Impact of intellectual capital on firm performance: Evidence from South African JSE listed firms

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I hereby declare that I have read and understood the regulations governing the submission of Master of Commerce dissertations, including those relating to length and plagiarism, as contained in the rules of the University, and that this dissertation conforms to those regulations.

Signed by candidate

DEDICATION

This research project is dedicated to my late mother, Mihloti Olivia Baloyi, whose faith in me continues to fuel me to this day.

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ABSTRACT

The new knowledge economy has created a global interest on the valuation of intellectual capital as well as its impact on firm performance and value. Developing economies have relatively only begun to investigate this relationship and progress has already been made in South Africa by a few researchers. The purpose of this study is to add to this investigation by exploring the relationship between intellectual capital and firm performance for South African listed firms in intellectual capital-intensive industries. A gap exists in South African research regarding the long-term impact of intellectual capital on firm performance. This relationship is important to define as firms may well make inappropriate decisions based on short-term relationships that do not create long-term value. This study applies a lag model in an aim to investigate this relationship in addition to the short-term relationship that exists between intellectual capital and firm performance. The study involves a quantitative analysis of data collected from firms in intellectual capital-intensive industries and makes use of the VAIC model developed by Ante Pulic to value intellectual capital. Measures of firm performance used are return on assets, total asset turnover and market capitalization. This study also makes use of panel data covering 62 JSE listed companies over 10 years. Empirical results show mixed outcomes regarding the relationship between intellectual capital and firm performance for both short-term models and lagged models. In some instances, no association was observed between intellectual capital and performance.

Keywords: Intellectual capital, VAIC, firm performance, South Africa.

Contents

Chapter 1

1.1. Introduction

As South Africa ventures on a journey of self-definition in the post-apartheid era, an important consideration finds itself amidst this whole process; how best can sustainable value be created? Corporate South Africa, which is the biggest contributor to South Africa's economic growth (StatsSA, 2019a), is a big player of interest. What really drives value for companies in the post-apartheid and post-industrial era? Since the late nineties, arguments for knowledge driven value creation have been contended for by many researchers (Edvinsson, 1997; Stewart, 1997; Sveiby, 1997; Pulic, 1998). A study by Morris (2015) found that South African firms' focus regarding the productivity of their operations is through improving their physical capital rather than their intellectual capital. Morris (2015) moreover argued that if South African firms desire to be competitive, they will need to cultivate their knowledge assets in order to improve their efficiency, consequently improving the country's growth.

1.2. Research Problem

First world country research around the world has produced evidence supporting the argument of value creation through knowledge and intellectual capital in place of physical capital. How much of this is true for developing countries like South Africa given that the country's financial models are built on first world countries' models whose intellectual capital development is already advanced? (Firer & Stainbank, 2003). Additionally, since emerging economies have more room for growth, they provide hope for global economic growth and thus their development is important (Firer & Williams, 2003). Pulic (1998) has discovered that human capital drives firm success regardless of the level of development in an economy after investigating the relationship between countries with a 1:5 Gross National Product (GNP) per capita ratio. South African findings have not fully confirmed this. Studies have produced mixed results regarding the relationship between intellectual capital and firm performance in South Africa (Firer & Williams, 2003; Firer & Stainbank, 2003; Morris, 2015; Schutz, 2018).

As a result, it is worth understanding the impact of intellectual capital on firm performance as the whole world moves into intangible drivers of value. As much as South Africa is a mineral intensive country, growing its intellectual capital base is worthwhile in moving away from non-renewable sources of production (Firer & Stainbank, 2003).

1.3. Research Objectives

Owing to the above, this study's objective is:

- To investigate the relationship between intellectual capital and firm performance for South African JSE-listed firms.

1.4. Research Question

In pursuit of the above objective, this current study seeks to answer the following question:

- Does intellectual capital affect firm performance in South Africa?

1.5. Motivation for the study

South African research has already made progress regarding the investigation of the relationship between intellectual capital and firm performance (Firer & Stainbank, 2003; Firer & Williams, 2003; Morris, 2015; Schutz, 2018). What previous studies have not investigated is the relationship between intellectual capital and delayed firm performance. This gap in prior studies provides this study with an opportunity to investigate whether intellectual capital could be linked to delayed firm performance. Studies that do not use a lagged performance model fail to capture fully the relationship that exists between intellectual capital and firm performance. Such studies also fail to correct for an endogeneity problem due to a causal relationship between intellectual capital and firm performance. Failure to correct for causality issues potentially results in a provision of misleading results that could potentially incentivise inappropriate behaviour. This entails that the proxies that are used to measure firm performance (especially those that are based on traditional accounting principles) and intellectual capital efficiency measurement should be based on the same principles. Lagging performance variables enhances the determination of the relationship between firm performance and intellectual capital even though conflicting measurement approaches are used. For example, human capital (salaries and wages) is dealt with as an expense in calculating a firm's net profit. The expense reduces a firm's net profit which becomes an input in calculating the return on a firm's assets. However, under VAIC calculations, the same amount is treated as an investment rather than an expense. Therefore, firm performance is reflected using traditional accounting figures, which are unlikely to capture or recognise intellectual capital as a resource; in the same breath, intellectual capital efficiency measurement does not reflect traditional accounting and measures intellectual capital as a resource rather than an expense. It follows that in any given period, all things remaining equal, any investment in human capital will lead to decreased performance based on traditional return on asset calculations. Nevertheless, in the long run, if

intellectual capital truly drives competitive advantage for firms, the firm's returns should increase through the increased productivity and efficiency of its operations and be realised in profits that accountants measure.

Owing to the above discussion, the motivation for this study is to explore the relationship between intellectual capital and delayed performance in addition to the relationship between intellectual capital and firm performance for corresponding periods.

1.6. Contribution to Knowledge

The results of this study are important to add to the findings regarding the definition of the relationship between intellectual capital and firm performance, which has also not been conclusive. They are also of importance to company management as they will provide useful information regarding the allocation of company resources in a manner that will maximise company value. Investors may also find this useful in their investment decision process. Consistent with Firer & Williams' (2003) study, the results from this study may provide information and inferences of other emerging countries in Africa and around the world.

1.7. Organisation of the study

Chapter 2 presents a review of prior studies, with focus on findings within South Africa and the rest of the world. Chapter 3 provides a discussion on the methodology that will be used to establish the findings of this study. Thereafter, Chapter 4 presents a discussion of the findings while chapter 5 concludes the study and offers recommendations for future research in this field.

Chapter 2

Literature Review

2.1. Definitions and History

In 1958, when research and development was on an upsurge and disparities were observed between companies' book values and market values, specifically within science-based companies, analysts Kronfeld and Rock (1958:90) proposed that the distinguishing factor between these values was "intellectual premium". Kronfeld and Rock (1958) described "intellectual capital" as the most significant component for these science-based firms. Nearly four decades later Stewart (1997) defined intellectual capital as information and knowledge that transfigures raw materials into more valuable materials. This includes intangible assets, staff talent, proprietary knowledge as well as customer and supplier relations. In an information-economy where purposeful knowledge is a great resource that drives value for firms and gives them competitive advantage (Bontis, 2001; Drucker, 1993; Kamukama & Sulait, 2017; Kaplan & Norton, 1996), research and development are no longer confined to science-based firms (Sveiby, 1997). A growing number of companies have been found to actively invest, grow and advance their intellectual capital (Edvinsson & Sullivan, 1996). Knowledge has taken the place of manual work as the groundwork and main ingredient for production (Elliott, 1992; Stewart, 1997; Pulic, 1998) and intellectual capital is necessary to intensify a firm's usefulness and overall profitability (Berzkalne & Zelgalve, 2014).

A study conducted by Sumedrea (2013) post the global financial crisis of 2007-2008 found that even in a time of crisis, company growth is principally driven by human and structural capital – It is the capacity of individuals to learn and adjust that will bring a firm out of a crisis. This ability becomes a "soft and intangible driver of consistent market leadership, continuous growth in sales and value creation for shareholders" (Roos, 1998: 151). Intellectual Capital constitutes only knowledge that has the ability to add value or create wealth. That is, knowledge that does not add value cannot be intellectual capital (Stewart, 1999). This gives intellectual capital the ability to explain partly the gap that exists between companies' book values and market values (Berzkalne & Zelgalve, 2014; Chauvin & Hirschey, 1993; Dzinkowski, 2000; Edvinsson, 1997; Mouritsen, Thorsgaard Larsen & Bukh, 2005; Stewart, 1999; Sveiby, 1997).

2.2. Measurement

The increased investment attention on intellectual capital needs an appropriate measurement system for these resources (Edvinsson, 1997; Petty & Guthrie, 2000). Many researchers have since endeavoured to develop a system most appropriate (Edvinsson, 1997; Pulic, 1998; Stewart, 1997; Sveiby, 1997). There has likewise been a growing demand by users of financial statements for disclosures relating to intellectual capital (Williams, 2001). An appealing notion may be to derive the value as simply the difference between book values and market values. However, share prices fluctuate, and a portion of these fluctuations can be attributed to inaccuracies in measurement by investors due to decisions based on investor mood and economic cycles (Sveiby, 1997).

The importance of measurement is not an investor-only issue, it is also important to management as it helps them explore the creative invisible drivers of future profits (Roos, 1998). Traditional measures of performance are not a good strategic guide for companies that are heavily reliant on intellectual capital (Roos, 1998), mainly because what is measured in companies is also what is managed (Roos & Roos, 1997). Since the use of intellectual capital as a source for strategic development is useful and advantageous for companies (Sumedrea, 2013), an appropriate measurement system will lead to an efficient allocation of resources for both management and investors (Firer & Williams, 2003). It is also important to ensure that these assets are measured from a performance evaluation perspective. Traditional measures of performance have been criticised for incentivising short termism as they do not capture drivers of sustainable future earnings (Kaplan & Norton, 1996). Changes in profits can be attributed to obscure changes in intellectual capital since there exists no consistency in the measurement of these resources. It follows that accounting profits are not an appropriate benchmark for companies that are heavily reliant on intellectual capital as the risk of manipulation is higher in the context of performance evaluation (Sveiby, 1997). Intellectual capital measurement would provide widespread information on value and performance and influence good behaviour (Chen, Zhu & Yuan Xie, 2004; Nazari & Herremans, 2007).

Based on the above, an appropriate intellectual capital measurement is important from a country perspective as well, if not more important. It is also equally important for the laws and regulations that are set at a national level to be guided by the efficient use and allocation of resources that create value for the country (Pulic, 2004). Measurement of a country's performance based on GDP alone is not sufficient in a knowledge economy. The knowledge

about the efficiency of value creating resources provides a more comprehensive understanding of country performance (Pulic, 2004). This is especially important in a country like South Africa where human capital sits idle due to high levels of unemployment (StatsSA, 2019b).

Most researchers have acknowledged the existing failure by accountants to quantify intellectual capital even though market returns encapsulate it (Bontis, 1998; Cañibano, García-Ayuson & Sánchez, 2000; Edvinsson, 1997; Pulic, 1998; Suojanen, 1954; Stewart, 1997). Increased intellectual capital investment leads to increased intellectual capital efficiency which in turn is acknowledged by the market and reflected in the market value of a firm (Pulic, 2000). Despite the above, it is amiss that the current outdated balance sheet does not acknowledge intellectual capital and creates distorted pictures of business performance (Pulic, 2004). This lack of acknowledgement is due to the limiting nature of accounting standards (Cañibano, García-Ayuson & Sánchez, 2000; Suojanen, 1954). As a result, accounting measures fail to record separate intellectual capital assets, as they do with physical capital assets, and as such, fail also to allow the quantification of their involvement in value creation (Sumedrea, 2013). These outdated accounting systems do not provide real-time dials on business nor do they acknowledge resources that drive firm value (Elliott, 1992). The isolation of financial accounting and reporting to investor interactions contributes to the disconnect and the accountants' straggle. This disconnect, unfortunately, is prevalent amongst finance, economics and most social sciences (Dempsey, 2014; Suojanen, 1954).

2.3. Accounting Measurement

Suojanen (1954) has argued that the accountant's limitation to intellectual capital measurement is as a result of scope. That is, the accounting restrictions are only to the extent of the objective that accountants aim to achieve. The scope of accounting standards and measuring tools has been to measure income to shareholders. This is the reason why traditional accounting's focus has been on income that remains to shareholders as a residual after covering all other costs (Suojanen, 1954). The objective of firm performance measurement is linked to the objective of the firm (Firer & Williams, 2003; Johanson et al., 1998) and the dominant view over the years has been the shareholder centric model (Donaldson & Preston, 1995) based on the neoclassical theory of the firm (Firer & Williams, 2003). Under this theory, a firm's primary objective is to maximise profits to shareholders as opposed to providing returns to all participants of the firm, such as employees, customers and lenders (Slater, 1997).

The introduction of different objectives of the firm have led to equally differing views on firm performance and measurement (Firer & Williams, 2003). The shift to a value creating firm for all stakeholders of the firm has been contended for by many researchers and experts from both a strategic and corporate governance perspective (Agle, Mitchell & Sonnenfeld, 1999; Berman et al., 1999; Clarkson, 1995; Donaldson & Preston, 1995; Harrison, Edward Freeman & Mônica Cavalcanti Sá, de Abreu, 2015; Slater, 1997). Management has also begun to consider itself responsible not only for the owners of equity but for other stakeholders as well (Knauth, 1953; Van Buren, 1999).

Thus, there has been a transformation in value creation from the industrial era where value was created through increased production to today's knowledge economy where value is largely created through knowledge (Elliott, 1992; Stewart, 1997; Pulic, 1998). The aim of the present-day firms has become rational value creation (Clarkson, 1995; Pulic, 2004) and based on this change, a new measuring system, with a new index must be introduced (Elliot, 1992; Pulic, 2004; Suojanen, 1954) because efficiency and not magnitude or capacity matters most in this economy (Pulic, 1998). Value Added is considered an appropriate measure of performance in the new knowledge economy (Firer & Williams, 2003; Pulic 2004). It is not based on traditional definitions of income and includes value created in business to all contributors of the firm (Suojanen, 1954). Based on this viewpoint, it will be impossible to understand the new economy using old lenses (Sveiby, 1997) and the accountants, unfortunately, have been accused of not updating their old lenses which consist of old definitions of income, value, and income beneficiaries (Bontis, 1998; Suojanen, 1954).

2.4. International Financial Reporting Standards

Intangible assets have gained some interest of accountants over the years. The International Financial Reporting Standards (IFRS) are one of the main international reporting guidelines which have been adopted by 166 countries as updated in April 2018 (International Accounting Standards Board, 2018c). South Africa has fully adopted IFRS, and the Johannesburg Stock Exchange (JSE) requires companies to adopt IFRS as a listing requirement (JSE Limited, 2005). *IAS 38 Intangible Assets* is a standard in IFRS that deals with the accounting treatment of intangible assets. The standard allows for assets to be recognized in the balance sheet relating to assets that are without physical substance, are non-monetary and are identifiable/separable from an entity. Additionally, the assets must meet the recognition criteria in order to be

recognised on the balance sheet. That is, the intangible assets will produce probable economic benefits and the cost of such assets can be measured reliably.

Internally generated intangible assets, including research and development costs, can also be recognized as assets given that they are incurred in the development phase of an intangible asset and not the research phase. In the research phase, the firm is merely gathering information and knowledge and is unable to demonstrate the probability of future economic benefits to flow into the firm as information gathered might suggest that it is not feasible to continue and develop the asset further. In the development phase however, firms apply their research knowledge to advance an asset and the probability of future economic benefits is improved at that stage. The International Financial Reporting Standards (2018a: A1529) state the following about the requirements for recognising research and development costs as an asset:

> *An intangible asset arising from development (or from the development phase of an internal project) shall be recognised if, and only if, an entity can demonstrate all of the following:*
>
> - *Technical feasibility of completing the intangible asset so that it will be available for use or sale.*
> - *Its intention to complete and ability to measure the intangible asset and use it or sell it.*
> - *Its ability to use or sell the intangible asset.*
> - *How the intangible asset will generate probable future economic benefits. Among other things, the entity can demonstrate the existence of a market for the output of the intangible asset or the intangible asset itself or, if it is to be used internally, the usefulness of the intangible asset.*
> - *The availability of adequate technical, financial and other resources to complete the development and to use or sell the intangible asset.*
> - *Its ability to measure reliably the expenditure attributable to the intangible asset during its development.*

An issue with IFRS's definition and recognition criteria for intangible assets is that they too are limiting (Cañibano, García-Ayuson & Sánchez, 2000). The first limiting factor being the definition requirement for the asset to be identifiable. Most intangible assets are not separable from an entity and/or do not arise from a legal contract and thus fail to meet that part of the definition.

The second limiting factor is the recognition requirement for the ability to measure the cost of the asset reliably. Some intangible assets are developed at no cost or an indeterminable cost and it makes no sense that they cannot be recognised as an asset on the balance sheet since the motive of the transaction is the same as with acquiring measurable assets, that is, to achieve higher profitability in the long term (Sveiby, 1997). An example of such is an investment in

customer relations, which speak to the culture that an entity cultivates in-house. IFRS does not recognise an asset for which a cost cannot be determined.

Only in the event of purchased intangible assets and during Mergers and Acquisitions do any previously unidentifiable assets become identifiable as a result of the transfer to the acquiring company (International Accounting Standards Board, 2018a). Accordingly, value can be placed on these assets by virtue of the amount paid for the acquisition (Sveiby, 1997). For example, Goodwill is an asset in the consolidated statements of a group that arises as a result of the difference between the fair value of the consideration given by the acquirer company and the fair value of the net assets of the acquired company (International Financial Reporting Standards, 2018a). By that definition, goodwill is the additional value perceived by markets that accountants fail to recognise.

