Intellectual capital measurement implications for organizational and market performance

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Submitted in accordance with the requirements for the degree of

Doctor of Philosophy

September 2014

The candidate confirms that the work submitted is his/her own, except where work which has formed part of jointly authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

The work in Chapter 3 and Chapter 11 of the thesis has appeared in publication as follows:

Spender, J. C., Bednarz-Łuczewska, P., Bordianu, A., & Rohaert, S. 2013. Intangibles: theory, categories, and the Kozminski matrix. Knowledge Management Research & Practice, 11(2), pp. 101-111.

Acknowledgements

My first acknowledgment goes to my mentor Andrew Robinson. He has been supporting me through the ups and downs of the PhD process, guided my career steps and encouraged me to continuously improve and exceed my limits. He always had a good advice and a word of wisdom to dispense which have taught me good life lessons and have influenced my development.

I would like to extend my acknowledgements to my family. My Mom is my tower of strength. My dear brother has always made me happy and never let me believe I am too smart. My father has always helped me think one step ahead and come up with solutions whenever I believed I had none. My grandmother – I know she looks down from heaven and is proud that all her efforts paid off.

I have made friends for life in Zainah, Vita and Jane, who have been next to me through my best and through my worst. Thank you girls! Also, I have been lucky to be surrounded bunch of friends who have always cared about my well-being, especially: Anca Dranca, Flaviu and Ramona Badea, Cristina Brian, Eva Toncea, Diana Badea-Hamdaoui and Ionut Pisau.

It has been an absolute pleasure to be part of community of academics who constantly share knowledge, help and support each other. I thank people in the Accounting and Finance division at Leeds University Business School for the great experience I had. A special thank you goes to my second supervisor Nick Wilson for his valuable advice, help and guidance. I express my gratitude to Kevin Keasey and Gianluca Veronesi for their support and guidance in my career pursuits. I strongly appreciate the constant kindness and care Michelle Dickson has showed for me. Finally, thanks to all the people who made Doctoral Seminar Series possible and believed in my leadership.

I am deeply indebted to JC Spender who has seen value in my work, helped me get it published and with whom I had numerous provoking debates. Also, I am very grateful to David Hillier and Allan Hodgson who have been the first to guide me towards pursuing a PhD.

Abstract

In the knowledge era, intellectual capital has been put forward as the key driver of corporate value and economic performance. In an economy which increasingly demands greater value creation it is essential to understand the mechanisms through which intellectual capital adds value. Despite this, the emerging picture of intellectual capital from an accounting perspective is somewhat confusing. The literature reveals mixed results about the performance enhancing properties of intellectual capital and says little about how this may be brought about. This thesis aims to bring better understanding and clarity to the topic.

It begins by "*taking a step back*" and questioning whether the choice of measurement and its ability to adequately capture intellectual capital could be one of the reasons for the mixed results found in the literature. In then proceeds to pin down the IC-performance effect by taking a contingency approach that investigates the relationship across multiple performance aspects, a wide range of intellectual capital measures and different industry sectors. In order to frame this empirical work the thesis pulls together a highly fragmented literature from both accounting and strategic management disciplines with the goal of exploring how intellectual capital measurement and performance can be improved by taking an interdisciplinary approach.

The findings show that the accounting discipline has the ability to capture intellectual capital and explain the mechanisms through which its elements add value to a company, but it faces difficulties and must be viewed in light of what other disciplines might add to the mix. In order to advance the measurement of intellectual capital measurement and its link to performance, the accounting profession has to accept that the existing objective measures cannot grasp some of the *"soft"* aspects of intellectual capital.

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1. Introduction

1.1. The importance of intellectual capital and its measurement

Intellectual capital has become the hallmark of economic viability and vitality in the knowledge era (Spender, 2011). Most forms of physical and financial assets are commodities unable to achieve further economies of scale (Alcaniz et. al., 2011), and yield on average the cost of capital (Lev et. al., 2009). By contrast, intellectual capital is the key competitive advantage which adds value to a company (Wall et. al., 2004; Joia, 2007; Tayles et. al., 2007). For this reason it has been named the unique major driver of corporate value (Tan et. al., 2007).

Intellectual capital is a non-financial intangible asset with a knowledge component, which is not fully owned or controlled by a company. It is known to comprise of three components: human capital, structural capital and relational capital. Human capital represents the value added by employees' knowledge. It refers to aspects, such as employees' education, knowledge, know-how, expertise, abilities, satisfaction and stability (Montequin et. al., 2006; Nazari & Herremans, 2007). Structural capital describes the knowledge which has been captured and institutionalized within the organization. It includes a company's communication infrastructure, information technology, innovation, research and development, databases, process handbooks, intellectual property, brands etc. (Bontis et. al., 2000). Relational capital represents the value of all relationships the company establishes with its stakeholders: customers, suppliers, competitors, government or industry associations (Montequin et. al., 2006; Bontis, 2001). It describes the company's knowledge in scanning and identifying opportunities in the market for value creation (Nazari & Herremans, 2007).

The evidence shows that companies are increasing their investment in all intellectual capital elements relative to tangible assets. For example, Seetharaman et. al. (2004) note that the ratio of tangible to intangible assets in 1929 was 70/30 but it had shifted to 37/63 by 1990, and it continues to change following the same trend. Cabrera and Cabrera (2002) not that 81% of leading European and US companies were already actively engaged in intangible assets investment by 2002 (Cabrera & Cabrera, 2002), with 50% to 90% of the value created by these firms coming from the management of intangible assets rather than the management of tangible assets (Wall et. al., 2004). In the UK, the nominal business investment in intangible assets has grown considerably from 6% of nominal market sector gross value added in 1970 to about 15% in 2004 (Marrano et. al., 2009).

Companies' incentive to invest in this resource is justified by the benefits associated with intellectual capital. For example, investment in research and development is associated with a firm's ability to sustain long term competitive advantage (Lev & Sougiannis, 1996). Additionally, companies investing heavily in intellectual capital elements, such as brands, patents and/or trademarks have a higher market value than companies which invest less in these elements (Hall et al., 2001; Barth et. al., 2003; Deng et. al., 2003; Seethamraju, 2003). Finally, Zucker et. al. (2003) found that intellectual capital allows companies to capture abnormal economic returns.

In an economy that emphasizes its reliance on intellectual capital to achieve high levels of performance, it is important to understand the mechanisms through which this resource adds value to a company (Alcaniz et. al., 2011; Bonacchi et. al., 2011). However, intellectual capital is abstract, immaterial, complex and different from the traditional assets, in that it is not fully owned and controlled by the company (Spender et. al., 2013). For this reason, it is difficult to explain its involvement in the value creation process. Researchers argue that "*what you can measure you can manage, and what you want to manage, you need to measure*" (Roos et. al., 1997) Hence, in order to be able to classify a company's intellectual capital, to identify how it supports a firm's goals and to quantify the contribution this resource is making to the organizational performance, managers and shareholders need to measure it (Dumay, 2009; Spender et. al., 2013).

The measurement of intellectual capital can improve organizational and market efficiency in addition to having the ability to aid the understanding of the value creation process. Organizational efficiency is improved because the measurement of intellectual capital allows for a better resource allocation which favours the investment in a firm's key value drivers (Kaplan & Norton, 1996; Marr et. al., 2003; Neely et. al., 2004). At the same time, market efficiency can be enhanced by intellectual capital measurement through improved transparency in business activities, which increases companies' capacity to raise capital and decreases its cost of capital (Andriessen, 2004a).

1.2. Research context

The main task of the accounting profession is to provide users with information that allows them to understand past, present and future organizational performance (Barth et. al., 2001). At present, intellectual capital is believed to play the central role in determining performance (Lev et. al., 2009), hence there is an increased demand for accountants to explain the value added by intellectual capital (de Villiers et. al., 2014). Given that intellectual capital and its involvement in the value creation process can be explained through measuring this resource, the accounting profession has suggested various solutions to the measurement of intellectual capital: intellectual capital proxies, accounting measures of intangible value and non-financial indicators.

One way of capturing the value of intellectual capital in accounting is through the recognition of intangible assets and goodwill on the balance sheet, and through the recording of intellectual capital investment related expenses on the income statement. All ways of capturing the value of intellectual capital enumerated above have been used by researchers and practitioners to approximate the monetary value of the different components of intellectual capital. For example, intangible assets and goodwill have been used to approximate the value of structural capital (Edvinsson, 1997), while the cost of employees' salaries and benefits have been utilized to account for human capital (Black & Lynch, 1996). Together they have been labelled "*intellectual capital proxies*".

Another way of capturing intellectual capital in the accounting discipline is through accounting measures of intangible value. The most utilized and cited accounting measures are: Market-to-Book Ratio (Chan, 2009), Tobin's Q (Bharadwaj et. al., 1999), Economic Value Added (Stewart, 1994; Belkaoui, 2003), Calculated Intangible Value (Stewart, 1995; Kujansivu & Lonnqvist, 2007) and Value Added Intellectual Capital Index (Pulic, 1998; Zeghal & Maaloul, 2010). These measures have been constructed based on two types of data: financial statements data and/or market valuations of the company (Spender et. al., 2013). Economic Value Added, Calculated Value Added and the Value Added Intellectual Capital Index depend on financial statements data, while Market-to-book ratio and Tobin's Q mostly rely on market valuations of the firm. Compared with the intellectual capital proxies, the accounting measures of intangible value have been built to quantitatively capture the overall value of intellectual capital rather than the individual value of its constituent parts.

Finally, intellectual capital value is captured in a narrative language in the annual reports and/or intellectual capital statements. Based on this information, accounting has built a list of possible non-financial indicators of intellectual capital, such as number of employees, number of customers, percentage of highly educated staff, number of patents etc. As with the intellectual capital proxies, the non-financial indicators are meant to evaluate separate intellectual capital components. However, contrary to the intellectual capital proxies, the non-financial indicators assign just a quantitative value to intellectual capital elements, not a monetary counterpart. Davison (2010) argues that non-financial indicators have become a more refined method of explaining the intellectual capital value as managers are responsible for what they choose to report in the absence of a well-regulated disclosure policy on intellectual capital. As a result, the reported non-financial indicators highlight the value drivers which fit a specific company's profile.

However, as is well documented in the literature, the measurement solutions for intellectual capital suggested in the accounting field face some challenges. One challenge is the fact that the suggested ways to capture intellectual capital value have limitations inherent to their construction (Levy & Duffey, 2007). Both the intellectual capital proxies and the accounting measures of intangible value, which use financial statement data, have been criticized for being past-oriented (Bontis, 2001; Levy & Duffey, 2007). Furthermore, due to an increased gap between the book and the market values, the data provided in the financial statements is believed to have less relevance, in that is considered unable to predict the market value of a firm (Lev, 2001; Walker, 2009). However, empirical evidence on the topic is inconclusive (Landsman, 2007).

In contrast, the accounting measures of intangible value which rely on market valuations are future oriented and reveal a firm's growth opportunities. However, market valuations are subject to irrational impulses and market sentiment (Gowthorpe, 2009; Maditinos et. al., 2011). If the stock markets are inefficient, using market value to infer the value of intellectual capital may lead to erroneous results (De, 2009).

Moreover, some researchers argue that intellectual capital proxies and accounting measures are biased due to different accounting practices across industries, inappropriate expensing of some intellectual capital elements and a failure to reflect opportunity costs and risk (Hirschey & Wichern, 1984). Nevertheless, intellectual capital proxies and the accounting measures rely on audited information, which is objective, verifiable and comparable (Maditinos et. al., 2011). Their use is justified on the grounds that it relies on the best currently available data accounting can provide on intellectual capital. Additionally, some researchers support the use of intellectual capital proxies and accounting measures of intangible value over non-financial indicators (Firer & Williams, 2003). Non-financial indicators are believed to be highly subjective and to have limited comparability and generalizability as they present only the information considered relevant by the managers (Caddy, 2002; Sveiby, 2005).

Another challenge of using accounting methods to measure intellectual capital is the mixed empirical evidence on the performance enhancing properties of intellectual capital (Ittner, 2008). Some researchers find a positive connection between intellectual capital and performance (Aboody & Lev, 2001; Gavious & Russ, 2009; Wang & Wu, 2012;), while others find a negative one (Chan et. al., 2001; Bell et. al., 2002; Hall & MacGarvie, 2009). These findings raise difficulties in understanding the value creation process and the effect of intellectual capital on performance.

Different arguments have been advanced to explain the mixed results found in the literature. First, the research in the field covers a range of performance aspects, such as economic, financial and market performance without providing strong arguments why intellectual capital should be positively linked with all these aspects of performance (Firer & Williams, 2003). Intellectual capital may positively influence some aspects of performance, while negatively influencing others. Nonetheless, most studies do not compare and contrast the relation intellectual capital has with different aspects of performance. Hence, there is a need to establish whether the intellectual capital relationship with performance is constant across various aspects of performance.

Second, empirical research covers various intellectual capital elements which are operationally distinct and, as a result, are believed to have a significantly different behaviour (Roos et. al., 2005). If they behave differently, intellectual capital elements should not be equally important in influencing performance (de Pablos, 2004) and this in part may explain the mixed results. Moreover, the core elements of intellectual capital are bound up together and interact with each other. Bukh (2003) states that value is added whenever there is an adequate combination of intellectual capital elements, however, little is known about the net effect on performance of combining the different elements of intellectual capital elements. Nielsen et. al. (2009) state that intellectual capital interactions have been researched in a reporting context, but less so in a measurement context. Hence, the study of intellectual capital measurement should consider all intellectual capital elements: human capital, structural capital and relational capital to avoid omitted variable bias. Also, it should explore the potential interaction between intellectual capital elements in order to determine the net intellectual capital effect.

Finally, the empirical evidence shows that the relationship between intellectual capital and performance is context dependent (Chauvin & Hirschey, 1993; Conolly & Hirschey, 2005; Pacharidis & Varsakelis, 2010). Factors such as firm size, uncertainty and industry have been proven to exert considerable influence on the results obtained. While industry effects are recognized, most of the studies tend to concentrate on high-technology/high-knowledge intensive sectors (Hall et. al., 2005; Tsai, 2005; Bardhan et. al., 2010; Braker & Ramaya, 2011; Chen et. al., 2013). Focusing the research on an industry abundant in intellectual capital is an appropriate research technique; however, it leaves a large gap in understanding how intellectual capital works in low-knowledge sectors. Also, it would be a promising line of research to investigate whether intellectual capital is similarly important for companies operating in low-knowledge industries compared to companies operating in high-knowledge industries.

As we have noted, the solutions for measuring intellectual capital suggested by the accounting profession have various limitations. Further, the use of these measures renders mixed results regarding the effect of intellectual capital on performance. Under these conditions the ability of the accounting profession to measure and assess the performance enhancing properties of intellectual capital is challenged. This raises a number of questions. First, how far do these limitations expand and how do they impact the accounting ability to capture intellectual capital? Second, given the necessity to understand the enhancing properties that intellectual capital has for performance, how does the choice of intellectual capital measure aid this understanding? Finally, taking into consideration the previous two questions, which one of the accounting methods to measure intellectual capital is the most useful capturing this resource and model its link with performance?

1.3. Research objectives

In order to address these questions the requirements of a good measure of intellectual capital need to be established. Levy and Duffey (2007) argue that a good intellectual capital measure should: 1) be clear about the resource(s) it is measuring and 2) facilitate a clearer understanding of the performance outcomes.

With respect to the first criteria, the previous section has argued that the prevailing accounting measures of intellectual capital have some limitations inherent to their construction (Levy & Duffey, 2007). Presenting these limitations reveals that different measurement solutions have different groundings and should, subsequently, have a different ability to reflect intellectual capital (Andriessen, 2004a). However, the ability of existing accounting measurements to capture intellectual capital has not been questioned before.

Intellectual capital proxies and non-financial indicators by construction can be clearly identified with an intellectual capital element. Hence, they are clear about what resource they are measuring. However, the ability of the accounting measures of intangible value to capture this resource is less clear. They are meant to capture the overall intellectual capital value, but their efficacy in capturing specific intellectual capital elements is not known and has not been previously explored (Andriessen, 2004a; Sveiby, 2005). Given the complexities of intellectual capital, in that its elements interact to produce both more value and more intellectual capital, it is interesting to reveal whether the accounting measures of intangible value capture the intellectual capital components or their interaction. The purpose is to understand the accounting measure of intangible value focus.

In relation to the second criteria, it has been suggested that the mixed results found in the literature could be related to the analysis of different performance aspects (Firer & Williams, 2003) and/or which intellectual capital element is under analysis (de Pablos, 2004). Furthermore, the literature suggests that there could be contingency factors which could lead to differences in how intellectual capital relates to performance (Chauvin & Hirschey, 1993; Conolly & Hirschey, 2005; Pacharidis & Varsakelis, 2010). In order to determine if such explanations are plausible, empirical research should examine and compare the performance effects of all intellectual capital components' across a range of performance measures – economic, financial and market and industries. Also, there is a need to establish the net effect of the interaction between all intellectual capital elements following a similar contingency approach (Nielsen et. al., 2009).

Another concern is that to date the empirical literature has not explored the possibility that the mixed results could actually be a consequence of the choice of intellectual capital measure employed in the studies: intellectual capital proxies, accounting measures of intangible value and non-financial indicators. This raises the possibility that different measures could reveal a significantly different image about the connection between intellectual capital and performance. Previous empirical research is fragmented and hard to compare (Ittner, 2008; Veltri, 2010). Researchers have used different research designs, models and samples. Therefore, a clear comparison of dissimilar measurement models and their ability to reveal the relationship between intellectual capital and performance is very hard to achieve. A consistent and robust comparison between the various methods and their link with performance is consequently needed and will help inform us on the merit of different intellectual capital measures.

Taking into consideration the identified gaps in the literature, this thesis aims to facilitate an understanding of the mechanisms through which intellectual capital adds value to a firm. However, instead of focusing solely on analysing its relationship with performance, it begins by *“taking a step back”* and questions whether the choice of measurement and its ability to adequately capture and measure intellectual capital could be one of the reasons for the mixed results found in the literature.

In order to reach this main goal, the thesis has the following sub-objectives. First, it assesses the appropriateness of various accounting measures of intangible value to capture intellectual capital. Following on from this it then investigates whether the choice of intellectual capital measurement could be one of the factors contributing to the mixed results found in the literature.

Second, in order to pin down this effect, the thesis takes a contingency approach on the subject and analyses multiple performance aspects and industry sectors. Due to the fact that non-financial indicators are highly subjective and have limited comparability and generalizability (Caddy, 2002; Sveiby, 2005), the emphasis is going to fall on determining whether the intellectual capital proxies and the accounting measures of intangible value present a different image on the link between intellectual capital and performance. The choice to focus on intellectual capital proxies and accounting measures of intangible value is further justified by the fact that previous studies which used non-financial indicators have reported a time-consuming data collection. Also, due to the difficulty in gathering data, researchers have been forced to limit their studies to either cross-sectional or longitudinal analysis on usually relatively small samples. This leaves a large gap in panel data type of analysis, which allows the study of large samples and, consequently, allows a greater generalization of results. Further, panel methodology has been deemed more suitable for the study of intellectual capital because it can model individual heterogeneity to which this resource is prone to.

Third, the aim of the thesis is to bring together all the results into a comprehensive review of the ability of intellectual capital proxies and the accounting measures of intangible value to reflect intellectual capital and link this resource to performance. The objective is to establish the most appropriate accounting method for measuring intellectual capital and make recommendations regarding the context in which the use of these methods can render favourable outcomes.

While multiple disciplines have made efforts to quantify intellectual capital and explain how it adds value in an organization (Petty & Guthrie, 2000; Marr, 2005), accounting and strategic management have been the most prolific disciplines in this area of research. Grojer (2001: p.695) states that accounting has become "*the art of background design*" to quantify intellectual capital as all the disciplines rely on accounting information as a basis for evaluating intellectual capital. However, in contrast with other disciplines, strategic management has developed its own perspective on capturing the value of intellectual capital. Furthermore, some researchers argue that interdisciplinary research between accounting and strategic management has benefits for the study of intellectual capital (Tayles & Ma, 2009), as it brings together two complementary perspectives (Spender et. al., 2013).

For this reason, this thesis takes an interdisciplinary approach between accounting and strategic management and examines how the accounting solutions for the measurement of intellectual capital could be further improved by learning from strategic management. That is not to say that strategic management measures are exempt from limitations, but rather that accounting can further improve the measurement of intellectual capital by taking into consideration the strategic management stance on the subject.

Therefore, the final aim of the thesis is to pull together a rather scattered and highly fragmented literature from accounting and strategic management disciplines with the goal of exploring how intellectual capital measurement can be further improved by taking an interdisciplinary approach.

1.4. Research design

The empirical investigation is divided into three standalone chapters which employ a panel data methodology based on the same sample of UK listed companies operating in low and high technology industry sectors over the period 2001 to 2011. The first empirical chapter of the thesis aims at establishing how efficient the different accounting measures of intangible value are at capturing intellectual capital. It aims to determine which elements of intellectual capital are captured by these measures. The analysis investigates how individual intellectual capital elements are captured by the accounting measures as well as possible interactions between these individual components. The chapter analyses the most used and cited accounting measures of intangible value: Market-to–book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index.

The second empirical chapter looks into how the individual intellectual capital components – human capital, structural capital and relational capital - as depicted by intellectual capital proxies, are associated with performance, in order to determine which component is more important in creating value. It also investigates if the intellectual capital elements are associated in the same manner with different measures of performance and whether the findings are contingent on the industry sector under analysis. The thesis focuses on the economic, financial and market dimensions of performance. Furthermore, it examines the effect on performance of combinations of different types of intellectual capital in order to determine the net effect of intellectual capital elements on performance.

The final empirical chapter looks into how the accounting measures of intangible value model the link between intellectual capital and performance. This chapter revisits the second empirical chapter in the sense that it addresses similar question. However, it expands the previous research by capturing the value of intellectual capital through the accounting measures of intangible value. It will allow not only a comparison between the ability of various accounting measures of intangible value to predict performance, which has not been previously done; but it will also aid the comparison with the intellectual capital proxies. As such, this last chapter will complete the investigation into the accounting discipline ability to capture intellectual capital, which maps a full range of intellectual capital measures.

1.5. Contributions

By reaching the planned research objectives this thesis contributes to the existent literature as follows. From a theoretical point of view, the thesis contributes to the literature by taking an interdisciplinary perspective on intellectual capital, despite its emphasis falling on the accounting discipline. It brings together theories and empirical research from accounting and strategic management and explains how an interdisciplinary approach may improve the understanding of intellectual capital, intellectual capital measurement and its link with different types of performance. By doing so it gives a balanced assessment of what the accounting profession does well and what it does not, as well as highlighting what can be learnt from the strategic management discipline regarding intellectual capital.

Taking a step back from the existing literature, the thesis offers insights into the ability of different accounting measures of intangible value to reflect intellectual capital. To the author's best knowledge, to date there has not been any direct enquiry into this topic. The various accounting measures of intangible value have been criticized at a theoretical level without much empirical proof regarding their efficacy of capturing all the components of intellectual capital.

The thesis is an exhaustive mapping process of the accounting discipline's ability to capture intellectual capital which takes into consideration multiple accounting measures, multiple performance aspects and various contingency factors (industry sector, knowledge profile) that could influence the relation between intellectual capital and performance. Earlier research has been limited to analysing only one measurement method; it has been fragmented and lacks comparability (Ittner, 2008; Veltri, 2010). By providing a better understanding of the accounting measures of intellectual capital and the way they model the link between intellectual capital and organisational performance, this thesis hopes to inform future research which aims at connecting intellectual capital with various aspects of performance.

From a methodological point of view, by focusing on publicly available accounting data this thesis is able to provide more breadth to the study of intellectual capital, because it allows for a comparison between distinct companies across time. Most of the previous research due to the nature of the data (company specific non-financial indicators) has been limited to cross-sectional and longitudinal studies. While this type of research offers more depth to the study of intellectual capital, they are limited in their generalizability. Therefore, there is a trade-off between breadth and comparability on the one hand, and depth and contextualization on the other. This study tries to balance this trade-off by making use of a panel data methodology for the study of intellectual capital. Such an approach is deemed more effective for the study of intellectual capital than longitudinal and cross-sectional studies because it is taking into consideration individual heterogeneity and long term effects (Pindado et. al., 2005).

Finally, intellectual capital research has focused on emerging countries, which have relied on intellectual capital and knowledge resources for the recent development of their economies, such as Taiwan, Malaysia and Indonesia (Dumay,2014). This leaves a large research gap regarding more developed countries like UK or US which have a complex economy developed in multiple sectors, but for which knowledge and intellectual capital resources are equally as important. For this reason, this study is going to analyse a panel data of UK listed companies belonging to multiple industry sectors.

1.6. Thesis structure

The last section of this chapter explains the structure of the thesis. The broad research interests of this thesis are intellectual capital, its measurement and its relation to performance. Nonetheless, before proceeding to intellectual capital research, one needs to establish what intellectual capital represents. Due to its complexity, intangibility and importance for the companies' activities, this resource has been named and defined in various manners. **Chapter 2** provides an overview of the existent intellectual capital definitions. It aims at showing intellectual capital's evolution as a research object, highlighting its dimensions and presenting its characteristics. Based on the definitions reviewed, Chapter 2 clearly conceptualizes intellectual capital and offers a refined, holistic and comprehensive definition to stand reference for the rest of the thesis.

Based on the definition derived in the previous chapter, **Chapter 3** describes how the accounting and strategic management disciplines have shaped the concept of intellectual capital by presenting the current theories in these disciplines. The chapter gives an assessment of how well these theories conceptualize intellectual capital and explores the advantages and disadvantages of an interdisciplinary approach to intellectual capital between accounting and strategic management. The purpose of this chapter is to identify the gaps in the theory regarding intellectual capital measurement and its influence on performance.

While Chapter 3 identifies the gaps in the accounting and strategic management theories regarding intellectual capital**, Chapter 4** focuses on explaining the empirical work led by these disciplines. Within the accounting and strategic management disciplines the thesis has identified two streams of empirical research: intangible value performance studies and organizational performance studies. Both streams of research are reviewed separately in order to identify the gaps of the empirical literature on intellectual capital.

Building on the gaps in the theory identified in Chapter 3 and the gaps of the empirical research identified in Chapter 4, **Chapter 5** formulates the research questions of the current thesis which are analysed in the following empirical chapters. Before proceeding with the empirical analysis, **Chapter 6** gives an overview of the methodology employed in two parts. First, the variables and measures employed in this study are presented. Second, the research design is described and a detailed justification for the choice of methodology used in the three empirical chapters is provided. **Chapter 7** describes the data collection procedures and provides an overview of the core data sample used in this thesis. It presents basic descriptive statistics of the variables employed in the study in order to frame the context to the following empirical analysis.

The empirical analysis in the thesis is divided in three standalone empirical chapters (Chapter 8 to Chapter 10), which draw on the same data-set and methodology with the objective to triangulate the three comparable empirical chapters**. Chapter 8** empirically analyses the ability of accounting measures of intangible value to capture separate intellectual capital elements and the interaction of these elements across low and high knowledge intensive industry sectors. It compares and contrasts the analysed accounting measures of intangible value (Market-to-book, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index) in order to establish their similarities and differences in capturing intellectual capital.

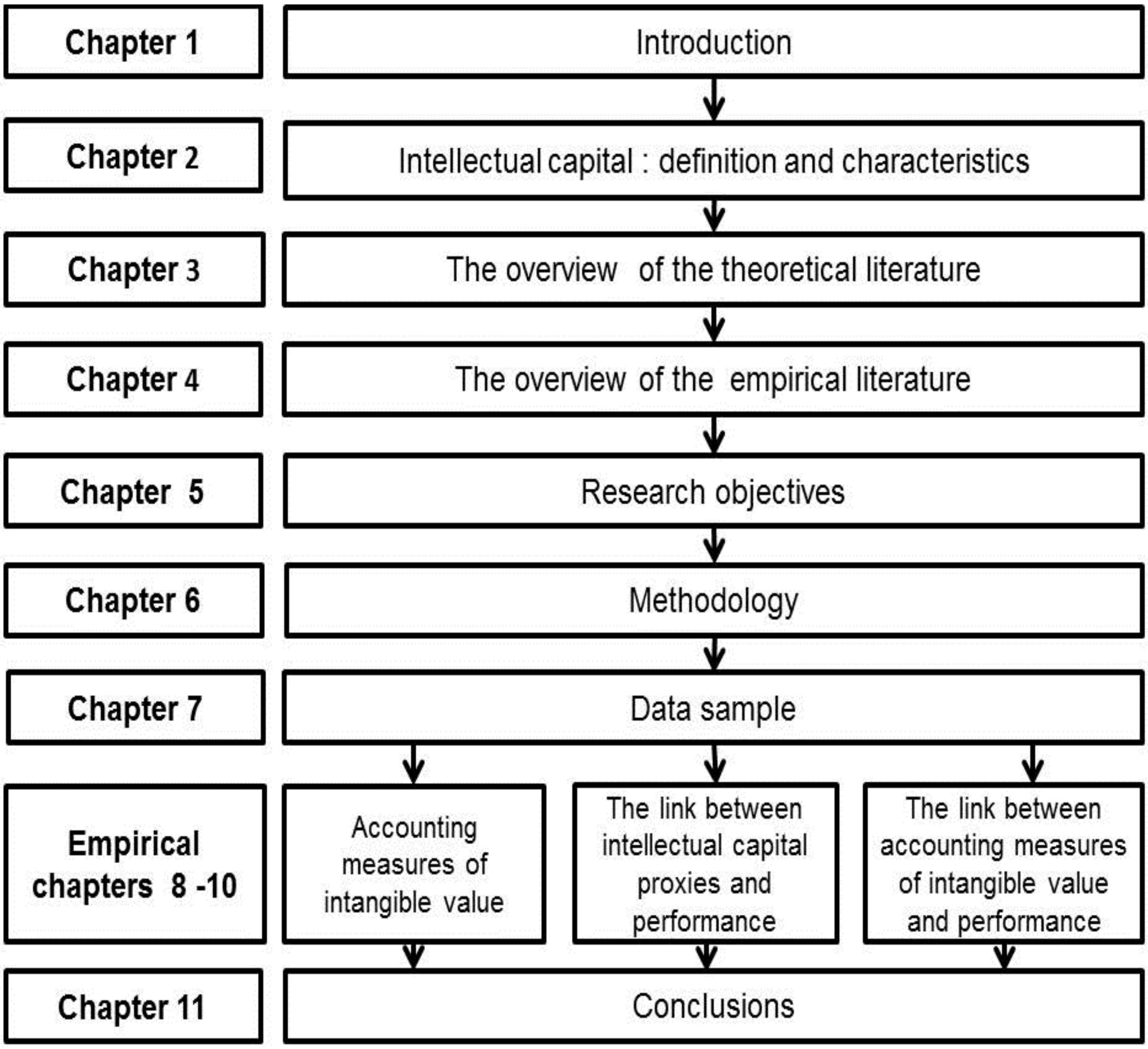
Chapter 9 takes a contingency approach to the relationship between intellectual capital and firm performance by considering multiple industry sectors and aspects of firm performance. Specifically, this chapter examines how intellectual capital elements influence the economic, financial and market performance of a company as depicted by intellectual capital proxies. It aims at establishing whether the intellectual capital elements have the same behaviour in influencing multiple aspects of performance across different industry sectors.

The goal of **Chapter 10** reflects on research questions posed in Chapter 9. Nonetheless, it observes the image presented by the accounting measures of intangible value regarding the link between intellectual capital and performance.

Similarly to Chapter 8, this chapter explores similarities and differences between the links of these measures with economic, financial and market performance. It compares and contrasts multiple accounting measures of intangible value connection with multiple aspects of performance across various industry sectors to form an exhaustive image about these measures mechanisms and usefulness.

The final chapter (**Chapter 11)** summarizes the key findings derived in the empirical chapters, triangulates the result and concludes on the main objectives of the thesis. Furthermore, it emphasizes the importance of the findings and discusses their implications. Finally, the chapter suggests directions for further research and discusses limitations of the thesis. The structure of the thesis is graphically summarized in Figure 1-1 below.

Figure 1-1 Thesis Structure



2. Intellectual capital: definition and characteristics

The increased importance of intellectual capital to organizational wellbeing and the economy at large has led both researchers and practitioners to try to explain and define this key resource of the knowledge economy. As a result, a plethora of definitions and perspectives on intellectual capital, which use multiple synonymous taxonomies, have been formulated in the literature (Nazari & Herremans, 2007; Choong, 2008).

In the accounting discipline, for example, intellectual capital has been termed as intangible asset (Sveiby, 1997), goodwill (Luthy, 1998), immaterial asset (Edvinsson & Malone,1997) or human assets (Andriessen & Tiessen, 2000). At the same time, the strategic management discipline refers to intellectual capital as strategic-firm resources (Barney, 1986), invisible assets (Itami, 1987), strategic firm-specific assets (Dierickx & Cool, 1989), intangible assets (Hall, 1993), core competencies (Prahalad & Hamel, 1990; Kaplan & Norton,1992), firm capabilities (Nohria & Eccles, 1991), knowledge assets (Teece, 1998), knowledge-based resources (Wiklund & Shepherd, 2003), or dynamic capabilities (Teece et.al., 1997). Despite this, the term intellectual capital has become established as the preferred *"catch-all"* phrase to capture this range of definitions and terminology (Gowthorpe, 2009).

A generally accepted definition of intellectual capital (IC) is yet to be found, despite the efforts of researchers to come to an agreement (Blair & Wallman, 2001). Recent theoretical developments within the field of intellectual capital are limited (Dumay, 2009; Dumay & Garanina, 2013) reinforcing the debate about the *"correct"* definition of intellectual capital. Furthermore, empirical studies treat IC as a clearly conceptualized term and seldom specify what perspective they are taking on the subject (Andriessen, 2004a).Consequently, it is unsurprising that the field is considered not to have evolved from its state of art (Spender, 2011). Differences between researchers' and practitioners' understanding still exist and the dominant debate at scholarly conferences revolves around what we mean by intellectual capital.

The message that all the models, frameworks, discussions and literature appear to convey is that "*IC is interesting, IC is complex and complicated and needs to be understood better*" (Dumay, 2009).Therefore, before looking at the performance effects of IC a necessary starting point is to develop a clearer understanding of intellectual capital, its characteristics and its evolution as a concept. For example, many empirical papers start with a review of the definitions of intellectual capital aiming to clarify the unit of analysis in the study. However, few explain what are the latest developments in our understanding of intellectual capital, what dimensions of intellectual capital are highlighted and what characteristics of intellectual capital can be derived from the definitions reviewed (Dumay & Garanina, 2013). Furthermore, they rarely explain the perspective they are taking on intellectual capital and how this perspective feeds into their analysis.

As a first attempt in the field, this chapter takes into account the multitude of intellectual capital definitions and divides them into categories which can aid a better understanding of intellectual capital dimensions. The aim is to frame the concept of intellectual capital and formulate a clear overarching intellectual capital definition to form the foundation of the thesis. Another objective is to derive the intellectual capital characteristics highlighted by these definitions which form the building blocks of the conceptualization suggested for this term. The next section will proceed to review the existent definitions and categorize them in an insightful manner for highlighting the intellectual capital dimensions.

2.1. Review of Intellectual capital definitions

In the early 1990s, Kaplan and Norton (1992) were developing the Balanced Scorecard, drawing attention to sources of value which do not have a financial angle. The idea that there is a non-financial internal asset which allows companies to attain high levels of performance had been promoted previously by authors such as Penrose (1959), Hermanson (1964), Flamholtz (1973) and Barney (1986), but did not receive too much attention from researchers. However, soon after the development of the Balanced Scorecard, the desire to improve the understanding of a firm’s value drivers and manage them better (Petty & Guthrie, 2000), led the Swedish company Skandia to appoint Lief Edvinsson as the first director of intellectual capital. A year later Skandia published the first intellectual capital report, marking the beginning of rich period of research into intellectual capital.

The wide array of studies across different disciplines resulted in a high number of intellectual capital definitions and terminologies. In appearance, these terminologies and their associated definitions have little in common with one another (Blair & Wallman, 2001; Andriessen, 2004b). However, a thorough examination of the wide array of terminologies and definitions reveals that various perspectives on intellectual capital can highlight different dimensions of a complex term. According to the intellectual capital dimensions identified, this thesis suggests that the definitions can be categorized in the following groups:

1. **Process definitions** which identify intellectual capital as a part of the production process,
2. **Knowledge definitions** which highlight the knowledge component of intellectual capital,
3. **Non-accounting definitions** which differentiate intellectual capital from the accounting concept of intangible assets,
4. **Classification models** which divide intellectual capital into individual elements and separately define each of them.

To the author's knowledge, to date there has not been any other attempt to classify the definitions of intellectual capital in an insightful manner which organizes the fragmented literature in order to ground the current understanding of intellectual capital. To support the suggested categorization, a complete list of the reviewed definitions in chronological and alphabetical order is provided in Table 2-1.The rest of this section will describe each category of definitions enumerated and present the information they reveal about intellectual capital.

2.1.1. Process definitions

The shift from a production era to a knowledge era marked the appearance of concepts related to intellectual capital. Researchers noticed that there is another factor of production involved in the value creation process together with land, capital and labour (Drucker, 1993; Nonaka & Takeuchi, 1995). In line with this advancement, **process definitions** focus on intellectual capital's ability to represent the new factor of production in the knowledge economy. For example, Smith (1994) states that intellectual capital (IC) represents "*all the elements of a business enterprise that exist in addition to working capital and tangible assets…that make the business work*". Following Smith's (1994) definition, Viedma (2001) sees intellectual capital as the "*company's core competencies, the key resources at its disposal*". Holistically, intellectual capital represents "*the combined intangible assets, which enable the company to function*" (Brooking, 1996). Building on the idea of a new factor of production and adding that the traditional factors of production are not able to yield above average returns (Lev et. al. , 2009), intellectual capital has been defined as the "*value driver that transforms productive resources into value-added assets*" (Hall, 1992; p. 136).

Table 2-1 Intellectual capital definitions

Authors	Definition	Stream
Itami (1991)	"Intangible assets are invisible assets that include a wide range of activities such as technology, consumer trust, brand image, corporate culture and management skills"	Classification models
Hall (1992,p.136)	"Intangible assets are value drivers that transform productive resources into value-added assets "	Process definition
Hudson (1993)	"a personal asset of individuals, a combination of genetic inheritance, education, experience, and attitude about life and business”	Knowledge definition
Smith (1994)	"Intangible assets are all the elements of a business enterprise that exist in addition to working capital and tangible assets. They are the elements, after working capital and tangible assets, hat make the business work and are often the primary contributors to the earning power of enterprise. Their existence is dependent on the presence, or expectation, of earnings"	Process definition
Brooking (1996, p.13)	"the combined intangible assets, which enable the company to function"	Process definition
Edvinsson (1997, p.372)	"IC of a firm is its possession of knowledge, applied experience, organizational technology, customer relationships and professional skill that provides it with a competitive edge in the market"	Knowledge definition Classification models
Edvinsson and Malone (1997,p.22)	"Intangible assets are those that have no physical existence but are still of value to the company" “knowledge that can be converted into value”	Non-accounting definition Knowledge definition
Roos et.al. (1997)	"includes all the processes and the assets which are not normally shown on the balance sheet and all the intangible assets which modern accounting methods consider…it includes the sum of the knowledge of its members and the practical translation of his/her knowledge"	Non-accounting definition
Roos and Roos (1997, p.415)	"Intellectual capital is the sum of the "hidden" assets of the company not fully captured on the balance sheet, and thus includes both what the heads of organizational members and what is left in the company when they leave."	Non-accounting definition
Sveiby(1997, p.10)	"IC has three dimensions (employee competence, internal structure and external structure)"	Classification models
Wiig (1997)	"Assets created through intellectual activities ranging from acquiring new knowledge (learning) and inventions to creating valuable relationships"	Knowledge definition
Bontis (1998)	"IC possesses intellectual attributes that can contribute value of a firm"	Process definition
Luthy (1998)	"something that is knowledge based, captured in an identifiable form, and useful in organizations"	Knowledge definition
Nahapiet and Ghoshal (1998, p.245)	"knowledge and knowing capability of a social collectivity, such as an organization, intellectual community or professional practice"	Knowledge definition

Stewart (1997,p XI)	"IC packaged useful knowledge" "IC is intellectual material - knowledge, information, intellectual property, experience - that can be put to use to create wealth - collective brainpower"	Knowledge definition
Bontis et.al (1999, p.397)	"IC is quite simply the collection of intangible resources and their flows. Intangible resources is any factor that contributes to the value generating processes of the company"	Process definition
Gransstrand (1999)	"IP is property directly related to the creativity ,knowledge and the identity of an individual"	Knowledge definition
Olve et.al (1999)	"an element of the company's market value as well as a market premium"	Non-accounting definition
Brennan and Connell (2000, p.1)	"Knowledge-based equity of a company"	Knowledge definition
Canibano et.al. (2000)	"identifiable (separable) non-monetary sources of probable future economic benefits to an entity that lack physical substance, have been acquired or developed internally from identifiable costs, have a finite life, have market value apart from the entity, and are owned or controlled by the firm as a result of past transactions or events"	Non-accounting definition
Harrison and Sullivan (2000, p.34)	"Knowledge that can be converted into profit"	Knowledge definition
Petty and Guthrie (2000, p.158)	"IC are indicative of the economic value of two categories (organization and human capital) of the intangible assets in a company"	Classification models
Sullivan (2000, p.228)	"IC is knowledge that can be converted into profit"	Knowledge definition
Heisig et. al. (2001, p.60)	"IC is valuable, yet invisible"	Non-accounting definition
Kriegbaum (2001)	"Physical not embodied financial goods. Their nature is not monetary, and they are an economic advantage for the company"	Non-accounting definition
Lev (2001, p.5)	"An intangible asset is a claim to future benefits that does not have a physical or financial (a stock or a bond) embodiment"	Non-accounting definition
Gu and Lev (2001, p.14)	"Intangibles are defined by their value drivers (R&D, advertising, IT, capital expenditures and human resources practices)"	Classification models
FASB NN (2001, p.6)	"Intangible assets are non-current, non-financial claims to future benefits that lacks a physical or financial term"	Non-accounting definition
Viedma Marti (2001, p.151)	"company’s core competencies, the key resources at its disposal"	Process definition
Daum (2002)	"Intangibles are characterized by a set of attributes, and they can bring in economic benefits rather quickly, and they often show network effects .Considers intangible assets to include human capital, R&D ,advertising and knowledge"	Process definition

Funk (2003)	"Intangibles relate to management creditability, innovativeness, brand identity, ability to attract talents, research leadership , social and environmental responsibility"	Knowledge definition
de Pablos (2003, p.63)	"A broad definition of intellectual capital states that it is the difference between the company's market value and its book value. Knowledge based resources that contribute to the sustained competitive advantage of the firm "	Knowledge definition
Rostogi (2003, p.230)	"IC may properly be viewed as the holistic meta-level capability of an enterprise to co-ordinate, orchestrate, and deploy its knowledge resources towards creating value in pursuit of its future vision"	Knowledge definition Process definition
Andriessen (2004b, p. 70)	"non-monetary resources without physical substance that in combination are able to produce future benefits for the company"	Non-accounting definition Process definition
Chen et. Al.(2004, pp.195)	"From a strategic perspective, IC is used to create and enhance the organizational value, and success requires IC and the ability to manage this scarce resource controlled by a company. From another point of view, IC measurement focuses on constructing an effective measurement model, in which financial and non-financial indices are combined together to reflect thoroughly a company's operations under the influence of knowledge economy and to offer more accurate information for knowledge management. "	Process definition Knowledge definition
Ernst&Young (2004)	“intellectual material that has been formalised, captured and leveraged to produce a higher-valued asset”	Knowledge definition
Mouritsen et.al (2004. p.48)	"IC mobilises things such as employees, customers, IT, managerial work and knowledge. IC cannot stand by itself as it is merely provides a mechanism that allows various assets to be bonded together in the productive process of the firm"	Process definition
Roos et.al.(2005)	"all non-monetary and non-physical resources that are fully or partly controlled by the organization and that contribute to the organization’s value creation"	Non-accounting definition Process definition
Deifenbach (2006, p.409)	"An intangible resource is everything of immaterial existence, which is used potentially usable for whatever purpose, which is renewable after use, and which not only decreases, but can remain or increase in quantity and/or quality while being used"	Non-accounting definition
Montequin et. al (2006)	"intangible assets are those assets that can have great value for an organization, generating competitive advantage in the future, but which typically have no physical presence and have traditionally not been recognized from a financial perspective"	Non-accounting definition
Nazari and Herremans (2007)	"intellectual material (which) if formalized and utilized effectively, it can create wealth by producing a higher value asset"	Knowledge definition

IC is able to add value to a business because it "*provides it with competitive edge in the market*" (Edvinsson, 1997: p. 372). Other authors emphasize that intellectual capital is not able to create value-added by itself, instead it "*is merely providing a mechanism that allows various assets to be bonded together in the productive process of the firm"* (Mouritsen, 2004) and "*they often show network effects*" (Daum,2002).

Therefore, the process definitions shaped intellectual capital as the key organizational resource, which brings value to a company by bonding into the production process all the other assets of the firm. Due to the fact that traditional production factors are not able to generate abnormal returns anymore, intellectual capital is identified by this stream of definitions to represent a company's competitive advantage.

2.1.2. Knowledge definitions

The previous category of intellectual capital definitions recognize the fact that this resource is the new factor of production and label it the key value driver, but they don't identify exactly what organizational resources represent intellectual capital. To address this issue, researchers have formulated identification criteria to indicate which organizational resources can represent intellectual capital. **Knowledge definitions** tie down intellectual capital to knowledge as an identification criterion. Edvinsson and Malone (1997) argue that only resources which have a knowledge component and produce value for the company can be classified as intellectual capital. According to them, intellectual capital is "*knowledge that can be converted into value*" (Edvinsson & Malone,1997). For Stewart (1997) IC is "*packaged useful knowledge*". Luthy (1998) narrows down Stewart's broad definition and adds a usefulness identification criterion. Intellectual capital, according to him, is "*something that is knowledge based, captured in an identifiable form, and useful in organizations*". Summarizing the aforementioned definitions, Ernst & Young (cited by Wall et. al., 2004) view intellectual capital as "*intellectual material that has been formalised, captured and leveraged to produce a higher-valued asset"*.

Instead of bringing clarification to what intellectual capital represents, definitions from the second stream managed to bring more confusion. They advocate "*knowledge*" is a prerequisite for organizational resources to represent intellectual capital and inevitably fell into the trap of having to provide philosophical explanations and take epistemological stances (Roos & Roos, 1997). Questions such as "*what is knowledge?*", "*what do we mean by knowing*?" and "*how is knowledge developed*?"

which have, for a long time, represented key concerns in philosophy, have been transferred to the understanding of intellectual capital.

Another challenging aspect of associating intellectual capital with knowledge is identifying at what level is it localized: individual or organizational? Some authors believe that knowledge is individual and, consequently, belongs to people. Hudson (1993) presents IC as "*a personal asset of individuals, a combination of genetic inheritance, education, experience, and attitude about life and business*". In contrast, Nahapiet and Ghoshal (1998) believe that intellectual capital is a term which should be defined at the organizational level and characterize it as "*knowledge and knowing capability of a social collective, such as an organization, intellectual community, or professional practice*". Edvinsson (1997) brings together the two levels of analysis and add another one: the relationships the organization establishes with its clients. Intellectual capital for him represents *"knowledge, applied experience, organizational technology, professional abilities and the relationship with the clients that provide the company with a competitive niche on the market".* Therefore, companies are the repository of individual knowledge which should be concerned with integrating this knowledge into organizational routines (Mourtisen et. al., 2001). Consequently, intellectual capital "*should not be person centred, but centred on collective processes and procedures"* (Mourtisen et. al., 2001).

The knowledge definitions identify "*knowledge*" as the essential prerequisite for an organizational resource to represent intellectual capital. As such, these definitions reduce the area of organizational resources which can add value to an organization and represent its competitive advantage. The association between intellectual capital and knowledge led researchers to make a clear distinction between individual knowledge and organizational knowledge, but also find a connection between the two in order to define intellectual capital. Consequently, intellectual capital represents individual knowledge which has been transformed into organizational routines and processes.

2.1.3. Non-accounting definitions

The knowledge component of intellectual capital emphasizes the immateriality (intangibility) of this resource. Intellectual capital is the *"invisible assets that include a wide range of activities"* (Itami, 1991) or a resource which is *"valuable, yet invisible*" (Heisig et. al., 2001). If intellectual capital is an immaterial resource, then it needs to be captured in order to be able to say something useful about it (Dumay, 2009; Spender et. al., 2013). Nazari and Herremans (2007) highlight the need to capture intellectual capital when studying how it produces value-added inside an organization by building their study on the following definition "*intellectual capital is intellectual material (which) if formalized and utilized effectively, it can create wealth by producing a higher value asset*".

The need to capture intellectual capital became more apparent after the "*dot com*" bubble which revealed that the total value of intellectual capital was not shown in financial statements (Lev, 2004) and that intellectual capital was still an abstract notion with unarticulated means to estimate its value. In order to emphasize that the value of intellectual capital is not reflected in the financial statements, definitions started to distinguish intellectual capital from intangible assets creating a set of **non-accounting definitions**. For example, Kreigbaum (2001) describes intellectual capital as "*not embodied financial goods. Their nature is not monetary, and they are an economic advantage for the company*". Andriessen (2004b) believes that intellectual capital resources represent "*nonmonetary resources without physical substance that in combination are able to produce future benefits for the company*". Funk (2003) defined intellectual capital by enumerating resources which are different from the accounting intangible assets:"*Intangibles which relate to management creditability, innovativeness, brand identity, ability to attract talents, research leadership, social and environmental responsibility*".

The non-accounting definitions expose the need to reduce the level of ambiguity in the conceptualization of intellectual capital and, by comparing it with the accounting terminology of intangible assets they emphasize the need to measure and capture intellectual capital in the same manner as traditional accounting assets.

2.1.4. Classification models

The definitions discussed previously describe intellectual capital as the new factor of production capable of deriving competitive advantage due to its knowledge component but only if it is leveraged and formalized. These definitions highlight that if intellectual capital is the key value driving resource at a company's disposal, managers need to be able to identify and measure it in order to achieve high levels of performance. One cannot manage what cannot be described (Andriessen, 2004b; Spender & Marr, 2006). While helpful in defining intellectual capital broadly, previous definitions have been considered by researchers too abstract, hindering the possibility to address practical issues regarding intellectual capital (Choong, 2008). Consequently, a number of authors have tried to address this concern by defining, classifying and categorizing intellectual capital components (Youndt et. al., 2004). They developed the so called **classification models**.

The first classification model was the Balanced Scorecard developed by Kaplan and Norton (1992). This model was not developed to specifically define intellectual capital components, but rather to identify non-financial sources of value inside a company. Its purpose was to provide a description of the value-creation process that links both tangible (financial) and intangible assets. Nevertheless, future models have built on the Balanced Scorecard division of intangible assets into **Customer**, **Internal Business** and **Innovation and Learning,** and presented them as intellectual capital elements.

The **Customer perspective** refers to the way the company is performing for its customer related to issues such as time, quality, product and costs. It is what the company does to "*differentiate itself from competitors to attract, retain and deepen the relationship with its customers*" (Kaplan & Norton, 2001: p.93). The **Internal Business Perspective** represents the company's efforts to internally meet its customer's expectations. It is the company's capacity to improve the supply-chain management, internal processes, asset utilization, resource-capacity management and other processes. The **Innovation and Learning Perspective** is "*the company's ability to innovate, improve and learn ties directly to the company's value*" (Kaplan & Norton, 1992: p. 76).

The Balanced Scorecard was the first step towards intellectual capital identification and measurement from a managerial perspective (Luthy, 1998). From an accounting perspective, the first attempt to define intellectual capital component by component was made by Anne Brooking (1996). She developed a similar classification model called the Technology Broker, which categorizes intellectual capital into: **market assets, human centered assets, intellectual property and infrastructure assets.** **Market assets** represent the competitive potential that one organization has due to the loyalty of its customers, its brands, distribution channels, contracts and publicity. **Human centered assets** are the experience, the creativity, the leadership abilities, the entrepreneurship abilities and the managerial abilities that the employees possess. **Infrastructure assets** represent the technology, the procedures, the corporate governance, hedging activities, case studies and the communication systems that a company develops as a way to organize its activity. **Intellectual property** is the know-how, business secrets, trademark products, licenses, brevets and patents. Interestingly, Anne Brooking (1996) includes know-how and business related resources into intellectual property, although they are not legally protected (Andriessen, 2004b).

The purpose of the Technology Broker model is to serve as an auditing tool of a company's intellectual capital. For this reason, Brooking (1996) uses *"asset"* terminology and puts an emphasis on those intellectual capital components which are easily identifiable and can have a monetary quantification, such as infrastructure assets and intellectual property (Alcaniz et. al, 2010). Compared to the Balanced Scorecard, the Technology Broker makes an important development in emphasizing the importance of employees as value drivers in the knowledge economy by introducing human centred assets as an intellectual capital element. However, the model does not consider human resources to be the most important factor in the value chain, instead this role is attributed to intellectual property and infrastructure.

Edvinsson (1997) groups intellectual capital elements for the Skandia Navigator model into **human capital** and **structural capital**. **Human capital** represents employees' knowledge, experience and abilities. **Structural capital** is simply defined as "*what is left behind when the staff went home*" (Edvinsson, 1997: p. 368). The importance of these elements is underlined in the proposed hierarchical structure of intellectual capital. Structural capital is divided into **customer capital** and **organizational capital,** where the latter can be further divided into **innovation capital** and **process capital**. Innovation capital in turn comprises of **intellectual property** and **intangible assets**. Human capital is a standalone element. Consequently, structural capital is considered to be more important than human capital in a similar way to the Technology Broker model developed by Anne Brooking (1996).

Compared to previous models, Skandia Navigator extends beyond the division of intellectual capital into components. It explains how these components are interrelated by using a house metaphor to group **operating environment**, **renewal and development (innovation), customer, process, human and financial focus** into a value-creation process. Edvinsson (1997) describes this process in the following way:

"The financial focus is the roof. The customer focus and process focus are the walls. The human focus is the soul of the house. The renewal and development is the platform." (Edvinsson, 1997: p. 371).

Moreover, Edvinsson (1997) adds a time dimension to the Skandia Navigator in order to highlight the fact that non-financial aspects of the company are future oriented and reveal a company's growth opportunities while the financial side is past oriented and consequently reveals past performance. Also, Skandia places more importance on the renewal and development and operating environment as the key value drivers and recognizes the fact that customers are not the only stakeholders that influence company's activities.

The same simple division of intellectual capital into structural capital and human capital is taken by Stewart (1997) and Roos et. al. (1997). Their purpose though is to differentiate between thinking resources (human capital) and non-thinking ones (structural capital). From their perspective, using this criterion for dividing intellectual capital into components clearly shows that these elements need different types of management in order to create value. In a similar vein, Roslender and Fincham (2004) and Hussi and Ahonen (2002) differentiate between primary intellectual capital, which they view as the most important intangibles, and secondary intellectual capital, which are those intangibles created by putting primary intellectual capital to work (Alcaniz et. al., 2011).

Sveiby (1997) uses a different classification criterion to point out that not all intellectual capital components belong to the organization; some of them are internal, while others are external. However, in contrast to previous models, he considers that competences of people to be the key value drivers, because it is the employees' ability to bring together the external and internal resources into a unique mix which creates value for the company. Accordingly, Sveiby (1997) divides intellectual capital into: **external structure**, **internal structure** and **people competences**. In Sveiby's view, the **internal structure** consists of patents, concepts, models, databases, computer systems or administrative systems which are created by the employees. He adds to these the informal and internal networks which he names *"culture"* or *"spirit"* (Sveiby, 1997). The **external structure** represents the relationships with customers and suppliers, brand names, trademarks and reputation. The external structure can be seen as the image of the company. It usually depends on the stakeholders' view and rarely belongs to the company itself (Sveiby, 1997). The competencies of employees have the same conceptualization as the previous human resources/capital perspectives. The Internal Assets Monitor developed by Sveiby (1997) to classify IC also differentiates between intellectual capital elements which determine the stability, efficiency and growth of the company. This categorization contradicts previous definitions as it prescribes that intellectual capital can refer to intangibles which besides growth also enforce stability and efficiency.

In contrast, the Intellectual Capital Benchmarking System (Viedma-Marti, 2001) builds on the ability of intellectual capital to determine growth and classifies it into: intangible products/services, architecture, alliances, competitive advantages, innovation, core competencies, culture and leadership. According to Viedma-Marti (2001), these intellectual capital components can be grouped into three intellectual capital classes: **human capital, structural capital** and **relational capital**. **Human capital** represents the force behind the human intellect and innovation of the firm. **Structural capital** is the firm’s ability to use human capital to create value. **Relational capital** is the ability of the firm to positively interact with business community members to stimulate the potential for wealth creation by enhancing human and structural capital. Viedma-Marti (2001) prefers relational capital terminology to a customer capital one because relational capital includes relationships with other third parties rather than just a company’s customers.

Lev (2001) calls intellectual capital components “*nexuses of intangibles*” and uses value generating activities rather than competitive advantage areas as classification criteria. Thus, intellectual capital comprises of **discovery, organizational practices and human resources**. The **discovery assets** refer to the innovation efforts of a company, the **organizational practices** represent the internal processes, while the **human resources** is the value of the unique personnel and the compensation policies such as investment in training or incentive-based compensation. This is the first classification model which actually tries to clearly evaluate human resources by associating them with the compensation that is given to the employees in different forms, ranging from wages to training opportunities.

Following the same logic, Chen et. al. (2004) divide intellectual capital into **human capital, structural capital, innovation capital** and **customer capital**. **Human capital** refers to the employees’ knowledge, skills, capability and attitudes in relation to fostering performances which customers are willing to pay for and the company’s profit comes from. **Structural capital** deals with the mechanism and the structure of an enterprise that can help support employees in their quest for optimum performance. **Innovation capital** is not an element of structural capital as in previous conceptualizations, but it is a standalone element which represents a company’s ability to innovate. **Customer capital** acts as a bridge between the other intellectual capital elements and it is the primary focus of a business.

Andreou et. al. (2007) empirically derive an intellectual capital classification. Their approach is that intellectual capital components are the result of the interaction between organizational value drivers and strategic objectives. Following this process of intellectual capital components formation they identify the following intellectual capital components: **market capital**, **human capital**, **decision effectiveness**, **organizational capital** (technology and process capital) and **innovation and customer capital**. These constructs were validated through a structural equation methodology on data obtained from interviewing 27 participants across different job levels. Their model is particularly interesting because it reveals that in practice not only does intellectual capital need to be managed but also the management process depicted by decision effectiveness is perceived as an intellectual capital element. As a result, Andreou et. al’s (2007) model implies that not only does intellectual capital represent the stock of resources which contribute to value creation process, but also the flow of knowledge described by management processes and mechanism, such as decision effectiveness.

Previously described classification models have only taken a static perspective, (Kianto et. al., 2014). As such, they consider intellectual capital a stock of knowledge flows accumulated at one moment in time (Bontis, 1998). This perspective is widely shared by researchers who make a clear distinction between intellectual capital and knowledge management activities (Heisig, 2010).

Many other classification models have been developed in the literature. In fact there are so many that some researchers started to doubt the usefulness of defining intellectual capital component by component (Dumay, 2009). One of the arguments made is that the apparent disagreement between authors brought confusion about how many components intellectual capital has and what each of these components comprises of (Youndt et. al., 2004).

Nevertheless, others have argued that the classification models differ only in appearance. Differences stem from the use of different terminologies for the same aspects of intellectual capital (Bontis, 2001). For example, Brooking's infrastructure assets component is very similar with Stewart's structural capital and Sveiby's internal structure. Also, the renewal and development perspective in Edvinsson's model is similar to Kaplan and Norton's learning and growth. Besides this, authors use different terminology in order to highlight the perspective they are taking on intellectual capital. Some of the models have been developed for auditing purposes, others for benchmarking purposes and commercial purposes etc. (Andriessen, 2004b).

However, there are still some differences regarding what each of these intellectual capital components contain (Andriessen, 2004b), which are generated by the fact that each company serving as a case study for the classification models development had a different strategy. To illustrate, infrastructure assets in Brooking's framework contain only resources which are easily identifiable, while Sveiby (1997) includes in the internal structure not only this type of resources, but also elements which are not necessarily identifiable, such as organizational culture.

Another argument against the classification models is that the described intellectual capital elements are interrelated and sometimes integral to each other (Mouritsen et. al, 2001). Indeed intellectual capital components are synergetic - when combined they produce more value than the sum of their individual parts (Lev, 2001; Bontis et. al., 2000; Bontis & Fitz-enz, 2002). To clarify, Nazari and Herremans (2007) argue that structural capital and relational capital cannot be created without human capital. Also, Bollen et. al. (2005) theoretically prove that the more human capital companies possess the more structural and relational capital is created. Overall, intellectual capital value comprises both the value of its individual elements and the production output of their interaction (Bontis & Fitz-enz, 2002). From this standpoint, separating intellectual capital into components would not bring any additional information about its influence and contribution to organizational life (Andriessen, 2004b).

However, without separating intellectual capital into components it would be impossible to explain how intellectual capital is deriving value inside an organization. Roslender and Fincham (2004) empirically show that in practice managers tend to categorize intellectual capital, even though the concept itself is not fully understood, because it offers a tangible visualization of the value creation process. From a managerial perspective, categorizing intellectual capital has allowed a better identification and, subsequently, a better management of this resource.

Supporters of separating intellectual capital into components assert that the value of a classification resides in its "*ability to function as a heuristic device, as a help construction for interpretation"* (Grojer, 2001: p. 696). Therefore, intellectual capital classifications are useful as long as they allow a better understanding of the intellectual components' behaviour. More specifically, the main interest surrounding intellectual capital is how each of its elements is able to create value by itself and together with others. Hence, the usefulness of classification models depends on whether there are considerable variances between the elements to suggest that a different management of the intellectual capital components is necessary and different IC elements influence performance in a different manner (Walker, 2009).

Consequently, categorizing intellectual capital might have the disadvantage of separating elements which operationally are inseparable, because it takes a stock perspective on intellectual capital. It has, on the other hand, the advantage that it allows a better identification of intellectual capital inside an organization and it divides it into elements which are sufficiently different between themselves to justify their separation. Hence, classifying intellectual capital into components allows a better conceptualization of this element and a better operationalization for research purposes (Roslender & Fincham, 2004). A closer scrutiny of the classification models presented shows that generally they are concerned with three categories: people (human capital), internal infrastructure (structural capital) and external relationships (relational capital) (Huang et. al., 2007).

2.1.5. Intellectual capital definitions conclusions

The intellectual capital definitions have been divided into four streams which highlight the dimensions of intellectual capital. Some of these definitions are complementary others contradictory. This section has describes how intellectual capital is framed by all the streams of definitions taken together and highlights these complementarities and contradictions.

The process definitions describe intellectual capital as the main value driver for competitive advantage. However, this characteristic is challenged by the classification models which indicate that intellectual capital can be divided in different, not-equally important elements. Moreover, Sveiby (1997) asserts that intellectual capital elements can actually be separated into elements which establish a company's stability, efficiency and/or growth. Hence, not all intellectual capital elements represent competitive advantage, but together through their synergy they have this ability.

The knowledge definitions emphasize the fact that intellectual capital represents organizational knowledge which has been created by transforming individual's knowledge into organizational routines and processes. These definitions also emphasize the immateriality and ambiguity surrounding intellectual capital which differentiates it from traditional accounting assets. As a consequence, non-accounting definitions highlight the fact that intellectual capital is a source of value different from financial sources.

The classification models divide intellectual capital into operationally distinct elements which have a significantly different behavior and are not equally important for value creation. Even though the classification models separate the intellectual capital into various components they do not contradict the argument that intellectual capital elements are bound up together and they create value through their synergy. However, classification models allow a better conceptualization of this element and a better operationalization for research purposes (Roslender & Fincham, 2004).

Based on these conclusions, the next section formulates an intellectual capital definition which will stand as reference for the rest of the thesis. Also, it highlights research relevant intellectual capital characteristics which can be easily derived from the formulated definition and, at the same time, unveils some characteristics of intellectual capital which are implied in the definitions but not explicitly stated.

2.2. Intellectual capital conceptualization

2.2.1. Thesis' intellectual capital definition

Taking into account all the definitions presented, intellectual capital is defined in this thesis as:

> *"an organizational resource without physical substance, but with a knowledge component which has the ability to add value inside an organization through the interaction of its elements "*

As with other authors, for the purpose of this thesis intellectual capital is divided into three core components: human capital, structural capital and relational capital (Lynn, 1998; Dzinkowski, 2000; Petty & Guthrie, 2000; Guthrie et al., 2004; Guthrie & Abeysekera, 2006).

Human capital represents the value added brought by employees to a company. It constitutes workforce considerations such as employee satisfaction or staff stability (Montequin et. al., 2006) and specific elements referring to employees' knowledge, know-how and expertise, abilities and competences (Nazari & Herremans, 2007). This component of intellectual capital is not owned by the company (Bontis et. al., 2000) and an employee's departure can result in a loss of organizational knowledge and become a threat for the organization (MacDougall & Hurst, 2005).

Structural capital describes the knowledge that has been captured and institutionalized within the organization. The structural capital includes infrastructure, information technology, databases, product technology, process handbooks, organization structure and routines and intellectual property elements such as brands, trademarks, copyrights and patents (Bontis et. al., 2000). Structural capital also includes any type of innovation and research and development which a company is undertaking. The creation of structural capital is strongly dependent on human capital, but it can be independently identified (Nazari & Herremans, 2007; Chen et. al., 2004). For instance, Roos et. al. (1997) consider that structural capital is "*what stays in the company when employees go home*".

