The relationship between VAIC™, company performance and market value of companies on the Johannesburg Securities Exchange

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ABSTRACT

Purpose - The purpose of this paper was to examine the impact of Intellectual Capital (IC), using the VAIC™ approach, against certain company performance indicators as well as market value on listed companies in South Africa.

Design/Methodology/Approach - The study used secondary data of 50 listed companies from the Johannesburg Securities Exchange (JSE) over a period of five years (2016-2020), obtained from the IRESS Expert Database, as a basis for its analysis of the relationship between VAIC™ (IC), company performance and market value. IC and its components are calculated using Pulic's (2000) VAIC™ approach. Company performance is measured by Return on Assets (ROA) and Asset Turnover (ATO). Market value is measured by the Tobin's Q calculated as market to book ratio (TQ). The two-way Fixed Effects regression model is applied to statistically test the relationship between IC and company performance indicators , as well as the relationship between IC and market value.

Findings - The results indicate that VAIC™ and capital employed efficiency (CEE), are positively and significantly associated with market value of listed companies in South Africa. The relationship between the remaining components of VAIC™, Human Capital Efficiency (HCE) and Structural Capital Efficiency (SCE), and company performance and market value was not found to be statistically significant.

Practical Implications - Within the South African context, physical and financial capital (represented by CEE) plays a dominant role in how market participants value the company, whilst HCE and SCE seem to have less of an influence on the market's perception of value. The recognition value by market participant, albeit confined to just one of the components of VAIC™, may be indicative of the market pre-empting such value in company performance going forward. These findings provide insight into the role that investment in IC can play in supporting company performance and market value of the company.

Originality/Value - This study provides a more recent analysis of the original work performed by Firer & Williams (2003) and Firer & Stainbank (2003). It also provides insight into progression and recognition of IC in the South African Market. Finally, this study contributes to the still limited body of academic literature on the relationship between the company's IC, its performance and its market value. The significance of this contribution is its focus on companies in an emerging market and the focus on South African companies in particular, given the dearth of such studies with this particular focus.

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LIST OF ABBREVIATIONS

ADF – Augmented Dicky-Fuller

ANN – Artificial Neural Network

ASEAN – The Association of South East Asian Nations

ASR – Annual Stock Return

ATO – Asset Turnover

A-VAIC – Adjusted Value Added Intellectual Coefficient

BSC – Balanced Score Card

BP – Breusch-Pagan

CC – Customer Capital

CEE – Capital Employed Efficiency

EBIT – Earnings Before Interest and Tax

EBITDA – Earnings Before Interest Tax Depreciation and Amortisation

EP – Employee Productivity

EPS – Earnings Per Share

EVA™ – Economic Value Added™

FE – Fixed Effects

GPM – Gross Profit Margin

HC – Human Capital

HCE – Human Capital Efficiency

IA – Intangible Assets

IC – Intellectual Capital

ICE – Intellectual Capital Efficiency

IP – Intellectual Property

JSE – Johannesburg Stock Exchange

LCap – Size of the company

Lev – Leverage Ratio of the company

M/B – Market to Book Ratio (market value ratio)

MVAIC – Modified Value Added Intellectual Coefficient

N/A – Not Applicable

NS – Not Significant

NPM – Net Profit Margin

OI/S – Operating Income over Sales

OLS – Ordinary Least Squares

PLR – Partial Linear Regression

PLS – Partial Least Squares

PP – Performance Prism

RC – Relational Capital

RE – Random Effects

RG – Revenue Growth

ROA – Return on Assets

ROE – Return on Equity

ROI – Operating Income over Total Assets

ROIC – Return on Invested Capital

ROS – Return on Sales (EBITDA over Sales)

SC – Structural Capital

SCE – Structural Capital Efficiency

TQ – Tobin's Q calculated as Market to Book Ratio

UK – United Kingdom

VA – Value Add

VAIC™ – Value Added Intellectual Coefficient™

VIF – Variance Inflation Factor

W – Wooldridge

CHAPTER 1: INTRODUCTION

1.1 Background

Contribution towards value creation within a company has traditionally been a result of a company's physical or financial resources (Maji & Goswami, 2016). However, institutions and companies, especially in emerging markets like South Africa, find it increasingly difficult to explain the significant difference in a company's market value compared to their book value (Chen, Cheng & Hwang, 2005). This difference is considered as a company's "hidden value" and this hidden value has been defined as the Intellectual Capital (IC) within the company (Edvinsson, 1997).

A number of leading researchers have performed studies in both developing and emerging markets (see Table 1 and Table 3) in an attempt to measure IC and establish a relationship with company performance and/or market value within their specific context or market. The dominant basis for measuring IC (and IC components) within these studies is driven largely by Pulic's (2000) Value Added Intellectual Coefficient™ (VAIC™).

Results varied across historical studies, with only Chen, Cheng & Hwang (2005) finding significant positive relationships between one or more IC components and all performance and/or market values measures under consideration. Within both developed country studies as well as emerging market studies, the trend still leaned towards physical and financial capital having significant relationships with performance/value proxies (see Table 2 and Table 4).

Studies within the South African context found that certain IC components (namely Human Capital (HC)) were significant and negatively associated with performance or market value proxies under consideration (Firer & Williams, 2003). Physical and financial capital were significantly and positively associated with company market value in South Africa (Firer & Williams, 2003).

Companies are becoming increasingly aware that their IC is playing a more prominent role, not only to improve company performance from a profitability

perspective, but to also enhance a company's market value. With an increasing growth and digitisation of systems, processes, products and markets, it has become more appropriate in the 21st century to measure and assess the impact of IC in relation to company performance and market value especially within a South African context.

1.2 Problem Statement

Given the progression and acknowledgement of IC on value creation over the past two decades, companies should be able to accurately define and measure IC. Measuring IC will enable companies in turn to determine the impact and relationship of its IC on company performance as well as its contribution to market value. However, an understanding of the measurement of IC, whilst improving, is still limited and an understanding of the relationship between IC and the company's performance and market value is also limited.

Lack of standardised measurement of IC as well lack of required disclosure on companies' IC hampers the ability of market participants as well as management to assess the contribution of IC towards value creation (Bontis, 2001). This also impacts transparency and comparability of IC related performance across companies as well as industries (Pulic, 2004).

The problem is therefore that there is a gap in literature regarding the understanding of IC and its contribution to company performance and market value which limits the insight of the impact of investment in IC on the company's performance and market value. This is especially true for South African companies.

This study seeks to partially address this gap in literature by looking at the relationship between the company's investment in IC and it's performance and market value, with a specific focus on South African companies. This study contributes to the broader body of knowledge on IC and its relationship to company performance and market value by highlighting the role played by

IC and components towards company performance and market value in South Africa.

1.3 Research Objectives

The current available research and theory do not provide up to date insight into the relationship of IC concepts in relation to company performance and market value specifically in South Africa. Consequently, this research aimed to further build on the research performed by Firer & Williams (2003) and Firer & Stainbank (2003) by applying a statistical model to test these relationships on more recently available data and information.

The aim of this study was accomplished by fulfilling the following objectives:

- This study summarises, simplifies and categorises IC and related concepts drawing from past theory and research.
- This study analyses and provides results and findings on IC and its relationship from previous studies in both developed countries as well as emerging market countries highlighting the importance of IC research focus and findings globally.
- This study utilises an existing standardised model of calculating and measuring IC and IC related components (using VAIC™) largely used in previous studies to:
    - Understand if there is any relationship between IC and company performance in South African listed companies.
    - Understand if there is any relationship between IC and market value in South African listed companies.
    - What type of impact (positive or negative) do components of IC have on company performance indicators in South Africa.
    - What type impact (positive or negative) do components of IC have on market value of companies in South Africa.

1.4 Research questions

To identify whether VAIC™ components have a significant relationship with company performance and market, the following research questions are considered in this research paper:

- Is there a significant relationship between VAIC™ and market value in South African listed companies?
- Is there a significant relationship between VAIC™ and Company performance indicators (Return on Assets (ROA) and Asset Turnover (ATO)) in South African listed companies?
- Is there a significant relationship between components VAIC™ (namely IC components) and market value in South African listed companies?
- Is there a significant relationship between components of VAIC™ (namely IC components) and company performance indicators (ROA and ATO) in South African listed companies?
- If significant relationships do exist, do these relationships impact positively or negatively on company performance or market value?

1.5 Research Motivation

Due to the ever-increasing focus on IC globally, there is a need to understand the relationship between IC and company performance, especially from an emerging market perspective. In South Africa, the original contribution to understanding this relationship was provided by Firer & Stainbank (2003) and Firer & Williams (2003). Since then, the economic landscape for South African companies has been significantly impacted by the 2008 global financial crisis, technological advancements and COVID-19. This research is motivated by the need to provide an update on the original research done in South Africa.

1.6 Significant Original Contribution

The significant contribution of this study is that it extends the original work done by Firer & Stainbank (2003) and Firer & Williams (2003) by providing an updated view of the relationship between the investment in IC and the company's performance and market value for South African companies against the backdrop of the aforementioned changes in the economic environment faced by South African companies. The results of the study has the potential to assist companies in making better informed decisions on their investment in IC.

In addition, this study fills a gap in literature; it adds to prior literature with a specific focus on an emerging market and provides some context of similarity and/or differences in the experiences of companies within this cohort of economies. Lastly, the study also reflects on similarity and/or differences with prior studies in developed countries.

1.7 Related Research

IC has been a widely researched topic with many researchers attempting to measure these components within specific industry or economic environment.

The pioneers of articulating the definitions, concepts and components of IC that are widely referenced today are from Edvinsson (1997), Stewart (1997), Bontis (1998) and Roos (1998). These concepts and related definitions have contributed significantly to scholars and researchers understanding IC.

Over time, various IC measurement models, each unique and with their own subjective criteria, were developed. A significant contribution was however made by Pulic (2000) to provide a uniform measurement principle in order to calculate components of IC by approaching it with a reporting/accounting lens and viewing IC related activities with a value added principles called the Value-Added Intellectual Coefficient (VAIC™).

Pulic's (2000) VAIC™ methodology although revolutionary from a standardised measurement perspective, did not fall short of criticism and proposed enhancements. The proposed adjustments and enhancements arose mainly from emerging market studies. Chen, Cheng & Hwang (2005) were the first to introduce innovation and Customer Capital (CC) methodology and calculation building on the original VAIC™. Vishnu & Gupta (2014) also built on VAIC™ by proposing an extended VAIC™ which was also adapted and used by Bayraktaroğlu, Calisir & Baskak (2019). In more recent adaptations of the original VAIC™, Soewarno & Tjahjadi (2020) also developed and applied an Adjusted Value Added Intellectual Coefficient (A-VAIC) to build on in their testing.

Notably, VAIC™ is the basis for most researchers attempting to establish a relationship between IC, company performance and/or market value.

From an emerging market context, Chen, Cheng & Hwang (2005) provided results from the Taiwanese perspective which were significant not only at a VAIC™ level but also from a HC component perspective and triggered many studies in emerging markets to define the relationship between IC and company performance and market value in emerging markets. Chu, Chan & Wu (2011) found significant results of VAIC™ with company performance in Hong Kong and is widely cited and compared to in almost all subsequent studies globally.

South African studies performed by Firer & Williams (2003) and Firer & Stainbank (2003) paved the way for studies within a South African listed company context. These studies found mixed results on VAIC™ as a whole (Firer & Stainbank, 2003), but the most interesting being the HC relationship with ATO and market value (Firer & Williams, 2003) which contrasted each other.

Although we have increased focus on this topic of research, it remains a topic which is still under researched within South Africa.

1.8 Data and Methodology

1.8.1 Data

This study made use of secondary data obtained from the IRESS Expert Database (previously McGregor BFA). The dataset consisted of a final sample size of 50 companies listed on the Johannesburg Securities Exchange (JSE) for a period of five years (2016 to 2020). The data does not specifically exclude specific industries. The process and method to arrive at a final sample size of 50 companies is detailed in Chapter 3.

1.8.2 Methodology

This study applies a two-ways Fixed Effects (FE) statistical panel data model as a primary basis for testing the relationship between VAIC™ (and its components) to company performance indicators (ROA and ATO) and to market value (Tobin's Q). The statistical models include control variables of leverage and company size. Various diagnostic tests are also performed to support the use of the two-ways FE model, they include tests for:

- Multicollinearity
- Unit Root tests and Stationarity
- Heteroskedasticity and Serial Correlation
- Endogeneity

The statistical testing is supplemented by a Pearson Correlation as well as various diagnostic tests.

1.8.2.1 Descriptive Statistics

This study provides a table of descriptive statistics to allow the reader to assess the characteristics of the sample size under consideration. The use of

descriptive statistics allows the researcher to diagnose and assess the data for further analysis, processing and diagnostic testing.

1.8.2.2 Model Specification

The model used in this study is presented to test the relationship between IC and ROA and ATO (measures of accounting performance) and the relationship between IC and Tobin's Q calculated as Market to Book Ratio (TQ) (a measure of market to book value). Drawing from the analysis of prior studies in both developed countries and emerging markets, the relationship is statistically modelled below to assess the relationship between dependent and independent variables:

$$Y_{it} = \alpha_i + \beta_{1it}X_{1it} + \beta_{2it}X_{2it} + \ldots + \beta_{kit}X_{kit} + \varepsilon_{it}$$

For two-ways FE Models:

$$\alpha_i = \alpha + \mu_i + \lambda_i \qquad \text{and} \qquad \varepsilon_{it} = \varepsilon_{it}$$

Where:

- Y_{it} = dependent variable for the *i*th cross-sectional unit (company) at time unit *t*.
- α_i = intercept for the *i*th cross-sectional unit (company).
- β_{kit}= coefficient for the *k*th independent variable related to the *i*th cross-sectional unit (company) at time unit *t*.
- X_{kit}= the *k*th independent variable related to the *i*th cross-sectional unit (company) at time unit *t*.
- μ_i = fixed unobservable individual heterogeneity component of the *i*th cross-sectional unit (individual company).
- λ_i = the fixed unobservable time effect component. It accounts for time-specific effects not included in the regression.
- ε_{it} = residual error component where $\varepsilon_{it} \sim \text{IID M } (0, \sigma_\varepsilon^2)$.

1.8.2.3 Bivariate Analysis

This study applies the Pearson Correlation analysis as a supplementary statistical test to pre-determine the relationship between variables under consideration. It also provides the researcher with the opportunity to identify issues with multicollinearity.

1.8.2.4 Multivariate Analysis

With the use of panel data, there are numerous statistical models that can be considered. The options available for panel data regression are the pooled Ordinary Least Squares (OLS) model, FE estimation and Random Effects (RE) estimation. The model applied in this study is the two-ways FE model. This approach was the most appropriate to deal with endogeneity as well as balanced panel dataset under consideration. The analysis was conducted as follows:

Model 1: The analysis was conducted to test the relationship between VAIC™ and market value in South African listed companies. This is structured to address the first and last research questions proposed.

Model 2: The analysis was conducted to test the relationship between VAIC™ and a profitability performance indicator of South African listed companies. This is structured to partially address the second and last research questions proposed.

Model 3: The analysis was conducted to test the relationship between VAIC™ and a productivity performance indicator of South African listed companies. This is structured to partially address the second and last research questions proposed.

