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INTELLECTUAL CAPITAL, VALUE CREATION AND FIRM PERFORMANCE IN SINGAPORE

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Abstract

Stocks are continuously traded on the stock exchange, representing current and future prospects, whilst accounting reports are prepared periodically: quarterly, half yearly or on an annual basis inevitably giving rise to a difference between their market and book values. There are many approaches to explaining the difference. This thesis takes the approach of intellectual capital and seeks to assess and evaluate the explanatory power of its components on value creation and firm performance. In this research, data is collected from the financial reports of 90 quoted companies in Singapore, over a ten-year period from 2005-2014, covering the period pre and post effects of the global financial crisis. Companies were drawn from three sectors: manufacturing, services and other business activities. The research methodology adopts the positivist paradigm and a deductive approach with quantitative analysis. Two types of panel data regression models are estimated: static panel data analysis estimates the relationships of the components of intellectual capital, financial performance and share price; dynamic panel data analysis examines the changes in share price with the factors of intellectual capital. It emerged that the components of intellectual capital (i.e. human capital, relational capital, process capital and innovation capital) have significant impacts on financial performance, share price and change in share price. Empirically validated frameworks linking these factors were developed for each sector. Furthermore, the outcomes differ across industry sectors. This present research thus contributes theoretically to available academic literature on the development of competitive advantage and value creation. It could also be useful to practitioners who are focused on value creation.

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List of Abbreviations

A	Amortisation
AB	Arellano and Bond Approach
AH	Anderson-Hsiao
ANCOVA	Analysis of Covariance
AR (1)	First-order autoregressive process
AR (2)	Second-order autoregressive process
ASEAN	Association of South-East Nations
ATO	Asset-To-Turnover
BSC	Balanced Scorecard
BV	Book Value
BVPS	Book Value Per Share
CE	Book Value of Net Assets of the company
CEE	Capital Employed Efficiency
CSR	Clean Surplus Relation
D	Depreciation
DBVPS	Delta Book Value Per Share
DCF	Discounted Cash Flow
DDM	Dividend Discount Model
DPD	Dynamic Panel Data
DEPS	Delta Earnings Per Share
DHUMCAP	Delta Human Capital
DINNCAP	Delta Innovation Capital
DLNS	Delta Logarithm of Sales
DPROCAP	Delta Process Capital
DRELCAP	Delta Relational Capital
DPT	Delta Change in Price
EC	Employee costs
EPS	Earnings Per Share
FDI	Foreign Direct Investment
FEM	Fixed Effects Model
FCF	Free Cash Flow
GDP	Gross Domestic Product
GEAR	Gearing
GMM	Generalised Method of Moments

HC or HUMCn	Human Capital
HCE	Human Capital Efficiency
HCTA	Human Capital over Total Assets
IC	Intellectual Capital
ICT	Information, Communications and Technology
ICE	Intellectual Capital Efficiency
INCTA	Innovation Capital over Total Assets
InnC or INNCn or INC	Innovation Capital
IVS	Innovation Voucher Scheme
LIM	Linear Information Model
LNS	Logarithm of Sales
LSE	London School of Economics
MAS	Monetary Authority of Singapore
MNCs	Multinational Companies
MV	Market Value
MV/BV or M/B	Market Value to Book Value
N	Cross-sectional units
NPV	Net Present Value
OBA	Other Business Activities
OECD	Organisation for Economic Co-operation and Development
OP	Operating
P	Share Price
P-BV	Difference between Share Price and Book Value
PAT	Number of Approved Patents
PC or PROCn	Process Capital
PER	Performance
PLS	Partial Least Squares
POLS	Pooled Ordinary Least Square
PRCTA	Process Capital over Total Assets
PRIME	Productivity, Resilience and Innovation for Manpower Excellence
PT+3	Change in Price in 3-months forward
PVED	Present Value of Expected Dividends Assumption
RBV	Resource-Based View
RC or RELCn	Relational Capital

R&D	Research & Development
RDD	R&D Expenses over Net Operating Expenses
RELCTA	Relational Capital over Total Assets
REM	Random Effects Model
RI or RIV	Residual Income Valuation Model
ROA	Return on Assets
ROE	Return on Equity
ROI	Return on Investment
S&P	Standard & Poor's
SC	Structural Capital
SCE	Structural Capital Efficiency
SCVA	Structural Capital Value Added
SGA	Selling, general and administrative expenses
SGD	Singapore Dollar
SGS	Singapore Government Securities
SGX	Singapore Exchange
SME	Small Medium Enterprise
SPD	Static Panel Data
SPRET	Change in Share Return
SPRET3	Change in Share Return in 3-months forward
STI	The Strait Times Index
STVA or SCE	Value Added Efficiency of Structural Capital
T	Number of Years / Time periods
V	Corporate Value
VA	Value Added
VACA	Value Added Capital Coefficient
VAIC^{TM}	Value Added Intellectual Coefficient
VAHU	Value Added Efficiency of Human Capital
VC	Value Creation

Chapter 1: Introduction

1.1 Background

Value creation is perceived as a substantial objective in today's financial markets, particularly when considered against the backdrop of the recent financial, liquidity and economic crises, which are affecting firm performance (Gharsellaoui, 2011). Management and corporate executives are under tremendous pressure to improve corporate performance and create value. Investors, on the contrary, seek to maximise returns on their capital. In today's market place, the key success of a company depends on its capacity to maximise shareholders' value (IMA, 1997).

Various researchers in several disciplines namely industrial economics, strategic management, international business, sociology, business policy, marketing, accounting and finance have tried to identify the factors that contribute to a company's level of profitability (Capon, et al., 1990; Goddard, et al., 2005). An example of a meta-analysis of over 300 studies by Capon, et al. (1990) disclosed that the determinants of financial performance include elements of environment, corporate strategy and firm-specific characteristics.

The classical corporate finance paradigm states that every business's goal is to achieve maximum wealth for its shareholders. Its financial report can be analysed to determine the firm value. In order to measure shareholders' wealth, financial analysts need to predict a company's future performance by assessing its profitability, growth, and corporate strategy (Varaiya, et al., 1987; Fairfield and Yohn, 2001). The theory behind creating shareholder value is to ensure that the market value exceeds the book value of the equity capital that was originally invested by the shareholders (Liow, 2010).

During the industrial revolution, value creation and firm performance were largely based on measures of production, manufacturing, agricultural output, and their contribution to economic growth. But in recent finance literature, previous studies

have been conducted to investigate whether the accounting factors contribute to the firm performance in the Australian manufacturing industry (McDonald, 1999), European manufacturing and services industries (Goddard, et al., 2005), Portuguese service industry (Nunes, et al., 2009; Serrasqueiro, 2009) and Japanese manufacturing industry (Nakano and Kim, 2011) amongst others. Using a panel data regression approach, Goddard, et al. (2005) examine whether traditional accounting factors such as gearing, liquidity, asset turnover, market share, size, and so on, are determinants of profitability that contribute to the growth of firms and add shareholder value.

The growing resurgence of interest in value creation has resulted in increased pressure from shareholders for companies to pay dividends and from company executives for bonuses and performance awards (Baum, et al., 2004; Gharsellaoui, 2011). Other value creation issues have been raised in the contexts of mergers and acquisitions (Rappaport, 1981); business unit evaluation (Arzac, 1986); corporate governance (OECD, 2012); intellectual capital (Edvinsson and Sullivan, 1996).

In the current era of globalisation, value creation is more dependent on intangible rather than physical assets (Cabrita and Vaz, 2006), although the latter are generally perceived to be more important in company financial statements (Marr, 2008). The new economy of information and knowledge, wealth of investors, growth and success of organisations are increasingly driven by intellectual capital (Marr, 2008; Yu and Zhang, 2008). In 1969, the phrase '*intellectual capital*' was firstly presented by the economist, John Galbraith, who described it as a wealth of assets and as an approach of value creation. It was further developed over the past two decades (Edvinsson and Sullivan, 1996; Bontis, 1998; Bontis, et al., 2000; Carson, et al., 2004; Khan, 2011; Martín-de-Castro, et al., 2011; Asadi, 2013). According to Brooking (1996) cited in Marr, et al., (2004a), intellectual capital is regarded as an amalgamation of assets: market, intellectual property, infrastructure and human-centred.

However, with the rapid growth of digital technology, internet, service and innovation industries, a new knowledge economy has emerged, giving rise to a notion of 'intellectual capital' wherein value creation is linked with competitive advantage as an intangible asset (Bontis, 1998; 2001). However, no unique definition of this concept is currently approved (Asadi, 2013).

Intellectual capital is defined as "the intellectual material – knowledge, information, intellectual property, experience – that can be put to use to create wealth".

(Source: Stewart, 1997 cited in Bontis, 1998, p.65)

The factors of intellectual capital that are now considered as the key drivers of value creation are:

Human capital is defined as "the knowledge that employees take with them upon leaving a firm such as knowledge, skills, experiences and abilities, motivation and tasks".

(Source: Cheng, et al., 2008, p.642)

Structural capital is defined as "the knowledge that belongs to the organization as a whole in terms of technologies, inventions, data, publications, strategy and culture, structures and systems, organizational routines and procedures".

(Source: Riahi-Belkaoui, 2003, p.217)

Relational capital is defined as "an intangible asset based on nurturing and developing high quality relationships with employees, customers, partners, suppliers, competitors, and other stakeholders that positively influenced performance and competitive advantage".

(Source: Yaseen, et al., 2016, p.169)

Process capital is defined as "an organisation's processes, techniques, systems and tools".

(Source: Van Buren, 1999a, p.76)

Innovation capital is defined as "the capability of an organization to innovate and to create new products and services".

(Source: Van Buren, 1999a, p.76)

Numerous studies have emphasised on the relationship of intellectual capital variables, firm performance and market value to assess whether human capital, relational capital, process capital and innovation capital enhance value creation particularly in the Chinese high-tech industry (Yu and Zhang, 2008), U.S. electrical industry (Wang, 2008), Taiwanese semi-conductor companies (Chang and Hsieh, 2011) and Indonesian pharmaceutical industry (Basuki and Kusumawardhani, 2012) among others. Further empirical studies emphasise that the interaction effects of human capital with the rest of the intellectual capital factors affect firm performance and value creation. More importantly, some of these studies seek to explain the linkage between book and market values in the knowledge economy (Wang and Chang, 2005; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Kamukama, et al., 2010; Ferraro and Veltri, 2011; St-Pierre and Audet, 2011; Scafarto, et al., 2016).

In spite of the newly popularity of intellectual capital in the knowledge economy and globalised world, its empirical validity and measurement are yet to be recognised as part of value creation. The present research attempts to address this deficiency in the literature by developing a framework for analysing the links of the components of intellectual capital, on the one hand, and firm performance (including share price performance) on the other.

1.2 Research Problem

Previous researchers had identified gaps in the literature on intellectual capital, value creation and firm performance. Mouritsen and Roslender (2009) called for more studies that go beyond the integration of intellectual capital and financial value. Furthermore, Beattie and Thomson (2010) point out that, following the

recent financial crisis, longitudinal studies were undertaken to investigate the scope to which intellectual capital and value creation affect market-to-book value.

The purpose of the present research is to build on the existing literature by investigating the way in which intellectual capital affects value creation (market value) and firm performance (book value).

1.3 Aim & Objectives

The aim of the actual research is to develop a framework for assessing the impact of intellectual capital on value creation and firm performance in Singapore.

More specifically, the objectives of this thesis are as follows:

1.3.1 To critically review the literature on intellectual capital, value creation and firm performance and identify relevant variables for research, within a conceptual framework.

1.3.2 To analyse the linkages between the components of intellectual capital, value creation and firm performance in the Singapore stock market.

1.3.3 To make an integrated assessment of the linkages between intellectual capital, value creation and firm performance in Singaporean listed companies and develop an empirically validated framework.

1.4 Research Questions

The research questions will be investigated as:

RQ1: To what extent can accounting profitability (and firm performance) be explained by intellectual capital variables in the Singaporean listed companies?

RQ2: Can the concept of intellectual capital and its components explain value creation in the Singaporean listed companies?

RQ3: Can an integrated model linking firm performance, intellectual capital and value creation be validated?

In order to investigate the above research questions, econometric estimations will be made in this present study relating to accounting profitability (ROE), market price (share price) and change in price. These concepts are thoroughly discussed in the literature review and methodology; and will be useful to investors, shareholders, business partners, management and staff in the value creation process. The thesis, therefore, builds up on existing literature, which is outlined in the next chapter and the contributions of the study are stated in the next section.

1.5 Contributions of the Study

The core contribution of the research is the development of a holistic model linking intellectual capital, firm performance and value creation for the Singaporean listed companies. Additionally, attempts will be made to track changes between the variables. The robustness of the estimation will be tested through investigating the effects of the changes in the intellectual capital variables. Such a model suggests implications and management strategies, companies in Singapore need to follow and meet shareholders requirements by adding value creation and increasing firm performance.

Chapter 2: Literature Review

In the literature review chapter, an extensive review is conducted on intellectual capital in current day management literature and its relevance in the knowledge economy: theoretical issues, concepts and empirical research on intellectual capital, the drivers of intellectual capital and the management theory of competitive advantage are extensively discussed. The gap in the literature is identified and the research problem is conceptualised in terms of firm performance and value creation.

2.1 Transformation from Industrial to Knowledge-Based Economy

The world has experienced different phases and transformation of economies and has been acknowledged by various classical economists (Kaur and Singh, 2016). Originally in the agriculture economy, land was the main driver of a country's economy written by Adam Smith (1776), however the industry and services sector did not exist at that time (Houghton and Sheehan, 2000; Tomé, 2011). In 1817, David Ricardo emphasised that capital and labour were the main sources of economic growth (Oakey, 2014). Karl Marx (1867) based his work on industrial capitalism, where natural resources such as labour, iron ore and coal were the core elements in the industrial economy (Houghton and Sheehan, 2000; Oakey, 2014) recognising that the industrial sector was the most important element of the developed countries (Tomé, 2011). In 1890, Alfred Marshall recognised that knowledge was a powerful mechanism of production (Marr, et al., 2004a).

During the industrial revolution, Schumpeter (1939) was one of the economists to introduce an economic theory particularly based on entrepreneurship and innovation of a capitalist system (Attar, 2015; Croitoru, 2017), acknowledging that growth depends mainly on key factors of technology, knowledge, human capital but precisely on innovation (Moe, 2009; Dworak, 2011; Dumitrascu and Dumitrascu, 2013; Peretto, 2015; Dosi, et al., 2017). According to Schumpeter's economic growth theory, innovation and imitation contribute to the efficiency of

production techniques for new products; but criticised that it may cause creative destruction as obsolete technologies are easily being switched to new ones; and when markets are saturated with industrial goods the economy is drifted into depression (Moe, 2009; Dosi, et al., 2017). Solo (1951) also argued that entrepreneur invention was the main cause of the technological process in the industrial revolution and this was well developed before the advancement of research and development (Attar, 2015). But economists have failed to acknowledge that these factors had contributed to the industrial success (Oakey, 2014).

With the post-capitalist and post-industrial society, Drucker (1992) foresees the arrival of a new economy and recognises that knowledge and information have been transformed into valuable resources of a modern economy whilst traditional factors of production: capital, land, labour, plant and machinery are encountered as secondary components (Bontis, 1998; Pulic, 2004a; Cabrita and Bontis, 2008; Tomé, 2011). There has been a transition from industrial economy of production and manufacturing based on cost to move away to services and knowledge-based industries based on value creation especially in the twentieth century of the modernised knowledge economy (Bontis, 1998; Powell and Snellman, 2004; Pulic, 2004a; Namasivayam and Denizci, 2006; Bang, et al., 2010; Tomé, 2011; O'Connor, et al., 2015).

In the 21st century, there has been a shift from the industrial revolution to a new knowledge economy (Carlaw, et al., 2006; Asadi, 2013). Knowledge economy is referred as "*production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. The key component of a knowledge economy is a great reliance on intellectual capabilities than on physical inputs or natural resources*" (Powell and Snellman, 2004, p.201). The world has been transformed rapidly into the "*third industrial revolution*" of the "*information age*", where knowledge has become the main factor of production (Tomé, 2011, p.528). Internet and information technology have also made substantial contributions to the

productivity of the manufacturing industry and a country's economic growth (Tassey, 2004).

Moreover, intellectual capital has been identified as the key element of a business asset, drivers of profitability and value creation in the post-industrial and knowledge economy (Bose and Oh, 2004; Marr, et al., 2004b; Alipour, 2012). The concept of intellectual capital has helped managers to identify the knowledge components of a company (Marr, et, al., 2004b). Drucker (1999) further emphasised that the management of a company has the biggest challenge to improve the productivity of the intelligent worker and produce high value-added goods and services (Namasivayam and Denizci, 2006; Leon, 2017). Other studies further emphasised human capital as the dominating factor of production, value creation and sustainable competitive advantage where workers improve the quality of goods and services, increase investment and economic growth (Cabrita and Bontis, 2008; Inshakov, 2013; Dementiev, 2014; Scafarto, et al., 2016).

Patents, copyrights, brands and trademarks are important intangible assets and factors of a company's success (Powell and Snellman, 2004; Hsiung and Wang, 2012). In addition to the innovativeness of workers (human capital), well-functioning working system, improvement and innovation process (structural capital); external relationships to a company (relational capital); creating and designing products and services (innovation capital); systems, processes, tools and techniques (process capital) are also key drivers of an organization success by maximizing profitability and future wealth creation (Bontis, 1998; Riahi-Belkaoui, 2003; Ståhle and Hong; 2002; Ferraro and Veltri, 2011; Asadi, 2013).

In today's business world, knowledge has been identified as the core development of sustainable competitive advantage that was originated by Porter (1980) when it is used, combined and transferred (Teece, et al., 1997; Edvinsson and Sullivan; 1996; Andreu, et al., 2008; Cabrita and Bontis, 2008). Andreu, et al. (2008) criticised that traditional sources are becoming less effective as technology evolution; globalisation and deregulations are changing the competitive and

market structures. As a result companies have to differentiate by producing rare, substitutable and non-imitable products and services against their competitors in order to sustain competitive advantage and create value for every businesses (Cheng, et al., 2008). The relevant literature is reviewed to demonstrate how intellectual capital, value creation and firm performance are important in the knowledge-based economy as discussed below.

2.2 Intellectual Capital

There is an ongoing debate on the determinants of the business value since the rise of a new era of 'knowledge-based economy' has started two decades ago, operating principally by knowledge and information, thus encountering strong advantages to intellectual capital (Van Buren, 1999a; Yu and Zhang, 2008). This may justify the tremendous difference of a company's book and market values as this leads to an invisible value hidden that is hardly recognised in the company's annual report (Shaikh, 2004; Chen, et al., 2005; Swartz, et al., 2006; Kujansivu and Lonnqvist, 2007; Pal and Soriya, 2012), which needs to be explored for further research.

But today, the knowledge-based economy emphasises the usefulness of intangible assets with a new emergent of 'intellectual capital' as an economic asset that contributes to the value creation of every business (Pulic, 2004a; Carson, et al., 2004; Khan, 2011). As criticisms have been received that the knowledge-based economy is widening the company's book and market values (Kim and Taylor, 2014), the objective of the current research is to empirically explore these differences with intellectual capital from a business perspective using a dataset of the financial reports of the Singaporean listed companies for ten years from 2005 to 2014. The current challenge is to determine whether or not such differences exist and have not been identified so far by academic researchers, scholars, management and other stakeholders.

2.2.1 What is Intellectual Capital?

Intellectual Capital was firstly introduced by Galbraith (1969) and has proved to be not only a fixed asset but also a process for achieving a corporate's goals and objectives (Bontis, 1998; Asadi, 2013). Edvinsson and Malone (1997) explained that intellectual capital allows knowledge to be transformed into value and further differentiated the book and market values of intellectual capital. It is categorised as intangible assets that includes brand name, technology, customer details and reputation that are not useful to a company's competitive forces (Low and Kalafut, 2002 cited in Muhammad and Ismail, 2009).

2.2.2.1 Definitions

The concept of 'Intellectual Capital' was already linked in human resource and accounting when developing theories to explain the essence, value and contribution made by people to the organisations in the early 1970s by Flamholtz (1974) and transaction cost economy theories by Williamson (1975) cited in Joshi, et al. (2013). Academic researchers and scholars have been working extensively on the intellectual capital literature. Consequently, it is now considered as a multi-disciplinary field as many definitions have been emerged from various academic disciplines (Chu, et al., 2011; Ferraro and Veltri, 2011). A number of definitions formulated by several researchers are summarised as follows:

- Intellectual Capital is a mixture of assets: market, human-centred, intellectual property and infrastructure allowing companies to perform, make better assessment and use of intellectual capital (Brooking, 1996 cited in Marr, et al., 2004a; Moon and Kym, 2006);

- Intellectual capital is regarded as an effective use of knowledge related to finished good whereas information is related to raw material (Bontis, 1998); and

- Intellectual capital is defined as "*the group of knowledge assets that are owned and/or controlled by an organisation and most significantly drive organisation value creation mechanisms for targeted company key stakeholders*" (Alipour, 2012, p.54).

2.2.2.2 Intellectual Capital Variables

Intellectual capital was primarily categorised into three major factors: human capital, relational capital and structural capital. Skandia Value Scheme further expands structural capital into process capital and innovation capital (Skandia, 1995; Wang and Chang, 2005; Ferraro and Veltri, 2011; Scafarto, et al., 2016).

2.2.2.3 Human Capital (HC)

Various researchers primarily conducted human capital (HC) concept: Schultz (1962, 1971), Becker (1964) and Mincer (1958, 1974) cited in Bechtel (2007). It was well established in the 1990's when the knowledge management and the organisational learning approach firstly emerged and developed by Drucker (1992). In 1996, the OECD recognises that human capital is considered as a core driver of economic wealth, prosperity and competitiveness in a macroeconomic point of view (Martín-de-Castro, et al., 2011). Human capital deals mainly with employee competences and consists of knowledge, capability, skills and employee's attitudes that contribute towards attracting customers and increasing a company's performance and profits, which can then turn into market value (Chen, et al., 2004). In addition, it emphasises on transforming tacit knowledge in a structured knowledge that employees possess. Examples of human capital are creativity, know-how, innovation capacity, teamwork capability, satisfaction, motivation, employee flexibility, loyalty, learning, training and education (Bontis, 1998; Ferraro and Veltri, 2011; Martín-de-Castro, et al., 2011).

2.2.2.4 Relational Capital (RC)

Relational capital so-called 'customer capital' characterises the external revenues generated by a company's brand, reputation, relationship with customers and suppliers, strategic alliances and network externalities (Seetharaman, et al., 2004). It also relies on a company structure to create value directly to its external stakeholders such as negotiation with financial institutions, commercial power, customer loyalty and power, environmental activities, distribution and partnering arrangements among others (Bontis, 1998; Marr, et al., 2004b; Ferraro and Veltri, 2011; Alipour, 2012).

2.2.2.5 Structural Capital (SC)

Structural capital is an internal structure which manages knowledge and includes tangible factors: intellectual property – patents, trademarks, copyrights; company systems, databases and intranet and intangible factors: culture and spirit (Seetharaman, et al., 2004). Contrarily, Namvar, et al. (2010, p.684) refer structural capital as processes, investments, activities and structures that belong to a company in order to maintain its human capital or influence its relational capital. Moreover, structural capital shows an organisational structure leads towards knowledge creation and development (Ordóñez de Pablos, 2003). It also has the ability to communicate and store intellectual data and materials. As a result from Skandia Value Scheme, two distinct categories namely process capital and innovation capital are subdivided or broken down from structural capital (Skandia, 1995).

2.2.2.6 Process Capital (PC)

Process capital includes systems, tools, techniques and processes that belong to a company. To achieve an effective process, companies should maintain a flexible operational process as it is regarded as a fundamental valuation factor from an investor perspective (Ferraro and Veltri, 2011). Cheng, et al. (2008) emphasise

that process capital represents a number of business activities oriented with investments in research & development, economy and productivity of administrative processes and lead time – these examples are expressed in terms of quality, time and error rate.

2.2.2.7 Innovation Capital (InnC)

Innovation capital involves in the capability of a company to launch, create and design its latest research & development, products and services. In addition, patent also prevents competitors to replicate any new product (Cheng, et al., 2008; Ferraro and Veltri, 2011). It was criticised by Moon and Kym (2006) that if the intellectual capital assets are intangible and nonfinancial, how could the efficiency and value of intellectual capital be recognised, evaluated and managed? Nevertheless, the annual reports may be inappropriate and improper when a company relies mainly on its intangible assets and invisible values of intellectual capital factors (Edvinsson, 1997; Kujansivu and Lonnqvist, 2007; Maditinos, et al., 2011). Despite the influences of intellectual capital and value relevance of intangible assets where the anomaly of book and market values of a company are constantly growing; organisations and its management are facing problems on how to measure intellectual capital (Dumay, 2009). Numerous researchers have developed different measurement of intellectual capital; but this thesis takes into account a non-monetary valuation, book value and market valuation measurements, which are considered below.

2.3 Intellectual Capital Measurements

In a modernised and growing knowledge-based economy, the measurements of intellectual capital are essential to ensure that a firm's financial position is good for future investors (Pal and Soriya, 2012). Marr, et al. (2004b) recognised that knowledge can be measured and categorized into two perspectives: internal and external. From an internal perspective, companies should identify knowledge / intellectual capital components to increase their performance and relate more on

knowledge management activities. On the contary, the external perspective refers to every business real market evaluation and is useful for accounting purposes (Marr, et al., 2004b). Intellectual capital has therefore led to a number of frameworks for measuring its concept: non-monetary valuation, book value and market-valuation.

2.3.1 Non-Monetary Valuation Measurement

Among various intellectual capital measurement tools, the non-monetary valuation tool of Skandia Navigator applied by Ordóñez de Pablos (2003); Shaikh (2004); Tan, et al. (2007); Nogueira, et al. (2010); and Pal and Soriya (2012) is summarised below:

2.3.1.1 Skandia Navigator and Skandia Value Scheme

Skandia is known to introduce the measurement of knowledge assets by developing an internal intellectual capital report in 1985. It emerged as the first company to build up the intellectual capital tools in 1991 by producing an intellectual capital supplement in its annual reports presented to its investors. It was the vice president and director at Skandia, Leif Edvinsson, who took the initiatives in developing a new reporting model of intellectual capital named as the 'Navigator' and structured into human capital, process, customer, financial, renewal and development. The new accounting taxonomy tries to analyse the market value of financial and non-financial hidden factors such as human and structural capitals (Edvinsson, 1997; Bontis, 2001; Ordóñez de Pablos, 2003).

Later, Edvinsson (1997) further developed the Navigator to Skandia Value Scheme as illustrated in *Appendix A*. It postulates that the market return of an organisation is distinguished between financial capital and intellectual capital, but was impossible to obtain its value as the intellectual capital is not easily depicted and disclosed in its annual report. In a conceptual framework, it is therefore viewed as the main type of value drivers for a company (Ashton, 2005).

The Skandia Value Scheme by Edvinsson (1997) expands the intellectual capital in different value drivers. Firstly, intellectual capital is classified from human capital and structural capital. Human capital comprises personal attributes of knowledge, skills and experience. Structural capital includes an organisation's internal and external drivers. Examples of internal drivers are organisational structures, client files, processes, databases, routines, and software manuals. Examples of external drivers are: alliance partners, suppliers and customers relationships. Edvinsson (1997) focuses on structural capital rather than human capital as a result of a small value of human capital. He further maintains that management transforms human capital into structural capital, except the latter remains after the human capital leaves the organisation.

Structural capital expands into two components: customer capital (internal) and organisational capital (external). Organisational capital includes both innovation and process capital. Innovation capital generates new knowledge for the creation of value whereas process capital applies existing knowledge to value creation for shareholders and customers. Finally, innovation capital follows the Navigator by incorporating renewal and development with intellectual property that are legally protected (examples: patents, copyrights, trademarks) and intangible assets consists of other intellectual capital factors that are not disclosed in the financial reports (Ashton, 2005). Moreover, in this research the book value and market valuation measurements are further examined in the following sections.

2.3.2 Book Value Measurement

Various attempts have been made towards developing intellectual capital with value creation and firm performance as monetary valuations in accordance with Tobin's Q (Tobin, 1969), MVA and EVA (Stewart, 1997) among others. Pulic (2004a, p.63) argues that the measurement of EVA concentrates mainly on capital employed. This research intrinsically focuses on related studies presented by two important models: Pulic (2004) Value Added Intellectual Coefficient (VAIC^{TM}) as

an accounting measurement applied on book value and more specifically enhances the contribution of the business's value added; and Ohlson (1995) model as a market valuation model of measuring intellectual capital with the company's share price.

2.3.2.1 Value Added Intellectual Coefficient (VAIC™)

In 1998, Ante Pulic introduced an intellectual capital methodology of 'Value Added Intellectual Coefficient (VAIC™)'. He agrees with other experts in the same field that traditional financial measures are inappropriate in our modern economy and tangibles are less important in the business processes (Pulic, 2004a). Previously the essence of a product or service was primarily based on quantity that was measured on revenues, costs and profits (Pulic, 2004b). But it is now predominately focused on value creation as perceived by customers. Knowledge, skills, solutions and values are important factors that have been transformed into value (Pulic, 2004b). As intangible resources are becoming the key success of value creation in achieving competitive advantage, a vital question emerges on how to accountable the intangible asset as a key element of value creation (Pulic, 2004a, b).

As a matter of fact, Pulic (2004a) suggests that a new index is appropriate to assess the business success in the value creation process with the contribution of all participants: management, employees, shareholders, investors and business partners. The index of the value creation efficiency of intellectual capital was introduced on every business real values and profits that consists of the knowledge age economy, value measurement system and efficiency measurement unit.

Techniques of measuring intellectual capital are still developing, but in the VAIC™ model, the concept of competitive advantage is emphasised and applied (Tan, et al., 2007). Academic researchers have used his work to analyse intellectual capital on company performance (Chen, et al., 2005; Shiu, 2006;

Swartz, et al., 2006; Tan, et al.; 2007; Diez, et al., 2010; Alipour, 2012; Asadi, 2013). The intellectual capital variables based on the VAIC™ model are explained below and are used as independent variables to measure and analyse the effects on the company's book value. The VAIC™ model is formulated below and *Exhibit 2.1* tabulates the variables of Pulic (2004) VAIC™ model.