A third limiting factor with IFRS is with control. One of the fundamental principles of asset recognition in IFRS is the ability to direct the use of an asset and restrict others from doing the same (International Accounting Standards Board, 2018b). Human capital cannot be recognised as an asset from an IFRS perspective as an entity cannot control their employees (Johanson et al., 1998). This is inconsistent with what Pulic, Stewart, Sveiby and other valuators of intellectual capital are trying to achieve in the knowledge economy; recognising an asset instead of an expense relating to employees, which they regard as the number one carriers of knowledge. In Stewart's (1999: 1) words, "the question of ownership and control matters less than the question of access". The mere fact that the knowledge of employees can be accessed by a firm should be enough to recognise a resource to the firm.

Finally, the International Financial Reporting Standards for Small and Medium-sized Entities (IFRS for SMEs) does not recognise intangible assets for anything that an entity develops and generates in-house (International Accounting Standards Board, 2015). This creates slight valuation issues as many small and medium-sized firms depend heavily on their internally generated intangible assets for competitive advantage and growth.

Although there is an attempt from IFRS to recognise intangible assets, there are still limitations due to the restrictions imbedded in the definition and recognition criteria. Any investment in these assets that does not meet the IFRS criteria goes through the financial statements as an expense that decreases profits (International Accounting Standards Board, 2018b). In addition to that, Andriessen (2004) pointed out the clear difference between measurement and valuation.

What accountants attempt to do is simply measurement and not valuation. Fundamentally, accounting measurement initially assigns the value of an asset as its cost and subsequently adjusts for items such as depreciation, amortisation and impairment. The same simple assumption does not work with intangible assets. "The cost of producing knowledge bears much less relationship to its value or price than the cost of producing, say, a ton of steel" (Lessem & Palsule, 2005: 22). Thus, even in a perfect world where accounting criteria are not restrictive and invincible drivers of value make their way to the balance sheet, the measurement of such assets would be at an adjusted cost, which would materially differ from their fair value.

Some researchers have further argued that the invisibility of intellectual capital is not in their intangibility but rather their invisibility on the balance sheet (Edvinsson, 1997; Roos & Roos, 1997; Sveiby, 1997). Thus, intellectual capital is interpreted as whatever accountants do not capture. These are investments in "information technologies that lead to value added networks and global area networks etc. [that are invisible on the balance sheet] (Edvinsson, 1997: 1). The differences can also be explained using the different kinds of knowledge as described by Edvinsson & Sullivan (1996). The first kind of knowledge being codified knowledge. This knowledge is transferable knowledge that can be defined and is able to have legally protective rights. These characteristics meet the definition of identifiable according to IFRS and would form part of intangible assets as defined. The second kind of knowledge on the other hand, tacit knowledge, is more difficult to define. It "is difficult to articulate and may be embedded in ways of doing things" (Edvinsson & Sullivan, 1996: 358), thus unidentifiable from a firm. This type of knowledge would not form part of intangible assets in the balance sheet. However, tacit knowledge has a lot of value, and it is in the interest of businesses to codify all business knowledge (Stewart, 1997). Edvinsson's model of firm value expands this thinking to regard intangible assets as only a portion of a firm's total intellectual capital. This is illustrated in figure 1 on the next page:

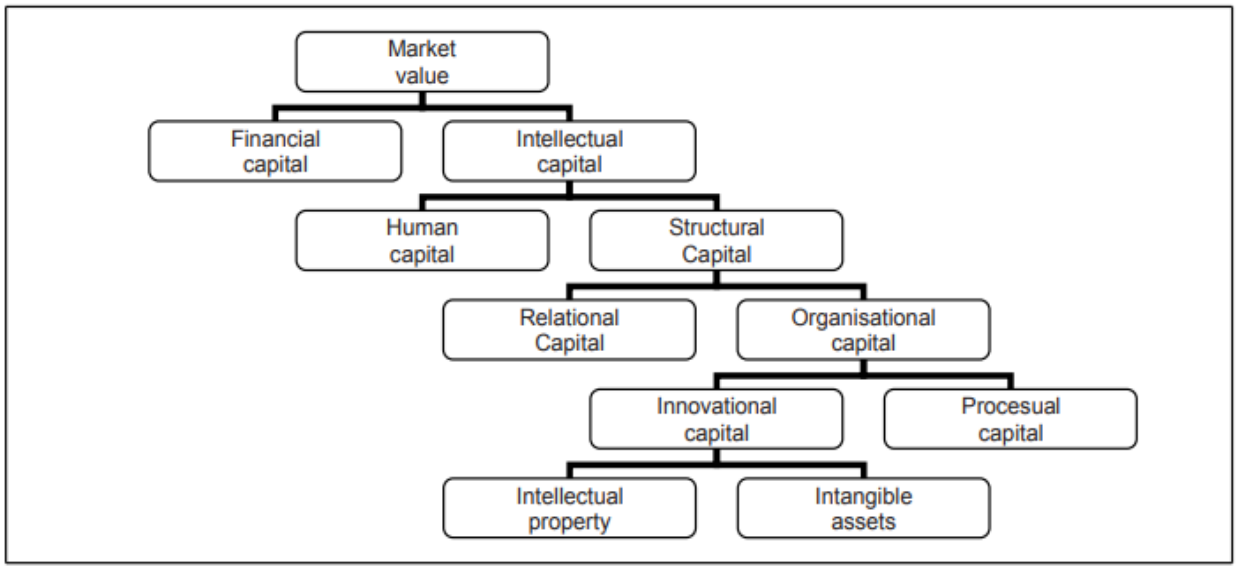


Figure 1: Edvinsson's structure of intellectual capital in Skandia (1997: 369).

The model shows intellectual capital encompassing human capital, relational capital, processual capital, intellectual property and intangible assets. Valuation and interpretation of which, will not prove an easy task (Bontis, 2001; Sveiby 1997).

2.5. Additional disclosures

There has been growing demand by users of financials for non-financial information, including quality of products, customer satisfaction, supplier relations, production progress, production time efficiency & productivity as well as the investment and advancement of human talent (Elliott, 1992). Suojanen (1954) found that this demand was met through extra disclosures and reporting of income in financial statements different from the usual income from the statement of profit and loss and other comprehensive income. These disclosures become supplements to the traditional quantitative financial reports (Edvinsson, 1997). However, companies only make these additional disclosures to the extent that their competitive advantage is not tempered with (Williams, 2001).

2.6. Valuation methods

There generally exists no active market for intellectual capital assets such as those that exist for assets that are tangible (Sveiby, 1997). This makes it difficult to determine the fair value of intellectual capital assets as they are not traded. Though a select few have tried to come up with a method of valuation, there has not been a method that has been universally accepted due to

no definite conclusion about the impact of intellectual capital on performance (Nazari & Herremans, 2007; Zhicheng et al., 2016).

What appears almost universally accepted are the constituents of intellectual capital. Most researchers and experts agree that intellectual capital is made up of human and structural capital (Edvinsson, 1997; Pulic, 1998). However, instead of falling under structural capital as in figure 1 above, some researchers consider relational capital as its own distinct component (Sumedrea, 2013).

2.6.1. Components of intellectual capital

2.6.1.1. Human Capital

Human capital (HC) is defined as employee brainpower and understanding. It includes "all knowledge, skills, abilities, talents, experience and know-how available to the organisation's members, as well as motivation and commitment to the organisation and its values, which are necessary for performing the required daily tasks, by applying the firm's strategies" (Sumedrea, 2013: 140). Human capital is, according to Stewart's (1997) argument, the most significant resource in business. "It is individuals, not the company, that own and control the chief source of competitive advantage" (Roos & Roos, 1997:3). Human capital does not constitute low-skilled and routine work that can be easily replaced and automated (Stewart, 1997). It constitutes specialists; highly proficient professionals who are driven and are good problem solvers. These are the real income drivers. (Sveiby, 1997). In Stewart's (1997: 86) words, "machines perform, often than a human being can, but do not invent".

2.6.1.2. Structural Capital

Structural Capital (SC) is what is left in a firm after employees have left (Edvinsson & Sullivan, 1996). It includes "information systems, knowledge encoded in the form of databases, processes and organisational procedures (which are not in the minds of employees, but on external media), trademarks, patents, and infrastructure required to support the application of the organisational strategies" (Sumedrea, 2013:140). It represents how much is needed to extract value over the use of human capital (Ordonez de Pablos, 2004) and maximises the potential of human capital (Edvinsson & Sullivan, 1996). Structural capital is important because it gives form and organisation to human intellect. It is important to structure the competencies, intelligence and know-how of experts using technology in order to ensure that these competencies remain in the company when the employees have left (Stewart, 1997). Less

dependency on human capital, through the generation of structural capital, safeguards a company's sustainability (Sveiby, 1997). However, human capital and structural capital must have a balance in order to maximise value creation (Edvinsson, 1997).

2.6.1.3. Relational Capital

Relational Capital is customer and supplier associations. It is "external links with suppliers and customers of the organisation, which allows it to buy and sell goods and services in an efficient and effective manner (through knowledge of customer preferences and of the factors that lead to a satisfactory relationship with them and so on)" (Sumedrea, 2013:140). This is difficult to measure, and most valuation models do not consider it in isolation (Sumedrea, 2013).

The interest and participation of researchers from different specialities around the world has led to proposals of different theories of intellectual capital measurement and valuation that consider different aspects (Nazari & Herremans, 2007). An overview of a selection of these methods follows next on this review.

2.7. The Intangible Assets Monitor

Sveiby (1997) argued for both financial and non-financial measures of valuing intangible assets. Suggesting that they share in the same uncertainty with financial measures. Both forms of measurement are not objective and non-financial measures should be just as accepted as the financial. Furthermore, Sveiby (1997) opined that the main reason financial measures seem real and objective is that they have been around for a long time. However, Pulic (1998) argued that there exists a challenge of comparability between companies concerning the use of non-financial measures. Sveiby's (1997) model, called the Intangible Assets Monitor, focuses on 3 quantities of measurement: External Structure, Internal Structure and Competence of Personnel. He suggested in his model to have a measurement for at least three consecutive years before a benchmark for comparison can be used by a company. However, this speaks only to a company's internal comparison. For example, using a budget or previous years' actual figures. He has acknowledged that the interpretation of non-financial measures is an obstacle and a hindrance to their usage (Sveiby, 1997).

Sveiby's model determines the ability of human capital to generate revenue (the leverage effect) using the formula in figure 2 below:

$$\text{Profit per Professional} = \underbrace{\frac{\text{Profit}}{\text{Revenue}}}_{\text{General indicators of corporate success}} * \underbrace{\frac{\text{Revenue}}{\text{No. of employees}}}_{\text{Sales efficiency indicator}} * \underbrace{\frac{\text{No. of employees}}{\text{No. of professionals}}}_{\text{Personnel efficiency indicator}}$$

Leverage indicator

Figure 2: Sveiby's formula for computing the leverage effect (1997:171).

There exists a number of problems with the relations above. An example is the irrationality of the relationship between professionals and employees. The more professionals there are amongst employees, the lower the leverage indicator (Pulic, 1998). This is inconsistent with Sveiby's (1997) argument that professionals are the major income producers in a firm.

2.8. The Balanced Scorecard

The Balanced Scorecard is another combined financial and non-financial measure developed by Kaplan & Norton (1996). The objective of this model is to factor in non-financial benchmarks and performance measures to enhance financial metrics. This gives companies the ability to track financial results and observe intellectual assets that drive these results at the same time. The key non-financial areas of focus are customer relations, key internal processes and learning and growth. This is what is used to measure intellectual capital. It allows for an expansion of a company's performance methods and provides an understanding of long-term strategic goals that factor in knowledge assets (Kaplan & Norton, 1996).

A challenge with this approach as it relates specifically to intellectual capital valuation is that it is non-monetary and shares the same limitations relating to comparability between companies (Pulic, 1998). It is also very simplistic (Johanson et al., 1998). Additionally, the Balanced Scorecard represents more a strategic guidance for management rather than a valuation method specific to intellectual capital as many companies use it to measure the efficiency of their operations (Sveiby, 1997).

2.9. The Skandia Navigator

Edvinsson (1997), the then director of intellectual capital at Skandia, argued that intellectual capital should be treated the same way as equity. The reason for this is that intellectual capital is contribution from an entity's stakeholders such as employees and customers and thus should

be treated the same as financial contributions from shareholders. The corresponding entry based on accounting's double entry system would be goodwill, enabling recognition and acknowledgement of value that develops over time. The model, called the Skandia Navigator and developed in 1991, has the same approach as the balanced score card and uses 169 indicators to determine the efficiency of Organisational Intellectual Capital (OIC). The goal of the model is increased management focus on non-financial elements (Edvinsson, 1997).

Edvinsson (1997) computes an Organisational Intellectual Capital (OIC) as the product of its Intellectual Capital Coefficient of Efficiency (ICCE) and its Intellectual Capital Absolute Measure (C).

An issue with this model is the subjectivity regarding the measurement and ranking of the indicators for different companies. There is also subjectivity in determining ICCE as it is the simple average of market share, satisfied customer index, leadership index, motivation index, R&D index, index of training hours, performance/quality goal and employee retention (Pulic, 1998). The subjectivity adds on to the problem of comparability (Bontis, 2001; Pulic, 1998). The model also shares the same limitations with the balanced score card in terms of the number of indicators it can practically handle (Edvinsson, 1997).

All three models suggested above need to come to a conclusion on a mutual indicator if they want to solve the issue of comparability (Pulic, 1998).

2.10. Value Added methods

Value Added is considered an appropriate measure of performance in the new economy (Firer & Williams, 2003; Pulic 1998). It is defined by Pulic (1998) as simply the difference between what goes into a company and what goes out. What goes in are the expenses relating to all inputs that went into the company and what goes out is all income generated from all products and services (outputs) (Pulic, 1998, 2000). Value added methods are based on the reordering of the balance sheet and income statement of a firm in order to take into account the firm's uniqueness (Mouritsen, 1998). Two of the value-added methods are Economic Value Added™ and Value-Added Intellectual Coefficient and these are discussed below:

2.10.1. Economic Value Added

Economic Value Added™ (EVA™) was developed by the global consulting company Stern Stewart with an objective to convey faithfully the real economic profit of a company (Jakub, Viera & Eva, 2015). It has become a foundation for all other value-added methods (Tseng & James Goo, 2005). Economic profit is "expressed as the surplus in created value over the expected return of the shareholders" (Daraban, 2017:168). EVA™ includes expenditures that are considered to be investments in the value-added computation in order to eliminate accounting distortions on economic profit (Stern, Stewart III & Chew, 1996). For example, research and development costs are adjusted from accounting profit as expenses and included as capital employed (Chen & Dodd, 1997). Other adjustments include training of human capital, marketing expenditure, restructuring and other costs that are estimated to payoff over time (Stern, Stewart III & Chew, 1996). However, Stern, Stewart & Chew (1996) recommend only making these adjustments to the extent that the benefit from the expenditure exceeds its cost.

A weakness with EVA™ is that it only focusses on one form of capital, physical capital, and would thus not be appropriate for the knowledge economy (Pulic, 2004). Additionally, EVA™ does not provide a better understanding specific to intangible resources and consequently does not provide information about intellectual capital's specific contribution to performance (Bontis et al., 1999). Moreover, EVA uses 164 areas of adjustments that, not only provide complexity and cost issues for managers, but also create comparability issues across companies (Bontis et al., 1999).

2.10.2. Value Added Intellectual Coefficient (VAIC)

Based on EVA™, Pulic (1998) developed the Value-Added Intellectual Coefficient (VAIC) approach to valuing intellectual capital. Since value creation is completely dependent on knowledge in the new economy, he suggests a measurement of performance from a value-added perspective that takes into account knowledge. This method has been used and accepted by many researchers (Alhassan & Asare, 2016; Anifowose et al., 2018; Berzkalne & Zelgalve, 2014; Bharathi Kamath, 2008; Clarke, Seng & Whiting, 2011; Firer & Williams, 2003; Sumedrea, 2013; Zhicheng et al., 2016). Under this model, Pulic (2004) aims to measure the efficiency of all resources that create or add value to a firm. This is because the efficiency of resources and the intelligence of products and services matters more than the mere existence of resources – A company can create more or less value given the same amount of resources (Pulic, 1998). Efficiency is the relationship between the resources utilised and the value that

has been created (Pulic, 2004). The existence of intellectual capital on its own is not sufficient, a firm's ability to leverage that capital is more important to productivity and value creation (Edvinsson & Sullivan, 1996; Zhicheng et al., 2016). Thus, company value depends on the ability of the company to proficiently apply its knowledge.

Pulic (1998: 3), indicated the following concerning what an intellectual capital valuation model should achieve:

> *In my opinion this measuring system has to meet two requirements:*
>
> - *It has to establish reliable and objective evidence of value creation processes. This means precise measuring of knowledge which employees incorporate into products and services.*
> - *It has to provide reliable and objective information on the employee's ability to create value. In fact intellectual inputs and outputs are generally ignored by managers and investors, even though they far outweigh the assets that appear on balance sheets.*

VAIC uses the same principle of adjusting accounting profits to take into account expenses that are considered investments as in EVA™. For VAIC, one of the noteworthy adjustments is employee costs. Employee costs under Pulic's VAIC are not included as expenses because they are recognized rather as an asset, a resource. Employees are viewed as the key drivers of value and are thus an investment (Edvinsson & Sullivan, 1996; Pulic, 1998). Pulic (1998) used VAIC and found that there is a high correlation between salaries and wages expenses and the success of a firm. This implies that a firm's success depends significantly on the development of a firm's employees (Sumedrea, 2013) and firms seem to agree with this given the high level of investment in developing and upskilling their employees (Edvinsson, 1997).