Model 4: The analysis was conducted to test the relationship between the individual components of the original VAIC™ and market value in South African listed companies. This is structured to address the third and last research questions proposed.

Model 5: The analysis was conducted to test the relationship between the individual components of the original VAIC™ and a profitability performance indicator of South African listed companies. This is structured to partially address the fourth and last research questions proposed.

Model 6: The analysis was conducted to test the relationship between the individual components of the original VAIC™ and a productivity performance indicator of South African listed companies. This is structured to partially address the fourth and last research questions proposed.

1.8.2.5 Diagnostic Tests

Various diagnostic tests are also performed in the study to support the use of the two-ways FE model, they include tests for:

- Multicollinearity – Variance Inflation Factor (VIF) as well as upper limits for the Pearson Correlation tests.
- Unit Root tests and Stationarity – Using the Augmented Dicky-Fuller (ADF) test to determine if there is unit roots in the variables (more commonly referred to as non-stationary variables).
- Heteroskedasticity and Serial Correlation – Using the Breusch-Pagan (BP) test for Heteroskedasticity and Wooldridge (W) for serial correlation.
- Endogeneity – Applying the two-ways FE model to address endogeneity concerns within the model.

1.8.2.6 Hypothesis

To understand the relationships that IC has with various indicators (profitability, productivity and market value) the following hypothesis were developed based on previous studies performed in South Africa:

- H1(a) - VAIC™ is positively associated with market value (TQ)
- H1(b) - VAIC™ is negatively associated with profitability (ROA)
- H1(c) - VAIC™ is positively associated with productivity (ATO)

- H2(a) - HCE is negatively associated with market value (TQ)
- H2(b) - HCE is positively associated with profitability (ROA)
- H2(c) - HCE is negatively associated with productivity (ATO)

- H3(a) - SCE is positively associated with market value (TQ)
- H3(b) - SCE is positively associated with profitability (ROA)
- H3(c) - SCE is positively associated with productivity (ATO)

- H4(a) - CEE is positively associated with market value (TQ)
- H4(b) - CEE is positively associated with profitability (ROA)
- H4(c) - CEE is positively associated with productivity (ATO)

1.9 Research Output

This research forms part of a complete dissertation for submission to the University of Cape Town in partial fulfilment of the requirements for the degree CM031FTX14: Master of Commerce (Corporate Finance and Valuations). This paper may be adapted for publication to peer-reviewed journals.

1.10 Limitations

The study's limitations consisted of the following:

- The general availability and access to data from all South African companies. Whilst ideally a study of this nature could be applied to all South African companies, accessing data beyond the listed environment is challenging and faces time constraints in trying to gather all financial data. Therefore, this study sample is limited to companies listed on the JSE only.
- The availability of all data points required for each listed company for the initial ten years under review. This resulted in exclusions of companies from the data set, limiting the overall sample size.
- The disclosure of salaries and wages is a key variable and input into calculating VAIC™ and components of VAIC™. Disclosing this key metric is not an accounting reporting nor JSE disclosure requirement, as a result, this further reduced the sample size materially for statistical testing.

1.11 Delimitations (scope)

The study referenced all listed companies. The delimitations applied in this study are as follows:

- Companies that consistently disclose metrics across all periods under consideration (2016-2020). This study as a result, specifically excludes companies that don't consistently disclose all data required in all of the five years under consideration. This entails companies that may have disclosed one to four periods (of the five years considered) are excluded. Including these would have resulted in an unbalanced panel dataset and further complications in statistical panel data modelling.
- Companies that are actively trading under the period of review, therefore companies that have been delisted or trading has been suspended have not been considered.

The resulting effect of both limitations and delimitation considerations have resulted in a sample profile that is heavily weighted towards the industrial and consumer products sector within South Africa.

1.12 Structure

The remainder of this research paper is organised as follows:

- Chapter 2 contains a review of existing research and literature on IC. This review was structured so that it firstly addresses the concepts, definitions and measurement models of IC. This is then followed by an in depth descriptive review and a content analysis of prior research.
- Chapter 3 outlines the model and hypothesis development, the nature of the data and data collection procedures, the statistical tools and approach used in the analysis and the research design.
- Chapter 4 covers the discussion of diagnostic tests and the results of principal regression models defined in chapter 3.
- Chapter 5 provides a summary of the study with concluding remarks as well as a description of the limitations of the study and suggested areas of future research.

1.13 Summary and Conclusion

This chapter provides a high level overview of the study. It expands on the purpose of the study to address a gap in research which relates to the relationship between the company's IC and company performance and IC and market value in the South African context. This section identifies a widely used standardised model (VAIC™) to measure specific components of IC. The data, methodology, limitations, delimitations and diagnostics tests carried out in this study were discussed in this chapter.

The next chapter contains a review of existing literature as well as other studies performed worldwide on IC. The review is structured so that it provides descriptive narrative and analysis of prior research in this area.

CHAPTER 2: LITERATURE REVIEW

This section of the paper introduces the concepts, definitions and categorisations of IC. It includes a summary of the most common models used in practise to measure IC. It also takes a look at the empirical research performed on the relationship between IC and company performance, as well as the relationship between IC and market value of a company. The focus is on research carried out in developed countries and emerging markets with a special focus on studies performed in South Africa.

2.1 Defining and Categorising Intellectual Capital

IC in the early years, has been defined by Stewart (1997:11), as the "the intellectual material – knowledge, information, intellectual property, experience that can be put to use to create wealth". IC is also commonly (and interchangeably) referred to as Intangible Assets (IA) – by the accounting profession, or as knowledge assets - by economists (Marr & Moustaghfir, 2005). Nadeem, Dumay & Massaro (2019) further elaborate on IC as the IA within a company that play a significant role in wealth creation. Researchers over the years have provided multiple interpretations and definitions of IC. Maji & Goswami (2016) have summarised a list of these key terms relating to IC; these include references such as knowledge, experience, skill, innovation, processes, relationships and technology. IC, aside from a wealth creation perspective, is also further viewed as containing or combining these elements listed by Maji & Goswami (2016), to provide a company with a competitive edge or competitive advantage within the markets they operate in (Kianto, Sáenz & Aramburu, 2017).

As important as it is to define what IC is, it is also important to define what IC is not. Bontis (1998) specifically excludes Intellectual Property (IP) from the definition of IC. Examples of IP are copyright, trademark and patent (Bontis, 1998). Based on the examples provided by Bontis (1998), IP assets typically

consists of those assets capitalised or recognised by companies on the balance sheet. This is consistent with Nadeem, Dumay & Massaro's (2019) view on IC assets, as those assets which are specifically excluded from being recorded on the balance sheet.

IC is therefore viewed as those "hidden", soft or intangible drivers of revenue growth and value creation in a company. Although researchers continuously update, debate and theorise what defines IC, there is general understanding that IC consist of three broad (knowledge-based) categorisations of a company (Maji & Goswami, 2016). These are:

- Human Capital (HC) – The individuals/natural persons within a company.
- Structural Capital (SC) – The company/organisation's structure.
- Relational Capital (RC) – The networks and relationships with stakeholders of and to a company.

All three categories are required to work in synergy with each other to constitute IC and drive value creation in a company (Maji & Goswami, 2016). The following paragraphs reflect on each of these in turn.

2.1.1 Human Capital

HC is defined by Roos (1998) as well as Marr & Moustaghfir (2005) as the knowledge, skill, experience and attitude of employees within a company. HC is also considered important as it is the primary driver towards innovation in a company (Bontis, 1998). People drive the creation, development and implementation of ideas and as a result innovation cannot be implemented without them (Kianto, Sáenz & Aramburu, 2017). HC is considered the most important category of IC (Kianto, Sáenz & Aramburu, 2017), and companies cannot accomplish its objectives (including driving innovation) without it. A company does not in a strict sense own or control the HC element or its people in the organisation (Kianto, Sáenz & Aramburu, 2017), as employees are allowed to voluntarily leave the company (almost daily) when they leave the

office premises or, permanently by way of resignation. A company can, however, direct and allocate its HC element during the hours the employee is required to perform its duties and obligations towards the company (typically directed by an individual's employment contract). HC is therefore primarily focused on the people element, their individual as well as combined value-add to a company within the context of the individual's role as well as the company's specific culture, values and philosophy (Bontis, 2001).

2.1.2 Structural Capital

SC is also commonly referred to as organisational capital. This relates to the "non-human" repository of knowledge within a company and how this knowledge is gathered, stored, maintained, updated and distributed throughout the company's structures, processes, systems and manuals (Kianto, Sáenz & Aramburu, 2017). An important characteristic of SC, is that SC remains behind in the company regardless of whether the HC element (employees/staff) leaves the company (Bontis, 2001), therefore unlike HC, SC can be owned, controlled and potentially sold by a company(Edvinsson, 1997) . It is therefore, critical for companies to convert as much of the individual and collective employee knowledge (i.e. the HC) into organisational knowledge (i.e. the SC) (Ordóñez de Pablos, 2004). SC although separately identifiable is intricately linked to HC, and is the factor that supports productivity of employees within a company (Bontis, 2001). The use of technology is a critical enabler to successfully capitalise on SC knowledge dissemination within a company. As with HC, having a strong supportive culture within a company enables the company to have a stronger presence of SC component in its overall IC base.

2.1.3 Relational Capital

RC, as the title suggested primarily refers to the relationships that exist between a company as well as external stakeholders to the company. RC, also commonly referred to as the social capital of a company (Kianto, Sáenz & Aramburu, 2017), draws on the knowledge developed and available through these relationships established and maintained with external stakeholders. These external stakeholders in relation to a company include (and are not limited to) customers, suppliers, partners, institutions, financiers and other external agents (Bontis, 2001; Kianto, Sáenz & Aramburu, 2017). This concept of IC recognises that companies cannot be considered in isolation, that they are dependent on the relationships that they build within the environment that they operate in (Hormiga, Batista-canino, & Sánchez-medina, 2011). A typical example of RC is customer loyalty, being the trust built between a company and its customer over time which continues to draw the customer to purchase products/services from a company. Earlier literature such as Edvinsson (1997) has classified RC as part of SC , however subsequent literature has identified RC as a significant separate component of IC that requires its own categorisation from SC (Bontis, 1998; Ordóñez de Pablos, 2004).

2.2 Intellectual Capital: Research Focus and Measurement Models

The earliest studies on the topic of IC performed in the 1990's were focused primarily on defining, categorising, bringing attention to and creating a general awareness surrounding the topic of IC (Marr, Gray & Neely, 2003). Once the concept and existence of IC was largely acknowledged, studies then progressed into the measurement of IC, how IC impacts company performance, IC impact on market value and IC disclosures (Maji & Goswami, 2016). IC impact on company performance and market value has been one of the most researched topics on IC drawing empirical research and analysis

over the last two decades in both emerging markets and developed countries. Another researched area that spawned out of these processes was the management of IC within a company and successfully capitalising on IC management. The underlying problem currently that lies within each research area is that there is no uniform or globally accepted standard/model to measure and monitor IC. There are multiple models used by companies to measure, manage, value and track IC (Nadeem, Dumay & Massaro, 2019); these models are monetary as well as non-monetary based models. Some models, such as the Balanced Scorecard (BSC) and the Performance Prism (PP), may contain non-monetary measurements as well as monetary principles; these are referred to as hybrid models. The vast array of models used by companies will therefore mean that they will find it difficult to benchmark themselves from an IC perspective to their peer group (or competitors) as they may use different models or different variations of selected models. A brief overview of some of the major models (or frameworks) applied in practise to measure IC now follows.

2.2.1 Non-monetary Measurement Models

The most prominent example of a non-monetary measurement model used to measure IC is the IA monitor. This framework identifies three non-financial measurement indicators, namely growth/renewal, efficiency and stability, to measure three categories of IA, namely external, internal and professional competence (Bontis, 2001). Although there are many more non-monetary models used to measure IC, the inherent problem with all of them is comparability across companies (Pulic, 2004). Pulic (2004) identifies the issue of transparency inherent in the number of indicators used by companies and across different levels within a company which adds another level of complexity with regard to comparability across company. Using these tools for benchmarking purposes therefore remains a significant challenge Pulic (2004).

2.2.2 Generic Intellectual Capital Performance Measurement Models

There exists a variety of generic measurement models, that although do not explicitly measure individual IC components, contain within them characteristics that drive the measurement and management of certain aspects of IC within them. Typical examples are the BSC approach and the PP approach.

The BSC is primarily a strategic performance management framework for an organisation that aids in optimising internal activities to enhance financial performance (Arora, 2002). These activities are centred around improvement of internal capacity, improved processes, improved customer retention and ultimately improved financial results. These constitute the four pillars on which the BSC is based. Arora (2002) suggests identifying proxy parameters within all four pillars (or perspectives) of the BSC to monitor knowledge management activities which could assist in the measurement and performance of IC. The challenge with the BSC is that the indexes (indicators) formulated using Arora's approach under each pillar will vary from company to company thus making comparison of knowledge management between two companies difficult (Arora, 2002). Pulic (2004) also does not find this as an appropriate IC measuring tool as it is more geared towards the strategy focus within a company.

The PP was considered as a 2nd generation performance management framework compared to the BSC. The model starts by identifying the wants and needs of the company's stakeholders, defining strategies to deliver on these wants and needs, ensuring that processes are in place to deliver on these strategies, ensuring that capabilities exist within the company to carry out and improve processes and finally identifying what it is the company wants in return from its stakeholders for delivering their wants and needs (Neely, Adams & Crowe, 2001). Therefore, the PP is underpinned by the relationship

between stakeholders and the company. Neely, Adams & Crowe (2001) emphasise that PP is a tool to be used in companies to manage the aspects of their business as outlined in the framework referred to above. The metrics or measures used to measure IC (similar to the BSC framework) could vary significantly from company to company even though they may apply the same (PP) framework, thus, as with the BSC, making it difficult to use as a benchmarking tool.

2.2.3 The Skandia Navigator

Skandia was the first large company to consciously report on its IC assets, in conjunction with its conventional financial report to shareholders in 1994. Lief Edvinsson was responsible for creating what was termed the Skandia Navigator as a model to report on Skandia's IC (Bontis, 2001). Within the operational environment of the business, the model identifies five key areas of focus. Chief among these is the focus on financial performance, but successful financial performance demands a focus on four key area, namely the company's customers, its human resources, it processes and its renewal and development (capacity building). It is these four key areas that define the companies IC and it is this IC that drive financial performance (Bontis, 2001; van den Berg, 2002). The Skandia IC Report consisted of 164 metrics to measure the organisations IC within key areas of focus. Whilst this was heralded as a considerable effort to report on IC metrics, every company would need to have a defined, and considerable understanding of its IC to correctly choose the correct assumptions and correctly use specific metrics out of the available 164 metrics (Bontis, 2001). The approach was also geared towards the balance sheet approach of measuring IA, and only views IC at a point in time rather than with reference to the fluidity and ever-changing landscape of an organisation with knowledge based assets (Bontis, 2001).