Exhibit 2.1: Definitions of the Variables of Pulic (2004) VAIC™ model

Symbol	Variable Definition
VA	Value-added for the company
OUTPUT	Total sales
INPUT	Cost of bought-in materials, components and services
OP	Operating
EC	Employee costs
D	Depreciation
A	Amortisation
HCE	Human Capital Efficiency coefficient of the company
HC	Total salaries and wages
SC	Structural capital for the company
SCE	Structural Capital Efficiency coefficient of the company
ICE	Intellectual Capital Efficiency coefficient (HCE + SCE)
CEE	Capital Employed Efficiency coefficient
CE	Book value of net assets of the company
VAIC	Value Added Intellectual coefficient

The first step of calculating Value-Added by Pulic (2004a) starts from:

$$VA = OUTPUT - INPUT$$

(Pulic, 2004a, p.64)

From the financial statements, Value-Added may be expressed as:

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

(Pulic, 2004a, p.64)

Value-added indicates how well a company is successful and creates value including salaries and interests, dividends, taxes and investments for future development (Pulic, 2004a). Moreover in the concept of VAIC™ model, intellectual capital includes human capital and structural capital (Ståhle, et al., 2011) where all expenditures for staffs are evaluated as human capital, salary expenses are considered as investment instead of cost and are no longer taken into consideration as input (Pulic, 2004a).

The first component efficiency of human capital (also known as Value Added Human Capital – VAHU) is treated as:

$$HCE = VA \div HC$$

(Pulic, 2004a, p.64)

The second factor 'Structural Capital' is measured as:

$$SC = VA - HC$$

(Pulic, 2004a, p.64)

Structural capital is a dependent variable on VA and HC, which means that when HC is greater in created VA, SC becomes smaller. SC may not occur when VA is less than the amount invested in HC. The total efficiency in intellectual capital increases as both HC and SC increase accordingly. Structural Capital Efficiency (SCE) also known as Structural Capital Value Added (SCVA) is measured as:

$$SCE = SC \div VA$$

(Pulic, 2004a, p.64)

Simultaneously, the efficiencies of human and structural capital are summed up to obtain the Intellectual Capital Efficiency (ICE) as follows:

$$ICE = HCE + SCE$$

(Pulic, 2004a, p.65)

Furthermore, Pulic (2004a) brings into account the financial and physical capital to the efficiency creation of value resources, where financial capital is referred as book value (Ståhle, et al., 2011). Previously, ICE was mostly dealt in the productivity of both manual worker and its work. As the economy is evolving, ICE is now considered as knowledge worker and its work. To this effect, the efficiency of the Capital Employed (named as Value Added Capital Coefficient – VACA) is adapted and calculated as follows:

$$CEE = VA \div CE$$

(Pulic, 2004a, p.65)

Finally, to obtain the entire value creation efficiency (VAIC), the three efficiency components are summed up as follows:

$$VAIC = ICE + CEE$$

(Pulic, 2004a, p.65)

Therefore, VAIC is expressed in terms of the intellectual capital performance and helps in explaining how the overall efficiency of an organisation works. According to Pulic (2004a), knowledge economy has been developed into the perception of value creation on both national and organisation levels. Value added replaces financial capital; VAIC and ICE are the new indicators in a company's success by taking over the traditional factors of return on equity (ROE), return on

investment (ROI), among others. VAIC and ICE can both indicate whether value is being created or destroyed.

However, Pulic (2004a) criticised that value destruction occurs when there is a decline in value creation efficiency, but return on investment (ROI) is expected to decrease efficiency rapidly. The average efficiency is represented by the outcomes of all individual corporations with the intellectual capital efficiency. The corporations whose performances are under-average have destroyed value due to the spending on resources for creating a particular unit of value added, thus exceeding a company's requirement (Pulic, 2004a).

Many researches have been undertaken to explore the effects of intellectual capital by applying the VAIC^{TM} model as intellectual capital measurement. However, Kim and Taylor (2004) criticised that this model has ignored the importance of share price. From this research, Ohlson (1995) valuation model has been selected to prove if there is any impact on the value relevance of intellectual capital components and company's profitability.

2.3.3 Market Valuation Measurement

The purposes for a business in evaluating its market valuation are mainly to assess its profits against its competitors in the stock market; analyse the value created by its management; assist them in making appropriate strategic decisions as to whether to expand or sell the business, merge or acquire other businesses; and whether to set initial public offering for raising capital expansion. Therefore owners, managers, investors, debtors and other related stakeholders follow the appreciation of the intrinsic value of a business (Wang, 2008).

There are different market valuation techniques in particular free cash flow (FCF) model or discounted cash flow (DCF) model and dividend discount model (DDM) also known as "Gordon Growth Model". However due to their common use at lower levels and complexity in market efficiencies, opportunity cost, forecasting

and restrictive assumptions about dividends payout (Fairfield, 1994; Wang, 2008), the author proposes to use Ohlson (1995) valuation model for its powerful and simplicity exerted in academia level by considering the accounting components namely earnings, book value and further develops with the other information '*v*' variable of intellectual capital as an invisible value for the company as adopted by various researchers: Swartz, et al. (2006); Wang (2008); Yu and Zhang (2008); Liu, et al. (2009); Ferraro and Veltri (2011).

2.3.3.1 Ohlson Valuation Model

In 1995, James A. Ohlson develops a model of market value of a company in relation with the three accounting concepts: earnings, book value and dividends. His approach uses a closed-form valuation, value and accounting data (Ohlson, 1995). Later, Ohlson (2001) revisits the valuation model named as the "Residual Income Valuation (RIV) model".

The advantages and assumptions are identified as: (i) accounting is unbiased; (ii) it is based on risk neutrality as present value of expected dividend depends on risk-free rate as a discount factor; (iii) clean surplus consistently holds; (iv) tax rates are not relevant for shareholders; (v) real options are not considered; (vi) no asymmetries information exist; and (vii) '*v*' variable and abnormal earnings are derived in an autoregressive process (Ohlson, 1995; Hand, 2011; Ferraro and Veltri, 2011). In addition, his model is a value relevance testing and was chosen for the purpose of this present research to determine if every business' value allows its market value to be linked with its book value and accounting information (Özer and Çam, 2016). But it was criticised that in the absence of market value (share price), the value relevance is irrelevant if only accounting information is being assessed (Özer and Çam, 2016). With discounted cash flow, other studies have justified that Ohlson model is a good example to analyse the share price movement with the use of residual income, book value and other company's information (Bernard, 1995; Liu, et al., 2009). *Exhibit 2.2* tabulates the variables of Ohlson (1995) valuation model.

Exhibit 2.2: Definitions of the Variables of Ohlson (1995) Valuation Model

Symbol	Variable Definition
MV_t or P_t	Market value or share price of a firm's equity at time t
d_t	Net dividends paid at time t
r	Cost of equity capital or discount rate
E_t [.]	Expected residual income at time t
b_t	Book value of a firm's at time t
x_t	Earnings (or net income) between period t - 1 and t
x^a_t	Abnormal earnings (residual income) at time t
v_t	Information other than abnormal earnings at time t
ω and γ	Parameters for abnormal earnings are not negative and less than one
ε_1 and ε_2	Mean-zero disturbance terms
α_1 and α_2	Coefficients
β_0	Intercept term
ε_t	Residual term
b_t	Variable
β_1 *and* β_2	Coefficients, replacing coefficients α_1 and α_2
BVPS	Book Value Per Share

Ohlson (1995) develops the value relevance model by making three assumptions. Firstly, he expresses the market value as the present value of all discounted future dividends of any company (Wang, 2008). Ferraro and Veltri (2011) further develop Ohlson (1995) model and derive market value of equity (or price) as the present value of all future dividends formulated as:

$$MV_t = \sum_{\tau=1}^{\infty} \frac{E_t\left[d_{t+\tau}\right]}{(1+r)^{\tau}} \qquad (1)$$

(Ferraro and Veltri, 2011, p.2)

The second equation refers as the clean surplus relation (CSR) where the book value of the firm is moving in a particular period, that is, today's firm book value equals to last year book value plus earnings minus dividends at time t and is formulated below:

$$b_t = b_{t-1} + x_t - d_t \quad (2)$$

(Ferraro and Veltri, 2011, p.2)

With a combination of equations 1 and 2 above, CSR enables future dividends to be replaced as future earnings and book value; market price is rewritten as:

$$MV_t = \sum_{\tau=1}^{\infty} \frac{E_t\left[b_{t+\tau-1} + x_{t+\tau} - b_{t+\tau}\right]}{(1+r)^{\tau}} \quad (3)$$

(Ferraro and Veltri, 2011, p.3)

Equation 3 was rewritten after the algebraic manipulations and was simplified as:

$$MV_t = b_t + \sum_{\tau=1}^{\infty} \frac{E_t\left[x_{t+\tau} - rb_{t+\tau-1}\right]}{(1+r)^{\tau}} - \frac{E_t\left[b_{t+\infty}\right]}{(1+r)^{\infty}} \quad (4)$$

(Ferraro and Veltri, 2011, p.3)

In equation 4, normal earnings referred as abnormal earnings is determined as earnings at time *t* minus book value at time *t*-1 multiple by rate of return is formulated as follows:

$$x^a_t = x_t - rb_{t-1} \quad (5)$$

(Ferraro and Veltri, 2011, p.3)

In equation 6, market value is formulated as the basic book value of equity plus future items of abnormal earnings which refers to the residual income of the dividend valuation model (Özer and Çam, 2016), where residual income is computed as net income less cost of equity, resulting in the following equation:

$$MV_t = b_t + \sum_{\tau=1}^{\infty} \frac{E_t\left[xa_{t+\tau}\right]}{(1+r)^{\tau}} \quad (6)$$

(Ferraro and Veltri, 2011, p.3)

The final assumption derived by Ohlson (1995) model and Feltham and Ohlson (1995) is the Linear Information model (LIM). Wang (2008) finds that this assumption is an important specification for a firm valuation research as it assumes that the time series behaviour of abnormal earnings satisfies the autoregressive process AR (1) (Ferraro and Veltri, 2011). Two accounting factors are included in this model: abnormal earnings and information other than abnormal earnings (Lo and Lys, 2000; Wang, 2008). With the linear regression analysis, the abnormal earnings can be estimated for period $t + 1$ is described below:

$$x^a_{t+1} = \omega x^a_t + v_t + \varepsilon_{1t+1} \quad (7a)$$

(Wang, 2008, p.553)

The information other than abnormal earnings at time is determined below:

$$v^a_t = \gamma v_t + \varepsilon_{2t+1} \quad (7b)$$

(Ferraro and Veltri, 2011, p.3)

Assuming that the abnormal earnings, x^a_t and information other than abnormal earnings, v_t both capture an autoregressive process of one interval, the parameter of persistence for abnormal earnings, ω should always be positive ($0 \leq \omega < 1$) and the parameter of persistence for information other than abnormal earnings, γ should be less than 1 ($0 \leq \gamma < 1$) (Wang, 2008, p.553).

Since the problem of observing future expectations depend on the linear information model, it produces a closed valuation equation that depends on the accounting information with the other element of '*v*' variable. The equations (6), (7a) and (7b) are combined and the market value is rewritten as follows:

$$MV_t = b_t + \alpha_1 x^a_t + \alpha_2 v_t \quad (8)$$

(Ferraro and Veltri, 2011, p.4)

In equation (8), the market value is ascertained by the book value, discounted future abnormal earnings and 'other information' than abnormal earnings as recommended by Ohlson (1995). This equation was modified to prove a causal effect within the firm's market value and accounting variables (Ferraro and Veltri, 2011). The intercept (β_0) and residual term (ε) were added to explain the price variations which are not explained by the variable (b_t) and coefficients α_1 and α_2, are replaced by the coefficients β_1 and β_2 as follows:

$$MV_t = \beta_0 + \beta_1 b_t + \beta_2 x^a_t + \beta_3 v_t + \varepsilon_t \quad (9)$$

(Ferraro and Veltri, 2011, p.4)

As abnormal earnings (x^a_t), net income (x_t) and '*v*' are not easy to estimate, equation (9) was simplified. The regression analysis addresses the importance and relationship between historical and forward accounting variables and the company's market value as follows:

$$P_t = \beta_0 + \beta_1 BVPS_t + \beta_2 EPS_t + \varepsilon_t \quad (10)$$

(Ferraro and Veltri, 2011, p.5)

However since there is a growing interest to find out what causes the book and market values to differ, the component '*v*' is considered as an element of the missing intangible asset so-called the "intellectual capital" (Swartz, et al., 2006;

Veltri and Silvestri, 2011). The latter represents the real value of a company with human resources, knowledge, process, skills and innovation capabilities (Wang, 2008). The intellectual capital components as a measurement of value creation adopting Ohlson (1995) valuation model is further explored as it may capture the element of '*v*' expressed as expected future accounting data (Wang, 2008; Ferraro and Veltri, 2011; Tseng, et al., 2014). Ferraro and Veltri (2011) incorporate the following equation in their research design model:

$$P_t = \beta_0 + \beta_1 BVPS_t + \beta_2 EPS_t + \beta_3 IC_t + \varepsilon_t \qquad (11)$$

(Ferraro and Veltri, 2011, p.9)

Nevertheless, one of the limitations raised by Ohlson (1995) is that gearing is not considered in the model. Based on this limitation, gearing is added in *Hypothesis 2* of this research. As a major interest of intellectual capital in the accounting and profitability process, the present research explores the linkages of intellectual capital factors following Ohlson (1995) model principally adopted by Ferraro and Veltri (2011), market value and profitability for quoted companies in the Singapore Exchange. In addition, the author proposes to analyse whether intellectual capital components have effects over time that link book and market values. An original and new equation was formulated in *Equation 3* and *Hypothesis 3* as discussed in *Chapter 4 – Research Methodology*. Various empirical researchers examine intellectual capital factors with Ohlson (1995) valuation model are discussed subsequently in this chapter.

2.4 Econometric Consideration on Intellectual Capital: A Study of Innovation Capital

Innovation capital measurement and performance within intellectual capital have certainly brought numerous debates among academic researchers and practitioners in today's globalised world (Edvinsson, et al., 2004). Innovation is described as the main factor contributing to growth strategies by increasing market share,

allowing companies to enter new markets and provide competitive advantages (Gunday, et al., 2011). In the innovative economy, competition among brand-owned companies is fierce as companies devote their energies in meeting customers needs and innovating in business processes with demand and supply chains (Yitmen, 2011). However, according to Gunday, et al. (2011) innovation does not only relate to product and process but also to marketing and organisation.

This research investigates how an integration of innovation capital and intellectual capital contributes to value creation on the firm performance in Singapore. The present challenge is to identify which innovation capital measurement or coefficient influence intellectual capital on an econometric consideration. Firstly, innovation capital is defined, the researcher then finds out whether there is an interaction between innovation capital and intellectual capital and finally whether innovation capital may influence a firm's performance.

2.4.1 What is Innovation Capital?

Innovation capital is categorised as new idea, product, service, process, system or innovative achievement that are completely original and created by an individual or an organisation (Van Buren, 1999a; Wu, et al., 2008; Wang, 2008; Moeller, 2009). Drucker (1993) cited in Wang (2008, p.560) defined innovation as "*the application of knowledge to produce new knowledge*". Moreover, Bose (2004, p.464) further describes innovation capital as a company's "*renewal strength*", which consists of intellectual property of intangible assets including its "secrets" and "*knowledge recipes*" and secured "*commercial rights*". Skandia (1995) introduces innovation capital as part of structural capital through intellectual capital by evaluating its market value with the 'Skandia Value Scheme' (Edvinsson, 1997) where innovation capital represents innovative products and processes (Marr, et al., 2004b). In the following section, the coefficients of innovation capital conducted by previous empirical researchers are examined and analysed with the innovation capital measurement.

2.4.2 Innovation Capital Measurement

In the modern era of knowledge-based economy, innovation capital is referred as a major driver of intellectual capital providing an ongoing development program in a company's structure. It consists of implementing research and development (R&D); relentlessly bring latest technology and products enabling customers demand and satisfaction to be met (Chen, et al., 2004).

Van Buren (1999a) presents his research with a number of innovation capital measures based on trademarks and copyrights; number of patents effectively used and awaiting registration, its net present value (NPV) and average age; research leadership; number of new ideas in the knowledge management database; new markets development investment; effectiveness of feedback mechanisms; new sales and opportunities exploited; direct communications to customer per year; R&D productivity; and percentage of R&D invested successfully in product design. Other researchers have analysed the innovation capital measurement with the coefficients of research & development (Wang, 2008; Liu, et al., 2009; Chang and Hsieh, 2011; Basuki and Kusumawardhani, 2012); and intangible assets (Yu and Zhang, 2008), their analyses and results are further discussed below.

2.4.2.1 Research & Development (R&D)

Wang (2008) explores intellectual capital and market value of Standard & Poor's 500 companies from 1996 to 2005. In her study, she focuses research & development expenses (per share) as the proxy factor of innovation capital. The result shows a positive relationship of R&D investments and share price in addition to positive outcomes in net income and asset size.

In addition, Liu, et al. (2009) analyse the benefits of intellectual capital on value creation and business value with Ohlson (1995) model based on the Taiwanese IT industry; and develops an appropriate business valuation model that helps in any managerial decision of intellectual capital. Under innovation capital, two

operational definitions of variables are used. The variable 'PAT' refers to the numbers of approved patents for the current period and the variable 'RDD' refers as R&D expenses over net operating expenses. At the end of a particular period, both variables indicate significant positive results with the corporate value of market price and at book value. In conclusion, it indicates that innovation capital creates value on companies, as PAT increase the shareholder's value in both R&D capacity and company's innovation; and with high ratio of RDD it proves that companies invest heavily on more product development and skill innovation. Consequently, it allows a more competitiveness approach and upgrades productivity thus affecting the market value of a business' equity on the long-term basis.

Chang and Hsieh (2011) extend Pulic (2004) VAIC^{TM} tool of measuring value creation with the use of the ratio of innovation capital efficiency. It is analysed by R&D expenditure over book value of share and this proves R&D per unit is creating value-added. Their study is based on the Taiwanese companies from 2000 to 2008. On both operating and financial performance, the innovation capital efficiency has a positive effect. It implies that the Taiwanese high-tech companies are well supported by R&D, investment level and infrastructure development and these factors are perceived as sources of value creation.

Similarly to Chang and Hsieh (2011), Basuki and Kusumawardhani (2012) examine the innovation capital efficiency and use the ratio R&D expenditure to value added. The results prove that intellectual capital has significant outcome in profitability including a positive significant effect of innovation capital efficient. They have also evaluated whether innovation capital efficiency affects productivity and asset turnover ratio but both shows no significant relationship.

2.4.2.2 Intangible Assets

Following Ohlson (1995) model, Yu and Zhang (2008) conduct their study to examine an interaction between intellectual capital and Chinese high-tech

corporate value from 2003 to 2005. In their research, they operationalise the measurement of innovation capital as intangible assets divided by a company's outstanding shares at a given period of time. The descriptive statistics result shows that the Chinese high-tech companies lacks to create value as they are not interested in investing heavily on R&D but would rather spend on advertising where both profit and share price figures could go up rapidly. In the next sections, the development of value creation with the balanced scorecard (BSC) framework (Kaplan and Norton, 1993), strategy map (Kaplan and Norton, 2000) and value creation map (Marr, et al., 2004a) are examined to demonstrate how they start to integrate both intangible assets and intellectual capital factors.

2.5 Value Creation

As part of an organisation strategy, value creation is crucial to intensify the confidence of the investors, customers, stakeholders and the general public. Today, organisations create sustainable value by using intangible assets and intellectual capital to maximise competitive advantage (Kaplan and Norton, 2004b; Marr, et al., 2004b). As more than 75 per cent is represented in the value of a business intangible assets, Kaplan and Norton (2004b) acknowledge the importance of strategy formulation and execution to address its purpose of bringing the intangible assets into use. This study highlights the importance and development of the value creation at a strategic management level by introducing the balanced scorecard (Kaplan and Norton, 1993, 2004a), the strategy map (Kaplan and Norton, 2004a, b) and the value creation map (Marr, et al., 2004a).

2.5.1 Balanced Scorecard (BSC) Framework

Kaplan and Norton firstly presented the balanced scorecard (BSC) in the 1990s as an effective value measurement of the management system that translates the strategic objectives of a company into performance measures. They identify human resource as a driver of intellectual capital. The four elements involved in the BSC framework are: financial performance; customers; internal business

processes; and organisational growth, learning and innovation that managers may choose and apply as a strategic objective to beat competitive demands (Kaplan and Norton, 1993). It is the sum of employee satisfaction, productivity, capability and sustainability (Moon and Kym, 2006, Chu, et al., 2011). It helps to convert corporate strategy in achieving its goals and objectives by implementing profitability measures (Bose and Thomas, 2007). It is regarded as a tool for communicating measurements of financial and non-financial information (Shaikh, 2004; Cheng, et al., 2008) and is also linked with a cause-and-effect relationship to improve a company's efficiency (Voelpel, et al., 2006).

Empirical studies demonstrate that the balanced scorecard is a significant tool and represent an innovative approach to measure and manage intellectual capital and firm performance (Andriessen, 2004; Kaplan and Norton, 2004a, c; Mouritsen, et al., 2005; Voelpel, et al., 2006; Bose and Thomas, 2007). It can solve issues of measuring and managing intellectual capital (Andriessen, 2004). It also arranges the combination of financial and non-financial evidence to connect with the business strategic and commercial interests (Mouritsen, et al., 2005; Bose and Thomas, 2007).

Petty and Guthrie (2000) argue that when measuring the internal human capital, the balanced scorecard focus more on customer capital rather than employees, although this could have analysed differently with the given metrics, the framework therefore provides inaccurate information on human capital. It was criticised that the balanced scorecard focuses on strategy rather than as a measurement of proxies of perspectives or value drivers of intellectual capital on company's profitability (Wang and Chang, 2005; Kehelwalatenna, 2016).

With the knowledge and innovative economy, Voelpel, et al. (2006) criticise that the balanced scorecard presents significant restrictions in dealing with the latest and rapid changes in the corporate network and dynamic environment. According to Voelpel, et al. (2006) the weaknesses of the BSC framework are: it does not allow any interactions with the four perspectives; it remains static despite the

challenges of changing and high competitive world; the external innovative connectivity is delayed by the internal balanced scorecard as it does not allocate any systematic linkages and external environment to interlink with the global network innovative economy; the knowledge creation and dynamic of innovation are underestimated (Bontis, et al., 1999).

Hoque and James (2000) emphasise that the measures of the balanced scorecard should be related to each other and coordinate with the company's strategy. It is important that the strategic objective of all perspectives relate to a cause-and-effect approach specifically missing to validate the balanced scorecard. The strategy map explicitly refers to the cause-and-effect linkage and is used as a "*double-loop learning"* or also known as a "*strategic learning loop"* (Kaplan and Norton, 2001 cited in Rompho, 2012, p.57). In order to expand the balanced scorecard approach, a strategy map further develops and designs by Kaplan and Norton (2004a, b) offers how a strategy links both tangible and intangible assets to the treatment of value creation. The significance of the strategy map is explored in the following section.

2.5.2 Strategy Map – How an organisation creates value

As stated above, the four major criteria of the balanced scorecard provide strong directions and priorities an organisation may take as part of its future strategic measures and the objectives of this model are linked with a cause-and-effect mechanism. In contrast, the strategy map is a visual concept connecting intangible assets to the investor's value creation with four interrelation perspectives (Kaplan and Norton, 2000, 2004a, b). Starting from the balanced scorecard to the strategy map, it is only when targeted customers are satisfied that the financial outcomes are achieved. In the customer value proposition, sales are generated from loyalty customers followed by the creation and delivery of the internal processes. Intangible assets provide the foundation of the strategy for internal processes (Kaplan and Norton, 2004a). However, it is not easy to communicate without a comprehensive description of a strategy, shared understanding and alignment,

executives cannot implement new strategies even with changes environment of competitive advantage, global competition, advanced technology, deregulation and customer sovereignty, especially derived from intangible assets of human and information capital (Kaplan and Norton, 2004b).

Therefore, it is essential to highlight further how the organisation creates value with a strategy map that links factors of a company's strategy and also forces the company to clarify the logic behind it (Kaplan and Norton, 2004a). Their research have been conducted by many case studies of various type of organisations and in different scenarios for private-sector organisations: Saatchi & Saatchi (Kaplan and Norton, 2004a, pp.157-161); Volvofinans, Media General, Inc.; public-sector organisations: UK Ministry of Defence and Economic Development Administration of the U.S. Department of Commerce; bank: Bank of Tokyo-Mitsubishi; non-profit organisations: American Diabetes Association, Boston Lyric Opera and Teach for America; among others by creating a unique and customised strategy map for every company, aligning investments in people (human capital), technology (innovation capital), organisational capital (structural capital) and financial perspective (Kaplan and Norton, 2004a, pp.402-438).

Empirical studies also emphasise the importance of the strategy map with the transformation of non-financial into financial performances (Scholey, 2005; Wu, 2005; Carlucci, 2012; González, et al., 2012). Carlucci (2012) recognise that it supports managers in their decision-making and critical thinking when formulating, evaluating and implementing the company's strategy at all levels of the business and also reduces the ambiguity of how the knowledge assets turn into value creation. The cause and effect relationship is achieved to meet the desired results with all four perspectives as it is created in a downward flow, thus helping managers and employees to understand, execute, test and measure the business system very effectively (Scholey, 2005; Capelo, et al., 2009; González, et al., 2012; Rompho, 2012). The strategy map refers as a "*strategic learning loop*", identifies a particular area of the business that is underperforming, thus the cause is quickly recognised with the operational control loop without affecting unrelated

factors. This leads to the managers or key executives to revise and validate the current strategy from a particular situation (Kunc, 2008; Rompho, 2012).

However, previous empirical studies have criticised that the strategy map, similar to the balanced scorecard does not take into consideration the time lag between cause and effect in their measurement, thus making it difficult to validate as it is too simple; it lacks a feedback loop and discriminates both causal and logic linkages (Norreklit, 2000; Kunc, 2008; Rompho, 2012). In addition, the strategy map should provide a correlation between each perspective in order to guide managers with a detailed explanation on how to implement and interpret it (Rompho, 2012). According to Lev (2001) cited in Rompho (2012), the valuation of intangible assets cannot be assessed on a stand-alone basis as the company's resources consist of different assets and these assets relate to each other when creating value. In his experiment design study, Rompho (2012) identifies a gap in the literature that the strategy map does not address how to statistically test its validity but only test its effect on how to improve decision-making at a managerial level.

Nevertheless, having to face new challenges and rapid changes of the knowledge economy and intellectual capital, Marr, et al. (2004a) extend the strategy map with the introduction of the value creation map and is examined in more detailed below.

2.5.3 Value Creation Map

For the purpose of investigating how intellectual capital and intangible assets generate value in a business, Marr, et al. (2004a) introduce a value creation map combining direct and indirect of intellectual capital variables to represent value creation by extending the strategy map approach of Kaplan and Norton (2000, 2004a, 2004b). They argue that previous empirical researchers try to map the drivers of performance in applying theory of the resource-based view of an organisation (Wernerfelt, 1984; Barney, 1991) while Penrose (1959) cited in

Marr, et al. (2004a) disagrees and finds that assets and firm resources exist as a bundle but did not consider the interrelation with other assets. Marr, et al. (2004a) objective is to determine the importance of the interrelationship between the organisational assets of physical and intangible assets.

The performance and value creation of an organisation occur when strategy is well implemented. As stated in *Chapter 1,* traditional resources were mainly capital, land and machines, but most recently the intellectual capital concept and knowledge assets have emerged whereby good managers have to recognise and apply key resources that determines profitability and increase the dynamics of value creation into their businesses (Nahapiet and Ghoshal, 1998; Marr, et al., 2004a; Carlucci, 2012). With a view to support management decisions and avoid any inappropriate resources on future investments, Carlucci (2012) recognises that it is crucial to highlight why and how intellectual capital, specifically knowledge assets, can be categorized into value creation with positive effects on firm performance and therefore suggests a knowledge asset mapping methodology to assess the firm's value creation dynamics with a cause-and-effect mechanism, whilst, Marr, et al. (2004a) emphasise their study on the value creation map.

2.5.3.1 Direct and Indirect Interactions

Following the same principles of the strategy map (Kaplan and Norton, 2000), Marr, et al. (2004a) design the value creation map to meet an organisation's objectives, mission and vision. The value creation map emphasizes on the importance of the stakeholder by extending the balanced scorecard approach. Its key value drivers help in identifying the dynamic interaction of different assets and contribute in maximising value creation. A selection of the key assets is therefore crucial in helping organizations to achieve their performance. Marr, et al. (2004a) create a "matrix of indirect dependences" which expresses how each performance objective integrates the combination of direct and indirect variables when creating the value creation map. For example: customer satisfaction was

taken into consideration as the main objective of an organization to explain value drivers.

Marr, et al. (2004a) present a longitudinal case study of a most successful manufacturing furniture company at Calia to find out how could the value creation map be implemented in the latest phrase of the product development. The strategic objectives at a managerial level were identified as the key value drivers with the use of a matrix of direct dependences. Semi-structured interviews reveal that the assets of the key drivers of the managers' performance are software for design, technical expertise, working practice, addressing issues and manual with codified procedures. Further structured interviews and group feedback sessions are carried out with the team leaders and managers to identify the matrix of indirect dependences with an interaction with the direct ones.

However, they identify issues such as poor integration between prototyping and design where knowledge and knowledge sharing are crucial; the designers technical expertise were very poor; there is a know-how gap between the designers and prototype builders; it is a high tacit knowledge and work environment, where it is difficult to transfer knowledge from one individual to another one; absence of prototyping activities and codified design rules. To improve, create and apply the stages of the value creation, the company has made radical changes with the standardization of the working practices by designing a new written manual to externalize and share knowledge; and drawing the cause and effects diagrams for the codification process. The designers have to adapt to technical knowledge with changes in design specifications (Marr, et al., 2004a).

Marr, et al. (2004a) therefore conclude that the value creation map process permits managers to highlight the fact that both profitability and critical resources bring contribution. In a nutshell, it applies the combination of direct and indirect interactions of value creation. One may see how intangible assets generate and create value for every business with the challenges and usefulness of balanced scorecard and strategy map. However, there is a call for further research and

investigation as to how to apply different tools and approaches to fully understand and visualize the firm value creation.

Based on Marr, et al. (2004a) value creation map, this research further investigates how the direct and indirect of intellectual capital factors have an effect on value creation and profitability, especially with human capital as it is perceived as the primary source of intellectual capital in a quantitative econometric approach and identify a missing gap in the literature following previous studies (Bontis, et al., 2000; Wang and Chang, 2005; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Kamukama, et al., 2010; Ferraro and Veltri, 2011; and Scafarto, et al., 2016).