Other adjustments to VAIC include: "interests on financial assets, dividends to investors, taxes to the state and investments in future development" (Pulic, 2004:64). Value added is thus expressed as:

$$VA = OP + EC + D + A$$

Where:

VA = Value added

OP = Operating income

EC = Employee costs

D = Depreciation expense

A = Amortisation expense

The attempt was not to move away from accounting definitions of income, but rather to show them in a different light of the new reality in the knowledge economy. In Pulic's (2004:66) words "The same data – revenue, profits, and costs – are brought into a new system of relationships, naturally much more complex than before, and new results are received, more objective and more appropriate for the new business reality". He also highlighted that since the reality is that economic activities are always valued from a market perspective using financial and monetary terms in financial statements, his measuring system would be based on the same reality. This makes VAIC an easy model to work with because all figures required for the valuation can be found on a firm's financial statements (Sumedrea, 2013).

VAIC breaks down the efficiency of the different forms of capital, the sum of which results in the total value-added intellectual coefficient. The efficiency of the different forms of capital is derived using the series of formulae that follows:

$$HCE = VA/HC$$

Where:

HCE = Human Capital Efficiency Coefficient

VA = Value Added

HC = Human Capital (Total salaries and wages for a company)

$$SCE = SC/VA$$

Where:

SCE = Structural Capital Efficiency Coefficient

SC = Structural Capital

VA = Value Added

Structural Capital (SC) above, is the difference between value added and the total salaries and wages of a company (HC). This is because structural capital is not independent. It hinges on value added and is a product of human capital (Pulic, 2004). "The less HC participates in value creation, the more SC is involved" (Pulic, 2000:708). Knowledge is fully within the minds of employees and structural capital, the expression of this knowledge, is dependent on the willingness of the employees to share their intellect (Stewart, 1997).

A firm's total intellectual capital efficiency is derived as the sum of its human capital efficiency and its structural capital efficiency. This is shown in the formula below:

$$ICE = HCE + SCE$$

Where:

ICE = Intellectual Capital Efficiency Coefficient

HCE = Human Capital Efficiency Coefficient

SCE = Structural Capital Efficiency Coefficient

VAIC measures efficiency using all resources that an entity uses in value creation. This includes the efficiency of intellectual and physical capital. "Intellectual capital cannot create value on its own" (Pulic, 1998:65). Elliot (1992) echoes this by saying that the post-industrial knowledge economy does not mean that we should forget pre-industrial traditional forms of capital (since they still contribute to value creation), the distribution is what has changed. Physical capital thus remains an important part of value creation.

The efficiency of physical capital is calculated as follows:

$$CEE = VA/CE$$

Where:

CEE = Capital Employed Efficiency Coefficient

VA = Value Added

CE = Book value of the net assets of a company

This represents the efficiency of assets recognised in the balance sheet of a firm. Total capital consists of physical capital and intellectual capital. The combination of the two forms of capital will provide full insight of all value creating assets (Pulic, 2004). Total capital efficiency can thus be shown as:

$$VAIC = ICE + CEE$$

Where:

VAIC = Value Added Intellectual Coefficient

ICE = Intellectual Capital Efficiency Coefficient

CEE = Capital Employed Efficiency Coefficient

VAIC enables companies to determine whether value is created or destroyed based on an entity's business model and beyond the distorted pictures created by traditional accounting numbers (Pulic, 2004). It represents an entity's value creation proficiency, and the higher it is, the better productivity the entity has achieved, and the better management has maximised on the entity's potential. Moreover, it directs management to weak areas within their value creation system, through the determination of efficiency from each form of capital and allows for intervention and improvement to take place (Pulic, 2000).

Limitations of the VAIC model include its inability to handle negative values (Zhicheng et al., 2016). It also does not include all constructs of intellectual capital (Nazari & Herremans, 2007). Moreover, VAIC does not take into account different sectors and makes comparability slightly difficult between intellectual capital intensive and non-intellectual capital-intensive sectors (Zhicheng et al., 2016).

Nevertheless, all the suggested models above should not be considered independently in order to get the most value from them. A combination of these models has the potential to produce a more comprehensive analysis of a company's intellectual capital (Nazari & Herremans, 2007).

The present study uses VAIC to determine the impact of intellectual capital on firm performance due to its advantages discussed above and its increased popularity. The use of VAIC will allow for an appropriate comparison with other studies that have also used VAIC. A discussion of how VAIC's limitations will be dealt with in this study can be found in the methodology section in Chapter 3.

2.11. Empirical evidence on the impact of intellectual capital on firm performance

The relationship between intellectual capital and firm performance needs enhanced definitions for firms to derive the most value through the management of their intellectual capital (Roos &Roos, 1997; Tseng & James Goo, 2005). Challenges exist regarding the definition of this relationship in practice. These challenges include:

The effect of time delays also called 'the time-lag trap' by Joia (2000). Time delays exist on the implementation and the realisation of intellectual capital. This is particularly the case with human and innovation capital, which demand time to generate results (Cohen & Kaimenakis, 2007; Joia, 2000). A company might go through "intellectual bankruptcy" and still make good short-term profits due to lower expenses [and delayed impact on performance] (Roos & Roos, 1997:3). This is explored further in this study through the investigation of the relationship

between intellectual capital and delayed performance in order to take into account the effect of time delays.

The Interdependence of intellectual capital components in generating firm value. Intellectual capital exists in complex relationships within and among its different elements and these elements are intertwined (Chen, Zhu & Yuan Xie, 2004; Stewart, 1997; Tseng & James Goo, 2005). "For example, working operational process generates cash flow (part of monetary capital) by a combination of elements of human capital, supported by structural and physical capital" (M'Pherson & Pike, 2001:252).

The zero-sum effect on intellectual capital investments. Intellectual capital investments are unlike physical capital investments. Financial outflows relating to investments in physical assets lead to definite assets due to probable future economic benefits and the net effect adds up to zero. This is not the case with intellectual capital investments (Tseng & James Goo, 2005). It is common within intellectual capital for outflows to not amount to any future economic benefits due to inappropriate investments, systems and culture (Roos & Roos, 1997). Intellectual capital has also been found to follow the law of increasing returns. That is, unlike physical assets, value created continually increases alongside an increase in intellectual capital investment (Arthur, 1996; Tan, Plowman & Hancock, 2007).

Current valuation and disclosure progress on intellectual capital is highlighted at only a point in time – a balance sheet approach. Roos & Roos (1997:2) have suggested "an adoption, alongside the balance sheet approach, of a profit and loss approach, which would help companies monitor the flows among different components of intellectual capital and between intellectual and financial capital". Thus, instead of showing intellectual capital only as a snapshot, movements in intellectual capital should be shown as well to enhance the analysis of these assets.

A variety of findings have been obtained relating to the impact of intellectual capital on firm performance. Some researchers have found a positive relationship between intellectual capital and firm performance (Alhassan & Asare, 2016; Anifowose et al., 2018; Bornemann, 1999; Chen, Cheng & Hwang, 2005; Chen, Zhu & Yuan Xie, 2004; Clarke, Seng & Whiting, 2011; Tan, Plowman & Hancock, 2007; Sumedrea, 2013; Tseng & James Goo, 2005; Zhicheng et al., 2016). Moreover, the study by Anifowose et al. (2018) found a positive correlation between intellectual capital efficiency and cash generated from operations for Nigerian companies. The

study by Chen, Cheng & Hwang (2005) has additionally found investors to place higher value on firms with high levels of intellectual capital.

Several researchers found mixed results on the relationship between intellectual capital and firm performance (Berzkalne & Zelgalve, 2014; Firer & Williams, 2003; Haris et al., 2019; Maditinos et al., 2011; Schutz, 2018). In these findings, different components of intellectual capital had different or unexpected relationships with firm performance. Maditinos et al. (2011) found no association between intellectual capital and firm performance for Greek listed companies.

A break-down of the impact of the different components of intellectual capital on firm performance follows next on this review.

2.11.1. The Impact of human capital on firm value and performance

The impact of human capital on performance remains uncertain with inconsistent results from different researchers. There has been evidence for both a positive correlation (Alhassan & Asare, 2016; Bharathi Kamath, 2008; Haris et al., 2019; Maditinos et al., 2011; Morris, 2015; Sumedrea, 2013;) and a negative correlation (Firer & Williams, 2003; Sherif & Elsayed, 2016; Tseng & James Goo, 2005; Zhicheng et al.,2016). In some studies, human capital has not been found to affect performance directly albeit it has been found to indirectly and positively impact performance through structural capital (Bontis, 1998; Tseng & James Goo, 2005). Human capital has also been found to have the highest degree of correlation with other forms of capital (Morris, 2015; Tseng & James Goo, 2005).

2.11.2. Impact of structural capital on firm value and performance

A study by Zhicheng et al., (2016) found structural capital to positively affect Return on Assets (ROA) and Return on Equity (ROE) but not productivity for companies with above average intellectual capital growth. This is because reducing human capital by increasing structural capital will only decrease costs (and consequently increase ROA and ROE) but will not improve the efficiency of assets. A few studies have produced results consistent with this finding (Berzkalne & Zelgalve, 2014; Haris et al., 2019).

Other studies have found structural capital to positively and directly affect firm performance (Anifowose et al., 2018; Firer & Williams, 2003; Sherif & Elsayed, 2016; Sumedrea, 2013).

2.11.3. Impact of physical capital on firm value and performance

Albeit this study's primary purpose is to evaluate the impact of intellectual capital on performance, the evaluation of the impact of physical capital on firm performance is still worthwhile. This is because the different forms of capital interact with each other to drive business performance and an optimal blend that produces the highest returns is of great value to firms (Elliot, 1992). Physical capital has been found to still be the biggest driver of performance for several firms in the knowledge economy (Clarke, Seng & Whiting, 2011; Firer & Williams, 2003; Maditinos et al., 2011; Sherif & Elsayed, 2016; Zhicheng et al., 2016). In a study by Alhassan & Asare (2016), physical capital was found to equally contribute to performance together with human capital.

2.12. Empirical evidence based on South Africa.

Firer & William's (2003) study found that physical capital remains the main driver of firm performance is South Africa. Their study was based on a sample of 75 publicly listed firms in South Africa that operate in intellectual capital-intensive industries such as banking, electrical, information technology and services. The study maintains that human capital does not have any correlation with the market performance of companies in South Africa. A more recent study by Morris (2015) had findings consistent with those of Firer & Williams. However, the study by Firer & Williams (2003) was limited in that it only focussed on one fiscal period using only evidence from 2001 reports.

A study by Firer & Stainbank (2003) investigated the explanatory power of intellectual capital on firm performance for 65 knowledge intensive companies. The results of this study indicated that intellectual capital could explain profitability and productivity but not market valuation. Additionally, the relationship between intellectual capital and profitability was found to be positive whereas the relationship between intellectual capital and productivity was negative.

Morris' (2015) study found human capital efficiency to have a high correlation with revenue growth in all industries except those that are consumer driven. In the consumer-driven industries, human capital efficiency was found to not drive revenue growth, though it was associated with higher profitability. This is dissimilar to the findings in the Firer & Williams study. The longer-term effect of human capital in South Africa is more unclear (Morris, 2015).

The results of the present study could potentially provide clarity on this delayed or long-term effect.

Schutz (2018) through the University of the Witwatersrand, studied the impact of intellectual capital on a firm's return on assets (ROA), revenue growth (RG), headline earnings per share (HEPS), market to book ratio (MB) and total share return (TSR) across 43 JSE-listed firms for a period running from 2001 to 2017. The study found no impact of intellectual capital on all measures of performance. Furthermore, the study found physical capital to similarly not impact performance. This is inconsistent with the Firer & Williams (2003) study, which found physical capital to be the main driver of performance in South Africa. The findings by Schutz (2018) on the impact of intellectual capital on RG & HEPS are likewise inconsistent with Morris' (2015) study, which found intellectual capital efficiency, through human capital efficiency, to positively affect RG & HEPS. Schutz has noted that their study was significantly less than that of Morris from a cross-sectional perspective.

2.13. Empirical evidence based on the impact of time-lags on firm performance

As already mentioned above, no study in South Africa has taken into account any delayed impact on performance. Internationally, only a few studies have taken this into account (Clarke, Seng & Whiting, 2011; Chen, Cheng & Hwang, 2005; Tan, Plowman & Hancock, 2007; Shiu, 2006). The study by Chen, Cheng & Hwang (2005) found intellectual capital to positively impact all measures of firm performance for a 3-year lag. Human capital was found to negatively impact asset turnover in findings by Shiu (2006) albeit all the other measures of performance were positively impacted by intellectual capital for a 1-year lag. The study by Tan, Plowmna & Hancook (2007) found a positive relationship between intellectual capital and an entity's earnings per share and return on equity for a 1-year lag.

2.14. Analysis by scope and industry

The research findings across the globe can be evaluated from a country & economy perspective, a time perspective as well as an industry perspective. The relationship and its intensity are different across different industries (Tan, Plowman & Hancock, 2007) and the intensifying power of intellectual capital on firm performance has been found to be more in high-tech companies than in non-high-tech companies (Tseng & James Goo, 2005).

Appendix A shows a break-down of different findings according to their industry and country.

The next chapters discuss the research methodology and data sampling applied in this study followed by a discussion of the results, conclusion and areas of future research.

Chapter 3

Methodology

This study investigates the relationship between intellectual capital and firm performance for companies listed on the South African Johannesburg Stock Exchange (JSE). This chapter entails how the research was conducted and discusses the research questions, hypotheses, research approach, research method as well as process.

3.1. Research Questions

The review of work done by other researchers has produced mixed results regarding the impact of intellectual capital on South African firm performance (Firer & Williams, 2003; Firer & Stainbank, 2003, Morris, 2015, Schutz, 2018). The current study adds to this research in an attempt to have more defined relationships between intellectual capital and firm performance in both a short and a long-term perspective.

The research questions developed are as follows:

1. What is the impact of human capital on a firm's short-term performance and long-term performance?
2. What is the impact of structural capital on a firm's short-term performance and long-term performance?
3. What is the impact of physical capital on a firm's short-term performance and long-term performance?

3.2. Hypothesis

The trend observed in past research indicates an improvement in both the definition of the relationship that exists between intellectual capital and firm performance as well as this relationship being observed to be more positive. In the earlier studies, no associations were observed between a firm's intellectual capital efficiency (human capital efficiency & structural capital efficiency) and its proxies of performance (Firer & Williams, 2003; Firer & Stainbank, 2003). In a more recent study by Morris (2015), positive correlations were observed between human capital and some proxies of performance.

Intellectual capital has been argued to be the main driver of a firm's competitive advantage, which is expected to drive long-lasting value for a firm rather than short-term returns. This is since a firm's returns such as ROA and ROE are based on accounting profits, and as discussed

under accounting limitations (2.2-2.4), accounting profits are decreased by investments in intellectual capital that are recognised as expenses. Following this, in any given year, an investment in intellectual capital is expected to decrease profits ceteris paribus. Additionally, as already discussed in the literature review (2.11), a time-lag exists between investments in intellectual capital and corresponding results (Joia, 2000). Thus, it is more likely than not that an investment in intellectual capital will not yield favourable returns in the year it occurs due to the accounting limitations and the effects of time-lags. Following this, considering time-lag effects is more appropriate in investigating the relationship between intellectual capital and firm performance. Once intellectual capital is applied efficiently to drive firm value and competitive advantage, it is expected that returns that are within the scope of accounting recognition will begin to be realised. Additionally, including time lags avoids omitted variable bias where the true model has time lag effects (Shi & Lee, 2017; Tao & Yu, 2012).

Based on this, the null (H_0) and alternative (H_1) hypotheses will be set out as follows in relation to short-term relationships:

> H_0: Intellectual capital (human capital and structural capital) has a positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the short-term.
>
> H_1: Intellectual capital (human capital and structural capital) has no positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the short-term.
>
> H_0: Physical capital has no positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the short-term.
>
> H_1: Physical capital has a positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the short-term.

Regarding long-term performance, the hypotheses are set out as follows:

> H_0: Intellectual capital (human capital and structural capital) has no positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the long-term.
>
> H_1: Intellectual capital (human capital and structural capital) has a positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the long-term.
>
> H_0: Physical capital has no positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the long-term.

H_1: Physical capital has a positive association with firm performance (Return on Assets, Total Asset Turnover, and Market to Book ratios) in the long-term.

The rationale as discussed above is that if intellectual capital truly drives competitive advantage for a firm, it will be realised through improved efficiencies that increase profits and sales in the long-term. Intellectual capital is therefore expected to bear fruit in the long run.