2.2.4 The IC-Index

The IC-Index was spearheaded by Goran Roos and is an attempt to consolidate multiple indices into a single index (Bontis, 2001; van den Berg, 2002). This index is considered "context-specific" because it allows for specific parameters to be set in conducting the measurement of IC (Bontis, 2001; van den Berg, 2002). Bontis (2001) suggests that a company should have a clear strategy and identify the sources of value of the company arising from the IC to assist in selecting the appropriate indicators. The IC-Index is dependent on two things, the indicators chosen to be used by an individual company, and the choice of weighting of the components by a company for the overall singular index. Due to these "context specific" characteristic of the IC-index, its application is limited as a universal standard (Bontis, 2001).

2.2.5 EVA™ Model

The Economic Value Added (EVA™) model was introduced by Stern Stewart and is simply defined as the rate of return generated by the capital employed by the company less the required rate of return defined by the company (Bontis, 2001). If the number is positive the company has generated EVA™ and if it is negative that the company has not generated EVA™. The EVA™ is a financial measurement system intended to capture most importantly the trade-off's that companies make when making capital investment decisions (Bontis, 2001; van den Berg, 2002). The benefit of using EVA™ is the relative simplicity in its application and the fact that a company recognises it requires a certain level of creativity which is considered intangible to create a positive EVA™ (Bontis, 2001; van den Berg, 2002). Bontis (2001) identifies three shortfalls' inherent in the EVA™, the first being the limitation of using book value assets and ignoring market values, the second being empirical research not conclusively showing that EVA™ is not a predictor of a company's market value, and lastly that the premise for EVA™ is that companies follow the shareholder maximisation principle and ignores other stakeholders.

2.2.6 Tobin's Q

Tobin's Q was created by James Tobin and attempts to capture the relationship between the market value of a company and the book value of the company to derive a replacement asset value index called the Tobin's Q (Bontis 1998; van den Berg, 2002). This index was used to identify the importance (or degree) of IC within the company and what portion of the company's value was essentially not captured within the conventions of its book value according to financial reporting standards. The higher the ratio the more IC intensive the specific company was considered to be and highlighted the importance of IC within that company. Bontis (1998) highlighted that the ratio will tend towards 1, however evidence from various studies highlight the fact that it will significantly differ from 1 for very long periods of time.

2.2.7 Value Added Intellectual Coefficient (VAIC™)

Value Added Intellectual Coefficient (VAIC™) was pioneered by Ante Pulic at the Austrian IC research centre in 1998 and was introduced by Pulic as a measure of Intellectual Capital Efficiency (ICE) (Iazzolino & Laise, 2013). VAIC™ focus is not on the valuation of IC but rather a measurement of the value created by different factors (including IC) within the company, therefore the focus is on the value added perspective from metrics using the value added income statement created by Ante Pulic (Iazzolino & Laise, 2013). The benefits of this method is that it uses accounting metrics (found and reported in many companies) to measure the "value added" component and has defined formulae to measure the Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE) and the Capital Employed Efficiency (CEE) which combined make up the VAIC™ (Pulic, 2000). In this way Pulic was able to bridge the gap between the IC research and research on performance measurement (Iazzolino & Laise, 2013).

VAIC™ although revolutionary, wasn't short of criticism or shortfalls as an IC measurement model. Iazzolino & Laise (2013) illustrated that EVA™ and VAIC™ measured value creation from two different perspectives (shareholder and stakeholder value perspectives) and therefore cannot be considered as truly rival measurement models. Bayraktaroğlu, Calisir, & Baskak (2019) highlighted components of IC which Pulic's methodology seems to have neglected. A major component missing from the VAIC™ seems to be the measurement of RC. Some of the concepts which Bayraktaroğlu, Calisir, & Baskak (2019) propose in their extended VAIC™ model are CC and innovation capital which don't necessarily capture all RC components however they attempt to break SCE up further to include these components. In this way Bayraktaroğlu, Calisir, & Baskak (2019) implied that RC was embodied within SCE measurement designed by Pulic's VAIC™. Nadeem, Dumay & Massaro (2019) also developed an A-VAIC model to adjust for some of the shortfalls by further expanding SCE element by effectively replacing it with Innovation Capital Efficiency (INVCE). Nazari & Herremans (2007) also proposed an extended VAIC™ model by breaking up SCE into further aspects of customer, innovation and process capital.

The original VAIC™ is the most commonly used framework to measure IC for empirical study due to its ease of use and its underlying basis of using accounting (reporting) metrics found in the financial statements. It also provides a standardised methodology to measure components of IC as compared to the other measurement models. VAIC™ recognises that every resource (financial, physical, human and structural) contributes to the "value-add" of a company (Zéghal & Maaloul, 2010).

2.3 Intellectual Capital, market value and company performance

There has been a number of studies measuring IC (VAIC™) in relation to company performance and market value in traditional knowledge based sectors as well as other generic (or general) sectors. These studies include

companies within emerging markets as well as developed countries. A review of the studies, its parameters and findings are presented in the sections below.

The review of studies in developed countries and emerging markets will be discussed separately in the following paragraphs. For each of these discussions the review will consider the following themes:

- The sector covered in the study, the numbers of years of observation of the study and the number of companies included in the study's sample.
- The independent and dependent variables used in the study.
- The type of testing and control variables used in the study.
- The results/findings of studies on VAIC™ as a whole within these studies.
- The results/findings of studies on sub-sets of VAIC™, namely, HCE, SCE and CEE.

2.3.1 Studies in Developed Countries

The discussion under 2.3.1.1 to 2.3.1.3 is considered important as a preamble into the discussion of the results of the studies under review; it provides context to the results of prior studies discussed in section 2.3.1.4 to 2.3.1.7. A similar approach is taken for the review of studies carried out on companies listed in emerging markets.

2.3.1.1 Sector, Period and Sample Size

Studies on IC, and its relationship to performance indicators and market value using VAIC™ have been performed by a number of researchers in developed countries. Table 1 and Table 2 present the summary of the developed countries parameters and findings. There are significantly lower number of published studies in developed countries that are readily available/accessible, compared to emerging markets. Developed countries studies largely focussed

on analysing the listed companies within countries such as Australia (Clarke, Seng & Whiting, 2011), Greece (Maditinos et al., 2011), Hong Kong (Chu, Chan & Wu, 2011), Singapore (Tan, Plowman & Hancock, 2007), the United Kingdom (UK) (Zéghal & Maaloul, 2010) and Joshi et al., (2013) focused on the listed (top 40) Australian financial companies. Ginesti, Caldarelli & Zampella (2018) performed their study on non-listed Italian companies.

Time periods that were considered, varied from one year (Ginesti, Caldarelli & Zampella, 2018; Zéghal & Maaloul, 2010) to nine years (Chu, Chan & Wu, 2011) with the most studies being performed over a three year period (Joshi et al., 2013; Maditinos et al., 2011; Tan, Plowman & Hancock, 2007). Chu, Chan & Wu (2011) in addition to using a nine year period of information, divided their dataset into two phases (the first five years and last four years) for testing.

Some studies covered a large number of companies like Clarke, Seng & Whiting (2011) with 2 161 companies, whilst others had observably lower number of companies under consideration such as Zéghal & Maaloul (2010) with only 96 companies. Joshi et al., (2013) only considered 40 companies in their study. The function of the number of companies considered as well as the time period under consideration impacted the number of observable datapoints across the studies in the developed countries.

2.3.1.2 Independent and Dependent Variables

Studies on companies in developed countries primarily used one or more company financial performance indicators as dependent variables, with only some studies (Chu, Chan & Wu, 2011; Maditinos et al., 2011; Tan, Plowman & Hancock, 2007; Zéghal & Maaloul, 2010) adding some form of market value proxy, as another dimension of dependent variable for additional testing.

The market to book ratio (M/B) was frequently used as a measure of market value, though there were a few exceptions; Tan, Plowman & Hancock (2007) used an Annual Stock Return (ASR) ratio as their measure of market based

performance. The ASR ratio calculates the percentage of the movement over a period of a year of a share/stock, including any dividend declared within that period (Tan, Plowman & Hancock, 2007).

The common ratios (or indicators) used for company financial performance were ROA and/or Return on Equity (ROE) across the developed countries studies. Some studies included measures such as ATO (Chu, Chan & Wu, 2011; Ginesti, Caldarelli & Zampella, 2018) and Revenue Growth (RG) (Clarke, Seng & Whiting, 2011; Maditinos et al., 2011).

Some studies included unique performance measures that were not contained in other studies; examples include, Employee Productivity (EP) (Clarke, Seng & Whiting, 2011), Earnings Per Share (EPS) (Tan, Plowman & Hancock, 2007) and Operating Income over Revenue (OI/S) (Zéghal & Maaloul, 2010).

The use of both VAIC™ at a composite level, and its individual components as independent variables were considered in the studies performed by Chu, Chan & Wu (2011), Clarke, Seng & Whiting (2011), Ginesti, Caldarelli, & Zampella (2018), Joshi et al., (2013) and Maditinos et al., (2011). In contrast to this, Tan, Plowman & Hancock (2007) and Zéghal & Maaloul (2010) focused specifically only on the components of VAIC™ as separate independent variables, with the latter combining HCE and SCE as one independent variable of ICE.

2.3.1.3 Type of testing and control variables utilised

All studies that focussed on developed countries considered correlation analysis between variables as an initial indication of the relationship between them (Chu, Chan & Wu, 2011; Clarke, Seng & Whiting, 2011; Ginesti, Caldarelli & Zampella, 2018; Joshi et al., 2013; Maditinos et al., 2011; Tan, Plowman & Hancock, 2007; Zéghal & Maaloul, 2010).

Researchers adopted regression analysis as the main method of testing the relationship between the independent variables and dependent variables with some studies opting for OLS regression (Clarke, Seng & Whiting, 2011; Ginesti, Caldarelli & Zampella, 2018), others for Partial Least Squares (PLS) regression (Tan, Plowman & Hancock, 2007) and some using ANOVA testing to supplement their regression analysis (Clarke, Seng & Whiting, 2011; Joshi et al., 2013; Tan, Plowman & Hancock, 2007).

Although there were a number of control variables considered in the studies under review, some studies chose not to include control variables in their analysis (Ginesti, Caldarelli, & Zampella, 2018; Maditinos et al., (2011); Tan, Plowman & Hancock, 2007) thus leaving the robustness of their results open to possible question. Company size was considered as a control variable given its potential influence of the company's performance from a book and market value perspective. In this regard Chu, Chan & Wu (2011) and Joshi et al., (2013) used market value of the company as a proxy company size whilst Zéghal & Maaloul (2010) used the book value of the company as a proxy company size. Leverage (Chu, Chan & Wu, 2011; Clarke, Seng & Whiting, 2011; Zéghal & Maaloul, 2010) and the financial sub-sector (Joshi et al., 2013), was used as an additional control variable due to their sector study, and "research intensity" (Clarke, Seng & Whiting, 2011) were also considered as control variables for their potential impact on the company's book and market performance. Very few studies considered the potential of a lagged effect of independent on dependent variables; of the many studies under review, only Clarke, Seng & Whiting (2011) considered a potential lagged relationship.

For a summary of the inputs use in the studies under as discussed under 2.3.1.1 to 2.3.1.3, see Table 1. Sections 2.3.1.4 to 2.1.3.7 will discuss the findings of studies that focussed on companies in developed countries.

2.3.1.4 *Review of VAIC™ Findings and Results*

Of the studies in developed countries that tested relationship between VAIC™ and the company's market and book values, the results were mixed. Companies listed in Hong Kong showed a positive relationship between VAIC™ and measure of performance (ROE and ROA) and a negative relationship between VAIC™ and ATO (Chu, Chan & Wu, 2011). All of these relationships were statistically significant. Clarke, Seng & Whiting (2011) observed that VAIC™ had a positive significant relationship across all four company performance metrics used. Joshi et al., (2013) and Maditinos et al., (2011) could not find a definitive relationship between VAIC™ and all forms of the company's market and accounting performance.

Tan, Plowman & Hancock (2007) took a slightly different approach in their analysis, they tested the relationship between the company's IC and its financial performance based on a Partial Linear Regression (PLR). The company's EPS, ROE and ASR was collectively referred to as "financial performance". They found a positive correlation between IC and company financial performance, as well as growth in IC and future financial performance.

In summary, the studies on the relationship between VAIC™ and the company's performance based on market and book values showed mixed results. Section 2.3.1.5 to 2.3.1.7 presents the results of studies focussing on the relationship between the components of VAIC™ and the company's performance. Table 2 provides a summary of these results.

2.3.1.5 *Review of HCE Findings and Results*

As with the overall VAIC™, the prior studies on the relationship between HCE and the company's profitability across the studies yielded mix results. Contrary to expectation, Chu, Chan & Wu (2011) found a significant negative

association with between HCE and market value; by contrast Maditinos et al., (2011) found this relationship between the two variables to be positive. Zéghal & Maaloul (2010) based their analysis of the relationship between market value and IC on the ICE; the ICE is a composite measure of IC which consists of HCE and SCE). They found a significant positive relationship among high technology companies.

Chu, Chan & Wu (2011) found no conclusive evidence of a relationship between HCE and ATO or ROE, but a strong positive association with ROA. Among companies listed in Australia, Clarke, Seng & Whiting (2011) found HCE to be significantly related to all performance measures used in their study. This however changed for some indicators when the lag regression testing was performed; the relationship between HCE and RG change from positive to negative and the relationship between HCE and ROA came out as insignificant. Joshi et al., (2013) who also based their study on companies listed in Australia, confined their study to a relationship between HCE and ROA; contrary to Clarke, Seng & Whiting (2011) that found no significant relationship between the two variables.

Ginesti, Caldarelli & Zampella (2018) found a significant negative relationship between HCE and accounting or book measures of accounting performance, a result that went contrary to expectation. while Joshi et al., (2013) found no significant relationship between its sole dependent variable (ROA) and HCE.

Zéghal & Maaloul (2010) found that ICE (a combination of HCE and SCE) to have a significant relationship with both accounting or book performance measures i.e. OI/S and ROA. This was found to be positive across all industries represented in the study.

Overall, in developed countries, investors did not factor HCE as a significant factor when considering market value of companies, with notable exceptions being UK high-tech industries (Zéghal & Maaloul, 2010), listed companies in Greece (Maditinos et al., 2011) and Australian and UK companies (Clarke,

Seng & Whiting, 2011; Zéghal & Maaloul, 2010). In Italy the market does not factor investment in IC in the form of HCE into the valuation of listed companies (Ginesti, Caldarelli & Zampella, 2018).

The next section considers the relationship between IC in the form of SCE and market and accounting or book values of return.

2.3.1.6 Review of SCE Findings and Results

SCE's relationship to market value was found to again have contrasting results across the developed countries studies. Chu, Chan & Wu (2011) noted a strong positive relationship between SCE and market value in Hong Kong, whilst in Greece SCE showed an insignificant in relationship with market value (Maditinos et al., 2011).

SCE showed a surprisingly insignificant relationship to all accounting measures of company performance for companies in Australia and Greece (Clarke, Seng & Whiting, 2011; Joshi et al., 2013; Maditinos et al., 2011). Chu, Chan & Wu (2011) were the only ones to find significant positive relationships of SCE and ROA and ROE, but the third measure of accounting performance, ATO, was found to have a negative relationship with SCE.

These results indicate that SCE may not play as significant a role in the perception of value add in developing countries when compared to HCE and CEE for companies in many countries with the exception being Hong Kong.