Relational capital represents the value of all relationships a company establishes with its stakeholders: customers, suppliers, competitors, government or industry associations (Montequin et. al, 2006; Bontis, 2001). It describes the knowledge of the company in scanning and identifying opportunities in the market for value creation (Nazari & Herremans, 2007). The literature considers the relationships that an organization is establishing with its customers as the most important channel to produce value (Bontis et. al., 2000), due to the fact that the company's existence depends on the customer's willingness to buy its products. However, the relationships with the other stakeholders are considered valuable because of the information, knowledge and other resources which might flow through strategic alliances, external collaborations and networks (Montequin et. al., 2006).

2.2.2. Intellectual capital characteristics

Based on the above, this section derives the characteristics of intellectual capital that might be relevant in a research context.

One of the most important characteristics of intellectual capital which can be derived from multiple definitions is that this firm's resource is **immaterial** or **intangible** in nature. Due to its intangibility, the volume, quality and even its existence are uncertain. The uncertainty surrounding this term leads to higher than normal levels of information asymmetry. Also, the intangibility criterion makes this asset very hard to be traded and if tradable, it is hard to find an efficient market for the transaction (Bukh et. al., 2005).

The process definitions emphasise the fact that intellectual capital components not only interact with the tangible asset base but also with one another in order to produce value. This means that IC components are **synergetic** - when combined they produce more value than the sum of their individual parts (Bradley, 1997; Bontis et. al., 2000; Lev, 2001; Bontis & Fitz-enz, 2002). For example, while formulating their framework (Balanced Scorecard) as a strategy map, Kaplan and Norton (1996) show that causal relationships can be noticed between employee satisfaction, customer satisfaction, customer loyalty and performance in influencing profit. Also, Roos and Roos (1997) show that human capital cannot create value without structural capital and relational capital. The fact that intellectual capital elements are synergetic makes it very hard to follow the benefits they separately generate and, also, impedes the measurement of the cash flow they generate (Roslender, 2004; Andriessen, 2004b).

As emphasized in the knowledge definitions intellectual capital has a knowledge factor. This knowledge resides both within the individuals and the organization, which means that at one moment in time intellectual capital is **partially controlled or owned** (Lev, 2001). The only intellectual capital component that can be owned or controlled is the structural capital. Relational capital is neither owned nor controlled by the organization. At best, a company can influence its relationships with all the stakeholders. Human capital is owned by the employees of a company. The company cannot own employees' competence, just because the employee comes to work (Andriessen, 2004b).

Also related to the knowledge dimension, intellectual capital is a **non-rival resource.** This signifies that intellectual capital components can be simultaneously used by many users without reducing its value (Lev, 2001; Andriessen, 2004b; Roos et. al., 2005)**.** An obvious illustration of this characteristic is a database (structural capital) which can be used by different people at the same time without losing its value. Moreover, taking into consideration that information could be added to this database, its value could instead increase.

Partial ownership and control translates into the fact that intellectual capital components have only **partial excludability**, in other words, it is very difficult to legally prevent others from appropriating this resource or drawing economic benefit from it (Kim & Mauborgne, 1999). A relationship can be broken, a brand can be matched, and a patent can be bypassed by using the information filed in the original patent. Additionally, IC provides opportunities for free-rider effects. For example, the technology innovated in a research and development process can be used by other companies to develop other products as patents are usually obtained for products and not for the technology itself (Flostrand, 2006).

Moreover, partial ownership and excludability characteristics show that the concept of intellectual capital is not synonymous with value creation. Also, it explains why some researchers are susceptible to accepting the notion of competitive advantage as an equivalent of intellectual capital. There are as many opportunities to lose value through intellectual capital as there are opportunities to add value.

An issue not clearly emphasized in the definitions, but related to the idea that intellectual capital elements can yield increased performance, is that intellectual capital components follow different laws of return compared to traditional assets (tangible assets or financial assets). Traditional assets follow the law of diminishing marginal returns (Roos et. al., 2005). The more you invest in these resources the more you have at your disposal and the more you use the less is left. The intellectual capital components follow different laws from one component to another but the general trend is to obtain **increasing marginal returns** (Bontis et. al, 1999**)**.

On the one hand, human capital follows the law of increasing marginal returns. The more knowledge, abilities, expertise, and information you have the more value can be produced. On the other hand, relational capital and structural capital components of intellectual capital follow the law of network economics. This means that initial investments tend to exhibit very little return and higher further investment is necessary to achieve a reasonable return. Also, there is an optimum level of intellectual capital investment to which the organizational returns can be increased (Roos et.al.,2005).

For example, when the fax machine was first released the number of persons being in possession of one was limited, making it impossible for the ones who made the investment to have any benefit out of it. However, as the number of fax machines increased, companies started benefiting from the speed and ease of sending information. These benefits lasted until there were so many owners that an easier and faster way of sending data was demanded.

This characteristic of IC components suggests that the benefits associated with an intangible asset do not depreciate as fast as in the case of traditional assets. Moreover, the components value can increase over time. However, a bigger initial investment is needed, and the risk associated with this investment is higher than in the case of traditional assets, because it is hard to evaluate whether the project is going to be successful (Roos et. al., 2005).

The aim of this chapter was to provide a conceptualization of intellectual capital to form a foundation for the thesis. The next chapter builds on these definition and characteristics in order to describe how accounting and strategic management disciplines explain intellectual capital. Moreover, the following chapter highlights how well accounting and strategic management disciplines conceptualize intellectual capital.

3. Intellectual capital: an interdisciplinary term

Different disciplines such as economics, law, finance, marketing, accounting and strategic management have individually contributed to intellectual capital research (Marr, 2005). Each of these disciplines is concerned with different problems surrounding intellectual capital ranging from how it is involved in the production function (economics) to how it can be protected using legal means (law) and how it can be translated into sustainable competitive advantage (management) (Marr & Roos, 2005). Across all these disciplines, accounting and strategic management have been the most prolific in the area of measuring intellectual capital's value and explaining its influence on performance, topics which make up a large part of the research literature and are the main focus of this thesis.

From an accounting perspective the focus has been on measuring intellectual capital (Roslender, 2004). Intellectual capitals link with performance is largely an empirical issue and lacks any strong theoretical underpinning. In contrast, strategic management better maps the theoretical relationship between intellectual capital and performance and separately constructs various measures in empirical studies of performance (Rumelt, 1991; Alcaniz et. al., 2011). Hence, while there are differences in approach there are potential complementarities between these disciplines with respect to intellectual capital research. Moreover, researchers suggest that there are benefits which can be derived from an interdisciplinary approach between accounting and strategic management regarding the business environment at large (Tayles & Ma, 2009) and specifically for the understanding of intellectual capital (Spender et. al., 2013). As proof of the benefits of an interdisciplinary approach, strategic management accounting appeared as a practice almost 30 years ago (Langfield-Smith, 2008).

Following on this theme, the current chapter describes the theories developed by the accounting and strategic management disciplines to explain the measurement of intellectual capital and its influence on performance. The empirical aspects are going to be detailed in a separate chapter. It then proceeds to evaluate each discipline's ability to conceptualize intellectual capital as defined in the thesis. Finally, the chapter explores whether there are benefits of an interdisciplinary approach to intellectual capital between accounting and strategic management by assessing the complementarities, the contradictions and the gaps of such an approach.

3.1. An accounting perspective on intellectual capital

The main task of the accounting profession is to provide users with information which allows them to identify the sources of value in a firm (Barth et.al. 2001). At present, intellectual capital is believed to play the central role in determining performance (Lev et. al., 2009). As a consequence, there is an increased demand for accountants to explain the value added by intellectual capital (de Villiers et. al., 2014). This demand is intensified by the discrepancy between the book and the market value, which shows there is a valuable resource for the market, which is widely not recorded in the balance sheet (Walker, 2009; Alcaniz et. al., 2011; Spender et. al., 2013).

Given that intellectual capital and its involvement in the value creation process can be explained through measuring this resource, the accounting profession has suggested three solutions to the measurement of intellectual capital: intellectual capital proxies, accounting measures of intangible value and non-financial indicators. The following section discusses each of these solutions for intellectual capital measurement and assesses their relative merits.

3.1.1. Intellectual capital proxies

Intellectual capital proxies refer to those intellectual capital elements which are either recognized as intangible assets or goodwill on the balance sheet or are expensed in the income statement as directed by the accounting standards IAS 38 "*Intangible Assets*" and IFRS 3 "*Business combinations*". These standards are described below in order to aid our understanding of these suggested measures of intellectual capital, their limitations and their consequences.

Intangible assets

In accounting, intangible assets are defined as: "*an identifiable non-monetary asset without physical substance. An asset is a resource that is controlled by the entity as a result of past events (for example, purchase or self-creation) and from which future economic benefits (inflows of cash or other assets) are expected.*" (IAS 38 "*Intangible assets*").

Based on the previous intangible assets definition, IAS 38 provides further indications of when such asset can be recognized. Accordingly, an intangible asset can be recognized in the balance sheet **at cost** if it fulfills the following criteria:

- it is easily identifiable - the asset is a measurable object without physical substance, which is controllable and can be clearly distinguished from the goodwill;
- future economic benefits are probable and can be correctly estimated and identified with a certain cash flow;
- the value of the asset can be correctly determined (Lev et. al., 2005).

Also, accounting standards state that the costs incurred for internally developed intangibles, other than R&D, can be capitalized as long as the assets are identifiable and have a limited useful life span. If the asset does not fulfill one of the above criteria its cost is immediately recognized as an expense at the moment of the event. When the intangibles are expensed, it results in a reduction of the current profits and earnings and in a likely increase of the future financial profits (Simon & Sullivan, 1993). In contrast, if intangibles are going to be capitalized, the current profits and earnings are going to be overstated to the detriment of future ones (Ely & Waymire, 1999; Aboody & Lev, 1998).

Chapter 2 (Section 2.2.1) presented a range of common characteristics which can be attributed to intellectual capital and differentiate it from traditional assets. Because of these characteristics, the accounting profession is unable to recognize its whole value on the balance sheet (Canibano et. al, 2000). First, intellectual capital is immaterial, very hard to capture and formalize and ultimately very difficult to identify. Second, intellectual capital's components are synergetic and interact with one another and with other assets making it difficult to identify them and the associated cash flow streams. Therefore, it is hard to estimate their future economic benefits or to correctly determine their value (Canibano et. al., 2000). Third, most intellectual capital components are not controlled by the company, such as human capital and relational capital (Roslender & Fincham, 2004; Alcaniz et. al., 2011). Finally, intellectual capital is generally non-tradable which further compounds valuation issues. Consequently, most intellectual capital components, especially those that are internally generated such as research and development, marketing expenses, developing costs for databases and training of human resources are not recognized in the balance sheet and are instead expensed (Lev et. al., 2005).

This means that instead of being recognized in the balance sheet, intellectual capital elements are recorded in the income statement. For this reason there will be an incorrect decrease in current profits which will translate to an increase in the future profits (Lev, 2003). There is a paradox in the fact that investments made in intangible assets are perceived as being detrimental to the company's position at the time of the investment given that intellectual capital represents a company's growth opportunities (Bontis, 2001). This leads to a systematic mispricing of companies with high intellectual capital levels which affects the capital markets and influences the gap between market and book values (Canibano et. al., 2000).

To illustrate, Lev (2003) empirically shows that investors are consistently undervaluing or overvaluing research and development expenses which is a structural capital element of the intellectual capital. However, intellectual capital will appear in the income statement when the investment is made, making the income statement a temporary repository of intellectual capital information, which will be lost in subsequent time periods (Ely & Waymire, 1999).

Therefore, because most intellectual capital elements are excluded from the balance sheet considering its value to be equivalent to the value of intangible assets may be misleading. The fact that intellectual capital does not represent intangible assets in the accounting sense has been acknowledged by researchers, especially those favouring non-accounting definitions (see section 2.1.3 "*Non-accounting definitions*"). However, because intellectual capital value does not appear on the balance sheet negatively affects the market by leading to systematic mispricing of companies and generates a gap between book and market values (Lev, 2003).

Goodwill

Another term used in the accounting discipline to capture an organizations' intellectual capital is goodwill. The term is defined as:

> "*the difference between the cost of the acquisition over the acquirer's interest in the net fair value of the identifiable assets, liabilities and contingent liabilities*" (IFRS 3 *"Business combinations"*).

In other words, goodwill represents the asset base which has not been previously recognized on the acquired company's balance sheet and which emerges through the difference between the cost of acquisition and the company's net value. Boekestein (2009) empirically shows that for companies in knowledge intensive industries, such as the pharmaceutical sector, the amount of money paid for the assets of a particular company is on average six times larger than the total assets last stated on the acquired company's balance sheet. This means that post-acquisition, intangibles (including goodwill) rise to approximately 59% of the total assets compared to 12% in the pre-acquisition period (Boekestein, 2009).

Boekestein's (2009) study is a further proof of what has been argued theoretically in the previous section: there are large parts of internally generated assets which are excluded from the balance sheet. Given that intellectual capital is largely excluded from the balance sheet, Lev et. al. (2005) assert that goodwill represents future economic benefits arising from intellectual capital components which do not meet the criteria for recognition in the balance sheet.

Nevertheless, even though goodwill includes a large part of internally generated intangibles it does not represent the overall value of intellectual capital (Boekestein, 2009). Spender and Marr (2006) posit that goodwill comprises mostly human capital and relational capital and, to some extent, structural capital. Their argument is based on the fact that human capital and relational capital are the elements of intellectual capital that are commonly excluded from the balance sheet, compared with structural capital (Spender & Marr, 2006). Hence, human capital and relational capital will be the elements recognized as goodwill at the time of acquisition. Further, they assert that goodwill can exclude aspects of intellectual capital whilst including elements of another nature.

As defined above, goodwill represents the amount by which the purchase price (market value) exceeds the net tangible assets (book value) of the acquired company. Accepting that intellectual capital is equal with this difference means accepting that intellectual capital value can be influenced by the book value and, consequently, by accounting rules (Mouritsen et. al., 2001). Similarly, the price of a company is often negotiated and might be influenced by other factors such as noise in the market or managers' power of negotiation (Gowthorpe, 2009). Thus, goodwill could also contain other noise factors besides the fair value of intellectual capital's elements (Edvinsson, 1997).

Even if it could capture intellectual capital only, the accounting concept of goodwill does not solve the problem of evaluating internally generated intangibles of an **acquiring** company. It is only evaluating internally generated intangibles of an **acquired** company. Moreover, goodwill represents a snapshot of the intangible value at the moment of acquisition and it is not clear whether this value is going to be preserved after the reorganization of the businesses. Generally, goodwill is perceived as being a "*trash item*", a residual of the accounting methodology (Sveiby, 1997), which should be deducted as soon as possible. Accounting standards state that it should be subject to periodic re-evaluations and a downward reduction of its value is irreversible (Jerman & Manzin, 2008).

Consequently, goodwill is just an approximation of intellectual capital comprising mostly the human and relational capital of an acquired company which can be affected by other factors independent of intellectual capital's value. As with intangible assets, this accounting method to measure intellectual capital does not solve the problem of evaluating internally generated intellectual capital, which means that intellectual capital investments are largely expensed.

In conclusion, accounting partially captures intellectual capital value in the financial statements as intangible assets and goodwill on the balance sheet. The intellectual capital investments which are not recognized in the balance sheet are instead expensed in the income statement. Intangible assets, goodwill and intellectual capital related expenses have been used together by researchers and practitioners to approximate the financial value of various separate intellectual capital elements. For example, intangible assets and goodwill have been used to approximate the value of structural capital (Edvinsson, 1997), while the expense of employees' salaries has been utilized to account for human capital (Black & Lynch, 1996). As presented in the introduction of this section, these methods of capturing intellectual capital have been labelled intellectual capital proxies and will be referred hereafter as such.

3.1.2. Accounting measures of intangible value

The accounting treatment of intangible assets and goodwill described previously clearly shows the challenges posed by the estimation of intellectual capital's value through intellectual capital proxies. Due to the imperfect nature of this estimation, the problem of intellectual capital measurement is further exacerbated in an economy which increasingly relies on this resource to achieve above average returns (Holland & Johansson, 2003). Intellectual capital measurement is needed for assessing the costs and benefits of economic activities and the discrepancy between book and market values (Brynjolfsson & Yang, 1999). Acknowledging this issue, accounting research has centered around developing measures for intellectual capital as means of capturing its value. These measures are known in the literature as the accounting measures of intangible value (Leadbeater, 1999).

The building blocks in creating measures for intellectual capital have been set by Hermanson's (1964) work on human resource accounting. The objective of human resource accounting objective was to *"quantify the economic value of people to the organization"* (Bontis, 1999: p.443), in order to provide input to managerial and financial decisions. Within this research there are three types of human resource accounting measurement models which have been proposed by researchers:

1. **cost models** - historical or acquisition cost (Brummet, Flamholtz and Pyle, 1968), replacement cost (Flamholtz, 1973) and opportunity cost (Hekimian and Jones, 1967);
2. **human resource value models**, i.e., a non-monetary behavioural emphasis model (Likert, 1967), combining non-monetary behavioural and monetary economic value models (Likert and Bowers, 1973; Gambling, 1974);
3. **monetary emphasis models**, i.e., discounted earnings, market values or wages approach (Morse, 1973; Friedman and Lev, 1974).

In line with these models, researchers have developed financial statement-based and market-based accounting measures of intangible value to account for the overall value of intellectual capital (Spender et. al., 2013). Financial statement-based measures are similar to the cost models because they involve in their computation balance sheet and income statement elements related to intellectual capital which rely on the historic cost principle. Market-based measures rely on market valuations of the firm for their estimation of intellectual capital and are analogous to monetary emphasis models. Some examples of financial statement-based measures are Economic Value Added (Stewart, 1994), Calculated Intangible Value (Stewart, 1995) and Value Added Intellectual Capital Index (Pulic, 1998), while the best known examples of market-based measures are Market-To-Book ratio and Tobin's Q.

Financial statement-based measures are typically justified on the grounds that they rely on the best available data accounting can provide on intellectual capital. However, some researchers argue that these measures are biased due to different accounting practices across industries, inappropriate expensing of research and development and advertising expenditures, a failure to reflect opportunity costs and risk, and replacement–cost accounting errors (Hirschey & Wichern, 1984). Moreover, balance sheet and income statement information present historical values and, accordingly, the measurement methods depending on this data are going to be past-oriented (Bontis, 2001; Levy & Duffey, 2007). Hence, it is presumed that accounting measurements do not reveal the growth opportunities reflected by a company's intellectual capital (Bontis, 2001). Nevertheless, empirical studies verify that these problems only reduce but do not destroy the usefulness of accounting measurements which rely on financial statements' data (Cahan et. al., 2000).

Alongside the growing distrust in the financial statements' data, there has been an increasing use of market based measures to describe intellectual capital. The argument in favour of these measures is that if intellectual capital represents a company's growth opportunities the market should reflect it in the firm's valuation. The counter argument is that market valuations are subject to irrational impulses and market sentiment (Gowthorpe, 2009; Maditinos et. al., 2011). If the stock markets are inefficient using market value to infer the value of intellectual capital may lead to erroneous results (De, 2009).

The drawback of both financial statement-based measures and market-based measures is ironically the purpose for which they were developed: capturing intellectual capital's whole value. By capturing intellectual capital in a single monetary value these accounting measurements are unclear about which intellectual capital elements they are capturing and how these elements are combined to give the overall IC value (Kannan & Aulbur, 2004; Nazari & Herremans, 2007; Levy & Duffey, 2008). Nonetheless, these measurements assign monetary or at least quantitative value to intellectual capital and are an estimate of the overall value of intellectual capital at one moment in time (Spender, 2009). Therefore, accounting measurements are not portraying intellectual capital's exact value, instead they aim at a good monetary approximation. Firer and Williams (2003) support the use of accounting methods for capturing intellectual capital mentioning that other emergent methods to capture this organizational resource are mostly customized to fit the profile of a specific company. As such, they lack opportunities for generalisation and have a limited comparability (Caddy, 2002; Sveiby, 2005). In contrast, intellectual capital's accounting measurements use audited information which is objective, verifiable and comparable (Maditinos et. al., 2011).

Therefore, the accounting measures of intangible value have been criticized at a theoretical level due to the nature of information they use for the estimation of intellectual capital. However, this information has other appealing qualities to the researchers: it is objective, verifiable and comparable. Hence, it seems that the most important drawback of these measures is the lack of understanding of how and which elements of intellectual capital they are capturing.

3.1.3. Non-financial indicators

Generally, developing intellectual capital value measures has accentuated the need to provide intellectual capital information both internally and externally (Malley, 2009). Internally, intellectual capital information is needed for managerial decisions and strategy implementation. Externally, intellectual capital information is required by investors to correctly approximate the market value (Garcia-Meca & Martinez, 2007).

In order to provide this information, projects such as the Danish IC Statement Guidelines (2003), PRISM (2001), MERITUM (2001) or DATI (2000) have supported the disclosure of IC information (Levy & Duffey, 2007). These projects divide intellectual capital into components in a similar manner with intellectual capital's classification models. They include a series of instructions about what each intellectual capital element should comprise of and give suggestions about how these elements could be measured using non-financial approximations.

The importance of these projects resides in the fact that they emphasize intellectual capital as being distinct from traditional tangible assets. For this reason, they suggest that intellectual capital should not be incorporated directly into the balance sheet. Instead it should be presented in a narrative form, using non-financial information about the term with supplementary diagrams and stories in intellectual capital statements (Davison, 2010; Guimón, 2005; Mouritsen et al., 2001). This method of accounting for IC information is at its inception and the disclosure of intellectual capital is not very well regulated (Chatzkel, 2003). Since the disclosure of non-financial indicators is not well regulated, managers are in charge of what they choose to report about this resource in the narrative format. As a result, the reported non-financial indicators highlight the value drivers which fit a specific company.

Davison (2010) holds that IC statements have become a more refined method of explaining the disparity between market and book values. However, because they can consist of non-numerate language that might not be shared by the readers of balance sheets, these statements have other limitations in explaining IC. They assume the preparers and users of IC statements should have and share the understanding about how IC's non-financial information is translated into organizational performance. For these reasons, non-financial indicators are believed to be highly subjective and to have limited comparability and generalizability as they present only the information considered relevant by the managers (Caddy, 2002; Sveiby, 2005)

The merit of non-financial indicators lies in its acknowledgement of the limitations of accounting standards' in capturing intellectual capital. Also, they emphasize the need to provide intellectual capital information internally and externally through both financial and non-financial elements. Nevertheless, they are highly subjective and consequently uncertain. Moreover, since the disclosure of non-financial indicators has not been well regulated the probability that a group of similar companies will disclose the same non-financial indicators is low thus limiting the comparability and ability to develop a better understanding of the intellectual capital value they are capturing.

3.1.4. Accounting for intellectual capital gaps

The previous section identified the accounting solutions for intellectual capital measurement, described their mechanisms and identified their advantages and disadvantages. Outlining the solutions revealed that they have different groundings and should, subsequently, have a different ability to reflect intellectual capital (Andriessen, 2004a). However, the ability of accounting measures to capture intellectual capital has not been questioned before.

Intellectual capital proxies and non-financial indicators by construction can be clearly identified with an intellectual capital element. Hence, they are clear about what resource they are measuring. However, the ability of the accounting measures of intangible value to capture and reflect these attributes if less clear. They are meant to capture the overall intellectual capital value but their efficacy in capturing specific intellectual capital elements is not known and has not been previously explored (Andriessen, 2004a; Sveiby, 2005).

Further, multiple measurement frameworks pertaining to the categories mentioned above have been developed both by practitioners and researchers (Marr et.al., 2003; Andriessen, 2004a; Levy & Duffey, 2007). Andriessen (2004a) identified 30 different frameworks, while in a more recent study Sveiby (2005) identified 34 of them. While researchers keep developing measurement frameworks, there is little understanding of how the existent ones work in terms of linking intellectual capital to performance (Dumay, 2009). The accounting discipline does not explain either why or how these measures are meant to capture intellectual capital and whether they are adequate measures for linking it to performance.

Moreover, researchers have created measurements which are believed to be incrementally better than the previous ones. However, there is little acknowledgement of how these measures relate with one another, how they compare and contrast, whether they are complementary and if they manage to explain intellectual capital better together than separately.

To conclude, in order to progress the accounting understanding of intellectual capital there is a need to better understand the current accounting measures of intellectual capital instead of developing new measures which rarely state what problems in intellectual capital measurement they assess. Given the complexities of intellectual capital it would be interesting to reveal how the accounting measures of intangible value capture intellectual capital components and their synergy in order to fully understand how they can aid the modelling and the analysis of the link between intellectual capital and performance.

3.2. A strategic management perspective on intellectual capital

While the accounting discipline has been concerned with measuring intellectual capital to explain the gap between the book and the market value, the strategic management discipline has tried to find an explanation for the existence of the firm and the performance disparities between similar companies (Marr & Roos, 2005). In relation to intellectual capital, strategic management research has been interested in its ability to constitute the competitive advantage of a firm and its ability to create value (Carlucci & Schiuma, 2007). Strategists formulated their ideas in theories, such as the resource-based theory of the firm, knowledge-based theory of the firm and dynamic capabilities theory. These theories and the way they can or cannot explain how intellectual capital influences performances are presented below.

3.2.1. Resource-based theory

The resource-based theory (RBT) focuses on the firm's internal influences. It states that organizations perform well and create value, when they implement strategies that respond to market opportunities by exploiting their competitive advantage, internal resources and capabilities (Marr & Roos, 2005; Barney & Clark,2007). Consequently, organizations need to understand which of the resources they possess represent competitive advantage and how to configure them to deliver value. Also, RBT provides some directives to recognize which resources could represent a sustainable competitive advantage. According to these directives, competitive advantage related resources are valuable, rare, difficult to imitate and hard to substitute (Barney, 1991).

Some intellectual capital elements fit the RBT description of competitive advantage due to their high immateriality which makes them almost integrally non-imitable and non-substitutable (Molloy et. al., 2011). Also, intellectual capital matches the concept of competitive advantage because its elements merge into the unique value-creation chain by interacting with one another and with other tangible resources in a firm-specific manner (Reed et. al., 2006).

However, the resource-based theory of the firm appeared mainly as a reaction to the competitive forces analysis developed by Porter (1979), which assesses a company's position by considering only its external forces. As such, the resource-based theory of the firm fails to recognize external opportunities as potential sources of value (Bontis, 2001). The relational capital component of intellectual capital is dependent to a certain extent on the external influences of a firm's stakeholders. Also, the resource-based theory of the firm does not take into account that internal resources like human capital can change over time due to certain organizational processes (Bontis, 2001).

Consequently, the resource-based theory of the firm cannot fully explain the mechanisms of intellectual capital inside an organization. The elements of intellectual capital that best fit this theory are the components of structural capital because they are neither external nor subject to change as opposed to the other two components of intellectual capital. Moreover, the resource-based theory of the firm has limitations beyond its ability to conceptualize the notion of intellectual capital. Namely, RBT accentuates the fact that managers need to identify the key organizational resources in order not to seize all valuable opportunities (Brooking, 1996). However, RBT does not explain how we should identify and measure these resources which are based on firm-specific interactions and often are intangible and unobservable such as firm capabilities (Amit & Schoemaker,1993). Also, RBT does not explain the mechanism through which various degrees of performance outcomes are achieved (Molloy et. al., 2011).

On these matters, critics of RBT like Foss and Knudsen (2003) and Priem and Butler (2001) express the following concerns. First, RBT is not prescriptive in that it does not provide managers with useful advice as to which specific resources they should accumulate to gain an advantage. Second, RBT lacks a clear definition of competitive advantage. That is not to say that RBT does not define competitive advantage but rather that the definition provided is abstract and leaves room for interpretation. Third, RBT suffers from a tautology problem stemming from the fact that competitive advantage resources are defined in terms of the performance outcomes associated with them. Finally, RBT is too broad in that many potentially advantageous resource configurations are possible (Reed et. al, 2006).

In summary, intellectual capital matches the concept of competitive advantage as described by the resource-based theory of the firm but it is not in line with other prescriptions made by this theory which do not fit some of the intellectual capital elements. Moreover, because RBT has some limitations in explaining how organizational performance could be derived by competitive advantage resources, it does not manage to reveal how intellectual capital could influence performance in an organization.

3.2.2. Knowledge-based theory

The understanding of competitive advantage is further developed by the knowledge-based theory of the firm (KBT). This theory emphasizes knowledge and organizational learning as key resources to bring value added to companies in the new-economy (Nonaka & Takeuchi, 1995; Davenport & Prusak, 1997).

According to KBT, competitive advantage is represented by tacit and explicit knowledge and the process of obtaining this knowledge (Lee et.al., 2005). Explicit knowledge is formal, systematic and embedded in organizational routines. It can be easily communicated and shared. Tacit knowledge, on the other hand, is not so easily expressed. It is highly personal, hard to formalize and difficult to communicate to others. It usually resides with the individual and may also be impossible to capture. According to Nonaka and Takeuchi (1995), who developed the knowledge-based theory of the firm, initially knowledge is tacit and value is derived in organizations by transforming this knowledge into explicit knowledge by following these steps: sharing tacit knowledge, creating concepts, justifying concepts, building archetypes and cross-levelling knowledge (Nonaka & Takeuchi, 1995).

Knowledge-based theory takes a stance on the value-creation process and tries to explain it; however, as with previous theory it has some limitations. It asserts that both tacit knowledge and explicit knowledge represent competitive advantage and in such way create value added. Nevertheless, the tacit knowledge is non-imitable, while the explicit knowledge is easy to replicate and, consequently, could diminish or destroy the competitive advantage (Barney, 1991). Dean and Kretschmer (2007: p. 586) argue that “*knowledge capitalized as intellectual property is more vulnerable than traditional capital in that it is open to multiple legal challenges*”. Therefore, even though the company derives value from transforming tacit knowledge into explicit knowledge, it can lose value the same way. This makes it unclear how value is derived in the end and if explicit knowledge is indeed offering a competitive edge to an organization (Coff, 2003).

Contrary to resource-based theory, the knowledge-based view recognises that changes in the internal structure of the firm might happen (Bontis, 2001). Thus, it can account for changes in intellectual capital structure and value. Nevertheless, the knowledge-based theory focuses on an individual without highlighting the overall organizational structure (Nonaka et. al., 2000), while intellectual capital denotes organizational knowledge obtained through formalizing individual knowledge (see Chapter 2). Moreover, KBT presents knowledge as a product of the interaction between individuals inside an organization; it does not explain how the organization extracts this knowledge and utilizes it for its advantage. Also, KBT does not explain how the organization can adapt to external influences based on the tacit knowledge of its employees (Spender,1996).

Intellectual capital has a knowledge component; consequently, the way it creates value could be explained by the knowledge-based theory. However, intellectual capital does not overlap with the concept of knowledge (Kianto et.al.,2014). First, knowledge is considered as more vague and abstract domain than intellectual capital (Roos, 1998). Second, as mentioned previously, intellectual capital represents an organizational resource and it describes the organizational knowledge rather than individual knowledge (Lee et. al., 2005). Finally, knowledge-based theory explains a process for knowledge management but the knowledge management process presumes different activities compared with intellectual capital management (Viedma-Marti, 2001). Knowledge management is more detailed and focuses on facilitating and managing knowledge related activities such as creation, capture, transformation and use (Wiig, 1997). Its function is to plan, implement, operate and monitor all the knowledge-related activities and programs required for effective intellectual capital management. Intellectual capital management focuses on building and governing intellectual assets from strategic and enterprise governance perspectives (Viedma-Marti, 2001).

To conclude, knowledge based theory is focused on explaining how value can be derived through knowledge. As with resource-based theory it has some limitations in explaining this process. However, because intellectual capital does not overlap with the concept of knowledge it is very hard to understand which of the mechanisms can be applied to intellectual capital.

3.2.3. Dynamic capabilities theory

To overcome the shortcomings of the resource-based and the knowledge-based theories of the firm in taking into account external factors influencing the firm, strategists developed the dynamic capabilities theory (Teece et.al., 1997). A dynamic capability represents:

> "*the ability to achieve new forms of competitive advantage by appropriately adapting, integrating and reconfiguring organizational skills, resources and competencies to match the requirements of a changing environment*" (Teece et. al., 1997: p. 515).

The dynamic capabilities theory underlines the fact that value comes primarily from organizational capabilities which are idiosyncratic and accumulated over time (Carlucci & Schiuma, 2007). More specifically, it sees the main competitive advantage of the company as a flow of information and knowledge materialized in capabilities. Therefore, it emphasizes that organizational knowledge provides the firm with a competitive edge in a similar vein as the knowledge-based theory (Bontis, 2001).

From a dynamic capability perspective, the value creation process is a chain of multiple interactions between different organizational resources and competencies directed by an organizational learning process (Bontis, 2001). Strategic management clearly differentiates intellectual capital from the dynamic capabilities, considering the latter to be a mediator between intellectual capital and performance (Wu et. al., 2007; Hsu & Wang, 2012). To be more precise, strategic management considers intellectual capital as the yardstick which serves for organizational learning (Bontis, 2001). From this perspective, as opposed to the dynamic capabilities concept, intellectual capital lacks a learning component (Hsu & Wang, 2012); it is the end result of organizational knowledge flow and learning and, consequently, a knowledge stock.

In practice, it is difficult to separate the stock and the flow of knowledge and organizational learning without establishing a time boundary. Looking back at Chapter

2, Andreou et.al. (2007) suggest a practice–tested classification model for intellectual capital components which reveals that "*decision making*" is perceived to be an intellectual capital component. This indicates that managers do not separate knowledge flow (decision making) from knowledge stock (intellectual capital).

The value creation process is clearly complex, based on interactions between various assets and requires a continuous feedback between knowledge stocks and flows (Spender et.al. 2013; Kianto et.al. 2014). Nevertheless, the separation of knowledge stock and flow has allowed for different intellectual capital categorizations and classification into, for instance, human, social or relational capital (Edvinsson, 1997; Edvinsson & Malone, 1997).

Nonetheless, this is merely the classification of something already in existence - the firm's stock of knowledge, while ignoring the fact that value may also reside in the value-adding process. Close examination of these intellectual capital components reveals that they are mutually defining and sustaining, intimately bound up with each other and operationally inseparable (Dumay, 2009; Andriessen, 2004b). This led to two interpretations of intellectual capital: a passive conceptualization which perceives intellectual capital as a knowledge stock; and a dynamic conceptualization which incorporates knowledge flows to intellectual capital (Kianto, 2007; Kianto et.al.; 2014). As mentioned previously, the literature has mainly focused on the passive conceptualization and this thesis takes the same perspective. However, if considering knowledge flows outside the intellectual capital jurisdiction, the dynamic capabilities theory does not manage to explain how intellectual capital adds value because the knowledge stocks synergies (intellectual capital elements synergies) are not considered possible without a knowledge flow (Kianto et.al.,2014).

There are two reasons why the dynamic capability theory is not fully explaining intellectual capital. First, the dynamic capability notion seemed more appealing to some strategists who have focused on "*soft*" aspects of an organization, such as organizational culture, management decisions, tacit knowledge etc., which refer to the flow of knowledge in an organization. As previously explained, intellectual capital does not expand to include flows of knowledge. Second, strategic management does not have a valid explanation of how intellectual capital elements interact with one another to create more value in the absence of knowledge flows.

3.2.4. Strategic management theories of intellectual capital gaps

Strategic management theories partially overlap the intellectual capital dimensions highlighted in Chapter 2, supporting the categorization of intellectual capital definitions suggested in this thesis. These theories emphasize the fact that the value added by intellectual capital depends on both external (exogenous) and internal (endogenous) factors (Ittner, 2008). Nevertheless, value is derived internally at an organizational level although strategists are unclear at which level intellectual capital should be evaluated: individual or organizational (Nonaka et. al., 2000). Additionally, the strategic management discipline makes efforts to explain the value creation process by presenting intellectual capital as a competitive advantage resource. Due to tautological problems which define competitive advantage by its influence on performance, the way intellectual capital influences organizational life and manages to influence performance remains unclear (Reed et.al.,2006).

Representing a competitive advantage resource as portrayed by the theories above signifies that higher intellectual capital value is directly translated into higher performance (Bontis & Fitz-enz, 2002). Consequently, strategic management theories presume that, on one hand, the relationship between intellectual capital and performance is linear and, on the other hand, intellectual capital is beneficial in all contexts. Nevertheless, these theories do not answer the question of why this should be the case. Performance cannot increase infinitely; it is bounded by the number of existent opportunities, management's knowledge and a firm's ability to learn (Penrose,1959).

Thus, despite its efforts to explain the value creation process, strategic management theories do not offer a complete understanding of how intellectual capital is involved in this process. Chatzkel (2004 quoted by Dumay2009: p. 193) explains that in order to move forward towards formulating an intellectual capital theory, strategic management academics and practitioners:

> *". . . must substantially demonstrate the relevance of IC as a working discipline that is useful to organizations to use to gauge and generate significant value and to effectively navigate to achieve strategic goals. Otherwise, the notion of IC and all its stands for will be seen as merely one more set of very interesting ideas that is continuingly elusive to grasp and use.*"

Nonetheless, strategic management accentuates the fact that dynamic organizational aspects, such as knowledge flows or organizational learning, are independent of the notion of intellectual capital but should be considered as valuable elements in the value creation process (Kianto et.al., 2014). Organizations themselves are dynamic systems of financial, tangible and intangible stocks and flows (Roos et. al., 1997). Notably, Andriessen (2004b) states that treating intellectual capital as a stock permits the evaluation of the wealth created by firms through their capabilities, yet, a stock is an accumulation of historical flows at one moment in time.

In conclusion, the gap in the strategic management literature with respect to intellectual capital remains finding a reasonable explanation of how this resource manages to create value via its elements and their interaction despite strategists' effort to develop all the theories described to elucidate this topic. Also, another gap is to establish whether this explanation is possible in the absence of knowledge flows.

3.3. An interdisciplinary perspective on intellectual capital

Researchers have called for a detailed examination of the complementarities between accounting and strategic management disciplines (Jorgensen & Messner, 2010). This call is not recent; similar ideas can be traced back to early '80s to Hopwood (1983), who saw accounting as an important and valued managerial practice which should be rooted into organizational activities

A focus on *''strategy-accounting talk''* (Chua, 2007: p. 492) allows for a discussion of how accounting is weaved into strategic considerations and debates, as well as how accounting concepts, such as *''profit''* or *''cost'',* are mobilised when crafting strategy. Combining this concern for strategy with a concern for the everyday practice of accounting seems promising in many respects for the organizations (Tayles & Ma, 2009) and for the understanding of intellectual capital (Spender et. al., 2013).

So far, this chapter has focused on presenting the way accounting and strategic management disciplines have separately contributed to the understanding of intellectual capital. The purpose is to track back the knowledge on this concept to a current of thought in order to better understand its groundings. Nevertheless, in line with researchers' encouragement for a "*strategy-accounting talk*", this section brings together the accounting and strategic management perspectives and describes their complementarities, their contradictions and their gaps in fully conceptualizing intellectual capital. This complex exercise should lay the foundations for understanding how the accounting discipline could improve the measurement of intellectual capital by taking a strategic management stance on the topic and will feed into the conclusions of this thesis.

Based on the theories described previously, it can be concluded that: on one hand, the accounting literature is externally oriented (Spender & Marr, 2006) and focuses on providing intellectual capital information to investors, with the purpose of reducing the gap between the book and market values. On the other hand, strategic management discipline is internally oriented (Spender & Marr, 2006) and explores the means by which intellectual capital can influence performance without fully explaining the process which connects the two.

The accounting discipline highlights the need for clear identification and measurement of intellectual capital. If internally oriented, this information could support strategy implementation because it would inform managers regarding the success of their decisions (Kaufmann & Schneider, 2004). Strategic management identifies intellectual capital as a resource which forms the basis of a company's competitive advantage and offers an understanding of how this resource is involved in the value-creation process by the enactment of strategic objectives (Roslender, 2004). Nonetheless, strategic objectives cannot be mobilised without being informed by the accounting information on intellectual capital. Accounting information on intellectual capital frames the value creation process in that it gives strategy a direction by influencing managerial decisions (Jorgenssen & Messner, 2010).

Therefore, accounting provides answers to questions of "what?" through the measurement of intellectual capital, while strategic managements answers questions of "how?" by trying to explain how intellectual capital influences performance. Referring to the stock-flow analogy, the accounting discipline provides information about the stock and the strategic management provides information about the flow. These developments in accounting and strategic management disciplines suggest that an interdisciplinary approach is appropriate for the representation of intellectual capital. Despite their individual deficiencies a complementary view of both accounting and strategic management could help the better understanding of organizational reality.

Nevertheless, while there are complementarities between the accounting and strategic management disciplines with respect to intellectual capital there are also some contradictions. The accounting discipline perceives the firm and implicitly intellectual capital as something which is measurable (Spender et. al., 2013). In line with this argument, accounting considers as part of value creation process only "*hard*" resources which are easily measurable (Kianto et. al., 2014). In contrast, strategic management differentiates between tacit and explicit knowledge, which highlights that besides "*hard*" resources there are also some "*soft*" resources which might be valuable to the firm. However, these *"soft"* resources are hard to identify and they might not have been realised yet and, hence, are hard to measure (Spender et. al., 2013). This contradiction seems to indicate that the accounting discipline does not unfold all areas of value creation because it is bounded by the measurement condition.

Further, there are some gaps in the understanding of intellectual capital that an interdisciplinary approach between the accounting and strategic management disciplines does not manage to cover. Both disciplines present intellectual capital as a valuable resource for the organization which should subsequently have a positive influence on organizational performance (Zeghal & Maaloul, 2010; Stam, 2009). The accounting discipline proposes the notion of "*asset*" related to intellectual capital, which by definition indicates that it should bring future economic benefits. Strategic management considers intellectual capital as a company's competitive advantage, based on increased performance outcomes, which it argues could be derived from this resource.

However, both disciplines ignore the notion of *"capital"* attached to intellectual capital. Capital as an accounting notion presumes intellectual capital assets should be counterbalanced by an intellectual capital liability (Harvey & Lusch, 1999; Caddy, 2000). Harvey and Lusch (1999: p. 86) note that: "*for every asset entered on the balance sheet in a standard accounting format, there must be a corresponding entry for liability or equity*". Just as knowledge processes, innovation, patents, brands and a host of other intangible assets create value, there are many things that create unrecorded and unrecognized intangible liabilities (Harvey & Lusch, 1999). These include things such as weak strategic planning processes, dangerous work conditions, potential environmental clean-up, product tampering and poor corporate reputation.

Hence, considering intellectual capital only on the assets side implies an assumption that all intellectual capital is transformed into equity, which is myopic (Harvey & Lusch, 1999), because it relies on the assumptions of market efficiency, rational agents and no transaction costs, all of which have been strongly challenged by the appearance of the intellectual capital term (Harvey & Lusch, 1998; Caddy, 2000). Recognizing intellectual capital liabilities is seen as a process of evaluating the down-side of an intellectual capital asset. Intellectual capital liabilities have been mainly connected with evaluating the effect of organizational reputation, even though Petty and Guthrie (2000) observed that reputation is not a part of intellectual capital, but a distinct element. However, estimating the value of intellectual capital liabilities is as difficult as estimating the value of reputation. Having some instructive examples, such as Enron or Skandia, for which the loss in market value has been catastrophic, evaluating the downside of intellectual capital proves to be an even more subjective process than recognizing intellectual capital assets (Harvey & Lusch, 1999; Walker, 2009).

On the same topic of intellectual capital liabilities, there are authors who assert that the terminology of *"capital"* is totally wrongful, given the traditional understanding of the capital and intellectual capital characteristics (Dean & Kretschmer, 2007). The economic concept of capital is a durable result of past production processes, transforming future production, while not being transformed itself. However, intellectual capital, due to its knowledge component, is being transformed while it is involved in the production process. Moreover, the accounting definition of capital presumes ownership, which as previously explained does not apply to all intellectual capital elements. Also, capital is a static concept, while we have seen that intellectual capital is a dynamic element.

In summary, an interdisciplinary approach between accounting and strategic management benefits the understanding of intellectual capital because their complementarity brings a more comprehensive understanding of the way this resource is involved in organizational processes. However, this approach also has limitations in that not all resources that strategic management considers part of the value creation process are measured by the accounting. Also, both disciplines assess the upside effect of intellectual capital and ignore the downsides which might be associated with it.

4. Overview of the empirical literature

The previous chapter presented the theories developed by the accounting and strategic management disciplines regarding intellectual capital measurement and its influence on performance. This chapter looks at the empirical research carried out with respect to these research topics.

The research concerning the influence of intellectual capital on performance within the accounting and strategic management disciplines has two streams: intangible value performance studies and organisational performance studies (Veltri, 2010). The intangible value performance studies inquire how the components of intellectual capital relate to the intangible value created in a company. The organisational performance studies investigate how the components of intellectual capital and the overall value of intellectual capital are associated with various aspects of performance such as economic, financial and market performance. The research on intellectual capital measurement has largely focused on developing various ways to capture intellectual capital. As such, it is usually an adjacent topic to the aforementioned empirical studies analysing the influence of intellectual capital on performance. Hence, the two research topics tend to be co-exist in the empirical literature.

The present chapter describes the two streams of research concerning the influence of intellectual capital on performance and, for each of the stream, emphasises the use of intellectual capital measures. As with the previous chapter, the aim is to present an up to date overview and critique of the empirical research in the accounting and strategic management disciplines.

4.1. Intangible value performance studies

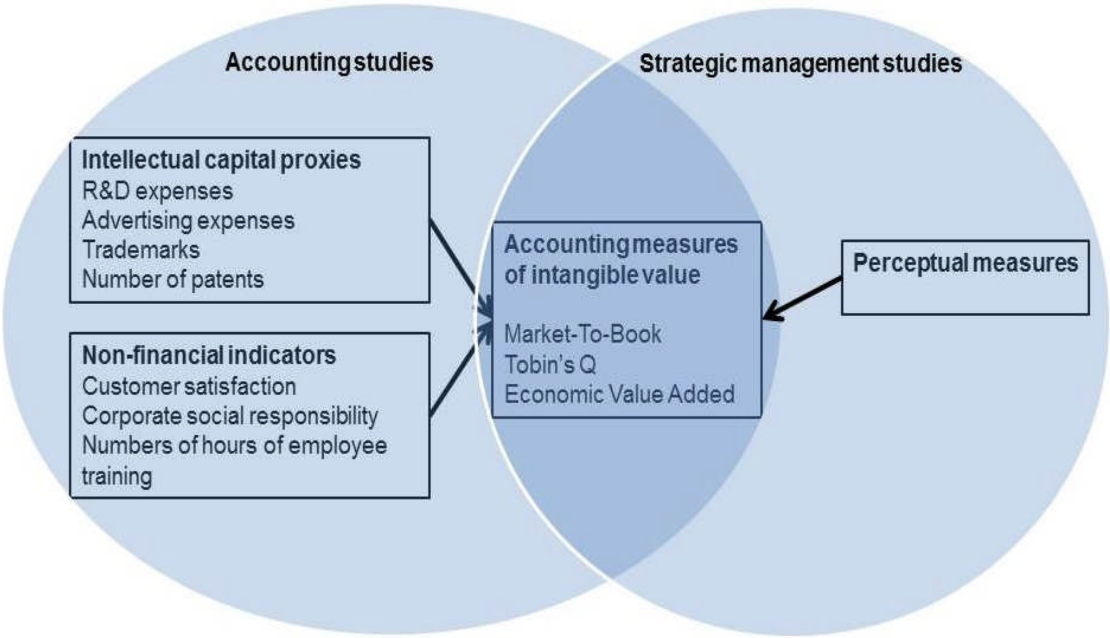
Empirical studies under this stream of research focus on explaining how intangible value is created inside an organisation. To be specific, they try to identify the determinants of intangible value. In order to achieve this goal, they usually analyse the association between the intellectual capital elements and different accounting measures of intangible value, such as Market-To-Book, Tobin’s Q and Economic Value Added etc.

The accounting studies use intellectual capital proxies in isolation of an intellectual capital terminology. Meaning that they use intellectual capital proxies (R&D expenses, IT expenses, advertising expenses, trademarks, patents or brands), but they are not specifically connecting these proxies with an intellectual capital component - human capital, structural capital or relational capital. Only a few studies in the accounting discipline adopt an intellectual capital terminology. These studies estimate the intellectual capital components by making use of non-financial indicators.

The strategic management studies usually use an intellectual capital terminology and empirically develop the measures they utilize to evaluate intellectual capital components. As such, they assess the managerial perceptions on the value of intellectual capital elements, typically on a Likert scale, to construct perceptual or subjective measures of intellectual capital.

Due to the complementarity between the accounting and strategic management approaches the measures used to capture intellectual capital sometimes overlap. This means that accounting studies might use strategic management type measures and vice versa. Figure 4.1 explains the structure of the literature, the measures utilised to capture intellectual capital's value and the relationships analysed. The empirical studies belonging to this stream of research are described in what follows and the concluding remarks identify the perceived gaps in the literature.

Figure 4-1 Intangible value performance studies



Strategic management theories argue that intellectual capital elements should increase intangible value through new and better quality products and processes, improvement of organisational efficiency and an increased capacity to assimilate external knowledge (Parchardis & Varsakelis, 2010). Thus, there should be a positive link between intellectual capital elements and the accounting measures of intangible value. Indeed a large body of empirical research developed by the accounting discipline supports the theoretical argument proposed by strategists.

For example, Connolly and Hirschey (1990), using data from Fortune 500 companies, find a significant effect of R&D intensity on Tobin's Q adjusted by sales. Sougiannis (1994) focuses on the long term effect of R&D expense on market value revealing that over a seven year period of time one dollar R&D expense is related to a five dollar increase in market value, as measured by the Market-to-book ratio. At the macro-economic level, using a panel data of eleven countries, Johesky and Magdinceva Sopova (2013) show that countries with higher R&D investments have a higher value of Tobin's Q value. Similarly, in recent years, a number of studies suggest a positive association between advertising expense and Tobin's Q (Joshi & Hanssens, 2007). Studying 172 Indian companies, Kundu et. al (2008) show that, besides a direct effect, advertising reveals an indirect positive influence on performance as well as increased sales and revenues.

Focusing on another intellectual capital element, Bharadwaj et. al.'s (1999) study found a significant positive association between a firms' IT investments and Tobin's Q based on US data over the period 1988-1993. Belkaoui (2003) criticises the use of Tobin's Q as a measure of intangible value performance because it only accounts for the value produced for the shareholders. He asserts that Economic Value Added is a more reliable measure as it accounts for the intangible value produced for all stakeholders (i.e. customers, suppliers) as well as capturing the value created by a company's activities. Despite the use of a different accounting measure, Belkaoui (2003) discovers a corresponding positive relationship between intellectual capital measured by the number of trademarks and intangible performance.

In contrast, other empirical evidence suggests that because intellectual capital is not recognised in the balance sheet, the market suffers from myopia when it comes to evaluating intellectual capital (Lev,2005). As a consequence, market-based accounting methods might negatively be associated with intellectual capital components. Further, intellectual capital investments have been proven to take several years to payback affecting current and future profits (Aboody & Lev, 1998; Ely & Waymire,1999), which in turn could lead to a negative association between accounting methods using income statement data and intellectual capital elements.

Supporting these claims, R&D concentration defined as R&D expense divided by sales is found to have a negative relation with the difference between market and book value on a sample of 390 US companies (Connolly & Hirschey, 1984). The findings of Hall and Oriani's (2006) panel study of companies from France, Germany and Italy are puzzling in the sense that a positive relationship of R&D with Tobin's Q is found for France and Germany, but not for Italy. According to them, mixed results were obtained due to the countries having dissimilar legal systems which, in turn, lead to different shareholder ownership characteristics inside organisations (Hall and Oriani, 2006).

Taking into consideration these mixed results, some authors have explored the idea that intellectual capital is not beneficial in all contexts. To investigate this, they analysed whether there exists a non-linear relationship between intellectual capital and intangible value performance. A non-linear intellectual capital-intangible performance relationship reveals that intellectual capital has an optimum point up to which it is beneficial for a company. After this point, intellectual capital is unable to add further intangible value (Roos et.al., 2005). Indeed, the findings of Bracker and Ramaya (2011) confirm that R&D expenses and advertising expenses have a non-linear connection with Tobin's Q on a sample of S&P companies from 1975 to 2007.

Furthermore, the mixed empirical evidence accentuates the importance of considering contingency factors. Sullivan (2001) contends that the value added by intellectual capital depends on both internal and external company factors. Industry factors and firm size have been consistently proven to have an influence on the relationship between intellectual capital and intangible value. For example, Chauvin and Hirchey (1993) show that companies in diverse industries have a considerable different relationship between R&D, advertising expenses and Tobin's Q. Also, they point out that within the same industry, there are variations for different sized companies. In a later paper, Connolly and Hirschey (2005) expand this study from a small sample of US companies to a sample of approximately 3100 companies from multiple countries for a five years period (1997-2001). They find similar industry and firm size effects (Connoly & Hirschey, 2005). Notably, large firms experience a marginally higher influence of R&D expenses on Tobin's Q compared to medium-sized and small-sized companies.

Likewise, Parcharidis and Varsakelis (2010) found a positive relationship between R&D investment and Tobin's Q on a panel data study of Greek companies for the period of 1996-2004, with considerable differences in intensity across industries and company size. Nevertheless, contrary to Chauvin and Hirschey (1993) and Connoly and Hirschey (2005), Pacharidis and Varsakelis (2010) discover that the intensity of the relationship is higher for smaller companies. Therefore, the direction of firm size on the link between intellectual capital and intangible value performance is questionable and could depend on other contingency factors.

Furthermore, researchers have advanced the idea that this variation in empirical results is due to the fact that most of the previous studies have concentrated on a single intellectual capital element at a time (Lin & Chen, 2005; Bardhan, 2010). Studying only one variable to account for all intellectual capital elements may wrongly attribute intangible value when using a regression methodology due to omitted variable bias. Analysing computer capital, Brynjolsson and Yang (1999: p.5) state that "*output increases associated with computer capital are not necessarily "excess" returns, but rather reflect returns on a collection of partially unmeasured assets*". Their statement implies that a single variable cannot account for all intellectual capital elements' influence on intangible performance (Brynjolsson & Yang, 1999). Indeed, Megna and Klock's (1993) suggest that using multiple indicators is superior to using only one indicator in constructing an intellectual capital factor.

Nonetheless, when different indicators are analysed in conjunction, the real complexities of studying intellectual capital are revealed. Different variables can be used to capture different aspects of the same intellectual capital element. At the same time, various variables can be used to measure separate intellectual capital components (Lin & Chen, 2005). To illustrate, a few examples are presented below.

Lin and Chen (2005: p.154) derive five measures for what they call R&D performance representing "*different dimensions of the R&D function and its contributions to various aspects of business performance*" : Tobin's Q, patent quality (citations per patent), R&D efficiency (logarithm of number of patents per R&D expense), R&D effectiveness (logarithm of number of citations per R&D expense), R&D efficiency (logarithm of number of citations per R&D expense) and intellectual asset intensity (logarithm of number of patents per total assets). Their study shows that each of these measures have a different ability to reflect R&D intensity, corporate technology concentration, number of patent claims, number of citations made, backward citation time lag, self-citation ratio and innovation originality.

These results are supported by Hall et. al 's (2005) study. They find that three different innovation measures - R&D to assets stocks, patents to R&D and citations to patents - are positively related to intangible value (Tobin's Q). Nevertheless, patent based measures do not have as much explanatory power as R&D based measures, but they do appear to add information above and beyond that obtained from R&D based measures (Hall, 1998; Hall et. al 2005). In contrast, a similar study shows that the number of patents is negatively associated with Tobin's Q, while R&D and number of citations are positively associated (McGahan & Silverman, 2006).

While these studies have measured a single intellectual capital element through multiple variables, Brynjolfsson and Yang (1999) use various measures in order to identify different aspects of intellectual capital. Their results on a sample of 820 non-financial firms from the US show a positive influence of IT spending, physical capital, R&D asset ratio and advertising asset ratio on the market value. Lee et. al. (2006) analyse the impact of R&D expenses, advertising expenses and the number of cited patents on Tobin's Q. They find a positive association between R&D expenses, the number of cited patents and Tobin's Q for a thirteen year sample of Taiwanese companies, but no association with advertising expenses.

A similar finding is presented by Chin et. al. (2004), who analyse average citations, R&D expense, competitors' average R&D expense and advertising expenses. The results on a sample of Taiwanese semiconductor companies from 1990 to 2002 indicate a positive relationship between all intellectual capital elements and Tobin's Q, with the exception of advertising expense. Youndt et. al. (2004) analyse whether there are differences between a companies' Tobin's Q according to the investment profiles in three intellectual capital components: human resource management, IT investment and R&D investment. Their results indicate that the higher the level of investment in the aforementioned IC components, the higher the intangible value created. However, there are differences in intangible performance between companies with different investment profiles: companies which invest more in human capital tend to achieve higher performance (Youndt et.al, 2004)

Overall, the results in this stream seem to depend on how different intellectual capital components are measured. These findings emphasise, on one hand, that different proxies have different abilities to capture various intellectual capital elements. On the other hand, they highlight that a nuanced understanding of intellectual capital is needed by virtue of possible complementarities between the diverse intellectual capital proxies and their ability to capture intellectual capital elements and reveal their interaction (Bardhan, 2010).

As a consequence, consideration of the complementarity and interactions between different elements of intellectual capital would seem to represent an advance in this field of empirical research. In line with this, researchers have shifted their focus towards proving that intellectual capital displays both direct and indirect effects on intangible value. An indirect effect is usually created through the interaction of different elements of intellectual capital and is a feature of both accounting and strategic management based approaches.

In accounting research, R&D and IT investments have been found to show an interaction effect in influencing intangible value (Bardhan et. al., 2010). Individually these intellectual capital elements are positively related to Tobin's Q across firms from different industries for the period of 1997-2004 (Bardhan et. al., 2010), but if the interaction between R&D and IT is taken into account, the positive impact of IT spending on Tobin's Q disappears, indicating that IT investment alone cannot produce intangible value (Bardhan et. al., 2010). In a different study, Lin et. al. (2006) show that R&D intensity needs to be supported by a corresponding commercialisation strategy in order for it to have a positive effect on Tobin's Q.

From a strategic management perspective, Luo and Bhattacharya (2006) analyse the link between corporate social responsibility (CSR), customer satisfaction and intangible performance (Tobin's Q). Using structural equation modelling on multiple secondary datasets from Fortune 500 companies they find that these intellectual capital components have an intricate relationship, depending on a companies' corporate ability (product quality, innovativeness capability). Specifically, CSR reduces customer satisfaction in companies showing low levels of corporate ability and, through this, negatively impacts the intangible value created (Luo & Bhattacharya, 2006).

Likewise, organisational slack has a mediating effect between technology diversity (number of dissimilar patents) and firm intangible value, as measured by three distinct variables: Tobin's Q, Economic Value Added and Market Value Added (Chen et.

al.,2013). Organisational slack reflects firm specific resources which can provide flexibility to create and to generate new resources or to strengthen and extend existing resources. If organisational slack resources are not absorbed by the company, then technology diversification negatively influences all measures of intangible value (Chen et. al., 2013).

So far, all the studies described have examined various intellectual capital elements by making use of terminologies related to this concept. Few studies under this stream have taken an intellectual capital terminology and they usually belong to the strategic management discipline. These studies rely on primary data gathered by means of survey to build human capital, structural capital and relational capital measures. One such study is the paper developed by Sáenz (2005) who creates a human capital indicator by assigning points to ten non-financial indicators according to a multitude of constructed benchmark values for the four companies under investigation. For example, if number of hours of training per employee is a non-financial indicator she gives 100 points to the company with the highest value and proportionally assigns points to the other companies. The data from these companies for the period of 2001-2003 shows that there is a positive association between human capital and market to book ratio, but this relation is not statistically significant (Sáenz,2005).

Another study breaks intellectual capital into the following elements: human capital, innovation capital, organisational capital and relational capital (Tseng & Goo, 2005). Following this IC classification, Tseng and Goo (2005) analyse the Taiwanese manufacturing sector and find a positive relationship between all intellectual capital components and performance. In order to measure IC components, they use managers' assessments of the quota contribution to the corporate value for each of these components. They determine how these measures are related to accounting measures, such as Market-to-Book ratio, Tobin's Q and Value Added Intellectual Capital index. Even though multiple IC measurement methods are used, the differences and similarities between how IC is associated with them is not specifically highlighted. Also, Tseng and Goo (2005) report significant differences in performance between high-tech companies and non-high-tech companies, with the former usually having higher corporate value.

Conclusions

The empirical literature covered in this section reveals mixed results about the ability of IC to affect intangible value. Some studies show a positive relation between intellectual capital components and accounting measures of intangible value (Connoly & Hirschey, 1990; Sougiannis, 1994; Joshi & Hanssens, 2007), while others report a negative association (Connoly & Hirschey, 1984; Ely & Waymire, 1999, Hall & Oriani, 2006;).

Both theoretical and methodological explanations have been advanced to account for these conflicting results. From a theoretical perspective, researchers argue that either intellectual capital is not beneficial in all circumstances for deriving intangible value (Ittner & Larcker,1998; Roos et. al., 2005; Bracker & Ramaya, 2011) or that the intellectual capital-accounting measures relationship is context dependent (Chauvin & Hirschey,1993; Chauvin & Hirschey,2005; Pacharidis & Varsakelis,2010). Factors such as firm size and industry effect have been shown to exert considerable influence on the results obtained. While industry effects are recognised, most of the studies tend to concentrate on high-technology sectors (Hall et. al., 2005; Tsai, 2005; Bardhan et. al., 2010; Braker & Ramaya, 2011; Chen et. al., 2013). Focusing the research on an industry abundant in intellectual capital is an appropriate research technique but it leaves a large gap in understanding how intellectual capital works in low-technology sectors. A more insightful line of enquiry would be to investigate how high-tech and low-tech sectors compare in terms of intellectual capital.

From a methodological point of view, it has been asserted that, for the study of intellectual capital, multiple proxies should be considered to account for its overall character (Megna & Klock, 1993; Brynjolsson & Yang, 1999). Nevertheless, when multiple measures have been considered, empirical evidence has shown that different proxies have a mixed ability to reflect intellectual capital components. Moreover, the ability of a proxy to reflect intellectual capital depends on other measures used in the study.

Some researchers argue that different intellectual capital proxies, non-financial indicators or perceptual measures have a different association with intangible value because they capture distinct intellectual capital elements which are known to interact with one another (Tseng & Goo, 2005). However, because empirical studies rarely use an intellectual capital terminology, it is very hard to associate the interactions between different proxies with interactions between separate intellectual capital components.

Also, it is difficult to fully comprehend how these are reflected by the accounting measures.

As a result, there are three issues which need to be considered: 1) studies have usually concentrated on individual intellectual capital elements 2) when they analyse multiple elements, studies render mixed results and 3) studies in this stream rarely use an intellectual capital terminology. These three issues point to gaps in our understanding regarding the relation between multiple intellectual capital components and the accounting measures of intangible value and these components interaction influence on intangible value.

Studies under this stream of research have considered that accounting measures of intangible value reveal intangible value performance. Other studies have pointed out that they could also refer to organizational performance. As such, these measures are characterized by multidimensionality (Richard et. al.,2009). Under these conditions, a question is raised: are these measures really capturing intellectual capital and its various elements as the theoretical literature suggests?

Analysing previously described research from the perspective that the accounting measures of intangible value are measures of overall intellectual capital value, it shows whether these measure capture a specific intellectual capital element. As such, the association between an accounting measure of intangible value and an intellectual capital element stands proof of these measures ability to capture intellectual capital.

Different measures have different groundings and should, consequently, have a different ability to reflect intellectual capital elements and their interaction. At the same time different intellectual capital elements have a significantly different behaviour which makes them operationally inseparable (Roos et. al., 2005). This could be another possible explanation for the mixed results found in the literature. However, most empirical studies have concentrated on Market-to-book ratio and Tobin's Q, with only a few considering Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital index. Differences and similarities between these measures in capturing intellectual capital have not been analysed before.

In conclusion, in order to advance this stream of research, contingency factors referring to firm size and industry sectors should be taken into consideration. Also, research should consider multiple intellectual capital elements and their interaction.

Finally, given the multidimensionality of the accounting measures of intangible value it should be re-examined whether they capture intellectual capital, its components and their components interaction.

4.2. Organisational performance studies

Concerns under this stream of research are similar to the ones described for the intangible value performance studies, in the sense that different intellectual capital elements are analysed separately, context issues are raised as well and diverse interactions are revealed. Nevertheless, the focus is no longer on the intangible value created, but on different aspects of performance be they economic, financial and market performance. Organisational performance studies have focused on the influence of individual elements of intellectual capital as well as its overall effect. Studies which focus on separate intellectual capital elements rely on measures, such as intellectual capital proxies, non-financial indicators and perceptual measures. At the same time, studies emphasising the overall effect of intellectual capital capture its value using accounting measures of intangible value. In order to highlight the differences in results, this section divides organisational performance studies by the measurement method employed to capture intellectual capital value.

4.2.1. Intellectual capital proxies, non-financial indicators and perceptual measures

These studies tend to approach the subject of intangibility from an intellectual capital perspective, and use a diverse range of methodologies from regression to factor analysis and panel data. Research under this stream brings insight into developing aggregate measurements to assess the interaction of different intellectual capital components. Also, it proposes various potential value creation processes through which intellectual capital could influence performance in different contexts.

Traditionally, performance is known to represent the financial returns to a firm's owners from the use of tangible resources (Bontis, 2001; Dean & Kretschmer, 2007). Recent theoretical developments in strategic-management specifically the resource-based theory of the firm, the knowledge-based theory of the firm and dynamic capabilities theory emphasise the importance of intangible resources, such as intellectual capital, in determining a firm's performance alongside existing tangible resources (Marr & Roos, 2005). More specifically, these theories assert that higher intellectual capital value directly translates into higher performance in all aspects of organisational well-being (Murthy & Mouritsen, 2011; Kianto et. al., 2013).