The hypothesised relationships are modelled in table 1 below:

Table 1
Regression models

Model	Regression equation
H_{1a}	$ROA_{it} = \alpha + \beta1\ HCE_{it} + \beta2\ SCE_{it} + \beta3\ CEE_{it} + \beta4\ SIZE_{it} + \beta5\ LEV_{it} + \beta6\ IND_{it} + \varepsilon_t$
H_{1b}	$ROA_{it} = \alpha + \beta1\ HCE_{it-1} + \beta2\ SCE_{it-1} + \beta3\ CEE_{it-1} + \beta4\ SIZE_{it} + \beta5\ LEV_{it} + \beta6\ IND_{it} + \varepsilon_t$
H_{2a}	$TAT_{it} = \alpha + \beta1\ HCE_{it} + \beta2\ SCE_{it} + \beta3\ CEE_{it} + \beta4\ SIZE_{it} + \beta5\ LEV_{it} + \beta6\ IND_{it} + \varepsilon_t$
H_{2b}	$TAT_{it} = \alpha + \beta1\ HCE_{it-1} + \beta2\ SCE_{it-1} + \beta3\ CEE_{it-1} + \beta4\ SIZE_{it} + \beta5\ LEV_{it} + \beta6\ IND_{it} + \varepsilon_t$
H_{3a}	$MB_{it} = \alpha + \beta1\ HCE_{it} + \beta2\ SCE_{it} + \beta3\ CEE_{it} + \beta4\ SIZE_{it} + \beta5\ LEV_{it} + \beta6\ IND_{it} + \varepsilon_t$
H_{3b}	$MB_{it} = \alpha + \beta1\ HCE_{it-1} + \beta2\ SCE_{it-1} + \beta3\ CEE_{it-1} + \beta4\ SIZE_{it} + \beta5\ LEV_{it} + \beta6\ IND_{it} + \varepsilon_t$

Time-lag used in investigating long-term relationships

There has not been much effort expended in research to determine the optimal time lag or a set lag to use in studies whose true models encompass time-lag effects. Some of this is caused by the fact that the relationships researchers are trying to investigate are unique, and therefore a one size fits all approach would be inappropriate (Dormann &Griffin, 2015). As it relates to intellectual capital, there exists no investigation into the period it takes to realise intellectual capital based on traditional measures of performance. This study makes use of a period of 1 fiscal year. 75% of studies that have performed lag models have used this (Clarke, Seng & Whiting, 2011; Tan, Plowman & Hancock, 2007; Shiu, 2006). The present study uses 1 year due to both its explanatory nature as well as to avoid underestimating the causal relationship between intellectual capital and firm performance due to using unnecessarily long periods (Cole & Maxwell, 2009; Dormann &Griffin, 2015; Dwyer, 1983). Using a 1-year lag will also allow for comparability with other studies that have used the same period.

3.3. Research Methodology

3.3.1. Measurement

Measurement of dependent variables

Firm performance has not been defined conclusively as it signifies different ideals for different stakeholders. A wide range of various proxies have been used and continue to be used by different stakeholders and researchers (Firer & Williams, 2003). The proxies used in this study are Return on Assets (ROA), Total Asset Turnover (TAT), and Market to Book Value (MB). These have comparably been used in prior studies (Firer & Williams, 2003; Maditinos et al., 2011; Morris, 2015; Sumedrea, 2013; Zhicheng et al., 2016). Some studies have used Return on Equity (ROE) as a measurement of performance (Chan, 2009; Clarke, Seng & Whiting, 2011; Maditinos et al., 2011; Tan, Plowman & Hancock, 2007). This study will not make use of this variable as ROE, calculated as a firm's net profit divided by its equity, is a performance measure that can be examined further as the product of three separate variables: profitability (net profit/sales), total asset turnover (sales/assets) and leverage (assets/equity) (De Wet & Du Toit, 2007). These determinants of ROE already form part of the dependent variables and the control variables in this study, and ROE will not be used in addition to these to avoid overfitting, redundancy and multicollinearity (Hawkins, 2004). The proxies used for performance have the following interpretations in this study in line with similar studies:

- ROA: The ratio of a firm's net profit divided by its total balance sheet assets;
- TAT: The ratio of a firm's total sales/revenue divided by its total balance sheet assets and;
- MB: The ratio of a firm's market capitalisation (calculated as the firm's share price multiplied by the number of shares in issue) to its equity (net assets).

Measure of independent variables

This study uses Pulic's VAIC model of valuing intellectual capital efficiency to determine the independent variables consistent with other studies (Alhassan & Asare, 2016;Anifowose et al., 2018; Berzkalne & Zelgalve, 2014; Bharathi Kamath, 2008; Clarke, Seng & Whiting, 2011; Firer & Williams, 2003;Sumedrea, 2013; Zhicheng et al., 2016). As already discussed in the review of literature, this model enables the quantification of the efficiency of a firm's value creating resources in their individual elements (Pulic, 1998, 2000, 2004). An advantage with VAIC is that it uses financial information which is easily accessible from an entity's audited financial results (Sumedrea, 2013). It allows for comparison between companies as it is a model based on financial numbers. Other models have measurements tailored to different business models, are non-financial and do not allow for objective comparison (Pulic, 1998).

Limitations of VAIC have already been discussed in the review of literature and include:

- Inability of VAIC to handle negative values (Zhicheng et al., 2016);
- Not allowing for comparability between intellectual capital intensive and non-intellectual capital intensive industries (Zhicheng et al., 2016);
- Not including all components of intellectual capital (Nazari & Herremans, 2007).

These shortfalls will be dealt with in this study by excluding observations with negative financial results consistent with Firer & Stainbank (2003). This study will also focus only on intellectual capital-intensive industries to allow for comparability in line with similar studies (Alhassan & Asare, 2016; Bharathi Kamath, 2008; Firer & Stainbank, 2003; Firer & Williams, 2003; Haris et al., 2019). Moreover, this study still uses VAIC regardless of its inability to measure relational capital separately. This is since most researchers still consider relational capital to be a subset of structural capital (Sumedrea, 2013), measurement of which is available in VAIC. Therefore, this study will not forego the value obtained from using VAIC simply due to its inability to measure relational capital separately. Using VAIC will also allow for comparison with prior studies, which have largely accepted VAIC as an appropriate valuation method (Alhassan & Asare, 2016;Anifowose et al., 2018; Berzkalne & Zelgalve, 2014; Bharathi Kamath, 2008; Clarke, Seng & Whiting, 2011; Firer & Williams, 2003; Sumedrea, 2013; Zhicheng et al., 2016).

This study makes use of the gross method of calculating value added, which includes the adding back of wages, depreciation and amortisation to operating profits to compute value added (Firer & Stainbank, 2003). The net method of value added does not include the adjustment to wages and salaries. The gross method calculation used in this study is in line with Pulic's argument that wages and salaries should not be included as inputs/expenses as they form part of investments that create value for a company (Pulic, 1998, 2000, 2004). Pulic has moreover argued that wages and salaries are a good proxy for a firm's human capital. He has disputed the argument that a firm could achieve a higher human capital efficiency by just having low salaries and wages as the formula would suggest by proving through investigation that low wages can never create high value for a firm. In his words "American VA cannot be achieved with African Salaries" (Pulic, 1998:14). Value is a function of the quality of employees, and the higher the quality of employees, the higher their remuneration.

Control Variables

A multiple linear regression is the main statistical tool used in this study. Given that there are other variables at organisational level that affect firm performance (Firer & Stainbank, 2003), such factors will be used as control variables. These control variables used are:

- Firm size: Represented by the natural log of the firm's market capitalisation (this avoids extreme values as market capitalisation varies with different companies);
- Firm leverage: Represented by the firm's Debt to Equity ratio (total debt divided by total equity);
- Industry type: Measured by dummy variables for all industries used in the study.

The use of these variables as control variables is comparable with prior studies (Chan, 2009; Firer & William, 2003; Firer & Stainbank, 2003; Morris, 2015; Zhicheng et al., 2016).

3.4. Research Method

Panel data was used to take into account multivariate regressions over time. Panel data models provide for observations of different firms over several years (De Jager, 2008). This enables analysis of complicated relationships and uncovering dynamic relationships that would not be possible under cross-sectional or time series models (Hsiao, 2007). This will be useful for the lagged model that this study will make use of. The use of panel data also considers firm heterogeneity, that is, non-uniformity within firms. It also limits regression errors where there are limitations of firm years observed (Baltagi & Song, 2006). This is useful for the study limitations faced in South Africa due to the structural breaks that occurred after apartheid in 1994 and the global financial crisis of 2008 (De Jager, 2008). Panel data also offers more sample variability through cross sectional time series and reduces collinearity between variables (De Jager, 2008). Additionally, panel data allows for the controlling of the impact of omitted variables (Hsiao, 2007), further minimising regression errors.

The studies by Firer & Williams (2003) and by Firer & Stainbank (2003) did not make use of panel data techniques and are consequently susceptible to the errors above that panel data limits.

3.5. Research Process

3.5.1. Data Collection and sampling procedures

The study investigates 62 listed firms in South Africa in knowledge-intensive industries. These are industries that rely mainly on human capital and structural capital in their production of goods & services. The industries are:

- Banking
- Computer Services
- Financial Services
- Healthcare Services
- Support Services

Initially, 71 companies in intellectual intensive industries were selected for the sample. Companies whose performance had negative values were removed as VAIC is limited to interpreting only positive values. The data was collected for the firms' financial years falling in the period 1 January 2009 to 31 December 2018 resulting in 564 firm years observed. The years 2007 and 2008 were excluded to minimise the impact of the global financial crisis on financial results. The aim was to study an unbroken period of 10 years. All sample data was obtained from the Bloomberg L.P. database. It can be considered reliable as all results have been audited by eternal auditors.

This study also aimed to provide an update relating to the relationship between intellectual capital and firm performance in South Africa. The most recent studies by Morris (2015) and Schutz (2018), investigated a period ending in 2011. Similar to Morris's (2015) study, all companies listed in the industries were used regardless of whether they got delisted in order to avoid survivorship bias.

The final sample consisted of 62 companies in industries highly driven by intellectual capital. The breakdown of these is shown in Table 2 below:

Table 2
Sample firms per industry and frequency

Industry	Frequency	Percentage (%)
Banks	6	9,68%
Computer services	9	14,52%
Financial services	31	50,00%
Healthcare services	5	8,06%
Support Services	11	17,74%
Total	62	100,00%

The hypotheses predict that intellectual capital (human and structural capital) will have a positive impact on performance only in the long term whereas physical capital will have a

positive impact on performance both in the long and short-term. Given that, and the 1-year time-lag used to investigate long-term impact, control variables and independent variables used in the regressions were gathered from 2009 to 2017. Performance data was gathered from the period between 2010 and 2018 for the long-term analysis whereas both control, dependent and independent variables were gathered from 2009 to 2018 for the short-term analysis.

3.5.2. Transformation of data

The transformation of data included the identification and winsorizing of outliers as well has a logarithmic transformation of the market capitalisation control variable.

Outliers

Identifying and dealing with outliers is important as outliers affect the distribution of data and create distortions of the general pattern. Identifying and dealing appropriately with outliers optimises analysis of results (Limas et al., 2004). Outliers in this study were identified using a model developed by Tukey called the outlier labelling rule (Hoaglin, Iglewicz & Tukey, 1986). This model has been found to be more resistant to extreme values as it does not make use of the mean of the data but rather its quartiles (Seo, 2006). The model is moreover applicable to non-normal distributions unlike other models. This model, however, has a limitation in that it cannot appropriately deal with small sample sizes (Seo, 2006). This limitation was not a matter of concern in the present study given the study's large sample size.

The model uses the following formula to determine the lower and upper bounds to identify probable outliers:

$$\text{Lower bound} = Q1 - g*(Q3-Q1)$$
$$\text{Upper bound} = Q3 + g*(Q3-Q1)$$

Where:

Q1 = First quartile

Q3 = Third quartile

g = Multiplication factor

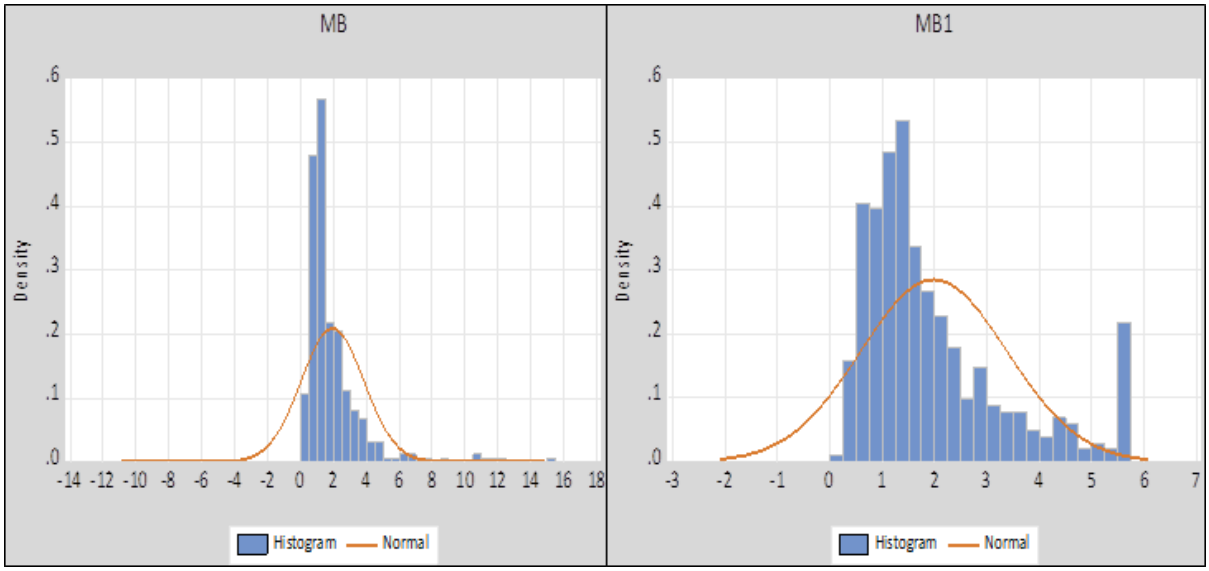
Values that lie outside the lower and upper bounds are considered probable outliers (Hoaglin & Iglewicz, 1987). Tukey initially suggested a value of 1.5 for the value of g outside of any statistical claim (Seo, 2006). This was however found to detect values that were not outliers as outliers and Hoaglin & Iglewicz (1987) fine-tuned Tukey's model by arguing for a value of 2.2

in place of the 1.5. This was statistically observed to be more appropriate, and the present study has used 2.2 as the multiplication factor.

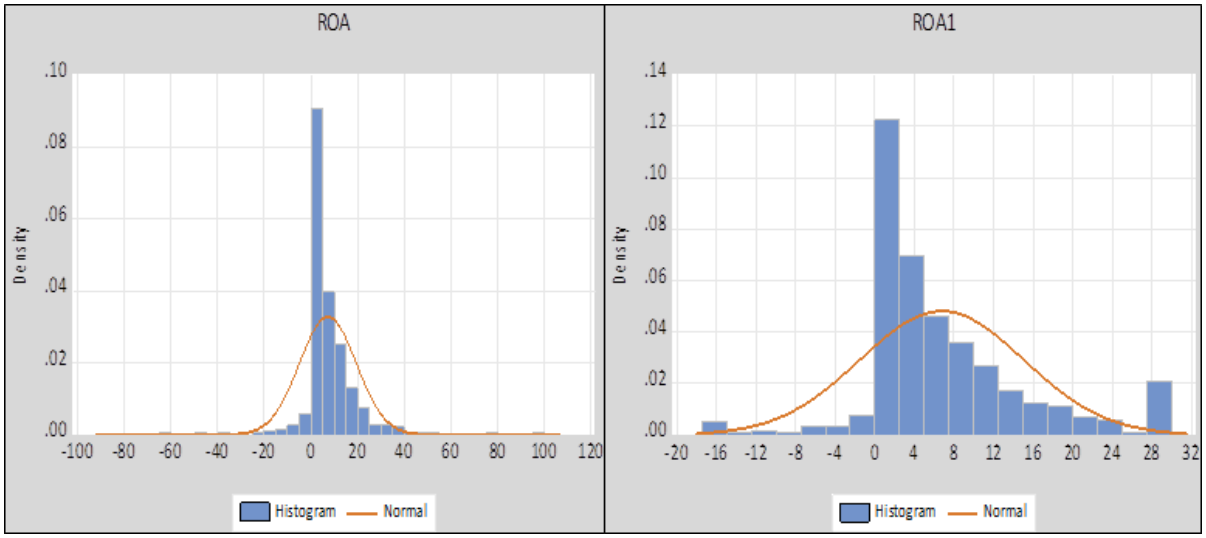
After detection, outliers were winsorized in substitute of trimming them completely from the data. Winsorizing of outliers is a process that includes adjusting outliers and watering them down to the nearest value in the common data set instead of deleting the outliers (Ghosh & Vogt, 2012). This enables the reduction of the impact of outliers without having to change the data substantially (Jadhav & Kashid, 2014). The winsorization process resulted in a total 88 of 4367 data points adjusted.

Market Capitalisation

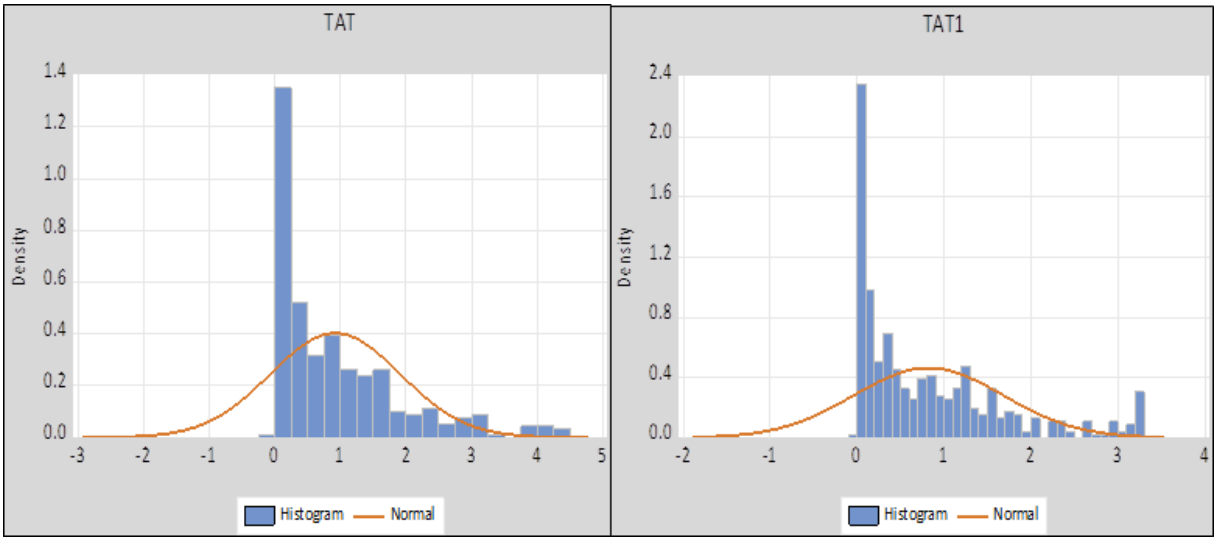
The market capitalisation was transformed using a logarithmic transformation consistent with similar studies (Firer & Williams, 2003; Firer & Stainbank, 2003 Morris, 2015; Zhicheng et at., 2016). This is since the market capitalisation of firms varies substantially due to fluctuating share prices (Barnes, 1982). Graphs 1- 3 show a contrast of untransformed and transformed dependent variables graphically.