Section 2.3.1.7 reviews the relationship between CEE, the third component of VAIC™ and market and accounting or book values of performance.

2.3.1.7 *Review of CEE Findings and Results*

Physical and financial capital (represented by CEE) is considered the element of VAIC™ that represents traditional elements of IC that create value in companies. In relation to market value, two studies found CEE to have a significant positive relationship with market value, with the only exception being the "traditional sector" within the UK (Chu, Chan & Wu, 2011; Zéghal & Maaloul, 2010). In contrast, Maditinos et al., (2011) did not find CEE to have a significant relationship with market value for companies in Greece.

CEE has a strong influence on the financial performance measures in companies across the developed countries studies. Some studies found a strong positive association between CEE and all of their performance indicators tested (Chu, Chan & Wu, 2011; Joshi et al., 2013), whilst some found this relationship in the majority of the performance indicators (Clarke, Seng & Whiting, 2011; Ginesti, Caldarelli & Zampella, 2018). Zéghal & Maaloul (2010) found a strong positive association with ROA in all sectors with the exception of the high-tech industries, whilst Maditinos et al., (2011) was the only study to have found an insignificant relationship with all company performance indicators.

Based on the review of prior studies on the relationship between, SCE, HCE, CEE and the company's performance, CEE and SCE seem to have a closer relationship to the company's performance, i.e. studies suggest a bias toward a positive relationship between the IC and company performance indicators.

For a summary of the results of the studies reviewed discussed under 2.3.1.4 to 2.3.1.7 see Table 2. In section 2.3.2 a similar review is documented considering the relationship between IC as a whole (VAIC™), SCE, HCE, CEE and the company's performance.

Table 1: Inputs - Impact of IC Company Performance (Developed Countries)

Author (Year)	Country/Region/ Area	Sector	VAIC™ and/or VAIC™ components or a modified/ version of VAIC™	Financial Performance indicators Tested? If so, which indicators used in the study?	Market Value tested? if so what indicator of market value?	Control and/or Dummy Variables Utilised
Chu, Chan & Wu (2011)	Hong Kong	Listed Companies (Overall)	VAIC™ and VAIC™ components	Yes: ATO, ROA and ROE	Yes: M/B Ratio	Company size (market cap) and leverage
Clarke, Seng & Whiting (2011)	Australia	Listed Companies (Overall)	VAIC™ and VAIC™ components	Yes: EP, RG, ROA and ROE	No	Leverage, Research Intensity, Year and Industry
Ginesti, Caldarelli, & Zampella (2018)	Italy	Italian Non-Listed (sectors not specified)	VAIC™ and VAIC™ components	Yes: ATO, ROA, ROE, and ROI	No	No[1]
Joshi et al., (2013)	Australia	Listed Financials (including Banking)	VAIC™ and VAIC™ components	Yes: ROA	No.	Company size (market cap) and financial sub sector
Maditinos et al., (2011)	Greece	Listed Companies (Overall)	VAIC™ and VAIC™ components	Yes: RG, ROA and ROE	Yes: M/B Ratio	No

Author (Year)	Country/Region/ Area	Sector	VAIC™ and/or VAIC™ components or a modified/ version of VAIC™	Financial Performance indicators Tested? If so, which indicators used in the study?	Market Value tested? if so what indicator of market value?	Control and/or Dummy Variables Utilised
Tan, Plowman & Hancock (2007)	Singapore	Listed Companies Overall	VAIC™ components	Yes: EPS and ROE	Yes: ASR Ratio	No
Zéghal & Maaloul (2010)	United Kingdom (UK)	Listed Companies (Overall)	VAIC™ components (with HCE and SCE combined as one indicator of ICE)	Yes: ROA and OI/S	Yes: M/B Ratio	Size (book value) and Leverage

Key

[1] - Use of control variables was not performed in the regression testing against company performance indicators; however, use of control variables was present in reputation assessment testing.

Table 2: Summary of Results and Testing in Developed Countries

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™
Chu, Chan & Wu (2011)	OLS regression models	ATO	NS	**Negative**	**Positive**	N/A	**Negative**
		ROA	**Positive**	**Positive**	**Positive**	N/A	**Positive**
		ROE	NS	**Positive**	**Positive**	N/A	**Positive**
		M/B	**Negative**	**Positive**	**Positive**	N/A	NS
Clarke, Seng & Whiting (2011)	OLS regression models supplemented with ANOVA	EP	**Positive**	NS	**Positive**	N/A	**Positive**
		RG	**Positive**	NS	NS	N/A	**Positive***
		ROA	**Positive**	NS	**Positive**	N/A	**Positive**
		ROE	**Positive**	NS	**Positive**	N/A	**Positive**
Ginesti, Caldarelli, & Zampella (2018)	OLS regression modesl	ATO	**Negative**	NS	**Positive**	N/A	N/S
		ROA	**Negative**	**Positive**	**Positive**	N/A	**Positive**
		ROE	**Negative**	**Positive**	NS	N/A	**Positive**
		ROI	**Negative**	**Positive**	**Positive**	N/A	**Positive**
Joshi et al., (2013)	OLS regression model supplemented with ANOVA	ROA	NS	NS	**Positive**	N/A	NS

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™
Maditinos et al., (2011)	OLS regression models	RG	NS	NS	NS	N/A	NS
		ROA	NS	NS	NS	N/A	NS
		ROE	**Positive**	NS	NS	N/A	NS
		M/B	**Positive**	NS	NS	N/A	NS
Tan, Plowman & Hancock (2007)	PLS testing supplemented with ANOVA	EPS	EPS, ROE and ASR collectively referred to as "financial performance". Significant Positive correlation between IC and company "financial performance", as well as growth in IC and future "financial performance"			N/A	N/A
		ROE				N/A	N/A
		ASR				N/A	N/A
Zéghal & Maaloul (2010)	OLS regression models	OI/S	N/A	N/A	**Negative**	**Positive**	N/A
		ROA	N/A	N/A	**Positive (except for "High Tech" Industries)**	**Positive**	N/A
		M/B	N/A	N/A	**Positive (Except in "Traditional Industries")**	**Positive only in "High Tech" Industries**	N/A

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™

Key
NS – No significant relationship was found or model was considered statistically insignificant
N/A – Variable not tested in the study and therefore not applicable
***** - Exception where no significant relationship was found with a lagged variable

2.3.2 Studies in Emerging Markets

As with the review of prior studies in developed countries, the following under sections 2.3.2.1 to 2.3.2.3 is considered important as a preamble into the discussion of the results of the studies under review; it provides context to the results of prior studies discussed in section 2.3.2.4 to 2.3.2.7.

2.3.2.1 Sector, Period and Sample Size

In contrast to the developed countries, there are significantly more studies of the relationship between VAIC™ and the company's performance in emerging markets. Table 3 and Table 4 present the summary of the emerging markets parameters and findings, respectively. Of the 19 studies under consideration, only four studies focused on the listed companies within the market as a whole (Chen, Cheng & Hwang, 2005; Dženopoljac et al., 2017; Firer & Stainbank, 2003; Morariu, 2014), the remainder of the studies focussed on specific sectors. The countries covered by the emerging market studies include The Association of Southeast Asians Nation (ASEAN) countries (Nimtrakoon, 2015), Bangladesh (Chowdhury, Rana & Azim, 2019), India (Ghosh & Mondal, 2009; Maji & Goswami, 2016; Mondal & Ghosh, 2012; Pal & Soriya, 2012; Vishnu & Gupta, 2014), Indonesia (Soewarno & Tjahjadi, 2020), Iran (Mehralian et al., 2012), Malaysia (Gan & Saleh, 2008; Ting & Lean, 2009), selected countries within the Middle East (Dženopoljac et al., 2017), Romania (Morariu, 2014), Serbia (Bontis, Janošević & Dženopoljac, 2015; Dženopoljac, Janoševic & Bontis, 2016; Komnenic & Pokrajčić, 2012), South Africa (Firer & Stainbank, 2003; Firer & Williams, 2003), Taiwan (Chen, Cheng & Hwang, 2005) and Turkey (Bayraktaroğlu, Calisir & Baskak, 2019; Calisir et al., 2010).

Time periods that were considered in these studies, span one year (Firer & Stainbank, 2003; Firer & Williams, 2003; Morariu, 2014; Nimtrakoon, 2015) to 11 years (Chen, Cheng & Hwang, 2005).

The dataset also varied, largely dependent on the number of companies and time frames under consideration of between 42 observations (Calisir et al., 2010) and 2 542 observations (Chen, Cheng & Hwang, 2005).

2.3.2.2 Independent and Dependent Variables

In the studies under review dependent variables consisted of one or more company performance indicators as well as market value information, however within many of the studies the lack of market value information imposed a significant limitation on its scope (Bontis, Janošević & Dženopoljac, 2015; Dženopoljac, Janoševic & Bontis, 2016; Komnenic & Pokrajčić, 2012; Maji & Goswami, 2016; Mondal & Ghosh, 2012; Vishnu & Gupta, 2014). All studies that analysed the relationship between IC and market value, used the M/B ratio as the proxy for market value. Other than Morariu (2014), all other studies used ROA as one of the company performance indicators with Maji & Goswami (2016) and Ting & Lean (2009) using it as their sole performance indicator. The next most common performance indicator used was ATO, however, Bontis, Janošević & Dženopoljac (2015), Chen, Cheng & Hwang (2005), Nimtrakoon (2015) and Vishnu & Gupta (2014) did not make reference instead they referred to margin or profitability ratios. As a performance measure of companies under review. EP as a measure of company performance was considered by Bontis, Janošević & Dženopoljac (2015) and Chen, Cheng & Hwang (2005), similar to Clarke, Seng & Whiting (2011) (see discussion under developed countries).

In line with the approach adopted in studies that focused on companies in developed countries, studies that focussed on companies in emerging markets utilised either VAIC™ and/or the components of VAIC™ as a measure of IC. A unique characteristic in the emerging market studies was the use of an extended, modified or adjusted form of VAIC™ (Bayraktaroğlu, Calisir & Baskak, 2019; Nimtrakoon, 2015; Soewarno & Tjahjadi, 2020; Vishnu & Gupta, 2014). Chen, Cheng & Hwang (2005) also added factors like innovation and

CC in their testing to supplement their VAIC™ testing. Maji & Goswami (2016), similar to Zéghal & Maaloul (2010), combined HCE and SCE as one indicator of ICE for testing.

2.3.2.3 *Type of testing and control variables utilised*

The most common statistical testing method used by studies in emerging markets was linear multiple regression analysis (see Table 3). Mehralian et al., (2012) supplemented this with Artificial Neural Network (ANN) testing, whilst Nimtrakoon (2015) included ANOVA testing similar to the two Australian studies (Clarke, Seng & Whiting, 2011; Joshi et al., 2013). Maji & Goswami (2016) performed their testing using Panel Data Fixed Effect Regression and Quantile Regression testing.

Company size was the most used control variable followed by a leverage. The industry in which the company operated was also considered by some studies as a control variable given the potential impact that the company performance measures considered (Dženopoljac et al., 2017; Firer & Stainbank, 2003; Firer & Williams, 2003; Morariu, 2014). Firer & Stainbank (2003), Ghosh & Mondal (2009) and Pal & Soriya (2012) used "physical capital intensity" as an additional control variable.

For a summary of the inputs use in the studies under as discussed under 2.3.2.1 to 2.3.2.3, see Table 3. Sections 2.3.2.4 to 2.3.2.7 will discuss the findings of studies that focussed on companies in emerging markets.

2.3.2.4 *Review of VAIC™ Findings and Results*

Based on the 19 studies reviewed that had a focus on companies in emerging markets, only three studies focused solely on VAIC™ as a whole (Firer & Stainbank, 2003; Ghosh & Mondal, 2009; Pal & Soriya, 2012). None of these

studies found any significant relationship between the company's performance based on market values and VAIC™. This is consistent with the two studies under developed countries by Chu, Chan & Wu (2011) and Maditinos et al., (2011).

For companies in South Africa the relationship between ATO and VAIC™ was found to be significantly positive (Firer & Stainbank, 2003), whilst Ghosh & Mondal, (2009) and Pal & Soriya, (2012) did not find a significant relationship between ATO and VAIC™ for companies in India.

For the relationship between ROA and VAIC™, Ghosh & Mondal (2009) could not draw any significant conclusions as they found only one year to be significantly positive, whilst Pal & Soriya (2012) found a statistically significant positive relationship between the two variables. Firer & Stainbank (2003) found a statistically significant negative relationship with ROA.

Pal & Soriya (2012) were the only ones to test the relationship between VAIC™ and ROE; they found the relationship to be significantly positive in the pharmaceutical industry only.

Similar to the developed countries, the mixed results across sectors as well as countries could not lead to definitive conclusions about VAIC™ and its relationship with company performance indicators in emerging markets.

2.3.2.5 Review of HCE Findings and Results

The results for the relationship between company performance based on market value and HCE yielded mixed results for companies in emerging markets, as it did for companies in developed countries. Chen, Cheng & Hwang, (2005), Nimtrakoon, (2015) and Soewarno & Tjahjadi, (2020) found a significant positive relationship between HCE and market value whilst Dženopoljac et al., (2017), Firer & Williams, (2003) and Morariu, (2014) found a

significant negative relationship between the two variables. The remaining studies (Table 4) could not find significant relationships.

HCE was found to have had significant positive relationships with company performance for many studies where company performance was based on an accounting or book measure (i.e. ROA, ROE, "margin ratio", "profitability ratio"). Table 4 shows this to be the case for studies carried out Turkey (Bayraktaroğlu, Calisir & Baskak, 2019; Calisir et al., 2010), Serbia (Bontis, Janošević & Dženopoljac, 2016; Komnenic & Pokrajčić, 2012), Taiwan (Chen, Cheng & Hwang, 2005), Bangladesh (Chowdhury, Rana & Azim, 2019), Malaysia (Gan & Saleh, 2008; Ting & Lean, 2009), India (Maji & Goswami, 2016; Mondal & Ghosh, 2012) ASEAN countries (Nimtrakoon, 2015) and Indonesia (Soewarno & Tjahjadi, 2020). Dženopoljac et al., (2017) found a significant negative relationship between HCE and Net Profit Margin (NPM) but no significant relationship with any of the other profitability indicators.

ATO was found to have a significant positive relationship with HCE in four studies (Gan & Saleh, 2008; Komnenic & Pokrajčić, 2012; Mondal & Ghosh, 2012; Soewarno & Tjahjadi, 2020) and significantly negative in others (Firer & Williams, 2003; Morariu, 2014).

Studies which used EP as a measure of company performance also had mixed results with Chen, Cheng & Hwang (2005) finding a significant positive relationship with HCE, whilst Bontis, Janošević & Dženopoljac (2015) finding a significant negative relationship with HCE.

In summary, the relationship between HCE and the company's performance is mixed, but with a bias towards positive for companies in emerging markets.

2.3.2.6 Review of SCE Findings and Results

Not unlike studies performed in developed countries, the influence of SCE in emerging markets seemed to have a less of notable significant relationships

with both market and book or accounting performance. Table 4 indicates that reference to SCE as an indicator of IC is somewhat less frequent than that of HCE and CEE.