First, intellectual capital has been recognised to represent a third factor of production to generate value along with physical and financial resources (Gu & Lev,2003). Subsequently, authors suggest that intellectual capital investment allows the company to enhance its economic performance beyond what is produced by physical and financial resources (Cappelletti & Khouatra,2004) through lower production costs and/or increased operational margins (Nakamura, 2001).

Second, because intellectual capital is believed to be a source of competitive advantage a company should have the ability to invest in this resource to earn a certain level of profit (Zeghal & Maaloul, 2010). For this reason, intellectual capital is believed to influence financial performance.

Finally, the gap between market and book values indicates that investors perceive intellectual capital as a valuable resource for a company, even though it is largely excluded from the balance sheet (Skinner, 2008). In this context, investors should place higher value on companies with greater intellectual capital (Firer & Williams, 2003; Chen et. al., 2005). Therefore, there should be a positive association between market performance and intellectual capital.

On the one hand, empirical research in strategic management confirms these performance based arguments whenever they study individual intellectual capital elements. For example, Gates and Langevin (2010) and Lim et. al. (2010) demonstrate that human capital is positively associated with an aggregate firm performance scale of both organisational and market performance and relational capital, represented by customer satisfaction, is found to be positively associated with market performance (Ittner & Larcker, 1998).

In contrast, accounting research on the relation between different intellectual capital elements – human capital, structural capital and relational capital - and various aspect of performance is decidedly mixed. Black and Lynch (1996) found a positive relationship between human capital and organisational performance - an increase in human capital of 10% as measured by the cost of investment in training brought about productivity growth of 9% in the manufacturing industries and 13% in other types of firms (Black & Lynch, 1996). Similarly, human capital approximated by salary expenses is found to have a positive and statistically significant relation with market performance (Gavious & Russ, 2009). In contrast, Bell et. al. (2002) show that human capital estimated by employee stock option expense is negatively associated with future abnormal earnings.

With respect to structural capital, Chan et. al (2001) found that firms with high R&D earn only marginally higher returns than those with low R&D because high R&D investments are associated with high returns volatility. In contrast, the stock market response to an increase in R&D investment is positive in a Finish context with a firm's stock return being positively associated with both contemporaneous R&D investments and past ones (Kallunki & Sahlström, 2003). Comparing short-term and long-term effects of R&D expenses, Ho et. al (2005) find that intensive R&D investment contributes positively to 1-year stock performance for manufacturing firms but not for non-manufacturing sectors. However, when testing 3-year stock market performance, the authors find no statistically significant relationship. In a similar vein Hall and MacGarvie (2009) test the influence of software patentability on market performance. They conduct an event study to look at the immediate market changes when patents are announced. Their findings indicate that investors' initial reaction to patents announcements is negative.

When the attention is turned towards organisational performance rather than market performance, the results indicate a positive influence of structural capital elements. Wang and Wu (2012) reveals that R&D is positively associated with operating income to sales on a sample of information and electronic industry companies from Taiwan, regardless of the firm's position in the industry value chain (up, mid, down) and the business type (own brand manufacturing or original equipment manufacturing). This relationship was tested previously by Aboody and Lev (2001) on 83 publicly-traded chemical companies from 1980 to 1999. Their results showed that a dollar invested in chemical R&D increases current and future operating income by two dollars.

The influence of relational capital on organisational performance is not as clear cut as the influence of structural capital. Frankeber and Graham (2003) study six recession periods and find that increases in advertising expenditure improve firm performance before and after recessions. In their study, advertising expense has a positive effect on market performance irrespective of the company characteristics and industry sector analysed. Nonetheless, Srinivasan and Lilien (2009) using a panel of 3804 publicly listed US firms from 1969 to 2007 find that increases in advertising spending improved profits for business-to-business and business-to-consumer, but not for service firms.

Further insights into the divergent results in both accounting and strategic management research can be gleamed when the influence of numerous intellectual capital elements is analysed. Some studies find that all intellectual capital elements have a positive connection with performance. For example, Bontis (1998) provided empirical evidence that supports a positive impact on organisational and market performance of all intellectual capital elements, in the first study on the effect of intellectual capital as an integrated construct on performance. Other studies suggest that only some elements have a positive link with performance, while others show a negative link. To illustrate, Deeds and Decarolis (1999) study the following intellectual capital elements: products in the pipeline, firm citations and patents, location, alliances and R&D expenditure. They find that only products in the pipeline, firm's citation and location are important to firm's market performance of biotechnology companies.

Finally, there is another body of empirical evidence indicating that there is no connection between intellectual capital components and performance. Malina et. al. (2007) statistically test, through the Granger causality methodology, whether there are cause and effect relationships between organisational performance and eleven non-financial intellectual capital indicators, measured in separate branches of a Fortune 500 company's North American distribution channel. They discover that there are no clear statistical cause and effect relationships between the non-financial measures of intellectual capital and performance, even though managers still perceive these measures beneficial for control purposes.

In order to be able to correctly allocate resources and improve performance, managers need to validate intellectual capital in a decision making context which highlights the value creation process (Lev et. al., 2007). Intellectual capital elements have a complex inter-relationship to one another and to performance. As such, it is not sufficient to merely analyse all intellectual capital elements in the same model, there is also a need to study interactions between the different IC elements (Rivkin, 2000; Siggelkow, 2002; Bontis & Stovel,2002). To address this knowledge gap, researchers have begun to explore various possible combinations of IC elements.

Some of these studies rely on accounting data and study intellectual capital interactions by introducing a cross-product element into the model. For instance, after controlling for firm and industry characteristics, Huang and Liu (2005) find that innovation (R&D expense) and IT investment have a positive interaction effect on return on assets and return on sales amongst a sample of 297 Taiwanese firms. In a

German study, Bollen et al. (2005) found that all components of intellectual capital have a significant influence over intellectual property (IP), and that IP has a significant direct positive relationship with performance. This demonstrates that intellectual capital can have an indirect relationship with performance as well as a direct one. Hsu and Wang (2012) show that dynamic capabilities almost completely mediate structural capital's effect on organisational performance. They consider the dynamic capabilities to be represented by R&D and marketing expenses. The value creation process described by them is: intellectual capital influences dynamic capabilities which in turn impact different types of performance.

Other empirical research similarly utilises accounting data, but it relies on a factor analysis procedure in order to determine various groupings of intellectual capital elements. From a methodological point of view, a factor analysis procedure implies that if different variables refer to the same underlining concept, they will load on the same factor (Field, 2005). Nevertheless, a variable can load into different factors. Consequently, it will show how intellectual capital elements interact to create its components and, ultimately, how these components are bound up together. These factors are regressed against performance measures to determine their effect on performance.

Li and Wu (2004) take a clear intellectual capital perspective and construct aggregate measures of human and structural capital following a factor analysis procedure. They find a positive influence of both components on a performance scale developed using total profits, sales growth, profit growth and return on total assets. Adding further depth, Wang and Chang (2005) divide intellectual capital components in human capital, innovation capital, process capital and customer capital. They find that, with the exception of human capital, all intellectual capital elements positively affect business performance with human capital having an indirect effect on performance through the other elements of intellectual capital. Also, this study reveals that there are causal relationships between the different types of intellectual capital: human capital affects innovation capital and process capital, while innovation capital affects process capital, which in turn influences customer capital and firm performance.

Nevertheless, most studies exploring intellectual capital interactions come from the strategic management discipline and use primary survey data and factor analysis to investigate how different intellectual capital elements are interrelated. Following this methodology, Arvanitis (2005) explores how firm productivity is enhanced by computerisation, new workplace organisation and skilled labour. Computerisation, organisation and skilled labour are assessed through the construct of dummy variables of different indicators. Composite indices obtained by means of factor analysis for technology, organisation and human capital have a statistically significant positive direct influence on productivity. Technology seems to be the element which adds the most value, followed by human capital and organisational factors. Also, there is a complementarity between technology and human capital which further enhances performance.

Kamukama et. al. (2010) examine of the effect of different intellectual capital elements and how they fuse to affect financial performance in microfinance institutions. They discover that the size of human capital effect on performance depends on structural capital and relational capital. No significant interaction between structural capital and relational capital was established in the study. Organisational performance was measured through a complex scale covering financial performance ratios of portfolio at risk, net profit ratio, loan loss recovery ratio, repayment rate, yield on portfolio and return on assets.

Ravichandran and Lertwonsatien (2005) present a value creation process for information system resources and capabilities. Their results indicate that information system human capital, IT infrastructure and information systems partnership quality influence information systems capabilities. In turn, information system capabilities determine IT support for core competencies. Through this channel they manage to influence positively both organisational and market performance. Organisational performance was constructed as an aggregate scale to assess the extent to which data of profitability, productivity, and financial performance exceeded those of their competitors in the past three years. Market performance was measured as a three-item scale that assessed the success of the firm in entering new markets and in bringing new products and services to the market during the past three years. For study reliability, the authors used actual performance measures as well, such as return on assets to account for organisational performance and sales growth to account for market-performance. The value creation process identified provides empirical support for the notion that information system resources have the potential to improve both organisational and market performance when its capabilities are channelled to develop distinctive firm competencies (Ravichandran & Lertwongsatien, 2005).

Cohen and Kaimenakis (2007) analysis starts from suggesting scales for intellectual capital components, such as human capital, structural capital and organisational capital. However, after carrying out factor analysis they conclude that intellectual capital elements do not combine clearly into these hypothesised categories but the factor loadings suggest a grouping according to whether intellectual capital is hard, soft or functional. For Greek medium sized companies, hard intellectual capital is positively associated with profit and functional intellectual capital with sales per employee. No other significant relation is discovered between hard, soft and functional intellectual capital and organisational performance measured by profit and sales per employee (Cohen & Kaimenakis, 2007).

This research on complementarities reveals that intellectual capital adds value whenever there is an adequate combination of its elements (Bukh, 2003). As such, the influence of an intellectual capital component on performance is tightly connected with the other intellectual capital components involved in the value creation process. Moreover, the studies on complementarities highlight the importance of studying the net effect of all intellectual capital components on performance.

Further advancing this stream of research, some authors claim that intellectual capital should be contextualized, in order to clarify its impact on performance. Through a survey study using principal component factor analysis and OLS regressions, Hoque (2005) shows that for 52 New Zealand manufacturing companies, non-financial aspects pertaining to intellectual capital are most useful in improving organisational performance in conditions of uncertainty. Further, Banker and Mashruwala (2007) show that environmental competition has a mediating effect on the relationship between employee satisfaction, customer satisfaction and performance (earnings). As with the previous stream of research, industry effects are found to exert considerable influence on the link between intellectual capital and performance (Subramaniam & Youndt, 2005; Cabrita & Bontis, 2008)

<u>Conclusions</u>

As with the previous stream of empirical research, studies investigating the IC indicators- performance link show mixed results, which often contradict the theoretical underpinnings of intellectual capital stating that it represents a company's competitive advantage (Ittner, 2008; Veltri, 2010). If intellectual capital is theoretically defined as representing a firm's competitive advantage, there should be a positive influence of this resource on all the aspects of organisational well-being. Nevertheless, a negative association between intellectual capital elements and various performance aspects is revealed by some of the empirical evidence.

Some authors argue the mixed results show that different components of intellectual capital are not performance relevant in all contexts, they are not equally important and they may affect performance in different ways (Bontis, 1998; de Pablos, 2004). Other authors assert that these inconsistencies are to be expected because intellectual capital is idiosyncratic and its elements combine in a unique manner in different organisations according to their context (Reed et. al., 2006). This argument is supported by studies analysing intellectual capital interactions which indicate that value is created whenever there is an adequate combination of intellectual capital elements (Bukh, 2003). Hence, interaction effects should be considered in determining the impact of intellectual capital on performance. The literature recommends an alternative methodology of analysing interactions through a factor analysis methodology (Kamukama et. al., 2010). Factor analysis is used from a necessity to summarise data of various intellectual capital elements into overall measures of its components (Field, 2005). While at the beginning, factor analysis used to be designed to create perceptual measures, recent advancements in the literature show that factor analysis can be employed using publicly available accounting data (Wang & Chang, 2005; Li & Wu, 2006; Hsu & Wang, 2012).

An alternative explanation for these mixed results rests on the elusive concept of performance in academia (Firer & Williams, 2003). The disagreement rests on the fact that authors are not very specific about what aspect of organisational well-being they are trying to measure: economic, financial or market performance (Firer & Williams, 2003). Generally, empirical studies in this stream of research have analysed the relation between a single intellectual capital element and separate performance aspects, or multiple intellectual capital elements and aggregate measures of performance. Only a few studies analyse multiple intellectual capital elements' influence on multiple **<u>separate</u>** performance aspects (Richard et. al., 2009). Most studies create a composite measure of performance through factor analysis, making it unclear what aspects of performance intellectual capital influences and how. Moreover, some studies which use composite performance measures do not distinguish between market and organisational performance, despite empirical evidence which emphasises the two types of performance are separate concepts (Richard et. al., 2009; Haslam et.

al. 2010). This leaves a large gap in understanding the value creation process of IC with regard to different aspects of performance.

This performance based literature also makes it clear that researchers should make a clear distinction between market and organisational performance (Lev & Radhakrishnan, 2003; Ludewig & Sadowsky, 2009; Piekkola, 2009). Moreover, they imply a possible connection between the two areas of performance as follows: intellectual capital creates organisational value which translates into a high market valuation (Ludewig & Sadowsky, 2009). While having the merit of emphasising the fact that organisational and market performance are separate performance aspects, the suggested direction of causality is not so straight forward. There is evidence that investors suffer a form of myopia regarding intellectual capital (Lev,2005). This means that even if intellectual capital increases organisational performance, this aspect might not be incorporated into market values by investors. Therefore, besides clarifying intellectual capital's relationship with various aspects of performance, an interesting research avenue would be to discover the connection between organisational and market performance regarding intellectual capital.

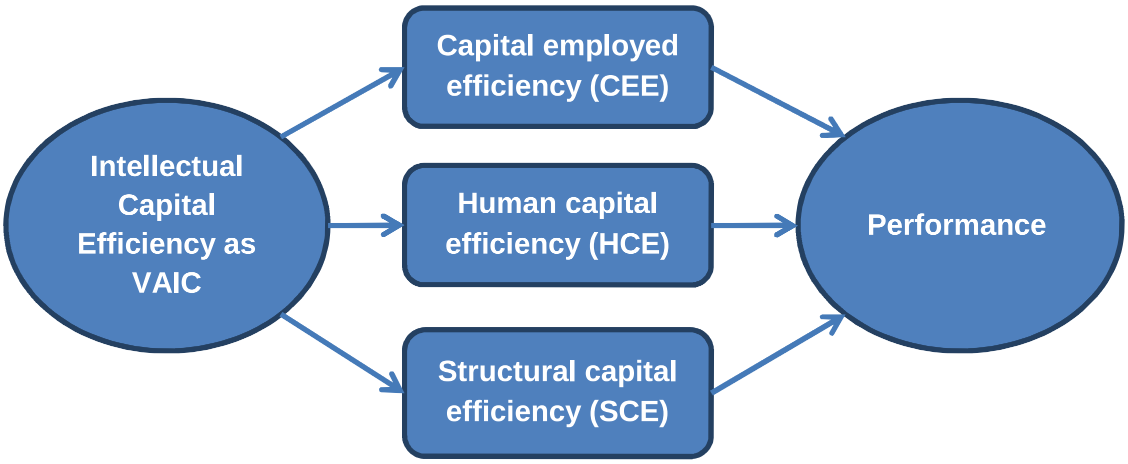
Another facet of the research is the concentration of analysis on high-technology and high-knowledge intensive industries (Ittner, 2008). While industry differences are highlighted, there is little knowledge or understanding of how intellectual capital influences market and organizational performance in low-technology and low-knowledge intensive sectors, nor how the intellectual capital-performance relationship differs between high-knowledge intensive and low-knowledge intensive companies. Despite this, the research base offers strong grounds to support the view that the impact of intellectual capital is context dependent and suggests that firm and industry characteristics should be included in the modelling of the relationship (Hoque, 2005; Banker & Mashruwala, 2007).

4.2.2. Accounting measures of intangible value

The previous section has detailed the empirical literature on the performance effects of different elements of intellectual capital as captured by different IC proxies, non-financial indicators and perceptual measures. This section reviews the performance literature as it pertains to the overall value of intellectual capital as captured by accounting measures of intangible value. This stream of organisational performance studies is scarcer than the one presented above. The papers which use accounting measures of intangible value tend to be concentrated around the Value Added Intellectual Capital Index (VAIC) method developed by Pulic (1998).

The VAIC method has become very popular due to its straightforward calculations, availability of reliable audited data and easy comparison across various industry sectors (Pulic, 2004). It is an efficiency measurement method that separates intellectual capital into capital employed, human capital and structural capital. In the empirical studies, the impact of IC on performance is determined either by using the overall VAIC measurement or by dividing VAIC in components and analysing each component's influence on performance. This conceptual framework on which the researchers formulate their hypothesis is presented below.

Figure 4-2 Value Added Intellectual Capital Index studies, adapted after Makki & Lodhi, 2009



The evidence regarding the influence of intellectual capital on performance using VAIC usually presents a positive relationship between the two elements (Pulic, 2004; Kujansivu & Lonnqvist, 2005; Chen et. al., 2005; Shiu, 2006). Nonetheless, when VAIC is divided in its components, the results are mixed and the findings are somewhat contradictory. The studies offer little comparison because they rarely use the same performance measures or the same control variables. Nevertheless, compared with the studies described in the previous sections, research using VAIC analyses all types of performance separately.

Ting and Lean (2009) analyse the relationship between VAIC and return on asset (ROA) as a measure of performance in a Malaysian context. Their analysis found that human capital efficiency (HCE) and capital employed efficiency (CEE) have a positive influence on performance, while structural capital efficiency (SCE) has a negative influence. Clarke et. al. (2011) used more variables to measure various aspects of performance: return on assets, return on equity, revenue and employee productivity. Their results, based on Australian companies, indicate that VAIC is positively associated with all performance measures although it has very low explanatory power for revenue growth. HCE and CEE are significantly and positively associated with all performance measures, the only exception being the relationship between CEE and revenue growth. However, SCE is not significant in explaining the value of any of the performance measures.

Tan et. al. (2007) consider that the value of ROA is already a component of the VAIC measure through the CEE component. Therefore, using ROA as a measure of performance, in their opinion, affects the reliability of the results. Instead they focus their study on return on equity, earnings per share and the annual stock return to measure companies' performance. Their results confirm a positive association between IC, IC components efficiency and all performance aspects.

These results are not confirmed in evidence from Pakistan; Makki and Lodhi (2009) find a positive relationship between CEE, HCE and profitability (net profit), but a significant negative relationship between SCE and performance. The relationship between SCE and performance starts becoming negative towards the end of their analysis period (2002-2006), showing that the economy started to rely more on "*soft intangibles*", such as human capital. Appuhami (2007) finds a negative relationship between capital employed and market annual returns, showing that investors in Thailand do not perceive the information about the capital employed valuable in the banking, finance and insurance sectors.

Frier and Williams (2003) found weak positive associations between CEE and SCE and measures of profitability (return on assets), productivity (turnover of total assets) and market valuation (market-to-book ratio of net assets). However, they find significant negative associations between human capital efficiency and the performance measures. Similar analysis by Chan (2009) support Firer and Williams's conclusion that the association between the VAIC and performance is weak and inconclusive given that different components of the measure affect performance in different ways.

Chen et. al. (2005) follow the research design of Firer and Williams (2003) and add research and development and advertising expenses as explanatory variables. The argument behind this being that they bring additional information, not captured by the structural capital value added variable. Another reason behind their amendment is that research and development and advertising expenses are subtracted from the computation of the value added, which is a key component in deriving the VAIC value. In contrast with the previous study, the results on the analysis of 65 Taiwanese companies, between 1992 and 2002, prove that intellectual capital components positively influence market performance (market-to-book ratio), economic performance (sales growth rate and net value added per employee) and financial performance (return on asset, return on equity,).

Tan et. al. (2007) prove that the mixed results disappear when the analysis is conducted on separate industries. They found that intellectual capital is more important in knowledge intensive sectors, such as Services or Property, and less important for sectors less reliant on knowledge, such as Manufacturing and Trading. On the same note, Daniel Zeghal and Anis Maaloul (2010) analyse VAIC model in an UK context and prove that there are differences between the industry sectors (high-tech, service and traditional). However, in their study the direction of intellectual capital impact on various performance measures is generally the same.

Another reason behind the mixed results could be that companies focus on different elements of intellectual capital when implementing their strategy. For example, Mavridis (2004) makes a comparison between Japanese banks and analyse how much each VAIC component contributes to the overall value. He founds that companies which have a high human capital efficiency element tend to get a higher overall VAIC, while the ones which rely on physical assets do not seem to attain above average performance. The same conclusion is drawn by Goh (2005) from empirical research on Malaysian banks after the implementation of a national policy of investment in knowledge assets and intellectual capital in 2001. In contrast, a similar study on 98 Indian banks for a period of five years (2000-2004) Kamath (2007) notices that the best performing companies are the ones which rely less on human capital and more on technology.

All the studies described above emphasise that the authors preferred to divide VAIC in its components instead of focusing on the overall value of intellectual capital. Also, they show that the influence of the VAIC components on performance vary from one study to another creating confusion about the net effect of the VAIC components.

Studies using alternative IC measurement methods for this second stream of research are limited. A study by Villalonga (2004) uses Tobin's Q as a measure of intangibility of a company and assesses its impact on performance. Using a dynamic panel data regression model, she found that companies' intangibility has a positive influence on the sustainability of profits as long as profits are positive. Also, she shows that intangibles could have a detrimental effect for the companies with negative profits because they can lock the companies in persistent disadvantages (constant negative profits).

Huang and Wang (2008) have focussed on the Economic Value Added measurement method. They analysed whether this method can better explain the variations in a firm's market performance compared with residual income. They found no difference in the explanatory power of market performance between the two measures for a sample of 37 Taiwanese listed companies. Also, they found that, if a proxy of IC (R&D expenditure) is added, the explanatory power of both measures increases.

Another exception in the literature is the study of Kujansivu and Lonnqvist (2007) on approximately 20000 Finish companies during the period 2001-2003. This study analyses the correlation between IC efficiency measured by the Value Added Intellectual capital index and IC value as measured by the Calculated Intangible Value method. They find a weak positive correlation between IC value and IC efficiency but with significant differences across industries. The correlation is much stronger in knowledge intensive industries like technology and business services.

As a result, there is limited evidence on how the other accounting measures of intangible value, besides VAIC, model the link between intellectual and performance. Also, there is little or no empirical investigation of the differences and similarities between these methods: which one is more efficient in predicting performance and how they differ across various industries. Moreover, the literature does not explain what VAIC characteristics directed them to choose this accounting measure particularly to capture intellectual capital. Finally, because some studies link the accounting measures of intangible value with performance independent of their ability to capture intellectual capital, there is a need to understand whether these measures ability to predict performance is in line with their ability to capture intellectual capital.

Conclusions

The literature on organisational performance studies, which analyse the influence of overall intellectual capital value on performance, is scarcer than previous streams of research. As a result, this literature has considerable gaps and much scope for further analysis. Studies under this stream largely concentrate on the Value Added Intellectual Capital Index as a measure of overall intellectual capital value. This leaves a large gap in understanding how other accounting measures of intangible value model the link between intellectual capital and performance. Additionally, the accounting measures of intangible value have been intensely criticised from a theoretical point of view with little empirical proof (Andriessen, 2004a; Sveiby, 2005). Financial statements- based measures have been especially criticised for being past oriented (Bontis, 2001; Levy & Duffey, 2007). As a result, it is believed they are unable to aid decision making due to the fact that they cannot be used to predict performance (Atkinson & Brown, 2001). There is a need to validate the theoretical criticism surrounding the accounting measures of intangible value in an empirical context.

Further, there has not been any comparison of the ability of these disparate accounting measures to link intellectual capital with performance. A comparison between different accounting measures will bring a wide understanding of these measures efficacy and usefulness.

Finally, the accounting measures of intangible value have been created due to the necessity to capture all intellectual capital value in a single quantitative number. Instead of exploring this advantage, studies under this stream divide VAIC in components leaving a large gap into getting a grasp of what is the effect of the overall intellectual capital value on performance.

While there are some large gaps in this stream of research, there is also some valuable empirical evidence. First, this stream reinforces the argument that intellectual capital is not connected with all types of performance in the same way. The empirical research shows that the relationship between intellectual capital and performance varies depending on the intellectual capital component utilised and on the aspect of performance under analysis. Second, compared with previous research streams, studies under this stream highlight much better the fact that different types of performance should be studied separately.

Chapters 3 and 4 presented the theoretical and empirical evidence on intellectual capital measurement and its influence on performance in the accounting and strategic management disciplines. These chapters gave a balanced assessment of the literature developed in both disciplines and derived the gaps of a wide and divided literature. The next chapter will build on the literature described in these chapters and provide a brief summary of the gaps identified in the literature in order to set out the research objectives of the thesis.

5. Research objectives

Intellectual capital is widely believed to be the central factor to achieving competitive advantage and to have performance enhancing properties in the knowledge economy (Wall et. al., 2004; Joia, 2007; Tayles et. al., 2007). The multiple definitions of intellectual capital and multiple classifications of its components, bring into light the multifaceted dimensions of this resource. As such, intellectual capital is abstract, immaterial, complex and different from the traditional assets, in that it is not fully owned and controlled by the company (Spender et. al., 2013). For this reason, this resource and its involvement in the value creation process needs to be better understood (Grojer, 2001; Dumay, 2009). In order to be able to quantify the contribution this resource is making to the organizational performance, intellectual capital needs to be measured (Dumay, 2009; Spender et. al., 2013).

Because the main task of the accounting profession is to provide users with information that allows them to understand organizational performance (Barth et. al., 2001), there is an increased demand for accountants to explain the value added by intellectual capital (de Villiers et. al., 2014). As a consequence, the accounting profession has suggested various solutions to the measurement of intellectual capital: intellectual capital proxies, accounting measures of intangible value and non-financial indicators.

However, as presented in Chapter 3, the accounting suggested solutions for the measurement of intellectual capital face some challenges. One such challenge is the fact that these solutions have limitations inherent to their construction. Some researchers argue that the intellectual capital proxies and the accounting measures of intangible value are biased due to different accounting practices across industries, inappropriate expensing of some intellectual capital elements and a failure to reflect opportunity costs and risk (Hirschey & Wichern, 1984). Nevertheless, intellectual capital proxies and the accounting measures rely on audited information, which is objective, verifiable and comparable (Maditinos et. al., 2011). Their use is justified on the grounds that it relies on the best currently available data accounting can provide on intellectual capital. Additionally, some researchers support the use of intellectual capital proxies and accounting measures of intangible value over non-financial indicators (Firer & Williams, 2003). Non-financial indicators are believed to be highly subjective and to have limited comparability and generalizability as they present only the information considered relevant by the managers (Caddy, 2002; Sveiby, 2005).

Another challenge of using accounting methods to measure intellectual capital is the mixed empirical evidence on the performance enhancing properties of intellectual capital (Ittner, 2008). Some researchers find a positive connection between intellectual capital and performance (Aboody & Lev, 2001; Gavious & Russ, 2009; Wang & Wu, 2012), while others find a negative one (Chan et. al., 2001; Bell et. al., 2002; Hall & MacGarvie, 2009).

All these aspects cast a shadow on the ability of the accounting discipline to measure intellectual capital and explain the value created by this resource and raises a couple of questions which need to be addressed. First, how far do the limitations of accounting measurement solution for intellectual capital expand and how do they impact the accounting ability to capture intellectual capital? Second, given the necessity to explain the value creation process, how does the choice of intellectual capital measure support this understanding? Finally, taking into consideration the previous two questions, which one of the accounting methods to measure intellectual capital is the most useful in capturing this resource and linking it to performance? In line with these questions, this thesis aims to "*take a step back*" from the common research in the field and get an insight into the "*black box"* of the measurement of intellectual capital, with the final purpose to aid the modelling of the relationship between intellectual capital and performance.

As with the accounting discipline, the strategic management discipline has been similarly interested in measuring intellectual capital and determining the impact it has on performance. Nonetheless, strategic management has developed its own perspective on capturing the value of intellectual capital. Researchers argue that interdisciplinary research between accounting and strategic management has benefits for the business environment at large (Tayles & Ma, 2009) and specifically for the study of intellectual capital (Spender et. al., 2013), as it brings together two complementary perspectives. For this reason, this thesis takes an interdisciplinary approach between accounting and strategic management and enquires how the accounting discipline can improve the measurement of intellectual capital by taking a strategic management stance on the topic.

Nevertheless, the focus is still on the accounting discipline and the measurements it suggests. Specifically, due to difficulties associated with the non-financial indicators data collection and the limitations imposed by the study of these measures (small samples, cross-sectional or longitudinal methodology); this thesis concentrates on intellectual capital proxies and the accounting measures of intangible value which use publicly available accounting data. This will facilitate the study of a large number of companies and the use of a panel data methodology.

The literature review of the empirical research evidence on the link between intellectual capital and performance has revealed that researcher's concerns vary, usually without any continuity from one stream of research to another. Different methodologies, intellectual capital measures and performance measures are being used in the studies, which limits comparison and the creation of logical connections between different complementary studies. Furthermore, comparable studies are rendering mixed results. Consequently, the literature is disconnected and scattered. As a result it hinders the understanding of intellectual capital. Hence, there is a necessity to take a holistic approach on the matter, which can reconcile the different suggested accounting solutions for the measurement of intellectual capital with the performance aspects analysed.

Characteristics of the sample used, measurement errors, and failure to control for other industry and firm-specific factors that influence firm performance have been cited as the primary reasons for the contrasting results (Bharadwaj et. al., 1999). Nevertheless, no study up to this point has explored the potential explanation that mixed results could be also a factor of the intellectual capital measurement used in the studies and their ability to model the association between intellectual capital and performance (Lin & Chen, 2005).

Levy and Duffey (2007) argue that a good intellectual capital measure should: 1) be clear about the resource(s) it is measuring and 2) facilitate a clearer understanding of the performance outcomes. With respect to the first criteria, the intellectual capital proxies are clear about what resources they are measuring, in that they can be clearly associated with an intellectual capital element. However, it is less clear what intellectual capital elements the accounting measures of intangible value are capturing, because they are meant to capture the intellectual capital overall value. As such, the first research objectives is to investigate how the accounting measures of intangible capture intellectual capital and its different elements - human capital, structural capital and relational capital.

In relation to the second criteria, it has been suggested that the mixed results found in the literature could be related to the analysis of different performance aspects (Firer & Williams, 2003) and/or various intellectual capital element studied (de Pablos, 2004). On one hand, it is believed that different intellectual capital elements have a dissimilar behaviour in influencing the same aspect of performance (Roos et. al., 2005). On the other hand, it is argued that the same component of intellectual capital can influence different aspects of performance in various manners (Bontis, 1998; de Pablos, 2004;) In order to investigate which one of these explanations is possible, if not both, the second objective of this thesis is to determine whether intellectual capital elements are equally beneficial for a range of traditional performance aspects: economic, financial and market performance. It first examines this topic by modelling the link between intellectual capital elements and performance by using intellectual capital proxies. It then sets out to model this association with the help of accounting measures of intangible value.

Finally, the last objective of the thesis is to compare and contrast how the intellectual capital proxies and the accounting measures of intangible model the association between intellectual capital and performance. This comparison will determine whether the accounting measures of intangible value ability to predict performance depends on their efficacy in capturing intellectual capital.

The next chapters will describe the methodology used to address the research objectives, present overview of the core data sample used in the thesis and proceed to the empirical analysis.

6. Methodology

The thesis has introduced the intellectual capital concept, described the theories in accounting and strategic management disciplines referring to this resource, reviewed the existing empirical research and formulated the research objectives, based on the gaps identified in the literature. In what follows, the methodology used to address the research objectives will be detailed in two parts. First, variables and measures employed in this study are going to be presented. Second, a justification for the choice of methodology will be provided and the research design will be described.

6.1. Variables and measures

6.1.1. Intellectual capital measurements

Both theoretical and empirical research has been undertaken on intellectual capital in recent years. Measuring and managing intellectual capital (IC) is considered to be important for a company's long-term success, and, thus, numerous IC indicators have been created to estimate intellectual capital components (Hsu & Wang, 2012). While the literature has been abounds of perceptual measures for intellectual capital, this thesis concentrates on accounting and publicly available information, which can be used to estimate intellectual capital elements. A review of the indicators employed in empirical research for each IC component is provided below and the choice of intellectual capital measurement for the purpose of this thesis is explained.

Human capital represents the value added brought by employees to a company. It constitutes workforce considerations, such as employee satisfaction or staff stability (Montequin et. al., 2006) and specific elements referring to employees' knowledge, know-how and expertise, abilities and competences (Nazari & Herremans, 2007). In order to reflect the value of this element, previous studies have captured human capital using a range of indicators: number of employees (Li & Wu,2004; Wang & Chang,2005), average share of skilled or educated employees (Ludewig & Sadowski, 2009; Hsu & Wang, 2012; Arvanitis, 2005), average years in service (Wang & Chang, 2005), change in the number of employees (Sáenz, 2005), employee productivity (Youndt et.al., 2004; Wang, 2008; Hsu & Wang, 2012;) the value of investment in human resources (Peneder, 2002) and/or the value of wages paid to the employee (Marrano & Haskey, 2006;Ting & Lean, 2009; Ludewig & Sadowski, 2009; Gavious & Russ, 2009).

Some of the indicators used to comprise human capital are thought to have the ability to capture other organizational aspects outside intellectual capital area. For example, the number of employees has been used in other studies to highlight the size of the company (Huang & Liu, 2005; Chen et. al. 2013). On the same note, employee productivity is thought to be an aspect of organizational performance (Wakelin, 2001; Cohen & Kaimenakis,2007; Clarke et. al. 2011). Other indicators, such as average educated employees, years in service and the change in the number of employees could lead to potential distorted conclusions (Davenport & Prusak, 1998). The fact that an employee is educated does not necessarily mean he is educated specifically for his job and he has more knowledge for successfully fulfilling his tasks. The average years in service could, on one hand, show employees loyalty to the company and his commitment to improve organizational intangible value, but on the other hand, it could signal difficulties in the job-market over that period. A similar explanation is valid for the change in the number of employees.

The value of the wages is inferred to be a good human capital indicator because, if fairly paid, it should reflect the value produced by the employees through their knowledge and skills. Moreover, according to efficiency wage literature, the level of salary received can improve productivity, reduce shirking and increase employees' commitment (Ludewig & Sadowski, 2009). Gavious and Russ (2009) find that investors perceive compensation expense as a proxy for human asset, which is omitted from the balance sheet. Moreover, higher wages are an indicative of valuable and skilled workers who have higher qualification and it is a more predictive measure than the previous human capital measures described i.e. it is correlated with other elements of human capital.

Three measures of human capital have been experimented with in this thesis: number of employees, wages and average wages per employee. Number of employees was found to capture size as indicated in the literature. The absolute value of wages was dependent on the number of the employees the company has. Hence, taking into literature recommendations and methodological considerations, human capital will be approximated in this thesis by average salary per employee. Nonetheless, this measure of human capital comes with its own set of limitations. While it is an indication of the knowledge possessed by employees, it does not expand to reflect how efficient an organization is in using this knowledge.

Structural capital describes knowledge which has been captured and institutionalized within the organization. The structural capital includes infrastructure, information technology, databases, product technology, process handbooks, organization structure and routines and intellectual property elements, such as brands, trademarks, copyrights and patents (Bontis et. al., 2000). Also, structural capital includes any type of innovation and research and development project a company establishes.

Structural capital is one of the most researched intellectual capital components, because it is more observable than the other two components, allowing for better identification and measurement. Structural capital value has been approximated by R&D investment (Li & Wu, 2004; Connolly & Hirschey, 2005; Parcharidis & Varsakelis,2010), IT investment (Bharadwaj et. al.,1999), advertising expenses (Chauvin & Hirshey, 1993; Li & Wu, 2004; Kundu et.al., 2008), number of patents (Lee et. al., 2006), number of trademarks (Belkaoui, 2003) and/or selling and general administrative expenses (Lev & Radhakrishnan, 2005; Piekkola, 2009; Lev et. al., 2009).

Researchers consider that R&D investment reveals the overall ability of one organization to use its infrastructure and information communication systems, in order to develop new products, technologies and solutions designed to overcome competitive advances (Leibowitz & Suen, 2000). Moreover, Hall and Bagchi-sen (2007) argue that R&D intensive companies are committed to innovation on a long term basis. Taking into consideration the structural capital definition, R&D expense is a good proxy for this element.

Wuyts et. al. (2004) and Lin et. al. (2006) use selling and general administrative expenses (SG&A) to proxy a firm's effort in commercialization of their knowledge assets. SG&A expenses include advertising expenses, IT expenses and R&D expenses which have not been recorded or reported as separate expense items in the income statements (Bell et. al., 2002; Gavious & Russ, 2009).

IAS 38 "Intangible Assets" lists the following items which can be recorded as intangible resources if they respect the recognition criteria presented in Chapter 3 (Section 3.1.1.): computer software, patents, copyrights, motion picture films, customer lists, mortgage servicing rights, fishing licences, import quotas, franchises. Therefore, items like patents and/or trademarks, which have been previously employed in empirical studies to capture intellectual capital, are all recorded under the intangible assets umbrella. Moreover, putting an emphasis on the intellectual capital elements excluded from the balance sheet, researchers ignored some of the intellectual capital items recorded under "*Intangible Assets*". Nevertheless, value is created by all intellectual capital elements, be they recorded on the balance sheet or not, and researchers should make efforts to analyse the entire base of intellectual capital.

Building on previous literature, structural capital is going to be approximated in this thesis using measures comprising of R&D expense, selling and general administrative expense and intangible assets value. R&D expense and SG&A expense might exert confounding effects with firm size or a company's propensity to invest (Srinivasan & Lilien, 2009). To account for this aspect, R&D expense and SG&A are scaled by firm's Total Operating Expense. The derived measures are interpreted as R&D intensity and SG&A intensity of a company. For the same reasons, the Intangible Assets have been deflated by Total Assets and the outcome is a measure of company's intangibility (Villalonga, 2004).

Relational capital represents the value of all relationships a company establishes with its stakeholders: customers, suppliers, competitors, government or industry associations (Montequin et. al., 2006; Bontis, 2001). It describes a company's knowledge in scanning and identifying opportunities in the market for value creation (Nazari & Herremans, 2007). This intellectual capital item has been previously approximated by brand value (Barth et. al.1998), customer satisfaction (Ittner & Larker, 1998; Luo & Bhattacharya, 2006) and/or pipeline content (Guo et al, 2004).Nevertheless, given the focus of this thesis on widely available accounting information none of these measures could be used and other measures which rely on the information we focus on had to be found.

Relational capital is an important intellectual capital element, because it accounts for the existent demand in companies' products and services. This demand translates into increased sales. If a product or service demand is company specific, not a general industry- wide demanded product, then company's sales should be above industry's average sales. Therefore, the value created by one company through its established customer relationships can be estimated by the sales above industry's average it obtains. For the purpose of this thesis, we measure the sales above industry's average by the ratio of sales divided by industry average sales, where industries have been classified according to the SIC codes.

Most of the previous studies consider customer capital the most important part of relational capital and ignore the value of other relationships a company is building (Cohen & Kaimenakis, 2007). On one hand, other firm's relationships are disregarded, because there is little information available about a company's network, in order to avoid sharing market secrets with competitors (Garcia-Meca et. al., 2005). On the other hand, there is a lack of appropriate quantitative measures for estimating the value of these relationships (Clarke et. al., 2011). In order to address this shortcoming, this thesis has been trying to find accounting measures which may indicate the value a company it is establishing with its suppliers and shareholders by using publicly available data. According with intellectual capital's definition, two indicators have been proposed as new measures of relational capital: number of subsidiaries and number of shareholders. The arguments behind these measures are as follows. The number of subsidiaries gives an indication about the depth of company's customer base and about the number of supplier relationships a company needs to establish to support these subsidiaries. The number of shareholders indicator is a double edge variable. On one hand, the more worthy the company will be the more shareholders it will attract. On the other hand, the shareholders can create value through enriching a company's network. Shareholders can enhance communication between companies they hold an investment in, encouraging profitable partnerships.

Nevertheless, databases offered access only to the latest number of subsidiaries and shareholders making it difficult to notice any change in this intellectual capital components and utilize a series statistical estimations. Moreover, in the analysis it was revealed that these two measures are related with firm size measures rather than with intellectual measures and a decision was made to drop these variables from the analysis to ensure clarity and reliability of results. Thus, we rely on sales above industry's average as a proxy for relational capital.

6.1.2. Accounting measures

The complexity of intellectual capital has led researchers to create a wealth of measurement models for intellectual capital (Andriessen, 2004a; Marr et. al., 2003). Few of these models come from the accounting discipline and they quantitatively evaluate intellectual capital, usually in a monetary format. This thesis analyses the accounting measures which have been either consistently used in empirical studies or are widely quoted by researchers to be measures of intellectual capital as follows.

Market-to-book ratio considers that the difference between the book value and the market value represents the value of a company's intellectual capital. **Market to book ratio** computes the value of intellectual capital by dividing the market value (end of the year price multiplied by numbers of common shares outstanding) by the book value of the company (total net assets).

$$\textbf{Market to book} = \frac{\textit{Market value}}{\textit{Book value}}$$

Tobin's Q is evaluating whether intellectual capital investments have been deployed efficiently (Andriessen, 2004b). It is based on the same assumption as the market-to-book ratio, but it substitutes the book value with the replacement cost of the assets. If Tobin's Q is greater than 1, the company will obtain higher value for money invested in intellectual capital (Luthy, 1998). Tobin's Q reflects the market expectations of less quantifiable dimensions which reflect the proportion of the firm's intangible assets besides its tangible total assets (Lin et. al., 2006).

Computing the replacement cost of the assets as suggested by Tobin (1968) and later on by Lindenberg and Ross (1981) can be a cumbersome process. Chung and Pruitt (1994) suggested that the replacement cost of asset can be approximated by the total assets value. The advantage of this method is that it uses a simple formula that requires financial and accounting information available in financial statements. Chung and Pruitt (1994) find that a series of regressions comparing their method of calculating q explained at least 96.6% of the variability of Tobin's Q obtained via the original formula. For this reason, this way of computing Tobin's Q has become widespread between researchers (Villalonga, 2004). This thesis uses Chung and Pritt's (1994) method for deriving Tobin's Q value.

$$\textbf{Tobin's Q} = \frac{\textbf{Market value} + \textbf{Current Liabilities} - \textbf{Current Assets} + \textbf{Inventories} + \textbf{Long term debt}}{\textbf{Total assets}}$$

Economic value added (EVA) has been developed by Stewart Stern (1994) to measure the value creation inside a company (Andriessen, 2004b; Mouritsen, 1998). EVA represents the value added created by the firm through its employees, suppliers, customers etc. (Strassman, 1999). It was intended to be a comprehensive measure for studying the performance of a whole business. If we accept the assumption that a company's increase in EVA only results from the effective management of the company's knowledge assets, and nothing else, then EVA is a reasonable proxy for measuring IC (Chan, 2009). The economic value added measure is obtained as follows:

EVA= Net operating profit after tax- Capital Charge

Capital charge= Cost of capital*Capital employed

Calculated intangible value (CIV) is designed for estimating the value of a company's intellectual capital. It was originally developed to increase lenders' interest in knowledge intensive businesses, in which most assets are intangible ones (Stewart, 1995). The method is based on the assumption that a company's premium earnings, i.e. the earnings greater than those of an average company within the industry, result from the company's intellectual capital. This means that, by utilising tangible assets, a company can reach only an average level of earnings, the premium is generated by IC (Kujansivu & Lonnqvist, 2007). CIV is a relatively complex model, which requires a series of 7 steps to be followed in order to compute the intellectual capital value.

1. Calculate company's pre-tax earnings for the previous three years
2. Calculate company's tangible assets for the previous three years
3. Calculate company's return on assets
4. Calculate the industry average return on assets for the previous three years
5. Calculate the gross excess return (premium) for the company using the following methodology: multiply the industry ROA with the value of intangible assets, and subtract this value from the pre-tax earnings.
6. Calculate the net excess return by multiplying the average tax rate with the gross excess return
7. Calculate the present value of the premium by using an appropriate discount rate usually the weighted average cost of capital.

Pulic (1998) developed ***Value added intellectual capital coefficient*** **(VAIC)** to measure the IC of companies. He is concerned with two other important aspects of valuation and value creation yet unsolved by other methods:

1. Market-based IC value cannot be calculated for companies that are not listed on the stock market. Such companies need an alternative way to determine their market-based IC value.
2. There is no adequate system monitoring the efficiency of current business activities performed by employees or whether their potential is directed towards value creation or value destruction.

VAIC is a measure of efficiency which tries to obtain intellectual capital overall value by separately considering the value of its components (Chen et. al., 2005). It also considers that value is created by employing both tangible and intangible resources (Kujansivu & Lonnqvist, 2007). The way the method can be implemented is presented next:

VAIC= Capital employed efficiency + Human capital efficiency + Structural capital efficiency

Capital employed efficiency=$\frac{\text{Capital employed}}{\text{Value added}}$**;**

Capital employed=Book Value of Net Assets;

Human capital efficiency =$\frac{\text{Human capital}}{\text{Value added}}$**; Human capital =Labour expense;**

Structural capital efficiency= $\frac{\text{Value added}}{\text{Structural capital}}$**; Structural capital= Operating income.**

Value Added= Operating Income + Labour expenses.

6.1.3. Performance measurements

Performance is viewed as a multifaceted high-order construct consisting of three dimensions: economic, financial and market performance (Hirschey & Wichern,1984). **Economic performance** represents operational profitability and productivity and it has been measured by **operating income** (Wang & Chang,2005), **operating income to sales** (Wang & Wu,2012; Zeghal & Maaloul,2010), **net profit** (Li & Wu,2004; Makki & Lodhi,2008; Kamukama et.al.,2010) and **employees' productivity** (Wakelin, 2001; Cohen & Kaimenakis,2007; Clarke et. al. 2011).

Financial performance reflects company's ability to invest in intellectual capital, in order to earn a certain level of profit, has been measured by **return on assets** (Shiu, 2006; Ting & Lean,2009; Srinivasan & Lilien, 2009; Chan, 2009; Kamukama et.al., 2010) **return on sales** (Ravichandran & Lertwongsatien, 2005; Huang & Liu,2005; Hsu & Wang, 2012), **return on equity** (Wang & Chang,2005; Tan et. al., 2007; Clarke et. al., 2011),**return on capital employed** (Rahman, 2012) and **earnings per share** (Tan et. al., 2007).

Market performance reflects the assessment about company's growth opportunities and its gains in the financial markets, and it has been approximated by **annual stock return** (Appuhami, 2007; Tan et. al., 2007), **stock price** (Wang & Chang, 2005) and **revenue growth** (Li & Wu, 2004; Clarke et. al. 2011; Maditinos et. al., 2011).

Companies need to address multiple stakeholders, such as managers, employees, suppliers, customers and governments; and pay attention to multiple organizational processes. Consequently, different measures are needed to assess performance in relation with these stakeholders and organizational processes (Wood & Jones, 1995). It is vital to understand that sometimes specific measures of performance are relevant only for assessing some aspects of organizational well-being.

The literature makes a clear distinction between organizational performance (financial and economic) and market performance. Empirical results support this distinction and emphasize the fact that organizational performance measures do not reflect the same underlying performance phenomenon that is captured by the market data (Hirschey & Wichern, 1984). The impact of intellectual capital on factors such as firm flexibility, agility and growth potential may not be fully represented in organizational performance measures in studies linking the intellectual capital to firm performance. However, measures such as annual returns reflect the ex-ante market valuation of the level and risk of future firm cash flows (Bardhan et. al., 2010).

Nevertheless, there is a non-systematic research and lack of clear guidance regarding performance in the field of intellectual capital to date (Ittner, 2008). Accurate and complete measurement of all performance aspects is essential for a clear understanding of how intellectual capital influences organizational reality. Therefore, both organizational and market performance should be analysed. Moreover, various features of organizational and market performance have to be distinguished and compared, in order to understand the mechanism through which intellectual capital is involved in the value creation process. With the purpose of revealing a comprehensive and holistic image of the intellectual capital- performance relation this thesis is going to examine organizational performance - economic and financial - and market performance aspects.

The economic performance measure employed in this study is Net Cash. Net cash is the sum of net operating cash, net financing cash and net investing cash as reported in the financial statements of the companies under analysis. This thesis uses net cash as a measure of performance for the following reasons. First, there is a lack of studies examining this important aspect of organizational performance. Second, this measure incorporates multiple aspects of organizational activities: operating, financing and investing. Finally, market measures are strongly connected to cash flows. Therefore, if higher intellectual capital investments lead to higher cash flows and these cash flows are translated into higher market performance, it follows that market values should incorporate intellectual capital information as well. If intellectual capital is significantly and positively connected with Net Cash, but not with the market performance it signals possible market myopia. Therefore, analysing how intellectual capital is connected with net cash and comparing it with how intellectual capital is associated with market measures should offer extra-information about how well the market measures manage to integrate intellectual capital value.

To reveal financial performance the thesis will use return on assets (ROA) and earnings per share (EPS). Return on assets represents the amount of earnings (before interest and tax) a company can achieve for each pound of assets it controls. ROA has been found to be highly correlated with similar measures such as Return on Sales, Return on Equity or Return on Capital employed (Hitt et. al., 1997). This thesis trialled all these measures. Nevertheless, as the literature indicated they are highly correlated and revealed the same outcomes. Hence, for the sake of simplicity and clarity in the analysis we dropped these measures from the analysis. Also, this decision was based on some researchers' arguments that ROA is more appropriate in IC studies because ROA is useful in high-tech industry for stock market valuations (Hsu & Wang, 2012). Subsequently, this thesis uses ROA as a measure of financial performance, computed as described below.

$$ROA = \frac{Net\ Income}{Total\ Assets};$$

Earnings per share (EPS) is a commonly used measure by analysts in the evaluation of companies in the financial market. It gives a measure of profitability that incorporates the result of all managerial decisions. The value of this variable was downloaded from Thomson One Banker and it is usually obtained following the formula below:

$$EPS = \frac{Year\ End\ Company's Price}{Number\ of\ Shares\ Outstanding};$$

While the stock price has been used as a measure of market performance in numerous studies, this thesis is measuring market performance by company's annual share return. Prices incorporate all information available on the market including past information. Annual returns reflect the changes in the stock price for a specific year and, consequently, comprise the new market information about a company. The fact that stock price might be confounded with the accounting measure for intellectual capital, Market-to-book-ratio and Tobin's Q represent another reason for choosing Annual share return as a measure of market performance in this thesis. Annual return was computed using the formula below:

$Annual\ return_t = \frac{Stock\ price_t + Dividends - Stock\ price_{t-1}}{Stock\ price_{t-1}}$, where t represents the current year.

6.1.4. Control variables

The existing empirical research suggests that IC measures are usually affected by the firm size, the financing profile of the company, the value of tangible assets that the company possesses and the industry in which the company operates (Hsu & Wang, 2012). Therefore, in order to support the theoretical model, corresponding control variables are included in the study. The literature review has indicated that there are both endogenous and exogenous factors influencing intellectual capital (Ittner, 2008). Therefore, the thesis considers the following control variables:

- Firm specific : firm's size, capital structure, company's age;
- Industry specific: industry, industry concentration, industry risk.

Size. From a theoretical point of view, it is expected that the larger the firm is the more it will invest in intellectual capital, because of its need for sustainable growth. The effect of firm size is inconsistent between empirical studies. On one hand, Chan et. al. (1992) argue that large firms may have better prospects for completing R&D projects, followed by a successful production and marketing plan. On the other hand, managerial inefficiencies and organizational inertia associated with large size might counteract the advantage of size (Parcharidis & Varsakelis, 2010). Nevertheless, organization size reflects past success and may influence current intellectual capital value (Ravichandran & Lerwongsatien, 2005). Previous empirical research has been controlling for company's size by including in the regression models variables, such as logarithm of number of employees (Huang & Liu, 2005; Chen et. al. 2013), logarithm of total sales (Ehie & Olibe, 2010) and logarithm of total assets (Deeds & Decarolis, 1999; Lin & Chen ,2005). This study is concerned with the base of intellectual capital resources and considers that it is important to control for the overall size of the asset base. Consequently, it accounts for company's size using logarithm of total assets.

***Capital structure*.** Due to the fact that intellectual capital is highly intangible, there is uncertainty regarding its volume and quality and, sometimes, even about its existence (Ehie & Olibe, 2010). The uncertainty surrounding this term leads to higher than normal levels of information asymmetry (Barth et. al., 2001; Metcalf, 2002). High levels of information asymmetry lead to an increased cost of capital for companies which highly invest in intellectual capital (Jensen et. al., 2003). Either because they want to exploit the insider knowledge about their intellectual capital or because they find the external financing too expensive, companies are more likely to rely on internal sources to finance the investment in intellectual capital elements, such as R&D (Pindado, 2005). To reflect a firm's financial risk and its ability to support intellectual capital investment, leverage is employed as a proxy for firm's capital structure (Huang & Liu, 2005; Hsu & Wang, 2012). It is calculated as the ratio between total debt and total shareholder's equity.

Age. Older firms are believed to have a longer experience in accumulating and managing intellectual capital (Piekkola, 2009). Moreover, organization's age is perceived as an indication of external legitimacy of the existence of inter-firm relationships, of the staying power, and of the pervasiveness of internal routines, all of which can affect current performance (Ravichandran & Lertwongsatien, 2005). Therefore, intellectual capital levels should be higher for older companies. On the other hand, older firms are more prone to knowledge spillovers and can also get locked in routine, which will lead to a negative relation with intellectual capital

Industry. There is a trade-off between the investment in tangibles assets, such as plant and equipment, machines and properties, and intangible assets. Companies which invest more in tangible assets will have fewer resources to invest in intangible assets and vice versa (Pindado, 2005). In the literature review part of this thesis, we mentioned the importance of contextualization and enumerated few studies which identified an industry effect in analysing intellectual capital measurement (Huang & Liu, 2005; Tan et.al., 2007; Zeghal & Malloul,2010). Therefore, when analysing a heterogeneous sample it is imposed to control for this effect. The thesis distinguishes between manufacturing and services companies as suggested by Chauvin and Hirschey (1993). Also, it differentiates between high-knowledge intensive and low knowledge intensive companies as emphasized in Gavious and Russ (2009). The classification of companies in different sectors is done considering the SIC codes and the category they fall under the NACE classification.

Industry concentration. Prior research has shown that industry concentration has important impact on firm's performance (Hsu & Boggs, 2003). The measure of industry concentration is based on computing the Herfindahl-Hirschman index for each firm, calculated by summing the squared market shares of each firm in the sector, as utilized in studies by Bharadwaj et al. (1999) and Bardhan et. al. (2010). High values of the HH-Index are indicative of pricing power and low competition and vice versa (Wilson et. al., 2012).

Industry risk. Industry conditions affect a company's ability to increase its profits and intangible value. In conditions of high risk it is expected that a company would have less opportunities to create value added. To control for this aspect, the thesis uses INDWOE (industry weight of evidence) variable. This variable measures the log odds of insolvency in each sector at t-1. Negative values of INDWOE indicate higher industry risk and positive values lower industry risk (Wilson et. al., 2012). A summary table of all the variables employed in the thesis and their usage in empirical chapters is provided below.

Table 6-1 List of variables

	Variables	***Type***
Human capital	Average salary per employee	Independent
Structural Capital	% of R&D to Total Operating Expenses	Independent
	% of SG&A to Total Operating Expenses	Independent
	% of Intangibles to Total Assets	Independent
Relational Capital	% of Sales above industry's average	Independent
Control variables	Logarithm of Total Assets	Control
	Leverage	Control
	Company's age in years	Control
	Industry risk	Control
	Herfingdahl index	Control
Accounting measures	Market-to-book ratio	dependent 8 chapter, independent 10 chapter
	Tobin's Q	dependent 8 chapter, independent 10 chapter
	Economic Value Added	dependent 8 chapter, independent 10 chapter
	Calculated Intangible Value	dependent 8 chapter, independent 10 chapter
	Value Added Intellectual Capital Index	dependent 8 chapter, independent 10 chapter
Performance measures	Net cash	Dependent
	Return on assets	Dependent
	Earnings per share	Dependent
	Annual return	Dependent

6.2. Research design

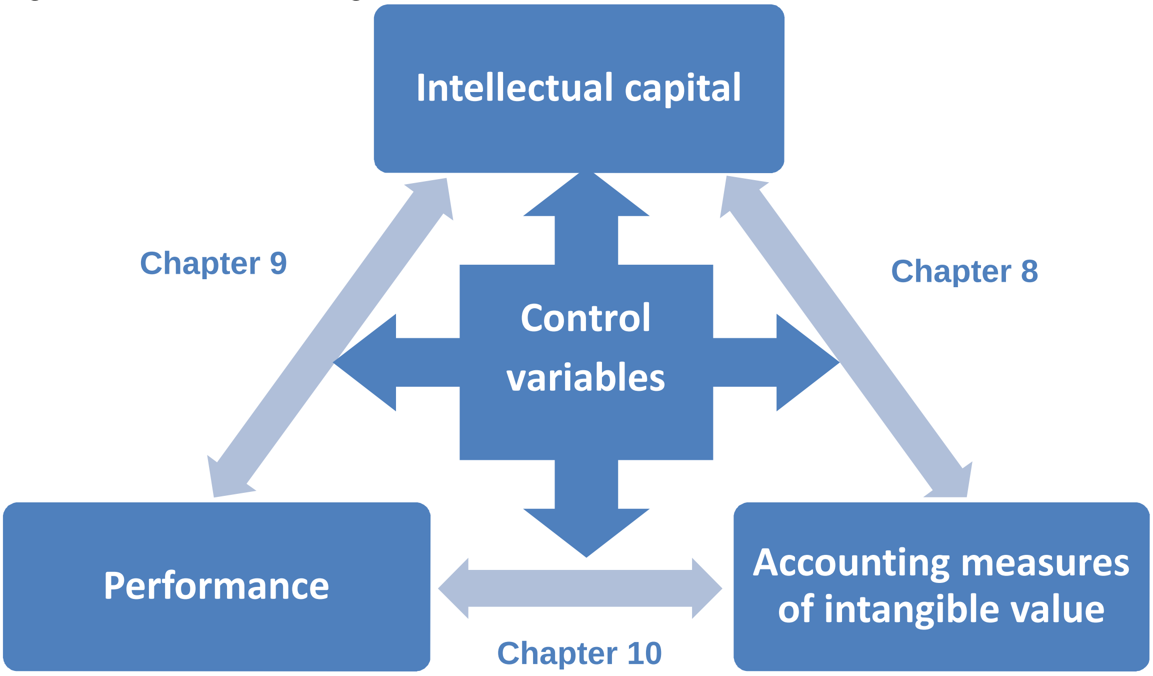
The empirical investigation is divided into three standalone chapters. The first empirical chapter of the thesis aims at establishing how efficient the different accounting measures of intangible value are at capturing intellectual capital. It aims to determine which elements of intellectual capital are captured by these measures. The analysis investigates how individual intellectual capital elements are captured by the accounting measures as well as possible interactions between these individual components. The chapter analyses the most used and cited accounting measures of intangible value: Market-to–book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index.

The second empirical chapter looks into how the individual intellectual capital components – human capital, structural capital and relational capital - as depicted by intellectual capital proxies, are associated with performance, in order to determine which component is more important in creating value. It also investigates if the intellectual capital elements are associated in the same manner with different measures of performance and whether the findings are contingent on the industry sector under analysis. The thesis focuses on the economic, financial and market dimensions of performance. Furthermore, it examines the effect on performance of combinations of different types of intellectual capital in order to determine the net effect of intellectual capital elements on performance.

The final empirical chapter looks into how the accounting measures of intangible value model the link between intellectual capital and performance. This chapter revisits the second empirical chapter in the sense that it addresses similar question. However, it expands the previous research by capturing the value of intellectual capital through the accounting measures of intangible value. A graphical representation of the proposed research framework is depicted below (Figure 6-1).

All three streams of research are going to utilize the same underlining methodology. On one hand, the same methodology is used because the thesis relies on the same data set for all three chapters. As a consequence, the data specification is going to be similar from one chapter to another. On the other hand, the same methodology is used because it will allow comparison and triangulation between results, in order to draw an overarching conclusion for the thesis. In what follows, the choice of methodology is justified; specifically, this section provides detailed explanations for choosing a random panel methodology for the study of intellectual capital.

Figure 6-1 Research design



Intellectual capital is the intangible resource which captures the value of a firm's distinctive business processes and systems, its corporate culture and strategy (Serenko et. al., 2009). Consequently, intellectual capital is strongly tied with the firm's strategy and behaviour in the market (Kaplan & Norton, 2000) and is uniquely characterizing a company. Due to the fact that intellectual capital is highly intangible and depicts the value of such things as business model, organizational culture or corporate strategy, it is highly probable that unobservable firm-specific factors are going to affect the model in the form of unobservable heterogeneity. A panel data methodology allows us to address the issue of individual heterogeneity surrounding intellectual capital by modelling it as an individual effect (Hausman & Taylor, 1981). Neither cross-sectional data methodologies nor longitudinal data methodologies allow for the consideration of these individual effects, which indicates that a panel data methodology is more appropriate for the study of intellectual capital.

Furthermore, the literature suggests that any empirical study into intellectual capital should explore it over the long term rather than at a specific point in time (Clarke et. al, 2011; Villalonga, 2004; Tan et. al., 2007). Kaplan and Norton (2000) show that, when intellectual capital is analysed on the short term, it might wrongfully lead to the conclusion that investment in intellectual capital components has a detrimental effect on the overall business. However, when conducting studies on the long term, a methodology which is able to capture dynamics is needed. Panel data methodology has the advantage of being able to capture these dynamics in the cross-sectional populations (Baltagi, 2005). Also, when performing a long-term analysis, companies might disappear for various reasons: bankruptcy, delisting or mergers. This translates into missing information about some companies in some periods, which is known as attrition bias. Panel data mitigates this attrition bias making this methodology appropriate for long-term studies (Hausman & Wise, 1979).

Another reason for using a panel data methodology for the study of intellectual capital is that it improves some econometric specifications, such as collinearity between variables. In the case of intellectual capital, collinearity might appear because intellectual capital elements are strongly bound up together (Hsu & Wang, 2012). Separating intellectual capital into different elements is a research tool which allows for understanding of its mechanisms; nevertheless, some elements might have characteristics which fit multiple intellectual capital components.

Thus, the motivation for adopting a panel data methodology for the study of intellectual capital relies on the fact that this methodology identifies and controls for unobservable heterogeneity, allows the study of dynamics, mitigates the attrition bias and can assess collinearity between variables. In order to eliminate the risk of obtaining biased results, panel data estimates the unobservable heterogeneity by modelling it as an individual effect (η_i). Moreover, since the panel has a time-series dimension, it allows for the control of macroeconomic aspects by including time dummy variables (d_t). As a result, in a panel methodology the error term is divided into three different components: firm-specific effect (η_i), time-specific effect (d_t) and random disturbance (e_{it}). Consequently, the basic specification of the model is as follows:

$$Y_{it}=\alpha_i+\beta X_{it}+\eta_i+d_t+e_{it}$$

Where Y_{it} is the i-th observation of the dependent variable with i=1,…,N companies and t=1,…T (years), α_i is a scalar and β is a Kx1 vector (K= number of variables). Factors which are difficult to measure objectively, such as corporate strategy, firm culture, and the propensity to innovate are incorporated into the panel model through an individual effect (η_i), which controls for the unobservable heterogeneity across firms in the analysis. e_{it} is the random disturbance (Hausman & Taylor, 1981).

With respect to panel methodology, there is a great deal of debate between statisticians about whether it is better to use a fixed effect model or a random effect analysis (Taylor, 2009). If the individual heterogeneity η_i is fixed, then it can be estimated through dummy variables as an individual intercept for each company under analysis, by following a fixed effects panel data model. However, if the individual unobservable heterogeneity η_i is randomly distributed across cross-sectional units and not correlated with any of the explanatory variable, it can be estimated as part of the error term in random effects model (Green, 2000; Baltagi, 2001).

There is no evidence directing which model is more appropriate in the study of intellectual capital. On one hand, the effect could be fixed. There are companies which consistently over-perform their competitors for long periods of time, due to the fact that they have company specific resource believed to be intellectual capital (Lev et. al., 2009). This presumes that firm’s unobservable characteristics such as management, strategy and organizational culture are maintained through time. On the other hand, given the actual fast paced environment, it is probable that companies would like to adapt to external circumstances in order to achieve high profits in a company specific manner. From this perspective, individual specificity is a random variable. Nevertheless, intellectual capital uniquely describes a company and individual effects are probable, making a panel methodology imperious.

From a methodological point of view, fixed effects model uses the variation within each firm through time to derive the coefficient estimates. Random effects model utilizes variation not only within each firm through time, but also the variation between firms. It can provide more efficient parameter estimates while accounting for unobserved time-invariant industry or firm-level factors, if they are uncorrelated with explanatory variables in the model (Bell & Jones, 2012). Also, the dummy variables approach to estimate individual unobservable heterogeneity, employed by the fixed effects model, is costly in terms of degrees of freedom lost. On the flip side of the coin, the fixed effects approach has one considerable virtue. There is rarely a justification for treating the individual effects as uncorrelated with the other regressors, as is assumed in the random effects model (Wooldridge, 2007). The random effect treatment, therefore, may suffer from the inconsistency due to this correlation between the included variables and the random effect.