Graph 1: Visual comparison between untransformed MB (left) and transformed MB (right)



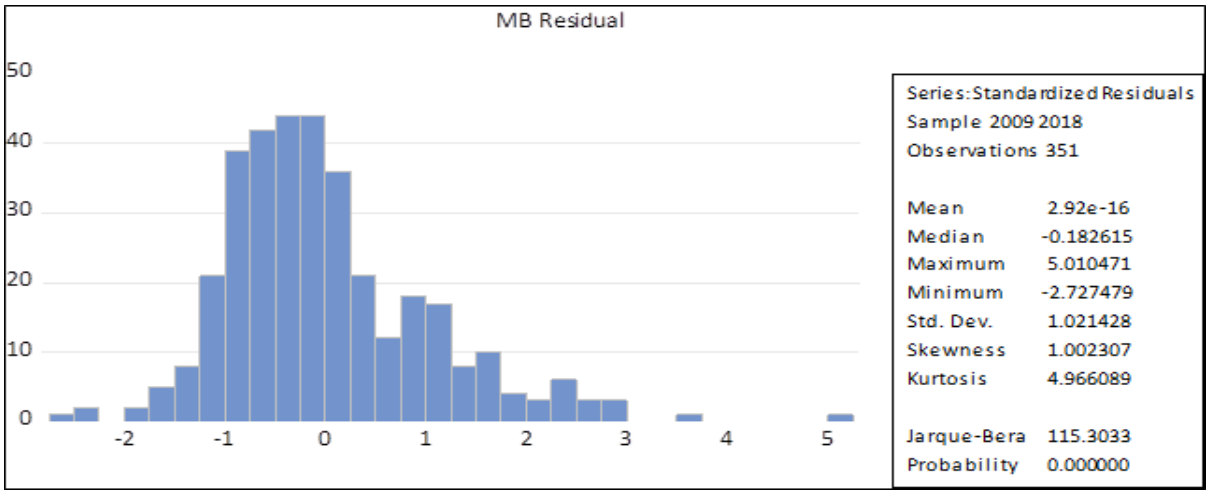
Graph 2: Visual comparison between untransformed ROA (left) and transformed ROA (right)



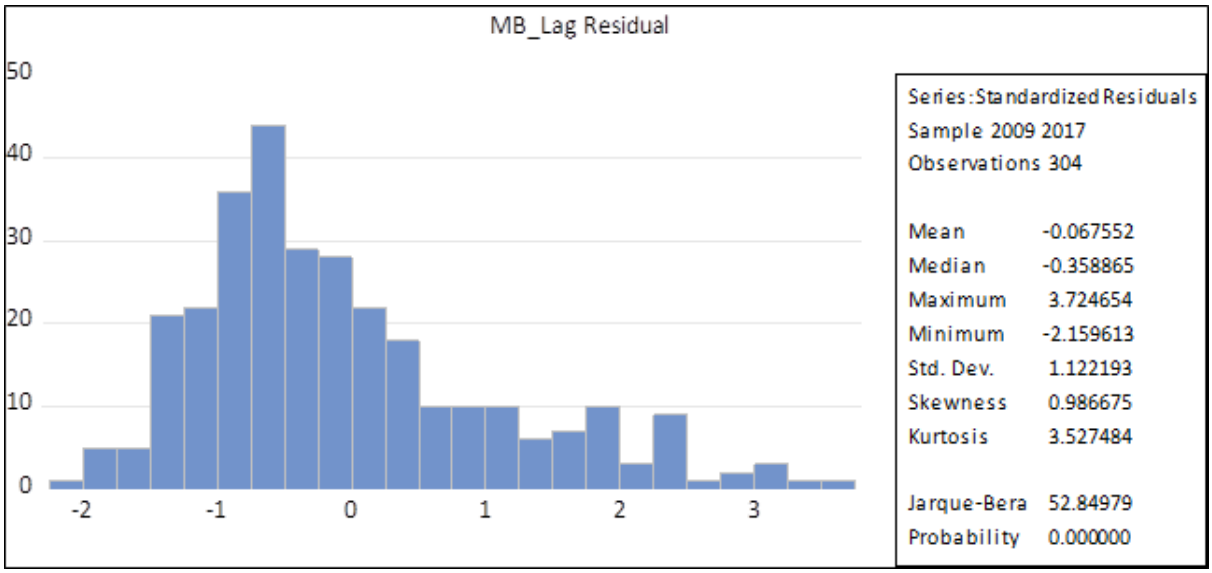
Graph 3: Visual comparison between untransformed TAT (left) and transformed TAT (right)

As seen in the graphs above, in some instances the transformation has led to more values around the edge of the tails. This is due to the winsorization process that did not eliminate outliers completely but rather adjusted them to the closest value within the lower and upper bounds. This result, though altering the data set is better than if the outliers were left in the data set or eliminated completely (Ghosh & Vogt, 2012).

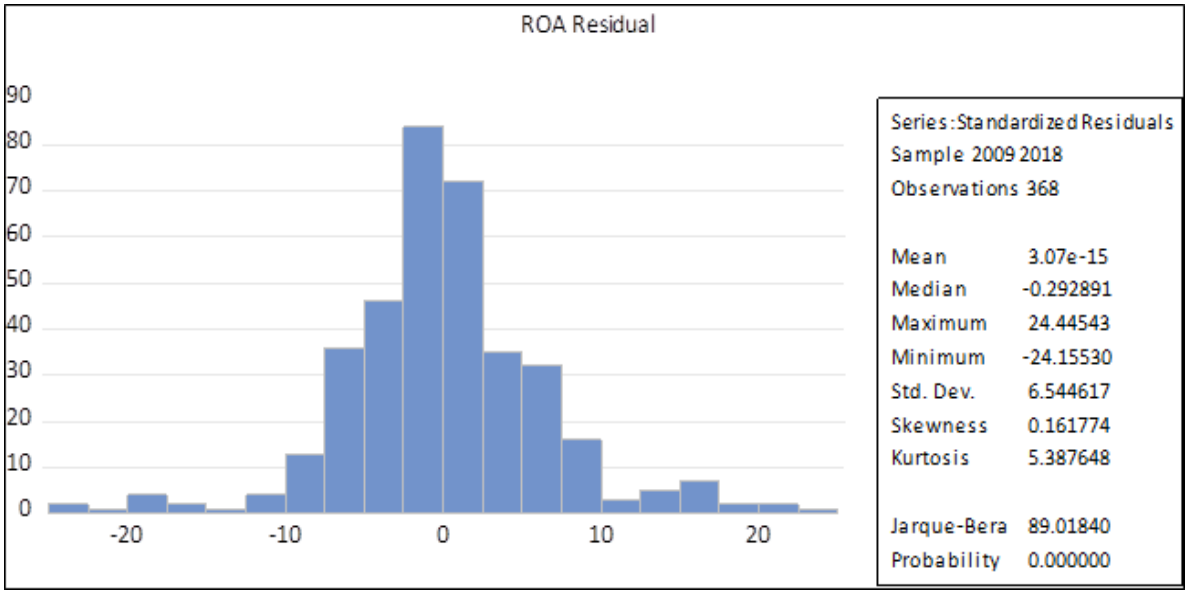
Additionally, the distributions of the dependent variables still do not mirror normal distributions after the transformations and that has the potential to violate regression assumptions. Williams, Grajales & Kurkiewicz (2013), have corrected the misconception that variables have to be normally distributed in order for the regression assumptions to be met. They have argued that it is the regression error, and not the variables that should be normally distributed. Descriptive statistics were run on the residuals for each model to determine whether they display a normal distribution. The results of this tests are shown in graphs 4-9 below:



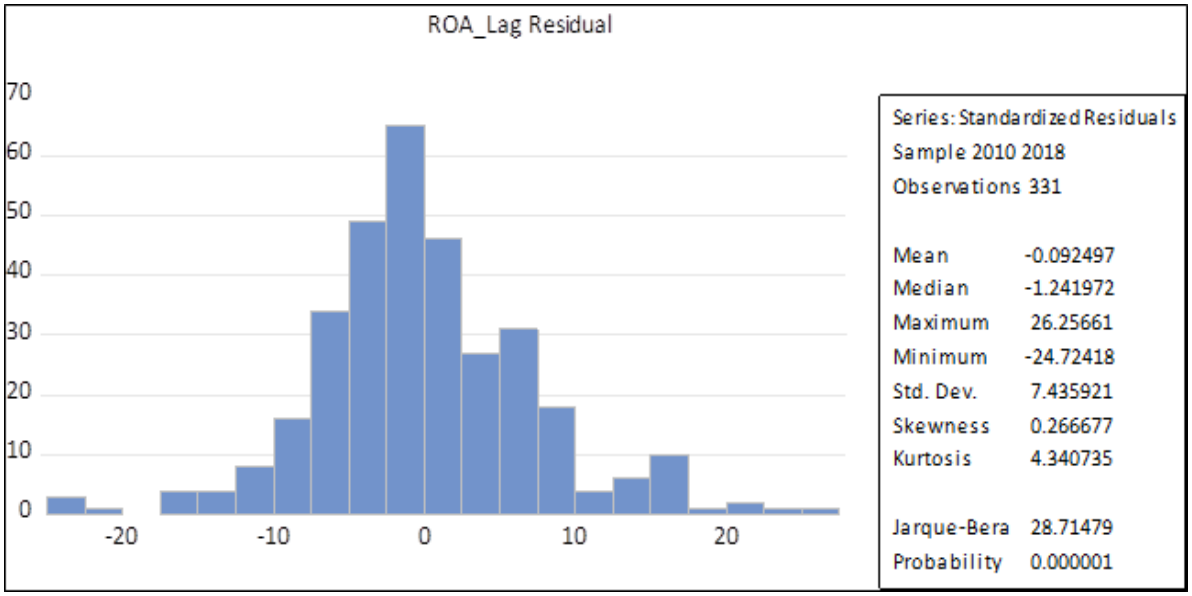
Graph 4: MB residual descriptive statistics and histogram



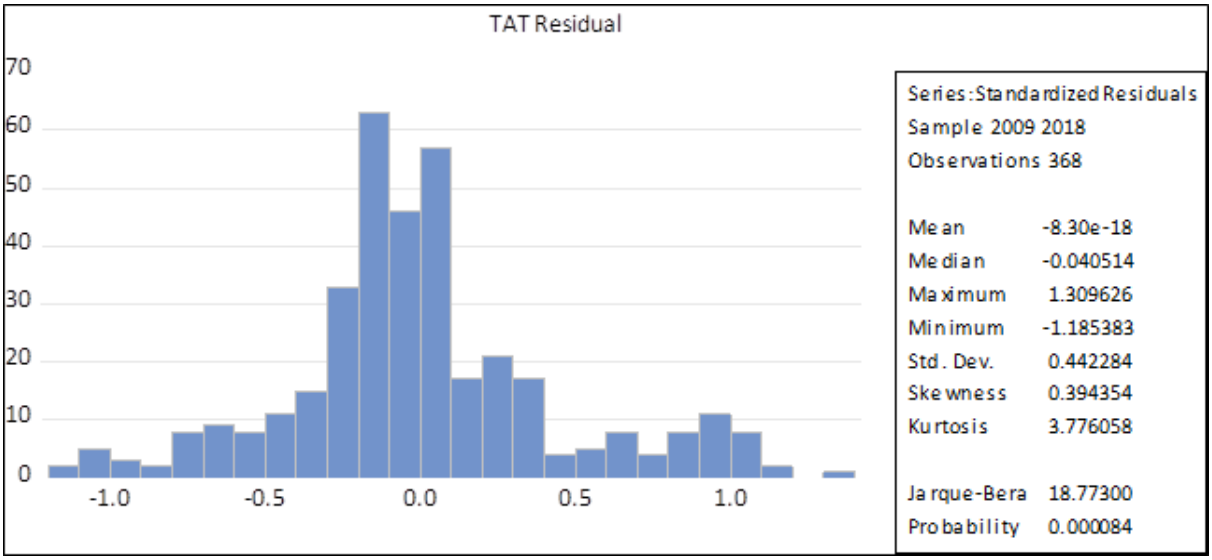
Graph 5: MB_lag residual descriptive statistics and histogram



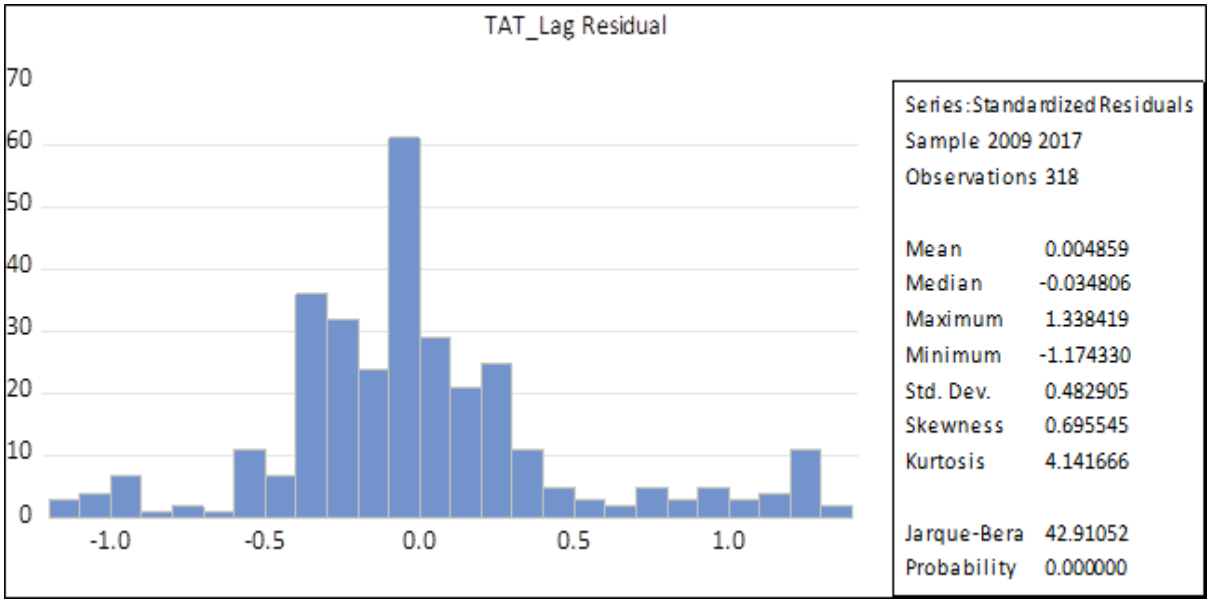
Graph 6: ROA residual descriptive statistics and histogram



Graph 7: ROA_lag residual descriptive statistics and histogram



Graph 8: TAT residual descriptive statistics and histogram



Graph 9: TAT_lag residual descriptive statistics and histogram

As observed above, the ROA model residuals exhibit normal distributions with the TAT model residuals not too far from normality. The residuals relating to the MB models do not exhibit normal distributions. The danger of this is that it may be challenging to make trustworthy inferences about the entire population that this data is drawn from (Williams, Grajales & Kurkiewicz, 2013). However, since the variables are financial ratios, the non-normality of these variables is common, and Barnes (1982) has shown that the normality of financial ratios is irrelevant for statistical models.

3.5.3. Multicollinearity test

Multicollinearity exists when the independent variables are collinear. This creates an issue regarding the determination of the true impact of each independent variable on the dependent variable (Mason & Perreault Jr, 1991). In this study, the biggest threat to multicollinearity is that which could exist between human capital and structural capital. A variance inflation factor method will be used to test for multicollinearity. The results are shown in tables 3 and 4 below:

Table 3
Variance Inflation Factor

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	4.884738	40.84886	NA
HCE1	1.833180	60.52051	11.03253
SCE1	24.01374	35.82899	11.16156
CEE1	0.640107	3.860603	1.636165
LN_CAP_	0.041301	24.00019	2.061214
LEVERAGE1	0.000433	2.235242	1.149188
B	1.716918	2.106853	1.797695
CS	1.819697	2.026218	1.756422
HS	2.415074	1.756189	1.603477
SS	1.340875	2.132932	1.727212

Table 4
Variance Inflation Factor – Lagged Model

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.028619	7.816936	NA
HCE1	0.005347	12.31071	7.130256
SCE1	0.102395	11.41342	7.314306
CEE1	0.002855	1.383965	1.095302
LN_CAP_	0.000234	4.960934	1.147298
LEVERAGE1	1.80E-06	1.207740	1.059997
B	0.043051	1.383649	1.220838
CS	0.036861	1.369365	1.183119
HS	0.050083	1.258809	1.142972
SS	0.028119	1.481848	1.195941

The variance inflation factors in table 3 confirm that multicollinearity exists between human capital efficiency and structural capital efficiency given factors above 10 (O'brien, 2007). This limitation and how it can be lessened is discussed under *limitations/risks*. The multicollinearity issue, however, is not as pervasive in the lagged model with factors less than 10.