Chen, Cheng & Hwang (2005) and Nimtrakoon (2015) found a significant positive relationship between market value and SCE, whilst Bayraktaroğlu, Calisir & Baskak, (2019) found a significant negative relationship.

As indicated in section 2.3.2.2, the main reference in prior research to accounting or book return was ROA followed by ROE. Chen, Cheng & Hwang (2005), Nimtrakoon (2015), Dženopoljac et al., (2017) and Firer & Williams (2003) found a positive relationship between ROA and SCE, while Soewarno & Tjahjadi (2020) and Komnenic & Pokrajčić (2012) found a positive relationship between ROE and SCE.

Dženopoljac et al., (2017) tested the relationship between SCE and a number of accounting or book measure of return, namely EBIT, EBITDA, NPM and Gross Profit Margin (GPM). All of these measures, except GPM had a positive relationship with SCE. The researchers did not comment on the rationale for the findings across these measures of accounting return.

In summary, prior research on the relationship between SCE as a form of IC, is sparse and that which has been done show a bias toward a positive relationship between the two variables.

2.3.2.7 Review of CEE Findings and Results

Prior research shows bias toward a positive relationship between CEE and the company performance when such performance was based on market value (Cheng & Hwang, 2005; Firer & Williams, 2003; Nimtrakoon, 2015; Soewarno & Tjahjadi, 2020).

The relationship between CEE and the company's performance based on accounting or book values was shown to be positive for all studies across all

measures of performance, with two exceptions. Dženopoljac et al., (2017) found a negative relationship between CEE and company performance based on NPM and ROA for countries in the Middle East countries and Dženopoljac, Janoševic & Bontis, (2016) found a negative relationship between CEE and company performance for companies in Serbia. Overall, these results were found to be similar to that of studies carried out on companies in developed countries.

Based on the review of prior studies on the relationship between, SCE, HCE, CEE, VAIC™ and the company's performance for companies listed in emerging markets, CEE and HCE seem to have a closer (frequently more positive) relationship to the company's performance than SCE and VAIC™. This differs somewhat from the experience of companies in developed countries where the stronger relationship was found between the company's performance and CEE and SCE.

For a summary of the results of the studies reviewed as discussed under 2.3.2.4 to 2.3.2.7 see Table 4.

Table 3: Inputs - Impact of IC company performance (Emerging Markets)

Author (Year)	Country/Region/Area	Sector	VAIC™ and/or VAIC™ components or a modified/ version of VAIC™	Financial Performance indicators Tested? If so, which indicators used in the study?	Market Value tested? if so what indicator of market value?	Control and/or Dummy Variables Utilised
Bayraktaroğlu, Calisir & Baskak (2019)	Turkey	Manufacturing Companies	VAIC™ components and extended VAIC components	Yes; ATO, ROA and ROE	Yes: M/B	None
Bontis, Janošević & Dženopoljac (2015)	Serbia	Hotels	VAIC™ components	Yes: Operating Profit, ROE, ROA, "Profitability" and EP	No.	Company size (Total Equity) and Leverage
Calisir et al., (2010)	Turkey	Listed Technology Companies	VAIC™ and VAIC™ components	Yes; ATO, ROA and ROE	Yes: M/B	Company Size (Market Value) and Leverage
Chen, Cheng & Hwang (2005)	Taiwan	Listed Companies (Overall)	VAIC™ and VAIC™ components and incorporating innovation and CC	Yes: EP, ROA, ROE and RG	Yes: M/B	None
Chowdhury, Rana & Azim (2019)	Bangladesh	Listed Pharmaceuticals	VAIC™ components	Yes: ATO, ROA and ROE	Yes: M/B	Company Size (Market Value) and Leverage

Author (Year)	Country/Region/Area	Sector	VAIC™ and/or VAIC™ components or a modified/ version of VAIC™	Financial Performance indicators Tested? If so, which indicators used in the study?	Market Value tested? if so what indicator of market value?	Control and/or Dummy Variables Utilised
Dženopoljac et al., (2017)	Middle East (Arab countries)	Listed Companies (Overall) but significant influence from Financial Sector in sample size	VAIC™ components	Yes: ATO, EBIT, EBITDA, GPM, NPM, ROE and ROA	Yes: M/B	Company Size, Leverage and Industry
Dženopoljac, Janoševic & Bontis (2016)	Serbia	Technology Companies	VAIC™ components	Yes: ROA, ROE, ATO, ROIC and a "profitability" ratio	No.	Company Size and Leverage
Firer & Stainbank (2003)	South Africa	Listed Companies (Overall)	VAIC™	Yes: ATO and ROA	Yes: M/B	Company Size, Leverage, Industry and "Physical Capital Intensity"
Firer & Williams (2003)	South Africa	Listed Companies (Only Industries considered IC intensive)	VAIC™ components	Yes: ATO and ROA	Yes: M/B	Company Size, Leverage, ROE and Industry
Gan & Saleh (2008)	Malaysia	Listed Technology Companies	VAIC™ and VAIC™ components	Yes: ATO and ROA	Yes: M/B	None
Ghosh and Mondal (2009)	India	Listed Software and Pharmaceuticals	VAIC™	Yes: ATO and ROA	Yes: M/B	Company size, Leverage and "Physical Capital Intensity"

Author (Year)	Country/Region/Area	Sector	VAIC™ and/or VAIC™ components or a modified/ version of VAIC™	Financial Performance indicators Tested? If so, which indicators used in the study?	Market Value tested? if so what indicator of market value?	Control and/or Dummy Variables Utilised
Komnenic & Pokrajčić (2012)	Serbia	Multinational Companies (large weighting towards financial services companies)	VAIC™ components	Yes: ATO, ROA and ROE	No	CEE, Company Size (Book Value)
Maji & Goswami (2016)	India	Engineering and Steel	VAIC™ and VAIC™ components (including HCE and SCE combined as one indicator of ICE)	Yes: ROA	No	Company Size (Sales) and Leverage
Mehralian et al., (2012)	Iran	Listed Pharmaceuticals Companies	VAIC™ and VAIC™ components	Yes: ROA and ATO	Yes: M/B	None
Mondal & Ghosh (2012)	India	Banking	VAIC™ and VAIC™ components	Yes: ATO, ROA and ROE	No	Company Size(Total Assets), Leverage and ATO
Morariu (2014)	Romania	Listed Companies (Overall)	VAIC™ and VAIC™ components	Yes: ATO and ROE	Yes: M/B	Company Size (Sales) and Industry

Author (Year)	Country/Region/Area	Sector	VAIC™ and/or VAIC™ components or a modified/ version of VAIC™	Financial Performance indicators Tested? If so, which indicators used in the study?	Market Value tested? if so what indicator of market value?	Control and/or Dummy Variables Utilised
Nimtrakoon (2015)	ASEAN	Listed Technology	MVAIC and MVAIC components	Yes: A "Margin Ratio" (Net profit over sales) and ROA	Yes: M/B	Company Size (Total Assets), Inflation Rates and Company Age
Pal & Soriya (2012)	India	Pharmaceuticals and Textiles	VAIC™	Yes: ATO, ROA and ROE	Yes: M/B	Company Size (Sales), Leverage and "Physical Capital Intensity"
Soewarno & Tjahjadi (2020)	Indonesia	Listed Banking Companies	VAIC™ and VAIC™ components. A-VAIC and A-VAIC components	Yes: ATO, ROA and ROE	Yes: M/B	Company Size (Total Assets), Leverage and Company Age
Ting & Lean (2009)	Malaysia	Listed Financial Services Companies	VAIC™ components	Yes: ROA	No	None
Vishnu & Gupta (2014)	India	Pharmaceuticals (Large)	e-VAIC™ components and VAIC™ components however excluding CEE for both in testing	Yes : ROA and ROS	No	None

Table 4: Summary of Results and Testing in Emerging Market Economies

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™
Bayraktaroğlu, Calisir & Baskak (2019)	OLS regression models	ATO	NS			N/A	N/A
		ROA	**Positive**	**Positive**	**Positive**	N/A	N/A
		ROE	**Positive**	NS	NS	N/A	N/A
		M/B	NS	**Negative**	NS	N/A	N/A
Bontis, Janošević & Dženopoljac (2015)	OLS regression models	Operating Profit	NS	NS	**Positive**	N/A	N/A
		"Profitability"	**Positive**	**Negative**	**Positive**	N/A	N/A
		ROE	NS	NS	**Positive**	N/A	N/A
		ROA	NS	NS	**Positive**	N/A	N/A
		EP	**Negative**	NS	**Positive**	N/A	N/A
Calisir et al. (2010)	OLS regression models	ATO	NS	NS	**Positive**	N/A	NS
		ROA	**Positive**	NS	NS	N/A	**Positive**
		ROE	**Positive**	NS	**Positive**	N/A	NS
		M/B	NS			N/A	NS
Chen, Cheng & Hwang (2005)	OLS regression models	EP	**Positive**	NS	**Positive**	N/A	**Positive**
		ROA	**Positive**	**Positive**	**Positive**	N/A	**Positive**
		ROE	**Positive**	NS	**Positive**	N/A	**Positive**
		RG	**Positive**	NS	**Positive**	N/A	**Positive**
		M/B	**Positive**	**Positive**	**Positive**	N/A	**Positive**

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™
Chowdhury, Rana & Azim (2019)	OLS regression models	ATO	NS	**Negative**	**Positive**	N/A	N/A
		ROA	**Positive**	NS	NS	N/A	N/A
		ROE	NS			N/A	N/A
		M/B	NS			N/A	N/A
Dženopoljac et al., (2017)	OLS regression models	ATO	NS	NS	**Positive**	N/A	N/A
		EBIT	NS	**Positive**	**Positive**	N/A	N/A
		EBITDA	NS	**Positive**	**Positive**	N/A	N/A
		GPM	NS	**Negative**	**Positive**	N/A	N/A
		NPM	**Negative**	**Positive**	**Negative**	N/A	N/A
		ROE	NS	NS	**Positive**	N/A	N/A
		ROA	NS	**Positive**	**Negative**	N/A	N/A
		M/B	**Negative**	NS	NS	N/A	N/A
Dženopoljac, Janoševic & Bontis (2016)	OLS regression models	ROA	NS	NS	**Negative**	N/A	N/A
		ROE	NS	NS	**Negative**	N/A	N/A
		ATO	NS	NS	**Positive**	N/A	N/A
		ROIC	NS			N/A	N/A
		"Profitability" Ratio	NS			N/A	N/A
Firer & Stainbank (2003)	OLS regression models	ATO	N/A			N/A	**Positive**
		ROA	N/A			N/A	**Negative**
		M/B	N/A			N/A	NS
Firer & Williams (2003)	OLS regression models	ATO	**Negative**	NS	NS	N/A	N/A
		ROA	NS	**Positive**	NS	N/A	N/A
		M/B	**Negative**	NS	**Positive**	N/A	N/A

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™
Gan & Saleh (2008)	OLS regression models	ATO	**Positive**	NS	**Positive**	N/A	**Positive**
		ROA	**Positive**	NS	**Positive**	N/A	**Positive**
		M/B	NS			N/A	NS
Ghosh & Mondal (2009)	OLS regression models	ATO	N/A	N/A	N/A	N/A	NS
		ROA	N/A	N/A	N/A	N/A	**Positive**
		M/B	N/A	N/A	N/A	N/A	NS
Komnenic & Pokrajčić (2012)	OLS regression models	ATO	**Positive**	NS	**Positive**	N/A	N/A
		ROA	**Positive**	NS	**Positive**	N/A	N/A
		ROE	**Positive**	**Positive**	**Positive**	N/A	N/A
Maji & Goswami (2016)	Panel FE regression models and quantile regression models	ROA	**Positive**	NS	**Positive**	**Positive**	**Positive**
Mehralian et al., (2012)	OLS regression models and ANN's	ATO	NS			N/A	NS
		ROA	NS	NS	**Positive**	N/A	NS
		M/B	NS			N/A	**Negative**
Mondal & Ghosh (2012)	OLS regression models	ATO	**Positive**	NS	**Positive**	N/A	**Positive**
		ROA	**Positive**	NS	NS	N/A	**Positive**
		ROE	**Positive**	NS	NS	N/A	N/S
Morariu (2014)	OLS regression models	ATO	**Negative**	NS	NS	N/A	NS
		ROE	NS			N/A	NS
		M/B	**Negative**	NS	NS	N/A	**Negative**
Nimtrakoon (2015)	OLS regression models and one-way ANOVA	"Margin Ratio"	**Positive**	NS	**Positive**	N/A	NS*
		ROA	**Positive**	NS	**Positive**	N/A	**Positive***
		M/B	**Positive**	**Positive**	**Positive**	N/A	**Positive***

Author (Year)	Type of Testing Performed	Dependent Variables	HCE	SCE	CEE	ICE (HCE+SCE)	VAIC ™
Pal & Soriya (2012)	OLS regression models	ATO	N/A			N/A	NS
		ROA	N/A			N/A	**Positive**
		ROE	N/A			N/A	**Positive**[1]
		M/B	N/A			N/A	NS
Soewarno & Tjahjadi (2020)	OLS regression models	ATO	**Positive**[4]	NS	**Positive**[4]	N/A	N/A
		ROA	**Positive**[2]	**Positive**[4]	**Positive**[4]	N/A	N/A
		ROE	**Positive**[2]	**Positive**[3]	**Positive**[4]	N/A	N/A
		M/B	**Positive**[4]	NS	**Positive**[4]	N/A	N/A
Ting & Lean (2009)	OLS regression models	ROA	**Positive**	NS	**Positive**	N/A	N/A
Vishnu & Gupta (2014)	OLS regression models	ROA	Authors concluded on which model fit the best against performance indicators rather than actual results.				
		ROS					

Key

NS – No significant relationship was found or model was considered statistically insignificant to draw a conclusion

N/A – Variable not tested in the study and therefore not applicable

* – Indicates the use of a modified VAIC™ (MVAIC) instead of Pulic's (2000) VAIC™

[1] – Result for Pharmaceuticals only, no for the other industry (textiles) tested.

[2] – Result only applies to only the A-VAIC method of calculating the variable and not significant in relation to the original VAIC™ methodology of calculating the respective variable.

[3] – Result only applies to only the original VAIC™ method of calculating the variable and not significant in relation to not the A-VAIC methodology of calculating the respective variable.

[4] – Result applies to both the original VAIC™ method of calculating the variable and the A-VAIC methodology of calculating the respective variable.

2.4 Summary and conclusions

In this chapter the study reviewed definitions and categorisations of IC as found in prior literature, it provided a summary of the most common models used in practise to measure IC and it reviewed prior research on the relationship between IC and company performance based on book and market values. This review focussed is on research carried out in developed countries and emerging markets with a special focus on studies performed in South Africa.

The review showed that prior studies categorised IC into three main categories, HC, SC and RC. Whilst many models of IC valuation was referred to in prior research the VAIC ™ and its components, HCE, CEE, SCE (and ICE) were the most frequent models of IC resorted to. The company's performance was found to be more frequently positively related to HCE and CEE for companies in developed countries and emerging economies, but in developed countries the bias is towards HCE and in emerging economies the bias is towards CEE. Studies using the composite VAIC™ as a whole and ICE were less frequently observed.