Following Arellano and Honoré (2001) suggestion, both models have been estimated for the models implemented in this thesis. If there are little differences between a fixed and a random effect model, they recommend the choice between models to be made based on the dependence of the error distribution on the explanatory variable. Clarke et. al. (2011) add to this condition the importance of between variance in determining sample heteroskedasticity. They concur that, if both individual characteristics and differences between units of analysis are important for the research question, then a random effects model would be more informative. We have previously highlighted the fact that, the study of individual characteristics is important in the intellectual capital analysis. However, in the definition section of this thesis, it has been shown that intellectual capital is a source of competitive advantage (de Pablos, 2003). Competitive advantage can be determined through comparison between similar companies. This means that, benchmarking against other companies is likely to reveal intellectual capital value (Lev, 2001). Hence, studying between variations is an important consideration for this chapter's research question.

Diagnosticchecks were performed which indicated the presence of errors autocorrelation (AR(1)). The dependence among residuals in a panel usually derives from the time series dimension. It is well known that the standard errors estimation can be biased when the residuals are not independent, resulting in either over- or under-estimation of the true variability of the coefficient estimates. Nevertheless, this aspect is widely ignored in finance and accounting literature (Petersen, 2009). Petersen (2009) indicates that 42% of papers in finance incorrectly overlook the standard errors for possible dependence. Consequently, to account for this aspect, autocorrelation robust estimators were used as recommended by Hoechle (2007) and Vogelsang (2008). The fixed effects model was estimated using Driscoll-Kraay standard errors (xtscc model in STATA). Random effects model was estimated using the AR(1) XTREG procedure in STATA (XTREGAR command), following the methodology recommended by Baltagi and Wu (1999).

Further diagnostic checks indicated between firms heteroskedasticity for the fixed effects models. Also, the estimated between variation in the random effects is usually higher than within variation. These two aspects would recommend the use of a random effects model. However, in order to make a choice, assumptions should be made about the error distribution in the random effects model with respect to endogeneity issues (dependence between error term and explanatory variables). The results obtained by following both a fixed and a random effects model are very robust. Hence, a conclusion was drawn that endogeneity does not posit significant problems for the models implemented.

Based on previously described arguments, this thesis implements a random effects with autocorrelated errors panel methodology. All results presented in the empirical chapters are based on this methodology, with the observation that the differences between a fixed effects and random effects model are not considerable. To ensure a logical flow of the empirical chapters, a summary of this detailed justification is going to be provided in the methodology section of each empirical chapter.

7. Data sample

The purpose of this chapter is to provide an overview of the core data sample used in the thesis. The filtering process of the data, conducted in order to reach the final data set is presented and basic descriptive statistics introduced. While this chapter presents an overview of the thesis sample, chapters eight to ten discuss more detailed descriptive statistics for the samples used in each empirical chapter.

7.1. Sampling process

Intellectual capital research has focused on countries, such as Taiwan, Malaysia and Indonesia, which base their economy mainly on the development of intellectual capital and knowledge resources. This leaves a large research gap regarding western developed economies like UK or US for which knowledge and intellectual capital resources are equally important. For this reason, this thesis chose to focus on a sample of UK based companies listed at the London Stock Exchange. In order to bring together all variables, the thesis brought together three datasets and linked them together through a laborious matching process. Thomson One Banker and Bloomberg were used for company-level data as will be detailed below. Finally, Credit Risk Management Centre database was used to obtain industry – level data on industry concentration and Herfindahl-Hirschman index.

The literature has suggested that it is important to distinguish between manufacturing and services companies and within these industries between high and low knowledge companies. Consequently, this thesis has focused on a sample of companies which operate in these industry sectors. It however excluded financial services companies due to the fact that these companies have different accounting requirements. As such, data was downloaded from Thomson One Banker for an initial sample of 1117 companies for the period 2001 to 2011. 133 companies had missing data on key variables except R&D expenses, number of employees, salaries and selling and general administrative expenses and were removed from the sample. R&D expenses, number of employees, salaries and selling and administrative expenses are items which are not consistently recorded in databases. Therefore, it was expected that data on these variables might have to be collected from multiple sources in order to have a comprehensive dataset. Information from Bloomberg and companies annual reports was added to the dataset to complement data from Thomson One Banker. After this, other data cleaning procedures were implemented to ensure that there is no missing data on all variables employed in the study including the ones previously mentioned.

14 firms where deleted because of missing data on the number of employees. A further 49 companies were removed because despite having employees they did not report any information about their salaries.

Disclosure of the R&D expenditures is not compulsory in the UK. Furthermore, the UK GAAP provides an option to capitalise the R&D expenditure which meets the criteria. Thereby, recording R&D depends on a firm's strategy and it is at management's discretion. Reporting R&D follows the same rules. Consequently, after completing R&D expense information from annual reports and Bloomberg database, this item still had missing information for 50.23% companies in our sample, consistent with previous studies. Braker and Ramaya (2011) identify 52% R&D items left blank in their sample of US companies, while Pacharidis & Varsakelis (2010) report that only 34.26% of the Greek companies in their sample provide information on R&D expense. Given the similarities of the US and UK system, it is expected that the number of companies which report R&D will be quite similar. The missing data on R&D was replaced with 0 values. It can be reasonably assumed that non-reported R&D means the company did not engage in R&D activities. In order to confirm this hypothesis, a random sample of 100 observations was selected from the main sample and annual reports checked for R&D expenses information. 97 of 100 cases had reported that they did not engage in R&D activities in at least 3 years of the 11 under analysis, while 3 companies did not report anything on the topic.

The panel data models used in this thesis require at least four consecutive years. As a result, 75 more companies were excluded from the analysis. Also, in order to conform to the panel data methodology requirements, two companies which had more than 24 months between two consecutive reporting dates and were excluded from the analysis as well. The resulting sample comprised of 844 companies. 5 companies had negative Selling and General Administrative Expenses and Total Operating Expenses value and have been omitted, due to inconsistency with the rest of the sample, which would have led to wrong conclusion about these companies. The final sample consists of 839 companies for which the time series length ranges between 4 and 11 years, with an average value of 5 years. These companies have been classified according to their 2007 SIC codes following European Classification of Economic Activities (NACE) classification into: low knowledge intensive manufacturing, high knowledge intensive manufacturing, low knowledge intensive services and high knowledge intensive services. Table 7-1 presents the SIC 2007–NACE classification compatibility and Table 7-2 summarizes the sampling process.

Table 7-1 SIC-NACE classification compatibility

Group	*Sic codes*	
	From	*To*
Low technology manufacturing		
Manufacturing of textiles, wood, refined petroleum related products	10	19
Manufacturing of non-metallic mineral products and basic metals	22	25
Other manufacturing, repair and installation of machinery and equipment	31	33
Total Low technology manufacturing		
High technology manufacturing		
Manufacturing of chemicals and pharmaceutical products	20	21
Manufacturing of computers, electrical equipment, machinery and equipment and transport equipment	26	30
Total High technology manufacturing		
Low knowledge intensive services		
Wholesale and Retail Trade	45	47
Land transport and transport via pipelines	49	
Warehousing and support activities for transportation, Postal and courier	52	53
Accommodation and Food Service	55	56
Real Estate	68	
Administrative and Support	77	
Travel agency, tour operator and other reservation service	79	
Services to buildings and landscape	81	
Office administrative, office support and other business support	82	
Other services	94	96
Activities of Households as Employers	97	99
Total Low knowledge intensive services		
High knowledge intensive services		
Air and water transport,	50	51
Information and communication	58	63
Professional, Scientific and Technical Activities	69	75
Employment activities	78	
Security and investigation activities	80	
Public administration, Education, Human Health, Entertainment	84	93
Total High knowledge intensive services		

Table 7-2 Sampling process

Sampling Process	
	Total Firms
Initial sample of UK listed companies from 2001 to 2011	1117
Less: Missing data companies	133
Less: Missing number of employees companies	14
Less: Missing salaries companies	49
Less :Companies with less than 4 consecutive years reported	75
Less: Companies with more than 24 months between reporting dates	2
Less: Negative SG&A and Total Operating Expenses values	5
Final sample	***839***

7.2. Data description

As presented in Table 7-3, the sample is dominated by services companies (635) with the highest number of companies operating in the high knowledge intensive services industry sector (431). In the manufacturing industry, there are 102 companies for both low knowledge intensive and high knowledge intensive domains. This distribution of the sample is consistent with previous empirical research on UK data, which reveals that UK economy relies in a proportion of 54% on services companies (Zeghal & Maaloul, 2010). The distribution of data between different sectors stands proof for the present knowledge economy era in which most of the businesses rely on knowledge assets. Manufacturing and services high knowledge intensive companies represent 63.52% of the total sample. The number of companies shows a general increasing trend over time with a slight decrease after the 2007-2008 crisis period. The next sections will present the general descriptive statistics for independent and control variables, accounting measures and performance measures which will be used in the analysis.

Table 7-3 Panel Structure by industry sector and fiscal year

Panel structure by industry sector and fiscal year					
Year	***Low knowledge intensive manufacturing***	***High knowledge intensive manufacturing***	***Low knowledge intensive services***	***High knowledge intensive services***	***Total***
2001	70	67	113	193	**443**
2002	74	75	125	224	**498**
2003	78	84	136	259	**557**
2004	81	88	158	308	**635**
2005	87	91	171	353	**702**
2006	93	93	183	396	**765**
2007	98	95	193	410	**796**
2008	101	98	197	423	**819**
2009	100	98	197	422	**817**
2010	99	97	195	411	**802**
2011	92	94	190	390	**766**
Firm-years	**973**	**980**	**1858**	**3789**	**7600**
Firms	**102**	**102**	**204**	**431**	**839**

7.2.1. Independent and control variables

Table 7-4 Independent and control variables descriptive statistics by sectors

Descriptive statistics of independent and control variables by sectors						
Manufacturing	***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***
Salaries	29.57	28.36	13.57	36.84	33.74	17.64
R&D (%)	2.31	0.08	6.37	9.55	2.89	16.79
SG&A (%)	33.76	26.48	22.69	44.86	38.94	25.05
Intan (%)	16.21	6.22	20.24	18.94	13.06	19.42
Sales (%)	76.28	9.04	205.42	113.97	5.05	472.27
Log (TA)	10.95	10.81	2.01	10.68	10.47	2.31
Leve	0.55	0.25	1.65	0.41	0.14	1.04
Age	45.80	26.99	40.89	28.66	15.01	29.51
HHI	789.74	387.14	1646.78	597.62	391.12	673.93
INDWOE	-0.33	-0.41	0.55	-0.16	-0.19	0.45
Services	***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***
Salaries	34.68	26.90	30.57	45.60	40.71	28.37
R&D (%)	1.24	0.00	5.11	8.02	0.00	17.14
SG&A (%)	37.01	29.18	27.53	50.24	44.71	29.55
Intan (%)	16.70	5.91	22.21	27.89	21.14	25.82
Sales (%)	97.74	13.26	229.00	84.01	3.27	289.71
log(TA)	11.37	11.28	2.38	10.47	10.16	2.56
Leve	0.49	0.28	1.77	0.34	0.10	1.79
Age	28.61	15.41	32.53	19.32	9.39	25.92
HHI	306.87	309.99	196.83	378.69	324.81	379.82
INDWOE	-0.04	0.00	0.40	0.13	0.24	0.44

Variables definition

Salaries = Average Salaries per Employee;	log(TA) = Logarithm of Total Assets;
R&D = % of R&D to Total Operating Expenses;	Leve = Leverage;
SG&A = % of SG&A to Total Operating Expenses;	Age = Company's Age;
Intan = % of Intangible Assets to Total Assets;	HHI = Herfingdahl-Hirsch index;
Sales = % of Sales above industry's average;	INDWOE = Industry's risk;

High knowledge intensive companies score high on all variables approximating intellectual capital components. Human capital approximated by average salaries per employee is the highest in the high knowledge intensive services sector (45600£ per employee), followed by high knowledge intensive manufacturing (36840£ per employee) which confirms the hypothesis on which we developed this measure: employees who require more knowledge to fulfil their work tasks be paid accordingly with their qualification and abilities.

Structural capital measures behave in the same manner. Consistent with the numerous previous papers, the R&D intensity is the highest in the knowledge intensive manufacturing (Chauvin & Hirschey, 1993; Ho et. al., 2005. This sector consists of industries such as "*Manufacturing of chemicals and pharmaceutical products*" and

"*Manufacturing of computers, electrical equipment, machinery and equipment and transport equipment*" which rely on R&D for developing high technology competitive products as part of their business model.

Companies in the high knowledge intensive services sector are putting more effort into developing organizational routines which would help the selling of their products and services with a mean average Selling and General Administrative Expenses of 50.24% of Total Operating Expenses. In a similar vein, this sector shows the highest intangibility as measured by Intangible Assets to Total Assets (27.89%). The sector with the second highest level of intangibles is the high knowledge intensive manufacturing (18.94%). This distribution of the data shows that knowledge intensive companies not only internalize knowledge through high R&D projects, they capitalize this expense and record it as Intangible Assets. Relational capital, as measured by the percent of Sales above industry average sales, shows the highest mean value for high technology manufacturing companies (113.97%), consistent with the newest developments in the consumer consumption which reveals a high demand for high-technology products (e.g. i-phone, tablets etc.)

Companies in the low knowledge intensive sector finance themselves with more debt compared with the high knowledge intensive companies. Consequently, the risk measured by leverage is the highest in low knowledge intensive manufacturing sector (0.55). The average value of INDWOE is negative in all industries except high knowledge intensive services (0.13). Generally, manufacturing companies have an industry wide risk higher than companies in the services industry. Similarly, competition is the highest for manufacturing firms with a mean value for low knowledge intensive sector of 789.74 and for high knowledge intensive sector 597.62. Also, manufacturing companies are the oldest in the sample revealing the fact that in general manufacturing companies belonged indeed to a production era which preceded the recent knowledge era. Hence, the manufacturing companies are characterized by increased competition and risk and a long period of time since they are active. Services and manufacturing organizations either in the low knowledge or high knowledge intensive sectors are on average very close in size as measured by the logarithm of Total Assets. Therefore, differences between industries are not coming from size differences. Nevertheless, there is still a need to control for size of companies in the same industry.

7.2.2. Accounting measures

Table 7-5 Accounting measures descriptive statistics by industry sector

Accounting measures descriptive statistics by industry sectors						
Manufacturing	***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***
MB	2.44	1.41	4.51	3.36	2.11	4.90
TQ	1.22	0.82	1.21	1.78	1.15	2.12
EVA ('000 £)	-3400.59	-508.38	61731.28	41129.72	-786.31	323118.30
CIV ('000 £)	561463.10	47147.18	2003672	1298427	26721.67	7011738
VAIC	1.92	2.07	1.93	1.45	2.05	4.41
Services	***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***
MB	2.39	1.42	4.54	2.93	1.86	6.62
TQ	1.37	0.95	1.41	1.84	1.05	2.49
EVA('000 £)	-23645.31	-1093.77	92969.95	-16681.33	-1126.12	88922.36
CIV ('000 £)	1658879	122878	5704596	1281510	16919	5602147
VAIC	2.28	2.14	2.82	1.65	1.98	3.16

Variables definition

MB = Market-to-Book Ratio; TQ = Tobin's Q;
EVA = Economic Value Added; CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index ;

The average Market-to-Book ratio is higher than 1 in all industry sectors indicating, on one hand, a decrease in the value relevance of accounting balance sheet information and, on the other hand, the presence of intellectual capital resources in all the companies under analysis. The highest mean Market-to-Book ratio is in the high knowledge intensive manufacturing sector (3.36) followed by high knowledge intensive services (2.93) highlighting the fact that these industries have resources which are not recorded on the balance sheet but positively valued by investors.

Similarly, Tobin's Q is higher than 1 proving that the average market value of the companies under analysis is higher than the replacement value of their total assets. Nevertheless, Tobin's Q median value is not above 1 in the low knowledge intensive industry sector illustrating the fact that these industries might not have intellectual capital in excess of the one already recorded on the balance sheet.

Average Economic Value Added is negative in all sectors except high knowledge intensive manufacturing where it has an average value of 41129.72 thousands GPB. However, in this sector the median value is negative (-786.31 thousands GBP). These values are consistent with previous studies analysing Economic Value Added. For example, Belkaoui (2003) deflates EVA by Total Assets and finds a negative mean value (-1.38) for US multinational companies in the sample under analysis.

The Calculated Intangible Value measure has the highest value in the low knowledge intensive manufacturing sector. This accounting measure of intellectual capital relies on industry benchmarks. Given the fact that low knowledge intensive manufacturing has the highest competition and risk, a high value of Calculated Intangible Value is expected in this industry.

The Value Added Intellectual Capital index has the highest value in the low knowledge intensive services industry sector and the lowest in the high knowledge intensive manufacturing. This measure indicates the intellectual capital efficiency and, although there aren't any suggestions regarding ideal VAIC values, it is presumed that a higher VAIC is equivalent with higher intellectual capital efficiency. High knowledge intensive manufacturing companies have between the highest rates of intellectual capital according with the intellectual capital proxies. However, according to VAIC measure it is not very efficient in deploying intellectual capital.

7.2.3. Performance measures

Table 7-6 Performance measures descriptive statistics by industry sector

Descriptive statistics of variables used in the analysis by sectors						
Manufacturing	***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***
Cash ('000 £)	60825.30	4670.75	189865.00	74856	3939	271882.00
ROA	-0.01	0.04	0.22	-0.07	0.04	0.34
EPS	0.12	0.07	0.28	0.09	0.03	0.26
Return (%)	13.56	5.63	62.15	12.95	0.00	72.96
Services	***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***
Cash ('000 £)	86325.70	7103.50	239106.00	68921.50	2457.00	225251.00
ROA	-0.04	0.04	0.35	-0.15	0.02	0.53
EPS	0.11	0.07	0.31	0.02	0.01	0.31
Return (%)	12.21	4.09	71.35	8.49	-4.00	72.31
Variables definition						
Cash = Net Cash;			EPS = Earnings per share;			
ROA = Return on assets;			Return = Annual share return;			

In terms of economic performance the most profitable companies (Net Cash) are in the low knowledge intensive services, followed by high knowledge intensive manufacturing companies which generate the highest average Net Cash. Return on Assets (ROA), has a negative mean, but the median values are positive. This indicates that over the period from 2001 to 2011 there have been some companies which have incurred a high loss per total assets. However, most of the company managed to maintain ROA, at relatively small but positive values generating some excess income per total assets. The best performing sector taking into consideration this measure has been the low knowledge intensive manufacturing sector.

Earnings per share is the highest for low knowledge intensive companies with average values of 0.12 in the manufacturing sector and 0.11 in the services sector. However, high values in these industries could be an indication of generally lower number of outstanding shares. Earnings per share is useful in comparing companies of the same industry, but not very efficient for comparing companies from different industries.

Average annual return values are similar for all industry sectors with the exception of high knowledge intensive services industry which has the lowest average (8.49%) and a negative median (-4%). Given the fact the industries in this sector are connected with the financial sector, which suffered a big downturn during the economic crisis, a lower value of the annual returns in this sector was expected.

Overall, Net Cash indicates that the most profitable companies are in the low knowledge intensive services and high knowledge intensive manufacturing, while the rest of performance measures indicate that the best performing companies are in the low knowledge intensive sectors.

8. Accounting measures ability to capture intellectual capital

8.1. Abstract

Purpose – This research aims to improve our understanding of the intellectual capital accounting measurements by investigating how they capture intellectual capital and its different elements - human capital, structural capital and relational capital.

Design/methodology/approach – The study analyses the most commonly used accounting measures of intellectual capital: Market-to-Book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index to determine differences and similarities between the measures and whether they are equally effective at capturing different features of intellectual capital. The analysis is based on an 11 year panel of UK listed companies in the low and high knowledge intensive manufacturing and services industries.

Findings – Accounting measurements are found to have a significantly different ability to reflect the different features of intellectual capital and their interaction from one measure to another and across different industries. Market-based accounting measures are found to capture intellectual capital better than financial statement-based ones.

Originality/value – Previous empirical research provides mixed results about the relationship between intellectual capital and organisational performance. Taking a step back from this analysis, this study questions whether these mixed results are a consequence of the choice of intellectual capital measure used in these studies, their efficacy as a measure of intellectual capital and their ability to adequately reflect the different elements of intellectual capital.

Practical implications – It provides a better understanding and assessment of accounting measures of intellectual capital. Also, it provides useful information on the modelling and analysis of the link between intellectual capital and organisational performance.

8.2. Introduction

The measurement of intellectual capital is one of the central research topics in accounting (Guthrie et. al., 2001). As a result, a multitude of measures intended to capture intellectual capital have been created and their efficacy debated. Despite this there had been little or no empirical investigation into their ability to capture this resource (Andriessen, 2004a; Sveiby, 2005). Notably, the accounting measures of intangible value have been the target of much criticism because they are unclear about which elements of intellectual capital, if any, they are capturing (Kannan & Aulbur, 2004; Nazari & Herremans, 2007; Levy & Duffey, 2007)

However, there has not been any direct research inquiry regarding the "*black box*" of these measures and their efficacy in capturing intellectual capital (Andriessen, 2004a). In order to address this deficiency, this chapter provides empirical evidence for two important questions which lie at the heart of the critique of accounting measures of intangible value:

1. What elements of intellectual capital are the accounting measures of intangible value capturing?
2. How well do these measures capture intellectual capital and its components synergies?

In order to answer these questions, this study analyses the association of multiple accounting measures of intangible value with all components of intellectual capital – human capital, structural capital, relational capital - and their interaction. It determines how well the accounting measures of intangible value capture some or all aspects of intellectual capital by scrutinising whether they are independent measures of this resource. Also, it compares their consistency in capturing intellectual capital over a range of industries.

The rest of the chapter is organised as follows. First, the literature reviews described in Chapters 3 and 4 are briefly revisited and relevant points are summarised in order to set up this chapter's research objectives. Second, the chapter details the methodology utilised. Third, the variables employed in the study are introduced and the descriptive statistics are presented. Finally, the results are presented and their meaning discussed.

8.3. Research objectives

Chapter 3 of this thesis revealed that the accounting measures of intangible value, either financial-statement based or market-based, have been theoretically considered to have flaws inherent to their construction. On one hand, financial-statement based measures rely on historical accounting data and are subject to different practices across industries, inappropriate expensing of research and development and advertising expenditures, a failure to reflect opportunity costs and risk, and replacement–cost accounting errors (Hirschey & Wichern, 1984). On the other hand, market-based accounting measures are subject to irrational impulses and market sentiment (Gowthorpe, 2009; Maditinos et. al., 2011).

Nevertheless, these measurements have the advantage of assigning a monetary or at least quantitative estimate to the overall intellectual capital value at a moment in time (Spender, 2009). Moreover, compared with other means of capturing intellectual capital, they rely on objective, verifiable and comparable data (Maditinos et. al., 2011). As a result, they can potentially aid the allocation of intellectual capital resources if their ability to capture this resource and their link to performance is known (Kaplan & Norton, 1996).

However, as we revealed (see Section 4.1) the accounting measures of intangible value have also been considered measures of intangible performance, which raises the question of whether they really capture intellectual capital as the theory prescribes. Based on the aforementioned flaws, the accounting measures have been considered to inappropriately capture intellectual capital and, consequently, to be *“noisy”* measures for predicting the performance derived from this resource.

Andriessen (2004a) notes that most of these measurements are a “*solution in search of a cause*”. Newly developed measures are believed to be incrementally better than the previous, but there is little acknowledgement of how these measures compare and contrast in their ability to explain intellectual capital value (Andriessen, 2004a). Therefore, instead of developing new measures, we should first try to understand the existing measures, their mechanisms and deficiencies (Dumay, 2009).

The existing empirical research is not systematic, renders mixed results and rarely makes use of intellectual capital terminology. Instead, it uses proxies which are known to be part of intellectual capital, such as R&D expenses, IT expenses, advertising expenses, trademarks, patents or brands. Some studies show a positive association between these proxies and various accounting measures (Connolly & Hirschey, 1990; Bharadwaj et. al., 1999; Joshi & Hanssens, 2007), while others report a negative association (Conolly & Hirschey, 1984; Hall & Oriani, 2006).

Both theoretical and methodological explanations have been advanced to account for the conflicting results. From a theoretical perspective, researchers argue that, either intellectual capital is not beneficial in all circumstances for deriving intangible value (Ittner & Larcker, 1998; Roos et.al., 2005; Bracker & Ramaya, 2011) or that the association between intellectual capital and accounting measures is context dependent (Chauvin & Hirschey, 1993; Chauvin & Hirschey, 2005; Pacharidis & Varsakelis, 2010). Factors such as firm size and industry sector have been shown to exert considerable influence on the results obtained. While industry effects are recognised most of the studies tend to concentrate on high-technology sectors (Hall et. al., 2005; Tsai, 2005; Bardhan et. al., 2010; Braker & Ramaya, 2011; Chen et. al., 2013). Focusing the research on an industry abundant in intellectual capital is an appropriate research technique, but it leaves a large gap in the understanding of how intellectual capital works in low-technology sectors. Despite intellectual capital being propagated as the main competitive advantage in today's knowledge economy, there are companies which do not rely extensively on this resource (Tan et. al., 2007). More insights into the workings of intellectual capital can be derived if both low knowledge and high knowledge companies are analysed, compared and contrasted.

From a methodological point of view, it has been asserted that multiple proxies of intellectual capital should be considered to account for its overall features (Megna & Klock, 1993; Brynjolsson & Yang, 1999). Nonetheless, when multiple measures have been considered, empirical evidence has shown that different proxies have a different ability to reflect the components of intellectual capital. Moreover, the ability of a proxy to reflect intellectual capital depends on the other measures employed in the study. The use of different combinations of measures leads to different conclusions regarding their association with the accounting measures of intangible value.

Some researchers argue that different intellectual capital proxies reflect a different association with intangible value because they capture separate intellectual capital elements which are known to interact with one another (Tseng & Goo, 2005). However, because empirical studies rarely use an intellectual capital terminology, it is very hard to associate the interactions between different proxies with interactions between separate intellectual capital components. Also, in the absence of an intellectual capital terminology, it is difficult to fully comprehend how various elements of intellectual capital and their interactions are reflected by the accounting measures of intangible value.

The literature has rarely taken into consideration that different accounting measures of intangible value used in the studies have been developed on different theoretical assumptions following a diverse set of methodologies (Sveiby, 2005). Some rely on financial statements data while others rely on market-based data. As such, it has rarely analysed multiple accounting measures of intangible value, compared and contrasted them. Given their divergent groundings, these methods should correspondently have a different ability to reflect diverse intellectual capital elements (Bontiz & Fitz-enz, 2002; Andriessen, 2004a). In a similar vein, they should have different links with organisational performance because different intellectual capital elements have a significantly different behaviour related to performance (Ross et. al., 2005). Comparing the different accounting methods would provide clarification of the mixed results found in the literature.

Most of the empirical studies in the area concentrate on Market-to-book ratio and Tobin's Q as measures of intangibility and to a lesser extent other measures, such as Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital index. Differences and similarities between these measures in capturing intellectual capital have not been analysed. Additionally, because studies use measures that vary from one study to another, they are rarely comparable.

The aim of this chapter is to take a step back from the common analysis found in the literature. It adopts an intellectual capital perspective and divides this resource into its components – human capital, structural capital and relational capital. It clearly identifies these components with proxy measures based on publicly available accounting information in order to gain a better understanding of the mechanisms of intellectual capital. Second, it questions the accounting measures' efficacy as estimates of intellectual capital and their ability to adequately reflect its different components and the components interactions. Finally, while previous studies have generally focused on a single accounting measure of intangible value, this chapter gives an exhaustive assessment of a wide range of accounting measures by comparing and contrasting their ability to capture intellectual capital in various contexts. Specifically, it studies the most known intellectual capital measures: Market-to-Book Ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital index.

Also, it takes a contingency approach which investigates whether the use of these accounting measures of intangible value is more appropriate for manufacturing or services companies with different knowledge profiles.

8.4. Methodology

In order to achieve the research objectives, the statistical procedure in this chapter is conducted in three stages. The first stage examines how various accounting measures of intangible value capture the different elements of intellectual capital across the whole sample. Accounting measures of intangible value have been developed to evaluate the overall value of intellectual capital and capture all its components - human capital, structural capital and relational capital (Spender, 2009). Given these elements do not exist in isolation any assessment needs to consider all intellectual capital elements together (Megna & Klock, 1993; Bryjnolsson & Yang, 1999). Hence, for the first stage of the analysis, the following model is estimated:

$$Accounting\_measure_{it}=\alpha+\beta_1*HC_{it}+\beta_2*SC_{it}+\beta_3*RC_{it}+\beta_{2y}*Controls_y+e_{it} \qquad (1a)$$

Where the dependent variable *"Accounting_measure"* takes various forms: Market-to-Book ratio, Tobin's Q, Economic Value Added (EVA), Calculate Intangible Value (CIV) and Value Added Intellectual Capital Index (VAIC). The independent variables capture different components of intellectual capital: HC represents human capital, SC is structural capital and RC is relational capital, using the previously described average Salary per Employee as a measure of **human capital**. The **structural capital** component is represented by R&D intensity (R&D expense to Total Operating Expenses), Selling and General administrative intensity (SG&A expense to Total Operating Expenses) and Intangibility (Intangible Assets to Total Assets). **Relational capital** is approximated by the percentage of a firm's sales above the industry average. The control variables included in each model are: logarithm of Total Assets to account for firm size, a firm's leverage to highlight the capital structure, a company's age since incorporation, the Herfingdahl–Hirsch index to represent industry concentration and the INWOE index to capture industry risk. Details on the variable selection and the literature recommending these measurements are provided in detail in Chapter 6 "*Methodology*". Therefore, model (1a) can be re-written as follows:

$$Accounting\_measure_{it}=\alpha+\beta_1*Salaries_{it}+\beta_2*R\&D_{it}+\beta_3*SG\&A_{it}+\beta_4*Intan+ +\beta_5*Sales+\beta_{6y}*Controls_y+e_{it} \qquad (1a)$$

Different models are specified in the first stage to check for robustness and the consistency of findings. We first enter in the model all the aforementioned variables separately and then all together.

The second stage enquires whether the components of intellectual capital are captured differently from one industry to another depending on the knowledge profile of the industry under analysis. Previous literature has indicated that there are differences between manufacturing and services companies' intellectual capital profiles (Chauvin & Hirschey, 1993). Some researchers also indicate that across the manufacturing and services industry sectors there might be differences between low and high knowledge intensive companies (Sáenz, 2005). Consequently, this stage of analysis implements equation (1b) in different industry sub-samples.

The third stage builds on the literature's suggestion that intellectual capital elements are synergetic and interact with one another. One of the suggested methodologies to study interaction effects is to introduce a cross-product element between various variables. Nevertheless, for this study this process would prove rather cumbersome as interaction effects between five variables which account for intellectual capital would generate ten possible combinations. Also, it would generate multicollinearity problems which would bias the estimation results. In order to reduce the data to a manageable level for the study of interaction effects, we employ a factor analysis procedure. The factor analysis also tests whether the theoretical division of intellectual capital holds in an empirical context (Huang et. al., 2007).

The factor analysis methodology determines the number of fundamental influences describing a domain of variables and quantifies the extent to which each variable is associated with an underlying influence (Sharma, 1996). From factor analysis, factor loadings and factor scores can be derived. Factor loadings represent the correlation of the original variable with the latent variable it describes. Factor scores are the scores of a subject on a factor (Rietveld & Van Hout, 1993). The factor scores computed for each firm across the factors extracted are used as measures of intellectual capital in models similar to the ones employed in the first and second stage.

The models specified in this chapter have been estimated using a random effects panel data methodology for each accounting measure separately. The following issues have been considered in making this choice. First, a panel data methodology considers individual heterogeneity for parameters estimation (Koop, 2008). This point is crucial for this study, because, in order to achieve its competitive advantage potential the decision to undertake intellectual capital investment is directed by a firm's strategy and, more importantly, intellectual capital is strongly linked to the specificity of each firm. Therefore, in order to eliminate the risk of obtaining biased results, panel data estimates this heterogeneity by modelling it as an individual effect (η_i). Moreover, since the panel has a time-series dimension, it allows for the control of macroeconomic aspects by including time dummy variables (d_t). As a result, in a panel methodology the error term is divided into three different components: firm-specific effect (η_i) , time-specific effect (d_t) and random disturbance (e_{it}). Consequently, the basic specification of the general model is:

$$Accounting\_measure_{it}=\alpha+\beta_1*Salaries_{it} +\beta_2*R\&D_{it} +\beta_3*SG\&A_{it} + \beta_4*Intan+ +\beta_5*Sales+\beta_{2y}*Controls_y+ \eta_i+ d_t + e_{it} \quad (1b)$$

Second, a random effects panel model was preferred to a fixed effects model because the unobservable heterogeneity η_i is considered randomly distributed across cross-sectional units and not correlated with any of the explanatory variable (Green, 2000; Baltagi, 2001) due to the specificity of intellectual capital. Also, both individual characteristics and differences between units of analysis are important for the research question under investigation as the similarities and differences are analysed between various methods and various industry sectors, making the random effects model more informative. Moreover, statistical testing revealed variance both within and between companies, with the second element being more prominent. The arguments directing the choice between a random effects model and a fixed effects model are presented in Chapter 6 (Section 6.2).

Diagnostic checks were performed which indicated the presence of autocorrelation (AR(1)). The dependence among residuals in a panel usually derives from the time series dimension. It is well known that the estimation of standard errors can be biased when the residuals are not independent, resulting in either over- or under-estimation of the true variability of the coefficient estimates. In order to account for this aspect, autocorrelation robust estimators were used as recommended by Hoechle (2007) and Vogelsang (2008). The random effects model was estimated using the AR(1) XTREG procedure in STATA (XTREGAR command) following the methodology recommended by Baltagi and Wu (1999).

The measures employed in our study represent end of the year values, while decisions to invest in intellectual capital are made at the time of annual budgets. There is no evidence showing that managers base their investment decision on intellectual capital on the aforementioned accounting measures. Consequently, it is unlikely for the intellectual capital component indicators and the accounting measures to be co-determined. In other words, the endogeneity should be minimal. Therefore, this chapter will report the result obtained using a random effects panel methodology, with the observation that differences between the fixed and random effects model are minimal. The multicollinearity in the models was checked and the variance inflation factors are within acceptable thresholds, suggesting that multicollinearity is not a problem for this study. No other significant issues were raised in the analysis.

8.5. Data

The data sample under analysis consists of 839 listed UK companies at the London Stock Exchange from 2001 to 2011 operating in various industries. Companies have been categorised into low knowledge intensive manufacturing, high knowledge intensive manufacturing, low knowledge intensive services and high knowledge services according to the NACE classification for knowledge intensive companies. This study has excluded financial services companies because these companies have a different intellectual capital profile than the other companies in the sample. Detailed information on the sample construction is provided in Chapter 7.

Table 8.1 presents the descriptive statistics for the dependent and independent variables employed in this chapter's study, which have been winsorized at 1st and 99th percentiles for each industry sector subsample, in order to mitigate the effect of outliers. Descriptive statistics in the Table 8.1 reveal that high knowledge intensive companies score higher than low knowledge intensive companies on all intellectual capital component measures. Similarly, the values of the accounting measures are higher for knowledge intensive companies with the exception of Value Added Intellectual Capital Index, which has the highest mean value in low knowledge intensive sectors. The average values of the Market-to-Book ratio and Tobin's Q are above 1, indicating that companies' market value exceeds their book value and, respectively, replacement value. This is consistent with practitioners and academic studies indicating the presence of intellectual capital, particularly in high knowledge intensive companies (Lin et. al., 2006). High knowledge and low knowledge intensive companies are on average similar in size. This is an important attribute of the sample as it implies that the findings do not derive from size differences as is often the case in prior work. Nevertheless, companies are different with respect to industries' characteristics. Manufacturing companies are subject to higher competition and higher risk compared to service sector companies. For further detailed analysis of the descriptive statistics see Chapter 7 (Section 7.2).

Table 8-2 shows some positive correlations between the human capital, structural capital and relational capital measures and the accounting measures of intangible value studies, which strengthens the confidence that these accounting measurements might capture at least some elements of intellectual capital. Most of the intellectual capital indicators show a diverse correlation, with switching signs from one measurement method to another. Intangibility as measured by intangibles over total assets is negatively correlated with Market-to-Book ratio, Tobin's Q and Value Added Intellectual Capital Index, which indicates that intangibles recorded on the balance sheet might not be captured by these accounting measures of intangible value.

The correlations are significant and relatively high for accounting measures which rely on the same type of data, namely financial statement-based measures and market-based measures. For example, Economic Value Added is strongly correlated with Calculated Intangible Value (0.24) and the Value Added Intellectual Capital Index is only weakly related with all the other accounting measures, with the exception of Calculated Intangible Value.

The market-based measures Market-to-Book ratio and Tobin's Q have the highest significant correlation (0.34). This correlation pattern for the accounting measures shows that indeed they are sufficiently different from one another to warrant further investigation of their similarities and differences in capturing intellectual capital.

Even though, there are small differences in the value of correlation factors for different industry sector sub-samples, overall the correlations are relatively stable at the sub-sample level. Therefore, the correlations tables for different industry sectors are not presented in this chapter.

Table 8-1 Descriptive statistics of independent and control variables by sectors

	All			Manufacturing						Services					
				Low knowledge intensive			High knowledge intensive			Low knowledge intensive			High knowledge intensive		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
MB	2.79	1.72	5.71	2.44	1.41	4.51	3.36	2.11	4.90	2.39	1.42	4.54	2.93	1.86	6.62
TQ	1.64	1.00	2.10	1.22	0.82	1.21	1.78	1.15	2.12	1.37	0.95	1.41	1.84	1.05	2.49
EVA('000 £)	-8992.94	-1001.03	143933	-3400.59	-508.38	61731.28	41129.72	-786.31	323118.30	-23645.31	-1093.77	92969.95	-16681.33	-1126.12	88922.36
CIV ('000 £)	1281813	37529.46	5524434	561463.10	47147.18	2003672	1298427	26721.67	7011738	1658879	122878	5704596	1281510	16918.90	5602147
VAIC	1.81	2.04	3.16	1.92	2.07	1.93	1.45	2.05	4.41	2.28	2.14	2.82	1.65	1.98	3.16
Salaries ('000 £)	39.75	34.13	27.04	29.57	28.36	13.57	36.84	33.74	17.64	34.68	26.90	30.57	45.60	40.71	28.37
R&D (%)	5.83	0.00	14.33	2.31	0.08	6.37	9.55	2.89	16.79	1.24	0.00	5.11	8.02	0.00	17.14
SG&A (%)	44.20	37.74	28.50	33.76	26.48	22.69	44.86	38.94	25.05	37.01	29.18	27.53	50.24	44.71	29.55
Intangibles (%)	22.51	13.49	24.15	16.21	6.22	20.24	18.94	13.06	19.42	16.70	5.91	22.21	27.89	21.14	25.82
Sales (%)	90.24	6.08	298.19	76.28	9.04	205.42	113.97	5.05	472.27	97.74	13.26	229.00	84.01	3.27	289.71
log(TA)	10.78	10.64	2.45	10.95	10.81	2.01	10.68	10.47	2.31	11.37	11.28	2.38	10.47	10.16	2.56
Leve	0.41	0.17	1.69	0.55	0.25	1.65	0.41	0.14	1.04	0.49	0.28	1.77	0.34	0.10	1.79
Age	26.19	11.95	31.54	45.80	26.99	40.89	28.66	15.01	29.51	28.61	15.41	32.53	19.32	9.39	25.92
HHI	441.99	324.81	715.44	789.74	387.14	1646.78	597.62	391.12	673.93	306.87	309.99	196.83	378.69	324.81	379.82
INDWOE	0.00	0.00	0.48	-0.33	-0.41	0.55	-0.16	-0.19	0.45	-0.04	0.00	0.40	0.13	0.24	0.44

Variables Definition

MB = Market-to-book ratio;
TQ = Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;
Salaries = Average Salaries per Employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl-Hirsch index;
INDWOE = Industry's risk;

Notes: The sample consists of 839 publicly traded United Kingdom firms listed on the London Stock Exchange, including 102 companies in low knowledge intensive industry, 102 in high knowledge intensive industry, 204 in low knowledge intensive services and 431 in high knowledge intensive services between January 2000 and December 2011

Table 8-2 Pearson correlations of the variables included in the analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) MB	1.00														
(2) TQ	0.34	1.00													
(3) EVA	0.09	0.08	1.00												
(4) CIV	0.05	-0.01*	0.24	1.00											
(5) VAIC	0.01*	-0.09	0.00*	0.12	1.00										
(6) Salaries	0.03	0.08	0.03	-0.04	0.03	1.00									
(7) R&D	0.10	0.25	0.07	-0.05	-0.13	0.19	1.00								
(8) SG&A	0.10	0.31	0.10	-0.12	-0.21	0.27	0.38	1.00							
(9) Intangibles	-0.03	-0.07	0.00*	-0.01*	-0.04	0.04	-0.04	0.07	1.00						
(10) Sales	0.06	-0.02	0.24	0.77	0.09	-0.07	-0.06	-0.15	0.08	1.00					
(11) log(TA)	-0.04	-0.29	-0.08	0.47	0.24	-0.07	-0.21	-0.44	0.09	0.53	1.00				
(12) Leve	0.54	-0.09	0.01*	0.13	0.06	-0.04	-0.08	-0.11	0.02*	0.08	0.16	1.00			
(13) Age	-0.09	-0.17	-0.04	0.04	0.10	-0.18	-0.16	-0.25	-0.13	0.06	0.25	0.04	1.00		
(14) HHI	-0.01*	-0.02*	0.01*	-0.02*	-0.03	-0.03	0.02*	-0.04	-0.06	-0.01*	-0.04	0.00*	0.09	1.00	
(15) INDWOE	0.02*	0.09	-0.02*	-0.04	-0.02	0.22	0.14	0.22	0.14	-0.04	-0.12	-0.05	-0.19	-0.13	1.00

Variables Definition

MB=Market-to-book ratio;
TQ=Tobin's Q;
EVA=Economic Value Added;
CIV=Calculated Intangible Value;
VAIC=Value Added Intellectual Capital Index;

Salaries=Average Salaries per Employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA)= Logarithm of Total Assets;

Leve=Leverage;
Age=Company's Age;
HHI= Herfingdahl-Hirsch index;
INDWOE=Industry's risk;

Notes: The sample consists of 839 publicly traded United Kingdom firms listed on the London Stock Exchange, including 102 companies in low knowledge intensive industry, 102 in high knowledge intensive industry, 204 in low knowledge intensive services and 431 in high knowledge intensive services between January 2000 and December 2011. Insignificant correlations (two tailed p-value < 0.05), are shown by *.

8.6. Empirical Results

8.6.1. Accounting measures ability to capture intellectual capital

This section describes the empirical results looking at the way each accounting method captures the intellectual capital elements in the overall sample. The results showing the link between our individual components measures of intellectual capital and Market-to-book ratio are provided in Table 8-3.

The results show that Market-to-Book ratio (MB) is consistently capturing intellectual capital elements. When the analysis is run on each intellectual capital element measure in turn (models 2 to 6), the difference between the market and the book value of a company reflects human capital ($\beta=0.0087$, $p<0.01$), R&D intensity ($\beta=0.0340$, $p<0.01$) and SG&A intensity ($\beta=0.0171$, $p<0.01$) and relational capital ($\beta=0.0019$, $p<0.01$). Thus, these investments are perceived by investors as assets, not as expenses (Ghosh & Wu, 2007).

The degree of intangibility of a company is negatively related with MB, which is reflecting the fact that investors find it difficult to evaluate a company with a high proportion of intangibles to total assets (Hofmann, 2005; Alcaniz et. al., 2011). Moreover, the results indicate that assets, such as brands, patents, trademarks, which are included in the Intangible Assets category in the balance sheet, are negatively assessed by the market. Tseng and Goo (2005) similarly find that elements of structural capital, such as Intangible Assets, are negatively related to MB.

These results are maintained in the analysis of all the intellectual capital elements together (model 1). The value of the coefficients modify slightly, showing that between intellectual capital elements there might be some interactions and commonalities, although generally the elements are separable one from another. For example, human capital coefficient drops to a value of 0.0054 reflecting that, aspects of human capital might interact with other intellectual capital elements. Given that human capital is the basis of an organisation's development this result is not surprising. Human resources are the ones developing R&D, determining what selling activities are needed and interacting with customers to determine the value of relational capital (Youndt et. al., 2004).

Table 8-3 MB relation with individual intellectual capital elements – all sample

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	Salaries	0.0054*	0.0087***				
		(0.0031)	(0.0031)				
Structural capital	R&D	0.0257***		0.0340***			
		(0.0062)		(0.0061)			
	SG&A	0.0125***			0.0171***		
		(0.0033)			(0.0032)		
	Intan	-0.0117***				-0.0130***	
		(0.0034)				(0.0034)	
Relational capital	Sales	0.0019***					0.0020***
		(0.0004)					(0.0004)
Control variables	log(TA)	-0.431***	-0.421***	-0.387***	-0.342***	-0.394***	-0.546***
		(0.0494)	(0.0412)	(0.0408)	(0.0432)	(0.0418)	(0.0472)
	Leve	2.358***	2.355***	2.355***	2.354***	2.355***	2.353***
		(0.0356)	(0.0358)	(0.0357)	(0.0357)	(0.0357)	(0.0357)
	Age	-0.0084**	-0.0099***	-0.0097***	-0.0091***	-0.0123***	-0.0099***
		(0.0034)	(0.0035)	(0.0034)	(0.0034)	(0.0035)	(0.0034)
	HHI	-6.19e-05	-5.61e-05	-5.82e-05	-4.01e-05	-6.05e-05	-5.99e-05
		(9.77e-05)	(9.89e-05)	(9.84e-05)	(9.86e-05)	(9.89e-05)	(9.86e-05)
	INDWOE	0.364**	0.417***	0.392***	0.389**	0.448***	0.430***
		(0.152)	(0.153)	(0.152)	(0.152)	(0.152)	(0.152)
	Constant	6.568***	6.919***	6.678***	5.630***	7.054***	8.354***
		(0.661)	(0.573)	(0.561)	(0.628)	(0.565)	(0.605)
	Firm-years	7,054	7,054	7,054	7,054	7,054	7,054
	No. of firms	813	813	813	813	813	813

Model 1 : $MB = \alpha_i + \beta_1 * Salaries + \beta_2 * R\&D + \beta_3 * SG\&A + \beta_4 * Intangibles + \beta_5 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 2 : $MB = \alpha_i + \beta_1 * Salaries + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 3 : $MB = \alpha_i + \beta_1 * R\&D + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 4 : $MB = \alpha_i + \beta_1 * SG\&A + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 5: $MB = \alpha_i + \beta_1 * Intan + e_i + d_i + \eta_i$

Model 6 : $MB = \alpha_i + \beta_1 * Sales + \beta y * Controls_y + e_i + d_i + \eta_i$

Variables definition

MB = Market-to-book ratio;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) =Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The relation between MB and the control variables is as expected. Larger companies have a significantly lower MB ratio as in Pacharidis and Varsekelis (2010). Companies which rely more on debt than equity to finance their activities have a higher MB. The market learns more about the activities of a company in time, hence older companies have a slightly smaller MB while industry concentration and risk do not significantly influence MB although they are negatively related in accordance with previous empirical results (Eden et. al, 2003; Ehie & Olibe, 2010). High values of INDWOE indicate lower risk; therefore, even though the coefficient is positive, the relation between the risk and MB is negative.

Turning next to **Tobin's Q** our results show a similar relation with intellectual capital elements as those for Market-to-Book ratio (Table 8-4). This resemblance is unsurprising given the strong correlation between these two accounting measures of intangible value. In models 2 through 6, Tobin's Q separately captures human capital (β=0.0029; $p<0.05$), R&D intensity (β=0.0133, $p<0.01$) and SG&A intensity (β=0.0068) as elements of structural capital and relational capital (β=0.0018;$p<0.01$).

When intellectual capital elements are incorporated together in the same model (model 1), Tobin's Q relation with human capital becomes insignificant suggesting that human capital interacts with the other components of intellectual capital. Tobin's Q association with R&D intensity and SG&A intensity is maintained with coefficient values of β=0.0104 ($p<0.01$) and β=0.0054 ($p<0.01$) respectively. Intangibility is negatively related with Tobin's Q both in the analysis of its individual relation with Tobin's Q and in the analysis with all intellectual capital elements. The explanation for this relation is similar with the explanations provided for Market-to-Book ratio: the market is finding it difficult to interpret the value of a company's intangible assets. Also, most of the recorded intangible assets on the balance sheet are prone to replication by competitors which can lead to investors negatively evaluating their recognition in the balance sheet (Kogut & Zander, 1992; Cohen, 2011).

The control variables in the Tobin's Q model follow the same pattern as those in the Market-to-Book model and follow the same reasoning. The results are in accordance with Bardhan et. al. (2010) study which reveals that industry characteristics are not significantly determining Tobin's Q value.

While the results for the most commonly used market-based measures, Market-to-Book ratio and Tobin's Q, show a remarkable level of agreement, the picture is different for those financial statement-based measures used less often in the empirical studies. The results obtained for **Economic Value Added (EVA)** reveal that only the human capital element is captured by this method (Table 8-5) over the period under analysis, this result persisting in both the separate and collective models, human capital showing a positive and significant relation with EVA with beta of β=136.5 ($p<0.05$) and β=144.5 ($p<0.05$) respectively in the full model (model 1).

Table 8-4 TQ relation with individual intellectual capital elements – all sample

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	Salaries	0.0017	0.0029**				
		(0.0012)	(0.0013)				
Structural capital	R&D	0.0104***		0.0133***			
		(0.0026)		(0.0026)			
	SG&A	0.0054***			0.0068***		
		(0.0013)			(0.0013)		
	Intan	-0.0083***				-0.0090***	
		(0.0013)				(0.0014)	
Relational capital	Sales	0.0017***					0.0018***
		(0.0002)					(0.0002)
Control variables	log(TA)	-0.472***	-0.454***	-0.432***	-0.411***	-0.427***	-0.552***
		(0.0229)	(0.0200)	(0.0197)	(0.0205)	(0.0205)	(0.0222)
	Leve	-0.00548	-0.00709	-0.00704	-0.00731	-0.00664	-0.00716
		(0.0112)	(0.0113)	(0.0113)	(0.0113)	(0.0112)	(0.0112)
	Age	-0.0018	-0.0020	-0.0020	-0.0018	-0.0034*	-0.0017
		(0.0017)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
	HHI	-8.80e-06	-3.87e-06	-4.67e-06	-5.07e-07	-6.17e-06	-5.85e-06
		(3.53e-05)	(3.57e-05)	(3.57e-05)	(3.57e-05)	(3.56e-05)	(3.55e-05)
	INDWOE	0.0864*	0.0930*	0.0882*	0.0878*	0.0994*	0.0931*
		(0.0524)	(0.0528)	(0.0529)	(0.0529)	(0.0527)	(0.0525)
	Constant	6.430***	6.433***	6.235***	5.783***	6.351***	7.439***
		(0.302)	(0.275)	(0.268)	(0.291)	(0.274)	(0.287)
	Firm-years	7,047	7,047	7,047	7,047	7,047	7,047
	No. of firms	812	812	812	812	812	812

Model 1 : $TQ = \alpha_i + \beta_1 * Salaries + \beta_2 * R\&D + \beta_3 * SG\&A + \beta_4 * Intangibles + \beta_5 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 2 : $TQ = \alpha_i + \beta_1 * Salaries + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 3 : $TQ = \alpha_i + \beta_1 * R\&D + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 4 : $TQ = \alpha_i + \beta_1 * SG\&A + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 5: $TQ = \alpha_i + \beta_1 * Intan + e_i + d_i + \eta_i$

Model 6 : $TQ = \alpha_i + \beta_1 * Sales + \beta y * Controls_y + e_i + d_i + \eta_i$

Variables definition

TQ = Tobin's Q;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

EVA captures the genuine profits a company obtains after covering its operating costs and its cost of capital (Young, 1997). It should reveal the added value by all company's stakeholders (Stewart, 1994). Therefore, one would expect that value, from an economic point of view, is added by all intellectual capital elements. However, the rest of the intellectual capital elements do not exhibit any statistically significant relation with EVA in any of the models employed.

Table 8-5 EVA relation with individual intellectual capital elements – all sample

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	***Salaries***	144.5**	136.5**				
		(66.77)	(65.97)				
Structural capital	***R&D***	-43.88		-42.70			
		(139.2)		(138.3)			
	SG&A	2.975			6.954		
		(74.29)			(73.43)		
	Intan	46.39				29.36	
		(73.61)				(73.45)	
Relational capital	***Sales***	5.051					3.566
		(11.37)					(11.37)
Control variables	***log(TA)***	-8,530***	-8,375***	-8,446***	-8,381***	-8,569***	-8,294***
		(1,447)	(1,333)	(1,336)	(1,361)	(1,382)	(1,374)
	Leve	145.8	123.9	111.7	113.5	109.6	137.4
		(495.1)	(487.9)	(488.0)	(488.3)	(488.0)	(494.7)
	Age	-40.05	-41.15	-57.30	-54.88	-50.36	-61.35
		(141.8)	(154.9)	(154.7)	(154.3)	(155.3)	(141.1)
	HHI	-0.143	-0.0771	-0.0633	-0.0653	-0.0552	-0.142
		(1.665)	(1.651)	(1.651)	(1.652)	(1.651)	(1.665)
	INDWOE	-5,790**	-5,891**	-5,902**	-5,903**	-5,911**	-5,792**
		(2,417)	(2,391)	(2,392)	(2,393)	(2,392)	(2,416)
	Constant	90,649***	89,801***	94,222***	93,133***	94,889***	92,685***
		(20,079)	(19,807)	(19,748)	(20,529)	(19,890)	(19,040)
	Firm-years	6,862	6,863	6,863	6,863	6,863	6,862
	No. of firms	804	804	804	804	804	804

Model 1 : $EVA = \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3*SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 2 : $EVA = \alpha_i+\beta_1*Salaries+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 3 : $EVA = \alpha_i+\beta_1*R\&D+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 4 : $EVA = \alpha_i+\beta_1*SG\&A+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 5: $EVA = \alpha_i+\beta_1*Intan+e_i+d_i+\eta_i$

Model 6 : $EVA = \alpha_i+\beta_1*Sales+\beta y*Controls_y+e_i+d_i+\eta_i$

Variables definition

EVA= Economic Value Added;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

EVA was proven to be connected with managerial compensation and employees' salaries before in studies by Rogerson (1997) and Young and O'Bryne (2001). The reasoning for this association is that EVA aligns the company's ability to pay wages (genuine profits) with their labour costs (Krauter et. al., 2003). Subsequently, these studies indicate that indeed EVA should capture human capital.

A closer examination shows that EVA has a negative average for most of the companies during the period under analysis which overlaps the financial crisis period. This may explain why the other components of intellectual capital are not captured by EVA in our sample. In line with this argument, the results are an indication of the possibility that EVA is very dependent on the company's ability to generate profits. In turn, a company's ability to generate profits is shaped by the external environment.

Turning to the control variables, it is evident that EVA is negatively related to Total Assets which suggest that larger companies do not necessarily add more economic value. Lovata & Costigan (2002) suggest that size increases the difficulty of observing relevant actions for the company and, as a result, value is destroyed. Nevertheless, these results contradict previous accounting methods results and the common belief that larger companies possess more intellectual capital.

It re-enforces the idea that accounting measures are capturing different features of intellectual capital. As expected, EVA is positively related with industry's risk because if the company engages in riskier projects, it should be appropriately compensated with higher value (Mouritsen, 1998). The other control variables do not exert a statistically significant relation with EVA.

Results for **Calculated Intangible Value (CIV)** presented in Table 8-6 indicate that it captures relational capital but little else. Both in the separate analysis of intellectual capital elements and in the analysis focusing on all the elements, CIV is positively and significantly related with sales above the industry average which represents relational capital.

Given our measure of relational capital, the results indicate that CIV is a measure useful in benchmarking a company against the industry (Nayak et. al., 2008; Aho et. al., 2011). In the context of the CIV methodology which calculates the excess return above the industry average for a period of three years, this explanation seems reasonable. CIV's association with size shows that larger companies are generally associated with higher intangible value as with our findings for Market-to-Book ratio and Tobin's Q. The models shows some leverage effect (β=31692, $p<0.1$), but again the control variables for this model are not that significant.

Table 8-6 CIV relation with individual intellectual capital elements – all sample

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	Salaries	3,312	2,483				
		(2,152)	(2,281)				
Structural capital	R&D	-789.5		25.63			
		(4,517)		(4,868)			
	SG&A	2,166			986.7		
		(2,390)			(2,556)		
	Intan	-5,184**				-5,555**	
		(2,383)				(2,575)	
Relational capital	Sales	10,335***					10,295***
		(320.5)					(322.3)
Control variables	log(TA)	263,948***	615,043***	615,300***	620,001***	642,013***	237,646***
		(42,124)	(45,752)	(45,827)	(46,713)	(47,453)	(40,218)
	Leve	31,692*	25,511	25,317	25,454	25,902	30,196*
		(16,534)	(16,472)	(16,476)	(16,483)	(16,470)	(16,507)
	Age	495.5	639.6	364.1	469.2	-567.1	660.8
		(3,434)	(5,203)	(5,192)	(5,186)	(5,211)	(3,440)
	HHI	-31.06	-19.82	-20.03	-19.88	-21.43	-30.18
		(55.03)	(56.29)	(56.31)	(56.31)	(56.28)	(55.01)
	INDWOE	-23,333	-14,200	-14,281	-14,451	-12,876	-22,496
		(80,629)	(81,568)	(81,593)	(81,611)	(81,555)	(80,548)
	Constant	-3.3e+06***	-6.5e+06***	-6.4e+06***	-6.5e+06***	-6.6e+06***	-2.9e+06***
		(553,181)	(672,570)	(670,225)	(697,846)	(675,091)	(519,460)
	Firm-years	6,738	6,739	6,739	6,739	6,739	6,738
	No. of firms	793	793	793	793	793	793

Model 1 : $CIV= \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3*SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 2 : $CIV= \alpha_i+\beta_1*Salaries+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 3 : $CIV= \alpha_i+\beta_1*R\&D+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 4 : $CIV= \alpha_i+\beta_1*SG\&A+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 5: $CIV= \alpha_i+\beta_1*Intan+e_i+d_i+\eta_i$

Model 6 : $CIV= \alpha_i+\beta_1*Sales+\beta y*Controls_y+e_i+d_i+\eta_i$

<u>Variables definition</u>

CIV= Calculated Intangible Value;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As with the model of Economic Value Added, the **<u>Value Added Intellectual Capital Index (VAIC)</u>** captures human capital. This is in concordance with Ståhle et. al.'s (2011) argument that VAIC is a measure of company's labour and capital investments. Given that both VAIC and EVA rely in their computation on value added, some similarities between the two methods are expected.

Table 8-7 VAIC relation with individual intellectual capital elements – all sample

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	**Salaries**	0.0111***	0.00858***				
		(0.00197)	(0.00195)				
Structural capital	**R&D**	-0.0102***		-0.0140***			
		(0.00389)		(0.00383)			
	SG&A	-0.0155***			-0.0149***		
		(0.00212)			(0.00205)		
	Intan	-0.00304				-0.00399*	
		(0.00211)				(0.00212)	
Relational capital	**Sales**	-0.000426*					-0.000615**
		(0.000242)					(0.000247)
Control variables	**log(TA)**	0.260***	0.307***	0.294***	0.239***	0.316***	0.342***
		(0.0314)	(0.0260)	(0.0261)	(0.0274)	(0.0265)	(0.0297)
	Leve	0.0237	0.0267	0.0240	0.0225	0.0258	0.0252
		(0.0200)	(0.0201)	(0.0201)	(0.0200)	(0.0201)	(0.0201)
	Age	0.00224	0.00452**	0.00312	0.00208	0.00319	0.00333
		(0.00225)	(0.00228)	(0.00227)	(0.00226)	(0.00228)	(0.00228)
	HHI	1.87e-05	3.28e-05	3.76e-05	2.35e-05	3.27e-05	3.67e-05
		(6.29e-05)	(6.34e-05)	(6.34e-05)	(6.32e-05)	(6.35e-05)	(6.35e-05)
	INDWOE	0.0937	0.0408	0.0740	0.0946	0.0619	0.0583
		(0.0960)	(0.0965)	(0.0966)	(0.0962)	(0.0966)	(0.0965)
	Constant	-0.770*	-1.930***	-1.536***	-0.392	-1.745***	-2.042***
		(0.417)	(0.358)	(0.357)	(0.396)	(0.355)	(0.380)
	Firm-Years	7,517	7,519	7,519	7,519	7,519	7,517
	No. of firms	836	836	836	836	836	836

Model 1 : $VAIC = \alpha_i + \beta_1 * Salaries + \beta_2 * R\&D + \beta_3 * SG\&A + \beta_4 * Intangibles + \beta_5 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 2 : $VAIC = \alpha_i + \beta_1 * Salaries + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 3 : $VAIC = \alpha_i + \beta_1 * R\&D + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 4 : $VAIC = \alpha_i + \beta_1 * SG\&A + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 5: $VAIC = \alpha_i + \beta_1 * Intan + e_i + d_i + \eta_i$

Model 6 : $VAIC = \alpha_i + \beta_1 * Sales + \beta y * Controls_y + e_i + d_i + \eta_i$

Variables definition

VAIC=Value Added Intellectual Capital Index
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VAIC is negatively related to R&D intensity and SG&A intensity both in the individual elements model (R&D: β=-0.0140, p<0.01; SG&A: β=-0.0149, p<0.01) and in the overall model (R&D: β=-0.0102,p<0.01; SG&A: β=-0.0155, p<0.01)., while Intangibility is only negatively related in the individual elements model Relational capital is also negatively related with VAIC. There is no prior empirical research to guide us on what the expected associations should be in the VAIC model, despite the fact that it is extensively used in organizational performance studies. Hence, the comments which can be made related with the results obtained in this study are limited to what is known about this method construction (see section 6.1.2.). Labour expenses are considered in the VAIC computation, as such a positive relation between human capital and VAIC is to be expected and it is confirmed by the results of this study.

Pulic (1998) considers structural capital and human capital are inversely proportionate because when more structural capital is involved in the value creation process less human capital is needed. The results of this study indicate that indeed there is an inverse relation between how human capital and structural capital are captured by VAIC. Specifically, all structural capital elements are negatively related to VAIC.

Finally, relational capital is not considered in the VAIC computation, but the value added element suggests that this accounting measure should account for the value added by all stakeholders and, subsequently, it should account for its relationship capital. However, VAIC emphasises the efficiency of intellectual capital in adding value and to derive this aspect it is divided by the value added of an organisation. Hence, there is an inverse relation between VAIC and relational capital. Size is an important effect for the estimation of VAIC, larger companies score statistically more significantly in terms of this measure. The rest of the control measures are insignificant for the estimation of Value Added Intellectual Capital Index.

Overall, there would seem that there are two distinct camps of measures. The first category, which includes measures such as Market-to-Book ratio and Tobin's Q, are capturing most of the intellectual capital elements. This explains why they are commonly used in the literature to the detriment of other measures. At the other extreme, we have a number of value added based measures which offer a less consistent picture in their ability to capture all intellectual capital elements. These results are consistent between the analysis run on separate intellectual capital elements and the analysis run on all intellectual capital elements together.

8.6.2. Industry differences in accounting measures' ability to capture intellectual capital

The previous section investigated the way the accounting measures of intangible value capture each intellectual capital element in the overall sample. This section takes the analysis a step further by continuing the analysis on all intellectual capital elements and distinguishing between manufacturing and services companies. It further considers in these sectors a distinction between low and knowledge intensive companies. The results obtained in this section will aid formulating a conclusion on whether there are underlying industry effects influencing the accounting measures ability to capture intellectual capital. This section will focus on detailing the way the accounting measures are capturing the IC elements in various sub-samples, it will not detail the behaviour of control variables. However, it is worth mentioning that with small exceptions, the control variables across various industry sectors behave in the same manner as it was described for the overall sample.

Following the same format as before, we start by discussing the **Market-to-Book ratio (MB)** model (see Table 8-8). The results show that MB has consistently the same ability to reflect intellectual capital for manufacturing and services companies. MB reflects human capital in the full sample, but not when the analysis is run on separate industry sectors. Neither manufacturing nor service sectors report any statistically significant association with human capital. In relation to structural capital, MB reflects R&D intensity and SG&A intensity for both manufacturing and services companies, while Intangibility is negatively related to MB, but only statistically significant in the services industry (β=-0.0131,$p<0.01$). Relational capital is captured by MB similarly in manufacturing and services industries showing a positive association with this accounting measure.

When the analysis is further broken down into low and high knowledge intensive companies, the sources of these effects and differences in MB's ability to capture intellectual capital become more apparent. Table 8-8 shows that human capital is positively associated with MB only in low knowledge intensive manufacturing (β=0.0239, $p<0.05$) and high knowledge services (β=0.0117, $p<0.05$). In the high knowledge intensive manufacturing human capital is not significantly related with MB, which indicates, on one hand, MB's inability to properly capture this intellectual capital resource or, on the other hand, it indicates that intellectual capital value is derived from other components in this industry (Sáenz, 2005). In the low knowledge intensive services sector human capital is negatively associated with MB ratio (β=-0.00807,

$p<0.10$), which reveals the fact that investors do not perceive this intellectual capital as an asset in this industry (Gavious & Russ, 2009). Taking into consideration the fact that most industries rely either on automated operations or low cost labour, this result signifies that the market may be penalising any unnecessary cost.

Also, referring back to the descriptive statistics, whereas the average value of human capital in this industry is not very different from other sectors what is noticeable is the high standard deviation. Consequently, MB inability to capture human capital in the low knowledge intensive services industry could be down to the market inability to correctly value this resource, because there is too much variability.