2.5.4 Human Capital: Further Consideration of its Moderating or Indirect Effect with Other Intellectual Capital Factors

Human capital, as stated earlier in this chapter, refers as the knowledge, abilities and skills generated by employees (Becker, 1964 cited in Kostopoulos, et al., 2015). Ronning (2011) points out that human capital manages the business with the knowledge and professional skills an individual possesses to deliver and produce goods and services. It is further embedded in employees' intelligence, competence, abilities, innovativeness, commitment, experience, attitude, leadership and managerial skills to meet certain targets set by an organisation (Bontis, et al., 2000; Hayton, 2005; Seleim, et al., 2007; Campbell, et al., 2012). It includes time and effort that staffs bring and invest at work (Davenport and Prusak, 1998). After consideration human capital, excluding other intellectual capital factors, is owned by the company as staff brings innovation, creativity and strategic renewal into the company (Bontis, 1998; Bontis and Fitz-enz, 2002; Cabrita and Bontis, 2008), however it can be risky and costly when the staff leaves the organisation as the firm has invested towards staff development and training (Edvinsson, 1997).

Tseng and Goo (2005) argue that human capital is not entirely controlled by the organisation. Whilst working, each individual is willing to participate towards the goals and objectives of the company; as a consequence, the company has no entire and direct control over all parts of intellectual capital. Previous empirical studies acknowledge that human capital is directly influencing profitability but also indirectly through structural capital and relational capital, thus creating value for an organisation (Bontis; 1998; Bontis, et al., 2000; Bontis and Fitz-enz; 2002; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009). Other studies include innovation capital and process capital (Wang and Chang, 2005; Cheng, et al., 2008; Ferraro and Veltri, 2011; Tseng, et al., 2014; Scafarto, et al., 2016).

This research further investigates how human capital and other variables of intellectual capital as interrelated factors may indirectly influence the profitability and value creation of companies. While it is well grounded in the intellectual capital literature, human capital is regarded to affect both value creation and profitability with its positively significant result and direct relationship (Chen, et al. 2005; Kamath, 2008; Ting and Lean, 2009) but may have adverse and negative results (Firer and Williams, 2003; Shiu, 2006); and the combined results depend on various financial indicators such as market-to-book value, shareholders returns (return on equity, ROE), profitability (return on assets, ROA) and productivity (asset-to-turnover, ATO) (Chu, et al., 2011; Maditinos, et al., 2011).

A growing academic literature also emphasises that other intellectual capital factors benefit from human capital (Wang and Chang, 2005; Bontis and Serenko, 2007; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Ferraro and Veltri, 2011; Scafarto, et al., 2016). With a limited research conducted in this particular area, the researcher extends her study by analysing the interaction of human capital and other intellectual capital factors in the firm's value creation and performance of the Singaporean listed companies.

2.6 Key Strategic Management Theories

Having said that the rise of the knowledge-based economy is moving rapidly with technology and globalisation changes, companies survive when they acknowledge that intangible assets and competencies contribute to value creation and company's performance (Teece, et al., 1997; Wang, et al., 2014). In accordance with the resource-based view theory, sustainable competitive advantage is achieved when a corporation can possess, manage and fully control its tangible and intangible assets by generating good performance. In order to validate this theory, there are four resources criteria to be met: valuable, unique, hardly imitable and difficult to substitute (Barney, 1991).

Resources do not mainly include physical or tangible assets; nevertheless intangible assets of human resource and knowledge should not be ignored and also contribute to sustainable competitive advantage (Denford, 2013). The knowledge-based view theory was therefore developed with a combination of resource-based view theory and epistemology to explore and contribute to a number of literatures namely organisational learning, evolutionary economics, innovation, new product development, organisational capabilities and competences (Grant, 1997). In addition, the knowledge-based view theory also recommends that knowledge, as a significant strategic resource, increases when productivity also increases with other inputs and focuses in value creation (Bogner and Bansal, 2007; Denford, 2013).

In the 1990's, intellectual capital has been emerged focusing on knowledge with the element of intangible assets or knowledge assets having effects on value creation and competitive advantage (Zardini, et al., 2015). Researchers suggest that sustainable business and growth strategies are achieved mainly with the contribution of staff knowledge that increases both firm performance and value creation (Iazzolino and Laise, 2016). It is also recognised that intangible assets / intellectual capital can be either static or dynamic where the former refers to the knowledge available within a firm and the latter is the flow of the progression of

knowledge in the stock market (Yaseen, et al., 2016). However, intellectual capital present major challenges within the management of a company, for example, how to ensure that the worker's capability and knowledge increase productivity, performance and value creation with the intangible assets.

In the following sections, two key strategic management theories of the resource and knowledge based view theories are briefly explored to find out how the two theories relate to the intellectual capital factors, firm performance and value creation especially in the fast-moving competitive environment and in the knowledge-based economy.

2.6.1 Resource-Based View

In 1959, Penrose introduced the theory of "*resource-based view*" ("RBV") to the strategic management field as a set of strategic resources such as knowledge, assets and processes; and recognise the importance of these resources to a company's competitive position (Curado and Bontis; 2006; Rivard, et al., 2006; Newbert, 2007; Abu Bakar and Ahmad, 2010). The concept is developed to focus principally on the firm's attributes and replace cooperation with its rivalry. It also refers as an extension to Porter's (1980) five forces analysis, which is based on industry specific, external environment and tools for analysing products. Sustainable competitive advantage can be succeeded by reinforcing the internal resources of a business and by avoiding external market forces that negatively influence its performance (Wernerfelt, 1984; Roos, et al., 2001; Ordóñez de Pablos, et al., 2007; Marzo, 2014; Campbell and Park, 2017).

In order to quantify the concept of resource-based view and encounter a sustainable competitive advantage, a strategic asset must fulfil four conditions that are "*valuable, rare, imperfectly imitable and non-substitutable*" (Barney, 1991, p.116). Firstly, a resource is "*valuable*" when a firm is able to exploit any opportunities or prevent competitive threats in a given market. Secondly, the resource is "*rare*" when limited firms in a specific market own it. Thirdly, the

resource is considered as "*imperfectly imitable*" when it is hard for its rivals to replicate or acquire for a lengthy period. Finally, provided that the resource is not strategically identical, it is "*non-substitutable*" (Meso and Smith, 2000). Therefore, firms have to implement value creation strategies so that these resources are difficult to replicate by competitors (Barney, 1991). For example, an innovative product is a major factor of competitive advantage and determinant of an organisation's good performance and achievement (Abu Bakar and Ahmad, 2010).

A capable company uses its available resources in such manner to create wealth when it gains competition successfully; provides a good customer value and resources such as relationships, knowledge and processes (Grant, 1991; Roos, et al., 2001). The resource-based view concentrates mainly on internal sources of an organisation to find out how it can outperform its competitors (Evans, et al., 2007; Campbell and Park, 2017). When developing a competitive advantage and building a niche competitive market, the internal environment is more important than the external environment as the current market place acknowledges it. A company generates profitable opportunities when finding its strengths in developing its core competencies with a combination of resources and capacities (Barney, 1991; Herremans and Isaac, 2004; Yang and Kang, 2008; Ferreira and Fernandes, 2017). The resource-based view also constitutes of a firm's strategic planning where internal resources are identified to match external environment (Wernerfelt, 1984). Moreover, Porter (1980) suggested that a sustainable competitive advantage is attained when external market forces bring negative impact on the profitability of every business.

The use and quality of strategic resources of tangible and intangible assets include information and knowledge, managerial skills and organisational routines; these assets may gain competitive advantages through holdings and acquisitions by improving firm performance (Wernerfelt, 1984; Barney, et al., 2001). Property, plant and equipment of tangible assets are either easily acquired at a lower-than-value price or imitable; but intellectual capital factors and tacit knowledge of

intangible assets meet the resource-based view criteria when they can hardly be changed and replicated by competitors (Meso and Smith, 2000; Riahi-Belkaoui, 2003; Curado and Bontis, 2006; Marzo, 2013; Scafarto, et al., 2016). Examples of resources are: brands, copyrights and patents; these resources are strictly protected allowing a company to earn full monopoly rights and incur high economic gains rather than normal returns (Wernerfelt, 1984; Teece, et al., 1997; Roos, et al., 2001; Martín-de-Castro, et al., 2011; Denford, 2013). Therefore the resources are significantly achieving and sustaining a business's competitive advantages and contribute to corporate performance (Kristandl and Bontis, 2007).

However, Pike, et al. (2006) argued that the resource-based view does not apply when a monopoly occurs with limited resources and when scarce resources are not available to competitors. It was further criticised that the weaknesses of the resource-based view limits its empirical testing and measuring intangible resources and capabilities of a firm's rivalry (Martín-de-Castro, et al., 2013; Delgado-Verde, et al., 2016). The knowledge-based view has later been emerged; its importance is therefore examined and reviewed in the next section to find out how its implication can be related to value creation and business profitability; and may fully promote the development of intellectual capital in the knowledge economy.

2.6.2 Knowledge-Based View

The productive paradigm is rapidly changing from manufacturing to services or information technology industries in the globalisation economy. The resource-based view theory explores the competences and capabilities of a company, whereas the knowledge-based view theory applies to the transformation, creation and transfer knowledge into competitive advantage (Curado and Bontis, 2006). The knowledge-based view theory is regarded as an extension of the resource-based view represented by the dynamic capabilities and refers as an heterogeneous knowledge to create, apply, share and integrate knowledge that determine competitive advantage by bringing a better competitive position to a company in a

given knowledge-based environment (Curado and Bontis, 2006; Kong, 2007; Kamukama, 2013; Mehralian, et al., 2014).

Furthermore, Yaseen, et al. (2016) highlight that based on the type of resources of knowledge process or nature, an organisation can incorporate its internal abilities, sources and external market opportunities to achieve its competitive advantage. The theory behind the knowledge-based view assumes that the advantages of resources and capabilities are derived from the integration of specialised knowledge (Grant, 1997; Denford, 2013). Knowledge is therefore an important intangible resource for growth that generates sustainable competitive advantage (Schiuma and Lerro; 2010; Sanchez-Gutierrez, et al., 2016). It recognises that knowledge is also a good source of value especially when a company has the abilities to generate wealth creation, acquire and use knowledge efficiently and effectively (Wang, et al., 2014). Resources do not depreciate in the knowledge-based view even when they are shared; they generate high returns (Curado and Bontis, 2006).

However, its limitation depends on both tacit and explicit knowledge as it is related to a firm's static internal resource where physical resources are controlled, traded and exploited. Knowledge is also distorted as information is focused on IT development rather than growth of understanding and visualising intellectual assets with tacit knowledge of the company's value creation (Kong, 2007). Based on the above explanations, it important to determine how the intellectual capital components promote sustainable competitive advantage in the knowledge-based economy from the key strategic management perspectives.

2.6.3 Effects of Intellectual Capital to a Firm's Sustainable Competitive Advantages

The significance of intellectual capital elements have been recognised as main contributions to the firm's sustainable competitive advantages as well as key factors for both value creation and performance of a rapid knowledge-based

economy; and may also justify why the market return is considerably larger than its book value of a business (Liang and Lin, 2008; Martín-de-Castro, et al., 2011; Campbell and Park, 2017). In addition, companies are encountering challenges to grow, survive and sustain competitiveness as they always depend on their staff knowledge for innovative ideas to increase competitive advantages (Marr and Spender, 2004; Singh and Rao, 2016). It is through the intellectual capital concept that businesses gain sustainable competitive advantage when adopting Barney (1991) four attributes: valuable, rare, costly to imitate and difficult to substitute, especially in an evolving market of the knowledge-based economy. Therefore, it is viewed equally as the knowledge assets that companies incorporate as part of their competitive advantage to create value in a particular market (Delgado-Verde, et al., 2016; Kianto, et al., 2017).

A long-term competitive advantage exists when competitors are unable to implement and duplicate a business's value creating strategies of the four attributes of the resource-based view concept. Human capital, as internal resources, can bring success to a company with its uniqueness due to the strategic value used to improve a company's efficiency, exploit opportunities or overcome threats (Evans, et al., 2007; Welbourne and Pardo-del-Val, 2009). It is recognised to be the heart of sustainable competitive advantages and main element of knowledge creation when the strategic goals of a company is to transform and develop talented employees (Daou, et al., 2013; Martín-de-Castro, et al., 2013). Mehralian, et al. (2013) further suggest that the resource-based view is related to knowledge, expertise and skills that individuals possess to create and utilise knowledge for improvement and learning. However, it may give rise to an improvement of a company's profitability predominantly in the knowledge-based economy of its operational activity in tangible assets of equipment and tools; or intangible assets of its workforce possessing leadership, problem-solving and risk-taking skills (Bozbura, 2004; Mehralian, et al., 2013). Intangible resources create a firm's wealth and sustain competitive advantage; mostly when companies spend on training, retention and transfer costs. From these perspectives, human capital

with tacit knowledge is therefore perceived as an important factor of intellectual capital (Hitt, et al., 2001; Cabrita and Bontis, 2008; Lim, et al., 2010).

Relational capital is referred as an intangible asset that creates value, develops, nurtures and maintains good communication with staffs, customers, suppliers, stakeholders and competitors, thus increase positively business financial performance and competitive advantage (Welbourne and Pardo-del-Val, 2009; Delgado-Verde, et al., 2011; Lopes-Costa, et al., 2015; Yaseen, et al., 2016; Sardo, et al., 2018). It relates to the embedded knowledge sharing and learning capabilities that exist between a company and its stakeholders thus leading towards innovation such as transfer ideas from one to another industry (Wang, et al., 2016; Kianto, et al., 2017). It further enhances the interaction of human capital and structural capital by influencing its stakeholder perceptions with its reputation, corporate power, market loyalty, brand and trademarks; contribute to financial capital growth and maximising wealth creation (Lennox, 2013; Dženopoljac, et al., 2016; Sardo, et al., 2018). Overall, relational capital helps a business's ability to create competitive advantage that relates not only on its unique resources but also on relational assets such as building up close and long-term relationships with key business partners. In addition, both customer loyalty and suppliers relationship strategies contribute to the sustainable competitive advantage with superior financial performance and help maintaining market share to avoid competitive threats (Dyer and Singh, 1998; Yang and Kang, 2008; Wang, 2014). Arguably, relational capital decreases transaction costs when switching suppliers or engaging in competitive bidding. These transactions costs contain threats that companies should monitor closely and control their business partners or suppliers. A reduction in transaction costs could give rise in productivity and create an impact on the supplier's profits (Kohtamäki, et al., 2013).

Process capital refers as an intangible resource that is required to develop knowledge, strategy, competencies and implementation from a company's infrastructure in order to generate an effective and efficient value creation (Shang and Wu, 2013; Matthies, 2014). Furthermore, Johnson (2002) describes process

capital as an element of tacit knowledge that includes process technologies and trade secrets. In order to retain a competitive edge in a particular market, a business needs to possess knowledge and professional skills, apply the relevant experience and technology; and maintain customer relationships (Shang and Wu, 2013).

Resource-based view scholars recognise the effects of intangible assets based mainly on innovation and knowledge, particularly, innovation capital is known as the core element of competitive advantage by creating capabilities resources and competences (Abu Bakar and Ahmad, 2010; Delgado-Verde, et al., 2016). Based on the knowledge management, innovation capital is considered as the most challenging business activity for competitive companies only when they are able to incur rapid economic growth, create latest products in new markets, expand production and continuously improve processes for the survival of the business (Martín-de-Castro, et al., 2013; Dickel and de Moura, 2016). Furthermore, a company's strategy is to develop an appropriate business model by integrating a unique and complex technology to make it difficult to duplicate and emphasises on knowledge creation that enables companies to outperform their competitors (Galbreath, 2005; Yang and Kang, 2008). Technology advancement and innovation are critically important in the dynamics of external environment as these factors increase growth, improve company's performance and guarantee competitiveness in any businesses (Kamasak, 2015; Sanchez-Gutierrez, et al., 2016). In the new digitalisation, globalisation and knowledge-based economy, businesses incur more competitive pressure, as they have to improve their product or service concepts constantly, be more creative, remain sustainable among their fierce competitors and retain their position in the global markets (Kamasak, 2015).

2.7 Empirical Studies of Intellectual Capital

Having reviewed the concepts on intellectual capital, value creation and firm performance identified the research gap from previous studies, in the next section,

the researcher examines how the VAIC^{TM} model was applied as an accounting concept by various researchers: Chen, et al., 2005; Tan, et al., 2007; Veltri and Silvesti, 2011; Alipour, 2012; Asadi, 2013, among others. However, other empirical studies have examined intellectual capital variables with firm performance of accounting profitability indicators (Van Buren, 1999b; Bontis, et al., 2000; Wang and Chang, 2005; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Scafarto, et al., 2016) or value creation of share price indicator using Ohlson (1995) valuation model (Swartz, et al., 2006; Wang, 2008; Yu and Zhang, 2008; Liu, et al., 2009; Ferraro and Veltri, 2011; Özer and Çam, 2016). These empirical studies have therefore inspired the author in conducting further research in this area.

2.7.1 Intellectual Capital – Pulic VAIC^{TM} Model as Accounting Concept

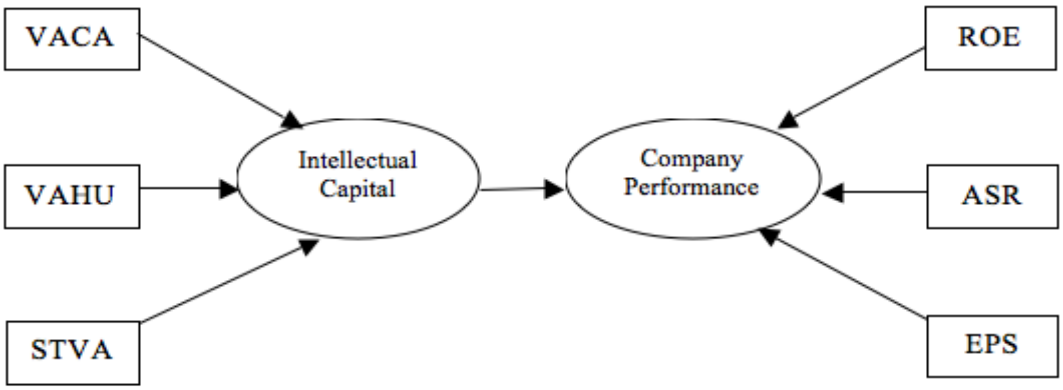
Various empirical studies have conducted their research on intellectual capital using the VAIC^{TM} model in addition with market return (Chen, et al., 2005; Tan, et al., 2007; Alipour, 2012; Asadi, 2013; Veltri and Silvestri, 2011). Firstly, Chen, et al. (2005) examine value creation efficiency, market valuation and financial profitability by analysing VAIC^{TM} model as the efficiency measurement of capital employed and market-to-book value ratios (M/B) in the Taiwanese listed companies. In addition, other financial dependent variables used are: ROE, ROA, employee productivity and sales growth. The independent variables applied are: research & development expenditures, advertising expenditures and the VAIC^{TM} factors.

Chen, et al. (2005) find that VAIC, value added efficiency of capital employed (VACA), value added efficiency of human capital (VAHU) are all positively linked with financial and M/B indicators except value added efficiency of structural capital (STVA) is positively associated with ROE. The results suggest that the market return is linked with capital employed, intellectual ability and human capital efficiencies. Moreover, R&D expenditure proves to have a positive relationship with M/B implying that innovative capital is an integral factor of

structural capital. They highlight that intellectual capital enhances both revenue growth and profitability in creating value and suggest investors to implement intellectual capital components and information in their decision-making.

Tan, et al. (2007) explore the linkage of financial returns and intellectual capital with a selection of 150 quoted companies in the Singapore Exchange between 2000 and 2002. They explore Pulic (1998) VAIC™ framework as other intellectual capital methods are unable to capture market-based valuation due to the fact that companies are not listed on the stock market; no alternative system in controlling the efficiencies of tangible and intangible assets of every business activities; and performance of employees might contribute towards value creation or destruction. With the use of the partial least squares, they examine ROE, EPS and annual stock return as dependent variables for the company performance and VACA, VAHU and STVA as independent variables on intellectual capital. *Figure 2.1* shows the conceptual model applies on the partial least squares and how it links the intellectual capital variables used by Pulic (2004) with the company performance.

Figure 2.1: Conceptual model – Interaction between Intellectual Capital and Pulic (2004) VAIC™ Model with Company Performance



(Source: Tan, et al., 2007, p.84)

The hypothesis and results conducted by Tan, et al. (2007) confirm that a positive but a weak correlation outcome exist between company performance and intellectual capital. Moreover, the rate of growth also has positive result. Their

result intellectual capital shows different contribution to different sector. The industries influence and highly contribute to intellectual capital are: services and property sectors followed by the manufacturing and trading sectors. Companies who operate their businesses with different assets and capabilities are able to compete effectively within various industries. While others rely on the physical and financial assets, others depend more on intellectual capital for a better success.

Alipour (2012) provides further investigation on the factors of intellectual capital of 39 Iranian insurance firms' performance from 2005 to 2007. He has selected ROA as dependent variable; VACA, VAHU, STVA and VAIC as independent variables and control variables: size, leverage and ROE. The results of his research have positive outcomes in VAHU, VACA and STVA with the profitability of ROA. Human capital efficiency indicates that staffs are valuable assets and compete well with others in the same market place, this variable should not be disregarded by organisations. Moreover, as structural capital has an impact on profitability, the internal system should be well outlined in collecting, capturing and disseminating information and data. He recognised that an organisation has to intensify its intangible assets by strengthening the employed capital efficiency. Further result indicates that a positive significant result of VAIC and company profitability confirm how intellectual capital influences its profitability.

Asadi (2013) conducts his study by evaluating intellectual capital of Iranian listed companies performance and market value with a superiority growing of the strategic process using panel data analysis for a 5 year-period from 2006 and 2010. The dependent variables include EPS from operations, net cash flow per share and rate of sales growth on financial performance; the independent variables are: VAIC^{TM} factors; and market-to-book value ratio representing market value. All VAIC^{TM} factors results are positive and significant with market return and financial profitability. However, they have negative results on firm size variable, as it affects the financial performance (Asadi, 2013). The results are consistent

with Bontis (1998), Riahi-Belkaoui (2003) and Rahman (2012) as they conclude that the intellectual capital domain is well accepted in the capital market as well as reflecting it in the share price.

Veltri and Silvestri (2011) recognise the importance concept of VAIC^{TM} model as it assesses a company's capability, its efficiency use in overall resources including both tangible and intangible assets on value creation efficiency. Pal and Soriya (2012) found the measurement is easy to calculate and can be applied in different industries and companies. Tan, et al. (2007) added that Pulic (2004) has identified two main problems of valuation and its value creation has not yet been resolved from various approaches. Firms that are not listed in a stock market are unable to use the market-based intellectual capital value and if no proper structure is in place to oversee the efficiency of employees this may lead directly towards value creation or destruction.

Due to the high interest of literature carried out in evaluating market price and intellectual capital using VAIC^{TM} model (Ferraro and Veltri, 2011), however according to the author, it is still uneasy about capturing a full explanation in finding out why a difference exists between book and market values of a company with VAIC^{TM} model. Various empirical studies have also considered measuring intellectual capital factors from an accounting perspective of a firm's performance. Their studies are analysed in the following section.

2.7.2 Firm Performance – Accounting Profitability Indicators

Van Buren (1999b) examines the core intellectual capital indicators and measurement of financial performance of 102 quoted companies in the U.S for two years 1998 and 1999. The financial performance variables are ROE, total shareholder return, sales per employee, gross profit margin, price to earnings ratio and market capitalisation per employee. The findings of human capital indicators are positive between the retention of key personnel and two of the financial performance indicators: sales and market capitalisation. A positive relationship

was found with the ability to attract talented staff and gross profit margin in 1998 but not in 1999. Nevertheless, both training expenditure and process capital have negative effects on market capitalisation. In addition, the measure of innovation capital was positively related with gross profit margin. Finally, their results failed to detect any significant result in the core indicators of customer capital and financial performance measures. The implication demonstrates that employees are very valuable as intellectual capital manages the knowledge of U.S companies. They suggest that successful companies will only survive in the knowledge era, when critical understanding is reached as knowledge resides in the abilities, competencies, skills and knowledge of staffs, and nowadays, the key success in every business consists of a good human resource development.

Bontis, et al. (2000) examine the interrelationship of intellectual capital and profitability of 107 Malaysian service and non-service companies. A partial least square (PLS) technique was applied to find any reliability measures. Their outcomes show that both industries have positive and significant relationships between human capital and customer capital; customer capital and structural capital; but human capital and structural capital are only positive and significant in the non-service companies; the result of structural capital and financial performance are positive but at different significant level: 5% in the service industry and 10% in the non-service industry; and both explanatory powers are strong in both industries. Their research implies that managers should be aware that human capital establishes a strong market relationship with their customers, as a good competence staff develops customer capital by understanding the customer's needs and also retains their loyalty. Human and structural capital results imply that the non-service industries including manufacturing and construction are strongly engaged in machinery and equipment rather than the service industry as it presents a challenge to capture the employee knowledge. It implies that firms investing heavily in the market-driven and customer-focus also attract customer with the use of routines and processes in the structural capital. Finally, a sustainable competitive advantage and high performance are obtained

when a company adds value in codifying its knowledge and developing its structural capital.

With the global competitive advantage, increasing development and growth in the IT industry, firm performance and competitive power are largely influenced by intellectual capital. A sample of 131 IT listed companies in Thailand were investigated to examine if there are any direct and indirect effects of intellectual capital with profitability by applying the partial least square regression for a five-years period from 1997 (Wang and Chang, 2005). Their results indicate that the factors of intellectual capital are positive and significant on profitability, except with human capital. Despite, no direct effect was obtained between human capital and company's performance; it has indirectly influenced performance through customer capital, process capital and innovation capital. Both process capital and innovation capital also influence customer capital. Moreover, innovation capital has indirectly influenced performance through process capital and its strength was mainly due to the production efficiency process applying on equipment and design. It also proves that both human capital and innovation capital support process capital although the latter has an adverse impact on its profitability, customer satisfaction relies on process capital with its quality of products and services but not with innovation capital. They emphasise that when a company wants to boost process capital, improvement should be carried out in both human capital and innovation capital. In order to improve innovation capital, management must develop human capital, as it is a leading feature of intellectual capital that increases the overall business performance.

With the innovative era, Cabrita and Bontis (2008) acknowledge that it is essential to know how a firm creates value with the composition of tangible and intangible resources and its interactions between them. They recognise the importance of value creation resulting from higher financial performance and intellectual capital. A dataset of 253 respondents from 53 Portuguese banks were selected to assess the interrelationship of intellectual capital factors and banks' profitability by applying the partial least square (PLS) regression. The decomposition of human

capital (HC) proves to be positively beneficial with structural capital (SC) and relational capital (RC). HC is both directly and indirectly influenced by RC through SC, and indirectly with bank performance (PER): HC-RC-PER, HC-SC-PER and HC-SC-RC-PER. Their research implies the interactions, combinations and transformations of the intellectual capital variables are all important in the Portuguese banks. As part of the intellectual capital elements, organisation should rely on human capital as employees increase value, implement proper information system in transforming human capital into firm's capability and generate firm's value in relational capital with market orientation such negotiation skills and customer relationships.

As specified by F-Jardón and Martos (2009), knowledge is an investment that creates multiple effects in businesses. Using a dataset of 113 SMEs of the Argentinian wood manufacturing industry, the direct and indirect impacts of intellectual capital factors and its profitability return were tested with the panel least square technique. When companies promote learning and professional qualifications human capital result proves positive with the indirect effect of other intellectual capital factors. Further implication shows proper staff training and good customers, suppliers and stakeholders relationships increase the company's profits efficiently with the use of processes and systems thus confirming structural capital is associated with human capital and relational capital. Consequently, the structural capital is increased when internal and external relations are combined.

As traditional accounting and financial instruments fail to emphasise the value relevance of intellectual capital, Scafarto, et al. (2016) examine a systematic approach of 18 global agribusiness firms from 2010 to 2014 by measuring intellectual capital factors and its extension with the indirect effect of human capital using the multiple regression analysis. Their study consists of four dependent variables of accounting measures: asset turnover (ATO), return on equity (ROE), return on investment (ROI) and return on assets (ROA); firm size and leverage are the control variables; and the independent variables are factors of intellectual capital. The direct positive and significant results are: process capital

with three of the four performance indicators, except ATO; relational capital with all financial indicators; size with ATO, ROE and ROI whereas the negative and significant findings are: human capital with ATO; innovation capital with all accounting measures and leverage with ROA and ROI.

In analysing the indirect effects of human capital, Scafarto, et al. (2016) find that innovation capital is positive and significant in three financial models; but not in ROA, relational capital and process capital have no interaction effects in any accounting indicators. A negative innovation capital implies firms cannot repay R&D investment faster due to regulatory and legislative requirements affecting the agribusiness industry. It further implies that companies investing heavily in relational capital maintain customer relationship and position themselves among competitors. A positive process capital suggests that ATO ratio is a predictor of financial and economic performances. The finding of the indirect relationship of human capital with innovation capital implies that organisations investing in high levels of human capital attract, retain highly talented, knowledgeable and skilled staff in obtaining good returns from R&D investments. Negative leverage indicates that the agribusiness firms rely more on internal finance and use less debt capital. Finally, large size of companies enjoys economies of scale and offset easily high costs of R&D, distribution and marketing costs. In the next section, empirical studies explain whether Ohlson's valuation model is suitable to evaluate intellectual capital variables and to distinguish why the firm's book and market values differ.

2.7.3 Value Creation – Intellectual Capital Variables adopting Ohlson (1995) Valuation Model

Over the last few decades, attention has been drawn among researchers and scholars that there are hidden values unexplained in the company's annual report. Researchers and scholars are now investigating the reasons why such differences exist between book and market values with the share price, intangible assets and intellectual capital factors (Nogueira, et al., 2010; Maditinos, et al., 2011).

Nevertheless, there are still debates whether shareholders are considering intellectual capital components when investing in a particular company and whether intellectual capital strengthens the company's value (Ferraro and Veltri, 2011).

Swartz, et al. (2006) identify the inconsistency of the book-to-market ratio as this has not yet been explained in the finance literature. It challenges businesses, regulators, accounting standard setters and users of accounting information for insufficient information in the company's annual report that constitutes its market return. In their study, they ascertain whether intellectual capital can explain its market return. They examined the value relevance of intellectual capital for 154 South African quoted companies covering eight years by integrating both Ohlson (1995) valuation and Pulic (1998) VAIC^{TM} models with an adjustment of the intellectual capital variable and were tested by the panel data least square regression. Their results reveal that capital employed efficient, human capital efficient, abnormal earnings, dividends and book value of assets have all positive and significant impacts, but only structural capital coefficient was insignificant when mixed with all independent variables and share prices of three months after the financial year of its financial reports. Overall, all VAIC^{TM} components are value relevant with the market prices. The research implication indicates that both accrual accounting data and the VAIC^{TM} components determine the share prices of the South African listed companies. They further suggest that the financial statements disclose sufficient information such as the book value of assets, earnings, revenues, expenses, cash flow, assets and liabilities; and future research may be conducted with different measurements and characteristics of any valuation method.