The chapter that follows will outline the data and methodology used in this study. The factors considered in reaching the final sample of companies used in the analysis and the factors considered in the choice of statistical tools to carry out the analysis of the relationship between IC and the company's performance will be discussed.

CHAPTER 3: DATA AND METHODOLOGY

3.1 Data

This study considers all companies listed on the JSE. Data was extracted from the IRESS Expert database. To ensure integrity, samples of data extracts were compared to the Bloomberg database. Both sources of information are considered prime sources of reliable information and have been used previously in international and national (South African) studies as prime sources of data (Firer & Williams, 2003; Firer & Stainbank, 2003).

Relevant financial and market data for a period of ten years between 2011 and 2020 was extracted. The total number of companies under consideration were 329. A critical component of calculating the components of IC under VAIC™ method, is the disclosure of salaries and wages. Factoring for companies that disclose this metric (in at least one of the ten years) reduces the sample size to 237 listed companies. When considering the entire ten year period, there were 204 companies who had missing data in one or more years, further reducing the sample size to a total of 34 companies.

Previous studies in South Africa (Firer & Williams, 2003; Firer & Stainbank, 2003) only considered one year of information. This study applied the time frame to the most recent five year period (2016-2020) available, similar to various studies performed in emerging market economies (Chowdhury, Rana & Azim, 2019; Dženopoljac et al., 2017; Ghosh & Mondal, 2009; Dženopoljac, Janoševic & Bontis, 2016). By applying this limited time frame to the initial dataset, the final sample size considered in the study increased by 16 – from 34 to a total of 50 listed South African companies under consideration. This compares favourably to prior studies such as Firer & Williams (2003) and Firer & Stainbank (2003). We considered the compromise on the number of periods included in the study to be worth the inclusion of the additional companies in the final sample.

Refer to Table 5 for a summary of the method used to get to the final sample of companies use in this study. Table 6 illustrates the distribution of the final data set among sectors represented on the JSE.

Table 5: Data Processing

Description	No of companies
Total listed company dataset from IRESS over 10 year period	329
Less: Companies that do not disclose salaries and wages in at least one of the 10 years	(92)
Companies that disclose salaries and wages in at least one year across the 10 years considered	**237**
Less: Companies that have missing data points across all 10 years	(203)
Listed companies that disclose all data over a 10 year period	**34**
Add: Adjustment for companies that have all data points by taking into account recent five year period	16
Total no of companies with all data points from 2016-2020	**50**

Table 6 shows that the total sample is dominated by the industrial sector, followed by the consumer products and services sector. This is not surprising given that listings on the JSE is dominated by companies from these sectors

Table 6: Sector Description

Sector	No of Companies	% of Total Sample
Mining and Resources	2	4%
Consumer Products and Services	14	28%
Financial Services and Real Estate	6	12%
Healthcare and Pharmaceuticals	2	4%
Industrials	21	42%
Technology and Telecommunications	5	10%
Total	**50**	**100%**

3.2 Methodology

The methodology used in this study to test the relationship between IC and ROA and ATO (measures of accounting performance) and the relationship between IC and TQ (a measure of market to book value).

The primary statistical methodology used in this study is the FE panel data regression supported by various diagnostics. The decision process followed on using the FE statistical model is detailed below.

3.2.1. Statistical Approach

The final dataset under consideration in this study consists of both cross sectional (different companies) as well as time series data (across various periods of time – five years). Based on these characteristics, a relevant statistical panel data regression model can be used to analyse the relationship dependent and independent variables. The options available for panel data regression are the pooled OLS model, FE estimation and RE estimation.

The majority of studies in Table 2 and Table 4 utilised pooled OLS regression models in their testing. The major pitfall in this regression model is that it does not consider unobserved individual company impact (heterogeneity), and therefore fails to account for company specific impact in supplementing financial performance (Maji & Goswami, 2016). Therefore, pooled OLS regression was not deemed appropriate for the panel dataset in this study.

This leaves the option of testing between FE and RE models for panel data. Although the Hausman test is commonly applied in practise to choose between FE and RE models, this is not necessarily the correct approach in deciding which model to use for panel data (Baltagi, 2021). Bell & Jones (2015) also emphasise that the Hausman test is not a test of FE and RE, and does not address the wider decision making framework for a wider range of problems. The RE model assumes that all the regressors and random individual effects are

exogenous in contrast to the FE model which allows for endogeneity of the individual effects and all the regressors (Baltagi, Bresson & Pirotte, 2003). Based on the strict exogeneity assumptions surrounding the use of the RE model, the FE model is preferred for all statistical regression testing performed.

The basic form of the FE model is displayed below:

$$\mathrm{Y}_{it} = \alpha_i + \beta_{1it}\mathrm{X}_{1it} + \beta_{2it}\mathrm{X}_{2it} + \ldots + \beta_{kit}\mathrm{X}_{kit} + \varepsilon_{it} \qquad \textbf{(1)}$$

$$\alpha_i = \alpha + \mu_i + \lambda_i \qquad \text{and} \qquad \varepsilon_{it} = \varepsilon_{it}$$

Where:

- Y_{it} = dependent variable for the *i*th cross-sectional unit (company) at time unit *t*.
- α_i = intercept for the *i*th cross-sectional unit (company).
- β_{kit}= coefficient for the *k*th independent variable related to the *i*th cross-sectional unit (company) at time unit *t*.
- X_{kit}= the *k*th independent variable related to the *i*th cross-sectional unit (company) at time unit *t*.
- μ_i = fixed unobservable individual heterogeneity component of the *i*th cross-sectional unit (individual company).
- λ_i = the fixed unobservable time effect component. It accounts for time-specific effects not included in the regression.
- ε_{it} = residual error component where $\varepsilon_{it} \sim \mathrm{IID\ M}\ (0, \sigma_\varepsilon^2)$.

In addition to the panel data regression applied, the Pearson Correlation analysis was also applied to provide a high level indication of the relationship between variables.

3.2.1.1 Independent Variables

The original VAIC™ and its components according to Pulic (2000) will be used as the independent variables. An important element when calculating VAIC™ is Value Add (VA). Pulic (2000) defines VA as output (revenue) less input

(expenses) and with a specific exclusion of labour costs as part of the input. By applying a similar approach previously used in South African studies by Firer & Williams (2003) and Firer & Stainbank (2003), we calculate (gross) Value Add from a stakeholder approach.

The formula for calculating VA:

$$\mathrm{VA}_i = \mathrm{I}_i + \mathrm{DP}_i + \mathrm{D}_i + \mathrm{T}_i + \mathrm{M}_i + \mathrm{R}_i + \mathrm{HC}_i \quad \textbf{(2)}$$

Where:

- VA_i = Value add of company *i.*
- I_i = Interest expense of company *i.*
- DP_i = Depreciation expense of company *i.*
- D_i = Dividends of company *i.*
- T_i = Corporate taxation of company *i.*
- M_i = Minority shareholders equity interest in the net income of subsidiaries of company *i.*
- R_i = Retained profits for the relevant year of company *i.*
- HC_i = Human capital for company *i* represented by Total Salaries and Wages for company *i.*

This is then used to derive the following formulae for HCE, SCE, CEE and *VAIC™*:

$$HCE_i = \frac{VA_i}{HC_i} \quad \textbf{(3)}$$

$$SCE_i = \frac{SC_i}{VA_i} \quad \textbf{(4)}$$

$$CEE_i = \frac{VA_i}{CE_i} \quad \textbf{(5)}$$

$$VAIC_i^{TM} = HCE_i + SCE_i + CEE_i \quad \textbf{(6)}$$

Where:

- VA_i = Value add of company *i.*

- HC_i = Human capital for company *i* represented by Total salaries and Wages for company *i*.
- SC_i = Structural Capital for company *i* derived as VA_i less HC_i
- CE_i = Capital Employed for company *i* derived as net book value (equity) of company *i*.
- $\mathrm{VAIC}_i^{\mathrm{TM}}$ = Value Added Intellectual coefficient for company *i*.
- HCE_i = Human Capital Efficiency for company *i*.
- SCE_i = Structural Capital Efficiency for company *i*.
- CEE_i = Capital Employed Efficiency for company *i*.

Various studies have used extended, modified or adjusted versions of VAIC™ (Bayraktaroğlu, Calisir & Baskak, 2019; Chen, Cheng & Hwang, 2005; Nimtrakoon, 2015; Soewarno & Tjahjadi, 2020; Vishnu & Gupta, 2014), however findings from these studies have failed to yield a significant difference in results, compared to the original VAIC™, hence the reference in this study to the original version of VAIC™.

3.2.1.2 Dependent Variables

The three performance indicators used in this study are ATO (productivity), ROA (profitability) and TQ (market value). These ratios are formulated as follows:

ATO = Revenue / Total Assets
ROA = Net Profit / Total Assets
TQ = Market Capitalisation / Net book value (equity)

3.2.1.3 Control Variables

The control variables utilised for multiple regression analysis in this study are:

i. Size of the Company (LCap)–- natural log of market cap of company *i*

ii. Leverage Ratio of the Company (Lev) – total debt / net book value (equity) of company *i*

3.3 Hypothesis

Basic financial theory suggests that a reasonable expectation of any good investment in a company is that there is a positive impact on the returns of the company based on its accounting book values. It is also reasonable to expect that good investment are recognised and rewarded by the market. An investment in the companies' CEE, HCE and SCE can be reasonably expected to have positive results on the company's return and productivity and can be reasonably expected be rewarded by the market. In light of this, the following hypothesis is defined for this study.

- H1(a) - VAIC™ is positively associated with market value (TQ)
- H1(b) - VAIC™ is positively associated with profitability (ROA)
- H1(c) - VAIC™ is positively associated with productivity (ATO)

- H2(a) - HCE is positively associated with market value (TQ)
- H2(b) - HCE is positively associated with profitability (ROA)
- H2(c) - HCE is positively associated with productivity (ATO)

- H3(a) - SCE is positively associated with market value (TQ)
- H3(b) - SCE is positively associated with profitability (ROA)
- H3(c) - SCE is positively associated with productivity (ATO)

- H4(a) - CEE is positively associated with market value (TQ)
- H4(b) - CEE is positively associated with profitability (ROA)
- H4(c) - CEE is positively associated with productivity (ATO)

3.4 Regression Models

Six panel data regression models have been developed to test the 12 hypotheses in this paper.

The following three panel data models test the relationship of VAIC™ and the dependent variables:

Model 1 (Hypothesis 1a)

$$\mathrm{TQ}_{it} = \alpha_i + \beta_1 \mathrm{VAIC}_{it}^{\mathrm{TM}} + \beta_2 \mathrm{LCap}_{it} + \beta_3 \mathrm{Lev}_{it} + \varepsilon_{it} \quad \textbf{(7)}$$

Model 2 (Hypothesis 1b)

$$\mathrm{ROA}_{it} = \alpha_i + \beta_1 \mathrm{VAIC}_{it}^{\mathrm{TM}} + \beta_2 \mathrm{LCap}_{it} + \beta_3 \mathrm{Lev}_{it} + \varepsilon_{it} \quad \textbf{(8)}$$

Model 3 (Hypothesis 1c)

$$\mathrm{ATO}_{it} = \alpha_i + \beta_1 \mathrm{VAIC}_{it}^{\mathrm{TM}} + \beta_2 \mathrm{LCap}_{it} + \beta_3 \mathrm{Lev}_{it} + \varepsilon_{it} \quad \textbf{(9)}$$

The following three models are used to test the remaining hypotheses developed:

Model 4 (Hypothesis 2a, 3a, 4a)

$$TQ_{it} = \alpha_i + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \beta_3 CEE_i + \beta_4 LCap_{it} + \beta_5 Lev_{it} + \varepsilon_{it} \quad \textbf{(10)}$$

Model 5 (Hypothesis 2b, 3b, 4b)

$$\mathrm{ROA}_{it} = \alpha_i + \beta_1 \mathrm{HCE}_{it} + \beta_2 \mathrm{SCE}_{it} + \beta_3 \mathrm{CEE}_i + \beta_4 \mathrm{LCap}_{it} + \beta_5 \mathrm{Lev}_{it} + \varepsilon_{it} \quad \textbf{(11)}$$

Model 6 (Hypothesis 2c, 3c, 4c)

$$ATO_{it} = \alpha_i + \beta_1 HCE_{it} + \beta_2 SCE_{it} + \beta_3 CEE_i + \beta_4 LCap_{it} + \beta_5 Lev_{it} + \varepsilon_{it} \quad \textbf{(12)}$$

3.5 Diagnostic Tests

To ensure the reliability of the statistical testing, the following diagnostic tests were performed:

- Multicollinearity
- Unit Root Tests and Stationarity
- Heteroskedasticity and Serial Correlation
- Endogeneity

3.5.1 Multicollinearity

Severe multicollinearity between independent variables in the regression model can cause large variances in the coefficients of the model (Baltagi, 2021). This study applies the VIF as well as the Pearson Correlation analysis amongst the independent variables to test for excessive collinearity.

3.5.1.1 Pearson Correlation

Pearson Correlation is used to measure both strength and direction of a relationship between two continuous variables. It is applied as an initial measure of multicollinearity between independent variables (Hair et al., 2010). It could be an indicative of the existence of multicollinearity in the sample data used in the analysis. A high level of multicollinearity can lead lower to confidence in the model's ability to predict the relationship between dependent and independent variables (Hair et al., 2010). This is because one or more independent variables can be predicted from another independent variable, thus making the prediction of the relationship be dependent and independent variable more difficult (Hair et al., 2010). Equation 13 describes the equation for calculating the correlation coefficient between variables in a dataset.

Formula for the Pearson Correlation:

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} \quad \textbf{(13)}$$

Where:

- r = correlation coefficient
- x_i = values of the x-variable in a sample
- $\bar{x}$ = mean of the values of the x-variable
- y_i = values of the y-variable in a sample
- $\bar{y}$ = values of the y-variable in a sample

The upper and lower bound of the correlation coefficient lie between −1 and +1. The closer the correlation coefficient is to 1, the stronger the relationship between the variables. A correlation coefficient of 1 predicts a perfect linear relationship whereas correlation coefficient at zero indicates no linear relationship between the variables. Kennedy (2008:6) indicates that multicollinearity may be a significant problem if the correlation between explanatory variables exceed 0.8.

3.5.1.2 Variance Inflation Factor

VIF performs a regression of the independent variables against each other, where large VIF value would display a high degree of multicollinearity between independent variables (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988). The problem with high collinearity is that it inflates the variance of the regression coefficient resulting in much higher confident intervals around the estimate of the regression coefficient due to higher standard errors. As a result, it becomes difficult to claim that the coefficient is significantly greater than zero (Hair et al., 2010).

Formula for the VIF:

$$VIF_i = \frac{1}{1 - R_i^2} \quad \textbf{(14)}$$

Where:

- R_i^2 represents the unadjusted coefficient of determination for regressing the ith independent variable on the remaining variables.

VIF can range from 1, indicative of non-correlated coefficients, to infinity, with higher values indicating higher levels of correlation between coefficients of variable of interest. The general rule in relation to this is that if the VIF exceeds 10, the independent variables are deemed to be collinear with the other independent variables (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988). Under such conditions the independent variable's predictive power is reduced (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988). Within the context of this study this should not pose a significant problem because the objective of the study is not to test a model's predictive power but simply to observe a relationship between dependent and independent variables. However, it is deemed important due to the potential impact on the direction of that relationship (i.e. positive or negative) when excessive high levels of multicollinearity exist (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988).