3.5.4. Hausman Specification Tests

This study uses panel data to investigate the relationship between the dependent and independent variables. Within panel data the two main models used for analysis are the fixed effects and the variable effects models. These models make certain assumptions about the error term. In the fixed effects model, the error term is assumed to be correlated with the observable explanatory variables whereas the random effects model assumes a random distribution of the error term which is uncorrelated with all other variables (Bell &Jones, 2015). Clark & Linzer (2015) indicated that the use of either models is a trade-off between minimising bias (fixed effects) and minimising the coefficient estimate variance (variable effects). The Hausman Specification test is a tool that can be used to determine which of the models is more appropriate in explaining the relationship between the dependent and independent variables. Results of the Hausman Specification test are shown in table 5 below for each of the 6 models:

Table 5
Hausman Specification Test per model

Correlated Random Effects - Hausman Test
Equation: ROA
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	8.211494	9	0.5130

Correlated Random Effects - Hausman Test
Equation: LAGGED_ROA
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	16.021854	5	0.0068

Correlated Random Effects - Hausman Test
Equation: TAT
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	15.717051	9	0.0730

Correlated Random Effects - Hausman Test
Equation: LAGGED_TAT
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	13.617481	5	0.0182

Correlated Random Effects - Hausman Test
Equation: MB
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	6.948144	9	0.6425

Correlated Random Effects - Hausman Test
Equation: LAGGED_MB
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	17.984099	5	0.0030

The Hausman Specification test examines correlation between unique errors and explanatory variables and the null hypothesis of the Hausman test is that the random effects is appropriate (Hausman, 1978). The results of the Hausman test above indicate that the random effects model is appropriate for the investigation of the short-term relationship between intellectual capital and firm performance. This is seen by the probability values of 0.5130, 0.0730 and 0.6425 for the respective ROA, TAT and MB variables. For the lagged model however, the fixed effects model has been suggested to be more appropriate by the Hausman test with probability values less than 0.05.

Therefore, the random effects model will be used for the contemporaneous models and the fixed effects model will be used for the lagged models.

3.6. Limitations/risks

The limitation faced in this study is the one regarding the multicollinearity between human capital efficiency and structural capital efficiency. The risk is that the regression results may

not determine appropriately the impact of each variable on firm performance. Thus, the interpretation of results from this study should take into account this interdependence by not isolating the results relating to the impact of human capital efficiency and structural capital efficiency on firm performance. Such interpretation as in the results, is comparable with prior studies (Firer & Williams, 2003; Firer & Stainbank, 2003 Morris, 2015; Zhicheng et at., 2016).

Chapter 4

Results and analysis

This chapter entails the statistical analysis, correlation analysis and multiple regression analysis. These will also be compared to previous studies.

4.1. Statistical Analysis and Descriptive statistics

Descriptive statistics provide summaries of data that can be used for analysis. This also enables researchers to ensure that the data used is suitable for the study. Table 6 below shows the descriptive statistics of the untransformed data after sampling and Table 7 shows the descriptive statistics of the transformed data.

Untransformed

The data illustrates an unbalanced panel due to the unequal number of observations within the different variables. This is common amongst economic empirical studies (Baltagi & Song, 2006). The dependent variables are MB, ROA and TAT. The respective means of these variables untransformed were 2.130723, 7.056378 and 0.843302. The average MB ratio of 2.130723 indicates a valuation of twice the book value of firms by the market. This implies that the market perceives additional value in these intellectual intensive firms that are not being captured or recognised by traditional accounting measures. This moreover supports the argument that intellectual capital not recognised in financial statements as assets bridge the gap between firm book values and market values (Berzkalne & Zelgalve, 2014; Chauvin & Hirschey, 1993; Dzinkowski, 2000; Edvinsson, 1997; Mouritsen, Thorsgaard Larsen & Bukh, 2005; Stewart, 1999; Sveiby, 1997). The results of the present study have the potential to confirm this argument, through the investigation of the relationship between intellectual capital efficiency and MB ratios, using multiple regression models. The average productivity represented by TAT of 0.843302 shows and inefficient use of assets by firms in generating revenue. This is an interesting finding considering that intellectual capital-intensive industries are expected to have better productivity through the efficient use of their intellectual capital. This is particularly expected in cases where intellectual capital assets are not recognised as assets but rather expenses, implying that the denominator in the TAT ratio would be reduced and ceteris paribus, lead to a higher average TAT ratio. The timing of the investments in both physical and intellectual assets may perhaps contribute to the lower average TAT ratio as any investments that arise towards the end of a fiscal year might not have enough time to be

incorporated into the relevant business processes and consequently be wholly productive in the same fiscal year. The TAT (lagged) regression results analyses that follow slightly later in this chapter have the potential of confirming this theory as they examine a delayed impact on productivity for both physical and intellectual investments. The average ROA indicates that on average firms are generating 7 cents of profit per R1 spent on total assets. The ROA exhibits the highest volatility amongst the dependent variables with the highest return at 98% and the lowest at -64% as well as a standard deviation of 11.39.

The MB ROA and TAT do not mirror a normal distribution given the skewness values of 2.910463, 1.496684 and 1.603234 respectively. A skewness of 0 would indicate that the variables are normally distributed. The kurtosis values above 3 of 14.38785, 19.60270 and 5.475102 indicate leptokurtic (peaked) curves with a lot of values above the sample mean. The non-normality of these variables is considered acceptable as it is likely that financial ratios are skewed (Firer & Stainbank, 2003; Barnes, 1982). Barnes (1982) has moreover demonstrated that the normality of financial ratios is irrelevant for statistical models.

Of the independent variables, firms are exhibiting a high efficiency of human capital with an average of 16.36563 while structural capital efficiency and physical capital efficiency have an average of 0.360408 and 0.522674 respectively. The overall average efficiency of these firms to create value as shown by the VAIC coefficient is 12.57018. This suggests that human capital in these firms is the greatest contributor to their value-added intellectual efficiencies. The heavy concentration of human capital could be of slight concern as it is in the best interest of firms to codify their human capital into structural capital and physical capital so as to allow value creation to continue after the brains have left. It is moreover interesting to note that these firms have low physical capital efficiency, which is expected for firms in intellectual capital-intensive industries. Human capital efficiency also exhibits the largest variance with a standard deviation of 203.1103 and minimum and maximum values of 1.0 and 2 924.625 respectively. This potentially speaks to the challenge of finding quality human capital that has the ability to create value.

The size of the firms as represented by the market capitalisation has the largest variance of the sample data with a range of 358 374.809 and a standard deviation of 53 157.25. This is since the market capitalisation is a function of a firm's share price multiplied by its market

capitalisation. The fluctuation of share prices, which is a function of market sentiments, contributes largely to this variation.

Transformed

The transformation process has not created substantial differences between the raw data and the transformed data. The respective means of the MB, ROA and TAT figures are 1.985250, 6.764654 and 0.821731 after transformation. This is in comparison to the respective untransformed means of 2.130723, 7.056378 and 0.843302. The interpretation of these values has not changed after the transformation. The distribution of the data has also not changed, and the MB, ROA and TAT data still mirror non-normal distributions. This is essential as it maintains the real representation and integrity of the performance figures. Of the independent variables, HCE, ICE and VAIC had substantial changes in their means from 16.36563 to 1.815087, 12.12998 to 2.171068 and 12.57018 to 2.684068 respectively. The reason for the change is due to the high volatility of HCE as mentioned above. HCE had a large number of outliers that resulted in a standardising of values after the winsorizing process. The standard deviation of HCE dropped from 203.1103 to 0.842542. Given that ICE is a function of HCE and SCE, and VAIC is function of ICE and CEE, both ICE and VAIC were as well proportionally affected by the changes to HCE. The average SCE remained at 0.360408 and the average CEE had a slight move from 0.522674 to 0.618371. Given that HCE still represents the greatest weight on the capital structure of the sample firms, the large transformation of HCE is not a cause of concern to the contribution of the variables to performance and the interpretation therefore. The volatility of the market capitalisation variable has as well decreased with its standard deviation decreasing from 53 157.25 to 2.376613 after the logarithmic transformation process.

Table 6
Descriptive statistics of untransformed sampled data

	CEE	HCE	ICE	SCE	VAIC	MB	ROA	TAT	CAP	LEVERAGE
Mean	0.522672	16.36563	12.12998	0.360408	12.57018	2.130723	7.056378	0.843302	24539.07	16.81178
Median	0.398606	1.499541	1.399619	0.334175	2.223121	1.504900	4.353400	0.506850	2016.517	11.32440
Maximum	7.982518	2924.625	2925.625	1.000000	2926.191	15.44450	98.03330	4.436800	358390.2	84.44380
Minimum	-65.47504	1.000000	0.000000	0.000000	-63.47957	0.029100	-63.98440	-0.034000	17.39070	0.000000
Std. Dev.	3.135854	203.1103	173.1064	0.233391	173.1321	1.941482	11.39493	0.929772	53157.25	18.50036
Skewness	-19.61662	14.18976	16.69544	0.439919	16.68802	2.910463	1.496684	1.603234	3.200665	1.424342
Kurtosis	414.9193	202.4116	279.8405	2.399076	279.6783	14.38785	19.60270	5.475102	14.52606	4.626520
Jarque-Bera	3388665.	691387.1	1827257.	19.39341	1825123.	2753.364	5455.024	314.4785	3078.189	213.8664
Probability	0.000000	0.000000	0.000000	0.000061	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	248.2692	6693.544	6841.311	147.7674	7089.580	860.8122	3245.934	387.9190	10429104	8019.217
Sum Sq. Dev.	4661.118	16831551	16870754	22.27875	16875770	1519.050	59598.63	396.7947	1.20E+12	162917.4
Observations	475	409	564	410	564	404	460	460	425	477

Table 7
Descriptive statistics of transformed sampled data

	CEE1	HCE1	ICE1	SCE1	VAIC1	MB1	ROA1	TAT1	LN_CAP_	LEVERAGE1
Mean	0.618371	1.815087	2.171068	0.360408	2.684068	1.985250	6.764654	0.821731	7.854586	16.77833
Median	0.398606	1.499541	1.830898	0.334175	2.607996	1.504900	4.353400	0.506850	7.609127	11.32440
Maximum	2.184519	4.272648	5.272306	1.000000	7.316801	5.717800	28.67960	3.289000	12.78938	76.35040
Minimum	0.000000	1.000000	1.000000	0.000000	0.000871	0.029100	-15.89970	-0.034000	2.855936	0.000000
Std. Dev.	0.557179	0.842542	1.063340	0.233391	1.323700	1.396843	8.287607	0.861141	2.376613	18.38567
Skewness	1.257399	1.469896	1.239281	0.439919	0.385202	1.305858	0.849048	1.269059	0.181277	1.392070
Kurtosis	3.662095	4.570783	3.937830	2.399076	3.299273	3.926128	4.288629	3.869023	2.066116	4.456696
Jarque-Bera	133.8427	189.3283	119.9728	19.39341	12.43786	129.2593	87.09515	137.9471	17.77182	196.2337
Probability	0.000000	0.000000	0.000000	0.000061	0.001991	0.000000	0.000000	0.000000	0.000138	0.000000
Sum	293.7261	742.3705	890.1379	147.7674	1172.938	802.0409	3111.741	377.9964	3338.199	8003.262
Sum Sq. Dev.	147.1523	289.6298	462.4534	22.27875	763.9518	786.3213	31526.15	340.3776	2394.875	160903.6
Observations	475	409	410	410	437	404	460	460	425	477

4.2. Pearson correlation analysis

A Pearson correlation test was run on all variables to test the strength of the association between the variables. Table 8 shows the Pearson Correlation Matrix for all transformed data.

The unconditional correlations below show VAIC to have a positive association with MB and ROA, and no strong association with TAT. The relation between VAIC and ROA is stronger than that of VAIC and MB.

Of the components of VAIC, SCE and HCE are negatively associated with TAT whereas they have positive associations with other performance measures. This suggests that sample firms with higher human and structural capital efficiencies were associated with low levels of productivity of their assets and higher market valuation as well as higher returns on their assets. CEE is found to be positively correlated with all measures of performance, implying that high levels of physical capital efficiency are associated with higher market valuations, higher asset productivity as well as higher profitability. This supports the hypothesis of this research study.

Of the control variables, the size of a firm is found to have a negative correlation with the firm's asset turnover and return on assets. There is however a positive association between a firm's size and its market valuation. Leverage is found to have no association with market valuation and total asset turnover. It does however have a negative association with return on assets.

A strong correlation exists between SCE and HCE with a correlation coefficient of 0.939747 and p value of 0. This confirms the results of past research that has investigated the relationship between the different components of intellectual capital. Human and structural capital were constantly found to have the highest association due to structural capital being a product of human capital (Chen, Zhu & Yuan Xie, 2004; Edvinsson, 1997; Stewart, 1997; Tseng & James Goo, 2005).

Table 8
Pearson Correlation Matrix

Correlation Probability	CEE1	HCE1	ICE1	SCE1	VAIC1	MB1	ROA1	TAT1	LN_CAP_	LEVERAGE1
CEE1	1.000000 -----									
HCE1	-0.036028 0.4686	1.000000 -----								
ICE1	-0.026993 0.5867	0.997224 0.0000	1.000000 -----							
SCE1	-0.001371 0.9780	0.939747 0.0000	0.944876 0.0000	1.000000 -----						
VAIC1	0.489975 0.0000	0.873626 0.0000	0.880143 0.0000	0.842944 0.0000	1.000000 -----					
MB1	0.232738 0.0000	0.202217 0.0001	0.213882 0.0001	0.250453 0.0000	0.247679 0.0000	1.000000 -----				
ROA1	0.208935 0.0000	0.324028 0.0000	0.332113 0.0000	0.355138 0.0000	0.366945 0.0000	0.215107 0.0000	1.000000 -----			
TAT1	0.446610 0.0000	-0.230473 0.0000	-0.218844 0.0000	-0.166649 0.0008	0.082403 0.0913	-0.196336 0.0001	0.282322 0.0000	1.000000 -----		
LN_CAP_	-0.290761 0.0000	-0.116415 0.0253	-0.126729 0.0147	-0.162775 0.0017	-0.211921 0.0000	0.307443 0.0000	-0.219909 0.0000	-0.501157 0.0000	1.000000 -----	
LEVERAGE1	0.123972 0.0068	0.002988 0.9521	-0.015337 0.7574	-0.050863 0.3054	0.072467 0.1313	-0.009536 0.8485	-0.106286 0.0226	0.079710 0.0877	0.032278 0.5069	1.000000 -----

4.3. ROA regression results (Model 1)

Dependent Variable: ROA1
Sample: 2009 2018
Periods included: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.792383	2.210144	-0.810980	0.4179
HCE1	4.190012	1.353950	3.094659	0.0021
SCE1	-1.145830	4.900381	-0.233825	0.8153
CEE1	0.321807	0.800067	0.402225	0.6878
LN_CAP_	-0.126462	0.203226	-0.622273	0.5342
LEVERAGE1	-0.055610	0.020811	-2.672137	0.0079
B	1.538157	1.310312	1.173886	0.2412
CS	5.266227	1.348962	3.903912	0.0001
HS	6.955874	1.554051	4.475963	0.0000
SS	4.845496	1.157961	4.184506	0.0000

HCE has a positive association with ROA whereas SCE and CEE do not have substantial associations with ROA. This is consistent with the findings by Morris (2015), who found a positive association between HCE and ROA for all industries under their study. The study by Firer & Williams (2003) only found a positive relationship between SCE and ROA, other independent variables had no substantial associations. This study has conflicting results to those of Firer & Williams as it relates to the impact of SCE, which is found in the present study to have no relationship with ROA. This is particularly interesting following that this study and that of Firer & Williams focused on the same industries however differing periods. Additionally, the Firer & Williams study did not make use of panel data as already discussed in the literature review. Of the control variables, market capitalisation has been found to have no relationship with ROA whereas leverage has a negative association with ROA. This is interesting given that the expectation is that a firm's return on assets will have a positive implication on its market valuation through enhanced market sentiments. In the study by Firer & Williams (2003), market capitalisation was found to have a negative association with profitability and leverage was found to have no association with ROA. Of the industry variables, only the banking industry has no association with ROA, all other industries have positive associations with ROA. The banking industry was likewise found to have no association with ROA in the study by Firer & Williams (2003).

4.4. ROA (lagged) regression results (Model 2)

Dependent Variable: LAG_ROA
Sample (adjusted): 2009 2017
Periods included: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.613747	2.620577	1.378989	0.1689
HCE1	1.916147	1.621654	1.181600	0.2383
SCE1	3.775852	5.759750	0.655558	0.5126
CEE1	2.395154	0.962497	2.488480	0.0134
LN_CAP_	-0.528874	0.240865	-2.195727	0.0289
LEVERAGE1	-0.047021	0.023965	-1.962097	0.0507
B	2.007093	1.508617	1.330419	0.1844
CS	1.513313	1.531969	0.987822	0.3240
HS	3.864934	1.886490	2.048744	0.0414
SS	1.733471	1.345299	1.288540	0.1986

No associations are observed between HCE, SCE and ROA under the lagged model. Only CEE has a positive association with ROA. This is contrast to the lagged model by Chen, Cheng & Hwang (2005), who in their 3-year lag model study for Taiwanese firms found a positive association between HCE, SCE, CEE and ROA. The results of the current study also do not support its hypothesis, which is rather in line with the findings of Chen, Cheng & Hwang (2005). A latent reason for the disparity could be the difference in the period used for the lag model as well as the different industries of focus. Physical capital has been found, as expected, to positively associate with ROA under the lag model. This confirms the findings of Firer & Williams (2003) that physical capital continues to be the main driver of value for South African firms and could as well be a reason for the intellectual capital components' lack of association with ROA. Regarding the control variables, market capitalisation was found to have a negative association with ROA in the current study and only the Health Services industry is found to have an association with ROA.