According to Wang (2008), there has been a switch from tangible to intangible assets in the firm's competitive advantage, where all types of organisations are not only involved with tangible but are more knowledge-based firms. Companies face challenges of uncertainty and complexity if intellectual capital does not reflect in the new business environment. She investigates the relationship of market value

and intellectual capital based on Ohlson (1995) model and analyses with a multiple regression technique of 893 IT and technology firms in the U.S. Standard & Poor's 500 from 1996 to 2005. Human capital proves to have no strong effect although the result of market price and employee productivity was positive. Highly knowledge-intensive companies use their market capitalisation to add value and increase competitive advantage resulting to positive findings on all intellectual capital factors. In addition, the implication of a moderate customer capital is to keep a good relationship with its strategic partners, customers and suppliers that bring value in the supply chain. Innovation capital constitutes an element of firm's value creation as knowledge sharing and employees experience bring innovative capability and competitiveness; and process capital enhances staff's efficiency and productivity.

With a rise in new technology, information and knowledge, Yu and Zhang (2008) acknowledge there is a lack of studies and evidence in the high-tech industry especially in the developing countries. Based on Ohlson (1995) valuation model, their research analyses the integration of intellectual capital indicators and the market returns of 41 high-tech companies with a total of 123 observations all quoted in the Shanghai securities exchange from 2003 to 2005. Human capital consists of employee productivity show a very strong connection with market value in the regression result. Custom capital comprises of sales and advertising expense, the latter has a positive significant result but sales are negatively significant. Whilst, the firm's intangible assets of R&D activities and innovation capital measurement have mixed results: positive result in the descriptive statistics but not in the regression analysis. They criticised that the Chinese high-tech companies lack to create values as they are not interested in investing heavily on R&D but would rather spend on advertising where both profit and share price figures could go up more rapidly.

According to Liu, et al. (2009), the corporate goal of every business is to maximise the investor's wealth and reflects in the movements of the share price. It is crucial for managers to understand the factors underlying these changes and

evaluate the capital market based on intangible assets and intellectual capital instead of limiting themselves on tangible production factors. They carry out their research on the validity of Ohlson (1995) valuation model with the intellectual capital indicators and value creation of 505 Taiwanese IT listed companies from 2001 to 2005. The significant results are: EPS and book value are positive on share price and corporate value; EPS is positive on book value (P-BV) model and market price; process capital with managerial expenses per employees variable and innovation capital with patents and R&D density factors are positive on share price (P) and P-BV; the importance of employees in human capital is positive but the age factor has a negative effect; the average of working experience and high educational employee's factors are insignificant and irrelevant with P and P-BV; and customer capital are not significant in all four variables of customer capital. Their research implies that the valuation model of Ohlson (1995) is adequate and validate within the Taiwanese IT Industry. The results show that financial capital indicators are very important in the valuation data for both corporate value and value creation; management decision enhances value creation in the process capital; patents increase shareholders wealth with innovative products; R&D density is high as a result of new development, skills and innovation; and the importance of employees and young generation contribute to corporate values. However, the information technology production line does not require highly qualified staff. It is impossible to reduce corporate value with experienced staff and the insignificant of customer capital is due to lack of bargaining power to suppliers to adjust prices. It was criticised that advertising does not influence the buying behaviour and aggressive competitions affect the pricing strategy by reducing company's revenues.

Despite a substantial increase in literature, it is still unknown whether investors realise the importance of intellectual capital enhances and creates values. With limitations inside VAIC^{TM} calculations, Ferraro and Veltri (2011) investigate the value relevance of intellectual capital on 189 Italian firms' market values, quoted on the Milan Stock Exchange for two years from 2006. Ohlson (1995) valuation model has relatively a good explanatory power when applying a fixed-effects

panel data regression with 524 observations. Their findings show that BVPS and EPS are both value relevance for shareholders. Among other intellectual variables, the relational capital has the most positive and significant relationship, but innovation has no significant effect on market value. Whilst the market price is negatively correlated with human capital and process capital, its moderating effect of human capital and process capital prove to be positively significant with market value; but have no indirect human capital interactions with relational capital and innovation capital. With high relational capital, customer loyalty and sales volumes are also high as these elements are reflected in the firm's market share. Critically, not all R&D expenses were available; as a result innovation capital would not be calculated effectively. The findings further imply that when general administrative expenses are high, process capital is weak and when salaries and benefits are too high, human capital is also weak.

To justify the gap of book and market returns of the business real value, Özer and Çam (2016) extend Ohlson model and ascertain that the value relevance of human capital indicator as 'other information' has incremental explanatory power on firm performance. Their dataset comprises of a sample of 922 observations of the Turkish listed industrial companies from 2004 to 2014 with the use of a panel regression of Driscoll Kraay standard errors. The findings of the coefficients on book value and abnormal earnings (known as residual earnings), net sales per employees and personnel expenses are consistently positive and highly significant implying that there are extraordinary powers over the market value. An increase in R^2 reveals an incremental explanatory power of human capital on market price whereas the *F-value* and *P-value* are significant and predict the firm's equity value. However, their study only elaborate on human capital but not on any other factors of intellectual capital. Their research implies that businesses may rely on taking valuation decisions, as human capital is value relevant with market value by capturing 'other information' especially personal expenses prove to be value drivers and should recognise their importance in the financial statements. In order to manage human assets successfully and maximise the company's long-term

competitiveness in the global market, management should implement adequate resource planning tool on compensation and reward policies.

2.7.4 Critical Appraisal of Measuring Intellectual Capital

Currently numerous methodologies of calculating intellectual capital have been set out but no unique measurement has been agreed yet (Tan, et al., 2007; Ferraro and Veltri, 2011). In this section, the author critically appraises the literature review based on previous empirical researches in this field and concludes how this study will be validated.

Measuring intellectual capital. The present challenge faces by researchers and practitioners is how the measurement of value creation of intellectual capital may justify the widening gap of the firm's book and market values. Various measurements namely Skandia navigator, balanced scorecard, market-to-book ratio, Pulic VAIC^{TM}, Ohlson valuation model and among others have been investigated by numerous researchers (Tan, et al., 2007; Ferraro and Veltri, 2011). However, researchers found that Ohlson (1995) valuation model relates to market-based, book value, earnings and 'other information' and more importantly, this model allows any modification to be adopted to the value relevance of intellectual capital rather than applying the simplified and limitations of VAIC^{TM} calculations or any other measurements (Swartz, et al., 2006; Wang, 2008; Yu and Zhang, 2008; Liu, et al., 2009; Ferraro and Veltri, 2011; Özer and Çam, 2016).

Moreover, with the introduction of value creation map (Marr, et al., 2004a) integrating both direct and indirect dependencies, empirical studies extend their research by integrating the value creation map as a moderating and cause-and-effect of the company's profits, accounting indicators and intellectual capital factors (Wang and Chang, 2005; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Scafarto, et al., 2016). Whilst these studies fail to evaluate the value creation of the business market return, Ferraro and Veltri (2011) did not evaluate

on any performance indicators as dependent variable but only rely on market value.

2.7.4.1 Direct Effects of Intellectual Capital Variables

Accounting Profitability Indicators. Contrary to the strength of structural capital, F-Jardón and Martos (2009) research failed to demonstrate that the results of human capital and relational capital are linked with profitability. Scafarto, et al. (2016) obtain mixed results: positive and significant results between process capital and three of the four performance indicators, except ATO and relational capital with all financial indicators; size with ATO, ROE and ROI; whereas human capital with ATO and innovation capital with all accounting measures and leverage with ROA and ROI have negative and significant results.

Market Price Indicator. Swartz, et al. (2006) results reveal human capital efficient, capital employed efficient, book value, dividends and abnormal earnings are all positive and significant with the market price of three months after the financial year-end, except structural capital coefficient was not significant. In contrast, all VAIC^{TM} results are positive and significant with the market prices of three months after the year-end. In contrast, Wang (2008) finds no strong relationship with human capital despite there was a strong link of employee productivity, customer capital produces a moderate effect and both process capital and innovation capital are robust in the market value of the U.S information technology and telecommunication services companies. Similarly, Yu and Zhang (2008) obtain a strong connection between human capital of employee productivity and the market value; but customer capital has mixed results: positive with advertising expenses and negative with sales; whilst innovation capital is negative in the regression analysis but not in the descriptive statistics. Following the studies of Swartz, et al. (2006), Ferraro and Veltri (2011) use the same concept in analysing the market price three months after its financial year-end. They obtain value relevance in BVPS and EPS, positive effect in relational capital and market value; negative outcomes in human capital and process capital; and no

effect in innovation capital. Similarly to Yu and Zhang (2008), Özer and Çam (2016) find the coefficients of net sales per employees and personnel expenses are positive and significant proving that their effects in the business' market return. The positive findings of the book value and abnormal earnings are consistent with Swartz, et al. (2006) and Ferraro and Veltri (2011) studies.

2.7.4.2 Human Capital Interaction with Other Intellectual Capital Factors

Accounting Profitability Indicators. Bontis, et al. (2000) find that both service and non-service industries are positive and significant with human capital and customer capital; in the non-service industry there is a positive moderating effect between human capital and structural capital, arguably not present in the other industry; and both industries have strong explanatory powers. In their findings, Cabrita and Bontis (2008) acknowledge that human capital influences bank performance with its moderating effect on both relational and structural capital, likewise, F-Jardón and Martos (2009) obtain similar results in the Argentinian wood manufacturing industry. The unique result found by Scafarto, et al. (2016) is that human capital has a moderating effect with innovation capital in three of the four performance indicators: ROE, ATO and ROI but unexpectedly, there is no interaction with relational capital or process capital.

Market Price Indicator. In Ferraro and Veltri (2011) study, human capital has only a positive interaction effect at 5% significant level with process capital and the market value, however there are no interrelation effects of human capital with relational capital and innovation capital.

2.8 Research Gap in Literature and Contribution

Having reviewed the current literature and to validate the direct and indirect effects of intellectual capital factors especially in the context of the Singaporean listed companies, static and dynamic panel data regressions analysis are applied to

control both observed and unobserved explanatory variables. The author has identified potential gaps in existing literature as follows:

Sampling. Limited study has been conducted on the drivers of intellectual capital factors specifically in Singapore: Tan, et al. (2007, 2008) investigate the intellectual capital and company's profitability in Singapore using Pulic VAIC™ model. With the limitation of Tan, et al. (2007, 2008) studies, no other research has been undertaken in Singapore to explore the effects on intellectual capital, value creation and firm performance. Singapore acknowledges the importance of intellectual capital and aims to become a knowledge-based and intellectual capital economy, where intangible assets of innovation, technology, know-how, intellectual property rights and human capital will overcome the traditional economy of production by creating value to businesses (Yue, 2004). Therefore, the author extends her research by analysing companies quoted in the Singapore Exchange (SGX) over a 10-years period from 2005 to 2014 of three sector-wise industries namely Manufacturing, Services and Other Business Activities (refers as 'OBA') and the overall listed companies (refers as 'All Companies').

Measurement. As there are unlimited measurements of intellectual capital, this study focus on Ohlson (1995) valuation model that identifies the 'other information' of the intellectual capital factors as being associated with the variation of book and market values. Furthermore, when Marr, et al. (2004a) introduces the value creation map, he requests further call for research on the investigation of the interrelationship of both direct and indirect dependencies of the intellectual capital, this research will pursue according to the accounting tools and approaches of the market price as value creation and the performance indicator as firm performance.

Dependent variables. By analysing the performance indicators of total assets; the current share price and one-year change in share price with three months after the company's financial year-end, this research adds further contribution to knowledge in the intellectual capital field by examining whether intellectual

capital, value creation and firm performance have an impact over time especially with one-year change of share prices from previous year to current year.

Independent variables. The direct effects of the intellectual capital factors and the interaction of human capital as a moderator factor with other intellectual capital components, book value per share and earnings per share are independent variables that have been identified to achieve the objectives of this study.

Control variables. Gearing and size. Gearing is used to identify how a company manages its debt based on its performance. The size of a company is applied to measure the impact of value creation resulting from monopoly power, economies of scale and bargaining power, if any.

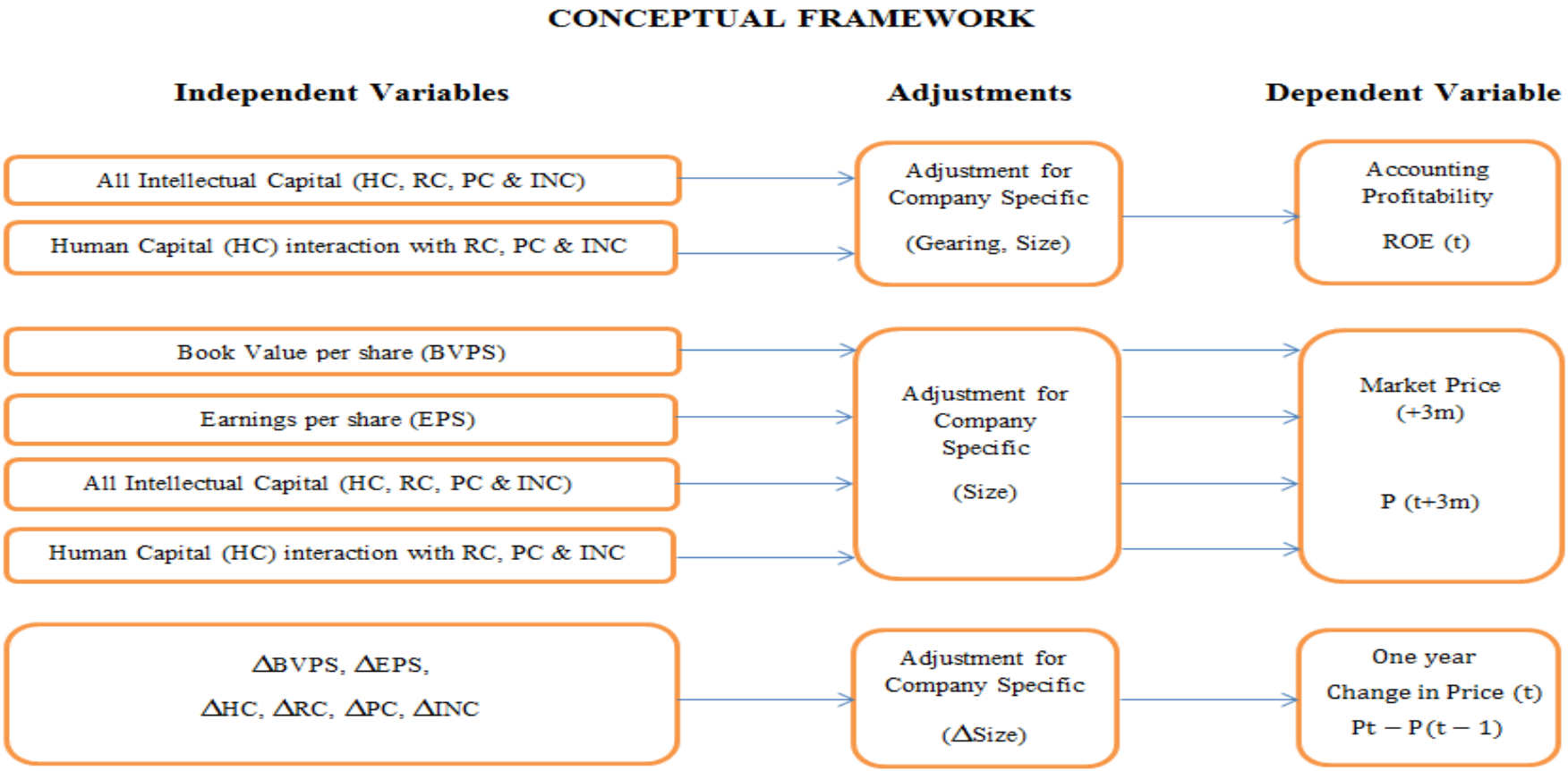
Strategic Management Approach. The contribution to literature, nevertheless, is an integrated research of both direct and indirect relationship of intellectual capital factors and strategic management approaches of the resource-based and knowledge-based views by examining with econometric analysis. As mentioned earlier, empirical researchers recognise that there is no literature covering the importance of resource and knowledge based view theories with a static approach (Martín-de-Castro, et al., 2013; Delgado-Verde, et al., 2016; Yaseen, et al., 2016), the research fills the gap in literature by investigating, testing and analysing how the intellectual capital factors perceived as important factors of a company's sustainable competitive advantage, value creation and performance with the performance indicators of book and market values with a static panel data regression analysis; and change in market value with a dynamic panel data regression approach through a proposed conceptual framework in the knowledge economy of the Singaporean listed companies.

Studies of the intellectual capital components and human capital have a direct and indirect relationship on other intellectual capital factors with firm performance at different performance indicators and value creation may reveal of great interest in the research academic field, investors, managers, other stakeholders and the

general public. Importantly, a suitable measurement is required to justify which factors may cause the book and market values of companies to differ. Further research in addressing gaps in the literature is required to quantify the interaction between human capital and other intellectual capital factors. *Appendix B* provides a summary list of key empirical studies in chronological order inspired by the author to fulfil her research.

In the next section, the Conceptual Framework presents how the research is undertaken showing the links of the dependent variables: ROE, market price and one year change in price; independent variables of the intellectual capital variables, book value per share, earnings per share and the interaction of human capital with other intellectual capital factors; and adjustment for company specific (or control variables) of gearing and size. The conceptual framework also outlines how the research questions will be answered with the hypotheses as stated in *Chapter 4*.

Figure 2.2: Conceptual Framework



(Source: Author)

2.9 Conceptual Framework For Research

Having identified the gap with the research problem and research questions in *Chapter 1, Figure 2.2* – the Conceptual Framework relates to various concepts and empirical studies primarily based on Ohlson (1995), Ferraro and Veltri (2011) and Scafarto, et al. (2016).

The conceptual framework investigates the linkage of intellectual capital and value creation; and analyses factors that drive accounting profitability, market price and one-year change in price. The conceptual framework model consists of the independent and interrelated components: intellectual capital variables, book value per share (BVPS), earnings per share (EPS) and human capital interaction with other intellectual capital factors which are interlinked with the dependent variables of accounting profitability (ROE_t), market price (P_{t+3m}) and one-year change in price ($P_t - P_{t-1}$); gearing and size are used to control the impact of the dependent variables in the panel data regression models. A summary of these concepts is explained below.

2.9.1 Dependent Variables

Three dependent variables are identified to answer the research questions as follows:

- Accounting Profitability representing book value and firm performance;
- Market Price representing market value and value creation; and
- One-Year Change in Price representing the change in market value and value creation with changes over time.

2.9.1.1 Accounting Profitability – Book Value

The first concept of the conceptual framework relates to *Equation 1* of *Hypothesis 1* to answer the first research question, as stated in *Chapter 4*. The dependent

variable measurement of accounting profitability (book value) constitutes of return on equity (ROE_t) represents the book value of firm performance. The traditional profitability measure of ROE is mainly considered as an important financial component for shareholders. It is well established and examined by previous empirical studies conducted by Firer and Williams (2003) and Chen, et al., (2005). ROE is a complex ratio calculation used in basic accounting measures, but has evolved with DuPont Model and econometric equation with regression analysis. However, the ratio of total assets adopted by Scafarto, et al. (2016) is perceived as a measurement of intangible-driven of value creation related to skilled workforce and good IT system; financial resources available for companies and investment engaged in the intellectual capital. This research, therefore, integrates the ratio of total assets in formulating the accounting profitability indicator with an econometric approach by using static panel data regression. This concept analyses how the intellectual capital components; human capital indirectly interacts with other intellectual capital factors; gearing and size have any effects on the accounting profitability indicator of ROE.

2.9.1.2 Market Price – Value Creation

Although intellectual capital may affect a business's book value, *Equation 2* of *Hypothesis 2* as indicated in *Chapter 4* was developed to answer the second research question and ascertain whether the variables of intellectual capital, human capital interaction with other intellectual capital factors, book value per share (BVPS), earnings per share (EPS) and size influence the business's market value. This concept relates to the maximisation of shareholders wealth as they expect managers to achieve goals and returns. Its movement is represented by a gain or loss of their wealth and is considered in the evaluation of capital markets. In relation to the capital market, Ohlson (1995) develops a valuation model as specified in *Section 2.3.3.1* – Ohlson Valuation Model, market price (P_{t+3m}) is the dependent variable of the market value and value creation represented by share price three months after the financial year of every companies. This model refers to prior research carried out by Ferraro and Veltri (2011) and incorporates a static

panel data regression equation in the measurement of market value and value creation.

2.9.1.3 One-Year Change in Price – Value Creation with Changes Over Time

The purpose of this final concept of the conceptual framework relates to *Equation 3* and *Hypothesis 3* as formulated and indicated in *Chapter 4*. The concept assumes whether the direct elements of intellectual capital, book value per share (BVPS), earnings per share (EPS) and size are reacting with the change of price over time. One-year change in price indicator represents a measurement of the value creation with change over time. This original concept is tested with the dynamic panel data regression model and its aim is to understand whether the intellectual capital factors explain the difference of the share prices from a cross-section perspective.

2.9.2 Independent Variables

Intellectual capital variables relate to the company's intangible assets: human capital, relational capital, process capital and innovation capital and their implications generate value and attain competitive advantages (Swartz, et al., 2006). The research objective is to investigate whether these hidden variables differentiate book and market values; and enhance value creation of the listed companies in Singapore. It has been criticised that the financial statements are no longer providing accurate figures when comparing the future performance and competitive capability; and intellectual capital is therefore a new concept of long-term sustainable profits (Wang, 2008). The research applies Ohlson (1995) '*v*' variable as proxy of intellectual capital (Swartz, et al., 2006; Wang, 2008; Ferraro and Veltri, 2011; Veltri and Silvestri, 2011) and is further applied in the measurement of accounting profitability, market price and one-year change in price indicators.

BVPS and EPS are additional independent variables that are investigated to measure both market value and value creation represented by market price; and change in market value is represented by one-year change in price. EPS refers as the revenue earned by a company after meeting cost of capital, interest, taxes and depreciation that are owned by investors (Bhatt and Sumangala, 2012).

Moreover, the conceptualisation of the framework is represented by the independent variable of human capital as a moderating effect or interaction with other intellectual capital factors: relational capital, process capital and innovation capital. Cabrita and Bontis (2008) emphasise that value creation exists through a nurtured and effective interaction of intellectual capital variables; the creativity of employees can indirectly influence the innovative products with an increase in the number of patents and may also build up a good reputation for the business which are translated into a better market valuation (F-Jardón and Martos, 2009). Additionally, Wang and Chang (2005) point out that there is unavailability of empirical studies to investigate the interrelationship between human capital and other factors of intellectual capital. Prior studies were conducted by Bontis, et al., 2000; Wang and Chang, 2005; Cabrita and Bontis, 2008; F-Jardón and Martos, 2009; Ferraro and Veltri, 2011; Scafarto, et al., 2016. Nevertheless to achieve the objective and contribution of this research, one-year change in price indicator is incorporated in addition to accounting profitability (ROE) and market price indicators.

Having established different concepts of the Conceptual Framework, the research methodology approach is used in conducting the research and is discussed in *Chapter 4*. Before conducting that, *Chapter 3* provides an overview of Singapore as a knowledge-based economy including its economy and the sector-wise performance of manufacturing and services industries.

Chapter 3: Singapore as a Knowledge-Based Economy

3.1 Introduction

Given its position in the centre of Asia, Singapore is one of the "*Four Asian Tiger*" countries with Hong Kong, South Korea and Taiwan, has attracted policy-makers and researchers around the world for its highly free-market, developed economy and outstanding economic performance over the last five decades (Anwar, et al., 2004 and Vu, 2011). It is also among the ten members of the Association of South-East Asia Nations (ASEAN) to maintain its integration and improve its co-operation in order to avoid any security threats or social destabilisation (Anonymous, 2015). Singapore is "*one of the first countries to take the route toward a knowledge-driven economy*" (The Information Technology Advisory Group, 1999 cited in Ofori, 2003, p.114).

3.2 Country Economy Overview

Singapore is known for its *economic and political stabilities* (Anwar, et al., 2004), well-positioned, fastest growing economies and safest country in the Asia Emerging markets although with its small and open economy (Zhou, 2016). The country has done remarkably well by recovering from several downturns (1) the mid-late 1970's with the oil price shocks; (2) the short recession in the developed countries in early 1980's; (3) the Asian financial crisis in 1997-1998 with a decline of 0.1% in GDP; (4) a decline of 2% in GDP in 1998 attributed to a lack of recovery in the Japanese economy and a slowdown in the U.S. stock market; (5) the dot.com burst in 2000; (6) the global financial crisis in 2007-2008; and (7) the global financial recession and economic turmoil in 2008-2012. It has also been exposed to competitive forces such as globalisation and negative impacts of liberalisation (Anwar, et al., 2004; Spence, 2009; MAS, 2015; and Yue and Das, 2015).

The success of its economic growth is mainly attributed to the government policies by providing an excellent infrastructure, political stability, productive labour and adoption of a commercial law (Anwar, et al., 2004). From 1999 to 2007, the *gross domestic product* (*GDP)* of Singapore grew on average 6.0% in ten years before the global recession. But in 2010, the economy recovered and grew by 15.2%. Since then, the economy growth has been on track and is sustainable. On average, its GDP grew 4.1% between 2011 and 2013 (Focus Economics, 2016a).

The aftermath of the global financial crisis and economic turmoil has caused high costs in housing, food prices, transportation and health care (Asia Economic Institute, 2008). The country had recorded a peak *inflation* rate at 5.7% in 2008. In 2015, it has the lowest inflation record over the last three decades; this was led by a fall in the global oil prices, low economic growth and poor rental in housing market (Teng, 2014; Min, 2016; Focus Economics, 2016b; Williams, 2016).

Unemployment peak rate was 3.3% in 2009, but the labour market force continues to strengthen by 1.3% in 2012 (Business Monitor International, 2013). *Singapore Dollar* (SGD) has a strong currency against the developed economies (Euro, Japanese Yen, Australian Dollar) and Asia countries (Korean Won, New Taiwan Dollar, Malaysian Ringgit) (MAS, 2012). Due to the global financial crisis and economic turmoil, Singapore has maintained the lowest *interest rate* of 0.25% for three consecutive years from 2011 to 2013 but started to increase slowly from 2014 and in 2015 the interest rate was 0.88% reaching its highest rate since 2008 (Focus Economics, 2016c).

The *Singapore Exchange* (SGX) was set up in 1973 with a combination of two countries: Malaysia and Singapore, but in the same year, they separated their entities (National Library Board Singapore, 2016). After the Australian Securities Exchange, SGX is the second stock exchange to be listed by private placement and public offering in the Asia Pacific region. It has its own bourse, which comprises of different components of benchmark indices: Straits Times Index

(STI) and MSCI Singapore Free Index (SGX, 2014). The STI main function is to track performance of the top 30 constituents having the highest market capitalisation in the Singapore Exchange (SGX) main board despite the SGX consists of 1,125 listed companies (SGX, 2015). The MSCI Singapore Index measures the returns of the mid and large-cap segments of the overall equity market covering 85% of the free float-adjusted market capitalisation with 28 constituents (listed companies) (MSCI Inc., 2016).

After the Asian financial crisis, in 1998 the Monetary Authority of Singapore (MAS) develops Singapore Government Securities (SGS) in an effort to build a strong liquidity SGS market in order to generate a strong *yield curve*. From1997 to 2011, the SGS market capitalisation grew from SGD 21.9 billion to SGD 138.5 billion, that is, six times more to ensure there is enough liquid and efficient government bond market (MAS, 2012). One of the reasons why the research is pursued in Singapore was for its good performance of the government yield curve and its strong economy. Graphical charts representing the country's economy over the years are referred in *Appendix C* – Singapore Economy: GDP in *Figure C-1*; inflation chart in *Figure C-2*; inflation data in *Figure C-3*; SGD performance against other currencies in *Figure C-4*; interest rate chart in *Figure C-5*; interest rate data in *Figure C-6;* and government yield curve in *Figure C-7*.

3.3 Singapore as a Knowledge-Based Economy in Innovation, Human Capital and Research & Development

Since 1959, the government of Singapore has dedicated itself to its population by delivering education, jobs, security, income, homes and welfare (Low, 2001). The country has encountered several economic developments over the years, moving from an entrepôt to a knowledge-based economy with a timeline of labour intensive growth from 1960 to 1969; skill intensive growth from 1970 to 1979; capital intensive growth from 1980 to 1989; technology intensive growth from 1990 to 1999; and knowledge and innovation economy based growth from 2000 onwards (Asian Development Bank, 2014). Due to the fast-growing globalisation

environment, knowledge-based economy, information technology and communication, the government has to meet challenges with growing affluence to reinvent itself economically, create new know-how and skills and convert from old economy production workers to new knowledge workers with intellectual capital (Low, 2001). They have also acquired foreign expertise and alliance to lead them towards innovation (Sidhu, et al., 2011).

Singapore aims to become a global economy hub (Ofori, 2003; Koh, 2006; OECD, 2013). As a country with no natural resources, Singapore has so far managed its human capital with great care; the business management is a crucial element to bring strength to the economy and competitive advantage (OECD, 2013). As part of its strategy, the government has liberalised their immigration policy from 2000 to 2011 and the non-residents workers rose from 745,500 to 1,394,400 giving rise from 18.7% to 26.9% of its overall population (Department of Statistics, 2011). They are encouraging businesses and foreign entrepreneurs to upgrade their technology and production procedures; and to invest heavily in developing human capital of local workers. Although in the past, the creativity of the foreign workers had greatly contributed to the growth and economic development of Singapore, the government is now tightening the entry for foreign workers (OECD, 2013).

Initially, the country has promoted foreign direct investment (FDI) to increase its economic growth, allowing them to participate in global trade, gaining access to high technology and making use to exploit good opportunities in domestic research and development (R&D) capabilities (Asian Development Bank, 2014). The government emphasises the importance of R&D by giving cash incentive to small and medium enterprises (SMEs) and helping them developing innovation skills, which will benefit towards a productivity-driven economic growth. In that respect, they also plan to build an R&D ecosystem consisting of corporate R&D laboratories, academic research institutes and public sector research bodies (OECD, 2013). As R&D also forms part of economic growth, intellectual property, investment, innovation and commercialisation activities, it has increased

and created values to large domestic businesses and multinational companies (MNCs) (Ramcharan, 2006; OECD, 2013). The Economic Development Board offers incentive to MNCs to relocate or build their R&D centres in Singapore, resulting to an increase of 85.7% of R&D expenditure from 2002 to 2010 (OECD, 2013). In 2010, the government objective was to help SMEs increasing their R&D capabilities and as part of their programme they introduce the Innovation Voucher Scheme (IVS) in partnership with the knowledge institutions to facilitate technology and knowhow to SMEs (OECD, 2013). It has also promoted ICT and high-tech industries and invested heavily in technical education to boost its workforce skills and talents that will lead to the country's strengths for a knowledge-based economy (Asian Development Bank, 2014).