3.5.2 Unit Root Test and Stationarity

Unit roots present in time series data may cause issues by displaying non-stationarity in the mean. Non-stationary data may be problematic in that they are unpredictable and therefore cannot be modelled. If unit root is present in the time series (i.e., data is non-stationary) the results of the analysis using this data may be unreliable, it could indicate relationships between variables that do not really exist (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988). If data is found to be stationarity, it can be assumed to exhibit characteristics of mean reversion i.e., it can be assumed that data will

fluctuate around a constant long run mean (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988).

This study uses the ADF test to test for unit root in each of the time series under consideration. The ADF test considers the stochastic process of form of:

$$y_i = \emptyset y_{i-1} + \varepsilon_i \quad \textbf{(15)}$$

Where:

- $|\emptyset| \leq 1$

If |ø| = 1 confirms the presence of a unit root and the data may be said to properties of a random walk (without drift); the data is therefore not classified as stationary. If |ø| < 1, the process is stationary.

The ADF test is applied to determine whether the principal regression equation has a unit root. The approach is as follows:

Represent the principal equation in first difference form as follows:

$$y_{it} - y_{it-1} = (\emptyset y_{it-1}) + \epsilon_{it} - y_{it-1} \quad \textbf{(16)}$$

or alternatively,

$$y_{it} - y_{it-1} = ((\emptyset - i) y_{it-1}) + \epsilon_{it} \quad \textbf{(17)}$$

If we set $\beta = \emptyset - 1$, then the equation can be represented as:

$$\Delta y_{it} = \Delta y_{it} = \beta(y_{it-1}) + \epsilon_{it}(y_{it-1}) + \epsilon_{it} \quad \textbf{(18)}$$

If we assume $\beta \leq 0$, effectively test for ø is transformed into a test that the for $\beta = 0$.

Out of this the following hypothesis can be derived:

- H_0: $\beta = 0$ (equivalent to ø = 1)

- H_1: $\beta < 0$ (equivalent to $\emptyset < 1$)

The null hypothesis assume that there is a unit root and that the time series is not stationary.

There are three forms of the ADF test that can be applied. The type one test takes the form $\Delta y_i = \beta_1 y_{i-1} + \varepsilon_i$ which assume no constant and no trend. The type two test takes the form $\Delta y_i = \beta_0 + \beta_1 y_{i-1} + \varepsilon_i$ which assume a constant and no trend. The type three test takes the form $\Delta y_i = \beta_0 + \beta_1 y_{i-1} + \beta_2 i + \varepsilon_i$ which assumes a constant and trend. In this study we make use of the type two test.

3.5.3 Heteroskedasticity and Serial Correlation

Heteroskedasticity indicates that the residual (error) term in the panel model varies over time and is not constant (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988), whilst serial correlation indicates that a variable is correlated with lagged version of itself resulting in residual errors that may be carried over time periods (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988). Under such conditions least squared coefficients of the regression can no longer be considered to be the best linear unbiased estimate of the regression coefficient (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988).

Each model under consideration was tested for heteroskedasticity and serial correlation using the BP test and the W test for panel models, respectively.

3.5.3.1 Breusch-Pagan Test

The BP test uses the following null and alternative hypotheses:

- **Null Hypothesis (H_0):** Homoscedasticity is present (the residuals are distributed with equal variance).

- **Alternative Hypothesis (H_A)**: Heteroscedasticity is present (the residuals are not distributed with equal variance).

The test is carried out in the following five steps.

i. Estimate the defined regression model (see Equation 1).
ii. Obtain predicted Y-values from the regression model. For study this refers to values of company performance (see Equation 1).
iii. Estimate an auxiliary regression defined by:

$$\hat{\varepsilon}^2 = \delta_0 + \delta_1 \hat{Y}_i \quad \textbf{(19)}$$

Where:

- $\hat{\varepsilon}^2$ = an estimate of the squared residuals of the fitted regression model

iv. From this auxiliary model obtain the R^2 value of the estimate residual.
v. Calculate the Chi-Square test statistic ($\varkappa^2$) where, $\varkappa^2 = nR^2$ and n = the total number of observations.
vi. If Chi-Square test statistic is significant, we can assume that the residual (error) term in the panel model varies over time and that evidence of heteroskedasticity is present in the model. In this case we reject the null hypothesis which assume that residual are distributed with equal variance and conclude that heteroskedasticity is present in the model.

In this study the BP test was carried out using the BP test in R.

3.5.3.2 Wooldridge (W) test

To test whether a variable is correlated with lagged version of itself which may result in residual errors that may be carried over time periods. The W test makes use of the residual from the principal regression model which may take the

basic form of the FE model used in this study as explained by Equation 1 in section 3.2.1.

However, the test makes use of the model in first difference form where:

$$y_{it} - y_{it-1} = (X_{it} - X_{it-1})\beta_1 + \epsilon_{it} - \epsilon_{it-1} \quad \textbf{(20)}$$

or alternatively,

$$\Delta y_{it} = (\Delta X_{it})\beta_1 + \Delta\epsilon_{it} \quad \textbf{(21)}$$

- μ_i = fixed unobservable individual heterogeneity component of the *i*th cross-sectional unit (individual company).

This differencing removes company-level fixed effects. We use the predicted values of the residuals of the first difference regression and then test the correlation between the residual of the first difference equation and its first lag i.e., $Corr(\Delta\epsilon_{it}, \Delta\epsilon_{it-1})$. If there's no serial correlation then the correlation should have a value of -0.5. If the correlation is equal to -0.5 the principal regression model in (Equation 1) will not have serial correlation. However, if it differs significantly, we have first order serial correlation in the principal regression model and can safely assume that errors correlated with error is subsequent periods.

3.5.4 Endogeneity

Endogeneity refers to situations in which explanatory variables in a regression model are correlated with errors terms. This happens when the regression model has omitted variables; variations caused by these variables will then be captured by the error term. In the presence of endogeneity, the least squares estimator can be biased and/or inconsistent (Antonakis et al., 2014). To address the issue surrounding potential endogeneity, this study applies a "two-way" FE

model (Imai & Kim, 2021; Wooldridge, 2021) which adjusts for unobserved company-specific and time-specific factors that may distort the relationship between the dependent and independent variable being modelled. The model assumed fixed company effects and fixed time effects. By including company FE, we effectively remove company specific time averages and apply pooled OLS regression to the (now altered) data (Wooldridge, 2021). Including time FE removes changes in the economic environment that have the same effect on all companies (Wooldridge, 2021).

3.6 Summary and Conclusions

This chapter provided an outline of the data used in the analysis and outlined the reasons for decisions in the data review to get the final sample of companies used in the analysis. In this chapter we also explain the measure taken to ensure the integrity of the data used and its suitability for the analysis undertaken. In this regard, we considered the impact of Multicollinearity and existence of Unit Root, Heteroskedasticity and Serial Correlation within the data. The models used to carry out the analysis of the relationship between the company's investment in IC and its performance were defined and potential problems with endogeneity are addressed.

In chapter 4 we report on the results of the tests for unit root, heteroskedasticity and serial correlation. This is followed by a discussion of the result of the six regression models define in chapter 3.

CHAPTER 4: FINDINGS AND DISCUSSION

4.1 Descriptive Statistics

One of the initial concerns in this study was the impact of the data clean-up as described in Table 5 on the final sample size. While a sample size of 20 observations is generally considered large enough to adequately describe the distribution of data, it is preferable that the sample be as large as possible to provide a better description of the distribution of the data and to provide more precise estimates of key statistics (mean, median, standard deviation and minimum and maximum values) (Hair et al., 2010). The final sample size of the data set in this study is 50, which provides a level of comfort regarding the its ability to provide a good description of the distribution of the data and to provide estimates of key statistics that are reliable.

Table 7: Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Min	Max
HCE	2.774	1.901	2.987	0.171	18.120
SCE	0.447	0.474	0.430	- 4.854	0.945
CEE	1.151	0.782	2.335	0.038	33.667
VAIC™	4.372	3.236	4.271	- 4.644	38.219
LCap	22.230	22.469	2.165	17.586	26.675
Lev	1.799	1.010	2.796	- 12.218	12.773
ATO	1.298	1.169	0.925	0.064	4.546
ROA	0.050	0.048	0.142	- 0.548	1.813
TQ	1.964	1.192	2.237	0.093	21.554

Table 7 represents the descriptive statistics of the key variables used in the test of the relationship between the company's IC and its performance. The relative mean and median values suggest that the data for all the variables under consideration do not suffer from significant impact of outliers. This is supported by the low standard deviation of the values around the mean for each of the values described in Table 5. For most variables under consideration, Table 7 shows that the mean values exceed the median values (with exception of SCE), suggesting a positive skew in the distribution of the data. However, the mean and median values are close enough for all variables to suggest that the distribution of these values are not significantly positively skewed.

4.2 Multicollinearity

4.2.1 Pearson Correlation

The results from the Pearson Correlation analysis between dependent and independent variables are displayed in Table 8 and Table 9.

Table 8: Pearson Correlation Analysis (Model 1 to 3)

	VAIC™	**LCap**	**Lev**	**ATO**	**ROA**	**TQ**
VAIC™	1.000					
LCap	0.103	1.000				
Lev	-0.113	0.340**	1.000			
ATO	0.154*	-0.239**	-0.197**	1.000		
ROA	0.030	0.190**	-0.119	0.218**	1.000	
TQ	0.345**	0.402**	-0.131*	0.169**	0.174**	1.000
Note: ** and * indicate significance at 1% and 5% levels respectively by two-tailed test						

The correlation coefficients between independent variables are significantly below the threshold of 0.8 from Kennedy (2008:6) therefore no significant multicollinearity issues are observed under each model.

Preliminary results from Table 8 indicate that VAIC™ is significant and positively correlated to both productivity (ATO) as well as market value (TQ). Company size (LCap) is significant and positively correlated to profitability (ROA) and market value whilst being significantly negatively correlated with productivity (ATO). Leverage (Lev) is significantly negatively correlated to both profitability (ROA) and market value (TQ). The coefficients (where significant) are larger for market value (TQ) compared to the other dependent variables

Table 9: Pearson Correlation Analysis (Model 4 to 6)

	HCE	SCE	CEE	LCap	Lev	ATO	ROA	TQ
HCE	1.000							
SCE	0.417**	1.000						
CEE	0.177**	0.070	1.000					
LCap	0.152*	0.259**	-0.054	1.000				
Lev	-0.010	0.073	-0.207**	0.340**	1.000			
ATO	0.070	-0.028	0.198**	-0.239**	-0.197**	1.000		
ROA	0.042	0.146*	-0.026	0.190**	-0.119	0.218**	1.000	
TQ	0.011	0.158*	0.588**	0.402**	-0.131*	0.169**	0.174**	1.000
Note: ** and * indicate significance at 1% and 5% levels respectively by two-tailed test								

Pearson Correlation results (for the components of VAIC™) in Table 9 show no significance in correlation between HCE and all three dependent variables. SCE has significant and positive correlation with profitability (ROA) and market value (TQ). Physical and financial capital represented by CEE, is significantly and positively correlated with productivity (ATO) and market value (TQ) with a larger coefficient towards the latter. This table indicates that CEE is the dominant component of VAIC™ for both productivity and market value correlations.

4.2.2 Variance Inflation Factor

The general rule in relation to this is that if the VIF exceeds 10, the independent variables are deemed to be collinear with the other independent variables (Hair et al., 2010; Kleinbaum, Kupper & Muller, 1988). The VIF values as recorded in the output of Models 1 to 6 in Tables 12 to 17 are significantly lower than 10, indicating that the variables in these regression models do not suffer from multicollinearity to the extent that is should pose a concern for the robustness of the output. This result concurs with that suggested by analysis under the Pearson Correlation.

4.3 Unit Root Test and Stationarity

Table 10 indicates the results from the ADF test. The p-value of the ADF test is less than 0.05, therefore Null Hypothesis indicating the presence of unit root can be rejected. All time-series data tested indicate stationarity, i.e. it is not unpredictable and can therefore be modelled without concerns about producing relationships that do not exist.

Table 10: Unit Root Testing Results

TQ	ATO	ROA	VAIC™	HCE	SCE	CEE	LCap	Lev
*S	*S	*S	*S	*S	*S	*S	*S	*S

**NS – The p-value of the ADF test is greater than 0.05, therefore the null hypothesis is accepted and there is presence of unit roots (non-stationarity) in the variable within the panel.*

**S – The p-value of the ADF test is less than 0.05, therefore Null Hypothesis rejected, and the variable is considered stationary in the panel dataset*

4.4 Heteroskedasticity and Serial Correlation

Table 11 indicates the results of the BP test and the W test for heteroskedasticity and serial correlation, respectively.

The p-value for both tests is less than 0.05, therefore the null hypothesis indicating homoskedasticity is rejected and null hypothesis indicating a lack of serial correlation is rejected.

The presence of heteroskedasticity and serial correlation in the data is problematic. To manage this, the study applies a clustered covariance matrix proposed by Arellano (Arellano, 1987). This is a Covariance Matrix for panel data used to estimate robust standard errors and related t-statistics for the regression model to accommodate heteroskedasticity and serial correlation.

Table 11: Heteroskedasticity and Serial Correlation Results

Regression Models applied	Heteroskedasticity Result (BP Test)	Serial Correlation Result (W Test)
Model 1	*Y	*Y
Model 2	*Y	*Y
Model 3	*Y	*Y
Model 4	*Y	*Y
Model 5	*Y	*Y
Model 6	*Y	*Y

**N – The p-value for the BP Test or W Test is greater than 0.05, therefore the respective null hypothesis is accepted, and there is no heteroskedasticity or serial correlation per the respective test applied.*

**Y – The p-value for the BP Test or W Test is less than 0.05, therefore the respective null hypothesis is rejected and there is heteroskedasticity or serial correlation per the respective test applied.*

4.5 Regression Results

4.5.1 Results of Model 1

Table 12 illustrates the results of Model 1, an analysis of the relationship between VAIC™ to TQ. The R-squared and adjusted R-squared results indicate that the independent variables in the regression model potentially explain a significant portion of movement in the dependent variable. The significance of the F-Statistic indicates that the model provides a good fit for results to be drawn. The VIF values calculated are significantly lower than the upper limit of 10 (Kleinbaum, Kupper & Muller, 1988), therefore issues surrounding multicollinearity are not considered significant.

Results from Model 1 indicate that VAIC™ has a significant and positive impact on market value of listed companies in South Africa. This supports the notion that companies in South Africa use both tangible and intangible resources to enhance its market value. The findings contrasts with results from the previous South African study (Firer & Stainbank, 2003) as well as other studies (Ghosh & Mondal, 2009; Pal & Soriya, 2012; Chu, Chan & Wu, 2011; Maditinos et al., 2011) where no significant relationship was found between VAIC™ and market value proxies.

The positive relationship between the company's market value and its size (represented by LCap) and the negative relationship between the company's market value and leverage is in line expectation based on similar results of prior studies (Dženopoljac et al., 2017; Firer & Stainbank, 2003; Firer & Williams, 2003; Morariu, 2014).