In all sectors, except low knowledge manufacturing, MB captures R&D intensity and SG&A intensity. These results seem to support the belief that in most cases investors perceive intellectual capital related expenses as assets (Lev,2005). However, there are also cases in which investors can fail to recognise the value of these expenses, as it shows in the case of low knowledge manufacturing companies. Another possible explanation could be that, since low knowledge manufacturing companies rely less on structural capital, they are not considered a source of competitive advantage and investors correctly assess this aspect. The results also support the idea of intellectual capital interaction, by having complementary coefficients between different structural capital elements. For example, a lower R&D intensity coefficient in high knowledge manufacturing is complemented by a higher SG&A intensity coefficient.

The proportion of intangibles from total assets is generally negatively associated with the Market-to-Book ratio. Therefore, the Market-to-Book ratio would seem to ignore the ability of the intellectual capital elements recorded on the balance sheet to create intangible value added. These results can be explained by the difference between tacit and explicit knowledge detailed in Chapter 3. Intangible assets represent explicit knowledge accessible to the public, which can be replicated by other companies, and consequently, becomes less valuable for the company.

As with the pattern observed for R&D intensity and SG&A intensity, sales above the industry average (relational capital) is positively and significantly related with MB in all industry sectors except low knowledge intensive manufacturing. Again it could be the case that, due to the nature of their business model, low knowledge manufacturing companies do not rely on relational capital.

Table 8-8 MB industry differences in capturing intellectual capital

$MB= \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3*SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$							
		Manufacturing			***Services***		
	Variables	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	0.0060	0.0239**	0.0079	0.0047	-0.0081*	0.0117**
		(0.0081)	(0.0110)	(0.0119)	(0.0035)	(0.0046)	(0.0047)
Structural capital	***R&D***	0.0395***	0.0107	0.0377**	0.0221***	0.0514**	0.0221***
		(0.0117)	(0.0247)	(0.0149)	(0.0073)	(0.0243)	(0.0081)
	SG&A	0.0173***	0.00168	0.0236**	0.0119***	0.0127**	0.0120**
		(0.0064)	(0.0077)	(0.0101)	(0.0039)	(0.0056)	(0.0050)
	Intan	-0.0054	0.0033	-0.0124	-0.0131***	-0.0201***	-0.0117**
		(0.0067)	(0.0085)	(0.0103)	(0.0039)	(0.0066)	(0.0048)
Relational capital	***Sales***	0.0020***	0.0008	0.0021***	0.0018***	0.0020**	0.0015***
		(0.0005)	(0.0011)	(0.0006)	(0.0005)	(0.0008)	(0.0006)
Control variables	***log(TA)***	-0.376***	-0.183	-0.512***	-0.440***	-0.410***	-0.444***
		(0.0899)	(0.127)	(0.138)	(0.0583)	(0.0888)	(0.0743)
	Leve	2.421***	2.250***	2.730***	2.338***	1.825***	2.581***
		(0.0605)	(0.0567)	(0.123)	(0.0427)	(0.0532)	(0.0571)
	Age	-0.0078*	-0.0104**	-0.0002	-0.0083*	-0.0142**	-0.0046
		(0.00447)	(0.00507)	(0.00857)	(0.00441)	(0.00583)	(0.00620)
	HHI	-6.9e-05	-1.8e-05	-0.0003	3.0e-05	-0.0009	0.0001
		(8.2e-05)	(7.3e-05)	(0.0002)	(0.0002)	(0.0006)	(0.0003)
	INDWOE	0.429**	0.250	0.573*	0.274	0.158	0.404
		(0.178)	(0.183)	(0.324)	(0.207)	(0.268)	(0.280)
	Constant	5.157***	2.364	7.296***	6.976***	7.144***	6.625***
		(1.075)	(1.494)	(1.595)	(0.728)	(1.103)	(0.927)
	Firm-years	1,845	915	930	5,209	1,733	3,476
	No. of firms	198	97	101	615	197	418

<u>Variables definition</u>

MB = Market-to-book ratio;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

<u>Tobin's Q</u>. The results for the Tobin's Q model are presented in Table 8-9. This table discloses the following. Tobin's Q captures intellectual capital elements differently for manufacturing companies than for services companies. In the manufacturing industry, Tobin's Q is positively related to R&D intensity (β=0.0123,p<0.05), intangibility (β=0.0061,p<0.05) and percent of sales above industry's average (β=0.0012,p<0.01). In the services industry it is positively associated with R&D intensity (β=0.0112,p<0.01), SG&A intensity (β=0.0055,p<0.01) and percent of sales above industry's average (β=0.0018,p<0.01), but negatively related with intangibility (β=-0.0104;p<0.01). This latter result shows that having a higher intangibility produces value above the replacement costs of the assets in the manufacturing industry, but not in the services sectors. Further, for the industry sub-samples of low and high knowledge intensive companies, Tobin's Q captures human capital only in the high knowledge intensive service industry for which an increase with £1 in average salary per employee is connected with an increase of 0.00421 in Tobin's Q ($\beta=0.00421$, $p<0.05$).

Structural capital elements are captured by Tobin's Q in a diverse manner from one element to another and also from one industry to another. The value of R&D intensity is statistically significant only for the high knowledge intensive industries, with a $\beta=0.0189$ ($p<0.05$) in the high knowledge intensive manufacturing and a $\beta=0.0108$ ($p<0.01$) in the high knowledge intensive services. This pattern conforms to the evidence that average R&D intensity is higher in these sectors than in the low knowledge intensive ones, with a higher coefficient for high knowledge manufacturing compared with the high knowledge intensive services. This result is in accordance with previous research which found that the association between R&D intensity connection and market value is greater in manufacturing companies than in non-manufacturing ones (Conolly & Hirschey, 2005; Ehie & Olibe, 2010).

Nevertheless, compared with the results for Market-to-Book ratio, the results for Tobin's Q do not suggest any interplay between R&D intensity and SG&A. SG&A intensity is a determinant of Tobin's Q independent of the R&D intensity measure. SG&A intensity is captured by Tobin's Q in all industry sectors except high knowledge intensive manufacturing. Investing in SG&A is more efficiently deployed in the low knowledge intensive manufacturing sector from a Tobin's Q perspective; an increase of 1% in SG&A intensity is associated with an increase of 0.0013% in Tobin's Q in this sector.

Companies' intangibility value as an intellectual capital element is only revealed by Tobin's Q in the high knowledge intensive manufacturing sector ($\beta=0.0012$, $p<0.05$). Coupling this information with the way Tobin's Q captures R&D investment intensity, suggests that if R&D projects result in clearly identifiable intangible assets for the company then this aspect will be captured by Tobin's Q. This result dovetails with the purpose of Tobin's Q as a measure of intellectual capital: evaluate whether intellectual capital investments have been deployed efficiently (Andriessen, 2004b). As with the Market-to-Book ratio, Tobin's Q has a negative relation with intangibility for the remaining industries which enforces the possibility that market values ignore the potential of recorded intangible assets' to create additional value.

Table 8-9 TQ industry differences in capturing intellectual capital

$TQ= \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3* SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$							
		Manufacturing			***Services***		
	Variables	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	-0.0028	-0.0007	0.00239	0.00209	-0.00171	0.00421**
		(0.0034)	(0.0036)	(0.0055)	(0.0014)	(0.0015)	(0.0019)
Structural capital	***R&D***	0.0123**	-0.0004	0.0189**	0.0112***	0.0076	0.0108***
		(0.0054)	(0.0082)	(0.0078)	(0.0029)	(0.0073)	(0.0034)
	SG&A	0.0046	0.0134***	-0.0048	0.0055***	0.0069***	0.0053**
		(0.0028)	(0.0026)	(0.0049)	(0.0015)	(0.0018)	(0.0021)
	Intan	0.0061**	-0.0008	0.0123**	-0.0104***	-0.0125***	-0.0090***
		(0.0030)	(0.0029)	(0.0052)	(0.0015)	(0.0021)	(0.0019)
Relational capital	***Sales***	0.0012***	0.0009**	0.0016***	0.0018***	0.0013***	0.0020***
		(0.0002)	(0.0004)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Control variables	***log(TA)***	-0.351***	-0.118***	-0.583***	-0.500***	-0.264***	-0.612***
		(0.0438)	(0.0438)	(0.0762)	(0.0266)	(0.0311)	(0.0359)
	Leve	-0.0039	-0.0057	-0.0158	-0.0059	0.0149	-0.0169
		(0.0233)	(0.0180)	(0.0506)	(0.0129)	(0.0143)	(0.0176)
	Age	-0.0034	-0.0046***	0.0022	-0.0013	-0.0094***	0.0061*
		(0.0023)	(0.0018)	(0.0052)	(0.0023)	(0.0022)	(0.0035)
	HHI	-1.34e-05	8.87e-06	-5.00e-05	5.24e-05	-0.0004**	8.62e-05
		(3.4e-05)	(2.3e-05)	(0.0001)	(8.0e-05)	(0.0002)	(9.5e-05)
	INDWOE	0.152**	0.0799	0.209	0.0325	0.0561	0.0732
		(0.0689)	(0.0580)	(0.133)	(0.0717)	(0.0787)	(0.101)
	Constant	5.160***	2.159***	8.164***	7.008***	4.681***	7.999***
		(0.510)	(0.510)	(0.845)	(0.313)	(0.377)	(0.419)
	Firm-years	1,845	915	930	5,202	1,736	3,466
	No. of firms	198	97	101	614	198	416

Variables definition

TQ=Tobin's Q;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Relational capital, measured by sales above the industry average, is captured by Tobin's Q in all the industry sectors under analysis. However, there are differences between sectors in the magnitude of coefficients. This reveals that for companies in service industries, such as Air and Water transport, Information and Communication, Financial and Insurance Activities and Professional, Scientific and Technical Activities, relational capital is associated with market value in excess of the replacement costs of the assets. Also, these industries are known to rely on their relational capital in order to derive their profits.

The results obtained from estimating the model for **Economic Value Added** are provided in Table 8-10. In a similar manner with the previous methods, there are differences in EVA's ability to capture intellectual capital for manufacturing companies compared to services companies. Overall, EVA has a limited ability to capture intellectual capital elements in any of the sectors under analysis and is the accounting measure which shows the most inconsistency from one sector to another.

Despite the fact that it has been widely alleged to value human capital investments (Mouritsen, 1998), when the analysis is broken down at industry level, EVA is not significantly associated with human capital in any of the industries. EVA is negatively associated with intangibility in the manufacturing industry (β=-582.8, $p<0.05$) and positively associated with the same measure in the services industry (β=143, $p<0.05$). Relational capital is again captured differently from manufacturing and services companies. In the manufacturing industry there is an overall positive relation (β=325.5, $p<0.01$), while in the services industry there is an overall negative relation (β=-94.97, $p<0.01$). Further details on sub-samples of low and high knowledge intensive companies are provided next.

These results point to EVA being a rather poor measure of intellectual capital components. Nevertheless, this thesis is measuring intellectual capital components through publicly available accounting data, specifically expenses pertaining to intellectual capital components. Usually, intellectual capital related expenses are deducted from income-based measures, such as EVA, which should translate into a lower value for the respective measure. This means, that there should be a negative relation between intellectual capital's elements and income-based measures. However, the results indicate no statistically significant connection between intellectual capital and EVA, which raises the question of whether this measure's deficiency in capturing intellectual capital is related to the fact that it is computed based on the income statement data.

From a methodological point of view, compared with the rest of the accounting measures studied, EVA analysis proved to be rather problematic. The choice of either fixed effects model or random effects model depends, other things being equal, on the type of variation observed in the sample. If the variation in the sample is due to variation within companies, it indicates that a fixed effects model is appropriate.

Table 8-10 EVA industry differences in capturing intellectual capital

*EVA= α_i+β_1*Salaries+β_2*R&D+β_3* SG&A+β_4*Intangibles+β_5*Sales+β_y*Controls$_y$+e_i+d_i+η_i*							
			Manufacturing			***Services***	
	Variables	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	330.6	150.3	177.0	58.60	24.60	61.65
		(240.2)	(180.6)	(399.9)	(57.39)	(94.09)	(71.48)
Structural capital	***R&D***	-92.81	-259.0	-149.0	-87.45	-77.43	-82.76
		(456.0)	(463.1)	(650.6)	(120.9)	(479.2)	(123.5)
	SG&A	223.4	28.01	406.0	-79.71	-166.2	-37.80
		(222.0)	(134.6)	(413.9)	(65.31)	(117.3)	(76.85)
	Intan	-582.8**	-154.3	-539.0	143.0**	122.7	136.0*
		(231.6)	(144.9)	(411.2)	(64.39)	(138.5)	(71.27)
Relational capital	***Sales***	325.5***	-221.5***	488.7***	-94.97***	-122.8***	-92.53***
		(24.14)	(21.33)	(32.83)	(9.330)	(17.55)	(10.74)
Control variables	***log(TA)***	-7,149*	6,985***	-8,373	-9,245***	-10,294***	-9,278***
		(3,880)	(2,440)	(6,579)	(1,114)	(1,930)	(1,331)
	Leve	1,440	3,381***	-492.9	25.98	-211.4	94.44
		(1,614)	(925.2)	(3,806)	(483.1)	(886.5)	(575.9)
	Age	-135.4	-215.6*	-293.9	156.0	-73.09	316.1**
		(251.7)	(116.0)	(522.3)	(95.19)	(128.0)	(133.2)
	HHI	-0.623	-0.238	-2.299	0.306	-7.362	1.315
		(2.402)	(1.275)	(7.536)	(3.154)	(10.66)	(3.211)
	INDWOE	-6,709	-5,322*	-9,218	-3,876	2,280	-8,802***
		(4,749)	(3,036)	(9,606)	(2,799)	(4,983)	(3,407)
	Constant	51,030	-54,622*	58,074	91,816***	123,889***	83,547***
		(44,443)	(28,205)	(71,751)	(13,027)	(23,528)	(15,337)
	Firm-years	1,821	920	901	5,041	1,696	3,345
	No. of firms	199	99	100	605	195	410

Variables definition

EVA = Economic Value Added
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

On the contrary, if the sample variation is due to the variation between companies, a random effects model is more appropriate. For EVA, in the low knowledge intensive manufacturing there is a large within variation, while for the rest of the industries there is predominantly between variations. Therefore, fitting either a fixed effects or a random effects model for all the industries has proved cumbersome. For this thesis, random effects model has been chosen because it fitted most industry sectors and allowed a comparison with the rest of the measures.

<u>Calculated Intangible Value (CIV)</u> is found to consistently capture relational capital even when the sample is split between manufacturing and services companies. The negative significant relation with intangibility is maintained only for services companies compared with the whole sample analysis (β=-6409.19, p<0.1). SG&A intensity shows a positive significant relation (β=4897.09, p<0.1) with CIV in the manufacturing industry. There is no other statistically significant relation for the overall sample of manufacturing companies or services companies.

Table 8-11 CIV industry differences in capturing intellectual capital

$CIV = \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3*SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$							
		Manufacturing			***Services***		
	Variables	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	550.4	-568.2	697.3	3634	7694	336.0
		(2921)	(2079)	(5013)	(2564)	(5157)	(2553)
Structural capital	***R&D***	3871.18	-1090.49	4639.70	-1708.97	3272.69	157609
		(5874.37)	(5692.04)	(8717.25)	(5478.79)	(25850)	(4532.63)
	SG&A	4897.09*	3337.61**	5891.11	1779.46	-1773.86	739.95
		(2807.79)	(1685.55)	(5430.37)	(2947.65)	(6606.89)	(2793.79)
	Intan	-773.55	482.79	-6.066	-6409.19**	-20890***	-1459.82
		(2993.36)	(1904.25)	(5526.96)	(2903.59)	(7752.87)	(2608.03)
Relational capital	***Sales***	9465.44***	3576.28***	11390***	10430***	5352.86***	12750***
		(340.25)	(331.30)	(478.55)	(427.82)	(1003.11)	(405.65)
Control variables	***log(TA)***	55510	168548***	29512	336863***	599844***	196050***
		(52583)	(39480)	(90847)	(51726)	(115188)	(49386)
	Leve	4590	8111	2194	39235*	61854	16600
		(18842)	(9457)	(45853)	(20288)	(47240)	(18401)
	Age	-4991	-5973**	-6407	3341	-537.1	1818
		(3653)	(2485)	(7779)	(4618)	(8522)	(4850)
	HHI	-26.54	14.55	-192.4*	27.42	299.7	34.84
		(28.45)	(13.19)	(98.47)	(137.4)	(556.7)	(115.0)
	INDWOE	20664	-35139	39043	-85622	-7938	-119298
		(55078)	(31124)	(114559)	(120052)	(258990)	(115737)
	Constant	-884815	-1.7e+06***	-671757	-3.4e+06***	-6.7e+06***	-1.5e+06**
		(601553)	(449709)	(983421)	(598256)	(1.368e+06)	(567173)
	Firm-years	1804	909	895	4934	1676	3258
	No. of firms	198	99	99	595	193	402

<u>Variables definition</u>

MB = Market-to-book ratio;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Switching the analysis to the knowledge profile of the companies, CIV is positively and significantly connected with relational capital measured by the percent of sales above the industry average in all industry sectors. Similarly, as with previous measures there are differences between the size of the coefficients for different industries with the highest values being in the high knowledge intensive sectors (high knowledge manufacturing $\beta=11390$, $p<0.01$; high knowledge services $\beta=12750$, $p<0.01$). This strong connection between the relational capital and calculated intangible value is expected, as directed by how both variables are constructed: relational capital and CIV presume industry benchmarking.

While the model construction explains the estimation findings with respect to relational capital, there is no explanation why CIV does not capture the other intellectual capital elements. Table 8-11 reveals that Calculated Intangible Value only captures SG&A intensity in low knowledge intensive manufacturing. The results indicate that CIV is a consistent measure of relational capital between different sectors. It is generally not useful to estimate other intellectual capital elements.

Finally the **Value Added Intellectual Capital Index (VAIC)** captures human capital for the services companies, but not for the manufacturing companies. In the services company VAIC shows a negative significant association with R&D intensity ($\beta=-0.0129$, $p<0.01$), SG&A intensity ($\beta=-0.0143$, $p<0.01$) and Sales ($\beta=-0.0005$, $p<0.01$), while in the manufacturing company a negative significant relation is only recorded for SG&A intensity ($\beta=-0.0220$, $p<0.01$).

Further, VAIC captures human capital in both low and high knowledge intensive services ($\beta=0.0116$, $p<0.01$; $\beta<0.0115$, $p<0.01$). Compared with the previous measures, which do not capture the value of intellectual capital elements in the low knowledge intensive manufacturing industry, VAIC reveals R&D intensity value for this industry. An increase in R&D intensity of 1% in low knowledge manufacturing is related to a 0.0344% increase in the VAIC value. Therefore, the VAIC accounting measure should be used with caution as it is not capturing many intellectual capital elements and when it does it is inconsistent across industry sectors.

Table 8-12 VAIC industry differences in capturing intellectual capital

		Manufacturing			Services		
*$VAIC = \alpha_i+\beta_1$*Salaries$+\beta_2$*R&D$+\beta_3$* SG&A$+\beta_4$*Intangibles$+\beta_5$*Sales$+\beta_y$*Controls$_y+e_i+d_i+\eta_i$*	***Variables***	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	0.0050	-0.0024	0.0125	0.0115***	0.0116***	0.0115***
		(0.0072)	(0.0063)	(0.0121)	(0.0020)	(0.0030)	(0.0025)
Structural capital	***R&D***	0.0034	0.0344**	-0.0060	-0.0129***	-0.0524***	-0.0125***
		(0.0110)	(0.0154)	(0.0161)	(0.0041)	(0.0159)	(0.0042)
	SG&A	-0.0220***	-0.0265***	-0.0190*	-0.0143***	-0.0097***	-0.0154***
		(0.0058)	(0.0044)	(0.0109)	(0.0022)	(0.0037)	(0.0027)
	Intan	-0.0048	0.0008	-0.0096	-0.0026	-0.0039	-0.0020
		(0.0060)	(0.0048)	(0.0109)	(0.0022)	(0.0042)	(0.0026)
Relational capital	***Sales***	-0.0003	-0.0007	-0.0004	-0.0005*	-0.0007	-0.0003
		(0.0005)	(0.0007)	(0.0007)	(0.0003)	(0.0006)	(0.0003)
Control variables	***log(TA)***	0.270***	0.229***	0.313**	0.259***	0.261***	0.257***
		(0.0838)	(0.0733)	(0.151)	(0.0330)	(0.0601)	(0.0385)
	Leve	-0.0462	-0.00421	-0.122	0.0350*	0.0408	0.0350
		(0.0554)	(0.0364)	(0.128)	(0.0212)	(0.0301)	(0.0275)
	Age	-0.0028	-0.0030	-0.0025	0.0044*	0.0102**	-0.0006
		(0.0044)	(0.0031)	(0.0101)	(0.0026)	(0.0045)	(0.0032)
	HHI	2.06e-05	9.34e-05*	-0.0002	-2.04e-05	2.35e-05	-7.15e-05
		(7.85e-05)	(4.84e-05)	(0.0002)	(0.0001)	(0.0003)	(0.0001)
	INDWOE	0.0709	-0.186	0.390	0.115	0.0641	0.101
		(0.169)	(0.120)	(0.348)	(0.119)	(0.168)	(0.153)
	Constant	-0.0284	0.322	-0.491	-0.906**	-0.871	-0.860*
		(0.989)	(0.846)	(1.741)	(0.409)	(0.729)	(0.482)
	Firm-years	1,939	964	975	5,578	1,830	3,748
	No. of firms	204	102	102	632	202	430

Variables definition

VAIC = Value Added Intellectual Capital Index;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

This section has investigated the ability of accounting measures of intangible value to capture intellectual capital in various industries. It has revealed that industry considerations are important for the study of intellectual capital. There are differences in the accounting measures ability to capture intellectual capital for manufacturing and services companies, and there are even more noticeable differences if these industry sectors are further divided into low and high knowledge intensive companies. Results suggest that the measures have a better ability to capture intellectual capital in high knowledge industry sectors as opposed to low knowledge industry sectors. This explains why most of the studies have focused on high knowledge industries and there is little information about low knowledge ones.

Specifically, Market-to-Book ratio is the most consistent accounting measure of intangible value in capturing the intellectual capital elements in the same manner from one industry to another. Similarly, Calculated Intangible Value is consistent between different industries, but it only captures relational capital. Tobin's Q shows consistency in capturing intellectual capital for companies with the same knowledge profile – low or high knowledge intensive companies while Economic Value Added proves inconsistent in its ability to reflect the elements of intellectual capital. The Value Added Intellectual Capital Index proves to be a poor measure of intellectual capital as it is only capturing human capital for services companies.

8.6.3. Interactions and aggregate measures of intellectual capital

Some of the inconsistencies found in the previous section may be due to the fact that the accounting measures of intangible value have been developed to measure the overall value of intellectual capital, instead of its separate elements (Spender, 2009). To probe this issue, this section investigates the extent to which the accounting measures of intangible value are better characterised by combinations of IC characteristics. The literature highlights that intellectual capital elements are synergetic in that they produce more value than the sum of their parts (Bradley, 1997; Lev, 2001; Bontis et. al., 2000; Bontis & Fitz-enz, 2002). Therefore as a final element of our investigation into the ability of accounting measures to capture the value of intellectual capital, it is necessary to explore how IC elements may combine to add value and whether these features are captured by or accounting measures (O'Donnel & Berkery, 2003).

As mentioned in the Methodology section of this chapter, the interactions between the elements of intellectual capital are studied with the help of factor analysis which reduces the data to the latent variables to which they refer to (Field, 2005). Five variables are employed in this thesis to account for the traditional intellectual capital components: human capital, structural capital and relational capital. The development of the intellectual capital components and its measurements was guided by the literature's perception of the relations and common characteristics shared among variables. Nevertheless, certain elements that participate in each sub-domain may not behave homogeneously due to their nature (Cohen & Kaimenakis, 2007). For example, company's brands are recorded in the balance sheet under the Intangible Assets umbrella. Brands have been used in the literature alternatively as measures of structural capital and/or relational capital. To illustrate, Beattie and Thomson (2007) include brands in relational capital, while Clarke et. al. (2011) consider them as a part of structural capital. Similarly, Selling and General Administrative expenses include the salaries of administrative personnel that have not been recorded together with the overall salaries expenses. However, salaries are considered a human capital measure. As a result, the conventional conceptualisation of intellectual capital might show different facets of this term in an empirical context (Huang et. al., 2007)

In order to identify patterns amongst the intellectual capital elements, reduce the variables to a manageable level and determine the proportions various variables participate to an identified pattern, a principal component factor analysis with an orthogonal varimax rotation was performed (Field, 2005). Different types of factor analysis have been tested (maximum likelihood, iterated principal factor). Also, besides an orthogonal rotation, an oblique rotation was tested too. Nonetheless, the type of analysis chosen is the only one which fits the different criteria set for factor extraction and loading (Costello & Osborne, 2005). Also, it was the only factor analysis which generated the same factor loadings for the sub-samples as for the whole sample. There are three steps in the application of a factor analysis technique: the initial extraction of factors, the rotation and the computation of factor scores. The initial results of the three steps in the factor analysis are described and discussed below.

Table 8-13 Factor loadings

	Initial Eigen Values/Extraction Sums of Squared Loadings				Rotation Sums of Squared Loadings			
	Eigen value	**Dif**	**%**	**Cumulative %**	**Eigen value**	**Dif**	**%**	**Cumulative %**
Factor1	1.61	0.54	0.32	0.32	1.61	0.54	0.32	0.32
Factor2	1.07	0.15	0.21	0.54	1.07	.	0.21	0.54
Factor3	0.92	0.11	0.18	0.72				
Factor4	0.82	0.24	0.16	0.88				
Factor5	0.58	.	0.12	1.00				

The general recommendation in the literature is to retain factors with an eigenvalue higher than 1 (Kootstra, 2004). After the examination of the factor solutions, two factors with eigenvalues higher than 1 in the first stage were retained which accounted for 54% of the total variance explained. From a theoretical point of view, it was expected that the variables are not going to load perfectly into three factors describing the three intellectual capital components because, as explained, Intangible Assets and Selling and General Administrative expenses are multifaceted elements.

Moreover, the intellectual capital proxies were developed from different models of a literature that is not always consistent (Huang et. al., 2007). Cohen and Kaimenkis (2007) and Huang et. al. (2007) conduct a factor analysis on proxies as well, which account for human capital, structural capital and relational capital. As with the results in this study, their variables do not perfectly load to describe categories of human capital, relational capital and structural capital.

To improve interpretability, the factor solution was rotated using the varimax orthogonal method (Green, 1978: p. 377). A varimax orthogonal rotation was the preferred method of rotation, because factor analysis was employed on one hand to observe the structure of the intellectual capital components, but also to reduce data and potential multicollinearity problems. Orthogonal rotation extracts the factor loading of the variables presuming there will be no correlation between the factors. The resulting factor loadings and percent of variance explained by each of the variables are shown in Table 8-14.

Table 8-14 Rotated factor loadings

	Factor 1 Potential IC	**Factor 2 Realised IC**
Salaries	0.62	0.11
R&D	0.70	-0.09
SG&A	0.80	0.04
Intan	0.11	0.83
Sales	-0.28	0.60

Variable definition
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;

Field (2005) recommends interpreting only factor loadings with an absolute value greater than 0.4. Taking this value as a threshold, average salaries per employee, R&D intensity (R&D expense to Total Operating Expense) and SG&A intensity (SG&A expense to Total Operating Expense) significantly load onto one factor. These intellectual capital elements are input factors in the production process, which may or not may be successfully transformed into outputs. Therefore, these elements have the potential of being transformed into future benefits for the company and the underlying aspect they describe has been generically named "***potential intellectual capital***".

Intangible assets recorded on the balance sheet usually represent the output of a production process. These intellectual capital elements can further participate in the production process and derive future benefits for a company. Similarly, the percent of sales above industry's average is an intellectual capital element which is realised and can be reintroduced in the production process to derive future value. Hence, the aspect described by intangibility and percent of sales above industry's average has been entitled "***realised intellectual capital***".

From the factor analysis, factor loadings and factor scores can be derived. Factor loadings represent the correlation of the original variable with the latent variable it describes. Factor scores are the scores of a subject on a factor (Rietveld & Van Hout, 1993). The factor scores computed for each firm across the two factors extracted will be used as the independent variables in the statistical analysis to represent potential and realised intellectual capital as aggregate measures of intellectual capital (for a discussion of this procedure see Green, 1978). The factor scores derived from the factor analysis are presented in Table 8-15.

Table 8-15 Factor scores

	Potential IC	***Realised IC***
Salaries	0.38903	0.11456
R&D	0.43441	-0.06615
SG&A	0.49867	0.05303
Intan	0.09028	0.7806
Sales	-0.15867	0.55042

Variable definition
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;

Tables 8-14 to 8-18 show the results for the accounting measures ability to capture intellectual capital elements synergies as depicted by the factor score measures of *"potential"* and *"realised"* intellectual capital. The tables also show how the accounting measures also capturing the overall intellectual capital value by introducing a cross-product interaction element between the two factors extracted.

The estimation results for ***Market-to-Book ratio*** are shown in Table 8-14. Compared with the previous analysis, MB is not as consistent in the manner it captures potential and realised intellectual capital from one industry to another. With respect to potential intellectual capital the differences are manifested between high and low knowledge intensive companies. For realised intellectual capital, the differences are more apparent between services and manufacturing companies.

To illustrate, Model 1 reveals that MB captures potential intellectual capital in the overall sample and in high knowledge intensive industry sectors for manufacturing (β=1.083, $p<0.01$) and services companies (β=0.638, $p<0.01$). MB captures realised intellectual capital only in the high knowledge intensive manufacturing (β=0.490, $p<0.05$). These results are consistent with the association between MB and individual intellectual capital elements and the factor scores. For example, in the low knowledge intensive services industry, Intangibility is negatively related to MB and percent of sales above industry's average is positively associated with this measure. Intangibility scores higher than percent of sales above the industry average in the realised intellectual capital factor, hence the negative relation of the latter with MB in the low knowledge intensive services industry.

Model 2 indicates that when the interaction between potential and realised intellectual capital is considered for the low knowledge manufacturing companies, not only are potential and realised intellectual capital statistically significant and show a positive association with MB, but also their interaction effect is significant and positive. This suggests that an interaction between potential and realised intellectual capital adds further to the positive effect of both individually. This outcome is in line with the knowledge-based theory, which states that value is produced whenever tacit knowledge (potential intellectual capital) is transformed into explicit knowledge (realised intellectual capital) (Nonaka & Takeuchi, 1995).

In contrast, for the rest of the industries the interaction effect has a negative influence on MB, supporting the arguments of the researchers who criticise the knowledge-based theory. Specifically, these researchers argue that realised intellectual capital is easy to imitate. Consequently, it can diminish or destroy the competitive advantage and negatively influence the value of the firm (Dean & Kretschmer, 2007)

These results indicate that Market-to-Book ratio's ability to capture combinations of intellectual capital elements is focused on potential intellectual capital and concentrated in the high knowledge intensive manufacturing. Realised intellectual capital is captured in the manufacturing industries; however, it depends on whether it is supported by potential intellectual capital. Also, the results show that MB captures the interaction between potential and realised intellectual capital only for low knowledge intensive manufacturing companies.

<u>Tobin's Q</u> is capturing potential intellectual capital in all industries, except high knowledge intensive manufacturing. It has a positive relation with realised intellectual capital for manufacturing companies, which is statistically significant in the high knowledge sector. Also, it has a negative relation with realised intellectual capital for services companies. The interaction between the aggregate measures is negatively related with Tobin's Q, but significant only for services companies.

Tobin's Q captures potential intellectual capital in the overall sample ($\beta=0.196, p<0.01$), for low knowledge intensive manufacturing ($\beta=0.354, p<0.01$), low knowledge intensive services ($\beta=0.0117, p<0.1$) and high knowledge intensive services ($\beta=0.237, p<0.01$). Interaction between elements of intellectual capital, such as the ones which form potential intellectual capital in this thesis have been previously found to have a positive influence on Tobin's Q. For example, the findings of Bardhan et. al. (2010) show a positive interaction effect of IT and R&D investments on Tobin's Q. Also, Pulic (1998) and Youndt et. al. (2004) show a positive influence on the firm of the interplay between human resources and infrastructure, all of which form the potential intellectual capital in this study.

Table 8-17 also reveals that Tobin's Q is positively associated with realised intellectual capital in high knowledge intensive manufacturing ($\beta=0.530, p<0.01$), but negatively associated with this term in low knowledge intensive services ($\beta=-0.217, p<0.01$) and high knowledge intensive services($\beta=-0.163, p<0.01$). Hence, it seems that realised intellectual capital is perceived as a knowledge spillover in the services industry. Previous research has shown that spillovers of realised intellectual capital are clustered around different industries (Harabi, 1997; Kaiser, 2002). Furthermore, Jaffe et. al. (2000) showed that intangible assets such as patents are more prone to knowledge spillovers than other types of intellectual capital. Finally, given the industry sector specifics, a positive effect of the realised intellectual capital is expected in the manufacturing companies, especially in the high knowledge intensive companies which they rely intensively in producing high technology equipment.

Table 8-16 MB and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing				Services			
			Low		High		Low		High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	0.562***	0.556***	0.381	0.523*	1.083***	0.788***	0.152	0.174	0.638***	0.654***
	(0.0995)	(0.0987)	(0.297)	(0.301)	(0.232)	(0.250)	(0.198)	(0.197)	(0.141)	(0.140)
Realised IC	-0.0926	-0.0946	0.201	0.537**	0.490**	0.347	-0.294	-0.450**	-0.212	-0.165
	(0.0932)	(0.0925)	(0.234)	(0.259)	(0.233)	(0.236)	(0.182)	(0.192)	(0.138)	(0.138)
Potential*Realised		-0.291***		0.754***		-0.646***		-0.392**		-0.227**
		(0.0730)		(0.254)		(0.220)		(0.162)		(0.102)
log(TA)	-0.327***	-0.349***	-0.155	-0.0882	-0.415***	-0.462***	-0.358***	-0.359***	-0.339***	-0.358***
	(0.0462)	(0.0461)	(0.121)	(0.123)	(0.131)	(0.131)	(0.0831)	(0.0827)	(0.0682)	(0.0682)
Leve	2.357***	2.355***	2.252***	2.252***	2.719***	2.724***	1.816***	1.818***	2.583***	2.580***
	(0.0357)	(0.0357)	(0.0564)	(0.0562)	(0.124)	(0.124)	(0.0534)	(0.0534)	(0.0571)	(0.0571)
Age	-0.0087**	-0.0078**	-0.0109**	-0.0120**	-0.0052	-0.0024	-0.0134**	-0.0133**	-0.0045	-0.0041
	(0.00346)	(0.00342)	(0.00526)	(0.00528)	(0.00894)	(0.00889)	(0.00596)	(0.00592)	(0.00633)	(0.00623)
HHI	-5.0e-05	-4.55e-05	-9.14e-06	-9.02e-06	-0.000217	-0.000254	-0.000801	-0.000753	0.000145	0.000159
	(9.9e-05)	(9.8e-05)	(7.3e-05)	(7.3e-05)	(0.0002)	(0.0002)	(0.0006)	(0.0006)	(0.0003)	(0.0003)
INDWOE	0.373**	0.371**	0.250	0.246	0.567*	0.613*	0.210	0.202	0.414	0.408
	(0.153)	(0.152)	(0.182)	(0.181)	(0.328)	(0.327)	(0.270)	(0.269)	(0.282)	(0.281)
Constant	6.318***	6.593***	3.181**	2.431*	8.358***	8.685***	6.695***	6.764***	6.465***	6.657***
	(0.609)	(0.608)	(1.354)	(1.376)	(1.455)	(1.445)	(0.977)	(0.973)	(0.804)	(0.803)
Firm- years	7054	7054	915	915	930	930	1733	1733	3476	3476
No. of firms	813	813	97	97	101	101	197	197	418	418

Variables definition

MB = Market-to-book ratio;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA)= Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated, but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8-17 TQ and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing Low		Manufacturing High		Services Low		Services High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	0.196***	0.194***	0.354***	0.352***	0.155	0.0923	0.117*	0.123*	0.237***	0.249***
	(0.0420)	(0.0417)	(0.101)	(0.101)	(0.121)	(0.128)	(0.0642)	(0.0637)	(0.0624)	(0.0620)
Realised IC	-0.0913**	-0.0609	0.0425	0.0293	0.530***	0.502***	-0.217***	-0.281***	-0.163***	-0.0882
	(0.0393)	(0.0392)	(0.0801)	(0.0873)	(0.124)	(0.125)	(0.0614)	(0.0628)	(0.0582)	(0.0605)
Potential*Realized		-0.194***		-0.0453		-0.166		-0.216***		-0.183***
		(0.0294)		(0.0843)		(0.109)		(0.0511)		(0.0429)
log(TA)	-0.401***	-0.413***	-0.0818*	-0.0825*	-0.508***	-0.519***	-0.225***	-0.224***	-0.532***	-0.543***
	(0.0219)	(0.0218)	(0.0423)	(0.0423)	(0.0712)	(0.0715)	(0.0299)	(0.0295)	(0.0344)	(0.0343)
Leve	-0.0067	-0.0071	-0.0058	-0.0058	-0.0175	-0.0159	0.0116	0.0124	-0.0162	-0.0177
	(0.0113)	(0.0113)	(0.0180)	(0.0180)	(0.0508)	(0.0507)	(0.0144)	(0.0144)	(0.0177)	(0.0177)
Age	-0.0020	-0.0013	-0.0048**	-0.0047**	0.0007	0.0015	-0.0092***	-0.0090***	0.0076**	0.0076**
	(0.0018)	(0.0018)	(0.0019)	(0.0019)	(0.0052)	(0.0052)	(0.0023)	(0.0022)	(0.0036)	(0.0035)
HHI	-3.7e-06	-1.0e-06	9.0e-06	8.7e-06	-3.7e-05	-4.6e-05	-0.0003**	-0.0003**	8.8e-05	0.0001
	(3.6e-05)	(3.6e-05)	(2.4e-05)	(2.4e-05)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(9.6e-05)	(9.6e-05)
INDWOE	0.0885*	0.0880*	0.0767	0.0776	0.206	0.213	0.0785	0.0746	0.0738	0.0700
	(0.0529)	(0.0528)	(0.0581)	(0.0582)	(0.134)	(0.134)	(0.0797)	(0.0794)	(0.102)	(0.102)
Constant	5.988***	6.162***	2.450***	2.464***	7.936***	8.010***	4.382***	4.412***	7.520***	7.631***
	(0.288)	(0.287)	(0.473)	(0.474)	(0.778)	(0.778)	(0.346)	(0.342)	(0.380)	(0.378)
Firm-years	7047	7047	915	915	930	930	1736	1736	3466	3466
No. of firms	812	812	97	97	101	101	198	198	416	416

Variables definition

TQ = Tobin's Q;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated, but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

When the interaction element is introduced the results described are maintained. However, the complementarity between realised and potential intellectual capital is not captured in any of the industries under analysis. Moreover, there is a negative significant connection between the interaction element and Tobin's Q in low knowledge intensive services ($\beta=-0.216$, $p<0.01$) and high knowledge intensive services ($\beta=-0.183$, $p<0.01$). Explanations for these findings are in line with the explanations provided for Market-to-Book ratio, regarding the interplay between tacit and explicit knowledge, namely potential and explicit knowledge. Again, given the fact that the services sector relies more on tacit knowledge, the negative affect generated by the fact that the tacit knowledge converts into explicit knowledge is expected.

The results on **Economic Value Added (EVA)** show rather than being able to capture the separate elements of intellectual capital, it is better placed at capturing the value of the overall package of potential and realised IC. Table 8-18 reveals **EVA** is capturing potential intellectual capital in the low knowledge intensive manufacturing industry ($\beta=10019$, $p<0.1$), despite the fact that in the separate analysis of the components EVA is not related with any of intellectual capital elements which compose this aggregate measure. Potential intellectual capital does not display any other significant relation with EVA in the rest of industry sectors.

EVA captures realised intellectual capital in the high knowledge intensive manufacturing industry ($\beta=43955$, $p<0.01$). This can be explained by the fact that EVA is associated with the percent of sales above the industry average which is part of the realised intellectual capital factor. Realised intellectual capital is negatively and significantly related to EVA in low knowledge intensive manufacturing ($\beta=-20790$, $p<0.01$) and low knowledge intensive services ($\beta=-9191$, $p<0.05$)).

The introduction of the interaction element between potential and realised intellectual capital does not affect EVA's connection with these aggregate measures. In addition, the interaction between potential and realised intellectual capital is captured by EVA in all industries except high knowledge intensive manufacturing, where this relation is insignificant.

These results suggest that value is added to a company only by the interplay between potential and realised intellectual capital. This concurs with the theoretical literature which argues that value is added in a company by the synergy of intellectual capital elements (Bradley, 1997; Lev, 2001; Bontis et. al., 2000; Bontis & Fitz-enz, 2002).

Table 8-18 EVA and aggregate measure of intellectual capital

VARIABLES	All		Manufacturing				Services			
			Low		High		Low		High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	2408	2412	10019*	20348***	-9133	-10472	2321	1875	2468	2080
	(2318)	(2314)	(5474)	(5353)	(11937)	(12031)	(4111)	(4072)	(2267)	(2255)
Realised IC	994.8	-980.7	-20790***	-7509*	43995***	46102***	-9191**	-4983	-1373	-4368**
	(2166)	(2205)	(4300)	(4342)	(11945)	(11906)	(3937)	(4061)	(2136)	(2214)
Potential*Realised		6902***		39721***		-6732		12499***		7130***
		(1528)		(4323)		(9267)		(3339)		(1509)
log(TA)	-8302***	-7789***	-643.9	4156*	10556	10315	-14024***	-13891***	-12346***	-11629***
	(1428)	(1428)	(2398)	(2338)	(7224)	(7200)	(1882)	(1847)	(1289)	(1287)
Leve	121.5	134.6	2974***	3025***	-168.5	-39.49	-24.93	-53.74	21.28	61.66
	(490.1)	(490.2)	(948.1)	(910.9)	(3860)	(3885)	(890.1)	(889.1)	(577.2)	(576.9)
Age	-38.60	-64.83	-148.3	-221.4*	-1174	-1137	-103.2	-109.9	257.9*	253.2*
	(150.3)	(150.0)	(119.7)	(114.1)	(732.2)	(720.4)	(137.2)	(133.8)	(136.9)	(135.5)
HHI	-0.0698	-0.147	-0.535	-0.608	2.978	2.619	-9.243	-8.716	1.192	0.781
	(1.656)	(1.654)	(1.289)	(1.240)	(7.705)	(7.739)	(10.71)	(10.68)	(3.258)	(3.247)
INDWOE	-5895**	-5914**	-5038	-5277*	-11380	-10997	1271	1428	-8867**	-8720**
	(2400)	(2398)	(3094)	(2975)	(9762)	(9829)	(5030)	(5014)	(3443)	(3434)
Constant	93906***	86359***	10117	-42960*	-39892	-37829	149108***	145255***	113564***	106224***
	(20205)	(20222)	(26623)	(25943)	(78386)	(77953)	(21962)	(21602)	(14113)	(14085)
Firm-years	6862	6862	920	920	901	901	1696	1696	3345	3345
No of firms	804	804	99	99	100	100	195	195	410	410

Variables definition

EVA = Economic Value Added ;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated, but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

This aspect is not captured by the market-based measures, such as Market-to-Book and Tobin's Q, suggesting that investors find it difficult to identify the value creation process. However, EVA manages to capture this value lending credence to the theoretical arguments which suggest that this accounting measure reveals the value created specifically by the company (Worthington & West, 2001).

Given the previous association of **Calculated Intangible Value (CIV)** with relational capital, it is unsurprising that this measure is associated with realised intellectual capital. Potential intellectual capital is negatively related to CIV, but significantly so only for high knowledge intensive services (β=-256848, $p<0.01$). As with Market-to-Book ratio and Tobin's Q; this accounting measure of intangible value negatively reflects the interaction effect between realised and potential intellectual capital for services companies.

CIV is consistently capturing realised intellectual capital with the exception of low knowledge intensive services industry. For these companies the positive relation between percent of sales above the industry average and CIV is surpassed by the fact that intangibility, which contributes as well to realised intellectual capital, shows a negative relation with CIV. Thus, the association between realised intellectual capital and CIV is not significant in this industry sector.

The argument of a knowledge spillover effect in the services industry, due to the conversion of potential intellectual capital into realised intellectual capital, is supported by the results obtained for CIV. Hence, the explanations are in line with the ones provided for Market-to-Book ratio and Tobin's Q.

For the **Value Added Intellectual Capital Index (VAIC)** the analysis reveals that this measure is unable to capture consistently the combinations of intellectual capital elements. VAIC is significantly negatively related to potential IC for low knowledge intensive manufacturing companies (β=-3.368, $p<0.05$). At the same time, VAIC is positively related with this element for low knowledge intensive services companies (β=2.507, $p<0.1$). No other significant relations are portrayed between VAIC and the aggregate measures of intellectual capital in the model without the interaction effect variables.

Table 8-19 CIV and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing				Services			
			Low		High		Low		High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	-203986**	-211845***	21475	-5640	-144979	-168101	-31896	248.5	-256848***	-263006***
	(79654)	(78347)	(64862)	(66861)	(164427)	(166338)	(225520)	(225344)	(92692)	(89940)
Realised IC	485513***	666394***	165659***	157477***	826445***	889631***	11226	-124207	381106***	838096***
	(75229)	(75077)	(54385)	(55606)	(169195)	(169992)	(221044)	(228063)	(86554)	(90180)
Potential*Realised		-603537***		-82400		-92513		-400022**		-736215***
		(51981)		(51269)		(127485)		(175832)		(58732)
log(TA)	522466***	503280***	230318***	230030***	321605***	332986***	786828***	794702***	458693***	455926***
	(48241)	(46613)	(41412)	(41530)	(105302)	(105387)	(114932)	(114128)	(61712)	(57378)
Leve	23950	24931	9719	9676	7713	9496	47324	49642	17689	16088
	(16614)	(16650)	(9350)	(9435)	(46824)	(47441)	(47238)	(47242)	(18411)	(18642)
Age	1539	3398	-6818**	-6638**	-21155	-21109	1592	1742	15029*	12832*
	(4828)	(4478)	(3131)	(2972)	(13352)	(12964)	(9224)	(9125)	(8172)	(6837)
HHI	-16.20	-8.986	15.63	15.56	-89.17	-93.94	182.5	170.0	51.87	96.65
	(56.56)	(56.43)	(13.07)	(13.18)	(101.4)	(102.8)	(557.5)	(557.2)	(118.0)	(118.6)
INDWOE	-17633	-12379	-41175	-40447	15734	20164	-1505	8922	-106894	-103871
	(82090)	(82047)	(30730)	(30998)	(117054)	(118686)	(260163)	(260024)	(118930)	(119519)
Constant	-5.32e+06***	-4.91e+06***	-1.91e+06***	-1.89e+06***	-1.61e+06	-1.71e+06	-8.40e+06***	-8.40e+06***	-3.58e+06***	-3.5e+06***
	(668091)	(635857)	(470839)	(470018)	(1.17e+06)	(1.16e+06)	(1.33e+06)	(1.32e+06)	(674013)	(625011)
Firm-years	6738	6738	909	909	895	895	1676	1676	3258	3258
No. of firms	793	793	99	99	99	99	193	193	402	402

Variables definition

CIV = Calculated Intangible Value;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age= Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated, but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8-20 VAIC and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing				Services			
			Low		High		Low		High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	1.692	1.719	-3.368**	-3.830**	-0.401	-0.358	2.507*	2.509*	2.423	2.417
	(1.684)	(1.686)	(1.506)	(1.505)	(1.442)	(1.653)	(1.334)	(1.336)	(2.926)	(2.926)
Realised IC	-1.027	-1.011	-1.270	-2.609**	-0.898	-0.878	-0.640	-0.631	-0.662	-0.788
	(1.611)	(1.612)	(1.159)	(1.274)	(1.404)	(1.457)	(1.168)	(1.299)	(2.951)	(2.986)
Potential*Realised		0.388		-3.137**		0.0826		0.0201		0.604
		(1.302)		(1.322)		(1.527)		(1.205)		(2.200)
log(TA)	2.156***	2.191***	0.508	0.239	0.501	0.508	0.565	0.566	3.481**	3.548**
	(0.753)	(0.762)	(0.553)	(0.559)	(0.755)	(0.765)	(0.483)	(0.484)	(1.399)	(1.421)
Leve	-0.158	-0.158	0.169	0.168	-0.171	-0.177	0.0331	0.0331	-0.0928	-0.0909
	(0.587)	(0.587)	(0.373)	(0.372)	(1.183)	(1.185)	(0.395)	(0.395)	(1.040)	(1.040)
Age	0.0252	0.0240	-0.00999	-0.00448	-0.0353	-0.0356	0.0743**	0.0744**	0.0189	0.0179
	(0.0556)	(0.0557)	(0.0234)	(0.0231)	(0.0498)	(0.0502)	(0.0323)	(0.0323)	(0.130)	(0.130)
HHI	0.0007	0.0007	0.0005	0.0005	-5.7e-05	-5.3e-05	-0.0003	-0.0003	0.0034	0.0033
	(0.0018)	(0.0018)	(0.0005)	(0.0005)	(0.0019)	(0.0019)	(0.0047)	(0.0047)	(0.0060)	(0.0060)
INDWOE	1.819	1.822	0.273	0.414	-0.477	-0.484	0.302	0.304	3.677	3.681
	(2.817)	(2.817)	(1.221)	(1.218)	(3.115)	(3.123)	(2.193)	(2.197)	(6.071)	(6.072)
Constant	-23.03**	-23.44**	-6.389	-3.272	-4.619	-4.672	-4.962	-4.970	-39.23**	-39.89**
	(10.04)	(10.13)	(6.293)	(6.367)	(9.225)	(9.282)	(6.074)	(6.090)	(16.75)	(16.92)
Firm-years	7517	7517	964	964	975	975	1830	1830	3748	3748
No. of firms	836	836	102	102	102	102	202	202	430	430

Variables definition

VAIC = Value Added Intellectual Capital Index;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated, but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The introduction of the interaction element does not modify the above relationship. VAIC is not capturing the interaction between potential and realised intellectual capital. It is only significant but negatively related to this interaction in the low knowledge intensive manufacturing industry (β=-3.3137, $p<0.01$). This inconsistency of VAIC in revealing any type of intellectual capital confirm the findings of the previous two sections, which indicated that VAIC is a rather poor measure of intellectual capital.

8.7. Findings and discussion

This chapter has taken a contingency approach by considering multiple accounting measures, diverse industry sectors and different knowledge profiles. First it inquired whether the financial statement-based and market-based accounting measures are able to capture intellectual capital elements for all the companies in the sample. Second, it examined if the accounting measures ability to capture intellectual capital depends on the industry sector and the knowledge profile of the companies. Finally, it investigated whether the intellectual capital measures capture the interactions between intellectual capital elements, with the aim of establishing whether some measures reflect better the overall intellectual capital value than the value of its separate elements. The findings of the chapter are summarised below.

The results illustrate that the financial statement-based and market-based accounting measures capture intellectual capital differently, with market-based measures having a better ability to reveal the value of this important corporate resource. The results also reveal that accounting measures have a significantly different ability to capture intellectual capital depending on the industry under analysis and none of the measures studied captures all intellectual capital element.

Table 8-21 summarises the accounting measures' ability to capture intellectual capital in different industry sectors by showing the sign of all significant associations between intellectual capital elements and the accounting measures studied ($p<0.1$). As presented in this table, the market-based measures have the same ability to capture intellectual capital. Nevertheless, there are still small differences between the two market-based measures used. For example, in the low knowledge intensive manufacturing Market-to-Book ratio captures human capital, while Tobin's Q captures relational capital and a part of structural capital elements.

Table 8-21 Results summary - industry differences

Manufacturing		Low knowledge Intensive					High knowledge intensive				
		MB	TQ	EVA	CIV	VAIC	MB	TQ	EVA	CIV	VAIC
Human Capital	Salaries	+									
Structural capital	R&D					+	+				
	SG&A		+		+	-	+	+			-
	Intan							+			
Relational capital	Sales		+	-	+		+	+	+	+	
Services		**Low knowledge Intensive**					**High knowledge intensive**				
		MB	TQ	EVA	CIV	VAIC	MB	TQ	EVA	CIV	VAIC
Human Capital	Salaries	-				+	+	+			+
Structural capital	R&D	+				-	+	+			-
	SG&A	+	+			-	+	+			-
	Intan	-	-		-		-	-	+		
Relational capital	Sales	+	+	-	+		+	+	-	+	

Variables definition

MB=Market-to-book ratio;
TQ=Tobin's Q;
EVA=Economic Value Added;
CIV=Calculated Intangible Value;
VAIC=Value Added Intellectual Capital Index;
Sales = % of Sales above industry's average;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;

Despite arguments stating that the market-based measures are not correctly valuing intellectual capital in high knowledge intensive industries (Lev, 2005), Market-to-Book and Tobin’s Q are particularly good measures in the sectors rich in intellectual capital resources. Moreover, even though the magnitude of coefficient differs, these measures are also uniform in capturing intellectual capital across industries. Conversely, financial-based measures are very much different from one another and generally capture fewer elements of intellectual capital and with a larger diversity from one industry to another.

Turning our attention towards the accounting measures ability to capture the overall value of intellectual capital, the trend of the findings is similar to the one just described. One important difference is that Economic Value Added better captures the overall intellectual capital value as opposed to its individual elements. Again, market-based measures seem to be more consistent in capturing the synergies between intellectual capital elements compared to financial statement-based measures. Nevertheless, the market-based measures are not capturing the interplay between realised and potential intellectual capital in some industries. Various explanations can be advanced for this aspect. First, it has been debated that there are some knowledge spillovers occurring especially in the services industry (Jaffe et. al., 2000). Second, it is possible that intellectual capital's interconnections are not easy to observe and value in the market (Lev, 2005). Nevertheless, as mentioned previously, Economic Value Added consistently captures this interplay, which is in line with the literature asserting that value is added when there is an adequate combination of intellectual capital elements (Bukh, 2003).

Table 8-22 Results summary- aggregate intellectual capital measures

Manufacturing	***Low knowledge Intensive***										***High knowledge intensive***									
	MB		***TQ***		***EVA***		***CIV***		***VAIC***		***MB***		***TQ***		***EVA***		***CIV***		***VAIC***	
Potential		+	+	+	+	+			-	-	+	+								
Realised		+			-	-	+	+		-	+		+	+	+	+	+	+		
Interaction		+				+				-		-								
Services	***Low knowledge Intensive***										***High knowledge intensive***									
	MB		***TQ***		***EVA***		***CIV***		***VAIC***		***MB***		***TQ***		***EVA***		***CIV***		***VAIC***	
Potential			+	+					+	+	+	+	+	+			-	-		
Realised		-	-	-	-								-			-	+	+		
Interaction		-		-		+	-					-		-		+		-		

Variables definition

MB= Market-to-book ratio;
TQ= Tobin's Q;
EVA= Economic Value Added;
CIV= Calculated Intangible Value;
VAIC= Value Added Intellectual capital Index;
Potential= Potential Intellectual Capital;
Realised= Realised Intellectual capital;

While admitting the superiority of market-based measures in capturing intellectual capital compared to financial statement-based measures, one flaw can be noticed: because of the limitation inherent to their construction, the market-based measures ignore balance sheet recorded Intangible Assets, as well as realised intellectual capital. Both of these intellectual capital elements are important sources of intellectual capital value (OECD, 2006).

Financial statements-based measures are poor at capturing intellectual capital components as measured in this thesis. Nevertheless, the focus has been on reaching a conclusion on the intellectual capital measures by using publicly available accounting data. As a consequence, intellectual capital elements have been approximated using cost-based indicators. Financial statement-based measures usually exclude intellectual capital related expenses, which should translate in a lower value for the financial statement-based measures. This means, that one might expect a negative relation between intellectual capital's elements and financial statement-based measures (Ely & Waymire, 1999). However, the results usually indicate no statistical significant connection between intellectual capital and income-based measures. This suggest that the deficiency of income-based measures in capturing intellectual capital might not be related to the fact that they are based on accounting data, as widely asserted in the theoretical literature, but that their deficiency in capturing intellectual capital is due to other factors. One such factor could be the fact that accounting discipline and, implicitly, accounting data has focused on the stock of resources due to its measurability concern (Spender et. al., 2013; Kianto et. al., 2014). As such, it loses considerations for flows of resources and the interaction between flows and stocks.

While it has been found that the market-based measures are good measures of intellectual capital, one must keep in mind that market-based measures can be affected by exogenous market factors that have nothing to do with intellectual capital (Garcia & Ayuso, 2003; Pike & Ross, 2005). Nevertheless, having a method that directly relates intellectual capital to a company's accounting and financial data is necessary in the actual knowledge economy (De, 2009; Axtle-Ortiz, 2013). As a result, a question is raised of how much we should rely on the market for setting the value of intellectual capital.

Moreover, this study can serve as a basis for the modelling of the relationship between intellectual capital and performance. Measures which do not capture intellectual capital appropriately should be used with caution in the analysis of intellectual capital and performance. If a positive relation is found between an accounting measure which does not reveal intellectual capital information and performance, it may be due to other factors and may not reflect their ability to capture intellectual capital as conceptualised in this thesis. Hence, this study provides a possible explanation for some of the mixed results in the empirical research by distinguishing between good measures and bad measures of intellectual capital. Additionally, it shows the importance of taking a contingency approach when studying intellectual capital as it has proven that not all the measures have the same ability to reflect intellectual capital in all industry sectors.

8.8. Conclusions

In conclusion, different measures have different ability to capture intellectual capital which should be considered for future studies analysing the influence of intellectual capital on performance. The context in which a company operates influences the way the accounting measures are capturing intellectual capital and its components; therefore, contextualisation is recommended. Also, accounting measures have boundaries in capturing the overall value of intellectual capital, but the flaws can be assessed through a careful research methodology.

This study has been exploratory in nature and it has few limitations. To capture intellectual capital elements only accounting data has been used. Therefore, for further research it is recommended that the use and appropriateness of non-financial measures is assessed. Also, due to limited accounting data some of the intellectual capital components have been estimated using only one indicator. Multiple intellectual capital indicators may be preferable as this could capture different aspects of the same element. A linear relation between intellectual capital elements and intellectual capital value has been assumed. Further research could explore if this relation holds.

9. Intellectual capital proxies and performance

9.1. Abstract

Purpose – The objective of this study is twofold. First, it aims at verifying whether all intellectual capital elements are equally beneficial for a range of traditional performance aspects: economic, financial and market performance. Second, it examines how intellectual capital proxies model the link between intellectual capital and performance.

Design/methodology/approach – The empirical data were drawn from a panel consisting of 839 United Kingdom companies listed at the London Stock Exchange, from four different industry sectors observed over the eleven-year period from 2001 to 2011. It uses a panel methodology to study the association between all intellectual capital elements and multiple performance aspects.

Findings – Research results suggest that investment in intellectual capital is partially beneficial for economic performance but less favourable for financial performance and is not statistically significant connected with market performance. The results also emphasize the importance of having different accounting measures of intellectual capital for modelling its link with financial performance.

Originality/value – It offers a comprehensive understanding of the connection between all intellectual capital components – human capital, structural capital and relational capital - and multiple performance aspects across a range of industry sectors.

Practical implications – It provides evidence on the ability of intellectual capital proxies' to model the link between intellectual capital and performance. It is part of the investigation into the efficacy of the accounting discipline to capture intellectual capital information.

9.2. Introduction

The ultimate goal of a firm is to create added value (Rubino, 2004; Marr et. al., 2004). Empirical research shows that companies, which constantly outperform similar competitor companies, rely extensively on intellectual capital (Lev et. al., 2009). Consequently, this intangible resource is believed to be the main firm value driver (Lev, 2001; Kaplan & Norton, 2004) and the new critical factor determining firm's performance (Pozzoli, 1996). Nevertheless, empirical evidence analysing the relationship between intellectual capital and performance report mixed results (Ittner, 2008; Veltri, 2010).

On one hand, the mixed results could be due to the fact that different intellectual capital elements have a dissimilar behaviour towards the same aspect of performance (Roos et. al., 2005). On the other hand, the mixed results could be a manifestation of the fact that same component of intellectual capital influences different aspects of performance in various manners (Bontis, 1998; de Pablos, 2004). There is empirical proof in support of both explanations, which reveals the complexity of intellectual capital and the difficulty in understanding the way it is involved in organisational activities. As such, in the new economic era where intellectual capital assets are increasingly considered the pivotal driving force behind wealth creation, an important question remains: are all intellectual capital elements equally beneficial for a range of performance aspects? One of this chapter's objectives is to answer this question.

Nonetheless, the literature has not explored whether the mixed results found in the literature could be also be due to the choice of intellectual capital measure employed in the studies. The intellectual capital proxies used to capture the value of intellectual capital components could have a limited ability to model the link between intellectual capital and different performance aspects. For example, they could be useful to link intellectual capital and economic performance, but not useful to link this resource to financial performance.

Therefore, this chapter's aim is twofold. First, it takes a contingency approach to the relationship between various intellectual capital elements by analysing multiple firm performance aspects across a range of industry sectors. Second, it investigates whether the mixed results obtained in the literature are, between other factors, also a consequence of the choice of intellectual capital measurement used in the studies.

The rest of the chapter is organized as follows. The literature presented in Chapter 4 (Section 4.2.1.) is going to be shortly revisited to offer foundation for the research objectives of this chapter. The following section outlines the research method applied and presents a short summary of the variables employed in the study. Empirical results are described in Section 9.6. of this chapter. Finally, the findings are explained in Section 9.8 followed by conclusions in Section 9.9.

9.3. Research objectives

Intellectual capital is widely believed to represent a company's competitive advantage (Wall et. al., 2004; Joia, 2007; Tayles et. al., 2007). For this reason, it is argued that this resource has a positive influence on all aspects of performance in a company be it economic, financial or market performance (Murthy & Mouritsen, 2011; Kianto et. al., 2013). Despite this theoretical argument, previous empirical research has revealed mixed conclusions on the relation between different intellectual capital elements – human capital, structural capital, relational capital - and various aspects of performance (Ittner, 2008).

The mixed results have been explained in two ways. First, it has been argued that the mixed results are proof of the fact that different intellectual capital elements have a dissimilar behaviour in influencing the same aspect of performance (Roos et. al., 2005). Second, it is believed that the same component of intellectual capital can influence different aspects of performance in various manners (Bontis, 1998; de Pablos, 2004). There is empirical proof in support of both explanations as described below.

All intellectual capital elements are generally found to positively influence economic performance (Black & Lynch, 1996; Sullivan & Sullivan, 2000; Wang & Wu, 2012). Authors suggest that intellectual capital investment allows the company to enhance its economic performance, beyond what is produced by physical and financial resources (Cappelletti & Khouatra, 2004), through production costs reduction and/or operational margins increase (Nakamura, 2001). Nonetheless, intellectual capital elements connection with the other two performance aspects is not as clear.

Because intellectual capital is believed to be a source of competitive advantage, strategic management theories argue this resource should equally enhance financial performance (Zeghal & Maaloul, 2010).Strategic management studies confirm the aforementioned arguments when studying separate intellectual elements (Gates & Langevin, 2010; Lim et. al., 2010). However, accounting studies find both a positive and negative relation between intellectual capital and financial performance (please refer to Section 4.2.1.). A negative relation between intellectual capital elements and financial performance is to be expected according to some authors, because most of the intellectual capital elements are expensed leading to a reduction in the current profits and earnings which are the basis of financial performance measures (Simon & Sullivan, 1993).

Similar results are found for the association of intellectual capital elements with market performance. Investors should place higher value on companies with greater intellectual capital due to the growth opportunities that intellectual capital elements reflect (Firer & Williams, 2003; Chen et. al., 2005). Nonetheless, Lev (2005) shows that the market suffers from myopia when it comes to evaluating intellectual capital: it is either underestimating or overestimating this resources. All three intellectual capital elements have been found to exert both a positive and negative connection with market estimates (please refer to Section 4.2.1).

Researchers assert that some of these inconsistencies are to be expected because intellectual capital is idiosyncratic and its elements combine in a unique manner, in different organizations, according to their context (Reed et. al., 2006). This argument is supported by studies analysing intellectual capital interactions, which indicate that value is created whenever there is an adequate combination of intellectual capital elements (Bukh, 2003). Hence, the interaction of the different elements of intellectual capital should be considered in determining their impact on performance.

Also, these studies have some theoretical and methodological limitations, which will be discussed next. From a theoretical point of view, intellectual capital is argued to have the ability to positively influence each performance aspect separately. However, there are no arguments for why intellectual capital should influence all types of performance at the same time (Marr, 2004). Intellectual capital may sometimes lead to positive outcome on one performance dimension such as profitability, but at the same time it could bring unfavourable outcomes on a different performance aspect such as efficiency (Haber & Reichel, 2005). Also, strategic management theories are known to suffer tautological problems because they direct the identification of competitive advantage resources by their positive influence on performance (Reed et. al., 2006).

From a methodological point of view, empirical studies have generally analysed the relationship between a single intellectual capital element and separate performance aspects; or, multiple intellectual capital elements and composite measures of performance. There are only a few studies which analyse the influence of multiple intellectual capital elements on multiple separate performance aspects (Richard et. al., 2009). By using a composite scale measure of performance, some studies blur what aspects of performance intellectual capital influences and how. Moreover, some studies, which use composite performance measure, do not clearly differentiate between market and organisational performance despite empirical evidence which emphasizes the two types of performance are separate concepts (Richard et. al., 2009; Haslam et. al., 2010). This gives scope for developing our understanding of the value creation process of different performance aspects with respect to intellectual capital.