In addition to the technology-related projects, the government has expanded the Innovation Voucher Scheme (IVS) into three more areas: human resource development, productivity and financial management (OECD, 2013). The Productivity and Innovation Credit gives tax credits not only to existing innovative companies but also to other innovated-related activities such as R&D activities, training and acquisition rights of intellectual property. The Technology Innovation Programme offers cash incentives to new and existing local businesses by subsidising projects such as new product development, new business processes and models. As an ongoing plan, the government with the collaboration of the industry "Productivity, Resilience and Innovation for Manpower Excellence" (PRIME), have facilitated holistic innovation solutions to encourage businesses building their innovation capabilities such as project consultancy, training schemes, industry conferences, among others (OECD, 2013).

As part of its knowledge-based economy strategy, the biomedical services cluster is the fourth pillar of the manufacturing industry consisting of biotechnology, pharmaceutical, medical device and healthcare service sectors was introduced by the National Science and Technology Board to increase technology and science capabilities (Ramcharan, 2006; Gwee, 2009; Asian Development Bank, 2014). Research engineers and scientists rose from 28.2% in 1990 to 87.9% in 2000 per

1,000 workers (Asian Development Bank, 2014). The country's competitive advantage is also to protect their creative, innovative and knowledge-intensive industries with intellectual property rights such as trademarks, patents, copyrights, and designs (Ramcharan, 2006). In 2018, it has been awarded as the 9th global intellectual property index for its innovation development on intellectual property rights (Lung, 2018).

Therefore, the key role of the Singapore's government in leading its country into a knowledge-based economy is to continuously increase investment in innovation and R&D capabilities; improve higher education systems and boost human capital by recognising the importance of competitiveness of knowledge incentive industries; introduce appropriate incentive, institutional and economic structures to attract investment in private sectors, telecom, information, communications and technology (Asian Development Bank, 2014).

3.4 Sector-Wise Performance

The economic performance of Singapore is mainly driven by its sector-wise performance of manufacturing and services industries known as the 'twin engines' of its economic growth (Ofori, 2003; Yue, 2004; Tan, 2005; Gwee, 2009; Asian Development Bank, 2014). *Figure C-8* of *Appendix C* shows how the share of GDP by each industry has performed from 2001 to 2015 (Department of Statistics Singapore, 2017). The main industries of manufacturing and services are detailed in the next section.

3.4.1 Manufacturing

According to Lee and Hung (2005), one of the key drivers and success of the Singapore economy is its manufacturing industry. The manufacturing industries comprise mainly of manufacturing systems, light industries, engineering systems, electronics, chemicals, biotechnology and aerospace. Manufacturing systems include communication equipment, computer peripherals, semiconductors, display

devices, industrial machinery and machine tools, precision engineering and systems. Light industries comprise of food and beverages, jewellery, furniture, textiles and apparel, printing and publishing. Engineering systems include metal fabrication, automotive components and marine industry (Anwar, et al., 2004; Lee and Hung, 2005). Between 2001 and 2007, the country's total GDP was above 25% as shown in *Figure C-8* of *Appendix C* – Share of GDP by industry (Department of Statistics Singapore, 2017). However, it started to decline from 2008 onwards due to many external factors such as the global financial crisis and oil prices (Department of Statistics Singapore, 2017).

3.4.2 Services

The services industry consists of wholesale & retail trade, information & communications, business services, transport & storage, accommodation & food services, community & personal services and recreation activities (Department of Statistics Singapore, 2015). Since the late 1980s the importance of the services industry increases steadily due to the industrialised economy representing two-third value added of its share of the total output in the economy (MAS, 1998). Remarkably the business services, finance and insurance within the services industry have achieved a steady growth in the GDP from 2001 to 2015 as indicated in *Figure C-8* of *Appendix C* (Department of Statistics Singapore, 2017). In 2014, the number of established services companies rose by 14.27% over the last five years making a total operating receipts of $2,873 billion in 2014 with 37.1% higher than in 2010 and a total operating expenditure incurred in 2014 was $2,807 billion representing an increase of 61.2% over the last 5 years, as shown in *Figure C-9 of Appendix C* – Services Sector from 2010 to 2015 representing the number of establishments, operating receipts and operating expenditure (Department of Statistics Singapore, 2015). An overview of the business services and financial services are also introduced below.

Its supporting sector is the key driver of the business services sector in the Singapore economy. In the last 25 years, the real GDP growth in this sector has

been relatively stable at around 12%. It also contributes actively to the knowledge-intensive that relies heavily on the professional expertise and knowledge. This sector remains resilience despite the turbulence years from 1997 to 2003 with the financial crisis, the IT bubble crisis, SARS epidemic affecting the Asia countries and the global financial crisis in 2007 (Leong, 2007). The share of GDP in the business services sector grew from 11.6% in 2001 to 15.6% in 2015 as indicated in *Figure C-8* – Share of GDP by industry and *Figure C-10* – Key Indicator of the Services Sector in 2015 indicates that the business services has 35% on the overall services industry (Department of Statistics Singapore, 2015; 2017).

During the global economic turmoil and financial recession crisis, its financial services sector performance was not affected, reflecting a very slow growth and relatively constant movement in the share of GDP from 11.4% in 2007, 11.3% in 2008, 11.6% in 2009 and a slight decline of 10.9% in 2010 as shown in *Figure C-8* – Share of GDP by industry (Department of Statistics Singapore, 2017).

3.5 Summary

Singapore, as an international financial centre, is known for its strong domestic economy, its currency stability; overlapping financial market time zones; its physical connectivity and favourable location both air and sea (Peebles and Wilson, 1996; MAS, 2010). Despite it lacks of natural resources, the transition from an industrial to a knowledge-based economy is to develop an innovation-based growth economy and encourage entrepreneurship, the strategy of the National Science and Technology Board is to strengthen its competitive forces into a global science and technology industry by attracting high value-added companies and to become a local R&D leader in the biotechnology, medical devices, pharmaceutical and healthcare services (Koh, 2006). Therefore, this research extends prior researcher investigation (Tan, et al., 2007) by using Singapore as a knowledge-based country and its sector-wise industries as a research setting and design.

Chapter 4: Research Methodology

4.1 Introduction

The research methodology chapter explains the methods adopted to address the research questions as outlined in *Chapter 1*. Its main focus is to explain the research methodology, which consists of the research: philosophy, paradigm, approach, strategy, design for the style chosen followed by the method of analysis and models used to answer the research questions related to intellectual capital, value creation and firm performance. A choice of variables and use of the operationalization of variables are described, followed by the sample data selection and where the sources of data come from. Finally, it addresses any ethical issues arise during the course of this study.

4.2 Problem Statement

Physical assets such as land, labour, capital and raw materials are traditionally known to be the valuable assets in finance and economics; and are the main determinants of firm profitability (Firer and Williams, 2003; Bose and Thomas, 2007; Yu, et al., 2010; Ahangar, 2011). Issues have been raised that conventional accounting and financial indicators measure physical and tangible assets but critically intangible assets were ignored (Wang, 2008; Yu, et al., 2010).

However, the tangible assets are no longer creating wealth for prosperous companies but technology and internet (Bontis, 2001). Knowledge, expertise, systems and innovation have changed the production pattern. The rapid changes in globalisation, knowledge economy, intellectual capital, technology innovation and intangible assets have radically changed the world's perceptions (Wang, 2008; Ahangar, 2011). Importantly, intellectual capital is considered as a dominant and great value asset of every business (Clarke, et al., 2011).

The business environment is changing very rapidly over the last decades. Knowledge is becoming the most strategic corporate assets that can differentiate any organisation from its competitive advantage (Marr and Spender, 2004). The growth of the knowledge-based economy is widening and providing inconsistency between book and market values (Pal and Soriya, 2012). Nevertheless, firms must identify knowledge assets / intellectual capital and how to measure them as there is no universal measurement accepted by researchers, scholars, management, practitioners and governed bodies. It is also criticised that the financial reporting standards is not flexible to recognise that intangible assets are important for capital investment where it reduces the differences of book and market values of a firm (Lev and Zarowin, 1999; Kim and Taylor, 2014).

Knowledge management is identified as a valuable element in the sustainability of competitive advantage, innovation and growth of intellectual capital in a firm performance. Managers are successful when they connect to the firm's knowledge management process. In a nutshell, its usage and implementation may result good outcomes in growth and acquisition of intellectual capital (Marr, 2008).

4.3 Research Philosophy

In every research, it is crucial to convey the characteristic of the research paradigm, issues of ontology (reality) and epistemology (knowledge) (Holden and Lynch, 2004). Some parameters such as beliefs, assumptions, perceptions, truth and reality can influence the direction from design to conclusion of a research, it is therefore essential to reduce any exposure and avoid any misunderstanding (Flowers, 2009).

Before carrying out any research, researchers have to question themselves: "*How to research?*" and "*What to research?*" and above all the researcher answers should focus on "*Why research?*" (Remenyi, et al., 1998 cited in Holden and Lynch, 2004, p.397). To answer the question "*How to research*" the researcher chooses one of the methodology approaches: qualitative (such as action research

or case study research) or quantitative (experimental research) or a combination of both. In order to choose "*What to research*" depends on the researcher's own interests and knowledge in the academic fields and how the researcher will contribute to knowledge. When reviewing the philosophical literature to find the original source of the research and choosing an appropriate research methodology "*how to research*", the researcher identifies "*Why research?*" is more important and look into something more detailed and deeper than practicalities (Holden and Lynch, 2004).

In this present study, the researcher major interests and inspirations are finance, economics, intellectual capital and knowledge economy. She decides to pursue her research in these particular areas to answer the question: "*What to research?*" As her interests lead to find why a gap exists between book and market values in the firm's financial statements, the question "*Why research?*" makes it clears that it is important to understand what constitute these differences. In order to get the answer of "*How to research?*" the researcher finds that by collecting quantitative with secondary data and analysing with descriptive statistics and panel data regressions, these results explain why such differences exist.

According to Holden and Lynch (2004), the research philosophy can be either subjective or objective approach to research, therefore leads to two significant approaches namely ontology and epistemology. These approaches are discussed in more detailed in the next section.

4.3.1 Ontological Perspective in the Knowledge Management

A research philosophy relies upon the development of knowledge and how the research will be conducted. According to Grix (2002), ontology is the starting point of all research follows logically by epistemology and methodology. Ontology explains subjectivism as a thought or an experience; and objectivism takes place in reality or independently exists. The ontological assumptions must be well defined, otherwise the researcher may miss out important aspects of

inquiry or phenomena that can lead to closed discussions or questions (Flowers, 2009). In a nutshell, ontology relates to the reality (Holden and Lynch, 2004) where the researcher may ask question such as: "*what is out there to know about*" (Grix, 2002, p.175). In the context of knowledge, Gruber (1993, p.199) refers ontology as "*an explicit specification of a conceptualization*". Jashapara (2011) identifies that ontology in knowledge is an overall conceptualisation, which are connected between different concepts or ideas. Examples are internet and corporate intranet – ontology has impact on individuals to manage information they receive on both sources. He suggests that the scope of ontology is to create a clear, coherent and consistent conceptualisation that is easy to reuse and is extensible.

Having identified the ontology in the context of knowledge, however, when finding what constitutes these realities, further explanation is requested on how these realities are assessed and what is the knowledge behind these realities. Therefore, these questions lead to epistemology (Flowers, 2009; Jashapara, 2011).

4.3.2 Epistemology Perspective in Intellectual Capital

According to Grix (2002), epistemology is a knowledge-gathering process that develops new theories or model rather than competing models and theories. The researcher relates to the existence of different views and it is important to ask questions: what, how and why these realities exist. In this research, the effectiveness of an organizational epistemological influencing people and value creation of companies are important. Intellectual capital resources consist of an organisation's competitive advantage and strategic logic in the rapid development of the knowledge economy (Marr, et al., 2003; Marr, 2005).

Marr (2004) recognise that knowledge creation is closely associated to the epistemological paradigm. It is important to choose a suitable and effective knowledge management approach. According to corporates and individuals opinions, it depends on the existing and combination of the epistemological

paradigm. Therefore, it is appropriate that the empirical data is collected via time-series, interviews, questionnaires or surveys before any future research of intellectual capital and knowledge management theories are carried out and enforced.

It is also believed that knowledge is created by the way it is managed, but it may lead to failure if it is poorly managed in the corporate epistemology. To ensure that there is an effective value creation in an organisation, there should be good interaction among staffs, resources and strategic logic, as they are related partly to knowledge management. Finally, knowledge development is dependent to any changes. It is important that managers as well as researchers recognise the importance of organizational epistemology and interpret any changes correctly (Marr, 2005). It is therefore crucial to choose a suitable research paradigm, which is discussed in the following section.

4.4 Research Paradigm: Positivist

The view of knowledge is originally driven by the daily use of information technology; a positive approach highlights the data creation through measurement, data capture and storage. Marr and Spender (2004) emphasise that the shift of interest from data to information has changed rapidly with globalisation and new era of knowledge.

In this research, the positivism approach in the knowledge economy is to find out how knowledge can be measured and managed especially with the use of intellectual capital components. The positivistic view of data gives an opportunity to economically value the historical stock of the knowledge-assets refers as intellectual capital and to record them as financial assets in the firm's financial statements (Marr and Spender, 2004). This study therefore uses the financial statements of the Singaporean listed companies to analyse the components of intellectual capital. Based on generalisation and observation (Saunders, et al.,

2000) and in the context of this research, the positivist paradigm is therefore appropriate.

4.5 Research Approach: Deductive

This research presents a deductive approach. The use behind the deductive reasoning is to develop a theory and hypothesis to design a research strategy by testing the hypothesis (Saunders, et al., 2000). The researcher knows a particular theoretical consideration, derives a hypothesis or a series of hypotheses in relation to a specific area of the research topic, and the hypotheses will be examined thoroughly. In addition, the deductive approach constitutes of developing a conceptual and theoretical structure before any testing is required through data collection (Gill and Johnson, 2010).

The deductive approach has several characteristics. In the finance and accounting research, the purpose of the research is to gather, forecast and control evidence of its environment. The research is "*the development and testing of new theories of 'how the world works' or refutation of widely used existing theories*" (Kinney, 1986, p.339). For example, the finance researcher is mainly concerned with firm characteristics whereby theory, hypothesis and facts are important characteristics. In general, the '*theory*' addresses a preliminary explanation of facts. Assuming that the theory is valid, the '*hypothesis*' predicts the facts that occur in a particular situation. '*Facts*' are observable events that made the hypothesis contributes to the credibility of the theory. But the researcher should not show that the hypothesis test results always comply with the theory but criticise and prove that the hypothesis may differ by adding credibility to the theory with alternative explanations from the observable facts (Kinney, 1986).

In this research, it is unclear why the market value of every business differs significantly from its book value. This leads to the researcher to ascertain which factors influence the firm's book and market values with the use of a deductive reasoning. The validity of the positivism and deductive research are set out to

assess an appropriateness of the development of the three hypotheses and are discussed later in this chapter.

4.6 Research Strategy: Quantitative Research

It is important to consider how the research objectives will be met when answering the research questions and the possibility to analyse the collected data. In this research, the quantitative research is applied, which involves in generating data in a quantitative form and is subdivided into experimental research, descriptive statistics and inferential statistics. Experimental research has greater control over the research environment, where the researcher is able to keep the variable constant while eliminating some of the variables. On the other hand, the descriptive statistics is well structured and understood as it is a group of statistical methods used to summarise, define or display quantitative data, examples are: mean, mode and median. Nevertheless, the inferential statistics makes predictions from observations and samples of data, examples are linear regressions, ANCOVA, logistic regression and correlation analysis (Collis and Hussey, 2009).

Reliability and validity are important to evaluate the measures of these concepts in the quantitative research process. The causality to the research findings has to be met (Saunders, et al., 2000; Bryman and Bell, 2007). Operationalisation is a process used to validate our findings. Further discussions on how to operationalize both intellectual capital components and accounting profitability variables are discussed later in this chapter. To sum up, the positivism approach uses the quantitative and experimental methods to test the deductive generalisations. It therefore concludes that the quantitative research is more likely associated with a deductive approach by testing the real facts and historical data.

4.7 Research Design: Styles Chosen

It is critical to develop a research design that is primarily generated from a theory to formulate and test the hypotheses, through data collection to find out if the

theory answers these attempts. To apply this design, the author conducts her research under a positivism paradigm in a deductive approach followed by a quantitative research. The validity of this research depends not only on the hypotheses, model and research questions but the research model is also very crucial. Research data is selected appropriately to test the hypotheses or model followed by a statistical analysis to validate the outcomes. Therefore, its validity is based mainly with an appropriateness of the measurement or verification with positive and negative outcomes (Coetsee, 2011).

The objectives of this research are identifying a set of existing theories and researches; finding a set of interrelated variables that link the specified relationships between intellectual capital in value creation and accounting profitability of a company; and analysing the variables with descriptive statistics and econometric equations of static and dynamic panel data regressions analysis with secondary data. Based on the Conceptual Framework outlined in *Chapter 2*, the researcher identifies the dependent variables as accounting profitability (ROE), share price (value creation) and one-year change in share price; the independent variables as intellectual capital factors and interrelationships of human capital with other intellectual capital factors. During the course of this chapter, it explains how the operationalisation of profitability and intellectual capital variables are calculated when selecting the choice of variables.

4.8 Research Questions and Hypotheses

As mentioned in *Chapter 1*, the purpose of this research is to examine and answer the research questions and the hypotheses are:

RQ1: To what extent can accounting profitability (and firm performance) be explained by intellectual capital variables in the Singaporean listed companies?

Hypothesis 1:

It is hypothesised that the variables of intellectual capital and the interaction of human capital with other intellectual capital components can explain accounting profitability as:

$$PERF_{i,t} = \beta_0 + \beta_1 HCTA_{i,t} + \beta_2 RELCTA_{i,t} + \beta_3 PRCTA_{i,t} + \beta_4 INCTA_{i,t} + \beta_5 GEAR_{i,t} + \beta_6 LNS_{i,t} + \beta_7 HCTA_{i,t} \times INCTA_{i,t} + \beta_8 HCTA_{i,t} \times PRCTA_{i,t} + \beta_9 HCTA_{i,t} \times RELCTA_{i,t} + \varepsilon_{i,t} \quad (1)$$

Exhibit 4.1: Definitions of the Variables in Equation 1

Variables	Definitions
$PERF_{i,t}$	Dependent variable of accounting profitability (book value) represented by total assets of firm *i* at time *t*
$HCTA_{i,t}$	Salaries & benefit expenses ÷ total assets of firm *i* at time *t*
$RELCTA_{i,t}$	Total revenue ÷ total assets of firm *i* at time *t*
$PRCTA_{i,t}$	Selling, general and administrative expenses ÷ total assets of firm *i* at time *t*
$INCTA_{i,t}$	Intangible assets and R&D ÷ total assets of firm *i* at time *t*
$GEAR_{i,t}$	Non current liabilities + short term borrowings ÷ total book equity (shareholders funds) of firm *i* at time *t*
$LNS_{i,t}$	Logarithm of total revenue of firm *i* at time *t*
$HCTA_{i,t}$ x $RELCTA_{i,t}$	Interaction between human capital and relational capital ÷ total assets of firm *i* at time *t*
$HCTA_{i,t}$ x $PRCTA_{i,t}$	Interaction between human capital and process capital ÷ total assets of firm *i* at time *t*
$HCTA_{i,t}$ x $INCTA_{i,t}$	Interaction between human capital and innovation capital ÷ total assets of firm *i* at time *t*
$\varepsilon_{i,t}$	Error term

(Source: Author)

RQ2: Can the concept of intellectual capital and its components explain value creation in the Singaporean listed companies?

It is hypothesised that the intellectual capital components and their interactions with human capital have an explanatory power in share price and change in share prices as:

Hypothesis 2:

$$P_{i,t+3} = \beta_0 + \beta_1 BVPS_{i,t} + \beta_2 EPS_{i,t} + \beta_3 HUMCAP_{i,t} + \beta_4 RELCAP_{i,t} + \beta_5 PROCAP_{i,t} + \beta_6 INNCAP_{i,t} + \beta_7 HUMCAP_{i,t} \text{ x } INNCAP_{i,t} + \beta_8 HUMCAP_{i,t} \text{ x } PROCAP_{i,t} + \beta_9 HUMCAP_{i,t} \text{ x } RELCAP_{i,t} + \beta_{10} LNS_{i,t} + \varepsilon_{i,t} \quad (2)$$

Exhibit 4.2: Definitions of the Variables in Equation 2

Variables	Definitions
$P_{i,t+3}$	Dependent variable of market value represented by market value represented by share price* of firm *i* at time *t*
$BVPS_{i,t}$	Book value per share (BVPS) of firm *i* at time *t*
$EPS_{i,t}$	Earnings per share (EPS) of firm *i* at time *t*
$HUMCAP_{i,t}$	Salaries & benefit expenses ÷ number of shares of firm *i* at time *t*
$RELCAP_{i,t}$	Total revenue ÷ number of shares of firm *i* at time *t*
$PROCAP_{i,t}$	Selling, general and administrative expenses ÷ number of shares of firm *i* at time *t*
$INNCAP_{i,t}$	Intangible assets and R&D ÷ number of shares of firm *i* at time *t*
$HUMCAP_{i,t}$ x $INNCAP_{i,t}$	Interaction of human capital and innovation capital of firm *i* at time *t*
$HUMCAP_{i,t}$ x $PROCAP_{i,t}$	Interaction of human capital and process capital of firm *i* at time *t*
$HUMCAP_{i,t}$ x $RELCAP_{i,t}$	Interaction of human capital and relational capital of firm *i* at time *t*
$LNS_{i,t}$	Logarithm of total revenue of firm *i* at time *t*
$\varepsilon_{i,t}$	Error term

(Source: Author)

* The share price three months after the firm's financial year-end allow stabilisation of the share price and are based on information available in the market after the financial year-end.

Hypothesis 3:

It is hypothesised that changes in share price can be explained by changes in the earnings per share, book value per share and changes in the components of intellectual capital.

$$DPT_{i,t+3} = \beta_0 + \beta_1 DPT\_3_{i,t-1} + \beta_2 DPT\_3_{i,t-2} + \beta_3 DEPS_{i,t} + \beta_4 DBVPS_{i,t} + \beta_5 DHUMCAP_{i,t} + \beta_6 DRELCAP_{i,t} + \beta_7 DRPOCAP_{i,t} + \beta_8 DINNCAP_{i,t} + \beta_9 DLNS_{i,t} + n_{i,t} \quad (3)$$

Exhibit 4.3: Definitions of the Variables in Equation 3

Variables	Definitions
$DPT_{i,t+3}$	Dependent variable of one-year change in price three months after the financial year-end of firm *i* at time *t*+3
$DPT\_3_{i,t-1}$ $DPT\_3_{i,t-2}$	Change in share price 3 months of the financial year-end of firm *i* at lags *(t-1) and (t-2)**
$DEPS_{i,t}$	Change in earnings per share (EPS) of *i* company at time *t*
$DBVPS_{i,t}$	Change in book value per share (BVPS) of *i* company at time *t*
$DHUMCAP_{i,t}$	Change in salaries & benefit expenses ÷ change in price of *i* company at time *t*
$DRELCAP_{i,t}$	Change in total revenue ÷ change in price of *i* company at time *t*
$DRPOCAP_{i,t}$	Change in selling, general and administrative expenses ÷ change in price of *i* company at time *t*
$DINNCAP_{i,t}$	Change in intangible assets and R&D ÷ change in price of *i* company at time *t*
$DLNS_{i,t}$	Change in logarithm of total revenue *i* company at time *t*
n_i	Control for all cross-sectional (between companies) variation in intellectual capital

(Source: Author)

* The lags *(t-1) and (t-2)* of the dependent variable *DPT* represent the valid instrument to overcome any observed endogeneity issues.

RQ3: Can an integrated model linking firm performance, intellectual capital and value creation be validated?

Having tested the validity of the hypotheses with the econometric equations above and assessing the extent and impact of intellectual capital components on value creation and firm performance in Singaporean listed companies, an attempt will be made to develop an empirically validated framework.

Note: 'Validity' is an important element to check the evaluation of the variables and to examine to what extent the intellectual capital or accounting concepts are measured accurately in this quantitative research (Hardy and Bryman, 2009; Heale and Twycross, 2015). It also allows identifying whether the variables determine and address the research questions with the appropriate models of the panel data regression (Gordon and Porter, 2009).

The identification of the choice of variables is followed by the operationalization of the variables are carried out in the following sections.

4.8.1 Choice of Variables

The drivers of intellectual capital are identified through analysis and a model linking profitability and value creation is developed and tested with the use of secondary data of the Singaporean companies quoted on its stock market for a ten-year period from 2005 to 2014. In this present study, the dependent variables are ROE on profitability and market value on value creation are applied using three important performance indicators: total assets (book value), share price (market value) and one-year change in share price. Furthermore, the independent variables of the intellectual capital drivers are namely human capital, relational capital, process capital, innovation capital, the interaction of human capital with other intellectual capital factors, book value per share, earnings per share; and the adjustment for company specific also known as control variables are gearing and

size. The use of the operationalization for both intellectual capital and accounting profitability variables are further discussed in the following section.

4.8.2 Operationalisation of Variables: Accounting Profitability and Intellectual Capital

According to Holden and Lynch (2004), an operationalised concept is required in order to allow facts to be measured in a quantitative analysis. As the concepts are normally abstract and cannot be observed easily, the relationship between the theory concepts cannot be tested empirically until all abstractions are converted into observable, or indicators which are tested and measured in the phenomenon of interest and can be operationalized (Gill and Johnson, 2010).

Exhibit 4.4 summaries the Operationalisation of Accounting Variables supported by empirical studies to analyse the effects of firm performance in Singapore.

Exhibit 4.4: Operationalisation of Accounting Variables

Accounting Variables	Measurement
Return on Equity	Profit After Tax ÷ Total Book Equity (Shareholders Funds)
Gearing	Non-Current Liabilities + Short term Borrowings ÷ Total Book Equity (Shareholders Funds)
Size	Logarithm of Total Revenue

(Source: Author)

A number of intellectual capital measurements with different proxies of intellectual capital variables have been applied by many empirical researchers, however, the author has been inspired as previously supported by prior studies (Van Buren, 1999a; Pulic, 2004; Swartz, et al., 2006; Yu and Zhang, 2008; Ferraro and Veltri, 2011). *Exhibit 4.5* provides a summary of the Operationalisation of Intellectual Capital variables that is implemented when

analysing how these components can explain value creation of companies quoted in the Singapore Exchange (SGX).

Exhibit 4.5: Operationalisation of Intellectual Capital Variables

IC Components	Proxy Variables	Supported by previous researchers
Human Capital	Salaries and benefit expenses ÷ No. of shares	Van Buren (1999a); Pulic (2004); Swartz, et al. (2006)
Relational Capital	Sales ÷ No. of shares	Van Buren (1999a); Yu and Zhang (2008)
Process Capital	Selling, General & Administrative expenses ÷ No. of shares	Van Buren (1999a); Yu and Zhang (2008)
Innovation Capital	Intangible assets ÷ No. of shares	Yu and Zhang (2008)

(Source: Ferraro and Veltri, 2011, p.10)

In addition to Ferraro and Veltri (2011) empirical study, an additional important element of total assets, as an accounting profitability indicator by replacing number of shares, has been established to operationalize and calculate the proxies of intellectual capital variables (Scafarto, et al., 2016). The total assets refer as the company's financial resources, hence reflecting their engagement in intellectual capital and knowledge investments (Lev, et al., 2009; Scafarto, et al., 2016). These elements help to validate this research in more detailed, critical analysis and findings as discussed in *Chapter 5*.

4.9 Population and Sample Selection

The population of the current study is publicly listed companies in the Singapore Exchange ('SGX'). Singapore is a highly developed market, knowledge-based economy and well known as one of the 'Four Asian Tigers'. After London, New York and Tokyo, Singapore Exchange 'SGX' is the fourth largest foreign exchange and the country is currently the fourth leading financial centre in the world (Wikipedia, 2013). Intellectual capital relates to brand name, intangible

assets, intellectual property rights and reputation, it is reasonable to assume that companies quoted in the Singapore Exchange (SGX) are best representatives of this research. The SGX constitutes of 780 listed companies in 2010, 798 in 2011, 808 in 2012, 831 in 2013 and 1,125 in 2014. After retrieving the five-years list of companies, two criteria are important for the selection of companies. Firstly, they should be consistently quoted from 2005 to 2014 in the Singapore Exchange and secondly, their main business activities should not be 100% in investment and holdings. As a result of these two criteria, the researcher limits her study, however did not restrict the criteria on companies that do not have the same accounting principle, that is, the same accounting year-end. Unfortunately, not all companies have R&D expenses but this factor was not restricted in the completion of this study.

The final sample consists of 90 companies quoted in the Singapore Exchange over a time of study of 10-years span from 2005 and 2014. The Singaporean listed companies have been categorised into three groups namely: Manufacturing, Services and Other Business Activities. Despite Other Business Activities consists of different nature of business other than Manufacturing and Services industries, the rationale to apply this sampling is to find its usefulness and results across the entire market of Singapore without leaving out any companies. The overall companies refer as 'All Companies' include the three industries. *Appendix D* – Singaporean-Listed Companies by sector wise gives a detailed list of business activities of all ninety listed companies. The analysis of data is mainly on secondary data sources and the research study focus on the elements of the financial statements of these listed companies. The following section describes where the sources of data are collected.

4.10 Sources of Data

The data sources comprise mainly annual reports and share prices collected from each company website, Yahoo Finance SG, Singapore Exchange, British Library, City Library and various Singapore Government websites. The key academic

journals such as Journal of Intellectual Capital, Journal of Knowledge Management, Measuring Business Excellence, Contemporary Accounting Research among others have been retrieved from Cardiff Metropolitan University Library, British Library, City Library, LSE Library and Google Scholar. For any missing annual report or other data sources, the researcher has contacted the relevant company and the Singapore government bodies directly. In the next section, the reasons why the panel data regression is chosen as a method of analysis are discussed.