4.5. TAT regression results (Model 3)

Dependent Variable: TAT1
Sample: 2009 2018
Periods included: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	0.978362	0.147816	6.618767	0.0000
HCE1	-0.000837	0.090553	-0.009244	0.9926
SCE1	-0.584625	0.327742	-1.783798	0.0753
CEE1	0.272059	0.053509	5.084347	0.0000
LN_CAP_	-0.078081	0.013592	-5.744696	0.0000
LEVERAGE1	0.004170	0.001392	2.995828	0.0029
B	-0.006770	0.087635	-0.077250	0.9385
CS	0.642673	0.090220	7.123412	0.0000
HS	0.510327	0.103936	4.909995	0.0000
SS	1.380662	0.077445	17.82754	0.0000

No association is observed between HCE, SCE and TAT. CEE has been found to have a positive association with TAT. The study by Firer & Williams (2003) also found no association between SCE and TAT, however, the study did find a negative association between HCE and TAT. The findings of the current study were expected as set out in the hypothesis due to the time-lag effect of realising intellectual capital. Market capitalisation has been found in this study to have a negative association with TAT whereas leverage has a positive association with TAT. Much as in the ROA model, the banking industry has no association with the TAT variable. Firer & Williams (2003) found no relationship between the control variables and TAT.

4.6. TAT (lagged) regression results (Model 4)

Dependent Variable: LAG_TAT
Sample (adjusted): 2009 2017
Periods included: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.486242	0.169172	2.874252	0.0043
HCE1	0.044726	0.073120	0.611678	0.5412
SCE1	-0.543091	0.319993	-1.697196	0.0907
CEE1	0.212898	0.053437	3.984133	0.0001
LN_CAP_	-0.009496	0.015309	-0.620337	0.5355
LEVERAGE1	-0.001525	0.001343	-1.135207	0.2572
B	-0.265664	0.207488	-1.280383	0.2014
CS	0.780380	0.191992	4.064640	0.0001
HS	0.405461	0.223793	1.811772	0.0710
SS	1.428123	0.167687	8.516585	0.0000

Similar to the short-term model, no associations exist between HCE, SCE and TAT under the

lag model. This contradicts with the expectations set out in the hypothesis of this study. CEE continues to be positively associated with TAT. Research by Shiu (2006) found a negative relationship between HCE and TAT for a 1-year lag model in their Taiwanese study. This is interesting given the expectation that the efficiency of human capital is expected to increase revenue, especially when the human capital is not recognised as assets and thus yielding a high TAT ratio. To have either no relationship or a negative relationship observed is good ground for further investigation and research. Market capitalisation and leverage were found to have no association with a firm's TAT for the succeeding year. Banking and Health Services were also found to have no association with TAT under the lagged model.

4.7. MB regression results (Model 5)

Dependent Variable: MB1
Sample: 2009 2018
Periods included: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.087250	0.382401	-2.843219	0.0047
HCE1	-0.767162	0.224453	-3.417911	0.0007
SCE1	4.757831	0.799924	5.947854	0.0000
CEE1	1.333804	0.128133	10.40956	0.0000
LN_CAP_	0.249536	0.033929	7.354553	0.0000
LEVERAGE1	-0.001917	0.003325	-0.576401	0.5647
B	0.592917	0.207151	2.862246	0.0045
CS	-0.413666	0.216885	-1.907305	0.0573
HS	0.048994	0.253126	0.193555	0.8466
SS	-0.607091	0.188397	-3.222405	0.0014

There is a negative association between HCE and MB. SCE and CEE are observed to have positive associations with MB, with SCE having the strongest relationship of the two. The study by Firer & Williams (2003) also found a negative association between HCE and MB. The study by Morris (2015) found no relationship between HCE and MB. These findings suggest that the South African markets have a negative to zero regard to human capital in South African firms. A study by Firer & Stainbank (2003) found that intellectual capital was unable to explain market valuation for the 2001 fiscal year. Market capitalisation has a positive association with MB while leverage has no association with MB. The Support Services industry

was found to have a negative association with market valuation whilst the Health Services and Computer Services industries have no associations with market valuation.

4.8. MB (lagged) regression results (Model 6)

Dependent Variable: LAG_MB
Sample (adjusted): 2009 2017
Periods included: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.076836	0.472426	0.162641	0.8709
HCE1	-0.371954	0.221841	-1.676668	0.0947
SCE1	1.892420	0.948362	1.995462	0.0469
CEE1	0.767036	0.146825	5.224158	0.0000
LN_CAP_	0.194225	0.042058	4.617998	0.0000
LEVERAGE1	-0.007064	0.003691	-1.913967	0.0566
B	0.632647	0.481471	1.313987	0.1899
CS	-0.296703	0.445833	-0.665503	0.5063
HS	0.762299	0.560250	1.360641	0.1747
SS	-0.339073	0.389805	-0.869853	0.3851

There exists no association between HCE and MB under the lag model. SCE and CEE are still positively associated with MB and SCE still has the strongest coefficient between the two. The study by Chen, Cheng & Hwang (2005) found positive associations between HCE, SCE, CEE and MB for their 3-year lagged model studying Taiwanese firms. The study by Shiu (2006) found a negative association between HCE and MB for their 1-year lagged model and a positive association between CEE and MB. Market capitalisation continues to have a positive association with MB for the succeeding year whilst leverage has no relationship with MB under the lag model. Under this model, none of the industries have any associations with a firm's MB.

4.9. Discussion

The results of this study have produced mixed results regarding the impact of intellectual capital on firm performance for South African firms in intellectual capital-intensive industries. The null hypothesis regarding impact of IC on short-term performance has been rejected as far as HCE and ROA are concerned. Increased efficiencies in an entity's human capital have been associated with a high return on the entity's assets. These findings are different from those study by Firer & Williams (2003), which found no association between HCE and ROA. The

null hypothesis is also rejected with regards to the relationship between SCE and MB. An increase in SCE has been observed to have a positive impact on valuation of the entity by the market. This is similar to the findings by Firer & Williams (2003). Regarding other performance measures, the null hypothesis cannot be rejected as the components of intellectual capital have had either a negative association or no association with a firm's measure of performance. Physical capital has been found to have positive associations with market valuation and total asset turnover. However, no association between physical capital and return on assets has been observed for contemporaneous relationships.

In relation to delayed impact on performance. The null hypothesis cannot be rejected for the association between intellectual capital and firm performance as no associations were observed between IC components and firm performance measures with the exception of SCE and MB. There is a positive relationship between a firm's MB and its prior year SCE. The null hypothesis is rejected regarding the association between CEE and firm performance as positive relationships have been observed in the multiple regression between CEE and all measures of performance. Indicating that physical capital remains the biggest contributor to firm performance in South Africa both in the short and long-term.

Having observed the results above, the multicollinearity between HCE and SCE cannot be ignored in the interpretation of results. Due to the interdependence of human capital and structural capital, it is possible that the contributions of each form of capital have not been fully defined as they two work together to create value. Structural capital is a product of human capital, and any contribution to value creation and performance it may have is with the assistance of human capital (Chen, Zhu & Yuan Xie, 2004; Stewart, 1997). The multicollinearity between human and structural capital is worth investigating further as discussed below under *Limitations and opportunities for further research*.

4.10. Limitations and opportunities for further research

One of the limitations faced in the present study is regarding the multicollinearity of human capital and structural capital. The implication is that the relationships observed between human capital efficiency and firm performance are likely to have an influence from structural capital efficiency and vice-versa. This is due to the interdependency of intellectual capital as already discussed in the literature review. The different components of intellectual capital are intertwined and participate in value creation through complex relationships (Chen, Zhu & Yuan

Xie, 2004; Stewart, 1997; Tseng & James Goo, 2005). An opportunity for further research would be to investigate the impact of one of the two variables to ascertain its impact on performance as well as to investigate the impact of the multicollinearity of these variables on the quality of results such as this one that have used both variables in their studies. Furthermore, there is an opportunity to explore an optimal mix of human and structural capital in maximising firm value.

The lack of several associations observed in this study may have been due to the study's use of a 1-year time lag for the realisation of intellectual capital due to its exploratory nature. Firer & Williams (2003) have argued that value-added and accounting profits capture two distinct and unrelated concepts. Thus, another area of further research would be to explore a lagged model using different periods in order to discover from a South African perspective, the optimal time lag for the realisation of intellectual capital, as well as to define conclusively the relationship between intellectual capital and firm performance. An appropriate time-lag period would also serve to allow for comprehension of the period it takes for value-added valuation methods to be consummated in traditional accounting profits.

Other areas of further research include the investigation of the relationship between intellectual capital and firm performance in non-capital-intensive industries. The knowledge economy is inescapable for all firms in all industries, it would add value from a South African perspective to define this relationship in other industries as well to allow for value-based decision making. It would likewise be worthwhile to investigate this relationship in other emerging economies so as to help make inferences about the developing world.

Chapter 5

Conclusion

With a growing global interest on intellectual capital in the new economy, now more than ever the relationship between intellectual capital and firm performance needs to be defined in order to enable decisions that maximize value creation. One of the challenges regarding the definition of this relationship is regarding the impact of time lags on the realisation of intellectual capital. This study investigated the impact of intellectual capital on a short-term perspective as well as made use of a lag model to determine delayed impact on performance. Using multiple regression analysis and panel data for 62 JSE listed firms in South Africa, the study produced mixed results consistent with other South African findings (Firer & Williams, 2003; Firer & Stainbank, 2003; Morris, 2015; Schutz, 2018).

The study used VAIC to determine the efficiency of a firm's intellectual capital. The results show that human capital efficiency has a positive impact on a firm's profitability and a negative impact on a firm's market valuation for corresponding periods. This is interesting as profits are often positively associated with market valuation. It could be following from what Firer & Williams (2003) argued, that physical capital efficiency remains the biggest contributor to market valuation in South Africa, and thus markets do not attribute any profitability to human capital efficiency but rather to physical capital efficiency. The results of this study will be of interest to the market in that regard to consider human capital efficiency as a driver of profits as well as a contributor to physical capital efficiency. Structural capital has been found to have a positive impact on a firm's market valuation in the short-term. Moreover, structural capital is a product of human capital, and thus fascinating that South African markets do not place value on the mere existence of human capital, but rather the transformation of human capital into structural capital. In as much as researchers have argued that market returns capture intellectual capital (Bontis, 1998; Cañibano, García-Ayuson & Sánchez, 2000; Edvinsson, 1997; Pulic, 1998; Suojanen, 1954; Stewart, 1997), from a South African context based on these findings, this is only through structural capital. These findings could potentially speak to the market's percept of the quality of human capital in South African firms. Additionally, the results of this study potentially echo the findings by Bontis (1998) and Tseng & James Goo (2005), who have found human capital to not affect performance directly but rather indirectly and positively through structural capital. The existence of multicollinearity between human

capital and structural capital should be taken into consideration in any implementation of policies using these findings. Physical capital remains the main driver of performance in South African firms.

Under the lag models, no associations were observed between intellectual capital and firm performance with the exception of SCE and MB, which have shown to have a positive relationship. This confirms once more that market valuation weighs heavily upon structural capital over human capital. It is moreover interesting to observe that human capital did not have a positive association with profitability in the lagged model as it did in the short-term model. The lack of associations observed in this study could owe to the limitations as discussed above under *Limitations and opportunities for further research*. Including the multicollinearity of human and structural capital as well as the use of a 1-year lag model due to the study's experimental nature. Given that VAIC and accounting profits use different principles of recognition, it may take longer than one year to reconcile and realise value-added efficiencies in traditional accounting profits. What has remained indisputable is the positive impact of physical capital on South African firm performance even under the lagged regression models. It can be concluded that as far as intellectual capital is concerned, the driver of performance in the South African context is structural capital through market valuation.

Appendix A: An analysis of the impact of intellectual capital on firm performance by scope

Intellectual Capital Positive Correlation To Firm Performance			
Study (by Author)	Scope		
	Country	No. of companies under study	Industry
Alhassan & Asare, 2016	Ghana	18	Banking
Anifowose et al., 2018	Nigeria	91	Multiple
Bornemann, 1999	Croatia	400	Multiple
	Austria	150	
Chen, Cheng & Hwang, 2005	Taiwan	4254 firm-year observations	Multiple
Chen, Zhu & Yuan Xie, 2004	China	31	High-tech
Clarke, Seng & Whiting, 2011	Australia	3944 – 8643 firm years	Multiple
Tan, Plowman & Hancock, 2007	Singapore	150	Multiple
Sumedrea, 2013	Romania	62	Non-Financial
Tseng & James Goo, 2005	Taiwan	500	Manufacturing
Zhicheng et al., 2016	Hong Kong	118	Multiple

Intellectual Capital Mixed Correlation To Firm Performance			
Study (by Author)	Scope		
	Country	No. of companies under study	Industry
Berzkalne & Zelgalve, 2014.	Latvia	64	Non-Financial & Real Estate
	Lithuania		
	Estonia		
Firer & Williams, 2003	South Africa	75	Intellectual Capital Intensive
Firer & Stainbank, 2003	South Africa	65	Intellectual Capital intensive
Haris et al., 2019	Pakistan	29	Banking
Maditinos et al., 2011	Greece	96	Multiple

Human Capital Positive Correlation To Firm Performance			
Study (by Author)	Scope		
	Country	No. of companies under study	Industry
Alhassan & Asare, 2016	Ghana	18	Banking
Bharathi Kamath, 2008	India	25	Pharmaceutical
Haris et al., 2019	Pakistan	29	Banking
Maditinos et al., 2011	Greece	96	Multiple
Morris, 2015	South Africa	390	Multiple
Sumedrea, 2013	Romania	62	Non-Financial

Human Capital Negative Correlation To Firm Performance			
Study (by Author)	Scope		
	Country	No. of companies under study	Industry
Firer & Williams, 2003	South Africa	75	Intellectual Capital Intensive
Sherif & Elsayed, 2016	Egypt	29	Insurance
Tseng & James Goo, 2005	Taiwan	500	Manufacturing
Zhicheng et al.,2016	Hong Kong	118	Multiple

Structural Capital Positive Correlation To Firm Performance			
Study (By Author)	Scope		
	Country	No. of companies under study	Industry
Anifowose et al., 2018	Nigeria	91	Multiple
Firer & Williams, 2003	South Africa	75	Intellectual Capital Intensive
Sherif & Elsayed, 2016	Egypt	29	Insurance
Sumedrea, 2013	Romania	62	Non-Financial

Structural Capital Negative Correlation To Firm Performance			
Study (By Author)	Scope		
	Country	No. of companies under study	Industry
Berzkalne & Zelgalve, 2014	Latvia Lithuania Estonia	64	Non-Financial & Non-Real Estate
Haris et al., 2019	Pakistan	29	Banking
Zhicheng et al.,2016	Hong Kong	118	Multiple

Physical Capital highest contributor To firm performance			
Study (By Author)	Scope		
	Country	No. of companies under study	Industry
Alhassan & Asare, 2016	Ghana	18	Banking
Clarke, Seng & Whiting, 2011	Australia	3944 – 8643 firm year	Multiple
Firer & Williams, 2003	South Africa	75	Intellectual Capital Intensive
Maditinos et al., 2011	Greece	96	Multiple
Sherif & Elsayed, 2016	Egypt	29	Insurance
Zhicheng et al.,2016	Hong Kong	118	Multiple

References

Agle, B., Mitchell, R. & Sonnenfeld, J. 1999. Who matters to CEOs? An investigation of stakeholder attributes and salience, corporate performance, and CEO values. *Academy of Management Journal.* 42(5):507-525. DOI: https://doi.org/10.2307/256973.

Alhassan, A.L. & Asare, N. 2016. Intellectual capital and bank productivity in emerging markets: evidence from Ghana. *Management Decision.* 54(3):589-609. DOI: https://doi.org/10.1108/MD-01-2015-0025.

Andriessen, D. 2004. IC valuation and measurement: classifying the state of the art. *Journal of Intellectual Capital.* 5(2):230-242. DOI: https://doi.org/10.1108/14691930410533669.

Anifowose, M., Abdul Rashid, H.M., Annuar, H.A. & Ibrahim, H. 2018. Intellectual capital efficiency and corporate book value: evidence from Nigerian economy. *Journal of Intellectual Capital.* 19(3):644-668. DOI: https://doi.org/10.1108/JIC-09-2016-0091.

Arthur, W.B. 1996. Increasing returns and the new world of business. *Harvard Business Review.* 74(4):100-150.

Baltagi, B.H. & Song, S.H. 2006. Unbalanced panel data: A survey. *Statistical Papers.* 47(4):493-523. DOI: https://doi.org/10.1007/s00362-006-0304-0.

Barnes, P. 1982. Methodological implications of non-normally distributed financial ratios. *Journal of Business Finance & Accounting.* 9(1):51-62. DOI: https://doi.org/10.1111/j.1468-5957.1982.tb00972.x.

Bell, A. & Jones, K. 2015. Explaining fixed effects: Random effects modeling of time-series cross-sectional and panel data. *Political Science Research and Methods.* 3(1):133-153. DOI: https://doi.org/10.1017/psrm.2014.7.

Berman, S., Wicks, A., Kotha, S. & Jones, T. 1999. Does Stakeholder Orientation Matter? The Relationship between Stakeholder Management Models and Firm Financial Performance. *Academy of Management Journal.* 42(5):488. DOI: https://doi.org/10.5465/256972.

Berzkalne, I. & Zelgalve, E. 2014. Intellectual Capital and Company Value. *Procedia-Social and Behavioral Sciences, 110, pp.887-896.* DOI: https://doi.org/10.1016/j.sbspro.2013.12.934.

Bharathi Kamath, G. 2008. Intellectual capital and corporate performance in Indian pharmaceutical industry. *Journal of Intellectual Capital.* 9(4):684-704. DOI: https://doi.org/10.1108/14691930810913221.

Bontis, N. 1998. Intellectual capital: an exploratory study that develops measures and models. *Management Decision.* 36(2):63-76. DOI: https://doi.org/10.1108/00251749810204142.