Another methodological issue highlighted in the literature review provided in Chapter 4 (Section 4.2.1.) is that firm and industry characteristics should be included in modelling the relationship between intellectual capital and performance (Hoque, 2005; Reed et. al., 2006; Banker & Mashruwala, 2007). While the industry differences have been highlighted, the literature has focused on high-technology and high-knowledge intensive industries (Ittner, 2008). As a result, there is limited understanding of how intellectual capital influences market and organizational performance in low-knowledge intensive sectors. It will be likewise interesting to research how the intellectual capital-performance relation differs between high-knowledge intensive and low-knowledge intensive companies and whether in a knowledge economy intellectual capital is important even for low-knowledge companies.

In an economy that increasingly focuses its attention on maximizing value creation capacity, it is important to clarify what is the additional factor central to achieving competitive advantage for the firm, its stakeholders and for the whole economy (Alcaniz et. al., 2010). Taking into consideration the theoretical arguments portrayed by the strategic management literature, the contradictory empirical evidence, the increasing importance of intellectual capital in the knowledge era and the different firm performance aspects an important empirical question still remains. Specifically, does intellectual capital value always translate into higher firm performance without any contingencies?

One possible explanation which has not been previously explored is that the mixed results found in the literature could also be down to the choice of intellectual capital measure employed in the studies. The intellectual capital proxies used to capture intellectual capital components value could have a limited ability to model the link between intellectual capital and different performance aspects.

Consequently, in order to bring insight into the subject, this chapter's main goal is to determine the relation between various intellectual capital elements and different performance aspects considering the context of low and high knowledge intensive industry sectors. Specifically, the study is going to look into economic, financial and market performance. Furthermore, it will consider intellectual capital interactions and determine if the interplay between intellectual capital elements has the capacity to increase the various types of performance under analysis. Finally, based on the results obtained, previous evidence supporting these results and theoretical arguments it will question the appropriateness of intellectual capital proxies to model the relationship between intellectual capital and performance.

9.4. Methodology

In order to address these issues the statistical analysis is divided in three stages. The first stage it is going to determine whether separate intellectual capital elements are associated in the same manner with different performance aspects in the overall sample. Theory suggests that all intellectual capital resources participate in the production process and, consequently, they should all be associated with performance (Bontis, 1998; Zucker et. al., 1999; Chen et. al., 2004). Therefore, performance should be determined by all three intellectual capital dimensions. Accordingly, this study considers that value is created by the combination of all intellectual capital elements and suggests implementing the subsequent model to answer the formulated research question:

$$Performance_{i,t}=\alpha+\beta_1*HC_{i,t} +\beta_2*SC_{i,t} +\beta_3*RC_{i,t} + Controls_{i,t}+ e_i \quad (1a)$$

Where performance refers to economic, financial and market performance. **Economic performance** is measured by Net Cash. To account for **financial performance** two alternative measures are used: return on assets and earning per share. **Market performance** is approximated by annual share return. HC represent **human capital** and as before is approximated by Average Salary per Employee. SC is **structural capital** and depicted by R&D intensity (R&D expense to Total Operating Expenses), SG&A intensity (Selling and General Administrative expense to Total Operating Expenses) and Intangibility (Intangible Assets to Total Assets). RC embodies **relational capital** as measured by the Percent of Sales above industry's average from

Total Sales. Controls represents the following control variables: firm's size (Chan et. al., 1992; Ravichandran & Lerwongsatien, 2005); firm's capital structure (Barth et. al. 2001; Metcalf, 2002; Pindado, 2005), firm's age (Piekkola, 2009) and industry characteristics such as, industry concentration (Bardhan et. al., 2010) and industry risk (Wilson et. al., 2012). To account for these dimensions, corresponding control variables are included in the study: logarithm of Total Assets to account for firm size, firm's leverage to highlight capital structure, company's age since incorporation, Herfingdahl–Hirsch index to represent industry concentration and INWOE index to capture industry risk. Details on the variable selection and the literature recommending them are provided in detail in Chapter 6 "*Methodology*". Replacing human capital, structural capital and relational capital with the corresponding measures equation (1a) can be re-written:

$$Performance_{it} = \alpha + \beta_1 {*} Salaries_{it} + \beta_2 {*} R\&D_{it} + \beta_3 {*} SG\&A_i + \beta_4 {*} Intan + \beta_5 {*} Sales + \beta_{6y} {*} Controls_y + e_{it} \quad (1b)$$

Different models are specified in the first stage to check the robustness and consistency of findings. We first enter into the model all the IC variables separately and then all together.

The second stage enquires how intellectual capital is connected with performance in different industry sectors and determines if the intellectual capital link with performance depends on the intellectual capital profile of the industry. Previous literature has indicated that there are differences between manufacturing and services companies' intellectual capital profiles. Some researchers have gone further by indicating that there may be differences in these sectors according to firms level of knowledge intensity i.e. whether they are high or low (Ittner, 2008). To test this we estimate equation (1b) in different industry sub-samples as follows: low knowledge intensive manufacturing, high knowledge manufacturing, low knowledge intensive services and high knowledge intensive services.

Theory suggests that intellectual capital components are synergetic – when combined they produce more value than the value of their individual parts (Bontis et. al., 2000; Lev, 2001). Hence, the third stage of our analysis builds on literature's suggestion that intellectual capital elements are synergetic and interact with one another. One of the suggested methodologies to study interaction effects is to introduce a cross-product element between various variables. Nevertheless, for this study this process would prove rather cumbersome as the interaction effects between the five variables which account for the intellectual capital components would generate ten possible combinations. Also, it would create multicollinearity problems which would bias the estimation results. In order to reduce the data at a manageable level for the study of interaction effects this thesis employs the same factor analysis procedure explained in Chapter 8. The factor scores obtained in the factor analysis are used as measures of intellectual capital in models similar to the ones employed in the first and second stage.

As with the previous empirical chapter, the models are estimated using a random effects model with autocorrelation robust estimators for each performance aspect separately. The choice of this specific panel methodology follows the same argumentation explained in Section 6.2. and Chapter 8.

9.5. Data

The data sample under analysis consists of 839 listed UK companies at the London Stock Exchange from 2001 to 2011 activating various industries. Companies have been categorized into low knowledge intensive manufacturing, high knowledge intensive manufacturing, low knowledge intensive services and high knowledge services according with the NACE classification for knowledge intensive companies. This study has excluded financial services companies due to the fact that these companies have a different intellectual capital profile than the other companies in the sample. Detailed information on the sample construction is provided in Chapter 7.

Table 9.1 presents the descriptive statistics for the dependent and independent variables employed in this study, which have been winsorized at 1st and 99th percentiles for each industry sector subsample, in order to mitigate the effect of outliers. Companies in the sample under analysis have generated on average a net cash flow of 72,902,940 £, have a negative average return on assets of -10%, a positive earnings per share of 5% and the annual share return over the period 2001-2011 is approximately 10.66%.

When the sample is split into industry sub-samples, Table 9.1's descriptive statistics reveal that that high knowledge intensive companies score higher than low knowledge intensive companies on all intellectual capital components measures. Nevertheless, the various aspects of performance do not follow the same trend. Return on Assets, Earnings per share and Annual share Return record the highest average values in the low knowledge intensive sectors for both manufacturing and services. This indicates that on average low knowledge intensive companies have been more profitable than high knowledge intensive companies with respect to financial and market performance. If we assess Net Cash, which gives an idea about future growth prospects, the highest average value is registered for low knowledge intensive services companies (86,325,700 £) and the next highest is for high knowledge intensive industry companies (74,856,000 £) advancing the idea, according to finance theory, that these companies are performing better than other companies from an economic point of view.

High knowledge and low knowledge intensive companies are, on average, very close in size. This is an important attribute of the sample which implies that the findings do not derive from size differences as it was in previous empirical papers. Nevertheless, companies are different with respect to industry characteristics. Manufacturing companies are subject to higher competition and higher risk compared to companies pertaining to service industries. An in depth analysis of the descriptive statistics is provided in Chapter 7 (Section 7.2.).

Correlation results presented in Table 9-2 indicate that intellectual capital dimensions (human capital, structural capital and relational capital) are generally negatively correlated with the measures of financial performance employed in this study, except relational capital (Sales above the industry average). This is contrary to theoretical suggestions that there is a positive association between intellectual capital and performance. Similar results, for various intellectual capital elements, were previously found by Chan et. al. (2001), Bell et. al. (2002) and Huang and Liu (2005). These studies use similar accounting data to capture the value of intellectual capital elements. Most of the studies which found positive correlations between intellectual capital elements and financial performance come from the strategic management discipline and use perceptual measures to account for intellectual capital. Nevertheless, perceptual measures are different from accounting data and this thesis purpose is to make sense of intellectual capital relations using publicly available accounting data.

All the correlations between explanatory variables used in various models are smaller than 0.8 and together with the variance inflation factor analysis suggests the absence of multicollinearity problems. At the industry level, there are small differences in the value of correlation factors, but overall the correlation relations are relatively the same at the sub-sample level. For this reason the correlation tables for different industry sectors are not presented in this chapter.

Table 9-1 Descriptive statistics of variables used in the analysis by industry sectors

	All			Manufacturing						Services					
				Low knowledge intensive			High knowledge intensive			Low knowledge intensive			High knowledge intensive		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Cash ('000 £)	72902.94	3770.40	231254.60	60825.35	4670.75	189864.70	74856.02	3939.00	271881.70	86325.75	7103.50	239105.60	68921.52	2457.00	225251.10
ROA	-0.10	0.03	0.44	-0.01	0.04	0.22	-0.07	0.04	0.34	-0.04	0.04	0.35	-0.15	0.02	0.53
EPS	0.07	0.03	0.30	0.12	0.07	0.28	0.09	0.03	0.26	0.12	0.07	0.31	0.02	0.01	0.31
Return (%)	10.66	0.00	70.92	13.56	5.63	62.15	12.95	0.00	72.96	12.21	4.09	71.35	8.49	-4.00	72.31
Salaries('000 £)	39.75	34.13	27.04	29.57	28.36	13.57	36.84	33.74	17.64	34.68	26.90	30.57	45.60	40.71	28.37
R&D (%)	5.83	0.00	14.33	2.31	0.08	6.37	9.55	2.89	16.79	1.24	0.00	5.11	8.02	0.00	17.14
SG&A (%)	44.20	37.74	28.50	33.76	26.48	22.69	44.86	38.94	25.05	37.01	29.18	27.53	50.24	44.71	29.55
Intangibles (%)	22.51	13.49	24.15	16.21	6.22	20.24	18.94	13.06	19.42	16.70	5.91	22.21	27.89	21.14	25.82
Sales (%)	90.24	6.08	298.19	76.28	9.04	205.42	113.97	5.05	472.27	97.74	13.26	229.00	84.01	3.27	289.71
log(TA)	10.78	10.64	2.45	10.95	10.81	2.01	10.68	10.47	2.31	11.37	11.28	2.38	10.47	10.16	2.56
Leve	0.41	0.17	1.69	0.55	0.25	1.65	0.41	0.14	1.04	0.49	0.28	1.77	0.34	0.10	1.79
Age	26.19	11.95	31.54	45.80	26.99	40.89	28.66	15.01	29.51	28.61	15.41	32.53	19.32	9.39	25.92
HHI	441.99	324.81	715.44	789.74	387.14	1646.78	597.62	391.12	673.93	306.87	309.99	196.83	378.69	324.81	379.82
INDWOE	0.00	0.00	0.48	-0.33	-0.41	0.55	-0.16	-0.19	0.45	-0.04	0.00	0.40	0.13	0.24	0.44

Variables Definition

Cash = Net Cash;
ROA = Return on Assets;
EPS = Earnings per Share ;
Return = Annual share return;

Salaries = Average Salaries per Employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;

log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl-Hirsch index ;
INDWOE = Industry's risk ;

Notes: The sample consists of 839 publicly traded United Kingdom firms listed on the London Stock Exchange, including 102 companies in low knowledge intensive industry, 102 in high knowledge intensive industry, 204 in low knowledge intensive services and 431 in high knowledge intensive services between January 2000 and December 2011

Table 9-2 Pearson correlations of the variables used in the analysis

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*
(1) Cash	1.00													
(2) ROA	0.09	1.00												
(3) EPS	0.21	0.33	1.00											
(4) Return	0.00*	0.18	0.14	1.00										
(5) Salaries	-0.05	-0.13	-0.07	-0.01*	1.00									
(6) R&D	-0.05	-0.24	-0.14	-0.02	0.19	1.00								
(7) SG&A	-0.13	-0.33	-0.17	-0.05	0.27	0.38	1.00							
(8) Intan	0.04	0.02*	-0.06	-0.07	0.04	-0.04	0.07	1.00						
(9) Sales	0.70	0.10	0.21	0.00*	-0.07	-0.06	-0.15	0.08	1.00					
(10) log(TA)	0.46	0.42	0.27	0.06	-0.07	-0.21	-0.44	0.09	0.53	1.00				
(11) Leve	0.09	0.07	0.07	-0.01*	-0.04	-0.08	-0.11	0.02*	0.08	0.16	1.00			
(12) Age	0.02	0.17	0.14	0.04	-0.18	-0.16	-0.25	-0.13	0.06	0.25	0.04	1.00		
(13) HHI	-0.01*	0.01*	0.00*	-0.03	-0.03	0.02*	-0.04	-0.06	-0.01*	-0.04	0.00*	0.09	1.00	
(14) INDWOE	-0.04	-0.09	-0.03	0.05	0.22	0.14	0.22	0.14	-0.04	-0.12	-0.05	-0.19	-0.13	1.00

Variables Definition

Cash= Net Cash;
ROA= Return on Assets;
EPS= Earnings per Share;
Return= Annual share return;
Salaries= Average Salaries per Employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA)= Logarithm of Total Assets;
Leve= Leverage;
Age= Company's Age;
HHI= Herfingdahl-Hirsch index;
INDWOE= Industry's risk;

Notes: The sample consists of 839 publicly traded United Kingdom firms listed on the London Stock Exchange, including 102 companies in low knowledge intensive industry, 102 in high knowledge intensive industry, 204 in low knowledge intensive services and 431 in high knowledge intensive services between January 2000 and December 2011. Insignificant correlations (two tailed p-value < 0.05), are shown by *.

9.6. Empirical results

9.6.1. Intellectual capital elements association with performance

This section presents the results for the first stage of the analysis described in the methodology section. Tables 9-3 to 9-6 describe how intellectual capital elements relate to economic performance as represented by Net Cash; financial performance approximated through two measures, Return on Assets and Earnings per Share; and, market performance as depicted by Annual share Return. The first column of the tables presents the analysis of all intellectual capital elements together and their influence on performance. The next five columns report separate equations for each of the five intellectual capital measures utilized in this thesis that make up human capital, structural capital and relational capital. In general, there are no differences in the reported performance effects of the different intellectual capital elements when the measures are included individually or together. This confirms the robustness of the results and allows us to concentrate on describing the relation between intellectual capital elements and performance as depicted in model 1.

Table 9-3 presents the results relating to **economic performance.** The results show with the exception of human capital and intangibility, most intellectual capital elements positively influence Net Cash as a measure of economic performance. Surprisingly, human capital does not have the ability to derive cash ($\beta=-201.7$, $p<0.05$). However, it is the human capital which generates innovation and creates the structural capital elements which are positively related to Net Cash. Hence, the results seem to suggest that just being in possession of human capital alone is not enough to generate cash. Human capital capacity needs to be leveraged and have a tangible outcome, such as structural capital, in order to generate cash (Petty & Guthrie, 2000; Hitt et. al., 2001).

Structural capital elements influence on economic performance can be summarized as follows: R&D intensity does not exert any influence; SG&A intensity is related to an increase in Net Cash; while Intangibility is not related to Net Cash at conventional significance levels although there is some evidence of a weak negative effect at the 10% significance level. Relational capital is strongly and significantly associated with Net Cash ($\beta=430.2$, $p<0.01$). Relational capital is expected to generate cash flows more than the other elements of intellectual capital because it is more difficult to imitate (Johnson, 1999), acts as a bridge between the other intellectual capital elements and it is the primary focus of a business (Chen et. al., 2004).

Table 9-3 Intellectual capital link with economic performance

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	Salaries	-201.7**	-252.8**				
		(101.1)	(114.4)				
Structural capital	R&D	32.16		209.2			
		(202.4)		(231.9)			
	SG&A	298.4***			346.1***		
		(109.3)			(122.9)		
	Intan	-184.9*				-216.6*	
		(107.7)				(121.6)	
Relational capital	Sales	430.2***					433.6***
		(12.90)					(12.91)
Control variables	log(TA)	24,441***	42,411***	42,603***	44,067***	43,157***	22,441***
		(1,669)	(1,793)	(1,805)	(1,876)	(1,845)	(1,560)
	Leve	493.0	231.0	261.7	295.2	279.7	440.2
		(963.7)	(992.3)	(992.4)	(992.3)	(992.1)	(963.7)
	Age	-329.6***	-450.0**	-415.1**	-388.4**	-452.6**	-317.1***
		(123.1)	(177.2)	(177.3)	(176.8)	(178.2)	(122.2)
	HHI	1.676	1.923	1.831	2.108	1.761	1.490
		(3.154)	(3.418)	(3.419)	(3.418)	(3.419)	(3.156)
	INDWOE	-8,602*	-7,734	-7,997	-8,196	-7,688	-8,482*
		(4,770)	(5,054)	(5,056)	(5,054)	(5,055)	(4,764)
	Constant	-234,573***	-386,824***	-395,954***	-424,609***	-397,919***	-209,548***
		(22,023)	(24,835)	(24,812)	(26,878)	(24,831)	(19,812)
	Firm-years	7,508	7,510	7,510	7,510	7,510	7,508
	No. of firms	827	827	827	827	827	827

Model 1 : $Cash = \alpha_i + \beta_1 * Salaries + \beta_2 * R\&D + \beta_3 * SG\&A + \beta_4 * Intangibles + \beta_5 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 2 : $Cash = \alpha_i + \beta_1 * Salaries + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 3 : $Cash = \alpha_i + \beta_1 * R\&D + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 4 : $Cash = \alpha_i + \beta_1 * SG\&A + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 5: $Cash = \alpha_i + \beta_1 * Intan + e_i + d_i + \eta_i$

Model 6 : $Cash = \alpha_i + \beta_1 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Variables definition

Cash = Net Cash;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Financial performance is related to intellectual capital in a different way than economic performance. Moreover, the two measures of financial performance employed in this study are distinct in their relationship to intellectual capital.

Return on assets (ROA) is negatively related to all measures of intellectual capital used in this thesis, except intangibility which is the only measure that does not rely on an expense element. These results may be explained by the fact that ROA relies in its computation on net income. On one hand, according to Ely and Waymire (1999) if intangibles are going to be capitalized, the current profits and earnings are going to be overstated to the detriment of the future ones, which explains the positive association between ROA and intangibility. On the other hand, if intangible assets are expensed it results in a reduction of the current profits and earnings (Simon & Sullivan, 1993), which clarifies the negative association between ROA and the other measures of intellectual capital used in this study. These arguments indicate that the use of intellectual capital proxies to model the link between intellectual capital and ROA might be inappropriate. At the same time, another probable explanation is that ROA is a poor measure of financial performance. ROA has been criticized before for being past-oriented and a poor measure to seize the value of intellectual capital stock (Loermans & Fink, 2005). However, ROA is a measure of efficiency (Chen et. al, 2005) and it should be a better measure of the efficiency with which intellectual capital resources are used.

The results for earnings per share (EPS) present another picture of the influence of intellectual capital on financial performance. Table 9-5 reveals a positive albeit insignificant link between human capital and EPS. Some researchers assert that human capital can create value only if the company continuously invests in human capital development and training in order to enhance its productivity (Birdi et. al., 2008) and ensure its participation in company's financial outcomes (Pendleton & Robinson, 2010). At the same time, other researchers argue that it is not enough to hire qualified employees, but there is also a need for structures to be put in place in order to leverage human capital knowledge (Petty & Guthrie, 2000; Hitt et. al., 2001). While wages as a measure of human capital provides a signal for the knowledge and education possessed by employees, it does not elaborate on how employees use this knowledge. Likewise it is not a signal of human capital development and participation, which may explain why no effect was found for human capital on earnings per share.

Surprisingly, all structural capital measures are negatively related to financial performance, although SG&A intensity is not significant. While theoretical arguments prescribe a positive relation, Bolton (1993) found that companies which have substandard performance (low earnings) engage in intense investment in intellectual capital elements, such as R&D, to create future growth opportunities. From this perspective, an inverse relation between intellectual capital elements and earnings per share is more plausible.

Table 9-4 Intellectual capital link with financial performance (ROA)

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	Salaries	-0.0017***	-0.0019***				
		(0.0003)	(0.0003)				
Structural capital	R&D	-0.0022***		-0.0030***			
		(0.0005)		(0.0005)			
	SG&A	-0.0010***			-0.0016***		
		(0.0003)			(0.0003)		
	Intan	0.0008***				0.0012***	
		(0.0003)				(0.0003)	
Relational capital	Sales	-0.0004***					-0.0004***
		(3.3e-05)					(3.4e-05)
Control variables	log(TA)	0.114***	0.104***	0.100***	0.0952***	0.102***	0.125***
		(0.0042)	(0.0036)	(0.0035)	(0.0037)	(0.0037)	(0.0040)
	Leve	0.0004	0.0008	0.0009	0.0008	0.0010	0.0010
		(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
	Age	-0.0002	-2.4e-05	9.0e-05	3.6e-05	0.0003	8.4e-06
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
	HHI	4.8e-06	4.0e-06	3.9e-06	2.4e-06	4.0e-06	4.0e-06
		(8.0e-06)	(8.2e-06)	(8.2e-06)	(8.2e-06)	(8.2e-06)	(8.2e-06)
	INDWOE	0.0194	0.0156	0.0155	0.0159	0.0116	0.0135
		(0.0121)	(0.0122)	(0.0122)	(0.0122)	(0.0123)	(0.0122)
	Constant	-1.192***	-1.140***	-1.138***	-1.030***	-1.179***	-1.383***
		(0.0555)	(0.0490)	(0.0480)	(0.0533)	(0.0489)	(0.0512)
	Firm-years	7,598	7,600	7,600	7,600	7,600	7,598
	No. of firms	839	839	839	839	839	839

Model 1 : ROA= $\alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3*SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 2 : ROA= $\alpha_i+\beta_1*Salaries+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 3 : ROA= $\alpha_i+\beta_1*R\&D+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 4 : ROA= $\alpha_i+\beta_1*SG\&A+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 5: ROA= $\alpha_i+\beta_1*Intan+e_i+d_i+\eta_i$

Model 6 : ROA= $\alpha_i+\beta_1*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

Variables definition

ROA = Return on Assets;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Furthermore, as with Return on Assets, EPS relies on net income in its computation. The intellectual capital proxies have been computed based on expense elements which are subtracted from the computation of net income. This aspect might explain why the results indicate a negative association between intellectual capital and Earnings per Share.

Table 9-5 Intellectual capital link with financial performance (EPS)

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	**Salaries**	0.0001	2.1e-05				
		(0.0002)	(0.0002)				
Structural capital	**R&D**	-0.0011***		-0.0011***			
		(0.0004)		(0.0003)			
	SG&A	-0.0003			-0.0003*		
		(0.0002)			(0.0002)		
	Intan	-0.0004**				-0.0004*	
		(0.000188)				(0.000188)	
Relational capital	**Sales**	0.0001***					0.0001***
		(2.4e-05)					(2.4e-05)
Control variables	**log(TA)**	0.0280***	0.0352***	0.0343***	0.0337***	0.0364***	0.0292***
		(0.0030)	(0.0025)	(0.0025)	(0.0027)	(0.0027)	(0.0028)
	Leve	0.0011	0.0012	0.0011	0.0011	0.0012	0.0012
		(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
	Age	0.0009***	0.0010***	0.0010***	0.0010***	0.0010***	0.0011***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
	HHI	-2.9e-06	-2.5e-06	-2.3e-06	-2.6e-06	-2.6e-06	-2.7e-06
		(5.3e-06)	(5.4e-06)	(5.4e-06)	(5.4e-06)	(5.4e-06)	(5.4e-06)
	INDWOE	0.0282***	0.0270***	0.0278***	0.0276***	0.0273***	0.0269***
		(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)
	Constant	-0.283***	-0.369***	-0.356***	-0.338***	-0.375***	-0.313***
		(0.0395)	(0.0346)	(0.0345)	(0.0380)	(0.0342)	(0.0361)
	Firm-years	7,598	7,600	7,600	7,600	7,600	7,598
	No. of firms	839	839	839	839	839	839

Model 1 : $EPS= \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3* SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 2 : $EPS= \alpha_i+\beta_1*Salaries+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 3 : $EPS= \alpha_i+\beta_1*R\&D+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 4 : $EPS= \alpha_i+\beta_1*SG\&A+\beta_y*Controls_y+e_i+d_i+\eta_i$

Model 5: $EPS= \alpha_i+\beta_1*Intan+e_i+d_i+\eta_i$

Model 6 : $EPS= \alpha_i+\beta_1*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

Variables definition

EPS = Earnings per share;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Thus, studying the impact of intellectual capital on financial performance with the help of intellectual capital proxies must be approached with caution. While a series of explanations have been advanced in the literature to support the largely negative and limited positive associations between various intellectual capital elements and financial performance, there are also some accounting identity issues, which could bring noise into the findings.

Finally, with regard to **market performance**, the evidence reported in Table 9-6 indicates that the market does not recognize the investment in intellectual capital as an asset. On one hand, human capital, R&D expense intensity and SG&A expense intensity have no effect on a company's returns. On the other hand, intangibility and relational capital are negatively associated with market performance. The market has been found before to suffer from myopia with respect to intellectual capital elements (Lev, 2005). It can either overestimate or underestimate intellectual capital elements. The results in this study show that some intellectual capital elements are equally underestimated and overestimated in firms, which on average has no effect on the market.

However, the results indicate that elements such as intangibility and relational capital are negatively valued by the market. A high intangibility shows that a company has low levels of tangible assets and, subsequently, a lower capacity to guarantee debts (Alcaniz et. al., 2011). These companies are perceived by the market to be too risky and hence valued negatively (Andriessen, 2004a). Relational capital has been argued to be one of the intellectual capital elements which are most difficult to imitate (Johnson, 1999). While this means that the company can derive economic or financial performance from this intellectual capital element, it also means that the market will find it very difficult to value it due to its uncertainty. At the same time, this uncertainty might be perceived as risk and valued in the same way as intangibility.

There is little evidence of consistent findings across the intellectual capital components or across the different performance measures. While there is some evidence that intellectual capital has "*competitive advantage*" enhancing properties (human capital and relational capital), equally there are instances where this is not the case especially with structural capital. This raises a number of questions. Firstly, are all performance measures appropriate for assessing the impact of intellectual capital. Can we expect the theoretical arguments surrounding competitive advantage to feed through to all performance measures? The theoretical case for how this might or might not happen needs to be worked through. Secondly, there are concerns that the reliance on publicly available accounting data poses methodological and measurement problems, especially in the case of financial performance, and raises the need to supplement accounting data with more qualitative measures of intellectual capital (and performance) in order to assess intellectual capital's performance enhancing properties.

Table 9-6 Intellectual capital link with market performance

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Human Capital	Salaries	-5.7e-05	9.6e-04				
		(0.0004)	(0.0004)				
Structural capital	R&D	-0.0571		-0.0634			
		(0.0723)		(0.0687)			
	SG&A	-0.0529			-0.0817**		
		(0.0404)			(0.0377)		
	Intan	-0.208***				-0.211***	
		(0.0405)				(0.0401)	
Relational capital	Sales	-0.0092***					-0.0101***
		(0.0036)					(0.0035)
Control variables	log(TA)	0.0232***	0.0165***	0.0159***	0.0131***	0.0191***	0.0240***
		(0.0052)	(0.0040)	(0.0041)	(0.0043)	(0.0041)	(0.0048)
	Leve	-0.0141**	-0.0138**	-0.0141**	-0.0142**	-0.0134**	-0.0141**
		(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)
	Age	0.000229	0.000570*	0.000543*	0.000491	0.000367	0.000497
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
	HHI	-5.4e-06	-3.9e-06	-3.8e-06	-4.6e-06	-5.7e-06	-3.3 e-06
		(1.3e-05)	(1.3e-05)	(1.3e-05)	(1.3e-05)	(1.3e-05)	(1.3e-05)
	INDWOE	0.0996***	0.0881***	0.0901***	0.0941***	0.0927***	0.0897***
		(0.0215)	(0.0214)	(0.0214)	(0.0215)	(0.0213)	(0.0213)
	Constant	-0.246***	-0.241***	-0.231***	-0.170**	-0.236***	-0.311***
		(0.0743)	(0.0622)	(0.0619)	(0.0690)	(0.0608)	(0.0658)
	Firm-years	6121	6121	6121	6121	6121	6121
	No. of firms	772	772	772	772	772	772

Model 1 : $Return = \alpha_i + \beta_1 * Salaries + \beta_2 * R\&D + \beta_3 * SG\&A + \beta_4 * Intangibles + \beta_5 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 2 : $Return = \alpha_i + \beta_1 * Salaries + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 3 : $Return = \alpha_i + \beta_1 * R\&D + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 4 : $Return = \alpha_i + \beta_1 * SG\&A + \beta_y * Controls_y + e_i + d_i + \eta_i$

Model 5: $Return = \alpha_i + \beta_1 * Intan + e_i + d_i + \eta_i$

Model 6 : $Return = \alpha_i + \beta_1 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

Variables definition

Return = Annual share return;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

9.6.2. Industry differences in the intellectual capital-performance link

The second stage of this analysis investigates whether the link between intellectual capital and performance depends on the industry sector under analysis. Initially the analysis distinguishes between the manufacturing and services sectors and further distinguishes between high or low knowledge intensive companies in each sector. Tables 9-7 to 9-10 present the results from estimating equation model for every performance aspect: economic, financial and market performance. The tables reveal the results for all manufacturing companies (column 1), low knowledge intensive manufacturing companies (column 2), high knowledge intensive manufacturing (column 3), all services companies (column 4), low knowledge intensive services companies (column 5) and high knowledge intensive services companies (column 6) . As before, we go through the results for each performance measure in turn.

Economic performance. As before economic performance reveals the most positive outcomes with regard to the different IC elements. Initially it is evident that there are clear differences in the relationship between intellectual capital elements and economic performance between sectors, especially with regard to the structural capital measures. These differences become even more apparent when the analysis is further broken down into low and high knowledge intensive companies. Human capital is linked negatively with economic performance only in the low knowledge intensive sectors (manufacturing: $\beta=-793.2$, $p<0.05$; services: $\beta=-438.0$, $p<0.05$). This suggests that companies in these industries cannot improve their economic performance by investing in higher human capital. On the contrary, investing in highly qualified employees is associated with a decrease in economic performance. This result supports the argument that in order to produce value human capital needs to be leveraged (Petty & Guthrie, 2000; Hitt et. al., 2001). Given the knowledge profile of the companies in this sector, highly qualified employees knowledge is not a necessary component of a successful business model.

With regards to structural capital, R&D intensity remains unrelated to Net Cash even when the analysis is further broken down into low and high knowledge intensive companies. The effects for selling and general administrative expense are consistently positive across all categories but only statistically significant in the case of low knowledge intensive services companies. In this industry sector, comprised mainly of the Wholesale and Retail Trade, Real Estate and Travel Agencies investing more in the routines and procedures internal to the firm which help selling its products and services is positively connected with Net Cash. The business model for these types of companies highly relies on selling services hence it makes sense that they derive the cash necessary for their operations from this activity and this intellectual capital element.

Table 9-7 Intellectual capital link with economic performance – industry differences

$Cash= \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3* SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$							
		Manufacturing			***Services***		
	Variables	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	-374.2	-793.2**	15.58	-216.5*	-438.0**	-73.84
		(257.2)	(386.0)	(358.7)	(113.5)	(208.4)	(133.5)
Structural capital	***R&D***	33.15	-197.2	-170.3	46.36	231.6	43.39
		(374.3)	(893.8)	(440.8)	(235.7)	(1,142)	(229.6)
	SG&A	251.1	216.5	481.2	285.9**	688.8***	130.4
		(202.8)	(260.1)	(310.3)	(128.0)	(257.3)	(144.0)
	Intan	501.8**	508.4*	456.7	-303.8**	-682.5**	-189.5
		(206.5)	(279.7)	(307.7)	(124.9)	(289.3)	(134.5)
Relational capital	***Sales***	465.7***	543.0***	453.3***	412.7***	354.8***	437.4***
		(15.49)	(37.99)	(16.85)	(17.24)	(37.19)	(18.76)
Control variables	***log(TA)***	19,651***	20,248***	16,307***	25,328***	34,707***	21,441***
		(2,801)	(4,042)	(3,985)	(1,984)	(4,005)	(2,229)
	Leve	-2,209	-4,239*	1,947	897.8	-1,516	1,843
		(2,053)	(2,336)	(4,095)	(1,094)	(2,171)	(1,241)
	Age	-471.2***	-599.2***	-159.3	-202.2	-135.8	-253.1
		(143.6)	(160.4)	(246.2)	(165.0)	(280.8)	(204.3)
	HHI	0.701	1.320	-0.521	3.737	55.66**	-1.494
		(2.833)	(2.978)	(7.375)	(7.131)	(26.46)	(7.129)
	INDWOE	-7,053	-10,232	-7,892	-7,410	-10,729	-6,794
		(6,367)	(7,843)	(11,042)	(6,464)	(12,352)	(7,578)
	Constant	-176,694***	-162,240***	-182,462***	-230,703***	-354,422***	-192,188***
		(33,636)	(47,376)	(47,473)	(24,000)	(49,423)	(26,707)
	Firm-years	1,951	972	979	5,557	1,840	3,717
	No. of firms	204	102	102	623	201	422

Variables definition

Cash = Net Cash;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As regards to intangibility there is a clear demarcation between sectors. A positive significant effect is revealed in the manufacturing sector a negative significant effect in the service sector. In both cases this results stems from low knowledge intensive companies within each sector. An increase in firm’s intangibility, in the low knowledge intensive manufacturing companies is related with an increase in Net Cash (β=508.4, $p<0.1$). Companies in this industry sector do not rely on knowledge activities in their business model. Therefore, it is the sector which innovates the least, with the highest competition (highest Herfingdahl-Hirsch index) and the highest risk to default (highest INDWOE). Consequently, the results reveal that being in possession of intangibles in this sector is an element of competitive advantage, signalling the company's ability to differentiate itself from the competitor companies and continue its activities. Coupling this information, with the human capital link to economic performance in this industry suggests there is a trade-off between intangible assets and human capital as found by Firer and Williams (2003).

Uniquely, economic performance is positively and significantly connected with relational capital in all industry subsamples. This indicates that these sectors have a similar ability to derive Net Cash from the relational capital, despite the industry they operate in and their knowledge profile. It highlights the importance of looking at both high and low knowledge companies to identify intellectual capital influence, despite this resource being more abundant in high knowledge companies.

By comparing low and high intensive knowledge companies it can be noticed that findings are in line with the knowledge profile of the industry. Notably, high knowledge models show either no effect or a positive effect of the intellectual capital elements. All the negative effects are found in the low knowledge models and account for the negative effects obtained in the whole sample analysis.

Financial performance. To account for financial performance this study employed multiple measures which have been used in previous empirical research. This section presents how intellectual capital is related to each of these financial performance measures according to their sector and level of knowledge intensity.

When **Return on Assets** is used as a measure of financial performance, then intellectual capital influence on financial performance is not very different between manufacturing and services companies. The relations described in the previous section for the overall sample are maintained across both sectors with the exception of Intangibility which is showing a positive link with ROA for services companies (β=0.108,$p<0.01$), while for manufacturing companies this link is not significant. It implies that in the services sector, if intellectual capital is capitalized (i.e. recorded as an intangible asset), then it will positively influence the financial performance of a company as measured by ROA. Human capital, R&D intensity, SG&A intensity and relational capital negatively relate with ROA.

If manufacturing and services companies are further divided in low and high knowledge intensive the relations described above uphold. Explanations for these results are in line with the fact that ROA either does not seize intellectual capital value (with the exception of Intangibility) or the intellectual capital proxies based on expenses are not appropriate to model the link between intellectual capital and this aspect of performance.

Table 9-8 Intellectual capital link with financial performance (ROA) – industry differences

$ROA = \alpha_i + \beta_1 * Salaries + \beta_2 * R\&D + \beta_3 * SG\&A + \beta_4 * Intangibles + \beta_5 * Sales + \beta_y * Controls_y + e_i + d_i + \eta_i$

		Manufacturing			Services		
	Variables	**All**	**Low**	**High**	**All**	**Low**	**High**
Human Capital	**Salaries**	-0.0014***	-0.0005	-0.0025***	-0.0017***	-0.0013***	-0.0022***
		(0.0005)	(0.0006)	(0.0008)	(0.0003)	(0.0003)	(0.0004)
Structural capital	**R&D**	-0.0040***	-0.0068***	-0.0028**	-0.0019***	-0.0046**	-0.0017**
		(0.0008)	(0.0015)	(0.0011)	(0.0006)	(0.0019)	(0.0007)
	SG&A	-0.0021***	-0.0014***	-0.0030***	-0.0008**	-0.0009**	-0.0008*
		(0.0004)	(0.0004)	(0.0007)	(0.0003)	(0.0004)	(0.0004)
	Intan	-0.0005	-0.0006	-0.0002	0.0011***	0.0010**	0.0009**
		(0.0004)	(0.0005)	(0.0007)	(0.0003)	(0.0005)	(0.0004)
Relational capital	**Sales**	-0.0002***	-0.0003***	-0.0002***	-0.0005***	-0.0004***	-0.0005***
		(3.9e-05)	(7.0e-05)	(5.1e-05)	(4.4e-05)	(6.3e-05)	(5.7e-05)
Control variables	**log(TA)**	0.0816***	0.0608***	0.108***	0.122***	0.0926***	0.139***
		(0.0065)	(0.0076)	(0.0108)	(0.0050)	(0.0067)	(0.0067)
	Leve	-0.0058	-0.0021	-0.0123*	0.0012	-0.0039	0.0034
		(0.0036)	(0.0033)	(0.0075)	(0.0029)	(0.0036)	(0.0038)
	Age	-8.8e-05	0.0005	-0.0020**	-0.0002	0.0007	-0.0011*
		(0.0004)	(0.0003)	(0.0008)	(0.0004)	(0.0005)	(0.0006)
	HHI	-3.9e-07	-4.2e-07	-8.2e-06	1.6e-06	-1.1e-05	1.8e-06
		(5.4e-06)	(4.7e-06)	(1.5e-05)	(1.9e-05)	(4.4e-05)	(2.3e-05)
	INDWOE	-0.0097	-0.0129	-0.0049	0.0403**	-0.0205	0.0534**
		(0.0111)	(0.0112)	(0.0204)	(0.0172)	(0.0207)	(0.0235)
	Constant	-0.747***	-0.597***	-0.874***	-1.372***	-0.978***	-1.563***
		(0.0754)	(0.0867)	(0.120)	(0.0613)	(0.0822)	(0.0805)
	Firm-years	1,953	973	980	5,645	1,858	3,787
	No. of firms	204	102	102	635	204	431

Variables definition

ROA = Return on assets;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

As with ROA, comparing the results for the link between intellectual capital and **Earnings per share** (EPS) between manufacturing and services companies reveals that there are not considerable differences between the two industries. Moreover, the results are broadly similar to the ones described for the overall sample with the exception of Intangibility. Intangibility does not yield a significant influence on EPS for manufacturing companies, while for service companies it yields a significantly negative influence (β=-0.0005, $p<0.05$). Capitalization of intellectual capital for services companies is negatively perceived by investors, leading managers to expense rather than capitalize whenever they have the choice (R&D) and in this way reduce company's earnings (Cazavan-Jeny & Jeanjean, 2006). The rest of the intellectual capital components preserve their relations with EPS: human capital is not significant, R&D intensity is exerting a broadly consistent negative influence, SG&A intensity does not show any significant influence and relational capital has a positive influence on EPS across both industry sectors.

The analysis of low and high knowledge intensive companies indicates some discrepancies between their experiences especially in the service sector. EPS is negatively and significantly related to R&D intensity and SG&A in high knowledge intensive service companies but not in their low knowledge counterparts.

Generally, the relation between the intellectual capital proxies and these measures is negative, which indicates that there might be a host of theoretical and methodological issues why the modelling of financial performance may be difficult or inappropriate. From a theoretical point of view intellectual capital might not beneficial for financial performance. From a methodological point of view, intellectual capital proxies are not appropriate measures to model the link between intellectual capital and financial performance.

Finally, with regard to **market performance** the effects of intellectual capital are again limited but some industry effects are revealed pointing to underling differences between manufacturing and services companies and also between low and high knowledge intensive companies with regard to R&D intensity, SGA&A intensity and intangibility and sales above the industry average. For example, R&D intensity is negatively and significantly related to annual share return (β=-0.870, $p<0.05$) only in the low knowledge intensive manufacturing sector. These companies do not rely on intense R&D investment to be able to run their operations.

Table 9-9 Intellectual capital link with financial performance (EPS) – industry differences

EPS= $\alpha_i+\beta_1$*Salaries+β_2*R&D+β_3* SG&A+β_4*Intangibles+β_5*Sales+β_y*Controls$_y$+e_i+d_i+η_i							
		Manufacturing			***Services***		
	Variables	***All***	***Low***	***High***	***All***	***Low***	***High***
Human Capital	***Salaries***	0.0002	0.0006	-0.0001	2.1e-05	0.0005	-0.0003
		(0.0004)	(0.0008)	(0.000530)	(0.0002)	(0.0003)	(0.0002)
Structural capital	***R&D***	-0.0021***	-0.0051***	-0.0016**	-0.0010**	-0.0025	-0.0009**
		(0.0008)	(0.0019)	(0.0008)	(0.0004)	(0.0018)	(0.0004)
	SG&A	-0.0002	-0.0002	-0.0001	-0.0003	4.72e-05	-0.0005*
		(0.0004)	(0.0006)	(0.0005)	(0.0002)	(0.0004)	(0.0003)
	Intan	-5.1e-05	-0.0004	0.0001	-0.0005**	-0.0007	-0.0004
		(0.0004)	(0.0006)	(0.0005)	(0.0002)	(0.0005)	(0.0002)
Relational capital	***Sales***	0.0002***	0.0003***	0.0002***	6.7e-05**	-0.0001*	0.00013***
		(3.7e-05)	(9.0e-05)	(3.8e-05)	(3.1e-05)	(5.9e-05)	(3.6e-05)
Control variables	***log(TA)***	0.0328***	0.0309***	0.0316***	0.0282***	0.0441***	0.0232***
		(0.0061)	(0.0097)	(0.0078)	(0.0034)	(0.0062)	(0.0041)
	Leve	0.0011	0.0085**	-0.0157***	0.0011	-0.0061*	0.0038*
		(0.0031)	(0.0040)	(0.0051)	(0.0018)	(0.0034)	(0.0020)
	Age	0.0010***	0.0012***	0.0005	0.0009***	0.0015***	0.0004
		(0.0004)	(0.0004)	(0.0006)	(0.0003)	(0.0004)	(0.0004)
	HHI	-4.9e-06	-6.1e-06	-3.4e-06	4.7e-06	4.0e-05	4.4e-07
		(4.8e-06)	(5.7e-06)	(1.1e-05)	(1.2e-05)	(4.2e-05)	(1.2e-05)
	INDWOE	0.0045	0.0087	-0.0046	0.0449***	0.0347*	0.0411***
		(0.0095)	(0.0135)	(0.0138)	(0.0109)	(0.0200)	(0.0130)
	Constant	-0.334***	-0.328***	-0.303***	-0.363***	-0.466***	-0.319***
		(0.0699)	(0.110)	(0.0864)	(0.0412)	(0.0768)	(0.0481)
	Firm-years	1,953	973	980	5,645	1,858	3,787
	No. of firms	204	102	102	635	204	431

Variables definition

EPS = Earnings per share;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In summary, industry effects are evident on the relation between intellectual capital elements and performance, with different outcomes across the various performances aspects analysed. Generally the link between structural capital elements and performance varies more across industries than the link between the other intellectual capital elements and performance. This provides an explanation for the mixed results found in the literature, as the focus has been on structural capital elements, because there are slightly easier to measure than the other intellectual capital components. Also, there are less negative effects on various types of performance for the high knowledge intensive companies than for the low knowledge intensive companies.

Table 9-10 Intellectual capital link with market performance – industry differences

$Return = \alpha_i+\beta_1*Salaries+\beta_2*R\&D+\beta_3*SG\&A+\beta_4*Intangibles+\beta_5*Sales+\beta_y*Controls_y+e_i+d_i+\eta_i$

		Manufacturing			*Services*		
	Variables	*All*	*Low*	*High*	*All*	*Low*	*High*
Human Capital	**Salaries**	0.000216	-0.000440	0.000222	-6.18e-05	-0.000670	0.000443
		(0.00129)	(0.00193)	(0.00184)	(0.000401)	(0.000645)	(0.000522)
Structural capital	**R&D**	-0.104	-0.870**	0.162	-0.0206	0.301	-0.0611
		(0.161)	(0.398)	(0.208)	(0.0830)	(0.371)	(0.0868)
	SG&A	-0.230**	-0.00521	-0.474***	-0.0165	-0.0359	-0.0121
		(0.0979)	(0.122)	(0.156)	(0.0450)	(0.0788)	(0.0552)
	Intan	-0.123	-0.0972	-0.0940	-0.224***	-0.116	-0.257***
		(0.0956)	(0.132)	(0.146)	(0.0455)	(0.0907)	(0.0534)
Relational capital	**Sales**	-0.00662	0.00265	-0.00550	-0.00938**	-0.0175*	-0.00678
		(0.0058)	(0.0147)	(0.0072)	(0.0046)	(0.0097)	(0.0053)
Control variables	**log(TA)**	0.0171	0.00105	0.0176	0.0243***	0.0362***	0.0195***
		(0.0116)	(0.0175)	(0.0179)	(0.00595)	(0.0108)	(0.00726)
	Leve	-0.0289**	-0.0311**	-0.0206	-0.0106	-0.0133	-0.00926
		(0.0129)	(0.0143)	(0.0252)	(0.00680)	(0.0120)	(0.00831)
	Age	-0.0003	-0.0003	-0.0006	0.0004	0.0007	0.0004
		(0.0005)	(0.0006)	(0.0010)	(0.0004)	(0.0006)	(0.0005)
	HHI	-7.0e-07	-5.2e-06	2.1e-05	-2.4e-05	-1.6e-05	- 3.0e-05
		(1.3e-05)	(1.4e-05)	(4.1e-05)	(3.4e-05)	(0.0001)	(3.6e-05)
	INDWOE	0.0735**	0.0763*	0.0550	0.114***	0.0995**	0.117***
		(0.0356)	(0.0418)	(0.0637)	(0.0271)	(0.0486)	(0.0335)
	Constant	-0.0943	0.237	-0.221	-0.328***	-0.311**	-0.376***
		(0.150)	(0.220)	(0.225)	(0.0827)	(0.152)	(0.0995)
	Firm- years	1620	803	817	4501	1520	2981
	No. of firms	189	92	97	583	191	392

Variables definition

Return = Annual Share Return;
Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sector dummy variables are estimated but suppressed in each of the models presented. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

9.6.3. Intellectual capital element interactions

The previous two sections presented results for the intellectual capital link with various performance aspects. The results described in both these sections indicated that, intellectual capital elements can positively influence economic performance. However, there is no strong empirical evidence of a positive link between this resource and financial performance or market performance. Nevertheless, the literature suggests that it is the combination of intellectual capital elements which may determine increased levels of performance (Bukh, 2003). For this reason, this section analyses how intellectual capital elements combine and how the combination between intellectual capital factors influences performance.

Therefore, this final section presents the results of the association between our aggregate measures of intellectual capital and the different performance measures. The aggregate measures have been obtained by the same factor analysis procedure described in Chapter 8 (Section 8.6.3). The factor analysis results presented in this chapter revealed that intellectual capital measures used in this study to quantify the intellectual capital components combine in two fundamental influences or factors: "*realised*" and "*potential*" intellectual capital. The combination of Average salaries per employee, R&D intensity and SG&A intensity describes the "***potential intellectual capital***". Intangibility and percent of sales above the industry average describe the second factor which has been labelled "***realised intellectual capital***".

Tables 9-11 to 9-14 present the results obtained for economic performance, financial performance and market performance. In all cases Model 1 is based on the inclusion of the two independent measures of IC - potential and realised, while Model 2 further includes the interaction term between these two factors.

For the overall sample, potential intellectual capital is negatively related to **economic performance** (Table 9-11). A negative relation between potential intellectual capital and Net Cash is maintained across all industry sectors. Nevertheless, it is significant just for low knowledge intensive manufacturing (β=-22818, $p<0.1$) and high knowledge intensive services (β=-11842, $p<0.05$). On the contrary, realised intellectual capital is positively and significantly related to Net Cash across all industries and in the overall sample, but the size of the effect is higher in high knowledge sectors. Thus, as expected companies derive cash flows from intellectual capital elements which have been incorporated in a company's activities and high knowledge companies are able to generate more cash from these resources.

When the interaction element between potential and realised intellectual capital is introduced, it suggests that investment in realised intellectual capital does not have the ability to improve the benefits of potential intellectual capital for economic performance. This effect is consistent across industry sectors.

Financial performance as captured by Return on Assets is negatively associated to potential intellectual capital in the overall sample and across the various industry sectors analysed in this study. There is no significant association between ROA and "*realised"* intellectual capital for the overall sample and services companies either with low knowledge intensive or high knowledge intensive profile. Interestingly, the estimates on the interaction term are consistently and significantly positive across all samples. As such, if potential intellectual capital is transformed into realised intellectual capital this will positively influence the financial performance of a company. Because ROA is a measure of efficiency, it was expected that it would reflect the efficiency with which the intellectual capital resources are used (Chen et. al., 2005).

If financial performance is approximated using Earnings per share as a proxy, the connection between the two intellectual capital factor scores and financial performance changes (Table 9-13). Potential intellectual capital is negatively and significantly related to EPS in the overall sample (β=-0.0199, $p<0.01$). However, when the analysis is broken down to industry sub-samples the negative significant relation is significant only for high knowledge manufacturing companies (β=-0.0305, $p<0.05$) and high knowledge services companies (β=-0.0297, $p<0.01$). Realised intellectual capital does not have a significant association with EPS in the overall sample. For manufacturing companies the link between realised intellectual capital and EPS is positive, but significant only in the high knowledge intensive sector. For services companies, the link between realised intellectual capital is negative, but significant only for low knowledge intensive services (β=-0.0290, $p<0.05$). There is no interaction effect between potential and realised intellectual capital for financial performance as reflected by Earnings per Share.

The results obtained for **market performance** are presented in Table 9-14. The results reveal that potential intellectual capital is not significantly related with market performance in the overall sample and , when the analysis is broken down in industry sub-samples, potential intellectual capital negatively influences this performance aspects only in the high knowledge intensive manufacturing industry (β=-0.0597,$p<0.05$). Companies in this sector include pharmaceutical companies for which the expense of intellectual capital elements instead of their capitalization is perceived as detrimental for the company because it is associated unsuccessful research projects (DiMassi & Grabowski, 2007). Realised intellectual capital is significantly and negatively related with annual share return in the overall sample and almost all industry sectors subsamples. Nonetheless, realised intellectual capital comprises of Intangibility and relational capital, which have been previously shown that are negatively valued by the market.

As with EPS, there is no interaction effect between potential and realised intellectual capital for market performance. It suggests that it might be difficult for the market to evaluate complex interactions and connection between intellectual capital elements.

Overall, realized intellectual capital generates economic performance across all industry sectors analysed. However, there are no other effects that the aggregate measures of intellectual capital have on any other performance aspects, except financial performance as measured by ROA. This interaction between intellectual capital elements gives an indication of a company's efficiency in transforming potential into realised intellectual capital which is capture by ROA.

Table 9-11 Economic performance and aggregate measures of intellectual capital

			Manufacturing				Services			
	All		Low		High		Low		High	
VARIABLES	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	-11769***	-13977***	-22818*	-41774***	-10834	-35062***	-12831	-11350	-11842**	-12189***
	(3747)	(3626)	(12251)	(11407)	(10186)	(10136)	(9377)	(9277)	(4721)	(4495)
Realised IC	30243***	36584***	47358***	39286***	107988***	99839***	15814*	4386	19663***	35691***
	(3446)	(3358)	(9266)	(9159)	(10037)	(9602)	(8643)	(9018)	(4400)	(4387)
Potential*Realised		-39343***		-56149***		-70149***		-30889***		-39567***
		(2554)		(9538)		(8527)		(7561)		(3124)
log(TA)	36541***	33958***	39043***	32545***	33214***	26954***	41690***	42277***	33645***	30846***
	(1895)	(1820)	(4821)	(4358)	(5743)	(5522)	(4194)	(4104)	(2505)	(2362)
Leve	133.9	115.9	-5187**	-5461**	1444	2813	-2689	-2578	2122*	1896
	(995.4)	(985.4)	(2386)	(2389)	(4433)	(4287)	(2199)	(2195)	(1283)	(1268)
Age	-342.2**	-223.2	-792.2***	-669.6***	-962.1**	-580.5	-73.54	-66.26	21.41	8.321
	(164.4)	(154.0)	(235.8)	(194.4)	(451.4)	(432.2)	(325.4)	(315.5)	(270.4)	(245.5)
HHI	2.232	3.051	1.286	2.057	7.571	4.386	51.85*	57.48**	-1.366	1.311
	(3.397)	(3.336)	(3.330)	(3.192)	(8.650)	(8.255)	(27.06)	(26.97)	(7.511)	(7.382)
INDWOE	-8258	-8256*	-13687*	-11576	-6794	-2771	-7721	-7018	-5489	-6764
	(5047)	(4974)	(8185)	(8126)	(12206)	(11824)	(12686)	(12631)	(8119)	(7939)
Constant	-324628***	-288280***	-322209***	-247096***	-236247***	-186245***	-393956***	-396967***	-292484***	-263758***
	(24896)	(23813)	(52840)	(48399)	(61968)	(59378)	(48636)	(47645)	(27542)	(26117)
Firm-years	7508	7508	972	972	979	979	1840	1840	3717	3717
No. of firms	827	827	102	102	102	102	201	201	422	422

Variables definition

Cash = Net Cash;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets ;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated, but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9-12 Financial performance (ROA) and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing				Services			
			Low		High		Low		High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	-0.0637***	-0.0605***	-0.0803***	-0.0697***	-0.129***	-0.112***	-0.0565***	-0.0586***	-0.0564***	-0.0571***
	(0.0083)	(0.0082)	(0.0174)	(0.0176)	(0.0178)	(0.0185)	(0.0150)	(0.0149)	(0.0125)	(0.0124)
Realised IC	-0.0106	-0.0146*	-0.0285**	-0.0156	-0.0509***	-0.0451**	-0.00827	0.0114	-0.00329	-0.0206*
	(0.0078)	(0.0077)	(0.0134)	(0.0140)	(0.0176)	(0.0175)	(0.0136)	(0.0143)	(0.0122)	(0.0124)
Potential*Realised		0.0577***		0.0452***		0.0474***		0.0526***		0.0572***
		(0.00603)		(0.0142)		(0.0156)		(0.0123)		(0.00897)
log(TA)	0.0959***	0.100***	0.0504***	0.0557***	0.100***	0.104***	0.0776***	0.0770***	0.115***	0.120***
	(0.0039)	(0.0039)	(0.0072)	(0.0074)	(0.0100)	(0.0100)	(0.0064)	(0.0063)	(0.0062)	(0.0062)
Leve	0.0007	0.0006	-0.0015	-0.0013	-0.0117	-0.0127*	-0.0030	-0.0031	0.0032	0.0034
	(0.0024)	(0.0024)	(0.0033)	(0.0033)	(0.0075)	(0.0075)	(0.0036)	(0.0036)	(0.0039)	(0.0039)
Age	-0.0001	-0.0003	0.0007*	0.0006	-0.0015*	-0.0017**	0.0005	0.0005	-0.0012*	-0.0012**
	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0008)	(0.0008)	(0.0005)	(0.0005)	(0.0006)	(0.0006)
HHI	2.9e-06	2.2e-06	-1.2e-06	-1.4e-06	-1.1e-05	-8.9e-06	-4.5e-06	-1.0e-05	-4.4e-07	-3.9e-06
	(8.1e-06)	(8.1e-06)	(4.7e-06)	(4.7e-06)	(1.5e-05)	(1.5e-05)	(4.5e-05)	(4.4e-05)	(2.3e-05)	(2.3e-05)
INDWOE	0.0190	0.0194	-0.0104	-0.0115	-0.00471	-0.00680	-0.0261	-0.0255	0.0535**	0.0550**
	(0.0122)	(0.0121)	(0.0113)	(0.0112)	(0.0205)	(0.0205)	(0.0210)	(0.0209)	(0.0239)	(0.0237)
Constant	-1.130***	-1.186***	-0.641***	-0.702***	-1.083***	-1.111***	-0.941***	-0.941***	-1.452***	-1.501***
	(0.0511)	(0.0509)	(0.0794)	(0.0812)	(0.108)	(0.107)	(0.0742)	(0.0736)	(0.0706)	(0.0703)
Firm-years	7598	7598	973	973	980	980	1858	1858	3787	3787
No. of firms	839	839	102	102	102	102	204	204	431	431

Variables definition

ROA = Return on Assets;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets ;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated ,but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9-13 Financial performance (EPS) and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing Low		Manufacturing High		Services Low		Services High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	-0.0199***	-0.0201***	-0.0350	-0.0367*	-0.0305**	-0.0355***	0.0177	0.0175	-0.0297***	-0.0299***
	(0.0057)	(0.0057)	(0.0215)	(0.0219)	(0.0132)	(0.0137)	(0.0140)	(0.0140)	(0.0074)	(0.0073)
Realised IC	0.0030	0.0033	0.0192	0.0177	0.0381***	0.0368***	-0.0290**	-0.0271**	-0.0001	0.0009
	(0.00537)	(0.00539)	(0.0172)	(0.0179)	(0.0131)	(0.0132)	(0.0126)	(0.0134)	(0.00703)	(0.00728)
Potential*Realised		-0.0029		-0.0062		-0.0150		0.0056		-0.0031
		(0.0041)		(0.0178)		(0.0114)		(0.0117)		(0.0052)
log(TA)	0.0324***	0.0322***	0.0421***	0.0413***	0.0359***	0.0346***	0.0440***	0.0441***	0.0274***	0.0272***
	(0.0028)	(0.0028)	(0.0093)	(0.0095)	(0.0075)	(0.0076)	(0.0058)	(0.0057)	(0.0038)	(0.0038)
Leve	0.0010	0.0010	0.0085**	0.0085**	-0.0157***	-0.0154***	-0.0059*	-0.0059*	0.0038*	0.0038*
	(0.0015)	(0.0015)	(0.0040)	(0.0040)	(0.0051)	(0.0051)	(0.0034)	(0.0034)	(0.00200	(0.0020)
Age	0.0009***	0.0009***	0.0012**	0.0012***	0.0003	0.0004	0.0015***	0.0015***	0.0004	0.0004
	(0.0002)	(0.0002)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
HHI	-2.5e-06	-2.5e-06	-5.7e-06	-5.7e-06	-1.5e-06	-2.3e-06	3.6e-05	3.6e-05	7.8e-07	9.2e-07
	(5.4e-06)	(5.4e-06)	(5.7e-06)	(5.7e-06)	(1.1e-05)	(1.1e-05)	(4.2e-05)	(4.2e-05)	(1.2e-05)	(1.2e-05)
INDWOE	0.0282***	0.0282***	0.0089	0.0090	-0.0041	-0.0033	0.0332*	0.0332*	0.0411***	0.0410***
	(0.0079)	(0.0079)	(0.0135)	(0.0135)	(0.0138)	(0.0138)	(0.0200)	(0.0200)	(0.0130)	(0.0130)
Constant	-0.345***	-0.342***	-0.444***	-0.435***	-0.334***	-0.324***	-0.472***	-0.473***	-0.399***	-0.397***
	(0.0367)	(0.0370)	(0.102)	(0.104)	(0.0807)	(0.0809)	(0.0673)	(0.0670)	(0.0422)	(0.0424)
Firm-years	7598	7598	973	973	980	980	1858	1858	3787	3787
No. of firms	839	839	102	102	102	102	204	204	431	431

<u>Variables definition</u>

EPS = Earnings per Share;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets ;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated ,but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9-14 Market performance and aggregate measures of intellectual capital

VARIABLES	All		Manufacturing Low		Manufacturing High		Services Low		Services High	
	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2	Model1	Model2
Potential IC	-0.0145	-0.0144	-0.0714	-0.0693	-0.0597**	-0.0671**	-0.0107	-0.0109	-0.00242	-0.00226
	(0.0110)	(0.0110)	(0.0457)	(0.0458)	(0.0289)	(0.0341)	(0.0269)	(0.0271)	(0.0143)	(0.0144)
Realised IC	-0.0597***	-0.0592***	-0.0158	-0.00136	-0.0635**	-0.0657**	-0.0519**	-0.0512**	-0.0670***	-0.0671***
	(0.0102)	(0.0104)	(0.0338)	(0.0437)	(0.0292)	(0.0296)	(0.0228)	(0.0260)	(0.0142)	(0.0143)
Potential*Realised		0.0025		0.0234		-0.0141		0.0015		-0.0016
		(0.00872)		(0.0450)		(0.0338)		(0.0245)		(0.0108)
log(TA)	0.0249***	0.0251***	0.00127	0.00250	0.0356**	0.0345**	0.0307***	0.0307***	0.0239***	0.0237***
	(0.0047)	(0.0048)	(0.0165)	(0.0166)	(0.0155)	(0.0157)	(0.0096)	(0.0097)	(0.0064)	(0.0065)
Leve	-0.0141**	-0.0142**	-0.0301**	-0.0302**	-0.0174	-0.0173	-0.0131	-0.0131	-0.00969	-0.00968
	(0.0060)	(0.0060)	(0.0143)	(0.0143)	(0.0252)	(0.0252)	(0.0119)	(0.0119)	(0.00830)	(0.00831)
Age	0.0002	0.0002	-0.0003	-0.0003	-0.0005	-0.0005	0.0006	0.0006	0.0004	0.0004
	(0.0003)	(0.0003)	(0.0006)	(0.0006)	(0.0010)	(0.0010)	(0.0006)	(0.0006)	(0.0005)	(0.0005)
HHI	-5.2e-06	-5.2e-06	-5.8e-06	-5.6e-06	1.8e-05	1.8e-05	-1.3e-05	-1.4e-05	-2.8e-05	-2.8e-05
	(1.3e-05)	(1.3e-05)	(1.3e-05)	(1.3e-05)	(4.1e-05)	(4.1e-05)	(0.0001)	(0.0001)	(3.6e-05)	(3.6e-05)
INDWOE	0.0998***	0.0998***	0.0759*	0.0738*	0.0624	0.0630	0.0952**	0.0954**	0.119***	0.119***
	(0.0215)	(0.0215)	(0.0416)	(0.0417)	(0.0638)	(0.0638)	(0.0483)	(0.0485)	(0.0335)	(0.0335)
Constant	-0.348***	-0.350***	0.144	0.131	-0.650***	-0.643***	-0.329**	-0.330**	-0.479***	-0.478***
	(0.0663)	(0.0667)	(0.193)	(0.194)	(0.186)	(0.187)	(0.130)	(0.130)	(0.0861)	(0.0867)
Firm-years	6121	6121	803	803	817	817	1520	1520	2981	2981
No. of firms	772	772	92	92	97	97	191	191	392	392

Variables definition

Return = Annual share return;
Potential IC = Potential Intellectual capital;
Realised IC = Realised Intellectual capital;
log(TA) = Logarithm of Total Assets ;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy and industry sectors dummy variables are estimated ,but suppressed. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

9.7. Robustness tests

The intellectual capital measures used in this study rely on income statement expenses related to this resource. From an accounting point of view, if intangibles are expenses they will result in a reduction of current profits and earnings and an increase in future economic and financial performance (Ely & Waymire, Aboody & Lev, 1998). Also, empirical research has argued the possibility of lagged effects in the research of intellectual capital link with performance. To account for this aspect, tests for one year, two years and three years lagged effects on intellectual capital elements have been performed. In order to test the robustness of the findings, firm-year observations were dropped in the process due to the lag procedure. The results for all the models remained consistent with the above findings.

In addition, strategic management theories do not only suggest a direct positive link between intellectual capital and performance, but they also try to explain performance differentials between competitor firms by means of intellectual capital (Spender et. al., 2013). As a result, intellectual capital should explain differences from the average in competitor companies performance (Ludewig & Sadowski, 2009). Hence, the influence on intellectual capital was tested on performance above the industry average. Once more, the results for all the models remained consistent with the above findings.

9.8. Findings

This chapter has explored the relationship between intellectual capital and different aspects of performance in low knowledge intensive manufacturing, high knowledge manufacturing, low knowledge services and high knowledge services industry sectors. Also, it has investigated the interaction of intellectual capital elements influence on performance.

The results reveal that, in a UK context, intellectual capital value behaviour towards performance differs from one performance measure to the other and across the different industries under analysis. A summary of the results obtained are showed in Table 9-15 below. This summary indicates that elements of intellectual capital, such as SG&A intensity, intangibility and sales above the industry average, are found to positively influence economic performance. The other intellectual capital elements analysed in this study either have no effect or they show a negative influence on economic performance limited to low knowledge intensive sectors. With few exceptions, the intellectual capital elements either show no effect or they have a negative influence on financial performance with differences between the two measures employed in this study to account for this aspect of performance. Generally, intellectual capital elements have a limited or no effect on market performance indicating a form of myopia regarding the valuation of this resource.

