satisfied only in Manufacture of paper. Some observations could be made by comparing a capital-intensive with a knowledge-intensive sector (Table 8).

As described in Table 8, the efficiency of intangible capital measured by VA/Intangible amortization is a significant predictor of the market value for Travel agency, whereas the same ratio is not a good predictor for Manufacture of paper. Furthermore, the efficiency of intangible capital has greater influence on Market Value in knowledge-intensive than in capital-intensive sectors; whereas the efficiency of physical capital influences the market value only in capital-intensive sectors. Furthermore, in the Advertising and market research sector, there is a great influence of the efficiency of human capital on the market value (represented by both FCFO/Sales and FCFO), as shown in Table 7 and Table 8.

4.3. Model 2 (2.1 and 2.2). First of all, considering FCFO/Sales as a dependent variable, hypothesis H3 is never satisfied; thus, there is no empirical evidence that intangible capital efficiency influences firm's market value in knowledge-intensive sectors. Using the same dependent variable, hypothesis H4 is verified only in Manufacture of paper, as VA/Tangible amortizations is significant in this sector as shown in Table 11.

Secondly, using FCFO as dependent variable, H3 is verified only in the Travel agency sector; whereas H4 is confirmed in the Manufacture of basic metals. Therefore, comparing these two sectors some aspects can be noticed (Table 10).

In the Travel agency sector the efficiency of intangible capital is higher than in the Manufacture of basic metals; in knowledge-intensive sectors (such as the Travel agency) the efficiency of intangible capital has a significant influence on market value; whereas in the Manufacture of basic metals, the efficiency of physical capital is more significant than in knowledge-intensive sectors (Travel agency) and it has a meaningful influence on market value.

Conclusions

The incipit of this study is that intellectual capital efficiency positively influences firms' market value. However, the impact of intellectual capital can be different in relation to the sectors in which it is taken into account. Thus, intellectual capital may be essential in knowledge-intensive industries, as KIFs (knowledge-intensive firms) base their business on intellectual capital rather than physical capital resources. Despite intellectual capital also being present in capital-intensive sectors, CIFs use more physical than intellectual capital resources.

In the literature there are few applications that try to classify KIFs and CIFs but they are confused. Hence, we have proposed a classification based on the efficiencies mentioned above.

Starting from Pulic's point of view (Pulic, 1998; 2000; 2008), we decomposed the VA according to the formulation based on factors of production; afterwards, starting from whole value of depreciations and amortizations we placed the efficiency of Human Capital side by side to efficiency of intangible assets (VA/Intangible amortizations) for intellectual capital measurement; whereas we defined the efficiency of tangible assets for measuring physical capital.

Subsequently, we tested the hypotheses described in the methodology of research in order to investigate the existing relationships between IC and market value within knowledge- and capital-intensive sectors.

In this study, we considered FCFO as a proxy of market value, because there are no listed firms in our sample; although FCFO takes into account only what happens within a company, not considering exogenous factors, which can affect firm's value.

In conclusion, the main aims of this study are:

1. Providing an objective knowledge- and capital-intensive sectors classification based on VA components.
2. Investigating the relationships between intellectual capital (IC) and market value (MV) within knowledge- and capital-intensive industries.

Further researches could regard analyses that take into account a wider sample of firms especially for knowledge-intensive sectors. Furthermore, a larger set of sectors (both knowledge- and capital-intensive) could be considered.

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Table 8. Model 1.1. Dependent variable: FCFO 2009-2011; independent variables 2005-2009

Model 1 Dependent variable: FCFO (Average) 2009-2011	TRAVEL			PAPER			ADVERTISING			COMPUTER			METAL			CHEMICAL		
	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.
(Constant)			-2.414	.018	-.144	.885		2.511	.027		-2.695	.011		-3.092	.002		-.144	.885
VA/Taxation	-.183	.102	1.036	.303	-11.976	.000	-.110	-.551	.592	.196	1.209	.236	.136	1.614	.109	-.718	-11.976	.000
VA/Net income	0.28*	.153	1.598	.114	.163	.871	-.133	-.558	.587	.050	.322	.750	.058	.723	.471	.009	.163	.871
VA/HC	0.30*	0.18*	1.752	.083	-.701	.484	-.790***	-3.775	.003	0.592**	2.950	.006	0.18**	2.182	.031	.043	-.701	.484
VA/Interest expenses	-0.39**	.072	.657	.513	2.719	.007	-.017	-.090	.930	-.159	-1.035	.309	.048	.575	.566	.151	2.719	.007
VA/Intangible amortizations	0.28*	.127	1.117	.267	.087	.931	-.033	-.164	.873	-.351	-1.695	.100	.023	.288	.774	.005	.087	.931
VA/Tangible amortizations	.080	0.244**	2.540	.013	.754	.452	-.076	-.296	.772	.137	.843	.405	.120	1.448	.150	.042	.754	.452
VA/Other amortizations (AVERAGE)	-.005	.104	1.096	.276	.208	.835	-.031	-.155	.879	0.29*	1.701	.099	.005	.067	.947	.011	.208	.835

Notes: * Significance level of 10%; ** significance level of 5%; *** significance level of 1%.