4.11 Methods of Analysis: Panel Data Regression

A panel data regression is chosen to analyse change over time (Hardy and Bryman, 2009). In order to test the validation of the three hypotheses for this research, the use of two panel data regression models is applied: static panel data (SPD) regression to measure both accounting profitability and share price indicators; and dynamic panel data (DPD) regression to measure one-year change in share price indicator. All variables will be tested for stationarity before actual estimation by applying the "Levin, Lin and Chu panel unit root test" (Levin, et al., 2002).

This current study analyses how the firm performance improves over a period of time and how the intellectual capital components changes between panel dates. As stated earlier, the sample is drawn from 90 companies quoted in Singapore Exchange over a ten-year period from 2005 to 2014. With the static panel data (SPD) regression analysis, the balanced panel data comprises of 370 balanced observations in the Manufacturing industry, 330 balanced observations in the Services industry, 200 balanced observations in Other Business Activities with a total of 900 balanced observations in All Companies for total assets and share price indicators. In contrast, the dynamic panel data (DPD) regression analysis consists of 222 balanced observations in the Manufacturing industry, 198 balanced observations in the Services industry, 120 balanced observations in

Other Business Activities and 540 balanced observations in All Companies, for one-year change in share price indicator.

4.11.1 Static Panel Data (SPD) Regression

In a static panel data regression model, unobserved explanatory variables are dealt through uses of pooled ordinary least square (POLS), fixed-effects (FEM) and random-effects (REM) estimator models (Hardy and Bryman, 2009; Ahn, et al., 2013). Fixed-effects model assumes that the intercept of every firm does not change over time despite this differ from the intercept of other firms. As a result, the intercept explains every firm's or individual's intercept is "time-invariant" (Gujarati, 2011, p.283) and "*the (slope) coefficients of the regressors do not vary across individuals or over time*" (Gujarati, 2003, p.642). However, the random-effects model is more suitable when the intercept (random) of "*each cross-sectional unit is uncorrelated with the regressors*" takes into consideration the "*time-invariant regressors*" whereas the "*variables are collinear with the subject-specific intercept*" in the fixed-effects model (Gujarati, 2011 p.293).

The research objective is to identify the implications of intellectual capital factors with different financial performance indicators where total assets as accounting profitability indicator represent the book value and share price indicator represents the market value. Both indicators are regressed against the drivers of intellectual capital using static panel data regression of fixed or random effects models, however at the initial stage of this research the pooled ordinary least square (POLS) did not produce any strong results and has therefore been eliminated.

In order to validate which of the two models and equations present the most favourable results, the Hausman test (1978) is applied. Bearing in mind that if *p*-value of the estimated chi-square statistics is too low, the Hausman test will strongly reject the random-effects model. It may be perceived that if the *p*-value is less than 5% the null hypothesis is rejected and the alternative hypothesis is accepted, there are significant results to conclude that the robustness of the fixed-

effects model analysis gives better results and is more appropriate than the random-effects model. However, if *p*-value is more than 5%, the null hypothesis cannot be rejected, but rather the null hypothesis is accepted, it may be determined that the random-effects model is more suitable (Gujarati, 2011).

However issues occur when the estimators are applied, the serial correlation, endogeneity and heteroskedasticity of some independent variables are being ignored in the static panel data. Arellano and Bond (1991) have developed the dynamic panel data of generalised method of moments (GMM) to address any econometric issues (Faustino and Leitão, 2007) and this model is therefore applied to test the third hypothesis and equation in this research.

4.11.2 Dynamic Panel Data (DPD) Regression

The rationale for applying panel data is to understand the dynamic model of adjustment and the nature associated with any economic relationships, if any (Baltagi, 2014). In the dynamic panel data regression model, the generalised method of moments (GMM) (1991) removes any unobserved industry-specific results. Empirical studies have applied this model to analyse the firm performance (Goddard, et al., 2005; Nunes, et al., 2009) and intellectual capital (Sardo, et al., 2018); but no study has yet applied the dynamic panel data regression model with the dependent variable of one-year change in share price (DPT); the independent variables of drivers of intellectual capital, book value per share (BVPS), earnings per share (EPS); and the control variable of size.

The third hypothesis is an interpreted model of the drivers of the intellectual capital in the short-run variation that cannot be explained after time-invariant of each sector-wise industry and the effects of company unit have been added to the intellectual capital model. In a nutshell, the equation examines the residual variation of intellectual capital that is difficult to explain in a variance decomposition analysis and harmonious to the business's competitive advantage particularly reported in the strategic management literature of both resource and

knowledge based view models.

To test the validity of this equation, when *N* is greater than *T*, Arellano and Bond (AB) (1991) approach is used. However, when *T* is large and *N* is small, Anderson-Hsiao (AH) dynamic panel data (DPD) method is appropriate. As *N* is greater than *T* in our sample, the most appropriate DPD estimator approach to be considered is Arellano and Bond (AB). For an estimation to be accepted, Sargan test requires that the validity of the over-identifying restrictions imposed by the lagged dependent variable. This test has a null hypothesis of some external causes, which are identified by *p*-value. The higher the *p*-value of Sargan's result the greater it is (Mileva, 2007).

In addition with the Sargan test, two tests AR (1) and AR (2) are required to test the Arellano and Bond estimator (Mileva, 2007). AR (1) is the first-order autoregressive process, usually rejects the null hypothesis whereas AR (2) of the second-order autoregressive process is more crucial as it detects autocorrelation at all levels (Mileva, 2007; Baltagi, 2009). The empirical findings or the model estimation for using these models must satisfy two important criteria: Sargan Test and AR (2) reference (Goddard, et al., 2005). In our research, one-year change in share price equation is estimated with two lags of the dependent variable with GMM DPD Arellano Bond estimators suitable for large *N*, small *T* at two lags and tested with Sargan's J statistic (which tests for over-identifying restrictions in a statistical model) and for serial correlation at two lags. For the model to be accepted, Sargan's J statistic must be > 0.05 and the serial correlation statistic should also be validated. For the equation to be extracted, both *p*-values of Sargan statistic and AR (2) statistic of F value must be more than 0.05 (Arellano and Bond, 1991; Mileva, 2007).

Based on the Conceptual Framework, it is important to discuss in the next chapter how to analyse the findings on the determinants and linkages between the variables of firm performance (book value) and value creation (market value) of the quoted companies in the Singapore Exchange with total assets as accounting profitability (ROE), share price and one-year change in share price indicators on

the drivers of intellectual capital are validated with the panel data regression approaches.

4.12 Ethical Approval

The research is based mainly with theoretical models and data collected from secondary sources, such as financial statements and share prices of the Singaporean listed companies. No use of primary data such as interviews, questionnaires and surveys has been conducted and as such no ethical approval is required from Cardiff Metropolitan University.

Chapter 5: Analysis and Findings

5.1 Introduction

In the analysis and findings chapter, data will be analysed to ascertain whether accounting profitability, share price and one-year change in share price indicators can be determined by intellectual capital factors and whether an integrated model of the three performance indicators can be empirically validated. The dataset comprises of 90 quoted companies in the Singapore Exchange for which data is available for the full consecutive 10 years from 2005 to 2014. The data is sub-classified under three main sectors namely manufacturing, services and other business activities and all the three sectors are integrated by an overall classification of 'All Companies'. The rationale for the sub-classification is that every intellectual capital components may differ from each industry and their role is crucial to determine their importance in the knowledge economy.

In view of producing an extensive analysis on the effects of intellectual capital, the stationarity of variables are firstly presented; then followed by descriptive statistics, panel data regression analysis, findings of the drivers of intellectual capital and interaction of human capital with other intellectual capital factors with accounting profitability as total assets indicator for firm performance, share price indicator for value creation and one-year change in share price indicator representing the determinants of value creation / market return for each industry.

5.2 Stationarity of Variables

Variables in a regression model are required to be stationary or else the results will not be reliable. Therefore, potential variables for a model have to be tested for stationarity before estimation. As the method involved for this model is panel data analysis, an appropriate panel unit root test (which is a test for stationarity) has to be applied. The test of Levin, Lin and Chu (2002) is considered adequate for this

purpose and was applied. The existence of a common unit root was rejected with 95% probability, implying stationarity of the data is used for analysis.

- ROE
- GEAR
- LNS
- RELCAP
- PROCAP
- HUMCAP
- INNCAP
- SPRET
- Pt+3
- EPS
- BVPS

The above variables are presented in *Appendix E* – Panel Unit Root Test Summary. The tests indicate that all the variables are stationary with > 95% confidence in *Exhibit E-1* – Results of the Levin, Lin and Chu Panel Unit Root Test on the existence of a common unit root.

5.3 Descriptive Statistics

Based on this research, the descriptive statistics presents the dependent variables as accounting performance, share price and one-year change in price, and the independent variables of the drivers of intellectual capital components.

Exhibit 5.1 presents the statistics of the means, standard deviation, minimum and maximum values for all dependent and independent variables gathered for the purpose of this research with the sub-sector wise: Manufacturing, Services and Other Business Activities and the main category: All Companies of the Singaporean listed companies. The format of the descriptive statistics was used based from existing empirical researchers: Nunes, et al. (2009) and Scafarto, et al. (2016).

Exhibit 5.1: Descriptive Statistics of Intellectual Capital Components with Accounting Performance

Variables	Observations	Mean	Std Dev	Minimum	Maximum
HCTA					
* Manufacturing	369	0.23351	0.20768	0.03135	1.03989
* Services	333	**0.26215**	0.32100	0.01159	2.99072
* Other Business Activities	199	0.18093	**0.84837**	**0.00174**	**11.84794**
* All Companies	898	0.22954	0.45467	**0.00174**	**11.84794**
RELCTA					
* Manufacturing	369	1.85591	2.03179	0.02822	21.65308
* Services	333	**1.87331**	2.13058	**0.02579**	10.62200
* Other Business Activities	199	1.82397	**3.82978**	0.03407	**28.37721**
* All Companies	898	1.85334	2.55128	0.02822	**28.37721**
PRCTA					
* Manufacturing	369	0.14931	0.12821	**0.00232**	0.58984
* Services	333	0.14752	0.36106	0.00337	2.16843
* Other Business Activities	199	**0.18997**	**0.67802**	0.00304	**8.91055**
* All Companies	898	0.15807	0.39210	0.00259	**8.91055**
INCTA					
* Manufacturing	369	0.04843	0.10171	0.00084	0.52515
* Services	333	**0.08668**	**0.18823**	0.00029	**1.46137**
* Other Business Activities	199	0.04054	0.11497	**0.00001**	0.80837
* All Companies	898	0.05909	0.13593	**0.00001**	**1.46137**
ROE					
* Manufacturing	369	**0.40796**	**1.79416**	0.00043	10.84346
* Services	333	0.32647	1.42866	0.01005	**13.96018**
* Other Business Activities	199	0.01972	0.38856	0.00185	2.00572
* All Companies	898	0.27991	1.38009	**0.00024**	**13.96018**
GEAR					
* Manufacturing	369	0.35909	0.44609	0.00508	2.23623
* Services	333	**0.97151**	**3.44534**	0.00049	**38.59292**
* Other Business Activities	199	0.41306	0.73075	0.00499	6.70362
* All Companies	898	0.55596	1.74620	**0.00011**	**38.59292**
LNS					
* Manufacturing	369	12.50540	2.40747	3.13549	23.72290
* Services	333	**13.19718**	**2.73873**	2.58680	**25.61800**
* Other Business Activities	199	12.37667	2.40034	**0.49279**	23.25596
* All Companies	898	12.73696	2.49940	**0.49279**	**25.61800**

(Source: Author)

From *Exhibit 5.1* – Descriptive Statistics of Intellectual Capital Components with Accounting Performance, the HCTA ranges from a minimum value of 0.00174 to a maximum value of 11.84794 in both Other Business Activities and All Companies; but Other Business Activities has the highest standard deviation of 0.84837 and the Services industry has the highest aggregate mean of 0.26215 out of maximum score of 1.000.

As for the volume of RELCTA, the highest mean aggregate of the Services industry is 1.87331, ranging from 1.85591 for Manufacturing industry, 1.85334 for All Companies and 1.82397 for Other Business Activities but the latter has the highest standard deviation of 3.82978. The RELCTA ranges from a minimum value of 0.02579 in the Services industry to a maximum value of 28.37721 in both Other Business Activities and All Companies.

Both the mean and standard deviation of Other Business Activities are higher than other sectors of the Singaporean listed companies for PRCTA with 0.18997 and 0.67802 respectively, however the results differ with a minimum range of 0.00232 in the Manufacturing industry and a maximum range of 8.91055 in Other Business Activities and All Companies.

INCTA has a highest mean of 0.08668 and standard deviation of 0.18823 in the Services industry. But the minimum value is 0.00001 for Other Business Activities and All Companies implying there is less innovation capital investment in these sectors of the Singaporean listed companies and a maximum value of 1.46137 in the Services industry and All Companies. Overall, the Services industry presents a better variation especially in innovation capital than the rest of the industries.

The ROE ranges from a minimum of 0.00024 in All Companies to a maximum of 13.96018 for both Services industry and All Companies and the Manufacturing industry has a highest aggregate mean of 0.40796 out of maximum score of 1.000 and a high standard deviation of 1.79416. This indicates that the shareholders are

getting higher return on equity in the Manufacturing industry than the rest of the industries.

GEAR has a higher mean of 0.97151 and standard deviation of 3.44534 in the Services industry and range from a minimum range of 0.00011 in All Companies to a maximum range of 38.59292 in the Services industry and All Companies, the results indicates that the Services industry presents a better variation than the rest of the industries.

Finally, the descriptive statistics result of accounting profitability variable for LNS has a higher mean with 13.19718 and a standard deviation of 2.73873 in the Services industry and the range varies from 0.49279 in Other Business Activities and All Companies to 25.61800 in the Services industry and All Companies. The results show that the size of the Services industry has performed better than other industries.

To summarise, the overall results indicate that the Services industry has the strongest mean in HCTA, RELCTA, INCTA, GEAR and LNS except in PRCTA and ROE. Other Business Activities have the greatest standard deviation in HCTA, RELCTA and PRCTA but the means and standard deviations of ROE are high in the Manufacturing industry; and INCTA and GEAR are high in the Services industry. The maximum ranges of All Companies are better in all intellectual capital factors.

The descriptive statistics of the drivers of intellectual capital with share price, EPS and BVPS are presented in *Exhibit 5.2*.

Exhibit 5.2: Descriptive Statistics of Intellectual Capital Components with Share Price

Variables	Observations	Mean	Std Dev	Minimum	Maximum
HUMCn					
* Manufacturing	369	0.19144	0.31677	0.00040	2.35953
* Services	333	**0.25445**	**0.42252**	**0.00011**	**2.44737**
* Other Business Activities	199	0.08407	0.17055	0.00017	0.88770
* All Companies	898	0.18804	0.33465	**0.00011**	**2.44737**
RELCn					
* Manufacturing	369	**2.27737**	**5.28315**	**0.00001**	**39.59097**
* Services	333	2.22862	4.06952	0.00077	25.34260
* Other Business Activities	199	0.78036	0.96573	0.00052	4.59061
* All Companies	898	1.89950	4.18906	**0.00001**	**39.59097**
PROCn					
* Manufacturing	369	**0.14819**	**0.44828**	0.00046	**3.95578**
* Services	333	0.11913	0.38176	0.00103	2.85897
* Other Business Activities	199	0.07469	0.11869	**0.00001**	0.57490
* All Companies	898	0.11785	0.36312	0.00011	**3.95578**
INNCn					
* Manufacturing	369	**0.13044**	**0.48257**	0.00009	**3.11392**
* Services	333	0.08620	0.19377	0.00004	1.12009
* Other Business Activities	199	0.03251	0.08932	**0.00001**	0.52359
* All Companies	898	0.09121	0.33379	**0.00001**	**3.11392**
EPS					
* Manufacturing	369	0.06385	0.28178	0.00047	1.10373
* Services	333	**0.15307**	0.25489	0.00013	**1.80126**
* Other Business Activities	199	0.14726	**0.28904**	0.00011	1.19520
* All Companies	898	0.11343	0.27130	**0.00005**	**1.80126**
BVPS					
* Manufacturing	369	0.96608	1.69463	0.00472	**13.17411**
* Services	333	1.17886	2.27232	**0.00045**	**13.17411**
* Other Business Activities	199	**1.78889**	**3.00580**	0.00067	12.82170
* All Companies	898	1.21199	2.24109	**0.00045**	**13.17411**

(Source: Author)

From *Exhibit 5.2* – Descriptive Statistics of Intellectual Capital Components with Share Price, the overall results of RELCn, PROCn and INNCn are all consistent, indicating that the Manufacturing industry has high mean, standard deviation, and maximum range. But except for HUMCn where the Services industry has a better average score in mean, standard deviation, minimum and maximum ranges. The minimum ranges also differ in PROCn for Other Business Activities; and INNCn for Other Business Activities and All Companies.

As for the volume of EPS, the highest mean aggregate in the Services is 0.15307, the minimum range from 0.00005 in All Companies to 1.80126 in both All Companies and Services industry but the standard deviation of 0.28904 is high in the Other Business Activities. For BVPS, both mean of 1.78889 and standard deviation of 3.00580 in Other Business Activities are higher than other industries and it ranges from a minimum range of 0.00045 in the Services industry and All Companies to a maximum range of 13.17411 in all industries with the exception of Other Business Activities.

It may conclude that in general, the Manufacturing industry contributes and brings value creation in intellectual capital especially in three factors: relational capital, process capital and innovation capital. The results have effectively reflected the greater variance, central tendency and spread in the data indicating that the Manufacturing industry is considerably more robust. However, the skills and knowledge of staffs of human capital are more related in the Services industry especially when Singapore is known for their high-class financial centre and business hub.

The descriptive statistics of share price (P), share price three-months forward (PT+3), change in share return (SPRET), change in share return three-months (SPRET) forward is presented in *Exhibit 5.3*.

Exhibit 5.3: Descriptive Statistics of One-Year Change in Share Price

Variables	Observations	Mean	Std Dev	Minimum	Maximum
P					
* Manufacturing	369	0.84726	1.85642	0.00236	13.80000
* Services	333	**1.88077**	**2.96391**	**0.00100**	**16.60000**
* Other Business Activities	199	1.33489	2.27772	0.00313	10.63000
* All Companies	898	1.31777	2.39912	**0.00100**	**16.60000**
PT+3					
* Manufacturing	369	0.88894	1.90532	0.00236	14.60000
* Services	333	**1.92563**	**3.08985**	**0.00100**	**18.80000**
* Other Business Activities	199	1.53055	2.77787	0.01000	14.60000
* All Companies	898	1.39228	2.56892	0.00236	**18.80000**
SPRET					
* Manufacturing	369	0.04536	0.58386	**0.00052**	2.46661
* Services	333	**0.14856**	0.65004	0.00172	**3.80348**
* Other Business Activities	199	0.09710	**0.69059**	0.00499	3.28091
* All Companies	898	0.09145	0.61891	0.00172	**3.80348**
SPRET3					
* Manufacturing	369	0.00893	0.56026	0.00660	2.16165
* Services	333	**0.06094**	0.53593	0.00455	**3.91202**
* Other Business Activities	199	0.02546	**0.58980**	**0.00166**	3.00403
* All Companies	898	0.01921	0.54269	0.00810	**3.91202**

(Source: Author)

From *Exhibit 5.3* – Descriptive Statistics of One-Year Change in Share Price, the mean, standard deviation, minimum and maximum ranges are also important in the change in price (P) and change in price in three-months forward (PT+3) in the Services industry. In addition, the Services industry has the highest mean and maximum range in both share return (SPRET) and change in share return in three-months forward (SPRET3). Overall, the Services industry has the highest mean, implying that it has the most central tendency amongst all the variables as data and information lie in this particular industry.

However, the share return (SPRET) and changes in the share return three-months forward (SPRET3) are better for Other Business Activities with a high standard deviation and a lower minimum range in changes in the share return three-months forward (SPRET3). Adversely, share return has only a minimum range effect in

the Manufacturing industry but no other significant results as opposed to the descriptive statistics of intellectual capital components with share prices.

The following data comprises of three market segments of the Singaporean listed companies: Manufacturing, Services, Other Business Activities industries and all the three industries are consolidated within All Companies. In order to get a good understanding of what is exactly happening in each sector, first of all Manufacturing industry will be completely analysed to find out the implication on the three performance indicators: ROE, share price and one-year change in share price, followed by Services industry, then Other Business Activities and finally the three sectors will be integrated and represented by All Companies. Their workings have been compiled and shown *Appendices H (1), H (2) and H (3).*

5.4 Estimation of Model for Manufacturing Industry

The model estimated for the Manufacturing industry is analysed in three performance indicators namely accounting profitability (ROE), share price and one-year change in share price.

5.4.1 Book Value of the Drivers Intellectual Capital with Accounting Performance Indicator in the Manufacturing Industry

To establish whether the components intellectual capital and accounting profitability have a relationship, the panel data approach of fixed-effects and random-effects models are applied. If *p*-value is < 5%, the Hausman test would imply the random-effects model is rejected and the fixed-effects model of the alternative hypothesis is more appropriate. The panel data regression workings on the drivers of intellectual capital components with ROE of the Manufacturing industry are presented in *Appendix F (1)* where the Hausman test is restated and indicates that *p*-value is < 5% as shown below:

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	36.864002	9	0.0000

Exhibit 5.4: Estimation of Fixed-Effects Model for Manufacturing Industry with ROE as Accounting Profitability Indicator

	Manufacturing Industry	
	Coefficient	***p*-value**
Intercept	-0.0690	0.8972
HCTA	-1.3787***	0.0000
RELCTA	-0.0726*	0.0866
PRCTA	0.2129	0.8174
INCTA	-0.4801	0.6934
GEAR	**0.1831***	0.0815
LNS	0.0544	0.2169
HCTA*INCTA	1.0293	0.8280
HCTA*PRCTA	-1.9576	0.3938
HCTA*RELCTA	**0.4883*****	0.0058
R^2	**0.8983*****	0.0000
F-Statistic	**63.6099*****	0.0000
Hausman Test	X^2 (9) 36.8640***	
No. of firms	37	
Observations	370	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in the Manufacturing industry as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (1)*.

For the estimation of the model for the Manufacturing industry with ROE as accounting profitability indicator as in *Exhibit 5.4*, the sample size is 37 firms and 370 observations. In accordance with the fixed-effects estimation model, the

results for the relationship between firm performance and drivers of intellectual capital of the Manufacturing sector are:

The model is valid (*p*-value of F-statistic < 0.01), with a good explanatory power (R^2 = 0.8983).

(1) There is no statistical relationship between the intercept and ROE;
(2) There is a negative and highly significant relationship between human capital and ROE;
(3) There is a negative and weakly significant relationship between relational capital and ROE;
(4) There is no statistical relationship between process capital and ROE;
(5) There is no statistical relationship between innovation capital and ROE;
(6) There is a positive and weakly significant relationship between gearing and ROE;
(7) There is no statistical relationship between size and ROE;
(8) There is no statistical relationship between the interaction of human capital and innovation capital with ROE;
(9) There is no statistical relationship between the interaction of human capital and process capital with ROE;
(10) There is a positive and highly significant relationship between the interaction of human capital and relational capital with ROE.

In summary, the estimation shows that the profits of Manufacturing companies are not affected by the level of revenue but are impacted on negatively by human capital and relational capital and positively by gearing and the interaction of human capital and relational capital.

5.4.2 Value Relevance of the Drivers of Intellectual Capital with Share Price Indicator in the Manufacturing Industry

Again, the Hausman Test presents that the fixed-effects model is better than the random-effects model as *p*-value is < 5%, which estimates the value relevance of intellectual capital of the share price indicator for the Manufacturing industry. The panel data regression workings on the drivers of intellectual capital components with share price of the Manufacturing industry are presented in *Appendix F (2)* where the result of the Hausman test is restated below:

Correlated Random Effects - Hausman Test
Equation: PRICE3RANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	221.542851	10	0.0000

Exhibit 5.5: Estimation of Fixed-Effects Model for Manufacturing Industry with Share Price as Market Value Indicator

	Manufacturing Industry	
	Coefficient	***p*-value**
Intercept	**1.1370****	0.0468
BVPS	**0.2358***	0.0632
EPS	-0.1683	0.3637
HUMCAP	1.1678	0.1550
RELCAP	-0.0297	0.2641
PROCAP	**1.4412*****	0.0000
INNCAP	**1.4038****	0.0150
HUMCAP*INNCAP	-2.5700***	0.0000
HUMCAP*PROCAP	-2.3341***	0.0000
HUMCAP*RELCAP	**0.1591*****	0.0047
LNS	-0.0626	0.1874
R^2	**0.9170*****	0.0000
F-Statistic	**77.6241*****	0.0000
Hausman Test	X^2 (10) 221.5429***	
No. of firms	37	
Observations	370	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in the Manufacturing industry as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (2)*.

In *Exhibit 5.5*, the estimation model for the Manufacturing industry with share price as market value indicator comprises of a dataset of 37 companies and 370 observations. The fixed-effects model results for the relationship between share price and drivers of intellectual capital of the Manufacturing sector are:

The model is valid (*p*-value of F-statistic < 0.01), with a good explanatory power (R^2 = 0.9170).

(1) There is a positive and significant relationship between intercept and share price;
(2) There is a positive and weakly significant relationship between the book value per share and share price;
(3) There is no statistical relationship between earnings per share and share price;
(4) There is no statistical relationship between human capital and share price;
(5) There is no statistical relationship between relational capital and share price;
(6) There is a positive and highly significant relationship between process capital and share price;
(7) There is a positive and significant relationship between innovation capital and share price;
(8) There is a negative and highly significant relationship between the interaction of human capital and innovation capital with share price;
(9) There is a negative and highly significant relationship between the interaction of human capital and process capital with share price;
(10) There is a positive and highly significant between the interaction of human capital and relational capital with share price;
(11) There is no statistical relationship between size and share price.

Overall, the estimation demonstrates that the share prices of the Manufacturing industry are influenced by value creation, impacted on positively by intercept, book value per share, process capital, innovation capital and the interaction of human capital and relational capital, however, negatively by the interactions of human capital with both innovation capital and process capital.

5.4.3 One-Year Change in Share Price on Drivers of Intellectual Capital for the Manufacturing Industry

Sargan test requires the validity of over-identifying restrictions are distributed under null hypothesis (Arellano and Bond, 1991). To ensure that the estimation is valid and accepted, *p*-value should be greater than 5%. However, Sargan test accepts the null hypothesis in the estimation of the Manufacturing industry, as the *p*-value of 0.1740 is more than 5%. AR (2) tests the validity of the null of zero second-order serial correlation as stated in Arellano and Bond (1991) studies. For the equation to be extracted, both *p*-value and coefficient should be more than 5% to be accepted. In *Exhibit 5.6 and Appendix F (3)*, the estimation of the Manufacturing industry has presented an outcome of *p*-value of more than 5% to validate the second-order serial correlation.

Exhibit 5.6: Estimation of Generalised Method of Moments (GMM) Model for Manufacturing Industry with One-Year Change in Share Price Indicator

	Manufacturing Industry	
	Coefficient	***p*-value**
DPT_3 (-1)	-0.3522***	0.0000
DPT_3 (-2)	-0.4489***	0.0000
DEPS	-0.0903***	0.0000
DBVPS	**0.6889*** **	0.0000
DHUMCAP	-0.8337***	0.0014
DRELCAP	0.0547	0.1520
DPROCAP	0.2005	0.4120
DINNCAP	-1.8952***	0.0000
DLNS	-0.9237***	0.0000
Sargan *p* value of J-Statistic	23.4479	0.1740
AR (2) Stat (F-Value)	0.1061	0.7452
No. of firms	37	
Total panel (balanced) observations	222	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Based on Dynamic Panel Data Regression (DPD).

To estimate one-year change in share price on the drivers of intellectual capital, the dynamic panel estimator was applied and includes 37 Manufacturing companies and 222 panel (balanced) observations. The results of the dynamic panel estimators of the Manufacturing sector in *Exhibit 5.6* are:

(1) There are negative and highly significant relationships in both estimated coefficients on DPT_3 (-1) and DPT_3 (-2) with one-year change in share price;

(2) There is a negative and highly significant relationship between change in earnings per share and one-year change in share price;

(3) There is a positive and highly significant relationship between change in book value per share and one-year change in share price;

(4) There is a negative and highly significant relationship between change in human capital and one-year change in share price;

(5) There is no statistical relationship between change in relational capital and one-year change in share price;

(6) There is no statistical relationship between change in process capital and one-year change in share price;

(7) There is a negative and highly significant relationship between change in innovation capital and one-year change in share price;

(8) There is a negative and highly significant relationship between change in size and one-year change in share price.

In summary, the dynamic panel data estimation shows that one-year change in share price of the Manufacturing companies are negatively influenced by value creation especially in delta prices (-1) and (-2), change in earnings per share, change in human capital, change in innovation capital and change in size; however positively by change in book value per share.