Table 9-15 Results summary - industry differences

Manufacturing		***Low knowledge intensive***				***High knowledge intensive***			
		Cash	***ROA***	***EPS***	***Return***	***Cash***	***ROA***	***EPS***	***Return***
Human capital	***Salaries***	-					-		
Structural capital	***R&D***		-	-	-		-	-	
	SG&A		-				-		-
	Intan	+							
Relational capital	***Sales***	+	-	+		+	-	+	
Services		***Low knowledge intensive***				***High knowledge intensive***			
		Cash	***ROA***	***EPS***	***Return***	***Cash***	***ROA***	***EPS***	***Return***
Human capital	***Salaries***	-	-				-		
Structural capital	***R&D***		-				-	-	
	SG&A	+	-				-	-	
	Intan	-	+				+		-
Relational capital	***Sales***	+	-	-	-	+	-	+	

Variables definition

Cash = Net Cash;
ROA = Return on Assets;
EPS = Earnings per Share;
Return = Annual share return;

Salaries = Average salaries per employee;
R&D = % of R&D to Total Operating Expenses;
SG&A = % of SG&A to Total Operating Expenses;
Intan = % of Intangible Assets to Total Assets;
Sales = % of Sales above industry's average;

Notes: the table shows the summary results for all performance aspects under analysis, **+** signifies positive statistical significant coefficient , **-** signifies negative statistical significant coefficient; p<0.1

As the elements of Intellectual capital are believed to produce more value in combination rather than individually (Bukh, 2003) the examination of this aspect was necessary to conclude on the intellectual ability to add value in an organization. The results of aggregate measures of intellectual capital confirm this hypothesis for some aspects of performance as follows (Table 9-16). The combination of intellectual capital elements under realised intellectual capital positively relates to Net Cash in all industry sectors. Also, realised intellectual capital positively influences Earnings per share in the high knowledge intensive manufacturing industry. *"Potential"* intellectual capital is either negatively linked with various types of performance or it does now show a significant connection. The interaction between potential and realised intellectual capital positively influences Return on Assets in all industry sectors, showing that the interaction of these elements adds value to their individual influences and never significantly negative in any of the performance specifications.

Table 9-16 Results summary - intellectual capital elements interaction

Manufacturing	***Low knowledge intensive***								***High knowledge intensive***							
	Cash		***ROA***		***EPS***		***Return***		***Cash***		***ROA***		***EPS***		***Return***	
Potential	-	-	-	-		-				-	-	-	-	-	-	-
Realised	+	+	-						+	+	-	-	+	+	-	-
Potential*Realised		-		+						-		+				
Services	***Low knowledge intensive***								***High knowledge intensive***							
	Cash		***ROA***		***EPS***		***Return***		***Cash***		***ROA***		***EPS***		***Return***	
Potential			-	-					-	-	-	-	-	-		
Realised	+				-	-	-	-	+	+		-			-	-
Potential*Realised		-		+						-		+				

Variables definition

Cash = Net Cash;
ROA = Return on Assets;
EPS = Earnings per Share;
Return = Annual Return;
Potential = Potential intellectual capital ;
Realised = Realised intellectual capital;

Notes: the table shows the summary results for all performance aspects under analysis, **+** signifies positive statistical significant coefficient , **-** signifies negative statistical significant coefficient

These findings draw attention to the link between intellectual capital elements and financial performance which is especially negative and statistically significant, compared to other performance measures. While the literature argues that not all elements of intellectual capital are beneficial for economic, financial and market performance (Ittner & Larcker, 1998; Roos et. al.,2005; Bracker & Ramaya, 2011), a mixture of non-effects, positive and negative influences was expected. Hence, the negative influence of intellectual capital on financial performance signals that there might be other aspects which should be taken into consideration. These aspects relate to the second objective of this chapter: examine how intellectual capital proxies model the link between intellectual capital and performance.

Some researchers argued that the study of intellectual capital influence on performance through cost-based may be unsuitable (Sveiby, 2001; Bontis, 2003; Firer & Williams, 2003) due to accounting identity problems (Felipe & McCombie, 2012). Specifically, intellectual capital elements based on cost are excluded from the income computation, while traditional financial measures of performance rely on income. The results obtained could be merely a reflection of this aspect instead of being a deficiency of intellectual capital in determining financial performance. For this reason, it is necessary to model the link between intellectual capital and performance by using other types of intellectual capital measures to be able to conclude on the matter. This aspect highlights the importance of accounting measures for overall intellectual capital value as objective and financial measures in the study of intellectual capital influence on performance. Chapter 10 will explore the relationship between intellectual capital and performance by quantifying intellectual capital using accounting measures of intangible value.

At the same time, intellectual capital proxies may have limitations because they don't capture information on *"soft"* aspect of organizational activities which have been demonstrated to determine whether a specific intellectual capital element has a negative or a positive influence on performance. For example, in order to produce value human capital needs structures and routines to be put in place to utilize employees' knowledge and enhance its value (Petty & Guthrie, 2000; Hitt et. al., 2001). While wages as a measure of human capital provides a signal for the knowledge and education possessed by employees, it does not expand to reflect how employees use this knowledge. As strategic management theories debate, the stock of intellectual capital as measured by accounting needs to be supported by knowledge flows in order to derive value (Section 3.2.3.).

The evidence also indicates that intellectual capital elements do not influence market performance either. Specifically, the results revealed multiple non-effects and some negative influences. Wakelin (2001) asserts that intellectual capital elements can be negatively associated with market values due to two possible types of economic spillovers: rent spillovers and knowledge spillovers. The former is associated with difficulties in capturing the full economic benefits of intellectual capital via a firm's price, while the latter deals with flows of knowledge which are not part of economic transaction. While it is hard to comment on knowledge spillovers based on the analysis carried out in this study, rent spillovers are a plausible explanation, it was expected that the market would value intellectual capital elements which are positively influencing Cash Flows.

Furthermore, Maditinos et. al. (2011) argue that there might not be any relation between market performance and intellectual capital since market values can be influenced by market sentiment and may not be based on the reality of a company. Changes in prices especially reveal market sentiment. If intellectual capital is positively linked with market performance, as measured by annual share return, it could be a possible proof that intellectual capital in a company depends on market sentiment. Therefore, this study indicates that intellectual capital value does not depend on the market's sentiment; it is a resource internal to the company with a certain value which needs to be determined.

9.9. Conclusions

This chapter has investigated the relation between intellectual capital and various aspects of performance referring to economic, financial and market aspects. Findings reveal that intellectual capital elements have a considerably different behaviour towards performance depending on the industry sector and performance aspect under analysis. Intellectual capital has a more positive influence on various types of performance aspects for high knowledge intensive companies which justify why this sector is widely researched. At the same time, it justifies the study of both low and high knowledge intensive sectors in order to understand the mechanisms through which intellectual capital adds value. As expected, intellectual capital elements show a different behaviour with respect to economic performance: some show a positive influence, others show no effect and the rest have a negative influence limited to the low knowledge intensive companies.

Intellectual capital has a negative relation with financial performance which suggests, on one hand, that intellectual capital proxies might not be appropriate measures to model the link between intellectual capital and financial performance. On the other hand, it could indicate that the accounting data on which the intellectual capital proxies are built does not take into consideration *"soft"* aspects of organizational well-being which refer to knowledge flows.

Finally, intellectual capital elements show no effect on the market performance or are negatively related with this aspect of performance. These results suggest that the market faces difficulties in capturing the full economic benefits of intellectual capital via a firm's price.

10. Accounting measures of intangible value and performance

10.1. Abstract

Purpose – This research aims to improve our understanding of the ability of accounting measures of intangible value to model the link between intellectual capital and various types of performance

Design/methodology/approach – The study uses a panel methodology to analyse multiple accounting measures of intangible value: Market-to-book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index. The analysis is based on an eleven year panel of data covering UK listed companies in various industry sectors.

Findings – Broadly accounting measurements are found to have the ability to predict various types of performance. However, there are discrepancies in the information they bring to our understanding of the link between intellectual capital and performance from one accounting measure to another and across different industries.

Originality/value – This research compares and contrasts multiple accounting measures of intangible value and their connection with multiple aspects of performance across various industry sectors to form an exhaustive picture of these measures and their usefulness.

Practical implications –This study is part of the investigation into the efficacy of the accounting discipline to capture intellectual capital information.

10.2. Introduction

The aim of this final empirical chapter is to "*complete the circle*" as regards our accounting investigation of intellectual capital. The one as yet unexplored field of research on intellectual capital is looking at the link between intellectual capital and performance as modelled by the accounting measures of intangible value such as Market-to-Book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index. There is a lot of mistrust in the ability of accounting measures of intangible value to model the link between intellectual capital and performance. Most of the criticism is at a theoretical level and based on observations related to the way in which these measures are constructed. There is however a growing but limited body of empirical research on the topic which largely revolves around studying Value Added Intellectual Capital Index. As a consequence, the ability of other accounting measures of intangible value to link intellectual capital and performance is largely unknown. Researchers argue that in order to draw a conclusion on the topic two conditions are necessary: an accounting measure should be clear about the resource(s) it is measuring and facilitate a clearer understanding of the performance outcomes (Levy & Duffey, 2007). While examining whether the accounting measures of intangible value fit the first condition was the goal of Chapter 8 "*Accounting measures ability to capture intellectual capital*", the second condition is the focus of this chapter.

Hence, this chapter's main aim is to examine what are the performance outcomes predicted by the accounting measures of intangible value. While prior research has focused on a single measurement method, our aim is to compare and contrast the effect of multiple accounting measures on multiple performance measures across a range of industry sectors in order to determine the context in which these measures are appropriate. Together with Chapters 8 and 9, it provides a comprehensive analysis and mapping of accounting research's ability to measure intellectual capital and model its link with performance. As a result, this chapter forms the basis for concluding whether the mixed results observed in the literature are, amongst other things, a consequence of the choice of intellectual capital measurement used in the studies. Additionally, it will help shape our opinion as to the best way that the accounting discipline can model the link between intellectual capital and performance.

The rest of this chapter will be organized as follows. First, the research objectives of this chapter are going to be developed. Second, the methodological approach is outlined followed by a description of the data. The results of our estimates are then reported, findings discussed and concluding comments made.

10.3. Research objectives

Intellectual capital is intangible, immaterial, rarely owned by the company and, consequently, hard to be captured (Bukh et. al., 2005). Chapter 3 (Section 3.1.1) argued that these intellectual capital characteristics led to its exclusion from the balance sheet which, in turn, generated a stringent need for intellectual capital information (Chen et. al., 2004; Bismuth & Tojo, 2008). In order to provide the needed intellectual capital information and capture its value, the accounting discipline developed multiple accounting measures of intangible value, such as Market-to-Book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Coefficient (Levy & Duffey, 2007).

Accounting measures have traditionally been concerned with assigning a monetary value to intellectual capital (Cezair, 2008). They can be grouped by the type of data they use to evaluate intellectual capital. As such, there are financial statements-based measures (Economic Value Added, Calculated Value Added and Value Added Intellectual Capital Index) and market-based measures (Market-to-Book Ratio and Tobin's Q). Both financial statement-based and market-based measures have been theoretically criticised due to limitations inherent to their construction. On one hand, these limitations are believed to hinder their ability to capture intellectual capital, and, on the other hand, their effectiveness in predicting performance. Financial statement-based measures have been criticised for relying on historical accounting data. Also, they are criticised for being subject to different accounting practices across industries, inappropriate expensing of research and development and advertising expenditures, a failure to reflect opportunity costs and risk and replacement–cost accounting errors (Hirschey & Wichern, 1984). Market-based accounting measures have been criticised on the basis that they are subject to irrational impulses and market sentiment (Gowthorpe, 2009; Maditinos et. al., 2011).

However, while researchers keep developing new measurement methods, criticise them and dismiss them, there is little understanding about how the existing means of capturing intellectual capital work (Andriessen, 2004a; Sveiby, 2005). As presented in the introduction, there are two key issues which should be explored with respect to accounting measure of intangible value: how intellectual capital is captured by the different measures and how these measures relate with performance (Levy & Duffey, 2007). The first issue was the subject of Chapter 8 "*Accounting measures ability to capture intellectual capital*". The results of Chapter 8 showed that the market-based measures (Market-to-Book ratio and Tobin's Q) have the ability to capture multiple intellectual capital components. Also, they indicated that financial statement-based measures are limited to capturing single features of intellectual capital (Economic Value Added and Calculated Intangible Value) or they only sporadically capturing intellectual capital (Value Added Intellectual Capital Index).

Building on these results, the current chapter investigates the accounting measures capacity to aid the prediction of various aspects of performance – economic, financial and market performance - and whether their predictive power is connected with their ability to capture intellectual capital.

There is a small but growing body of research looking at how the accounting measures of intangible value predict performance. Such studies are largely concentrated on the Value Added Intellectual Capital Index (VAIC) method developed by Pulic (1998) but also embrace Tobin's Q, CIV and EVA measures. Generally, the empirical studies find a positive association between VAIC and various types of performance (Pulic, 2004; Chen et. al., 2005; Shiu, 2006). However, most studies divide VAIC into its component parts and study their individual association with various types of performance (Makki & Lodhi, 2009). The VAIC components are found to have a different association with performance from one component to another and across various aspects of performance, which raises some questions about this measure (please refer to Chapter 4 (Section 4.2.2)). Moreover, theoretical debates around VAIC point to it having limitations in depicting intellectual capital value (Ståhle et. al., 2013; Iazzolino & Laise, 2014), which have been confirmed in Chapter 8.

Due to the criticism surrounding VAIC, there is a need to investigate other accounting measures of intangible value. On one hand, this will aid our understanding of how to best model the link between intellectual capital and performance. On the other hand, it will allow a direct comparison between the various methods, help verify the results of previous empirical studies and shed more light on the efficiency of each accounting measure (Maditinos et. al., 2011).

Moreover, previous empirical studies linking the VAIC method and performance are rarely directly comparable because they use different performance measures (Shiu, 2006; Clarke et. al., 2011). Hence, in order to understand the behaviour of the accounting measures across a wide array of circumstances and ensure comparability, there is a need to consider multiple aspects of performance – economic, financial and market performance.

In the literature there are also a limited number of studies which analyse other accounting measures of intangible value and performance. Some examples are the studies of Villalonga (2004), Huang and Wang (2008) and Richieri et. al. (2014). Using Tobin's Q as a measure of intangibility, Villalonga (2004) find a positive relationship between intangibility and the persistence of profits so long as profits are positive. Also, she proves that intangibles investment can have a detrimental effect for companies with negative profits. Calculated Intangible Value is found to be positively connected with return on assets, return on sales and return on equity (Richieri et. al., 2014). Huang and Wang (2008) focus on the Economic Value Added measurement method to assess whether this method can better explain the variations in a firm's market performance compared to the residual income. They found no difference in the explanatory power of market performance between the two measures for a sample of 37 Taiwanese listed companies.

The reason behind accounting measures of intangible value, such as Market-to-Book ratio and Tobin's Q, being rarely used in the intellectual capital -performance literature is that they have a multidimensional conceptualization (Richard et. al., 2009). They are presented in the literature both as measures of intellectual capital and performance. Due to their multidimensionality, data identity issues can arise when studying their association with performance. Researchers argue that this issue is common in studies exclusively relying on accounting data but largely ignored by researchers (Felipe & McCombie, 2010; Temple, 2010)

In such cases, Richard et.al. (2009) recommend a strong theoretical rationale for the nature of the measures and a triangulation using multiple measures. The rationale for the nature of these measures has been reinforced throughout the thesis and theoretically developed in Section 3.1.2. Also, it is supported by empirical results in Chapter 8. This chapter completes the triangulation of multiple measures as suggested by Richard et. al. (2009). It takes into account the issues presented and discusses its implications by utilising corroborating information from Chapter 8 and Chapter 9. Overall, it considers there is value added in exploring all the accounting measures of intangible value in order to offer comparability between studies and highlight how far the accounting discipline can stretch in the study of intellectual capital.

10.4. Methodology

As presented in the previous section, the objective of this chapter is to determine whether the accounting measures of intangible value have the same ability to predict various types of performance across a range of industry sectors: low knowledge intensive manufacturing, high knowledge intensive manufacturing, low knowledge intensive services and high knowledge intensive services. The following models are going to be used to empirically determine the connection between the accounting methods under analysis and various types of performance:

$$Cash_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ e_i \quad (1a)$$
$$EPS_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ e_i \quad (2a)$$
$$ROA_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ e_i \quad (3a)$$
$$Annual\_return_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ e_i \quad (4a)$$

Where Cash represent company's net cash, EPS is earnings per share, ROA is return on assets and Annual return represents the annual market return. Accounting_method is one of the following: Market-to-book; Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index. Controls represents control variables referring to the following dimensions: firm's size (Chan et. al, 1992; Ravichandran & Lerwongsatien, 2005); firm's capital structure (Barth et.al. 2001; Metcalf, 2002; Pindado, 2005), firm's age (Piekkola, 2009) and industry characteristics such as, industry's concentration (Bardhan et. al., 2010) and industry's risk (Wilson et. al., 2012). To account for these dimensions, corresponding control variables are included in the study: logarithm of Total Assets account for firm size, firm's leverage to highlight the capital structure, company's age since incorporation, Herfingdahl–Hirsch index to represent industry concentration and INWOE index to capture industry risk. Details on the variable selection and the literature recommending these measurements are provided in detail in Chapter 6 "*Methodology*".

The model specified in this chapter has been estimated by using a random effects panel data methodology for each performance aspect separately. The following issues have been considered in making this choice. First, a panel data methodology considers individual heterogeneity for parameters estimation (Koop, 2008). This point is crucial for this study, because, in order to achieve its competitive advantage potential, the decision to undertake intellectual capital investment is directed by firm's strategy and, more importantly, intellectual capital is strongly linked to the specificity of each firm. Therefore, in order to eliminate the risk of obtaining biased results, panel data estimates this heterogeneity by modelling it as an individual effect (η_i). Moreover, as a panel has a time-series dimension, it allows for the control of macroeconomic aspects by including time dummy variables (d_t). As a result, in a panel methodology the error term is divided in three different components: firm-specific effect (η_i), time-specific effect (d_t) and random disturbance (e_{it}). Consequently, the basic specification of the model is as follows:

$$Cash_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ \eta_i +d_t +e_{it} \quad (1b)$$

$$EPS_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ \eta_i +d_t +e_{it} \quad (2b)$$

$$ROA_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ \eta_i +d_t +e_{it} \quad (3b)$$

$$Annual\_return_{i,t}=\alpha+\beta_1*Accounting\_measure_{i,t} + Controls_{i,t}+ \eta_i +d_t +e_{it} \quad (4b)$$

Second, as with the methodology in previous chapter's, a random effects model was preferred to a fixed effects one because the unobservable heterogeneity η_i is considered randomly distributed across cross-sectional units and not correlated with any of the explanatory variable (Green, 2000; Baltagi, 2001) due to intellectual capital specificity. Also, both individual characteristics and differences between units of analysis are important for the research question under analysis as the similarities and differences are analysed between various measures, but also for various industry sectors, meaning the random effects model would be more informative. Moreover, statistical analysis indicated variance both within and between individuals, with the second being more prominent. Finally, a random effects model has been chosen for the purpose of comparing and triangulating the results of the three empirical chapters.

Diagnostic checks were performed which indicated the presence of autocorrelation (AR(1)). The dependence among residuals in a panel usually derives from the time series dimension. It is well known that the estimated standard errors may be biased when the residuals are not independent, resulting in either over- or under-estimation of the true variability of the coefficient estimates. In order to account for this aspect, autocorrelation robust estimators were used as recommended by Hoechle (2007) and Vogelsang (2008). Random effects model was estimated using the AR(1) XTREG procedure in STATA (XTREGAR command) following the methodology recommended by Baltagi and Wu (1999).

Endogeneity is not considered an issue for this study because intellectual capital investment decisions are made at the time of annual budgets, while performance is measured at the end of the year. Also, while managers consider intellectual capital aspects in their strategy formulation in order to have a deterministic relation between accounting measurement measures and performance an indication that managers use exactly the same measures employed in this study for their decision making is needed.

10.5. Data

The data consists of 839 listed UK companies at the London Stock Exchange from 2001 to 2011 across various industries. Companies have been categorized into low knowledge intensive manufacturing, high knowledge intensive manufacturing, low knowledge intensive services and high knowledge services according with the NACE classification for knowledge intensive companies. This study has excluded financial services companies because these companies have a different intellectual capital profile to other companies in the sample. Detailed information on the sample construction is provided in Chapter 7.

Table 10.1 presents the descriptive statistics for the dependent and independent variables employed in this study, which have been winsorized at 1st and 99th percentiles for each industry sector sub-sample, in order to mitigate the effect of outliers. Table 10.1's descriptive statistics reveal that Net Cash, representing economic performance, has the highest average value in the low knowledge intensive services industry sector (86,325,700 £) and the next highest in the high knowledge intensive industry sector (74,856,000 £) advancing the ideas that these sectors might have the highest growth opportunities in the future. Return on assets and earnings per share measures which depict financial performance have the highest values in the low knowledge intensive manufacturing and services. Hence, from a financial point of view these sectors over the period 2001-2011 have been on average the most profitable. Annual return captures the market performance of an organization. In our sample the best performing according to this measure have been companies in the low knowledge intensive manufacturing (0.14) and high knowledge intensive manufacturing (0.13) closely followed by low knowledge intensive services (0.14). The lowest market performance is recorded in the high knowledge intensive services (8%). This pattern of market performance reflects the fact that the high knowledge intensive sector is closely related to the financial services industry which was considerably affected by the financial crisis. Nevertheless, it is worth emphasizing the fact that despite the financial crisis over this period all industries had on average a positive return.

The average values of the Market-to-Book ratio and Tobin’s Q are above 1, indicating that companies’ market value exceeds their book value and replacement value, consistent with practitioners and academic studies indicating the presence of intellectual capital, particularly in high knowledge intensive companies. Economic Value Added indicates that the richest sector in terms of intellectual capital is the high knowledge intensive manufacturing sector (41,129,720 £), while according to Calculated Intangible Value and Value Added Intellectual Capital Index the highest intellectual capital is in the low knowledge intensive services industry.

High knowledge and low knowledge intensive companies are, on average, very close in size. This is important attribute of the sample which implies that the findings do not derive from size differences as was the case in previous empirical work. Nevertheless, companies are different with respect to industry characteristics. Manufacturing companies are subject to higher competition and higher risk compared to service sector companies. An in depth analysis of the descriptive statistics is provided in Chapter 7 (Section 7.2).

Correlation results presented in Table 10-2 indicate an overall positive relation between the accounting measures of intangible value and various types of performance. Tobin’s Q is an exception from this rule showing a negative and statistically significant correlation with Net Cash (-0.03), Return on assets (-0.41) and Earnings per Share (-0.04).

Also, Economic Value Added and Calculated Intangible Value have a negative correlation with Annual Return but this correlation is not statistically significant. All the correlations between explanatory variables are smaller than 0.8 and together with the variance inflation factor analysis suggests the absence of multicollinearity problems. At the industry sample level, there are small differences in the value of correlation factors, but overall the correlation relations are broadly the same at the sub-sample level. Therefore, the correlation tables for different industry sectors are not presented in this chapter.

Table 10-1 Descriptive statistics of the variables under analysis

	All			***Manufacturing***						***Services***					
				Low knowledge intensive			***High knowledge intensive***			***Low knowledge intensive***			***High knowledge intensive***		
	Mean	***Median***	***SD***	***Mean***	***Median***	***SD***	***Mean***	***Median***	***SD***	***Mean***	***Median***	***SD***	***Mean***	***Median***	***SD***
Cash ('1000 £)	72902.94	3770.40	231254.60	60825.35	4670.75	189864.7	74856.02	3939.00	271881.70	86325.75	7103.50	239105.60	68921.52	2457.00	225251.10
ROA	-0.10	0.03	0.44	-0.01	0.04	0.22	-0.07	0.04	0.34	-0.04	0.04	0.35	-0.15	0.02	0.53
EPS	0.07	0.03	0.30	0.12	0.07	0.28	0.09	0.03	0.26	0.12	0.07	0.31	0.02	0.01	0.31
Return (%)	10.66	0.00	70.92	13.56	5.63	62.15	12.95	0.00	72.96	12.21	4.09	71.35	8.49	-4.00	72.31
MB	2.79	1.72	5.71	2.44	1.41	4.51	3.36	2.11	4.90	2.39	1.42	4.54	2.93	1.86	6.62
TQ	1.64	1.00	2.10	1.22	0.82	1.21	1.78	1.15	2.12	1.37	0.95	1.41	1.84	1.05	2.49
EVA ('1000 £)	-8992.94	-1001.03	143933	-3400.59	-508.38	61731.28	41129.72	-786.31	323118.30	-23645.31	-1093.77	92969.95	-16681.33	-1126.12	88922.36
CIV ('1000 £)	1281813	37529.46	5524434	561463.10	47147.18	2003672	1298427	26721.67	7011738	1658879	122878	5704596	1281510	16918.90	5602147
VAIC	1.81	2.04	3.16	1.92	2.07	1.93	1.45	2.05	4.41	2.28	2.14	2.82	1.65	1.98	3.16
log(TA)	10.78	10.64	2.45	10.95	10.81	2.01	10.68	10.47	2.31	11.37	11.28	2.38	10.47	10.16	2.56
Leve	0.41	0.17	1.69	0.55	0.25	1.65	0.41	0.14	1.04	0.49	0.28	1.77	0.34	0.10	1.79
Age	26.19	11.95	31.54	45.80	26.99	40.89	28.66	15.01	29.51	28.61	15.41	32.53	19.32	9.39	25.92
HHI	441.99	324.81	715.44	789.74	387.14	1646.78	597.62	391.12	673.93	306.87	309.99	196.83	378.69	324.81	379.82
INDWOE	0.00	0.00	0.48	-0.33	-0.41	0.55	-0.16	-0.19	0.45	-0.04	0.00	0.40	0.13	0.24	0.44

Variables definition

Cash = Net Cash;
ROA = Return on Assets;
EPS = Earnings per Share;
Return = Annual Return;
MB = Market-to-book ratio;
TQ =Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual capital Index;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl-Hirsch Index;
INDWOE = Industry's risk;

Notes: The sample consists of 839 publicly traded United Kingdom firms listed on the London Stock Exchange, including 102 companies in low knowledge intensive industry, 102 in high knowledge intensive industry, 204 in low knowledge intensive services and 431 in high knowledge intensive services between January 2000 and December 2011

Table 10-2 Pearson correlation table of the variables under analysis

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*
(1)Cash	1													
(2)ROA	0.11	1												
(3)EPS	0.30	0.37	1											
(4)Return	0.01*	0.18	0.15	1										
(5)MB	0.04	-0.01*	0.06	0.14	1									
(6)TQ	-0.03	-0.41	-0.04	0.20	0.34	1								
(7)EVA	0.06	0.02*	0.11	-0.003*	0.09	0.08	1							
(8)CIV	0.70	0.09	0.28	-0.003*	0.05	-0.01*	0.24	1						
(9)VAIC	0.11	0.26	0.19	0.07	0.01*	-0.09	0.003*	0.12	1					
(10)log(TA)	0.55	0.42	0.36	0.06	-0.04	-0.29	-0.08	0.47	0.24	1				
(11)Leve	0.10	0.07	0.08	-0.01*	0.54	-0.09	0.01*	0.13	0.06	0.16	1			
(12)Age	0.05	0.17	0.18	0.04	-0.09	-0.17	-0.04	0.04	0.10	0.25	0.04	1		
(13)HHI	-0.02*	0.006*	-0.004*	-0.03	-0.009*	-0.02*	0.01*	-0.02*	-0.03	-0.04	0.002*	0.09	1	
(14)INDWOE	-0.05	-0.09	-0.05	0.05	0.02	0.09	-0.02*	-0.04	-0.02	-0.12	-0.05	-0.19	-0.13	1

Variables definition

Cash = Net Cash;
ROA= Return on assets;
EPS = Earnings per share;
Return = Annual stock return;
MB = Market-to-book ratio;
TQ = Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

The sample consists of 839 publicly traded United Kingdom firms listed on the London Stock Exchange, including 102 companies in low knowledge intensive industry, 102 in high knowledge intensive industry, 204 in low knowledge intensive services and 431 in high knowledge intensive services between January 2000 and December 2011. Insignificant correlations (two tailed p-value < 0.05), are shown by *.

10.6. Empirical results

This section presents the results of our estimations for each performance aspect separately. First the results obtained for the whole sample are reported, after which the sample is broken down into industry sectors sub-samples to determine if there are any industry specific differences in the relationship between accounting measures and performance. The column heading of the tables indicates the independent variable (Accounting_measure) used in the estimation model. In all instances we use the empirical evidence from our analytical work in chapters 8 and 9 to inform our interpretation of the findings.

10.6.1. Economic performance

Table 10.3 depicts the link between intellectual capital and economic performance (Net Cash) as modelled by the accounting measures of intangible value for the overall sample. Market-to-Book ratio (MB), Tobin's Q (TQ) and Calculated Intangible Value (CIV) are positively and significantly associated with economic performance. As we have seen previously, all these measures capture at least some intellectual capital elements – human capital, structural capital or relational capital, with CIV being concentrated on relational capital. As revealed in Chapter 9, relational capital is the main value driver for Net Cash, which justifies why there is a positive link between this aspect of performance and CIV.

Economic Value Added (EVA) is negatively related to Net Cash in the whole sample but only significant at the 10% significance level. In the whole sample EVA has been shown to capture human capital (Chapter 8) which does not positively contribute to Net Cash hence the finding here. The Value Added Intellectual Capital Index (VAIC) is the only accounting measure which is not showing a statistically significant relation with Net Cash for the full sample analysis. Again this is in line with the fact that VAIC does not capture intellectual capital very well.

Breaking down the analysis into industry sectors brings more insight into how each of the accounting methods is related to economic performance. For example, Market-to-book ratio has predictive ability for the economic performance as measured by Net Cash in the high knowledge intensive sectors (manufacturing: $\beta=3511$, $p<0.05$; services: $\beta=894.9$, $p<0.1$), but not in the low knowledge intensive ones. As far as, Chapter 8 revealed, for companies operating in low knowledge intensive companies, MB captures intellectual capital elements which are not influencing economic performance (human capital) and, hence, there is no effect on Net Cash.

Tobin's Q is positively and statistically significantly connected with economic performance in all industry sectors except for low knowledge intensive manufacturing firms. As with MB, Tobin's Q in these sectors has been seen to capture elements of intellectual capital which do not lead to increased economic performance and as a consequence the net effect on economic performance is nil.

Economic Value Added (EVA) is significantly linked to Net Cash for high knowledge intensive manufacturing companies (β=0.284,p<0.01). This is the only sector in which EVA captures relational capital which is the main driver of economic performance. The rest of relations follow the trend described for the whole sample results.

Calculated Intangible Value (CIV) is the accounting measure which shows the most consistent set of positive results in connection with Net Cash. The intensity of this relation varies across industry sectors with the highest intensity being registered for the low knowledge intensive manufacturing companies and it is due to the fact that, as mentioned in the whole sample analysis, CIV captures relational capital.

Table 10-3 Net Cash results – whole sample

$Cash_{i,t}=\alpha+\beta_1*Accounting\_method_{i,t}+Controls_{i,t}+e_i$					
	MB	***TQ***	***EVA***	***CIV***	***VAIC***
Accounting method	1059**	7596***	-0.0424*	0.0173***	-664.4
log (TA)	51689***	53809***	50968***	37654***	51171***
Leve	-180.7	2428*	2415*	1151	2376*
Age	-456.6**	-438.5**	-471.9***	-419.2***	-461.6**
HHI	2.760	2.682	2.687	3.119	2.737
INDWOE	-7495	-8122	-7318	-7021	-7114
Constant	-505344***	-538113***	-494620***	-356636***	-496211***
Firm-years	6493	6493	6493	6493	6493
No of firms	771	771	771	771	771

Variables definition

Cash = Net Cash;	VAIC = Value Added Intellectual Capital Index;
MB = Market-to-book ratio;	log (TA) = Logarithm of Total Assets;
TQ = Tobin's Q;	Leve = Leverage;
EVA = Economic Value Added;	Age = Company's Age;
CIV = Calculated Intangible Value;	HHI = Herfingdahl - Hirsch Index;
	INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

Table 10-4 Net cash results - industry differences

Manufacturing	Low knowledge intensive						High knowledge intensive				
	MB	TQ	EVA	CIV	VAIC		MB	TQ	EVA	CIV	VAIC
Accounting method	-2499	1954	0.0584	0.0565***	214.7		3511**	10929***	0.284***	0.0266***	-1207
log (TA)	53049***	53983***	54188***	28892***	53448***		69569***	70948***	60135***	35263***	66572***
Leve	-452.7	-6059**	-6315**	-6788***	-6083**		-3757	6455	5608	3749	6130
Age	-902.4***	-856.2***	-865.2***	-408.7**	-868.1***		-1841***	-1818***	-1419***	-602.8**	-1835***
HHI	1.663	1.811	1.906	1.445	1.704		5.762	5.325	3.120	4.408	4.813
INDWOE	-17604**	-18022**	-17804**	-14276*	-18016**		-8372	-10284	-3091	-9119	-5892
Constant	-484211***	-500703***	-500581***	-259054***	-492561***		-644623***	-672570***	-551402***	-324478***	-598312***
Observations	886	886	886	886	886		877	877	877	877	877
No of companies	96	96	96	96	96		99	99	99	99	99
Services	**Low knowledge intensive**						**High knowledge intensive**				
	MB	**TQ**	**EVA**	**CIV**	**VAIC**		**MB**	**TQ**	**EVA**	**CIV**	**VAIC**
Accounting method	25.27	7787*	-0.197***	0.0116***	-4476**		894.9*	7089***	-0.287***	0.0186***	321.9
log (TA)	52246***	53513***	50322***	43618***	53396***		47382***	50219***	43582***	31670***	46774***
Leve	-362.8	-363.9	-2.629	-1211	-264.8		2828	5336***	5347***	3990**	5244***
Age	-71.87	-14.42	-82.40	-65.35	-29.42		-53.50	-79.06	1.559	-209.6	-58.60
HHI	68.48**	72.02**	72.97**	84.46***	68.08**		-1.111	-2.061	-0.673	-1.453	-0.904
INDWOE	-5954	-4975	-4357	-3030	-5292		-4179	-5360	-6863	-2880	-3979
Constant	-527931***	-555660***	-508676***	-442017***	-531399***		-461453***	-502938***	-423487***	-317448***	-453105***
Observations	1628	1628	1628	1628	1628		3102	3102	3102	3102	3102
No of companies	189	189	189	189	189		387	387	387	387	387

Variable description

Cash= Net Cash;
MB = Market-to-book ratio;
TQ = Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

The Value Added Intellectual Capital Index (VAIC) has the least significant association with economic performance. It is generally not significantly related to economic performance in any of the industry sectors except low knowledge intensive services for which the relation with Net Cash is negative and statistically significant (β=-4476,$p<0.05$) reflecting its inability to capture intellectual capital.

Overall, the ability of the accounting measures of intangible value to predict economic performance depends on their ability to capture intellectual capital. As we saw in Chapter 8, if they capture intellectual capital elements which influence economic performance, the connection between the measure and economic performance is going to be positive. However, if their ability to capture intellectual capital focuses on elements which do not drive economic performance the net effect of these measures is nil.

10.6.2. Financial performance

Financial performance is approximated in this study using to two measures Return on Assets and Earnings per Share. When the analysis is carried out on the whole sample, Market-to-book ratio does not have any predictive ability for Return on Assets (ROA), while Tobin's Q and Calculated Intangible Value show a negative statistically significant relation with ROA. Economic Value Added and Value Added Intellectual Capital Index present a positive significant association with return on assets. These results are presented in the Table 10-5 below.

As we have shown, Market-to-Book ratio, Tobin's Q and Calculated Intangible Value capture intellectual capital elements which are not related with financial performance as measured by ROA. As such, they either have no effect on ROA or they have a negative association with this measure. Both, Economic Value Added and ROA are associated with the interaction term between potential and realized intellectual capital resulting in a positive association between the accounting measure and financial performance. Most of the literature studying intellectual capitals influence on performance by associating Value Added Intellectual Capital Index with ROA finds a similar positive association between the two measures (Tan et. al., 2007; Ting & Lean, 2009). However, these measures are positively related, despite their inability to reflect any of three elements of intellectual capital. This suggests that ROA and VAIC may be capturing other beneficial aspect of organizational well-being, but their positive connection is independent of their ability to reflect intellectual capital elements as measured in this thesis.

Table 10-5 Return on Assets results - whole sample

$ROA_{i,t}=\alpha+\beta1*Accounting\_method_{i,t} + Controls_{i,t}+ e_i$					
	MB	***TQ***	***EVA***	***CIV***	***VAIC***
Accounting method	-0.000134	-0.0378***	1.76e-07***	-5.94e-09***	0.00934***
log (TA)	0.0761***	0.0631***	0.0773***	0.0818***	0.0738***
Leve	-0.00406	-0.00471**	-0.00448**	-0.00405*	-0.00431*
Age	0.000521*	0.000374	0.000543**	0.000492*	0.000476*
HHI	1.85e-06	1.65e-06	2.10e-06	1.93e-06	1.58e-06
INDWOE	0.00431	0.00918	0.00489	0.00421	0.00317
Constant	-0.870***	-0.667***	-0.885***	-0.930***	-0.860***
Observations	6540	6540	6540	6540	6540
No of companies	777	777	777	777	777

<u>**Variables definition**</u>	VAIC = Value Added Intellectual Capital Index;
ROA = Return on Assets;	log (TA) = Logarithm of Total Assets;
MB = Market-to-book ratio;	Leve = Leverage;
TQ = Tobin's Q;	Age = Company's Age;
EVA = Economic Value Added;	HHI = Herfingdahl - Hirsch Index;
CIV = Calculated Intangible Value;	INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

At the industry level, the relations described for the whole sample hold with the exception of Market-to-Book ratio's association with ROA for low knowledge intensive manufacturing companies. Given the fact that Market-to-Book captures intellectual capital in this sector, while ROA is not positively associated with any of the intellectual capital elements this results leads to the conclusion that specifically for this industry, ROA and Market-to-Book might be capturing some other favourable non-intellectual capital elements which lead to a positive outcome. Therefore, if financial performance is measured using Return on Assets, some of the results could be a manifestation of the data identity feature discusses in Section 10.3. Specifically, the connection between ROA & Market-to-Book ratio for low knowledge intensive manufacturing companies and the connection between ROA and VAIC might be evidence of such effects.

Table 10-6 Return on Assets results- industry differences

Manufacturing	Low knowledge intensive					High knowledge intensive				
	MB	TQ	EVA	CIV	VAIC	MB	TQ	EVA	CIV	VAIC
Accounting method	0.00688***	0.00803	2.3e-07**	-4.52e-09	0.0140***	-0.00780***	-0.0135***	-1.9e-08	-5.8e-09**	0.00666***
log (TA)	0.0357***	0.0353***	0.0361***	0.0369***	0.0316***	0.0806***	0.0780***	0.0872***	0.0936***	0.0836***
Leve	-0.0161***	-0.000464	-0.00139	-0.000367	-0.000577	0.00606	-0.0167**	-0.0165**	-0.0162**	-0.0154**
Age	0.00119***	0.00114***	0.00111***	0.00105***	0.00109***	0.000229	0.000303	0.000239	3.58e-06	0.000262
HHI	2.55e-07	-1.11e-07	9.1e-08	9.52e-08	-2.53e-06	2.07e-05	2.19e-05	2.25e-05*	2.19e-05	2.37e-05*
INDWOE	-0.0167*	-0.0155	-0.0144	-0.0155	-0.0136	-0.0165	-0.0193	-0.0221	-0.0212	-0.0234
Constant	-0.454***	-0.450***	-0.449***	-0.453***	-0.421***	-0.906***	-0.876***	-1.004***	-1.061***	-0.979***
Firm-years	886	886	886	886	886	877	877	877	877	877
No. of firms	96	96	96	96	96	99	99	99	99	99
Services	**Low knowledge intensive**					**High knowledge intensive**				
	MB	TQ	EVA	CIV	VAIC	MB	TQ	EVA	CIV	VAIC
Accounting method	-0.00292*	-0.0236***	2.3e-07***	-3.3e-09**	0.00620**	0.00113	-0.0455***	4.8e-07***	-9.2e-09***	0.0115***
log (TA)	0.0667***	0.0631***	0.0711***	0.0710***	0.0667***	0.0874***	0.0677***	0.0929***	0.0956***	0.0838***
Leve	-0.00167	-0.00681**	-0.00708**	-0.00680*	-0.00700**	-0.00564	-0.00340	-0.00281	-0.00209	-0.00254
Age	0.000616	0.000489	0.000676	0.000660	0.000594	-0.000103	-3.00e-05	-0.000221	-7.22e-05	-0.000142
HHI	-3.32e-06	-7.93e-06	3.33e-06	1.27e-06	3.86e-07	-2.66e-05	-2.02e-05	-2.69e-05	-2.67e-05	-2.59e-05
INDWOE	0.000835	-0.00207	-0.000206	0.000538	-0.000379	0.0204	0.0296	0.0242	0.0190	0.0197
Constant	-0.766***	-0.694***	-0.823***	-0.822***	-0.787***	-1.089***	-0.787***	-1.136***	-1.160***	-1.063***
Firm-years	1635	1635	1635	1635	1635	3142	3142	3142	3142	3142
No. of firms	190	190	190	190	190	392	392	392	392	392

Variable description

ROA = Return on Assets;
MB = Market-to-book ratio;
TQ = Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

Moving to the second measure of financial performance, Earnings per Share, the conclusions about the connection between accounting methods and financial performance differs. Both in the whole sample and in the analysis divided by industry sector Earnings per Share (EPS) is positively connected with all the accounting measures. For the whole sample analysis, the link between EPS and accounting measures of intangible is statistically significant (Table 10-7). When the analysis is brought down to industry level ((Table 10-8), there is some industry variation: the relation is positive but not statistically significant for Tobin's Q and Calculated Intangible Value in low knowledge intensive services and Economic Value Added in low knowledge intensive manufacturing. Hence, overall all accounting measures can predict a company's financial performance as measured by EPS.

Table 10-7 Earnings per share results - whole sample

$EPS_{i,t}=\alpha+\beta1*Accounting\_method_{i,t} + Controls_{i,t} + e_i$					
	MB	***TQ***	***EVA***	***CIV***	***VAIC***
Accounting method	0.00354***	0.0109***	2.5e-07***	6.9e-09***	0.00547***
log (TA)	0.0436***	0.0450***	0.0433***	0.0350***	0.0404***
Leve	-0.00888***	-0.000191	-0.000308	-0.000548	-0.000170
Age	0.00107***	0.00109***	0.00107***	0.00107***	0.00101***
HHI	-3.59e-06	-3.88e-06	-3.55e-06	-3.92e-06	-3.99e-06
INDWOE	0.0278***	0.0274***	0.0298***	0.0288***	0.0283***
Constant	-0.460***	-0.484***	-0.450***	-0.361***	-0.425***
Firm-years	6540	6540	6540	6540	6540
No. of firms	777	777	777	777	777

Variables definition	VAIC = Value Added Intellectual Capital Index;
EPS = Earnings per share;	log (TA) = Logarithm of Total Assets;
MB = Market-to-book ratio;	Leve = Leverage;
TQ = Tobin's Q;	Age = Company's Age;
EVA = Economic Value Added;	HHI = Herfingdahl - Hirsch Index ;
CIV = Calculated Intangible Value;	INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

However, these results need to be considered alongside the evidence which shows that EPS does not capture nor reflect any of the intellectual capital elements measured by our intellectual capital proxies. There are two possible explanations. First, financial performance as measured by EPS is driven by intellectual capital elements; however, the intellectual capital proxies are poor measures to model the link between the two because they rely on expense items. Second, this could be a reflection of the data identity issues signalled at the beginning of this chapter. Namely, EPS and all the measures used in this study refer to the same organizational well-being factor, independent of the accounting measures ability to capture intellectual capital.

Table 10-8 Earnings per share results - industry differences

Manufacturing	Low knowledge intensive						High knowledge intensive				
	MB	TQ	EVA	CIV	VAIC		MB	TQ	EVA	CIV	VAIC
Accounting method	0.0105***	0.0307***	2.00e-07	5.7e-08***	0.0117***		0.00700***	0.0206***	2.7e-07***	1.4e-08***	0.00283**
log (TA)	0.0527***	0.0543***	0.0521***	0.0221**	0.0481***		0.0586***	0.0611***	0.0428***	0.0368***	0.0519***
Leve	-0.0151**	0.00888**	0.00816*	0.00783*	0.00859**		-0.0343***	-0.0133**	-0.0144***	-0.0146***	-0.0131**
Age	0.00143***	0.00148***	0.00130***	0.00178***	0.00128***		0.000366	0.000400	0.000854	0.000954*	0.000316
HHI	-4.54e-06	-4.97e-06	-4.81e-06	-6.52e-06	-6.43e-06		-3.73e-07	-1.11e-06	-2.32e-06	-7.56e-07	-1.71e-06
INDWOE	-0.00561	-0.00466	-0.00220	-0.00170	-0.000807		-0.00716	-0.00955	-0.00395	-0.00716	-0.00526
Constant	-0.571***	-0.616***	-0.550***	-0.257**	-0.525***		-0.630***	-0.680***	-0.455***	-0.399***	-0.536***
Firm-years	886	886	886	886	886		877	877	877	877	877
No. of firms	96	96	96	96	96		99	99	99	99	99
Services	**Low knowledge intensive**						**High knowledge intensive**				
	MB	**TQ**	**EVA**	**CIV**	**VAIC**		**MB**	**TQ**	**EVA**	**CIV**	**VAIC**
Accounting method	0.00599***	0.0122	2.11e-07**	2.15e-09	0.00781**		0.00207***	0.00738***	2.5e-07***	8.6e-09***	0.00578***
log (TA)	0.0456***	0.0446***	0.0465***	0.0408***	0.0409***		0.0393***	0.0412***	0.0413***	0.0299***	0.0369***
Leve	-0.0177***	-0.00703*	-0.00706*	-0.00710*	-0.00705*		-0.00333	0.00237	0.00227	0.00197	0.00235
Age	0.00167***	0.00168***	0.00160***	0.00159***	0.00151***		0.000755*	0.000731*	0.000684*	0.000703*	0.000716*
HHI	5.11e-05	5.05e-05	4.88e-05	4.55e-05	4.79e-05		-8.88e-06	-9.85e-06	-8.98e-06	-9.05e-06	-8.20e-06
INDWOE	0.0330	0.0357*	0.0341	0.0346	0.0334		0.0502***	0.0492***	0.0526***	0.0519***	0.0498***
Constant	-0.507***	-0.500***	-0.500***	-0.437***	-0.454***		-0.508***	-0.537***	-0.519***	-0.415***	-0.485***
Firm-years	1635	1635	1635	1635	1635		3142	3142	3142	3142	3142
No. of firms	190	190	190	190	190		392	392	392	392	392

Variable description

EPS=Earnings per shar;
MB = Market-to-book ratio;
TQ = Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

10.6.3. Market performance

Market performance as reflected by companies' annual return is positively and significantly related to Market-to-Book ratio (β=2.731, p<0.01), Tobin's Q (β=9.209, p>0.01). The same intellectual capital elements which are negatively associated with Market-to-Book and Tobin's Q are negatively associated with the market as well. In this instance, it could be a case of identification between measures, since Annual Return, Market-to-Book and Tobin's Q rely on the share price of a company in their computation. As such, the three measures could refer to market performance, while Market-to-book and Tobin's Q are also measures of intellectual capital.

Market performance does not exhibit any significant relation with Economic Value Added and has a negative statistically significant relation with Calculated Intangible Value. Economic Value Added does not capture many intellectual capital elements justifying the non-effect. Calculated Intangible Value is focused on relational capital and realized intellectual capital both of which are negatively valued by the market as shown in Chapter 9, supporting the results found in this chapter.

Table 10-9 Annual return results - whole sample

$Returni_{,t}=\alpha+\beta_1*Accounting\ \_method_{i,t} + Controls_{i,t}+ e_i$					
	MB	***TQ***	***EVA***	***CIV***	***VAIC***
Accounting measure	2.731***	9.209***	-4.20e-07	-4.04e-07**	0.920***
log (TA)	2.060***	2.660***	1.382***	1.886***	1.157***
Leve	-7.048***	-0.937	-1.361**	-1.276**	-1.371**
Age	0.0753**	0.0954***	0.0421	0.0378	0.0382
HHI	-0.0004	-0.0003	-0.0006	-0.0006	-0.0006
INDWOE	6.742***	5.820***	8.217***	8.221***	8.046***
Constant	-30.66***	-44.70***	-17.70***	-23.01***	-16.80***
Observations	5,726	5,726	5,726	5,726	5,726
No of companies	735	735	735	735	735

Variables definition	VAIC = Value Added Intellectual Capital Index;
ROA = Return on Assets;	log (TA) = Logarithm of Total Assets;
MB = Market-to-book ratio;	Leve = Leverage;
TQ = Tobin's Q;	Age = Company's Age;
EVA = Economic Value Added;	HHI = Herfingdahl - Hirsch Index;
CIV = Calculated Intangible Value;	INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

When the analysis is broken down by industry sub-samples, some industry variability is evident for Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index, while Market-to-Book and Tobin's Q show a consistent positive connection with market performance across all industry sectors.

Table 10-10 Annual return results - industry differences

$Return_{i,t}=α+β_1*Accounting\_method_{i,t} + Controls_{i,t}+ e_i$											
Manufacturing	***Low knowledge intensive***						***High knowledge intensive***				
	MB	***TQ***	***EVA***	***CIV***	***VAIC***		***MB***	***TQ***	***EVA***	***CIV***	***VAIC***
Accounting measure	4.045***	17.39***	6.63e-06	5.42e-07	4.042***		2.873***	11.12***	-1.20e-05	-7.46e-07*	0.493
log (TA)	0.594	0.797	0.294	-0.0911	-0.632		2.423**	2.322**	2.822**	3.339**	1.728
Leve	-11.64***	-3.231**	-3.016**	-3.018**	-3.070**		-7.610**	0.0482	-0.463	-0.412	-0.602
Age	0.0703	0.121**	0.00623	0.0120	0.00684		0.0829	0.123	-0.00290	-0.0171	0.0321
HHI	-0.000348	-5.86e-06	-0.000511	-0.000569	-0.000498		0.00229	0.00202	0.00180	0.00177	0.00189
INDWOE	4.699	5.118	6.730	6.746	6.584		-5.426	-10.50*	0.351	0.568	-0.218
Constant	9.628	-8.707	19.71	23.41	22.47		-65.58***	-76.48***	-59.22***	-63.86***	-49.51***
Firm-years	787	787	787	787	787		774	774	774	774	774
No. of firms	92	92	92	92	92		94	94	94	94	94
Services	***Low knowledge intensive***						***High knowledge intensive***				
	MB	***TQ***	***EVA***	***CIV***	***VAIC***		***MB***	***TQ***	***EVA***	***CIV***	***VAIC***
Accounting measure	3.963***	13.96***	4.72e-05**	-8.47e-07**	-0.0979		2.404***	7.786***	8.19e-06	-1.32e-07	1.426***
log (TA)	3.224***	3.389***	3.338***	3.420***	2.389***		1.951***	2.860***	1.288**	1.344**	0.842
Leve	-6.808***	-0.842	-1.368	-0.918	-1.238		-6.628***	-0.358	-0.970	-0.931	-0.963
Age	0.123**	0.183***	0.0765	0.0727	0.0702		0.0553	0.0537	0.0373	0.0383	0.0388
HHI	-0.00416	0.00107	-0.00432	-0.00301	-0.00485		-0.00372	-0.00466	-0.00346	-0.00347	-0.00330
INDWOE	8.919*	9.910**	8.611*	8.515*	8.312*		8.639***	7.694**	9.906***	9.846***	9.909***
Constant	-38.20***	-54.39***	-31.42**	-32.90**	-20.51		-44.11***	-60.86***	-32.71***	-33.31***	-30.62***
Firm-years	1,442	1,442	1,442	1,442	1,442		2,723	2,723	2,723	2,723	2,723
No. of firms	182	182	182	182	182		367	367	367	367	367

Variable description

ROA = Return on Assets;
MB = Market-to-book ratio;
TQ = Tobin's Q;
EVA = Economic Value Added;
CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;
log(TA) = Logarithm of Total Assets;
Leve = Leverage;
Age = Company's Age;
HHI = Herfingdahl - Hirsch Index;
INDWOE = Industry's risk;

Notes: Year dummy variables are estimated (but suppressed) in each of the models presented. Industry sector dummy variables were included in the random effects model estimated for all the companies in the sample. Standard errors are suppressed. *** p<0.01, ** p<0.05, * p<0.1

Economic Value Added positively relates to market performance only for low knowledge intensive services companies. In this industry sector, Economic Value Added captures with relational capital, which in turn is related to market performance. This explains the results found for this particular sector. Value Added Intellectual Capital Index is positively connected with Annual return in low knowledge intensive manufacturing industries (β=4.042, $p<0.01$) and high knowledge intensive services (β=1.426, $p<0.01$), as both measures have been shown in Chapter 8 and 9 are negatively related to structural capital elements in these industries. For the rest of the industry sectors the connection between Value Added Intellectual Capital Index and Annual return is not significant.

10.7. Findings and conclusions

While the literature has explored the relation between Value Added Intellectual Capital Index and different measures of performance, the relation between the other known accounting measures of intangible value and performance is limited or non-existent. This chapter has filled this gap by analysing multiple accounting measures and their link with various aspects of performance. The purpose of this analysis was, on one hand, to determine how an accounting measure is associated with various types of performance and, on the other hand, to compare intellectual capital's accounting measurements efficacy in predicting various types of performance.

The results indicate that indeed each accounting measure has a different relation with various types of performance and this relation depends in some cases on the company's industry sector. For example, Market-to-book ratio in general has a positive relation with the measures of performance used in this study. Nevertheless, this relation is not maintained for all the measures of performance, nor through all the industry sectors. Table 10-11 presents a summary of the results by depicting the sign of the statistically significant relations ($p<0.1$). While industry effects for each method are expected, it is interesting that the relation between the different measures and the same aspect of performance is dissimilar. This means that different accounting measures will give contradictory information about the intellectual capital link with a certain type of performance in a specific industry sector.

Under these conditions the question that arises is: which one of the accounting measures analysed can be used to model the link between intellectual capital and performance? Which one of them most appropriately connects this resource to performance? Some of the relations summarized above are in line with the intellectual capital element captured by that measure and whether this element is the driver behind the aspect of performance analysed. For example, Calculated Intangible Value captures relational capital and realized intellectual capital. As shown in Chapter 9, these elements drive economic performance. As a result, there is a positive relation between Calculated Intangible Value and economic performance (Net Cash).

Table 10-11 Results summary

Manufacturing	*Low knowledge intensive*				*High knowledge intensive*			
	Cash	*ROA*	*EPS*	*Return*	*Cash*	*ROA*	*EPS*	*Return*
MB		+	+	+	+	-	+	+
TQ			+	+	+	-	+	+
EVA		+			+		+	
CIV	+		+		+	-	+	-
VAIC		+	+	+		+	+	
Services	*Low knowledge intensive*				*High knowledge intensive*			
	Cash	*ROA*	*EPS*	*Return*	*Cash*	*ROA*	*EPS*	*Return*
MB		-	+	+	+		+	+
TQ	+	-		+	+	-	+	+
EVA	-	+	+	+	-	+	+	
CIV	+	-		-	+	-	+	
VAIC	-	+	+			+	+	+

Variables definition
Cash = Net Cash; MB = Market-to-book;
ROA = Return on Assets; TQ = Tobin's Q;
EPS = Earnings per share; EVA = Economic Value Added;
Return = Annual return; CIV = Calculated Intangible Value;
VAIC = Value Added Intellectual Capital Index;

Some other relations presented are not connected with the ability of an accounting measure to capture intellectual capital. An obvious example is Earnings per Share, which is positively related with all the accounting measures of intangible value despite the dissimilarities between their ability to reflect some or any intellectual capital elements and how that specific element influences Earnings per Share. These relations need to be interpreted with caution as three possible explanations arise for these effects. First, financial performance as measured by EPS is driven by intellectual capital elements, however, there are identification issues between the intellectual capital proxies and EPS as both measures rely on expense items. Second, EPS and all the accounting measures of intangible value used in this study refer to the same organizational well-being factor, which is not related with intellectual capital but results in a positive outcome. Third, EPS is a poor measure of financial performance.

To answer the questions posed, due to difficulties in the use and application of accounting data, the indication seems to be that the best measures are the ones which capture the intellectual capital elements in their connection with performance. Whenever the results indicate that data identity problems might arise, it is hard to conclude on the efficacy of an accounting measure to capture intellectual capital and to link this resource with performance.

11. Conclusions

In the knowledge era, intellectual capital has been put forward as the key driver of corporate value and economic performance. While it is increasingly argued that the potential of more traditional physical and financial assets have been exhausted, intellectual capital is seen as a *"new"* untapped force for economic prosperity. Despite this, the emerging picture of intellectual capital from an accounting perspective is somewhat confusing and questions remain unanswered about what we actually know about intellectual capital - how far does the ability of the accounting discipline to capture and measure intellectual capital expand? How does the choice of intellectual capital measure influence our understanding of the impact this resource has on performance? Finally, which measure is more appropriate to facilitate this understanding?

This thesis has addressed these issues and added value to existing knowledge in two ways. Theoretically it has spent time bringing together a rather fragmented literature on intellectual capital measurement and its impact on performance. This has largely focused on bringing together the distinct accounting and strategic management literatures on intellectual capital and organizing this literature in a comprehensive manner that could bring further insight into the measurement of intellectual capital and the mechanisms through which intellectual capital adds value to a firm. Providing empirical insights into these issues formed the second part of the thesis. While analysis of the link between intellectual capital and performance was always a central aim of the thesis, our theoretical work highlighted the diversity and the problems surrounding the measurement of intellectual capital. As a result, instead of focusing solely on analysing the relationship between intellectual capital and performance, the thesis has taken a step back and questioned the efficacy of accounting solutions for intellectual capital measurement.

Overall, the main goal of the thesis has been to investigate the limitations of the accounting field in measuring intellectual capital and modelling this resource's link with performance. In accessing this contribution, it has taken an interdisciplinary approach, with the aim that other disciplines may aid our critique of the accounting disciplines approach to intellectual capital and recommend areas for improvement and advancing knowledge.

The empirical analysis is divided into three separate but complementary chapters. The first empirical study has assessed the appropriateness of various accounting measures of intangible value to capture intellectual capital, its components and the components interaction. The second empirical study has investigated how intellectual capital elements connect with various aspects of performance as modelled by the use of intellectual capital proxies. Finally, the third chapter "*completes the circle*" by studying the link between overall value of intellectual capital and performance as modelled by the accounting measures of intangible value. As such, these chapters revisit the key themes of accounting research on intellectual capital and in so doing offer a more comprehensive assessment of the current *"state of affairs"* and areas for improvement.

The remainder of the chapter presents a summary of findings for each empirical chapter and brings together all the theoretical considerations and empirical results to provide a comprehensive assessment of the ability of the accounting discipline to capture intellectual capital and model its link with performance. It describes the limitations of the study and recommends further research. Finally, concludes by making recommendations on how the accounting discipline can advance the measurement of intellectual capital.

11.1. Summary of findings

11.1.1. The accounting measures ability to capture intellectual capital

The literature review highlighted the necessity to take a step back from the conventional performance focused research in the field and instead begin by investigating the way intellectual capital is measured. The first step of this investigation involved opening up and understanding the *"black box"* of accounting measures of intangible value. There has not been any other direct enquiry into this topic in the literature which creates much scope for the analysis in this chapter. Specifically, the first empirical chapter questioned the efficacy of different accounting measures of intangible value to adequately capture intellectual capital, the different components of intellectual capital and their interactions. It focused on the most widely known and used measures of intellectual capital (Market-to-Book Ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index) and adopted a contingency approach which examined whether these measures are more appropriate for manufacturing or services companies with different knowledge profiles. Thus, it offers a comprehensive in-depth assessment of the accounting measures of intangible value.

The findings show that there are two distinct camps of measures with respect to their ability to capture intellectual capital, which by chance coincides with the measures division into market-based measures and financial statements-based measures. The market-based measures, such as Market-to-Book and Tobin's Q, are capturing the majority of the intellectual capital elements, concurring with the fact that they are widely used in the literature. The financial-based measures (Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index) offer a less consistent picture in their ability to capture all intellectual capital elements.

The analysis of different industry sectors confirms this division of measures in that the market-based measures capture a range of intellectual capital elements especially those in knowledge intensive sectors (manufacturing and services). This supports existing research which focuses on knowledge intensive firms. Conversely, the financial statements-based measures are characterised more by their diversity of *"appearance"* and their inability to capture the different elements of intellectual capital as well as revealing a larger diversity across industry sectors.

Similar trends and characteristics are revealed in the way the accounting measures of intangible value capture the synergies between intellectual capital elements. One important difference is that Economic Value Added better captures the combined elements of intellectual value as depicted by the interaction between aggregate measures of *"potential"* and *"realised"* intellectual capital, as opposed to its individual elements. Market-based measures consistently capture *"potential"* intellectual capital but do not capture any interaction between *"potential"* and *"realised"* intellectual capital. In contrast, the Calculated Intangible Value measure consistently captures "*realised"* intellectual capital. Finally, Value Added Intellectual Capital Index ability to capture synergies between intellectual capital elements is limited in line with its ability to capture separate intellectual capital elements.

11.1.2. Intellectual capital proxies and performance

The objective of the second empirical has been twofold. Firstly, it aimed at examining whether all intellectual capital elements – human, structural and relational, are equally beneficial at enhancing a range of traditional performance measures: economic, financial and market performance. Secondly, in the context of key theoretical debates and prior empirical work it aimed at assessing the appropriateness of using intellectual capital proxies to model the relationship between intellectual capital and performance.

It first examined whether separate intellectual capital elements are associated in the same way with different aspects of performance in the overall sample and then proceeded to look at this effect across different industry sectors. Finally, as the elements of intellectual capital are believed to produce more value in combination rather than individually (Bukh, 2003), the effect of the interconnection between the elements of intellectual capital on performance was explored.

The results reveal that, in a UK context, the behaviour of different intellectual capital elements towards performance differs from one performance measure to the other and across the different industries under analysis. There is little evidence of consistent findings across the intellectual capital components or across the different performance measures and, as such, the results are better characterised by their differences than their similarities. For example, elements of intellectual capital, such as SG&A intensity, intangibility and sales above the industry average, are found to positively influence economic performance. The other intellectual capital elements analysed in this study either have no effect or they show a negative influence on economic performance limited to low knowledge intensive sectors. With few exceptions, the intellectual capital elements either show no effect or they have a negative influence on financial performance with differences between the two measures employed in this study to account for this aspect of performance (Return on Assets and Earnings per Share). Generally, it was found that intellectual capital elements have a limited or no effect on market performance indicating a form of investors' myopia regarding the valuation of this resource.

Lastly, the results of the aggregated factor measure of intellectual capital and performance confirm that at least for some aspects of performance, the synergies between the elements of intellectual capital are valuable. *"Realised"* intellectual capital positively relates to Net Cash in all industry sectors. *"Potential"* intellectual capital is either showing no effect or is negatively linked with all aspects of performance. The interaction between *"potential"* and *"realised"* intellectual capital positively influences Return on Assets in all industry sectors, showing that the interaction of these elements adds value to their individual influences.

Theoretically it has been argued that not all elements of intellectual capital are beneficial for economic, financial and market performance (Ittner & Larcker, 1998; Roos et. al., 2005; Bracker & Ramaya, 2011). Nonetheless, a mixture of non-effects, positive and negative influences of intellectual capital elements on performance was expected. Hence, the negative influence of intellectual capital on financial performance signals that there might be other aspects which should be taken into consideration. On one hand, intellectual capital proxies might not be appropriate measures to model the link between intellectual capital and financial performance. On the other hand, it could indicate that the accounting data on which the intellectual capital proxies are built does not take into consideration *"soft"* aspects of organizational well-being which refer to knowledge flows.

11.1.3. Accounting measures of intangible value and performance

The third and final empirical chapter covered the final *"piece of the jigsaw"* of accounting research on IC by comparing and contrasting the ability of different accounting measures of intangible value to predict performance across a range of industry sectors. By and large, the ability of these measures to model the link between intellectual capital and various types of performance should depend on their efficacy in capturing intellectual capital. Consequently, the interpretation of performance effects in this chapter rested on how well these measures capture intellectual capital (see Chapter 8) and how well the elements of intellectual capital are linked to performance (Chapter 9). Thus, informed by our previous two chapters, the link between the most commonly used measures of intangible value- Market-to-Book ratio, Tobin's Q, Economic Value Added, Calculated Intangible Value and Value Added Intellectual Capital Index, and a range of performance measures – economic, financial and market, was assessed.

The findings show that while most of the accounting measures of intangible value have the ability to predict performance, this ability varies from one measure to another and across different industry sector. In other words, it indicates that the choice of measure will results in a different link between intellectual capital and performance which in turn raises the question about which accounting measure is best utilized to connect this resource with performance. This is where information from the first and second empirical chapters becomes relevant. The findings for some measures of intangible value seem legitimate and robust as they concur with that measures ability to measure intellectual capital as well as whether the elements of intellectual capital they depict are drivers of improved performance. For example, Chapter 8 showed that Calculated

Intangible Value captures relational capital and realized intellectual capital. At the same time Chapter 9 revealed that the same elements drive economic performance. As a result, a positive relation between Calculated Intangible Value and economic performance was expected and found in this chapter. Some other associations are different from what it would be expected given the accounting measure efficacy to capture an intellectual capital element and whether this element influences performance. An obvious manifestation of this aspect can be observed for the association of all accounting measures with Earnings per Share, which are all positive, despite the dissimilarities between their ability to reflect some or any intellectual capital elements and how that specific element influences Earnings per Share.