Bontis, N., Dragonetti, N.C., Jacobsen, K. & Roos, G. 1999. The knowledge toolbox: *European Management Journal.* 17(4):391-402. DOI: https://doi.org/10.1016/S0263-2373(99)00019-5.

Bornemann, M. 1999. Potential of value systems according to the VAIC™ method. *International Journal of Technology Management.* 18(5):463-475. DOI: https://doi.org/10.1504/IJTM.1999.002781.

Cañibano, L. 2018. Accounting and intangibles. *Revista De Contabilidad.* 21(1):1-6. DOI: https://doi.org/10.1016/j.rcsar.2017.12.001.

Chan, K.H. 2009. Impact of intellectual capital on organisational performance. *The Learning Organization.* DOI: https://doi.org/10.1108/09696470910927641.

Chauvin, K.W. & Hirschey, M. 1993. Advertising, R&D Expenditures and the Market Value of the Firm. *Financial Management.* 22(4):128-140. DOI: https://doi.org/10.2307/3665583.

Chen, J., Zhu, Z. & Yuan Xie, H. 2004. Measuring intellectual capital: a new model and empirical study. *Journal of Intellectual Capital.* 5(1):195-212. DOI: https://doi.org/10.1108/14691930410513003.

Chen, M., Cheng, S. & Hwang, Y. 2005. An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of Intellectual Capital.* 6(2):159-176. DOI: https://doi.org/10.1108/14691930510592771.

Chen, S. & Dodd, J., L. 1997. Economic value added (EVA (TM)): An empirical examination of a new corporate performance measure. Pittsburg, KS : Gladys A Kelce School of Business and Economics Pittsburg State University.

Clark, T.S. & Linzer, D.A. 2015. Should I use fixed or random effects? *Political Science Research and Methods.* 3(2):399-408. DOI: https://doi.org/10.1017/psrm.2014.32.

Clarke, M., Seng, D. & Whiting, R.H. 2011. Intellectual capital and firm performance in Australia. *Journal of Intellectual Capital.* 12(4):505-530. DOI: https://doi.org/10.1108/14691931111181706.

Clarkson, M. 1995. A stakeholder framework for analyzing and evaluating corporate social performance. *Academy of Management Review.* 20(1):92. DOI: https://doi.org/10.5465/amr.1995.9503271994.

Cohen, S. & Kaimenakis, N. 2007. Intellectual capital and corporate performance in knowledge-intensive SMEs. *The Learning Organization.* DOI: https://doi.org/10.1108/09696470710739417.

Cole, D.A. & Maxwell, S.E. 2009. Statistical methods for risk-outcome research: Being sensitive to longitudinal structure. *Annual Review of Clinical Psychology.* 5:71-96. DOI: https://doi.org/10.1146/annurev-clinpsy-060508-130357.

Daraban, M.C. 2017. Economic Value Added – A General Review of the Concept. *Ovidius University Annals: Economic Sciences Series.* XVII(1):168-173.

de Jager, P. 2008. Panel data techniques and accounting research. *Meditari Accountancy Research.* 16(2):53-68. DOI: https://doi.org/10.1108/10222529200800012.

De Wet, J. & Du Toit, E. 2007. Return on equity: A popular, but flawed measure of corporate financial performance. *South African Journal of Business Management.* 38(1):59-69. DOI: https://doi.org/10.4102/sajbm.v38i1.578.

Dempsey, M., 2014. The Modigliani and Miller Propositions: The History of a Failed Foundation for Corporate Finance? *Abacus*. *50*(3), pp.279-295. DOI: https://doi.org/10.1111/abac.12030.

Donaldson, T. & Preston, L. 1995. The stakeholder theory of the corporation: concepts, evidence, and implications. *Academy of Management Review*. 20(1):65-91. DOI: https://doi.org/10.2307/258887.

Dormann, C. & Griffin, M.A. 2015. Optimal time lags in panel studies. *Psychological Methods*. 20(4):489. DOI: https:// doi.org /10.1037/met0000041.

Drucker, P.F. 1993. The rise of the knowledge society. *Wilson Quarterly*. 17(2):52. DOI: https://doi.org/10.2307/40258682.

Dwyer, J.H., 1983. *Statistical models for the social and behavioral sciences*. Oxford University Press, USA.

Dzinkowski, R.,2000. The value of intellectual capital. *Journal of business strategy*, *21*(4), pp.3-3.

Edvinsson, L. 1997. Developing intellectual capital at Skandia. *Long range planning*, *30*(3), pp.366-373. DOI: https://doi.org/10.1016/S0024-6301(97)90248-X.

Edvinsson, L. and Sullivan, P. 1996. Developing a model for managing intellectual capital. *European management journal*, *14*(4), pp.356-364. DOI: https://doi.org/10.1016/0263-2373(96)00022-9.

Elliott, R. 1992. The Third Wave Breaks on the Shores of Accounting. *Accounting Horizons*. 6(2):61.

Firer, S. & Mitchell Williams, S. 2003. Intellectual capital and traditional measures of corporate performance. *Journal of Intellectual Capital*. 4(3):348-360. DOI: https://doi.org/10.1108/14691930310487806.

Firer, S. & Stainbank, L. 2003. Testing the relationship between intellectual capital and a company's performance: evidence from South Africa. *Meditari Accountancy Research*. 11(1):25-44. DOI: https://doi.org/10.1108/10222529200300003.

Ghosh, D. and Vogt, A. 2012. Outliers: An evaluation of methodologies. In *Joint statistical meetings* (pp. 3455-3460).

Haris, M., Yao, H., Tariq, G., Malik, A. & Javaid, H.M. 2019. Intellectual Capital Performance and Profitability of Banks: Evidence from Pakistan. *Journal of Risk and Financial Management*. 12(2):56. DOI: https://doi.org/10.3390/jrfm12020056.

Harrison, J.S., Edward Freeman, R. & Mônica Cavalcanti Sá, de Abreu. 2015. Stakeholder Theory as an Ethical Approach to Effective Management: applying the theory to multiple contexts. *Revista Brasileira De Gestão De Negócios*. 17(55):858-869. DOI: https://doi.org/10.7819/rbgn.v17i55.2647.

Hausman, J.A. 1978. Specification tests in econometrics. *Econometrica: Journal of the Econometric Society*. :1251-1271. DOI: https://doi.org/10.2307/1913827.

Hawkins, D.M. 2004. The problem of overfitting. *Journal of Chemical Information and Computer Sciences.* 44(1):1-12. DOI: https://doi.org/10.1021/ci0342472.

Hoaglin, D.C. & Iglewicz, B. 1987. Fine-tuning some resistant rules for outlier labeling. *Journal of the American Statistical Association.* 82(400):1147-1149. DOI: https://doi.org/10.1080/01621459.1987.10478551.

Hoaglin, D.C., Iglewicz, B. & Tukey, J.W. 1986. Performance of some resistant rules for outlier labeling. *Journal of the American Statistical Association.* 81(396):991-999. DOI: https://doi.org/10.1080/01621459.1986.10478363.

Hsiao, C. 2007. Panel data analysis—advantages and challenges. *Sociedad de Estadística e Investigación Operativa.* 16(1):1-22. DOI: https://doi.org/ 10.1007/s11749-007-0046-x.

International Accounting Standards Board. 2018a. *The annotated IFRS standards: standards issued 1 January 2018 reflecting changes not yet required.* London: IFRS Foundation.

International Accounting Standards Board. 2018b. *Conceptual framework for financial reporting: including IFRS practice statement 1 management commentary, IFRS practice statement 2 making materiality judgements, and amendments to references to the conceptual framework in IFRS standards.* London: IFRS Foundation.

International Accounting Standards Board. 2018c. *Who Uses IFRS Standards?*. Available: https://www.ifrs.org/use-around-the-world/use-of-ifrs-standards-by-jurisdiction/.

International Accounting Standards Board. 2015. International financial reporting standard for small and medium-sized entities (IFRS for SMEs). London: IFRS Foundation Publications.

Jadhav, N.H. & Kashid, D.N. 2014. Robust Winsorized Shrinkage Estimators for Linear Regression Model. *Journal of Modern Applied Statistical Methods.* 13(2):7. DOI: https://doi.org/10.22237/jmasm/1414814760.

Jakub, S., Viera, B. & Eva, K. 2015. Economic Value Added as a Measurement Tool of Financial Performance. *Procedia Economics and Finance*. 26:484-489. DOI: https://doi.org/10.1016/S2212-5671(15)00877-1.

Joia, L.A. 2000. Measuring intangible corporate assets: linking business strategy with intellectual capital. *Journal of Intellectual Capital.* 1(1):68-84. DOI: https://doi.org./10.1108/14691930010371636.

JSE Limited & Listings Requirements. 2005. JSE Limited Listings Requirements. Available: https://www.jse.co.za/content/JSEEducationItems/Service%20Issue%2017.

Kamukama, N. & Sulait, T. 2017. Intellectual capital and competitive advantage in Uganda's microfinance industry. *African Journal of Economic and Management Studies.* 8(4):498-514. DOI: https://doi.org/10.1108/AJEMS-02-2017-0021.

Kaplan, R.S. & Norton, D.P. 1996. Using the balanced scorecard as a strategic management system. *Harvard Business Review*. 85(7/8), 150–161.

Knauth, O.W. 1953. Group Interest and Managerial Enterprise. *The Journal of Industrial Economics.* 1(2):88-98. DOI: https://doi.org/10.2307/2097331.

Kronfeld, M. & Rock, A. 1958. Some Considerations of the Infinite. The Analysts Journal. 14(5):87. DOI: https://doi.org/10.2469/faj.v14.n5.87.

Lessem, R. & Palsule, S. 2005. *From Management Education to Civic Reconstruction: The Emerging Ecology of Organisation.* Routledge.

Limas, M.C., Meré, J.B.O., de Pisón Ascacibar, Francisco J Martínez & González, E.P.V. 2004. Outlier detection and data cleaning in multivariate non-normal samples: the PAELLA algorithm. *Data Mining and Knowledge Discovery.* 9(2):171-187. DOI: https://doi.org./10.1023/B:DAMI.0000031630.50685.7c.

Maditinos, D., Chatzoudes, D., Tsairidis, C. & Theriou, G. 2011. The impact of intellectual capital on firms' market value and financial performance. *Journal of Intellectual Capital.* 12(1):132-151. DOI: https://doi.org/10.1108/14691931111097944.

Mason, C.H. & Perreault Jr, W.D. 1991. Collinearity, power, and interpretation of multiple regression analysis. *Journal of Marketing Research.* 28(3):268-280. DOI: https://doi.org/10.1177/002224379102800302.

Morris, C. 2015. An industry analysis of the power of human capital for corporate performance: evidence from South Africa. *South African Journal of Economic and Management Sciences.* 18(4):486-499. DOI: https://doi.org/10.17159/2222-3436/2015/V18N4a4.

Mouritsen, J., Thorsgaard Larsen, H. & Bukh, P.N. 2005. Dealing with the knowledge economy: intellectual capital versus balanced scorecard. *Journal of Intellectual Capital.* 6(1):8-27. DOI: https://doi.org/10.1108/14691930510574636.

Mouritsen, J. 1998. Driving growth: economic value added versus intellectual capital. *Management Accounting Research.* 9(4):461-482. DOI: https://doi.org/10.1006/mare.1998.0090.

M'Pherson, P.K. & Pike, S. 2001. Accounting, empirical measurement and intellectual capital. *Journal of Intellectual Capital.* 2(3):246-260. DOI: https://doi.org/10.1108/EUM0000000005659.

Nazari, J.A. & Herremans, I.M. 2007. Extended VAIC model: measuring intellectual capital components. *Journal of Intellectual Capital.* 8(4):595-609. DOI: https://doi.org/10.1108/14691930710830774.

O'brien, R.M. 2007. A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity.* 41(5):673-690. DOI: https://doi.org//10.1007/s11135-006-9018-6.

O'Donnell, D. & O'Regan, P. 2000. The structural dimensions of intellectual capital: emerging challenges for management and accounting. *Southern African Business Review.* 4(2):14-20.

Petty, R. & Guthrie, J. 2000. Intellectual capital literature review. *Journal of Intellectual Capital.* 1(2):155-176. DOI: https://doi.org/10.1108/14691930010348731.

Pew Tan, H., Plowman, D. & Hancock, P. 2007. Intellectual capital and financial returns of companies. *Journal of Intellectual Capital.* 8(1):76-95. DOI: https://doi.org/10.1108/14691930710715079.

Pulic, A. 1998. Measuring the performance of intellectual potential in knowledge economy. *2nd McMaster Word Congress on Measuring and Managing Intellectual Capital by the Austrian Team for Intellectual Potential.* 1-20.

Pulic, A. 2000. VAIC™–an accounting tool for IC management. *International Journal of Technology Management.* 20(5-8):702-714. DOI: https://doi.org/10.1504/IJTM.2000.002891.

Pulic, A. 2004. Intellectual capital - does it create or destroy value? *Measuring Business Excellence.* 8(1):62-68. DOI: https://doi.org/10.1108/13683040410524757.

Roos, G. & Roos, J. 1997. Measuring your company's intellectual performance. *Long Range Planning.* 30(3):413-426. DOI: https://doi.org/10.1016/S0024-6301(97)90260-0.

Roos, J. 1998. Exploring the concept of intellectual capital (IC). *Long Range Planning.* 31(1):150-153. DOI: https://doi.org/10.1016/S0024-6301(97)87431-6.

Seo, S. 2006. *A review and comparison of methods for detecting outliers in univariate data sets* (Doctoral dissertation, University of Pittsburgh).

Sherif, M. & Elsayed, M. 2016. The impact of intellectual capital on corporate performance: Evidence from the Egyptian insurance market. *International Journal of Innovation Management.* 20(03):1650034. DOI: https://doi.org/10.1142/S1363919616500341.

Shi, W. and Lee, L.F. 2017. Spatial dynamic panel data models with interactive fixed effects. *Journal of Econometrics*, *197*(2), pp.323-347. DOI: https://doi.org/10.1016/j.jeconom.2016.12.001.

Shiu, H. 2006. The application of the value-added intellectual coefficient to measure corporate performance: evidence from technological firms. *International Journal of Management.* 23(2):356.

Schutz, K. Intellectual capital and firm performance among JSE-listed firms. *Doctoral Dissertation.* Available: http://wiredspace.wits.ac.za/handle/10539/28301.

Slater, S. 1997. Developing a customer value-based theory of the firm. *Journal of the Academy of Marketing Science.* 25(2):162-167. DOI: https://doi.org/10.1007/BF02894352.

Ståhle, P., Ståhle, S. & Aho, S. 2011. Value added intellectual coefficient (VAIC): a critical analysis. *Journal of Intellectual Capital.* 12(4):531-551. DOI: https://doi.org/10.1108/14691931111181715.

StatsSA. 2019a. Statistical release: Gross domestic product. Pretoria: *Statistics South Africa*.

StatsSA. 2019b. Statistical release: Quarterly Labour Force Survey. Pretoria: *Statistics South Africa*.

Stern, J.M., Stewart III, G.B. & Chew Jr., D.H. 1996. EVA: An integrated financial management system. *European Financial Management.* 2(2):223. DOI: https://doi.org/10.1111/j.1468-036X.1996.tb00039.x.

Stewart, T. and Ruckdeschel, C., 1998. Intellectual capital: The new wealth of organizations. *Performance Improvement*, *37*(7), pp.56-59.

Stewart, T.A. 1997. *Intellectual capital: the new wealth of organizations*. London: Nicholas Brealey Pub.

Sumedrea, S., 2013. Intellectual capital and firm performance: a dynamic relationship in crisis time. *Procedia Economics and Finance*, *6*, pp.137-144. DOI: https://doi.org/10.1016/S2212-5671(13)00125-1.

Suojanen, W. 1954. Accounting Theory and the Large Corporation. *The Accounting Review*. 29(3):391.

Sveiby, K.E. 1997. *The new organizational wealth: managing & measuring knowledge-based assets.* 1st ed. San Francisco: Berrett-Koehler.

Tao, J. & Yu, J. 2012. The spatial time lag in panel data models. *Economics Letters.* 117(3):544-547. DOI: https://doi.org/10.1016/j.econlet.2012.07.025.

Tseng, C. & James Goo, Y. 2005. Intellectual capital and corporate value in an emerging economy: empirical study of Taiwanese manufacturers. *R&D Management.* 35(2):187-201. DOI: https://doi.org/10.1111/j.1467-9310.2005.00382.x.

Johanson, U., Eklov, G., Holmgren, M. and MÂrtensson, M., 1998. Human resource costing and accounting versus the balanced scorecard: a literature survey of experience with the concepts. *School of Business Stockholm University*, pp.01-11.

Van Buren M.E. (2002) Making Knowledge Count. In: Sleezer C.M., Wentling T.L., Cude R.L. (eds) Human Resource Development and Information Technology. Operations Research/Computer Science Interfaces Series, vol 17. Springer, Boston, MA. DOI: https://doi.org/10.1007/978-1-4615-0827-4_6.

Williams, M.N., Grajales, C.A.G. & Kurkiewicz, D. 2013. Assumptions of multiple regression: Correcting two misconceptions. *Practical Assessment, Research, and Evaluation.* 18(1):11. DOI: https://doi.org/10.7275/55hn-wk47.

Williams, S. 2001. Is intellectual capital performance and disclosure practices related? *Journal of Intellectual Capital.* 2(3):192-203. DOI: https://doi.org/10.1108/14691930110399932.

Zhicheng, L., Zhuoer, C., Shing, L.T.T. and Wah, C.S.K. 2016. The impact of intellectual capital on companies' performances: A study based on MAKE Award winners and non-MAKE Award winner companies. *Procedia Computer Science*, *99*, pp.181-194. DOI: https://doi.org/10.1016/j.procs.2016.09.110.