Table 9. Model 1.2. Dependent variable: FCFO/Sales 2009-2011; independent variables 2005-2009

Model 1 Dependent variable: FCFO/ Sales (Average) 2009-2011	TRAVEL			PAPER			ADVERTISING			COMPUTER			METAL			CHEMICAL		
	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.
(Constant)		-1.539	.142		-2.414	.018		3.238	.007		-2.776	.009		-2.947	.004		-.122	.903
VA/Taxation	-.022	-.495	.627	.102	1.036	.303	-.125	-.742	.472	.207	1.305	.201	.284	3.589	.000	-.411	-5.141	.000
VA/Net income	0.98***	24.398	.000	.153	1.598	.114	-.068	-.337	.742	-.001	-.006	.995	.060	.795	.428	.013	.182	.856
VA/HC	0.11**	2.607	.018	0.18*	1.752	.083	-.818***	-4.609	.001	.518	2.643	.013	.204	2.568	.011	-.048	-.598	.551
VA/Interest expenses	-.054	-1.292	.214	.072	.657	.513	-.067	-.407	.691	-.267	-1.775	.085	.022	.281	.779	.031	.425	.671
VA/Intangible amortizations	0.18***	4.685	.000	.127	1.117	.267	-.234	-1.351	.202	-.197	-.970	.339	-.035	-.460	.647	.009	.123	.902
VA/Tangible amortizations	-.046	-1.159	.262	0.24**	2.540	.013	-.108	-.500	.626	.119	.744	.462	.017	.223	.824	.045	.603	.547
VA/Other amortizations	-.014	-.353	.729	.104	1.096	.276	-.012	-.070	.946	.307	1.795	.082	-.242	-3.172	.002	.014	.192	.848

Notes: * Significance level of 10%; ** significance level of 5%; *** significance level of 1%.

Table 10. Model 2.1. Dependent variable: FCFO 2009-2011; independent variables 2002-2009

Model 2 Dependent variable: FCFO (Average) 2009-2011	PAPER			ADVERTISING			TRAVEL			COMPUTER			METAL			CHEMICAL		
	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.
(Constant)		-1.629	.107		3.280	.007		-0.56	0.583		.919	.363		-2.896	0.004		3.628	0
VA/Taxation	-.093	-1.027	.307	-.138	-.766	.458	-0.13	-0.655	0.522	.043	.295	.769	0.16**	1.991	0.048	-0.101	-1.087	0.279
VA/Net income	.007	.069	.945	-.091	-.502	.625	0.025	0.137	0.893	.010	.067	.947	0.17**	2.233	0.027	-0.034	-0.41	0.682
VA/HC	0.235**	2.352	.021	-.864	-4.447	.001	0.267	1.556	0.138	-.093	-.624	.536	0.14*	1.81	0.072	-0.286	-3.258	0.001
VA/Interest expenses	-.053	-.519	.605	.031	.169	.868	-0.44**	-2.273	0.036	.046	.315	.754	0.012	0.147	0.883	-0.046	-0.532	0.595
VA/Intangible amortizations	.369	3.476	.001	.049	.262	.798	0.32*	2.039	0.057	.028	.102	.919	0.023	0.287	0.775	0.008	0.09	0.928
VA/Tangible amortizations	.001	.015	.988	-.093	-.495	.630	0.229	1.353	0.194	-.042	-.151	.881	0.16**	2.018	0.045	-0.177	-2.055	0.042
VA/Other amortizations	.016	.181	.857	.027	.154	.880	-0.06	-0.383	0.707	.000	-.003	.998	0.017	0.212	0.832	-0.129	-1.518	0.131

Notes: * Significance level of 10%; ** significance level of 5%; *** significance level of 1%.

Table 11. Model 2.2. Dependent variable: FCFO/Sales 2009-2011; independent variables 2002-2009

Model 2 Dependent variable: FCFO/Sales (Average) 2009-2011	PAPER			ADVERTISING			TRAVEL			COMPUTER			METAL			CHEMICAL		
	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.	Beta	*t*	Sig.
(Constant)		-1.344	.182		4.330	.001		-.875	.394		.561	.578		-1.476	.142		-1.905	.059
VA/Taxation	-.126	-1.314	.192	-.138	-.963	.354	.500	1.715	.105	0.24*	1.769	.083	.107	1.348	.180	.075	.948	.344
VA/Net income	.038	.374	.709	-.026	-.183	.858	.214	.793	.439	-.031	-.240	.811	.039	.493	.623	-.005	-.060	.952
VA/HC	.114	1.070	.288	-.859	-5.542	.000	.117	.467	.647	-.167	-1.225	.226	.111	1.378	.170	.089	1.088	.278
VA/Interest expenses	.022	.206	.837	-.017	-.116	.910	-.471	-1.674	.113	.201	1.523	.134	-.027	-.333	.740	.026	.324	.746
VA/Intangible amortizations	.166	1.472	.144	-.180	-1.218	.247	.228	.983	.340	.386	1.519	.135	-.210	-2.618	.010	-.001	-.013	.990
VA/Tangible amortizations	0.25**	2.570	.012	-.090	-.602	.558	.207	.833	.416	-.374	-1.458	.151	.110	1.371	.172	.067	.859	.392
VA/Other amortizations	.096	1.008	.316	.015	.106	.918	-.106	-.456	.654	.101	.776	.441	-.041	-.525	.600	.010	.130	.897

Notes: * Significance level of 10%; ** significance level of 5%; *** significance level of 1%.