Hence, one strong recommendation coming from this thesis is that in order to assess the performance enhancing properties of intellectual capital the choice of accounting measure of intangible value should be one which can be shown to adequately capture the key characteristics and value of intellectual capital. The accounting measures of intangible value, which have been found to have this property, related to most of the performance measures are Market-to-Book ratio and Tobin's Q and to a certain extent, Calculated Intangible Value.

11.2. Discussion of findings

As mentioned in the introduction of this chapter, the main goal of this thesis is to assess the ability of accounting as a discipline to measure intellectual capital and model its influence on performance. In order to reach this goal the thesis carried out a mapping exercise to triangulate multiple measures of intellectual capital pertaining to intellectual capital proxies and the accounting measures of intangible value. The findings in these chapters will be used to support our assessment of the suggested accounting solutions for the measurement of intellectual capital and conclude on the subject of this thesis according to the criteria for a good measure of intellectual capital which was set out in the introduction of this thesis. Specifically, a good measure should, on one hand, be clear about the resource(s) it is measuring and, on the other hand, facilitate a clearer understanding of the performance outcomes (Levy & Duffey, 2007).

Intellectual capital proxies are very clear about what resources they are measuring, in that they can be clearly associated with an intellectual capital element. However, when used to model the link between intellectual capital and various aspects of performance, attention was drawn towards the negative influence that these intellectual capital proxies are predicting for some aspects of performance, especially financial performance. Various theoretical and methodological arguments can be provided to explain these results (see Chapter 9). However, the fact that these associations are manifested specifically for intellectual capital proxies based on expense elements signals potential deficiencies in these measures due to data identification issues and hence their ability to link the intellectual capital elements and financial performance.. Intellectual capital elements based on expense items are excluded from the income computation, while traditional financial measures of performance rely on income. Thus, the results obtained could be merely a reflection of this aspect instead of being a proof of a negative influence of intellectual capital on financial performance.

Further, intellectual capital proxies showed a negative connection between some intellectual capital components and performance, which have previously been found to have a positive influence if "*soft*" aspects of organizational activities are taken into consideration and/or other types of measures are used. Intellectual capital proxies measure stocks of resources, as opposed to flows of resources. The strategic management discipline has argued that the flows of resources determine whether a stock of resources has a negative or a positive influence on performance (Chapter 3). For example, human capital can create value only if structures are put in place in order to leverage the employees knowledge and enhance its value (Petty & Guthrie, 2000; Hitt et.al., 2001), such as employee participation (Pendleton & Robinson, 2010). However, accounting measures of human capital such as wages provides a signal for the knowledge and education possessed by employees; it does not expand to reflect how employees use this knowledge. Thus, it is suggested that intellectual capital proxies should be used alongside strategic management type of measures to account for both stocks and flows of resources which produce value.

Finally, the accounting conceptualization of intellectual capital perceives this resource to be an asset. Nonetheless, Harvey and Lusch (1999: p. 86) note that: "*for every asset entered on the balance sheet in a standard accounting format, there must be a corresponding entry for liability or equity*". As such, another aspect that needs to be taken into consideration is that intellectual capital proxies could also reflect a host of unrecorded and unrecognized intangible liabilities, which could justify the negative relation that these proxies reflect for the connection between intellectual capital and performance (Caddy, 2000).

Therefore, while intellectual capital proxies are clear about what resources they are measuring, in the sense that they can be clearly identified with an intellectual capital component – human, structural and/or relational capital - their use for modelling the relationship between intellectual capital and performance should be approached with caution as they are prone to a series of limitations.

Moving the assessment of the representation of IC within the accounting discipline and specifically the accounting measures of intangible value, this thesis has explored their *"black box"* and revealed that they have a varied ability to capturing intellectual capital, with market-based measures being broadly better at capturing this resource than financial statement-based measures. However, in contrast with the intellectual capital proxies, all the accounting measures of intangible value show a positive link between intellectual capital and performance.

In order to be able to aid intellectual capital resource allocation, the ability of these accounting measures of intangible value to predict performance should be connected with their efficacy to capture intellectual capital. Specifically, if an accounting measure of intangible value captures an intellectual capital element which drives performance, then there should be a positive connection between the specific accounting measure and the performance aspect analysed. However, based on the results obtained across our empirical chapters it has been shown that this is not always the case. It is worth emphasizing that as with intellectual capital proxies, problems with the accounting measures of intangible value revolve around connecting intellectual capital with financial performance.

There are three possible explanations. First, the performance aspect analysed is driven by intellectual capital elements captured by the accounting measure, however, due to the way intellectual capital proxies have been measured data identity problems blur the results. Second, some accounting measures of intangible value despite their wide conceptualization of measures of intellectual capital might be measuring other aspects of organizational well-being, which interferes with their ability to model the link between intellectual capital and performance. As such, as with the intellectual capital proxies, there are data identity problems for the accounting measures of intangible value. Third, the measures of performance utilized are rather poor.

To sum up, intellectual capital proxies are clear about the resources they are measuring, but they render surprising results about the connection between intellectual capital elements and performance (specifically financial performance) given theoretical arguments about the intellectual capital characteristics. The accounting measures for intangible value are able to predict performance, but they are not very clear about what intellectual capital elements they are measuring. In order for the companies to be able to use these measures for resource allocation purposes, they should be linked back to the intellectual capital elements they are capturing. In doing so, it can be noticed that some results obtained by using the accounting measures of intangible value don’t coincide with their ability to capture intellectual capital. Therefore, intellectual capital proxies should be used to connect intellectual capital with economic and market performance. The accounting measures of intangible value should be used whenever the performance outcomes they predict are in line with their ability to capture intellectual capital.

11.3. Limitations and further research

This thesis provides a novel attempt to unveil the *“black box”* of accounting measurement of intellectual capital, which integrates literature from the accounting and strategic management disciplines. Nonetheless, studies in this thesis have several limitations which should be addressed in future research.

First, this thesis has relied on publicly available data to construct the intellectual capital proxies. Nevertheless, there are other proxies which although built on accounting data are not disclosed (e.g. brand, patent and trademark values, revenues brought by certain type of customers etc.). Future research should try to get access to this data and incorporate it in the analysis.

Second, the investigation has focused on intellectual capital proxies and the accounting measures of intangible value and has not explored the information added by non-financial indicators, because of the difficulty and time consuming nature of gathering this type of data for a panel dataset. Future research should explore how the accounting discipline captures intellectual capital through these non-financial indicators. Also, it could investigate whether there are complementarities between non-financial indicators and intellectual capital proxies in capturing the value of various intellectual capital elements. Furthermore, the same type of mapping exercise done in this thesis could be replicated with non-financial indicators.

Finally, in line with the literature, this thesis has considered endogeneity to be a minor problem. On one hand, there are timing differences. On the other hand, it would be hard to estimate if there is a double determination between the aspects under analysis for the companies in the sample. Specifically, it would imply to investigate if the intellectual capital measures studied are employed in the performance measurement system of the studied companies. This aspect could be subject to a more applied in-depth study which could determine which measures are used in practice. Also, it would have been difficult to find an instrument without involving non-financial indicators. However, it is recommended to assess endogeneity if future research has reasonable evidence to consider aspects it could affect the results.

11.4. Implications

The findings of this thesis show that the accounting discipline has the ability to capture and measure intellectual capital and model its link with performance but that this is not without difficulties and must be viewed in light of what other disciplines might add to the mix. While there are some inherent difficulties in relying solely on publicly available accounting data to investigate intellectual capital, our approach does show that with the proper contextualization and measurement of intellectual capital accounting studies have value and aid our understanding. That being said, as with any area of research there is scope for improvement and much may be gained by considering how other disciplines measure both intellectual capital and performance.

The contextualization aspect recommends the use of accounting solutions for the measurement of intellectual capital whenever they are correctly connecting intellectual capital and performance. Taking into consideration the conceptualization of intellectual capital, theoretical arguments and empirical proof, the accounting discipline broadly manages to present a clear link between intellectual capital and economic performance and market performance. The intellectual capital proxies found to influence economic performance are: Sales above industry's average and, limited to one industry sector only, Intangibility and SG&A intensity. Also, Market-to-Book ratio, Tobin's Q and Calculated Intangible Value have been found to link intellectual capital with Net Cash according to their ability to capture intellectual capital elements.

Nevertheless, there is still scope for improvement with respect to intellectual capital measurement in the accounting discipline mainly due to the nature of data it provides for both intellectual capital measures and performance measures. On one hand, this data does not capture *"soft"* aspect of organizational reality. In this respect, it could be improved by strategic management approach on the subject and adopt measures which refer to flows of resources. These measures should focus on flows, which are known to influence the success of stock resources measured by the accounting profession. For example, they could cover aspects such as organizational structure, routines, culture etc. Caution might need to be taken as these *"soft"* aspects are uniquely describing an organization and are specific to its characteristics. Thus, this data is going to be idiosyncratic and rarely comparable.

Furthermore, the accounting discipline might have to rely on managerial input in order to understand and unfold sources of intellectual capital and, as a consequence, it might have to incorporate subjective data. However, this thesis has shown that there are industry differences and similarities and a way forward could be to develop with the help of managers a list of measures specific to each industry that the companies should disclose and test them in practice Nonetheless, the accounting discipline should be open to continuously extend and adapt the list of measures as there might be untapped sources of value that even managers are not aware of and, hence, they are not measuring yet (Spender et. al., 2013).

Therefore, the accounting discipline has a choice between: 1) relying on the financial statement data it already provides in the financial statements (intellectual capital proxies), but link intellectual capital just with some aspects of performance; 2) rely on the market-based type of measures (Market-to-Book, Tobin's Q) and consider prices correctly incorporate intellectual capital information; and 3) open up the accounting discipline to input from managers.

Finally, while this thesis has made considerable efforts to separate the accounting measures of intangible value from the performance measures used in the literature, there is confusion in the empirical research due to the multidimensionality of these measures. While, these problems are not limited to the accounting discipline, progress can be made in the field if the measures can be categorized and uniformly used for the same purpose. Another issue flagged up by the measures multidimensionality is the difficulty in separating the value of intellectual capital from the benefits it derives for the company. Again, on this aspect accounting may benefit from working with the strategic management discipline which has already noticed that intellectual capital resources (competitive advantage) are defined according with the performance outcomes they derive.

In effect, while accounting has to date made a valuable contribution there is work still to be done. Making advances within the accounting field while benefiting from knowledge elsewhere will improve our understanding of intellectual capital across all disciplines. This will result in one winner – our knowledge of intellectual capital.

References

Aboody, D. and Lev,B., (1998), The value relevance of intangibles: The case of software capitalization, Journal of Accounting Research, 36, pp. 161-191

Aboody, D. and Lev, B., (2001), The productivity of chemical research and development. Working paper, Stern School of Business, New York Stern University, New York, NY.

Aho, S., Ståhle, S. and Ståhle, P., (2011), A critical assessment of Stewart's CIV method, Measuring Business Excellence, 15(4), pp. 27-35.

Alcaniz, L., Gomez-Bezares, F. and Roslender, R., (2011), Theoretical perspective on intellectual capital: A backward look and a proposal for going forward, Accounting Forum, 35 (2), pp.104-117

Amit, R., and Schoemaker, P. J., (1993), Strategic assets and organizational rent, Strategic management journal, 14(1), pp. 33-46.

Andreou, A. N., Green, A., and Stankosky, M., (2007), A framework of intangible valuation areas and antecedents, Journal of Intellectual Capital, 8(1), pp.52-75.

Andriessen, D., (2004a), IC valuation and measurement: classifying the state of the art, Journal of intellectual capital, 5(2), pp. 230-242.

Andriessen, D., (2004b), Making sense of intellectual capital, Elsevier, Oxford, UK

Andriessen, D. and Tiessen, A., (2000), Weightless Weight – Find your real value in a future of intangible assets, Pearson Education London

Andriessen, D.,(2001), Weightless wealth: four modifications to standard IC theory. Journal of Intellectual Capital, 2(3), pp. 204–214.

Appuhami, B. R., (2007), The Impact of Intellectual Capital on Investors' Capital Gain on Shares: An Empirical Investigation in Thai Banking, Finance and Insurance Sector, Journal of Internet Banking and Commerce, 12(1), pp. 1-14.

Arellano, M., and Honoré, B., (2001), Panel data models: some recent developments. Handbook of econometrics, 5, pp. 3229-3296.

Arvanitis, S., (2005), Computerization, workplace organization, skilled labour and firm productivity: Evidence for the Swiss business sector, Economics of Innovation and New Technology, 14(4), pp. 225-249.

Atkinson, H., and Brown, J. B., (2001), Rethinking performance measures: assessing progress in UK hotels, International Journal of Contemporary Hospitality Management, 13(3), 128-136.

Axtle-Ortiz, M. A., (2013), Perceiving the value of intangible assets in context, Journal of Business Research, 66(3), 417-424.

Baltagi, B. H., (2001), Econometric Analysis of Panel Data. 2d ed. New York: John Wiley and Sons.

Baltagi, B.H., (2005), Econometric Analysis of Panel Data, Wiley

Banker, R., and Mashruwala, R, (2007), The moderating role of competition in the relationship between nonfinancial measures and financial performance, Contemporary Accounting Research, 24 (3), pp. 763-793.

Bardhan, I., Krishnan, V. V., and Lin, S., (2010, December), Complementarity Effects of RandD and Information Technology on Firm Market Value, In Workshop on Information Systems Economics.

Barney, J., (1986), Strategic factor markets: expectations, luck and business strategy, Management science, 32(10), pp.1231-1241.

Barney, J., (1991), Firm Resources and Sustained Competitive Advantage, Journal of Management, 17(1), pp. 99-120.

Barney, J. and Clark, D. N., (2007), Resource-based theory: Creating and sustaining competitive advantage, Oxford: Oxford University Press.

Barney, J. B., and Hesterly, W. S., (2006), Strategic management and competitive advantage: Concepts and cases. Upper Saddle River, NJ: Pearson/Prentice Hall

Barth, M. E., Clement, M. B., Foster, G., and Kasznik, R.,(2003), Brand values and capital market valuation. In: Hand, J., and Lev, B., eds. Intangible assets: values, measures, and risks. New York: Oxford University Press, pp. 153–184.

Barth, M. E., Clement M. B., Foster, G., and Kasznik R., (1998), Brand values and capital market valuation, Review of Accounting Studies, 3(1), pp. 41−68.

Barth, M. E., Kasznik, R. and McNichols, M.,(2001), Analyst coverage and intangible assets, Journal of Accounting Research, 39(1), pp. 1-34.

Beattie V., and Thomson S. J.,(2010), Intellectual Capital Reporting: Academic utopia or Corporate Reality in a Brave New World, Ed Accountants of Scotland.

Belkaoui, A. R., (2003). Intellectual capital and firm performance of US multinational firms: A study of the resource-based and stakeholder views, Journal of Intellectual Capital, 4(2).

Bell, A., and Jones, K., (2012), Explaining fixed effects: random effects modelling of time-series cross-sectional and panel data, Political Science Research and Methods, pp. 1-21.

Bell, T. B., Landsman, W. R., Miller, B. L., and Yeh, S., (2002), The valuation implications of employee stock option accounting for profitable computer software firms, The Accounting Review, 77(4), pp. 971-996.

Bharadwaj, A.S., Bharadwaj, S.G. and Konsynski, B.R., (1999), Information Technology Effects on Firm Performance as Measured by Tobin's q, Management Science, 45(6), pp. 1008-1024.

Birdi, K., Clegg, C., Patterson, M., Robinson, A., Stride, C. B., Wall, T. D., and Wood, S. J., (2008), The impact of human resource and operational management practices on company productivity: A longitudinal study, Personnel Psychology, 61(3), pp.467-501.

Bismuth, A. and Tojo, Y., (2008), Creating value from intellectual assets, Journal of Intellectual Capital, 3(2), pp. 228-245.

Black, S. E., and Lynch, L. M., (1996 May), Human-capital investments and productivity, The American Economic Review, pp. 263-267.

Blair, M. and Wallman, S., (2001), Unseen wealth, Brookings Institution, Washington DC.

Boekestein, G., (2009), Acquisitions reveal the hidden intellectual capital of pharmaceutical companies, Journal of Intellectual Capital, 10(3), pp. 389 – 400.

Bollen, L., Vergauwen, P. and Schnieders, S., (2005), Linking intellectual capital and intellectual property to company performance, Management Decision, 43(9), pp. 1161- 1185.

Bolton, M. K., (1993), Organizational innovation and substandard performance: when is necessity the mother of innovation?, Organization science, 4(1), pp. 57-75.

Bonacchi, M., Kolev, K., and Lev, B., (2011), The Analysis and Valuation of Subscription-Based Enterprises, Working paper, Yale University.

Bontis, N., (1998), Intellectual capital: an exploratory study that develops measures and models, Management decision, 36(2), pp. 63-76.

Bontis, N., (1999), Managing organizational knowledge by diagnosing intellectual capital: framing and advancing the state of the field, International Journal of Technology Management, 18 (5-8), pp. 433-62.

Bontis, N., (2000), Assessing knowledge assets: a review of the models used to measure intellectual capital, available at: www.business.mcmaster.ca (Accessed December 2010)

Bontis, N., (2001), Assessing knowledge assets: a review of the models used to measure intellectual capital , International Journal of Management Reviews, 3(1), pp. 41-60

Bontis, N. and Fitz-enz, J. ,(2002), Intellectual capital ROI: a causal map of human capital antecedents and consequents, Journal of Intellectual Capital, 3(3), pp. 223-47.

Bontis, N., Dragonetti, N. C., Jacobsen, K., and Roos, G., (1999), The knowledge toolbox: A review of the tools available to measure and manage intangible resources. European management journal, 17(4), pp. 391-402.

Bontis, N., Keow, W. C. C. and Richardson, S., (2000), Intellectual capital and business performance in Malaysian industries, Journal of Intellectual Capital, 1(1), pp. 85-100.

Bracker, K., and Krishnan, R. (2011). Examining the impact of research and development expenditures on Tobin's Q. Academy of Strategic Management Journal, 10(1), pp. 63-78.

Bradley, K. (1997). Intellectual capital and the new wealth of nations, Business Strategy Review, 8(1), pp. 53-62.

Brennan, N. and Connell, B., (2000), Intellectual capital: current issues and policy implications, Journal of Intellectual Capital, 1(3), pp. 206-240.

Brooking, A., (1996), Intellectual Capital: Core Asset for the Third Millennium Enterprise, Thomson Business Press, London

Brynjolfsson, E. and Yang, S., (1999, April), The intangible costs and benefits of computer investments: Evidence from the financial markets. In Atlanta, Georgia: Proceedings of the International Conference on Information Systems.

Bukh, P. N., (2003), The relevance of intellectual capital disclosure: a paradox, Accounting, Auditing and Accountability Journal, 16(1), pp. 49-56.

Bukh, P. N., Nielsen, C., Gormsen, P. and Mouritsen, J., (2005), Disclosure of information on intellectual capital in Danish IPO prospectuses, Accounting, Auditing and Accountability Journal, 18(6), pp. 713 – 732.

Cabrera, Á., Cabrera, E., (2002), Knowledge-sharing Dilemmas, Organization Studies, 23(5), pp. 687-710.

Cabrita, M. D. R. and Bontis, N.,(2008), Intellectual capital and business performance in the Portuguese banking industry, International Journal of Technology Management, 43(1), pp. 212-237.

Caddy I., (2000), Intellectual capital: recognizing both assets and liabilities, Journal of Intellectual Capital, 1(2), pp.129 – 146.

Caddy, I., (2002), Issues concerning intellectual capital metrics and measurement of intellectual capital, Singapore Management Review, 24(3), pp.77-88.

Cahan, S. F., Courtenay, S. M., Gronnewoller, P. L., and Upton, D. R., (2000), Value relevance of mandated comprehensive income disclosures, Journal of Business Finance and Accounting, 27(9–10), pp.1233-1265.

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

Cappelletti, L., and Khouatra, D., (2004), Concepts et mesure de la création de valeur organisationnelle. Comptabilité-Contrôle-Audit,(1), pp.127-146.

Carlucci, D. and Schiuma, G., (2007), Exploring intellectual capital concept in strategic management research, in: Joia Antonio Luiz, 2007, Strategies for information technology and intellectual capital, Information science reference, pp.10 -28.

Cazavan-Jeny, A. and Jeanjean, T., (2006), The negative impact of R and D capitalization: a value relevance approach, European Accounting Review, 15(1), pp. 37- 61.

Chan, K. H., (2009), Impact of Intellectual Capital on Organisational Performance: An Empirical Study of Companies in the Hang Seng Index (Part 1 and 2), The Learning Organization, 16(1), pp. 4-21.

Chan, L. K., Lakonishok, J., and Sougiannis, T., (2001), The stock market valuation of research and development expenditures, The Journal of Finance, 56(6), pp. 2431- 2456.

Chatzkel, J., (2003), The collapse of Enron and the role of intellectual capital, Journal of Intellectual Capital, 4(2), pp.127-143.

Chauvin, K. W. and Hirschey, M., (1993), Advertising, R and D expenditures and the market value of the firm, Financial management, pp.128-140.

Chen, J., Zhu, Z. and Yuan, H. X., (2004), Measuring intellectual capital: new model and empirical study, Journal of intellectual capital, 5(1), pp.195-212

Chen, M.-C., Cheng, S.-J. and Hwang, Y.,(2005), An Empirical Investigation of the Relationship between Intellectual Capital Firms' Market Value and Financial Performance, Journal of Intellectual Capital, 6(2), pp. 159–176.

Chen, Y. M., Yang, D. H., and Lin, F. J., (2013), Does technological diversification matter to firm performance? The moderating role of organizational slack, Journal of Business Research, 66(10), pp. 1970-1975.

Chin, C. L., Lee, P., Chi, H. Y. and Anandarajan, A., (2006), Patent citation, R&D spillover, and Tobin's Q: evidence from Taiwan semiconductor industry, Review of Quantitative Finance and Accounting, 26(1), pp. 67-84.

Choong, K-K., (2008), Intellectual capital: definitions, categorization and reporting models, Journal of Intellectual Capital, 9(4), pp. 609 – 638.

Chua, W. F., (2007), Accounting, measuring, reporting and strategizing–Re-using verbs: A review essay, Accounting, Organizations and Society, 32(4), pp.487-494.

Chung, K. H. and Pruitt, S. W., (1994), A simple approximation of Tobin's q, Financial management, pp. 70-74.

Clarke, M., Seng, D., and Whiting, R. H. ,(2011), Intellectual capital and firm performance in Australia, Journal of Intellectual Capital, 12(4), 505-530.

Coff, R. W.,(2003), The emergent knowledge‐based theory of competitive advantage: an evolutionary approach to integrating economics and management, Managerial and Decision Economics, 24(4), pp. 245-251.

Cohen, J. A.,(2011), Intangible assets: valuation and economic benefit (Vol.273). John Wiley and Sons.

Cohen, S. and Kaimenakis, N., (2007), Intellectual capital and corporate performance in knowledge intensive SMEs, The Learning Organization, 14(3), pp.241-262.

Connolly, R. A., and Hirschey M., (1984), R&D, Market Structure and Profits: A Value-Based Approach, Review of Economics and Statistics, 66, pp. 682-686.

Connolly, R. A. and Hirschey, M., (1990), Firm size and R& D effectiveness: A value-based test, Economics Letters, 32(3), pp. 277-281.

Connolly, R.A. and Hirschey, M.,(2005), Firm size and the effect of R&D on Tobin’s Q, R&D Management, 35(2), pp. 217-223

Costello, A. B., & Osborne, J. W.,(2011), Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. 2005. Available at: http:/pareonline. net/pdf/v10n7. pdf. Accessed August, 2011.

Daum, J. H., (2002), Intangible Assets and Value Creation, Wiley, Chichester

Davenport, T. H., and Prusak, L., (1997), Information ecology: Mastering the information and knowledge environment, Oxford University Press.

Davenport, T. H. and Prusak, L., (1998), Working knowledge: How organizations manage what they know, Harvard Business Press.

Davison, J., (2010), [In]visible [in]tangibles: Visual Portraits of the Business Elite. Accounting,Organisation and Society, 35(2), pp.165-183.

de Pablos, P. O., (2003), Intellectual capital reporting in Spain: a comparative view, Journal of Intellectual Capital, 4(1), pp. 61-81.

de Pablos, P. O., (2004), Measuring and reporting structural capital: lessons from European learning firms, Journal of Intellectual Capital, 5(4), pp. 629-647.

de Villiers, C., Rinaldi, L., and Unerman, J., (2014), Integrated Reporting: Insights, gaps and an agenda for future research, Accounting, Auditing and Accountability Journal, 27(7).

De, S., (2009), Intangible Determinants of Market Value in the New Economy: A Dynamic Panel Data Analysis of the Indian Software Industry, The Singapore Economic Review, 54(3), pp. 379-398.

Dean, A., and Kretschmer, M., (2007), Can ideas be capital? Factors of production in the postindustrial economy: a review and critique, Academy of Management Review, 32(2), pp. 573-594.

Deeds, D. L., and Decarolis, D. M., (1999), The impact of stocks and flows of organizational knowledge on firm performance: an empirical investigation of the biotechnology industry, Strategic management journal, 20(10), pp.953-968

Deng, Z., Lev. B., and Narin, F., (2003), Science and technology as predictors of stock performance. In: Hand, J., and Lev, B., eds. Intangible assets: values, measures, and risks, New York: Oxford University Press, pp.207–227.

Diefenbach, T., (2006), Intangible resources: a categorical system of knowledge and other intangible assets, Journal of Intellectual Capital, 7(3), pp. 406-420.

Dierickx, I. and Cool, K.,(1989), Asset stock accumulation and sustainability of competitive advantage, Management Science, 35(12), pp.1504-1511.

DiMasi, J. A. and Grabowski, H. G., (2007), The cost of biopharmaceutical R&D: is biotech different?, Managerial and Decision Economics, 28(4–5), pp.469-479.

Drucker, P. F. and Drucker, P. F.,(1993), Post-capitalist society. Routledge.

Dumay, J.,(2009), Intellectual capital measurement: a critical approach, Journal of intellectual capital, 10(2), pp. 190-210.

Dumay, J., (2014), 15 years of the "Journal of Intellectual Capital" and counting: A manifesto for transformational IC research, Journal of Intellectual Capital, 15(1), pp. 2-37.

Dumay, J., and Garanina, T., (2013), Intellectual capital research: a critical examination of the third stage, Journal of Intellectual Capital, 14(1), pp.10-25.

Dzinkowski R., 2000, The measurement and management of intellectual capital: an introduction, British Management Accounting, 78(2), pp.32

Edvinsson, L., (1997), Developing intellectual capital at Skandia, Long Range Planning, 30(3), pp. 266-373.

Edvinsson, L. and Malone, M.S.,(1997), Intellectual Capital: The Proven Way to Establish Your Company's Real Value by Measuring its Hidden Values, Piatkus, London.

Ehie, I. C. and Olibe, K., (2010), The effect of R and D investment on firm value: An examination of US manufacturing and service industries, International Journal of Production Economics, 128(1), pp. 127-135.

Ely, K. and Waymire, G., (1999), Accounting standard-setting organizations and earnings relevance: longitudinal evidence from NYSE common stocks, 1927–1993, Journal of Accounting Research, 37, pp. 293–318.

Felipe, J. and McCombie, J., (2012), Aggregate production functions and the accounting identity critique: Further reflections on Temple's criticisms and misunderstandings (No. 718). Working Paper, Levy Economics Institute.

Field, A., (2005), Discovering statistics with SPSS. London: Sage.

Firer, S. and Williams, S. M., (2003), Intellectual capital and traditional measures of corporate performance, Journal of intellectual capital, 4(3), pp. 348-360.

Flamholtz, E.G., (1971), A model for human resource valuation: a stochastic process with service rewards, The Accounting Review, pp. 253-267.

Flöstrand, P., (2006), The sell side – observations on intellectual capital indicators, Journal of Intellectual Capital, 7(4), pp.457 – 473.

Foss, N. J. and Knudsen, T., (2003), The resource-based tangle: towards a sustainable explanation of competitive advantage, Managerial and Decision Economics, 24(4), pp. 291-307.

Frankenberger, K. D., and Graham, R. C. ,(2003),Should firms increase advertising expenditures during recessions?, MSI Reports, pp.03-115.

Funk, A., (2003), Sustainability and performance, MIT Sloan Management Review, 44(2).

García-Ayuso, M., (2003), Factors explaining the inefficient valuation of intangibles, Accounting, Auditing and Accountability Journal, 16(1), pp. 57-69.

Garcia-Meca, E., and Martínez, I., (2007),The use of intellectual capital information in investment decisions: an empirical study using analyst reports, The International Journal of Accounting, 42(1), pp.57-81.

García-Meca, E., Parra, I., Larrán, M., and Martínez, I., (2005), The explanatory factors of intellectual capital disclosure to financial analysts, European Accounting Review, 14(1), pp.63-94.

Gates, S. and Langevin, P.,(2010), Human capital measures, strategy, and performance: HR managers' perceptions, Accounting, Auditing and Accountability Journal, 23(1), pp.111-132.

Gavious, I. and Russ M., (2009), The valuation implications of human capital in transactions and outside the exchange, Advances in Accounting, 25(2), pp. 165-173.

Ghosh, D. and Wu, A., (2007), Intellectual capital and capital markets: additional evidence, Journal of Intellectual Capital, 8(2), pp.216-235.

Goh P. C., 2005, Intellectual Capital Performance of Commercial Banks in Malaysia, Journal of Intellectual Capital, 6(3), pp. 385-396.

Gowthorpe, C., 2009, Wider still and wider? A critical discussion of intellectual capital recognition measurement and control in a boundary theoretical context, Critical perspectives on Accounting, 20(7), pp. 823-834

Granstrand, O., (1999), The Economics and the Management of Intellectual Property, Edward Elgar Publishing, Cheltenham

Greene W.H., (2000), Econometric Analysis, 4th Edition, Upper Saddle River, NJ Prentice

Grojer J. E., (2001), Intangibles and accounting classifications: in search of a classification strategy, Accounting, Organizations and Society, 26 (7/8), pp. 695-713.

Gu, F. Lev, B. (2001). Intangible assets: measurement, drivers, usefulness. Available at: www.stern.nyu.edu/~blev/, Accessed March 2011

Guo, R., Lev, B. and Zhou, N., (2004), Competitive costs of disclosure by biotech IPOs. Journal of Accounting Research, 42(2), pp.319−355.

Guthrie J., Petty, Yongvanich K. and Ricceri F., (2004), Using content analysis as a research method to inquire into intellectual capital reporting, Journal of Intellectual Capital, 5(2), pp. 282-293.

Guthrie, J. and Abeysekera, I., (2006), Content analysis of social, environmental reporting: what is new?, Journal of Human Resource Costing and Accounting, 10(2), pp. 114 – 126.

Haber, S. and Reichel, A., (2005), Identifying performance measures of small ventures—the case of the tourism industry, Journal of Small Business Management, 43(3), pp. 257-286.

Hall, B. H., (1999), Innovation and market value (No. w6984). National bureau of economic research

Hall, B.H. and MacGarvie, M., (2010), The Private Value of Software Patents, Research Policy, 39(7), September 2010, pp. 994-1009.

Hall, B. H. and Oriani, R., (2006), Does the market value R&D investment by European firms? Evidence from a panel of manufacturing firms in France, Germany, and Italy. International Journal of Industrial Organization, 24(5), pp. 971-993.

Hall, B. H., Jaffe, A., and Trajtenberg, M., (2005), Market value and patent citations, RAND Journal of economics, 36(1), pp. 16-38.

Hall, L. A., Bagchi-Sen, S., (2007), An analysis of firm-level innovation strategies in the US biotechnology industry, Technovation, 27(1–2), pp. 4–14.

Hall, R. (1992). The strategic analysis of intangible resources. Strategic management journal, 13(2), pp. 135-144.

Hall, R., (1993), A framework linking intangible resources and capabilities to sustainable competitive advantage, Strategic Management Journal, 14, pp. 607-18.

Hall, R., (2000), The Stock Market and Capital Accumulation, Working Paper, Hoover Institution and Department of Economics, Stanford University.

Harabi, N., (1997), Vertical relations between firms and innovation: An empirical investigation of German firms (No. 97-10),ZEW Discussion Papers.

Harrison, S. and Sullivan, P.H., (2000), Profiting from intellectual capital – learning from leading companies, Journal of Intellectual Capital, 1(1), pp. 33-46.

Hausman, J. A. and Taylor, W. E., (1981), Panel data and unobservable individual effects, Econometrica, 49.

Hausman J. A. and. Wise D. A., (1979), Attrition Bias in Experimental and Panel Data: The Gary Income Maintenance Experiment, Econometrica , 47(2) pp. 455-473

Heisig, P., (2010), Harmonisation of knowledge management – comparing 160 KM frameworks around the globe, Journal of Knowledge Management, 18(4), pp. 4-31.

Heisig, P., Vorbeck, J. and Niebubr, J., (2001), Intellectual capital, in: Mertins, K., Heisig, P. and Vorbeck, J. (Eds), Knowledge Management – Best Practices in Europe, Springer, Berlin

Hermanson, R.H., (1964), Accounting for Human Assets , Occasional Paper No.14, Division of Research, Graduate School of business Administration, Michigan State University, pp. 4-5.

Hirschey, M. and Wichern, D. W., (1984), Accounting and market-value measures of profitability: Consistency, determinants, and uses, Journal of Business and Economic Statistics, 2(4), pp. 375-383.

Hitt, M. A., Hoskisson, R. E. and Kim, H, (1997), International diversification: Effects on innovation and firm performance in product-diversified firms, Academy of Management journal, 40(4), pp. 767-798.

Ho, Y. K., Keh, H. T. and Ong, J. M., (2005), The effects of R&D and advertising on firm value: an examination of manufacturing and nonmanufacturing firms, Engineering Management, IEEE Transactions on, 52(1), pp. 3-14.

Hoechle, D., (2007), Robust standard errors for panel regressions with cross-sectional dependence, Stata Journal, 7(3), p. 281

Hofmann, J., (2005), Value intangibles, Deutsche Bank Research, available at: http://www.dbresearch.com/PROD/DBRINTERNETDEPROD/PROD0000000000192034.pdf accessed June 2011

Holland J., (2001), Financial institutions, intangibles and corporate governance, Accounting,Auditing and Accountability Journal, 14(4), pp. 479-529.

Holland J. and Johanson, U., (2003), Value-relevant information on corporate intangibles-creation, use and barriers in capital markets – ‘between a rock and a hard place’, Journal of Intellectual Capital, 4(4), pp. 465-486.

Hopwood, A. G., (1983), On trying to study accounting in the contexts in which it operates, Accounting, Organizations and Society, 8(2), pp.287-305.

Hoque, A., (2005), Linking environmental uncertainty to non-financial performance measures and performance: a research note, The British Accounting Review, 37, pp. 471–481.

Hoque, Z. and James, W., (2000), Linking balanced scorecard measures to size and market factors: impact on organizational performance, Journal of Management Accounting Research, 12, pp.1–17.

Hsu, C. C. and Boggs, D. J., (2003), Internationalization and performance: Traditional measures and their decomposition, Multinational Business Review, 11(3), pp. 23-50.

Hsu, L. C. and Wang, C. H., (2012), Clarifying the effect of intellectual capital on performance: the mediating role of dynamic capability, British Journal of Management, 23(2), pp.179-205.

Huang, C. H. and Liu, C. J., (2005), Exploration for the relationship between Innovation, IT and Performance, Journal of Intellectual Capital, 6(2), pp. 237–252.

Huang, C.C. and Wang, M., (2008), The effects of economic value added and intellectual capital on the market value of firms: An empirical Study, International Journal of Management, 25(4), pp .722-731.

Huang, C. C., Luther, R. and Tayles, M., (2007), An evidence-based taxonomy of intellectual capital, Journal of Intellectual Capital, 8(3), pp. 86-408.

Hudson, W.J., (1993), Intellectual capital: how to build it, enhance it, use it, Wiley, New York.

Hussi, T. and Ahonen, G., (2002), Managing intangible assets–a question of integration and delicate balance, Journal of intellectual capital, 3(3), pp. 277-286.

Itami, H., (1987), Mobilizing Invisible Assets, Harvard University Press, Cambridge,

Ittner, C., (2008), Does measuring intangibles for management purposes improve performance? A review of the evidence, Accounting and Business Research, 38(3), pp.261-272.

Ittner, C. and Larcker, D., (1998), Are non-financial measures leading indicators of financial performance? An analysis of customer satisfaction, Journal of Accounting Research, 36, pp.1–35.

Jaffe, A. B., Trajtenberg, M. and Fogarty, M. S., (2000), Knowledge spillovers and patent citations: Evidence from a survey of inventors, NBER/Sloan~, 21.

Jensen, M.A., Petersen C. and Plenborg T., (2003), The correlation between non-compulsory information in the annual report and the company's cost of capital, Focus, no. 58 – 22. The Copenhagen Stock Exchange.

Jerman, M. and Manzin, M., (2008), Accounting treatment of goodwill in IFRS and US GAAP, Organizacija , 41(6), pp. 218–225.

Johnson, W. H., (1999), An integrative taxonomy of intellectual capital: measuring the stock and flow of intellectual capital components in the firm, International Journal of Technology Management, 18(5), pp.562-575.

Joia, L. A., (2007), Strategies for Information Technology and Intellectual Capital: Challenges and Opportunities, Igi Global.

Jørgensen, B., and Messner, M., (2010), Accounting and strategising: A case study from new product development. Accounting, Organizations and Society, 35(2), pp. 184-204.

Josheki, D. and Magdinceva Sopova, M., (2013), Market value of the firms and R&D investment : Theoretical overview and empirical estimation for the panel of countries, available at http://hdl.handle.net/10419/68488 (Accessed Feb 2014)

Joshi, A., and Hanssens, D. M., (2010), The direct and indirect effects of advertising spending on firm value, Journal of Marketing, 74(1), pp.20-33.

Kaiser, R., (2003), Multi-level science policy and regional innovation: the case of the Munich cluster for pharmaceutical biotechnology, European Planning Studies, 11(7),pp. 841-857.

Kallapur Sanjay and Kwan Sabrina Y. S.,(2004),The Value Relevance and Reliability of Brand Assets Recognized by U.K. Firms ,The Accounting Review, 79(1), pp.151-172

Kallunki, J. P. and Sahlstrom, P., (2003), Stock Market Valuation of R&D Expenditures in R&D-intensive Economy: Evidence from Finland. Liiketaloudellinen aikakauskirja, pp.109-121.

Kamath, G. B., (2007), The intellectual capital performance of the Indian banking sector. Journal of Intellectual Capital, 8(1), pp.96-123.

Kamukama, N., Ahiauzu, A., and Ntayi, J. M., (2010), Intellectual capital and performance: testing interaction effects, Journal of Intellectual Capital, 11(4), pp.554- 574.

Kannan, G. and Aulbur, W. G.,(2004), Intellectual capital measurement effectiveness, Journal of intellectual capital, 5(3), pp. 389-413.

Kaplan, R. S. and Norton, D. P., (1992). The balanced scorecard measures that drive performance, Harvard Business Review, 70, pp.71-79.

Kaplan, R. S., and Norton, D. P., (1996), The balanced scorecard: translating strategy into action. Harvard Business Press.

Kaplan, R. S. and Norton, D. P.,(2000), Having trouble with your strategy? Then map it.Harvard Business Review, 78, pp.167-176

Kaplan, R. S., and Norton, D. P.,(2001), Transforming the balanced scorecard from performance measurement to strategic management: Part I, Accounting horizons, 15(1), pp.87-104.

Kaufmann, L. and Schneider, Y., (2004), Intangibles: A synthesis of current research, Journal of Intellectual Capital, 5(3), pp.366 – 388

Kianto, A., (2007), What do we really mean by the dynamic dimension of intellectual capital?, International Journal of Learning and Intellectual Capital, 4(4), pp. 342-356.

Kianto, A., Ritala, P., Spender, J. C., and Vanhala, M., (2014), The interaction of intellectual capital assets and knowledge management practices in organizational value creation, Journal of Intellectual Capital, 15(3), pp. 362-375.

Kim, W. C. and Mauborgne,R.,(1999), Strategy, value innovation and knowledge economy, Sloan Management Review, 40, pp.41-54.

Kogut, B., and Zander, U., (1992), Knowledge of the firm, combinative capabilities, and the replication of technology, Organization science, 3(3), pp.383-397.

Koop, G. M., (2008), An introduction to econometrics, John Wiley and Sons.

Krauter, E., Basso, L. C., and Kimura, H., (2004), The Relationship Between Profitsharing/Gainsharing Plans, Productivity and Economic Value Added, Gainsharing Plans, Productivity and Economic Value Added.

Kriegbaum, C., (2001), Markencontrolling: Bewertung und Steuerung von Marken als immaterielle Vermögenswerte im Rahmen eines unternehmenswertorientierten Controlling. Vahlen.

Kujansivu P. and Lonnqvist A.,(2007), Investigating the Value and Efficiency of Intellectual Capital, Journal of Intellectual Capital, 8(2), pp. 272-287

Kundu, M. A., Kulkarni, P., and NK, A. M., (2010), Advertising and Firm Value: Mapping the Relationship between Advertising, Profitability and Business Strategy in India. Narosa Publications.

Landsman, W. R. , (2007), Is fair value accounting information relevant and reliable? Evidence from capital market research., Accounting and Business Research, 37(sup1), pp.19-30

Langfield-Smith, K., (2008), Strategic management accounting: how far have we come in 25 years?, Accounting, Auditing and Accountability Journal, 21(2), pp.204-228.

Leadbeater, C., (1999), New measures for the new economy. In International Symposium on Measuring and Reporting Intellectual Capital: Experience, Issues, and Prospects.

Lee, K. C., Lee, S., and Kang, I., (2005), KMPI: Measuring knowledge management performance , Information and Management, 42(8), pp.469–482

Lee, P., Chin, C., Chi, H. Y., and Anandarajan, A., (2006), Patent citation, R&D spillover, and Tobin's Q: evidence from Taiwan semiconductor industry, Review of Quantitative Finance and Accounting, 26(1),pp. 67-84

Lev, B., (2001), Intangibles: Management, Measurement, and Reporting, Washington

Lev, B., (2003), Remarks on the measurement, valuation, and reporting of intangible assets.

Lev, B., (2004), Sharpening the Intangibles Edge, Harvard Business Review, 82 No.6, pp.108–116

Lev, B. and Radhakrishnan, S., (2005), The valuation of organization capital. In Measuring capital in the new economy, University of Chicago Press. pp.73-110

Lev, B. and Sougiannis, T., (1996), The capitalization, amortization, and value–relevance of R&D, Journal of Accounting and Economics, 21(1), pp.107–138

Lev, B., Canibano L. and Marr Bernard.,(2005), An accounting perspective on intellectual capital, in Marr Bernard, 2005, Perspectives on intellectual capital, Elsevier, Oxford

Lev, B., Radhakrishnan, S., and Zhang, W., (2009), Organization capital, Abacus, 45 (3), pp. 275-298.

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

Levy, F. and Duffey M. R., 2007, A review of existing methods to quantify intangible assets, Int. J. Accounting, Auditing and Performance Evaluation, 4 (4/5), pp. 382-399

Li, D. Q., and Wu, X. B., (2004), Empirical study on the linkage of intellectual capital and firm performance. In Engineering Management Conference, 2004. Proceedings. 2004 IEEE International, 2, pp. 515-519

Lim, L. L., Chan, C. C., and Dallimore, P., (2010), Perceptions of human capital measures: from corporate executives and investors, Journal of Business and Psychology, 25(4), pp.673-688.

Lin, B. W., and Chen, J. S., (2005), Corporate technology portfolios and R&D performance measures: a study of technology intensive firms, R&D Management, 35(2),pp. 157-170

Lin, B. W., Lee, Y., and Hung, S. C., (2006), R&D intensity and commercialization orientation effects on financial performance, Journal of Business Research, 59(6), pp. 679-685.

Lindenberg, E.B. and S.A. Ross, 1981, Tobin's q Ratio and Industrial Organization, Journal of Business (January), pp. 1-32.

Loermans, J., and Fink, D., (2005), How organisations evaluate their knowledge management projects: a meta-study of the period 1992–2002, Knowledge Management Research and Practice, 3(3), pp. 125-135.

Lovata, L. M., and Costigan, M. L., (2002), Empirical analysis of adopters of economic value added, Management Accounting Research, 13(2), pp. 215-228.

Ludewig, O., and Sadowski, D., (2009), Measuring Organizational Capital, Schmalenbach Business Review, 61,pp. 393-412.

Luo, X., and Bhattacharya, C. B., (2006), Corporate social responsibility, customer satisfaction, and market value, Journal of marketing, 70(4),pp.1-18

Luthy DH., (1998), Intellectual capital and its measurement, available at http://www3.bus.osaka-cu.ac.jp/apira98/archives/pdfs/25.pdf (Accessed October 2010)

Lynn B. ,1998, Intellectual capital, CMA Management, 72(1), pp.10-15.

MacDougall, S. L., and Hurst, D., (2005), Identifying tangible costs, benefits and risks of an investment in intellectual capital: Contracting contingent knowledge workers, Journal of intellectual capital, 6(1), pp. 53-71.

Maditinos, D., Chatzoudes, D., Tsairidis, C., and Theriou, G., (2011), The impact of intellectual capital on firms' market value and financial performance, Journal of intellectual capital, 12(1), pp. 132-151.

Makki, M. A. M. and Lodhi, S. A., (2009), Impact of Intellectual Capital on Return on Investment in Pakistani corporate Sector, Australian Journal of Basic and Applied Sciences, 3(3), pp. 2995-3007.

Malina, M., Norreklit, H., and Selto, F.,(2007), Relations among measures, climate of control, and performance measurement models, Contemporary Accounting Research, 24, pp.935–982.

Malley, A. , (2009), International Research into Non-financial Reporting, available at: http://cpaupdate.cpaaustralia.com.au/cpalink/1019_31529?Division1/4NewþSouthþWales andSegment1/4TheþRest (accessed Mar 2013)

Marr B. and Roos G., (2005), A strategy perspective on intellectual capital in Perspectives on intellectual capital – multidisciplinary insights into management, measurement and reporting, Marr, B. (Ed.), Butterworth-Heinemann,Oxford, pp. 28-41.

Marr, B., (2005), Management consulting practice on intellectual capital: Editorial and introduction to special issue, Journal of Intellectual Capital, 6(4), pp.469-473.

Marr, B., Gray, D., and Neely, A., (2003), Why do firms measure their intellectual capital?, Journal of intellectual capital, 4(4), pp. 441-464.

Marrano, M. G. and Haskel, J., (2006), How much does the UK invest in intangible assets? Department of Economics Queen Mary University of London Working Paper, available at: http://www.economics.qmul.ac.uk/papers/doc/wp578.pdf (accessed Oct 2010)

Marrano, M. G., Haskel, J., and Wallis, G., (2009), What happened to the knowledge economy? ICT, intangible investment, and Britain's productivity record revisited, Review of Income and Wealth, 55(3), pp.686-716.

Mavridis, D. G.,(2004), The Intellectual Capital Performance of the Japanese Banking Sector, Journal of Intellectual Capital, 5(1), pp. 92-115.

McGahan, A. M. and Silverman, B. S., (2006), Profiting from technological innovation by others: The effect of competitor patenting on firm value, Research Policy, 35(8), pp. 1222-1242

Megna, P. and Klock, M., (1993), The impact of intangible capital on Tobin's q in the semiconductor industry, The American Economic Review, pp.265-269

Metcalf, G., (2002), A Systems View of Intellectual capital, Synergy Matters, Part 2, pp.115-120.

Michael, H. and Lusch R., (1999), Balancing the intellectual capital books: intangible liabilities, European Management Journal, 17(1), pp. 85-92.

Molloy, J. C., Chadwick, C., Ployhart, R. E., and Golden, S. J., (2011), Making Intangibles “Tangible” in Tests of Resource-Based Theory A Multidisciplinary Construct Validation Approach. Journal of Management, 37(5), pp.1496-1518.

Montequín, V. R., Fernández, F. O., Cabal, V. A., and Gutierrez, N. R., (2006), An integrated framework for intellectual capital measurement and knowledge management implementation in small and medium-sized enterprises, Journal of Information Science, 32(6), pp. 525-538.

Mouritsen, J., Larsen H.T. and Bukh P.N.D., (2001), Intellectual capital and the ‘capable firm’: narrating, visualising and numbering for managing knowledge, Accounting, Organizations and Society, 26(7-8), pp. 735-762

Mouritsen, J., (1998), Driving growth: Economic value added versus intellectual capital, Management Accounting Research, 9(4), pp. 461-482.

Mouritsen, J., Bukh, P. N., and Marr, B., (2004), Reporting on intellectual capital: why, what and how? , Measuring Business Excellence, 8(1), pp.46-54.

Murthy, V. and Mouritsen, J., (2011), The performance of intellectual capital: mobilising relationships between intellectual and financial capital in a bank, Accounting, Auditing and Accountability Journal, 24(5), pp.622-646.

Nahapiet, J. and Ghoshal, S., (1998), Social capital, intellectual capital and the organizational advantage, Academy of Management Review, 23(2), pp.242-266

Nakamura, L., (2001), What is the US gross investment in intangibles? (At least) one trillion dollars a year! (No. 01-15).

Nayak, N. R., Mohanty, M. and Mishra B. B., (2008), Valuation of Intellectual Capital: The case of Financial Services Industry in India, Vilakshan, (The journal of XIM, Bhubaneswar), 5(1)

Nazari, J. A., and Herremans, I. M., (2007), Extended VAIC model: measuring intellectual capital components., Journal of Intellectual Capital, 8(4), pp.595-609.

Neely, A., Kennerley M. and Martinez, V., (2004), Does the balanced scorecard work? An empirical investigation,Proceedings of the EurOMA International Conference, Fontainebleau, 27-29

Nielsen, C., Roslender, R. and Bukh, P.N.,(2009), Intellectual Capital Reporting: Can a strategy perspective solve accounting problems? In Lytras and Ordonez de Pablos (Eds.) Knowledge Ecology in Global Business, IGI Global.

Nohria, N. and Eccles, R.,(1991), Networks and organizations: Structure, form, and action, pp.288-308. Harvard Business School Press.

Nonaka I. and Takeuchi H.,(1995), The knowledge-creating company. New York: Oxford University Press

Nonaka, I., Toyama, R. and Nagata, A., (2000), A firm as a knowledge creating entity: a new perspective on the theory of the firm, Industrial and Corporate Change, 9, pp.1-20

O'Bryne, S. and Young, S. D., (2000), EVA and Value-Based Management: A Practical Guide to Implementation. McGrow Hill.

O'Donnell, D. and Berkery, G., (2003), Human interaction: the critical source of intangible value, Journal of Intellectual Capital, 4(1), pp. 82-99

OECD, (2006), Intellectual assets and value creation: implications for corporate reporting, Paris

Olve, N.G., Roy, J., and Wetter, M., (1999), A practical guide to using the balanced scorecard – performance drivers, Chichester: John Wiley and Son

Parcharidis, E. G., and Varsakelis, N. C., (2010), R&D and Tobin's q in an emerging financial market: the case of the Athens Stock Exchange, Managerial and Decision Economics, 31(5), pp. 353-361.

Pendleton, A., and Robinson, A., (2010), Employee stock ownership, investment, and productivity: An interaction-based approach, Industrial and Labor Relations Review, pp.3-29.

Peneder, M., (2002), Intangible investment and human resources, Journal of Evolutionary Economics, 12(1-2). pp. 107-134

Penrose, E. T., 1959/1995, The Theory of the Growth of the Firm, 3rd ed. Oxford University Press, Oxford, UK.

Petersen, M. A., (2009), Estimating standard errors in finance panel data sets: Comparing approaches, Review of financial studies, 22(1), pp. 435-480.

Petty, R. and Guthrie, J., (2000), Intellectual capital: Australian annual reporting practices, Journal of Intellectual Capital, 1 (3), pp.241-251.

Piekkola, H., (2010), Intangibles: Can they explain the unexplained. University of Vaasa Department of Economics Working Paper, 15.

Pike S. and Roos G.,(2005), Mathematics and modern business management, Journal of Intellectual Capital, 5(2), pp. 243-256.

Pike S., Rylander A., and Roos G.,(2002), Intellectual capital management and disclosure. In: Bontis, N., and Choo, C. W., eds. The strategic management of intellectual capital and organizational knowledge. New York: Oxford University Press,pp. 657–671.

Pindado J., V. de Queiroz and C. de la Torre, (2005), How do firm characteristics influence the relationship between R&D and Firm Value?, Financial Management, 39(2), pp. 757-782

Porter, M. E., (1979), How competitive forces shape strategy (pp. 21-38). Boston: Harvard Business Review.

Priem, R. L., and Butler, J. E. (2001). Is the resource-based “view” a useful perspective for strategic management research?, Academy of management review, 26(1),pp.22-40.

Pulic A., (2004), Intellectual capital-does it create or destroy value, Measuring Business Excellence, 8(1), pp. 62-68

Pulic A., (1998), Measuring the performance of intellectual potential in knowledge economy, Available online: http://www.measuringip.at/Opapers/Pulic/Vaictxt.vaictxt.html

Rahman, S., (2012), The role of intellectual capital in determining differences between stock market and financial performance, International Research Journal of Finance and Economics, 89, pp.46-77.

Rastogi, P. N., (2003), The nature and role of IC: Rethinking the process of value creation and sustained enterprise growth. Journal of Intellectual Capital,4(2), pp.227-248.

Ravichandran ,T. and Lertwongsatien, C., (2005), Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective, Journal of Management Information Systems, 21(4),pp. 237-276.

Reed K.K., Lubatkin M. and Srinivasan N., (2006), Proposing and testing an intellectual capital-based view of the firm, Journal of Management Studies,43(4), pp. 867-893

Richard, P. J., Devinney, T. M., Yip, G. S., and Johnson, G., (2009), Measuring organizational performance: Towards methodological best practice, Journal of management

Richieri, F. L., Basso L. C. and Leiva Martin D. D., (2008), Intellectual Capital and the Creation of Value in Brazilian Companies. available at: http://ssrn/abstract=1081849.

Rietveld, T., and Van Hout, R.,(1993)., Statistical techniques for the study of language and language behaviour, Walter de Gruyter.

Rivkin, J. W., (2000), Imitation of complex strategies, Management Sci., 46, pp. 824-844.

Rogerson, W. P.,(1997), Intertemporal cost allocation and managerial investment incentives: A theory explaining the use of economic value added as a performance measure. Journal of Political Economy, 105(4),pp.770-795.

Roos G., Pike S. and Fernstrom L., (2005), Managing intellectual capital in practice, Elsevier, Oxford

Roos J., Roos G., Dragonetti N. C. and Edvinsson L., (1997), Intellectual Capital: Navigating in the New Business Landscape, Macmillan, Houndmills, Basingtoke.

Roos J.,(1998),Exploring the concept of intellectual capital, Long Range Planning, 31(1), pp.150 - 153,

Roos,G. and Roos, J., (1997), Measuring Your Company's Intellectual Performance, Long Range Planning, 30(3), pp.413-426.

Roslender, R. and Fincham, R., (2004), Intellectual capital accounting in the UK: A field study perspective, Accounting, Auditing and Accountability Journal, 17(2), pp.178 – 209

Roslender, R.,(2004), Accounting for intellectual capital: rethinking its theoretical underpinnings, Measuring Business Excellence, 8(1), pp.38-45

Sáenz J., (2005), Human capital indicators, business performance and market-to-book ratio", Journal of Intellectual Capital, 6(3), pp.374 – 384

Seethamraju, C.,(2003), The value relevance of trademarks, In: Hand, J., and Lev, B., eds. Intangible assets: values, measures, and risks New York: Oxford University Press, pp.228–247.

Seetharaman A., Teng L.K. L. and Saravanan A.S., (2004), Comparative justification on intellectual capital, Journal of Intellectual Capital, 5(4), pp.522 – 539

Serenko A., Bontis N. and Grant J., (2009), A scientometric analysis of the Proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 period, Journal of Intellectual Capital,10(1), pp.8 – 21

Sharma, S., (1996), Applied multivariate techniques. John Wiley and Sons, Inc..

Shiu H.J., (2006), The application of the value added intellectual coefficient to measure corporate performance: evidence from technological firms, International Journal of Management, 23(2), pp. 356-365.

Siggelkow, N., (2002), Misperceiving interactions among complements and substitutes: Organizational consequences, Management Sci., 48, pp. 900-916.

Simon, C. J., and Sullivan, M. W., (1993), The measurement and determinants of brand equity: a financial approach, Marketing science, 12(1),pp. 28-52.

Skinner, D. J., (2008), Accounting for intangibles–a critical review of policy recommendations., Accounting and Business Research, 38(3),pp. 191-204.

Smith, G.V., (1994), The New Role of Intellectual Property in Commercial Transactions, Wiley, New York, NY

Sofian, S., Rasid, S., Zaleha A., Mehri, M. and Muhammad, A., (2011), A Moderating Effect of Intellectual Capital on Relevance of Earnings and Cost of Equity Relationship: Review of Contemporary Literature, Australian Journal of Basic and Applied Sciences, 5(9), pp. 1633-1639

Sougiannis, T., (1994), The accounting based valuation of corporate R&D, Accounting review, pp.44-68.

Spender, J.C., (1996), Making knowledge the basis of dynamic theory of the firm, Strategic Management Journal, 17(2), pp.45-62

Spender, J.C. and Marr B.(2006), How a knowledge- based approach might illuminate the notion of human capital and its measurement, Expert Systems with Application, 30(2), pp.265-271.

Spender, J.C., (2009), Organizational capital: concept, measure or heuristic, In: Organizational Capital: Modelling, Measuring and Contextualising, pp.5-23.

Spender, J. C., (2011), The problems and challenges of researching intellectual capital. Managing Knowledge Assets and Business Value Creation in Organizations : Measures and dynamics, pp.1-12.

Spender, J.C., Bednarz-Łuczewska, P., Bordianu, A., and Rohaert, S., (2013), Intangibles: theory, categories, and the Kozminski matrix. Knowledge Management Research and Practice, 11(2), pp. 101-111

Srinivasan, R., and Lilien, G. L., (2009), R&D, advertising and firm performance in recessions. ISBM Report, 3

Ståhle, P., Ståhle, S., and Aho, S., (2011), Value added intellectual coefficient (VAIC): a critical analysis, Journal of Intellectual Capital, 12(4), pp.531-551.

Stam, C., (2009), Intellectual liabilities: lessons from The Decline and Fall of the Roman Empire, VINE, 39(1), pp.92 - 104

Stewart, T.A.,(1997), Intellectual capital - The New Wealth of Organizations, London: Nicholas Brealey.

Stewart, G. B., (1994). EVA^{TM}: Fast And Fantasy, Journal of applied corporate finance, 7(2), pp.71-84.

Stewart, T. A., (1995), Trying to grasp the intangible, Fortune, 132(7), pp. 157-161.

Stovel, M., and Bontis, N. (2002).Voluntary turnover: knowledge management– friend or foe? , Journal of intellectual Capital, 3(3), pp. 303-322

Strassmann, P. A., (1999), Calculating knowledge capital. Available at: files.strassmann.com/pubs/km/1999-10.php

Subramaniam, M. and Youndt, M. A., (2005), The influence of intellectual capital on the types of innovative capabilities, Academy of Management Journal, 48(3), pp.450-463.

Sullivan, Jr, P. H. and Sullivan Sr, P. H., (2000), Valuing intangibles companies–an intellectual capital approach, Journal of Intellectual capital, 1(4), pp. 328-340.

Sullivan, P. H., (2000), Value driven intellectual capital: how to convert intangible corporate assets into market value. John Wiley and Sons, Inc.

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

Sveiby, K. E., (2001), A knowledge-based theory of the firm to guide in strategy formulation, Journal of intellectual capital, 2(4), pp.344-358.

Sveiby, K. E., (2005),Methods for measuring intangible assets, available at: http://www.sveiby.com/articles/IntangibleMethods.htm (accessed May 15, 2011)

Tan, H. P., Plowman, D., and Hancock, P. ,(2007), Intellectual capital and financial returns of companies, Journal of Intellectual capital, 8(1), pp.76-95.

Tayles, M. and Ma, Y., (2009), On the emergence of strategic management accounting; an institutional perspective, Accounting and Business Research, 39, pp 473-495

Tayles, M., Pike, R. H., and Sofian, S., (2007), Intellectual capital, management accounting practices and corporate performance: perceptions of managers, Accounting, Auditing and Accountability Journal, 20(4), pp.522-548

Taylor, M. P., (2007), Tied Migration and Subsequent Employment: Evidence from Couples in Britain. Oxford Bulletin of Economics and Statistics, 69(6), pp.795-818.

Teece, D. J., (1998), Capturing Value from Knowledge Assets: The New Economy, Markets for Know-how, and Intangible Assets, California Management Review, 40, pp. 55–79.

Teece, D. J., Pisano, G. and Sithen, A., (1997), Dynamic capabilities and strategic management, Strategic Management Journal, 18(7), pp. 509–533.

Teece, D. J., (2000), Strategies for managing knowledge assets: the role of firm structure and industrial context, Long Range Planning, 33(1), pp. 35-54

Temple, J., (2010), Aggregate production functions, growth economics, and the part-time tyranny of the identity: a reply to Felipe and McCombie. International Review of Applied Economics, 24(6), pp. 685-692.

Ting, I. W. K. and Lean, H. H., (2009), Intellectual capital performance of financial institutions in Malaysia, Journal of Intellectual capital, 10(4), pp. 588-599.

Tsai, D. H., (2005), Knowledge Spillovers and High-technology Clustering: Evidence from Taiwan's Hsinchu Science-Based Industrial Park, Contemporary Economic Policy, 23(1), pp.116-128.

Tseng, C. Y. and Goo, Y. J. J., (2005), Intellectual capital and corporate value in an emerging economy: Empirical study of Taiwanese manufacturers, R&D Management, 35 (2), pp. 187-201.

Veltri, S., (2010), Empirical evidence of relationships between Intellectual Capital performance and firm value, Economia Aziendale Online, 1(2-3), pp.101-118.

Viedma-Marti, J.M., (2001), ICBS – intellectual capital benchmarking system, Journal of Intellectual Capital, 2 (2), pp. 148-64.

Villalonga, B., (2004), Intangible resources, Tobin’s q, and sustainability of performance differences, Journal of Economic Behavior and Organization, 54, pp. 205– 230

Vogelsang, T. J., (2012), Heteroskedasticity, autocorrelation, and spatial correlation robust inference in linear panel models with fixed-effects, Journal of Econometrics, 166(2),pp. 303-319.

Wakelin, K., (2001), Productivity growth and R&D expenditure in UK manufacturing firms, Research policy, 30(7), pp.1079-1090.

Walker, R.G., (2009), Discussion of Lev, Radhakrishnan and Zhang, ABACUS, 45(3), pp. 299-311

Wall, A., Kirk, R., and Martin, G., (2004), Intellectual Capital: Measuring the Immeasurable?, Elsevier.

Wang, H. W. and Wu, M. C., (2012), Business type, industry value chain, and R&D performance: Evidence from high-tech firms in an emerging market, Technological Forecasting and Social Change, 79(2), pp. 326-340.

Wang, W. Y. and Chang, C., (2005), Intellectual capital and performance in causal models: evidence from the information technology industry in Taiwan, Journal of Intellectual Capital, 6(2), pp. 222-236.

Wiig, K. M., (1997), Knowledge management: where did it come from and where will it go?, Expert systems with applications, 13(1), pp.1-14.

Wiklund, J. and Shepherd, D., (2003), Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses, Strategic Management Journal, 24(13), pp. 1307–1314.

Wilson, N., Wright, M., Siegel, D. S. and Scholes, L., (2012), Private equity portfolio company performance during the global recession, Journal of Corporate Finance, 18(1), pp. 193-205.

Wood, D. J. and Jones, R. E., (1995), Stakeholder mismatching: A theoretical problem in empirical research on corporate social performance, International journal of organizational analysis, 3(3), pp.229-267.

Wooldridge, J., (2007), What's New in Econometrics? Lecture 10 Difference-in-Differences Estimation. NBER Summer Institute, available at: www.nber.org/WNE/Slides7–31–07/slides_10_diffindiffs [accessed April, 9, 2011].

Wu S. H., Lin L. Y. and Hsu M. Y., (2007), Intellectual capital, dynamic capabilities and innovative performance of organizations, International Journal of Technology Management 39(3-4), pp. 279-296

Wuyts, S., Dutta, S. and Stremersch, S., (2004), Portfolios of interfirm agreements in technology-intensive markets: consequences for innovation and profitability, Journal of Marketing, 68(2), pp. 88-100.

Yongvanich, K. and Guthrie, J., (2005), Extended performance reporting: An examination of the Australian mining industry, Accounting Forum, 29(1), pp. 103-119.

Youndt, M. A., Subramaniam M., and Snell S. A., (2004), Intellectual capital profiles: An examination of investments and returns, Journal of Management Studies, 41, pp. 335–362

Zéghal, D. and Maaloul, A., (2010), Analysing value added as an indicator of intellectual capital and its consequences on company performance, Journal of Intellectual Capital, 11(1), pp. 39-60.

Zucker, L. G., Darby, M. R., and Brewer, M. B., (2003), Intellectual human capital and the birth of US biotechnology enterprises. In: Hand, J., and Lev, B., eds. Intangible assets: values, measures, and risks. New York: Oxford University Press, pp.185–206.