Exhibit 5.7: Summary of Empirical Relationships of ROE, Share Price and Delta Price of the Manufacturing Industry

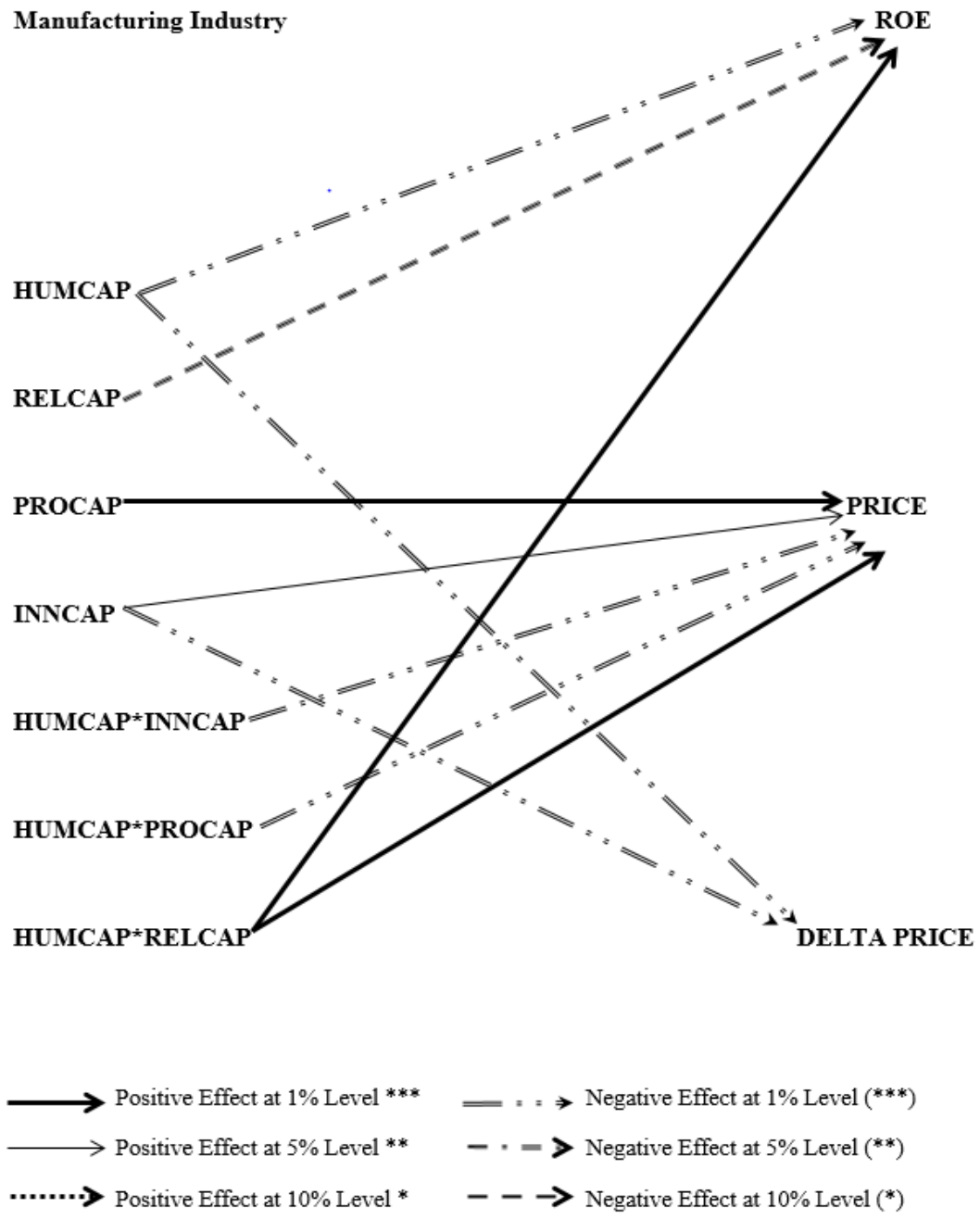
Manufacturing Industry	ROE	Share Price	Delta Price
HC	-ve (1%)	-	-ve (1%)
RC	-ve (10%)	-	-
PC	-	**+ve 1%**	-
InnC	-	+ve 5%	-ve (1%)
HC x InnC	-	-ve (1%)	
HC x PC	-	-ve (1%)	
HC x RC	**+ve 1%**	**+ve 1%**	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

From *Exhibit 5.7* and *Figure 5.1*, there is a clear inference that intellectual capital variables have good explanatory powers for value added in the Manufacturing industry whether with ROE, share price or delta price. Human capital has negative impacts with both ROE and delta price. Relational capital has also a negative effect with ROE while process capital and innovation capital have positive outcomes with share price but the latter has a negative impact with delta price. The interactions of human capital with both innovation capital and process capital are negative with share price. Finally, both ROE and share price indicators have positive relationships with the interaction of human capital and relational capital.

Figure 5.1: Integrated model of Manufacturing industry analytical test for the performance indicators of ROE, Price and Delta Price



(Source: Author)

5.5 Estimation of Model for Services Industry

In the following section, an estimation of model for Services Industry is carried out for the three performance indicators of ROE accounting profitability, share price and one-year change in share price.

5.5.1 Book Value on the Drivers of Intellectual Capital in the Services Industry with Accounting Performance

Following the estimation of the Hausman test, the result proves that the null hypothesis of the random-effects model cannot be accepted but rejected, as *p*-value is less than 5% the alternative hypothesis of the fixed-effects model is being accepted in the Services industry as restated from *Appendix F (1)*:

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	30.347037	9	0.0004

Exhibit 5.8: Estimation of Fixed-Effects Model for Services Industry with ROE as Accounting Profitability Indicator

	Services Industry	
	Coefficient	***p*-value**
Intercept	0.1986	0.8285
HCTA	**1.4463***	0.0784
RELCTA	0.0298	0.6157
PRCTA	-3.1502***	0.0000
INCTA	1.3821	0.1516
GEAR	**0.3334*****	0.0000
LNS	-0.0140	0.8372
HCTA*INCTA	-8.3695***	0.0121
HCTA*PRCTA	**3.6157*****	0.0013
HCTA*RELCTA	-0.2075*	0.0722
R^2	**0.6191*****	0.0004
F-Statistic	**11.4159*****	0.0000
Hausman Test	X^2 (9) 30.3470***	
No. of firms	33	
Observations	330	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in the Services industry as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (1)*.

In *Exhibit 5.8*, the estimation model for the Services industry with ROE as accounting profitability indicator comprises of a dataset of 33 companies and 330 observations. The fixed-effects model results for the Services sector are:

The model is valid (*p*-value of F-Statistic < 0.01), with a good explanatory power (R^2 = 0.6191).

(1) There is no statistical relationship between the intercept and ROE;

(2) There is a positive and weakly significant relationship between human capital and ROE;

(3) There is no statistical relationship between relational capital and ROE;
(4) There is a negative and highly statistical relationship between process capital and ROE;
(5) There is no statistical relationship between innovation capital and ROE;
(6) There is a positive and highly significant relationship between gearing and ROE;
(7) There is no statistical relationship between size and ROE;
(8) There is a negative and highly relationship between the interaction of human capital and innovation capital with ROE;
(9) There is a positive and highly significant relationship between the interaction of human capital and process capital with ROE;
(10) There is a negative and weakly significant relationship between the interaction of human capital and relational capital with ROE.

In summary, the estimation results indicate that the profits of Services companies are not affected by the level of revenue but are impacted on negatively by process capital, the interactions of human capital with innovation capital and relational capital, however, positively by human capital, gearing and the interaction of human capital and process capital.

5.5.2 Value Relevance of the Drivers of Intellectual Capital with Share Price indicator in the Services Industry

From the estimation of the Hausman Test, *p*-value is less than 5% the null hypothesis of the random-effects model is therefore rejected and the underlying results of the fixed-effects model is again more appropriate to analyse the value relevance of the drivers of intellectual capital in the Services industry as indicated below and restated in *Appendix F (2)*.

Correlated Random Effects - Hausman Test
Equation: PT_3SRANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	70.324262	10	0.0000

Exhibit 5.9: Estimation of Fixed-Effects Model for Services Industry with Share Price as Market Value Indicator

	Services Industry	
	Coefficient	***p*-value**
Intercept	**2.3000****	0.0130
BVPS	-0.0424	0.7776
EPS	**2.0293*****	0.0000
HUMCAP	-0.4085	0.7188
RELCAP	-0.0001	0.9984
PROCAP	1.8145	0.3597
INNCAP	0.4169	0.4623
HUMCAP*INNCAP	-1.9114*	0.0847
HUMCAP*PROCAP	**2.6004***	0.0553
HUMCAP*RELCAP	0.0170	0.7990
LNS	-0.0731	0.2926
R^2	**0.9453*****	0.0000
F-Statistic	**118.0929*****	0.0000
Hausman Test	X^2 (10) 70.3243***	
No. of firms	33	
Observations	330	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in the Services industry as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (2)*.

In *Exhibit 5.9* of the estimation of model with share price as market value indicator, the dataset comprises of 33 Services companies and 330 observations. The fixed-effects model results for the Services sector are:

The model is valid (*p*-value of F-Statistic < 0.01), with a good explanatory power (R^2 = 0.9453).

(1) There is a positive and significant relationship between the intercept and share price;
(2) There is no statistical relationship between book value per share and share price;
(3) There is a positive and highly significant relationship between earnings per share and share price;
(4) There is no statistical relationship between human capital and share price;
(5) There is no statistical relationship between relational capital and share price;
(6) There is no statistical relationship between process capital and share price;
(7) There is no statistical relationship between innovation capital and share price;
(8) There is a negative and weakly significant relationship between the interaction of human capital and innovation capital with share price;
(9) There is a positive and weakly significant relationship between the interaction of human capital and process capital with share price;
(10) There is no statistical relationship between the interaction of human capital and relational capital with share price;
(11) There is no statistical relationship between size and share price.

Overall, the estimation indicates that the share prices of Services companies are influenced by value creation, impacted on positively by intercept, earnings per share and the interaction of human capital and process capital, but negatively by the interaction of human capital and innovation capital.

5.5.3 One-Year Change in Share Price on Drivers of Intellectual Capital for the Services Industry

To validate the over-identifying restrictions (Arellano and Bond, 1991), the Sargan test result also accepts the null hypothesis for the Services industry estimator, as *p*-value of 0.3480 is more than 5%. In addition, to validate the null of zero second-order serial correlation of AR (2) of Arellano and Bond (1991) study, *p*-value should be more than 0.05. The Services industry result of 0.2176 therefore satisfies the criteria of the second-order serial correlation as indicated in *Exhibit 5.10* and restated in *Appendix F (3)*.

Exhibit 5.10: Estimation of Generalised Method of Moments (GMM) Model for Services Industry with One-Year Change in Share Price Indicator

	Services Industry	
	Coefficient	***p*-value**
DPT_3 (-1)	-0.2043***	0.0000
DPT_3 (-2)	-0.0926***	0.0022
DEPS	**1.8675*** **	0.0000
DBVPS	**0.7143*** **	0.0000
DHUMCAP	-9.7140***	0.0000
DRELCAP	**0.2960***	0.0537
DPROCAP	**12.9842*** **	0.0000
DINNCAP	-2.4820***	0.0002
DLNS	-1.8686***	0.0000
Sargan *p* value of J-Statistic	19.7347	0.3480
AR (2) Stat (F-Value)	1.5351	0.2176
No. of firms	33	
Total panel (balanced) observations	198	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Based on Dynamic Panel Data Regression (DPD).

To estimate one-year change in share price on the drivers of intellectual capital, the dynamic panel estimator was applied in a sample of 33 companies and 198 panel (balanced) observations of the Services industry in Singapore. In *Exhibit 5.10*, the results of the dynamic panel estimators of the Services sector are:

(1) There are negative and highly significant relationships in both estimated coefficients on DPT_3 (-1) and DPT_3 (-2) with one-year change in share price;
(2) There is a positive and highly significant relationship between change in earnings per share and one-year change in share price;
(3) There is a positive and highly significant relationship between change in book value per share and one-year change in share price;
(4) There is a negative and highly significant relationship between change in human capital and one-year change in share price;
(5) There is a positive and weakly significant relationship between change in relational capital and one-year change in share price;
(6) There is a positive and highly significant relationship between change in process capital and one-year change in share price;
(7) There is a negative and highly significant relationship between change in innovation capital and one-year change in share price;
(8) There is a negative and highly significant relationship between change in size and one-year change in share price.

In summary, the dynamic panel data estimation shows that one-year change in share price of Services companies are value relevance but are impacted on negatively by delta prices (-1) and (-2), change in human capital, change in innovation capital and change in size, however positively by change in earnings per share, change in book value per share, change in relational capital and change in process capital.

Exhibit 5.11: Summary of Empirical Relationships of ROE, Share Price and Delta Price of the Services Industry

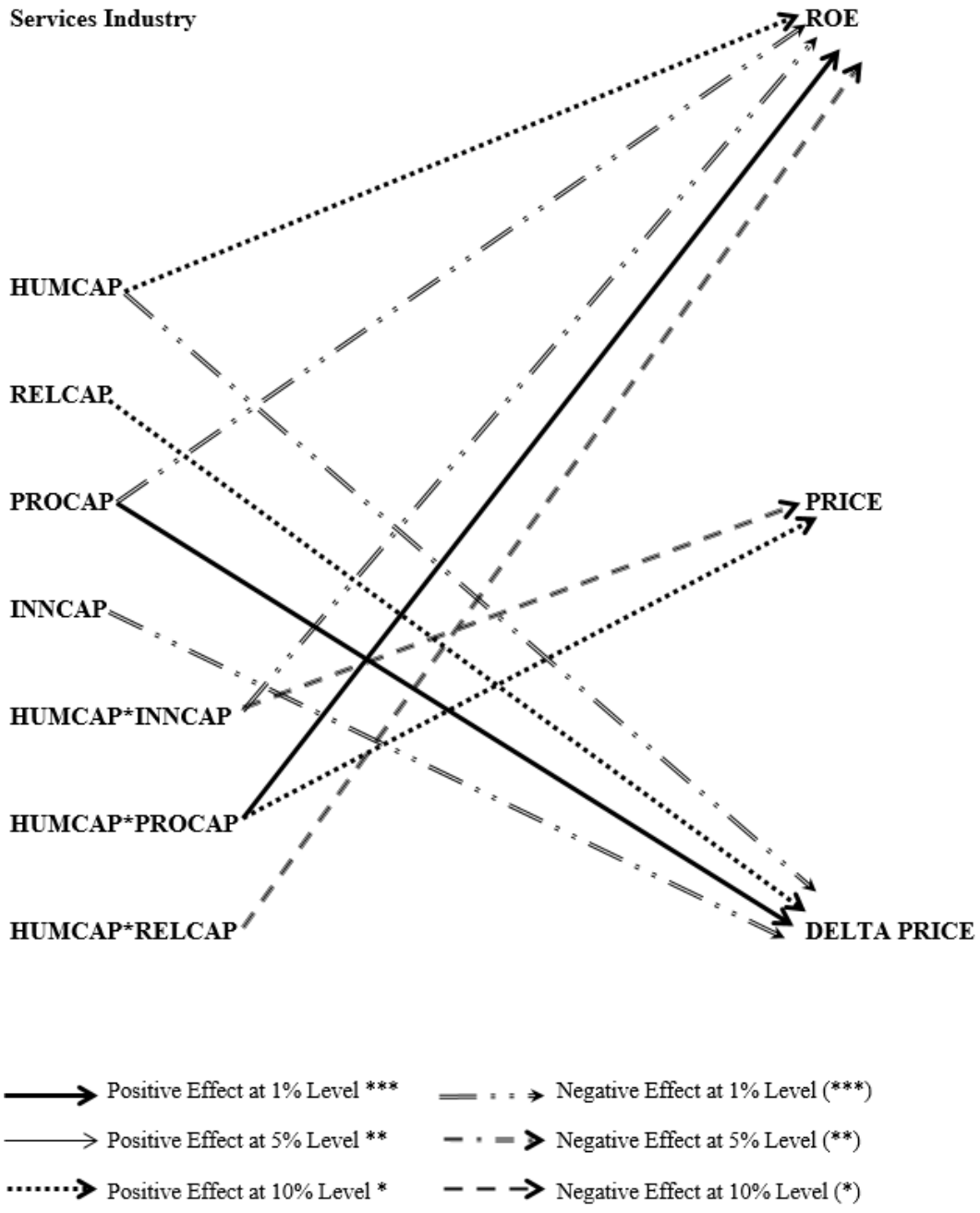
Services Industry	ROE	Share Price	Delta Price
HC	+ve 10%	-	-ve (1%)
RC	-	-	+ve 10%
PC	-ve (1%)	-	**+ve 1%**
InnC	-	-	-ve (1%)
HC x InnC	-ve (1%)	-ve (10%)	
HC x PC	**+ve 1%**	+ve 10%	
HC x RC	-ve (10%)	-	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

From *Exhibit 5.11* and *Figure 5.2*, there is an inference that intellectual capital components have strong explanatory powers for value creation in the Services industry with ROE and delta price but weakly with share price. Human capital is positive with ROE however negative with delta price. Relational capital has only a positive effect with delta price. Process capital has a negative effect with ROE but a positive impact with delta price. Innovation capital has only a negative impact with delta price. The interaction of human capital and innovation capital has negative outcomes with ROE and share price. The interaction of human capital and process capital has positive results with ROE and share price. Finally, the interaction of human capital and relational capital has a negative effect with ROE.

Figure 5.2: Integrated model of Services industry analytical test for the performance indicators of ROE, Price and Delta Price



(Source: Author)

5.6 Estimation of Model for Other Business Activities

The estimation of model for Other Business Activities is also analysed in three performance indicators namely accounting profitability (ROE), share price and one-year change in share price.

5.6.1 Book Value of the Drivers Intellectual Capital with Accounting Performance Indicator in Other Business Activities

Again, the Hausman test has been applied to evaluate the results of the book value of intellectual capital with the accounting profitability indicator for Other Business Activities performance. The result implies that if *p*-value is < 5%, the fixed-effects model of the alternative hypothesis is more appropriate than the random-effects model of the null hypothesis. The random-effects model is therefore rejected. The panel data regression workings on the drivers of intellectual capital components with ROE of Other Business Activities are shown in *Appendix F (1)* where the Hausman test is restated and indicates that *p*-value is < 5% as indicated below:

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	75.808520	9	0.0000

Exhibit 5.12: Estimation of Fixed-Effects Model for Other Business Activities with ROE as Accounting Profitability Indicator

	Other Business Activities	
	Coefficient	***p*-value**
Intercept	-0.0386	0.8434
HCTA	-1.6121***	0.0001
RELCTA	**0.1020*** **	0.0000
PRCTA	-0.1761	0.1478
INCTA	**1.8967*** **	0.0000
GEAR	**0.2880*** **	0.0000
LNS	-0.0027	0.8567
HCTA*INCTA	-4.0815	0.1890
HCTA*PRCTA	**0.5730*** **	0.0000
HCTA*RELCTA	-0.1384***	0.0000
R^2	**0.6964*** **	0.0000
F-Statistic	**14.0115*** **	0.0000
Hausman Test	X^2 (9) 75.8085***	
No. of firms	20	
Observations	200	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in Other Business Activities as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (1)*.

In *Exhibit 5.12*, a dataset of 20 companies for Other Business Activities and 200 observations were analysed. In accordance with the fixed-effects estimation model, the results for the relationship between firm performance and drivers of intellectual capital for Other Business Activities are:

The model is valid (*p*-value of F-Statistic < 0.01), with a good explanatory power (R^2 = 0.6964).

(1) There is no statistical relationship between the intercept and ROE;

(2) There is a negative and highly significant relationship between human capital and ROE;

(3) There is a positive and highly significant relationship between relational capital and ROE;
(4) There is no statistical relationship between process capital and ROE;
(5) There is a positive and highly significant relationship between innovation capital and ROE;
(6) There is a positive and highly significant relationship between gearing and ROE;
(7) There is no statistical relationship between size and ROE;
(8) There is no statistical relationship between the interaction of human capital and innovation capital with ROE;
(9) There is a positive and highly significant relationship between the interaction of human capital and process capital with ROE;
(10) There is a negative and highly significant relationship between the interaction of human capital and relational capital with ROE.

Overall, the estimation shows that the profits of Other Business Activities companies are not affected by the level of revenue but are impacted on negatively by human capital and the interaction of human capital and relational capital, however positively by relational capital, innovation capital, gearing and the interaction of human capital and process capital.

5.6.2 Value Relevance of the Drivers of Intellectual Capital with Share Price indicator in Other Business Activities

To assess the value relevance of the drivers of intellectual capital and share price with the panel data approach, the Hausman test was used to evaluate if a correlation or non-correlation exists between the dependent and independent variables. From the Hausman test result below, as the *p*-value is less than 5% the null hypothesis of the random-effects model is rejected and the alternative hypothesis of the fixed-effects model is accepted. The result below is also restated in *Appendix F (2)*.

Correlated Random Effects - Hausman Test
Equation: PRICE3ORANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	27.902259	10	0.0019

Exhibit 5.13: Estimation of Fixed-Effects Model for Other Business Activities with Share Price as Market Value Indicator

	Other Business Activities	
	Coefficient	***p*-value**
Intercept	0.7740	0.1649
BVPS	**0.5256*** **	0.0000
EPS	0.5517	0.2875
HUMCAP	**6.6594** **	0.0383
RELCAP	0.3582	0.1478
PROCAP	-8.2053**	0.0152
INNCAP	2.1210	0.1303
HUMCAP*INNCAP	-17.7119	0.1384
HUMCAP*PROCAP	3.9368	0.6904
HUMCAP*RELCAP	-2.7935***	0.0040
LNS	-0.0055	0.8988
R^2	**0.9517*** **	0.0019
F-Statistic	**115.4006*** **	0.0000
Hausman Test	X^2 (10) 27.9023***	
No. of firms	20	
Observations	200	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in Other Business Activities as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (2)*.

Based on a sample of 20 companies of Other Business Activities and 200 observations, the fixed-effects model results as in *Exhibit 5.13* refers to the relationship of share price and drivers of intellectual capital for Other Business Activities are:

The model is valid (*p*-value of F-Statistic < 0.01), with a good explanatory power (R^2 = 0.9517).

(1) There is no statistical relationship between the intercept and share price;
(2) There is a positive and highly significant relationship between book value per share and share price;
(3) There is no statistical relationship between earnings per share and share price;
(4) There is a positive and significant relationship between human capital and share price;
(5) There is no statistical relationship between relational capital and share price;
(6) There is a negative and significant relationship between process capital and share price;
(7) There is no statistical relationship between innovation capital and share price;
(8) There is no statistical relationship between the interaction of human capital and innovation capital with share price;
(9) There is no statistical relationship between the interaction of human capital and process capital with share price;
(10) There is a negative and highly significant relationship between the interaction of human capital and relational capital with share price;
(11) There is no statistical relationship between size and share price.

In summary, the estimation demonstrates that the share prices of Other Business Activities companies are influenced by value creation, impacted on negatively by process capital and the interaction between human capital and relational capital, but positively by book value per share and human capital.

5.6.3 One-Year Change in Share Price on Drivers of Intellectual Capital for Other Business Activities

Similarly to the Manufacturing and Services industries results, the results of Other Business Activities for both *p*-values of 0.2806 and 0.9609 of Sargan test meets the criteria to accept the null hypothesis and AR (2) of the second-order correlation respectively are acceptable and are restated in *Appendix F (3)*.

Exhibit 5.14: Estimation of Generalised Method of Moments (GMM) Model for Other Business Activities with One-Year Change in Share Price Indicator

	Other Business Activities	
	Coefficient	***p*-value**
DPT_3 (-1)	-0.2720***	0.0000
DPT_3 (-2)	-0.3093***	0.0000
DEPS	0.1637	0.7617
DBVPS	**0.7676*** **	0.0000
DHUMCAP	**9.9530*** **	0.0000
DRELCAP	**1.6831** **	0.0302
DPROCAP	-13.4528***	0.0086
DINNCAP	-3.7726	0.4950
DLNS	-0.0182	0.6319
Sargan *p* value of J-Statistic	13.1974	0.2806
AR (2) Stat (F-Value)	0.0024	0.9609
No. of firms	20	
Total panel (balanced) observations	120	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Based on Dynamic Panel Data Regression (DPD).

In *Exhibit 5.14*, the estimation model of one-year change in share price on the drivers of intellectual capital for Other Business Activities consists of a dataset of 20 companies and 120 panel (balanced) observations. The dynamic panel data results for Other Business Activities are:

(1) There are negative and highly significant relationships between DPT_3 (-1) and DPT_3 (-2) with one-year change in share price;
(2) There is no statistical relationship between change in earnings per share and one-year change in share price;
(3) There is a positive and highly significant relationship between change in book value per share and one-year change in share price;
(4) There is a positive and highly significant relationship between change in human capital and one-year change in share price;
(5) There is a positive and significant relationship between change in relational capital and one-year change in share price;
(6) There is a negative and highly significant relationship between change in process capital and one-year change in share price;
(7) There is no statistical relationship between change in innovation capital and one-year change in share price;
(8) There is no statistical relationship between change in size and one-year change in share price.

Overall, the estimation shows that the dynamic panel data estimation shows that one-year change in share price of Other Business Activities companies are value relevance but are impacted on negatively by delta prices (-1) and (-2) and change in process capital, however positively by change in book value per share, change in human capital and change in relational capital.

Exhibit 5.15: Summary of Empirical Relationships of ROE, Share Price and Delta Price of Other Business Activities

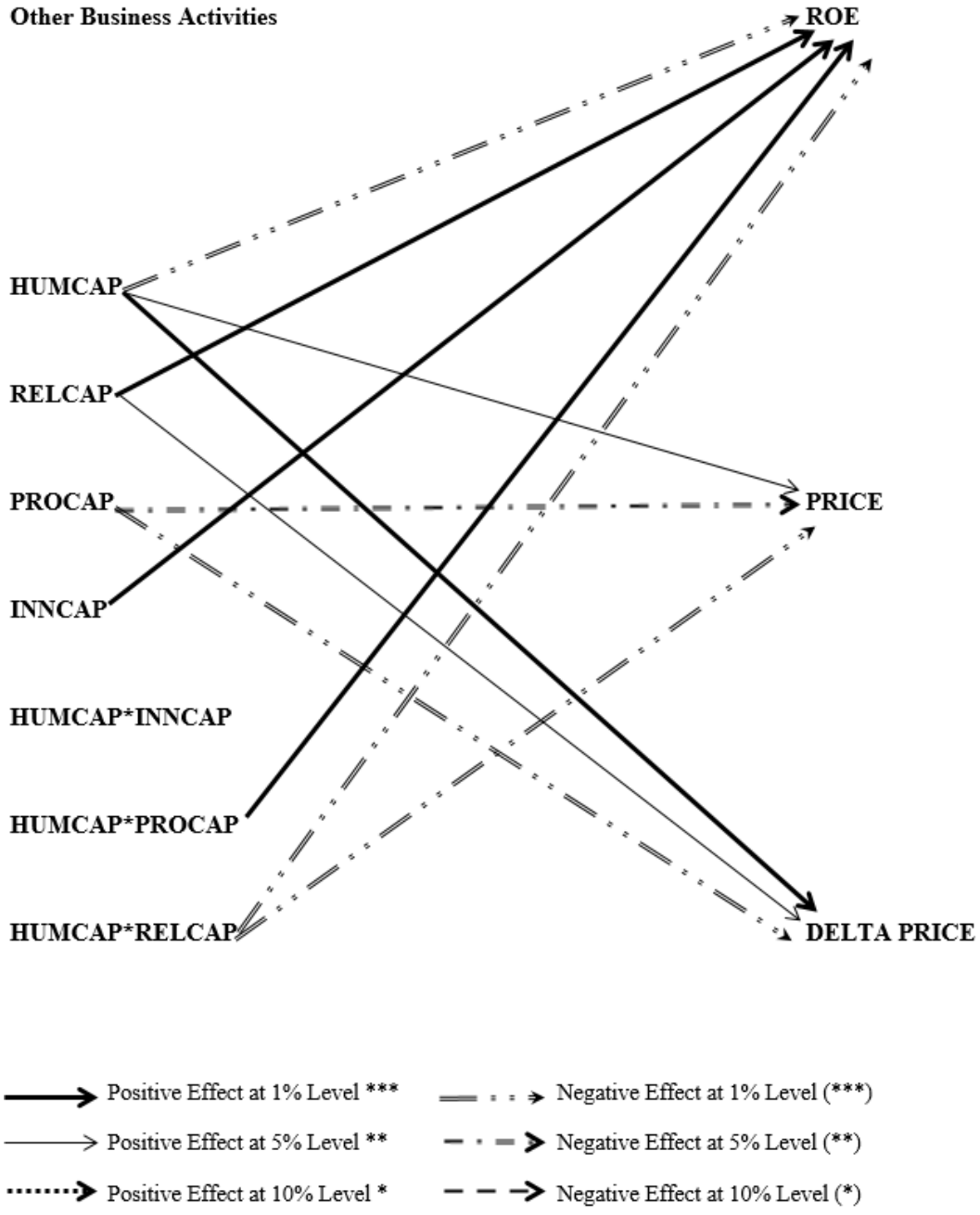
Other Business Activities	ROE	Share Price	Delta Price
HC	-ve (1%)	+ve 5%	**+ve 1%**
RC	**+ve 1%**	-	+ve 5%
PC	-	-ve (5%)	-ve (1%)
InnC	**+ve 1%**	-	-
HC x InnC	-	-	
HC x PC	**+ve 1%**	-	
HC x RC	-ve (1%)	-ve (1%)	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

As presented in *Exhibit 5.15* and *Figure 5.3*, there is a clear inference that intellectual capital components have strong explanatory powers for value creation in the Other Business Activities companies with ROE, share price and delta price. Human capital has positive effects with share price and delta price but a negative effect with ROE. Relational capital has positive impacts with both ROE and delta price. Process capital has negative effects with both share price and delta price. Innovation capital has a positive impact with ROE. There is no statistical relationship between the interaction of human capital and innovation capital with ROE, share price and delta price. The interaction of human capital and process capital has a positive impact with ROE. Finally, the interaction of human capital and relational capital has negative effects with both ROE and share price.

Figure 5.3: Integrated model of Other Business Activities analytical test for all performance indicators of ROE, Price and Delta Price



(Source: Author)

5.7 Estimation of Model for All Companies

In this section, the estimation of model for the consolidated companies of the three industries is analysed in three performance indicators namely accounting profitability (ROE), share price and one-year change in share price. All Companies consist of the three sectors: Manufacturing, Services and Other Business Activities.

5.7.1 Book Value of the Drivers Intellectual Capital with Accounting Performance Indicator in All Companies

The estimation of the Hausman test has been applied and the results between fixed-effects and random-effects models of the book value of intellectual capital on firm performance with the accounting profitability indicator for All Companies prove that the fixed-effects model remains more favourable than the random-effects model as *p*-value is less than 5%. As shown below, the panel data regression workings on the drivers of intellectual capital components with ROE of All Companies and are restated in *Appendix F (1).*

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	26.599060	9	0.0016

Exhibit 5.16: Estimation of Fixed-Effects Model for All Companies with ROE as Accounting Profitability Indicator

	All Companies	
	Coefficient	***p*-value**
Intercept	0.1630	0.6262
HCTA	-0.8316***	0.0000
RELCTA	-0.0314	0.1810
PRCTA	-0.6953***	0.0015
INCTA	**0.9256***	0.0610
GEAR	**0.3060*****	0.0000
LNS	0.0185	0.4726
HCTA*INCTA	-3.9500**	0.0444
HCTA*PRCTA	0.0262	0.7267
HCTA*RELCTA	**0.0641****	0.0378
R^2	**0.8004*****	0.0016
F-Statistic	**32.7684*****	0.0000
Hausman Test	X^2 (9) 26.5991***	
No. of firms	90	
Observations	900	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in the overall Singaporean companies as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (1)*.

From the estimation of the fixed-effects model with a dataset of 90 firms and 900 observations of all Singaporean companies, the results for the relationship between firm performance and drivers of intellectual capital for All Companies are:

The model is valid (p-value of F-Statistic < 0.01), with a good explanatory power (R^2 = 0.8004).

(1) There is no statistical relationship between the intercept and ROE;

(2) There is a negative and highly significant relationship between human capital and ROE;
(3) There is no statistical relationship between relational capital and ROE;
(4) There is a negative and highly significant relationship between process capital and ROE;
(5) There is a positive and weakly significant relationship between innovation capital and ROE;
(6) There is a positive and highly significant relationship between gearing and ROE;
(7) There is no statistical relationship between size and ROE;
(8) There is a negative and significant relationship between the interaction of human capital and innovation capital with ROE;
(9) There is no statistical relationship between the interaction of human capital and process capital with ROE;
(10) There is a positive and significant relationship between the interaction of human capital and relational capital with ROE.