The results from Model 1 confirms hypothesis H1(a) indicating a positive relationship between VAIC™ and the company's market value (TQ).

Table 12: Two-ways FE Regression results Model 1

Independent Variable	*Coefficient*	*Standard Error*	*t-statistic*	*F Statistic*	*VIF*
VAIC™	0.467 **	0.057 [1]	8.199 [1]	220.856 **	1.037
LCap	0.656 **	0.192 [1]	3.418 [1]		1.157
Lev	-0.206 **	0.050 [1]	-4.123 [1]		1.159

Notes: Dependent variable under this model is TQ.

R^2 Value = 0.774 and Adjusted R^2 Value = 0.709

* = *significance at the 5% level*

** = *significance at the 1% level*

[1] = robust standard error and t-statistic reported in the presence of both Heteroskedasticity and Serial Correlation using the Arellano robust covariance matrix for panel data.

4.5.2 Results of Model 2

Table 13 illustrates the results of Model 2, an analysis of the relationship between VAIC™ to the company's ROA. The R-squared and adjusted R-squared results indicate that the independent variables in the regression model do not explain a significant portion of movement in the dependent variable. The model shows that none of the independent variables exhibit a significant relationship with the dependent variable (ROA). The VIF values calculated are significantly lower than the upper limit of 10 (Kleinbaum, Kupper & Muller, 1988), therefore the model does not present any concern associated with multicollinearity. Ghosh & Mondal (2009) and Joshi et al., (2013) showed similar results of an inconclusive relationship between VAIC™ and ROA. The findings of this study contrasts with that of Firer & Stainbank (2003) who found a significant negative relationship between VAIC™ and the company's ROA.

The control variables, LCap and Lev shows the expected positive and negative associations with the company's ROA, but these lack statistical significance. These are not in line with expectation, but given the low R^2 and adjusted R^2 values, is no surprise.

Given the low explanatory power of the model as indicated by it R^2 values and its F-Statistic, Model 2 fails to confirm the hypothesised negative relationship between VAIC™ and the company's ROA. Hypothesis H1(b) cannot be confirmed.

Table 13: Two-ways FE Regression results Model 2

Independent Variable	***Coefficient***	***Standard Error***	***t-statistic***	***F Statistic***	***VIF***
VAIC™	0.002	0.002 [1]	0.891 [1]	1.100	1.037
LCap	0.035	0.023 [1]	1.495 [1]		1.157
Lev	-0.003	0.006 [1]	-0.5224 [1]		1.159
Notes: Dependent variable under this model is ROA. *R^2 Value = 0.016 and Adjusted R^2 Value = -0.268* * = *significance at the 5% level* ** = *significance at the 1% level* [1] = robust standard error and t-statistic reported in the presence of both Heteroskedasticity and Serial Correlation using the Arellano robust covariance matrix for panel data.					

4.5.3 Results of Model 3

Table 14 illustrates the results of Model 3, an analysis of the relationship between VAIC™ to the company's ATO. The results are similar to that of Model 2 in that none of the independent variables are significant. As with Model 2, the low R-squared values contribute to the low explanatory power of this model. The VIF values calculated are significantly lower than the upper limit of 10 (Kleinbaum, Kupper & Muller, 1988), therefore the model does not present any concern associated with multicollinearity.

The control variables, LCap and Lev shows the expected positive and negative associations with the company's ATO, but these lack statistical significance. These are not in line with expectation, but given the low R^2 and adjusted R^2 values, is no surprise.

Whilst Firer & Stainbank (2003) found a significant positive relationship between VAIC™ and productivity (ATO) in their study of South African companies, this study fails to provide such evidence; Model 3 fails to confirm the hypothesised positive relationship between VAIC™ and the company's ATO.

Table 14: Two-ways FE Regression results Model 3

Independent Variable	***Coefficient***	***Standard Error***	***t-statistic***	***F Statistic***	***VIF***
VAIC™	-0.010	0.009 [1]	-1.195 [1]	2.290	1.037
LCap	-0.094	0.065 [1]	1.429 [1]		1.157
Lev	-0.035	0.036 [1]	-0.973 [1]		1.159

Notes: Dependent variable under this model is ATO.

R^2 Value = 0.034 and Adjusted R^2 Value = -0.246

** = significance at the 5% level*

*** = significance at the 1% level*

[1] = robust standard error and t-statistic reported in the presence of both Heteroskedasticity and Serial Correlation using the Arellano robust covariance matrix for panel data.

4.5.4 Results of Model 4

Table 15 illustrates the results of Model 4, an analysis of the relationship between the components of VAIC™ (i.e. HCE, SCE and CEE) to the company's TQ. The high R-squared (and adjusted R-squared values) as well as significance of the F-Statistic suggests a good fit for the model that looks promising for its ability to explain the relationship between components of VAIC™ and the company's market value, however, as the information is Table 15 suggests, only one element of VAIC™ displays a statistically independent relationship with TQ. The VIF values calculated are significantly lower than the upper limit of 10 (Kleinbaum, Kupper & Muller, 1988), therefore issues surrounding multicollinearity are not considered significant.

The reader is reminded that HCE, SCE and CEE are components of VAIC™ , whilst HCE and SCE are considered to be components of IC. These results of Model 4 show that IC components (HCE and SCE) are not significantly associated with market value. These findings were similar to that of most prior studies on companies in other emerging markets (see Table 4), but contrast with that of Firer & Williams (2003), who also focussed on South African companies. Firer & Williams (2003 found HCE and SCE to have significant negative and positive relationships with market value, respectively.

CEE was found to be significantly positively associated with TQ implying that South African investors respond positively to the company's capital employment efficiency. This corresponds with the findings of Firer & Williams (2003).

The control variables, LCap and Lev show significant positive and negative associations with the company's TQ, respectively. These are in line with expectation.

The failure to find significant relationships between HCE and TQ and SCE and TQ implies that the results of Model 4 does not support results hypothesis H2(a) and H3(a). However, the significant positive association of CEE with market value does support hypothesis H4(a).

Table 15: Two-ways FE Regression results Model 4

Independent Variable	*Coefficient*	*Standard Error*	*t-statistic*	*F Statistic*	*VIF*
HCE	0.096	0.104 [1]	0.927 [1]	199.519 **	1.250
SCE	-0.076	0.085 [1]	-0.894 [1]		1.271
CEE	0.569 **	0.028 [1]	20.1425 [1]		1.080
LCap	0.943 **	0.189 [1]	4.990 [1]		1.212
Lev	-0.130 *	0.060 [1]	-2.164 [1]		1.179

Notes: Dependent variable under this model is TQ. *R^2 Value = 0.839 and Adjusted R^2 Value = 0.791* * = *significance at the 5% level* ** = *significance at the 1% level* [1] = robust standard error and t-statistic reported in the presence of both Heteroskedasticity and Serial Correlation using the Arellano robust covariance matrix for panel data.

4.5.5 Results of Model 5

Table 16 illustrates the results of Model 5, an analysis of the relationship between the components of VAIC™ (i.e. HCE, SCE and CEE) to the company's profitability (ROA). None of the independent variables show a significant relationship with ROA. This is not surprising given the low R^2 and adjusted R^2 values. These results are not unlike that of Firer & Williams (2003) who could only find one component of VAIC™, SCE to have a significant positive relationship with the company's profitability (ROA). Notably the finding of Firer & Williams (2003) was only significant at the 10% confidence interval.

The control variables, LCap and Lev shows the expected positive and negative associations with the company's ROA, but these lack statistical significance. These are not in line with expectation, but given the low R^2 and adjusted R^2 values, is no surprise.

The results of the relationship between the components of VAIC™ and the company's profitability, based on Model 5 do not support the relationship hypothesised in hypothesis H2(b), H3(b) and H4(b).

Table 16: Two-ways FE Regression results Model 5

Independent Variable	*Coefficient*	*Standard Error*	*t-statistic*	*F Statistic*	*VIF*
HCE	0.021	0.014 [1]	1.456 [1]	1.1904	1.250
SCE	0.021	0.013 [1]	1.631 [1]		1.271
CEE	-0.002	0.003 [1]	-0.745 [1]		1.080
LCap	0.022	0.026 [1]	0.847 [1]		1.212
Lev	-0.006	0.008 [1]	--0.813 [1]		1.179

Notes: Dependent variable under this model is ROA.

R^2 Value = 0.030 and Adjusted R^2 Value = -0.264

** = significance at the 5% level*

*** = significance at the 1% level*

[1] = robust standard error and t-statistic reported in the presence of both Heteroskedasticity and Serial Correlation using the Arellano robust covariance matrix for panel data.

4.5.6 Results of Model 6

Table 17 illustrates the results of Model 6, an analysis of the relationship between the components of VAIC™ (i.e. HCE, SCE and CEE) to the company's productivity (ATO). Similar to the finding under Model 5, none of the independent variables show a significant relationship with ATO and again, this is not surprising given the low R^2 and adjusted R^2 values. This weaker relationship between the components of VAIC™ and the company's ATO is similar to the outcome earlier studies by Firer & Williams (2003) on South African companies in which only HCE to have a significant relationship with productivity.

LCap did not show the expected positive relationship with ATO, whilst Lev did show the expected negative relationship with the company's ATO. However, both relationships lacked statistical significance.

The results of Model 6 therefore fail to support the hypothesised relationship between the components of VAIC™ and the company's ATO as hypothesised in hypotheses H2(c), H3(c) and H4(c).

Table 17: Two-ways FE Regression results Model 6

Independent Variable	*Coefficient*	*Standard Error*	*t-statistic*	*F Statistic*	*VIF*
HCE	0.040	0.030 [1]	1.326 [1]	1.614	1.250
SCE	-0.045	0.023 [1]	-1.961 [1]		1.271
CEE	-0.015	0.014 [1]	-1.116 [1]		1.080
LCap	-0.112	0.068 [1]	-1.641 [1]		1.212
Lev	-0.037	0.040 [1]	-0.943 [1]		1.179

Notes: Dependent variable under this model is ROA.

R^2 Value = 0.041 and Adjusted R^2 Value = -0.250

** = significance at the 5% level*

*** = significance at the 1% level*

[1] = robust standard error and t-statistic reported in the presence of both Heteroskedasticity and Serial Correlation using the Arellano robust covariance matrix for panel data.

4.6 Summary and Conclusion

After testing data for potential presence of multicollinearity, ensuring stationarity of the data and treating for the presence for heteroskedasticity and serial correlation with the data, Model 1 to 6, as defined in section 3.4 of chapter 3, were run to test the hypothesised relationship between VAIC™ and its components and the company's performance based on book values and market values (as described in section 3.3 of chapter 3). Table 18 provides a summary of the results of Models 1 to 6.

Table 18: Summary of the results

Model Number	Hypothesis	Dependent Variable	Independent Variable	Hypothesised Relationship	Result	Significant (Y/N)
1	1a	VAIC™	TQ	+	+	**Y**
2	1b	VAIC™	ROA	+	+	N
3	1c	VAIC™	ATO	+	-	N
4	2a	HCE	TQ	+	+	N
4	2b	SCE	TQ	+	-	N
4	2c	CEE	TQ	+	+	**Y**
5	3a	HCE	ROA	+	+	N
5	3b	SCE	ROA	+	+	N
5	3c	CEE	ROA	+	-	N
6	4a	HCE	ATO	+	+	N
6	4b	SCE	ATO	+	-	N
6	4c	CEE	ATO	+	-	N

Table 18 illustrates seven of the 12 hypothesised relationships between the company's VAIC™ and components of VAIC™ with the company's book and market performance were confirmed. However, only two of these relationships proved to be statistically significant i.e. the relationship between VAIC™ and the company's market value, and the relationship between CEE and company's market value. It would appear from the results that the market values the investment in IC by South African companies, especially with regard to the CEE aspect of the VAIC™ as defined by Equation 6 in section 3.2.1.1. Though the investment in IC is rewarded by the market, it is still to manifest itself in a statistically significant way in the company's book performance measures. The recognition by the market could be seen as an indication of an

expectation that the investment in IC will eventually manifest itself through a positive impact in accounting returns (ROA) and company productivity (ATO).

CHAPTER 5: CONCLUSION

This study attempted to build on the previous IC research performed in South Africa by Firer & Stainbank (2003) and Firer & Williams (2003). The purpose of this study was to investigate the relationship between IC and company performance and market value for a selection of on South African companies by to find out whether:

- a significant relationship exists between IC (including IC components) and market value of listed companies in South Africa; and
- a significant relationship exists between IC (including IC components) and company performance indicators (based on book value) of listed companies in South Africa.

If these significant relationships do exist, the study sought to identify whether these were positive or negative.

This study reviewed definitions, concepts and categorisations of IC as found in prior literature, it also provided a summary of the most common models used in practise to measure IC and it reviewed prior research (in both developed countries and emerging markets) on the relationship between IC (specifically within the context of Pulic's (2000) VAIC™ methodology) and company performance based on book values and company market values.

This study tested 12 hypotheses surrounding the research question of which only two findings were statistically significant:

- VAIC™ significantly positively associated with market value; and
- CEE significantly positively associated with market value.

The results showed that even though VAIC™ was significant and positively associated with market value (Model 1), the component contributor to this was in fact CEE and not pure IC components (HCE and SCE). This corresponds with the findings of Firer & Williams (2003).

No significant association could be made in relation to IC components HCE and SCE. These findings contrast with that of Firer & Williams (2003), who also focussed on South African companies. Firer & Williams (2003 found HCE and SCE to have significant negative and positive relationships with TQ, respectively.

5.1 Limitations in the study

The availability and access to data from all South African companies (listed and unlisted) continues to be a significant hurdle for finance and IC researchers alike. Accessing data beyond the listed environment is challenging and faces time constraints in trying to gather all data required. Compounding this issue is the critical disclosure of salaries and wages in order to apply the VAIC™ methodology to measure IC components. There is currently no regulatory or accounting standard requirement to disclose this metric for listed companies in South Africa, as such, becomes entirely voluntary to do so. This results in further concentration of sample size upon which to perform empirical testing.

The demographic of the sample size considered in this study is dominated largely by companies within the industrials sector (42%) and consumer products and services sector (28%). The typical IC intensive sectors such mining and materials (4%), healthcare and pharmaceuticals (4%) and technology and telecommunications (10%) are underrepresented in this sample. This may be the leading cause for the insignificance of IC components HCE and SCE, in the testing performed.

5.2 Future research

Future research within a South African context may be conducted on specific sectors or by comparing results two or more sectors to determine whether investment in IC impacts sectors differently.

Researchers, may also focus on the industries/sectors that are considered IC intensive (data dependent) but have been underrepresented in this study. These include(and are not limited to) healthcare and pharmaceuticals, technology and telecommunications, mining and professional services.

If access to unlisted company data is possible without significant constraint, researchers can look into IC and its impact among the South African unlisted companies to provide further insight into privately owned companies.

A unique opportunity also exists for researchers to consolidate data across studies and perform an in depth comparison of IC and impact between emerging markets and developed countries.

IC continues to attract attention of academics and decision makers within companies. The shift in global attention towards IC and its role in companies will continue to spark interest in IC given the ever increasing digitisation and evolution of markets globally.

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