Overall, the estimation shows that the profits of All Companies are not affected by the level of revenue but are impacted on negatively by human capital, process capital and the interaction of human capital and innovation capital, however, positively by innovation capital, gearing and the interaction between human capital and relational capital.

5.7.2 Value Relevance of the Drivers of Intellectual Capital with Share Price indicator in All Companies

To assess the value relevance of the drivers of intellectual capital with share price indicator, both fixed-effects and random-effects models have been applied. In order to evaluate both models, the Hausman test was conducted and as a result, it proves again that the fixed-effects model is more appropriate than the random-effects model meaning that as *p*-value is less than 5%, the null hypothesis of the random-effects model is rejected and the alternative hypothesis of the fixed-

effects model is therefore acceptable as indicated below and restated in *Appendix F (2).*

Correlated Random Effects - Hausman Test
Equation: PRICE3RANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	111.584323	10	0.0000

Exhibit 5.17: Estimation of Fixed-Effects Model for All Companies with Share Price as Market Value Indicator

	All Companies	
	Coefficient	***p*-value**
Intercept	**1.3438*** **	0.0007
BVPS	**0.2943*** **	0.0000
EPS	0.2644	0.1331
HUMCAP	**1.3951** **	0.0150
RELCAP	0.0024	0.9165
PROCAP	**1.5787*** **	0.0000
INNCAP	-0.1442	0.6874
HUMCAP*INNCAP	-0.6200	0.1147
HUMCAP*PROCAP	-0.1684	0.6071
HUMCAP*RELCAP	0.0082	0.8292
LNS	-0.0585*	0.0589
R^2	**0.9287*** **	0.0000
F-Statistic	**105.2317*** **	0.0000
Hausman Test	X^2 (10) 111.5843***	
No. of firms	90	
Observations	900	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* The fixed-effects model is better than the random-effects model in the overall Singaporean companies as the Hausman test result indicates that *p*-value is less than 5%, refers in *Appendix F (2)*.

From the estimation of the model for All Companies, the dataset comprises of 90 firms and 900 observations. Based on the fixed-effects estimation model, the results for the relationship between firm performance and drivers of intellectual capital for All Companies are:

The model is valid (*p*-value of F-Statistic < 0.01), with a good explanatory power (R^2 = 0.9287).

(1) There is a positive and highly significant relationship between the intercept and share price;
(2) There is a positive and highly significant relationship between book value per share and share price;
(3) There is no statistical relationship between earnings per share and share price;
(4) There is a positive and significant relationship between human capital and share price;
(5) There is no statistical relationship between relational capital and share price;
(6) There is a positive and highly significant relationship between process capital and share price;
(7) There is no statistical relationship between innovation capital and share price;
(8) There is no statistical relationship between the interaction of human capital and innovation capital with share price;
(9) There is no statistical relationship between the interaction of human capital and process capital with share price;
(10) There is no statistical relationship between the interaction of human capital and relational capital with share price;
(11) There is a negative and weakly significant relationship between size and share price.

In summary, the estimation demonstrates that the share prices of All Companies are not affected by value creation but impacted on negatively by size, however positively by intercept, BVPS, human capital and process capital.

5.7.3 One-Year Change in Share Price on Drivers of Intellectual Capital for All Companies

Having applied the GMM DPD Arellano Bond (1991) estimators suitable for large N = 90 companies and small T = 10 years, the Sargan test *p*-value of J-Statistic was used to validate the over-identifying restrictions. For the model to be accepted, both *p*-values of Sargan test of 0.4942 and AR (2) statistic of F-value of 0.8667 at two lags for the second-order serial correlation should be more than 5% (Arellano Bond, 1991). As indicated below and restated in *Appendix F (3)* both Sargan test and AR (2) are robust and satisfy meet the GMM (1991) dynamic estimators.

Exhibit 5.18: Estimation of Generalised Method of Moments (GMM) Model for All Companies with One-Year Change in Share Price Indicator

	All Companies	
	Coefficient	***p*-value**
DPT_3 (-1)	-0.3156***	0.0000
DPT_3 (-2)	-0.1971***	0.0000
DEPS	**0.7008*** **	0.0000
DBVPS	**2.6747*** **	0.0000
DHUMCAP	-0.4022	0.6051
DRELCAP	-0.1335*	0.0650
DPROCAP	-1.6906***	0.0070
DINNCAP	-4.8299***	0.0000
DLNS	0.0469	0.5088
Sargan *p* value of J-Statistic	17.4241	0.4942
AR (2) Stat (F-Value)	0.0282	0.8667
No. of firms	90	
Total panel (balanced) observations	540	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Based on Dynamic Panel Data Regression (DPD).

The estimation model of one-year change in share price on the drivers of intellectual capital for All Companies consists of a dataset of 90 companies with total panel (balanced) of 540 observations as indicated in *Exhibit 5.18*. The dynamic panel data results are:

(1) There are negative and highly significant relationships between DPT_3 (-1) and DPT_3 (-2) and one-year change in share price;
(2) There is a positive and highly significant relationship between change in earnings per share and one-year change in share price;
(3) There is a positive and highly significant relationship between change in book value per share and one-year change in share price;
(4) There is no statistical relationship between change in human capital and one-year change in share price;
(5) There is a negative and weakly significant relationship between change in relational capital and one-year change in share price;
(6) There is a negative and highly significant relationship between change in process capital and one-year change in share price;
(7) There is a negative and highly significant relationship between change in innovation capital and one-year change in share price;
(8) There is no statistical significant relationship between change in size and one-year change in share price.

Overall, the dynamic panel data estimation shows that one-year change in share price of All Companies are value relevance but are impacted on negatively by delta prices (-1) and (-2), change in relational capital, change in process capital and change in innovation capital, however positively by change in EPS and change in BVPS.

Exhibit 5.19: Summary of Empirical Relationships of ROE, Share Price and Delta Price of All Companies

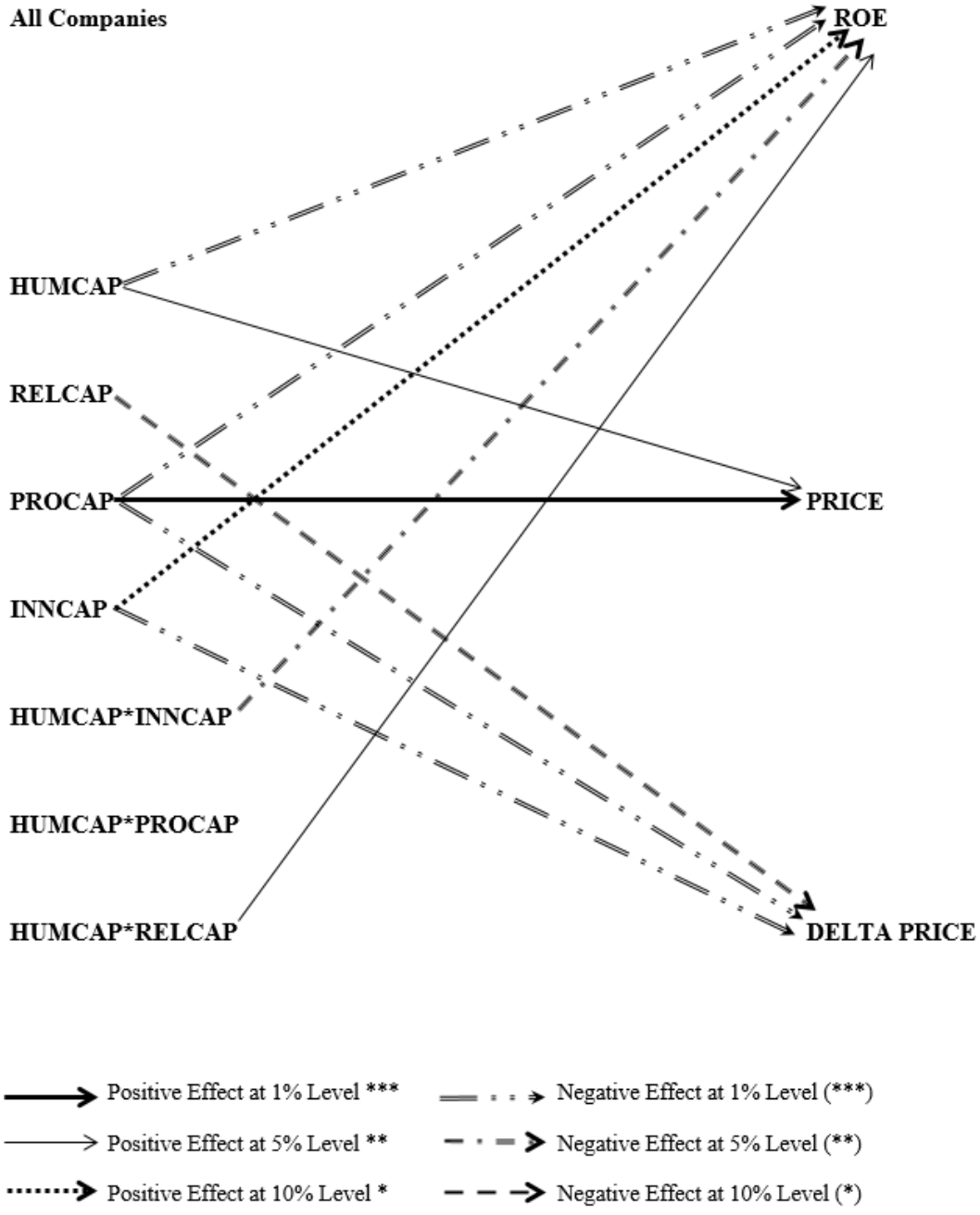
All Companies	ROE	Share Price	Delta Price
HC	-ve (1%)	+ve 5%	-
RC	-	-	-ve (10%)
PC	-ve (1%)	**+ve 1%**	-ve (1%)
InnC	+ve 10%	-	-ve (1%)
HC x InnC	-ve (5%)	-	
HC x PC	-	-	
HC x RC	+ve 5%	-	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

From *Exhibit 5.19* and *Figure 5.4*, there is an inference that intellectual capital components have explanatory powers for value creation in All Companies with ROE, share price but weakly in delta price. Human capital has a negative effect with ROE but a positive impact with share price. Relational capital has only a negative effect with delta price. Process capital has negative effects with both ROE and delta price but a positive impact with share price. Innovation capital is positive with ROE and negative with delta price. The interaction of human capital and innovation capital is negative with ROE. The interaction of human capital and process capital has no statistical relationship with ROE and share price. Finally, the interaction of human capital and relational capital is positive with ROE.

Figure 5.4: Integrated model of All Companies analytical test for all performance indicators of ROE, Price and Delta Price



(Source: Author)

5.8 Summary

The research analysed the findings on the drivers of the intellectual capital components with the performance indicators: total assets representing book value and share price representing market value, and further examine a new performance indicator of one-year change in share price three-months forward of the financial year-end. It infers that the results differ for each sector and the factors of intellectual capital have significant impacts on accounting performance (ROE), share price and changes in share price.

Overall, the drivers of the intellectual capital components measured with financial performance indicate that they have better explanatory powers for Other Business Activities than for other sectors of Singaporean industries. In contrast, the impact of the intellectual capital factors with share price reveals that the Manufacturing industry brings more value creation with process capital, innovation capital and the interaction of human capital and relational capital. Importantly, the original contribution of this present study reveals that there are positive and significant impacts between the drivers of intellectual capital and changes in share price in the Services and Other Business Activities companies, bringing additional value creation in the knowledge-based economy of Singapore.

Following the significant results, it is important to find out how this study has an impact on the management concept of competitive advantage and value creation by comparing the results with other empirical studies in *Chapter 6*.

Chapter 6: Discussions

6.1 Introduction

Based on the current research, gross profit reflects the accounting concept for value creation with an increase of the knowledge-based economy as it represents the difference between selling price and buying price in a company's income statement especially inside two major elements of intellectual capital, namely human capital and process capital relate directly to gross profit. Relational capital is an intangible asset that provides a source of value creation and innovation capital provides an opportunity to every business to build competitive advantage in a rapid knowledge economy.

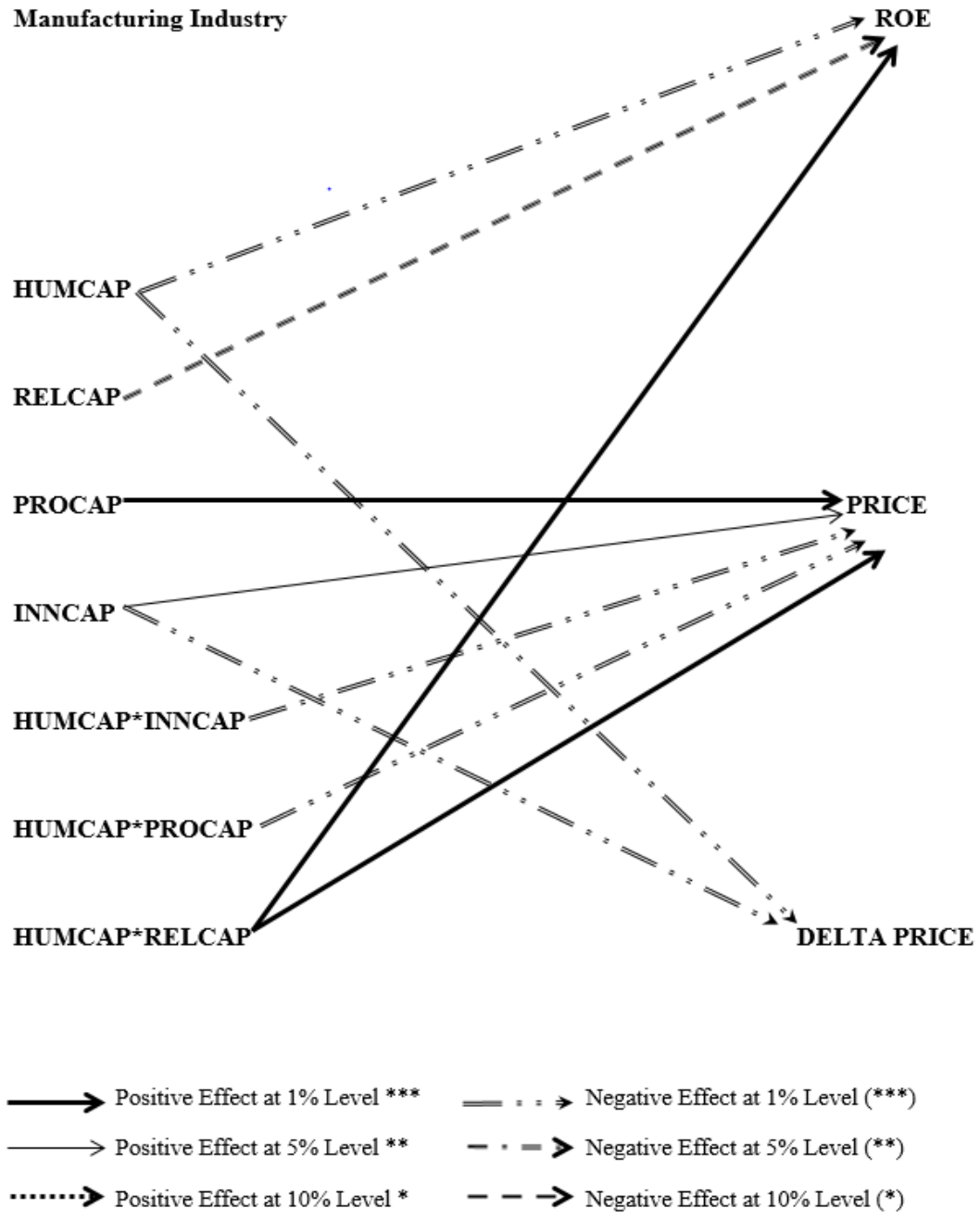
Chapter 5 refers to the analysis and explanatory of the findings on the drivers of intellectual capital components with the significance of book value represented by ROE as accounting performance indicator; the market value represented by share price indicator and change in the market value represented by one-year change in share price indicator of the Singaporean listed companies for a ten-year period from 2005 to 2014. The first part of this chapter consists of discussions and implications of the research findings that relate and contribute to the existing management concept of competitive advantage for each sector. The second part of *Chapter 6* comprises of a critical comparison of the research findings with other empirical research studies. The results of the accounting factors of gearing and size; and the valuation components of book value per share (BVPS) and earnings per share (EPS) have been disregarded in the discussions as not many empirical researchers have used the same adjustments as company specific. Finally, the author addresses her recommendations to the management of companies in Singapore on the importance and development of any future value creation and performance based on the drivers of intellectual capital.

6.2 Research Implications

This section consists of comparing and incorporating the findings with the management concepts to extract any competitive advantage or sustainability of the Singaporean industries: Manufacturing, Services and Other Business Activities. However, All Companies have been discarded in this chapter due to lack of any tremendous impacts when compared with each sector. It is therefore recommended to analyse each sector separately as they present strong and diverse significant results with value creation and firm performance.

6.2.1 Manufacturing Industry

As previously mentioned in *Chapter 5*, the integrated model of Manufacturing industry analytical test for all performance indicators of ROE, price and delta price is restated below to explain and apply the implications of the management concept of competitive advantage and value creation.



(Source: Author)

In the Manufacturing industry, human capital has negative impacts with accounting performance and change in share price indicators, implying a high trend towards automation. This justifies the researcher's expectation because when the Manufacturing companies have high salaries and benefit expenses, staffs tend to be less efficient. As mentioned earlier, both human capital and process

capital are important elements of gross profit. Process capital is positive on share price implying that the industry spends more money on advertisement, marketing and processes among others.

The innovation capital of the Manufacturing industry has a positive impact with share price implies that when innovation capital is positive, the value of the brand, patent or trademark has a better competitive advantage among its competitors; R&D and innovative products have also contributed to the value creation of this industry. However in the dynamic of the Manufacturing industry, the innovation capital is negative in change in share price when manufacturing products become obsolete it requires radical changes with the development of its latest products (Delgado-Verde, et al., 2016).

The relational capital has only a negative effect with accounting performance indicator in the Manufacturing industry. It is transparent that in this particular industry the revenue has fallen due to market saturation, lack of product development, novelty and technology especially in the fast moving knowledge-based economy as compared in the booming industrial economy (Delgado-Verde, et al., 2016). The interaction of human capital and process capital shows a negative impact with the share price indicator. This implies when human capital is negative, process capital is also negative and when human capital is positive, process capital is also positive, as the two variables of intellectual capital are significant to the company's gross profit.

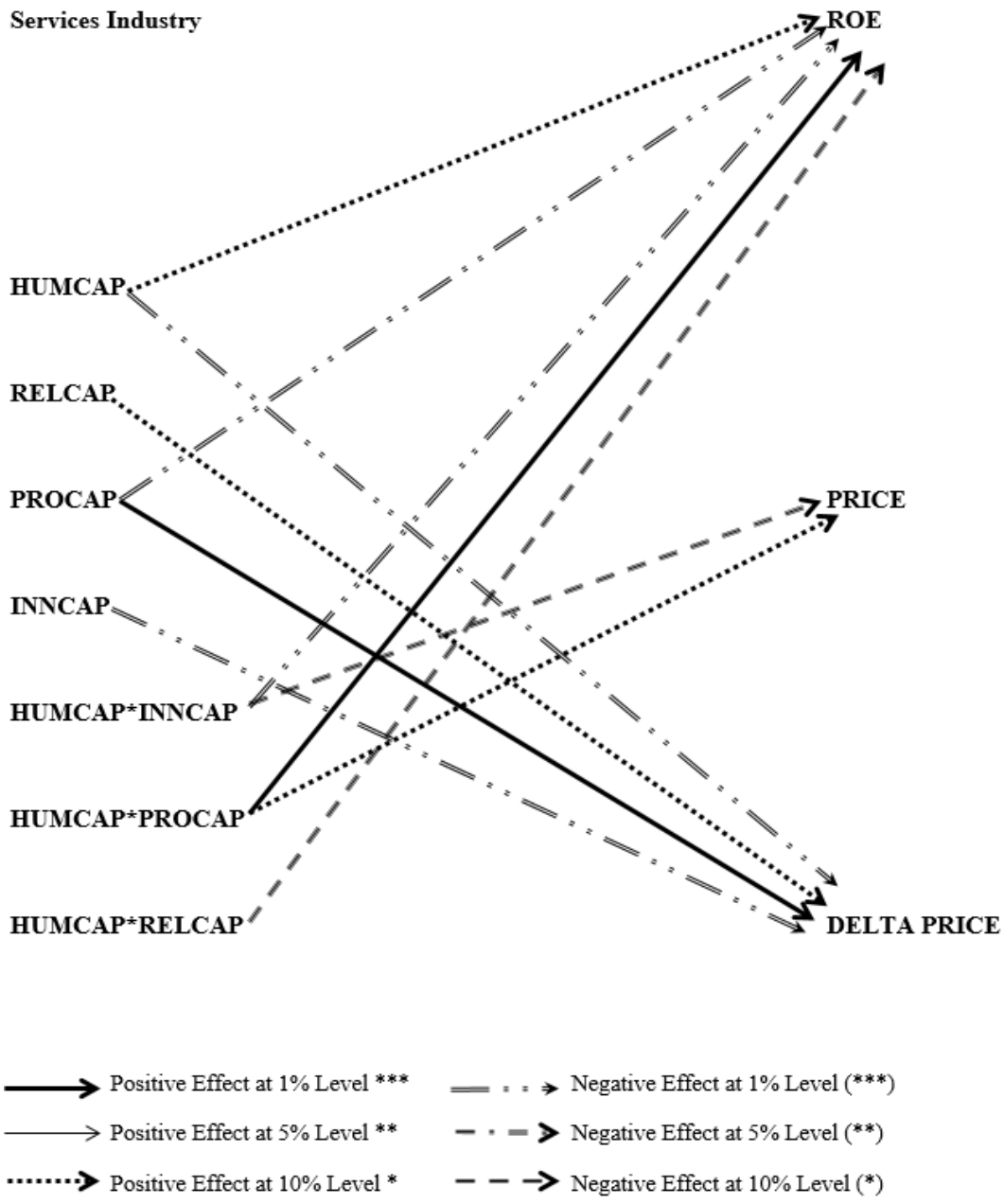
Critically, there is a negative result between the indirect effect of human capital and innovation capital with the market value indicator. Despite employees have valuable skills and knowledge and have the ability to integrate innovative products, it has not increased market opportunities (Mehralian, et al., 2013; Tseng, et al., 2014). It is noteworthy that investors are still interested to invest in the Manufacturing industry where human resource adds value in both innovation capital and market value. There is still an interest for the management of the Manufacturing companies to create incentives towards innovative activities and

work behaviour by gaining competitive advantage among its competitors and achieving competitive sustainability by launching extensive knowledge management contributions (Wei and Xie, 2008; Cheng, et al., 2010; Jorgensen, et al., 2014). Dumay, et al. (2013) point out that the key interrelated factors of human capital and innovation capital to increase success are ideas and capability based, personality and discovery driven, organisation culture and improve current practice.

In contrast, the moderating effect of human capital and relational capital has positive effects with both accounting performance and share price. From the resource-based view theory, human resource gains competitive advantage when companies can attract high qualified and skilled labour. Employees are encouraged to increase turnover, increase profitability, reduce costs of manufacturing and improve quality of products. At the same time more dividends will be distributed to investors leading to an increase in wealth creation and company's market value (Ordóñez de Pablos and Lytras, 2008). However, firms should avoid any resources that are easily duplicated or imitated and to eliminate any sustainable competitive advantage, firms should not have any substitute products that are easily transferable especially with the rapid and advanced technology (Ordóñez de Pablos and Lytras, 2008).

6.2.2 Services Industry

As stated in *Chapter 5*, the integrated model of Services industry analytical test for all performance indicators of ROE, Price and Delta Price is demonstrated in the following diagram to discuss the implication of the management concept of competitive advantage and value creation.



(Source: Author)

Human capital is positive and weakly significant with the accounting performance indicator, but obtains negative effect with change in share price. The contributions of high educated, skilled and talented staffs automatically increase the profitability of the Services industry especially given its important consideration in gross profit. In the resource-based view, valuable human resources are difficult to replicate or imitate thus allowing the services companies to sustain higher profits than other industries (Barney, 1991; Bowman and Swart, 2007). Dynamic capability is another factor that generates new human resource with high salaries as it enhances both value creation and value capture (Bowman and Swart, 2007). In addition, Hitt, et al. (2001) recognise that tacit knowledge is built up through experience only when the intelligent employee stays in the same professional service firm. By retaining its workforce, the services company is able to increase shareholder value, build good reputation and competitive advantage; customers also gain information asymmetries with the high quality of services received from the company and its human capital (Hitt, et al., 2001; Bowman and Swart, 2007). However in the knowledge-based of the professional services industry, the reasons behind the negative effect of human capital may arise due to weak bargaining power, threat to exit, high replacement costs and so on (Bowman and Swart, 2007).

In contrast, process capital has a negative effect with accounting performance indicator and a positive effect with change in share price in the Services industry. The negative result implies that when selling, general and administration expenses are high they affect the gross profit of the company. However, a positive outcome in the change in share price may result to a transformation in selling and administrative processes with a more sustainable system, thus increasing learning and knowledge development, creating and generating new information. Consequently, competitiveness may be retained to attract more investment and the company's success entirely depends on its competitive position in a given market (Sanchez-Gutierrez, et al., 2016).

Referring to the resource-based view theory, a negative result of innovation capital with a change in the share price in the Services industry is affected when information technology and systems are easily purchased and duplicated by competitors. Technology is quite narrow and cannot be seen as a competitive advantage and sustained the performance of companies (Riahi-Belkaoui, 2003; Wu, et al., 2006; Keramati, et al., 2009). Kristandl and Bontis (2007) added that if an element of the intellectual capital is easy to substitute, copy, imitate and is not unique, it is not contributing or creating value to increase the company's performance or stocks. It clearly indicates that innovation can be rare in the knowledge-based economy of Singapore or may not be important and is therefore ignored by the Services industry.

Relational capital has a positive and significant result with the business valuation of change in share price indicator. This implies that the sales turnover generated by the Services industry has an impact on the corporate performance and value creation. The strategic value behind relational capital highlighted by Martín-de-Castro et al. (2011) is that it enhances market valuation of existing knowledge base, provides needs and opportunities with competitive dynamics and guides companies how to improve and develop new knowledge.

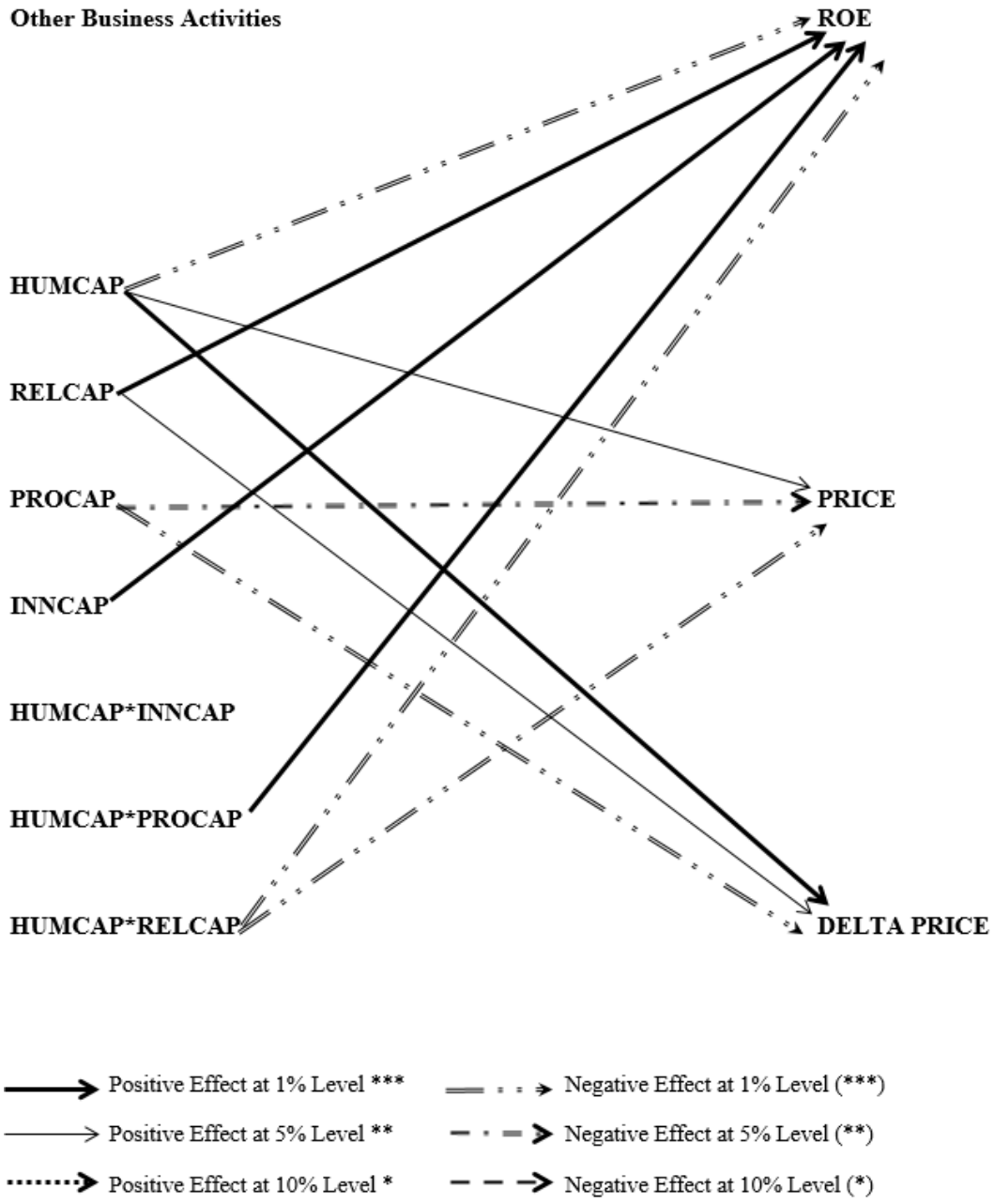
The interrelationship of human capital and process capital is positively significant with both accounting performance and share price indicators, more specifically they are both strong features of intellectual capital that are tremendous linked to gross profit. Matthies (2014) recognises that process capital is essential for strategic planning and managing human resources. He added that given an availability of resources with employees' efficiency, a business should be able to perform by making transparent investment decisions that could lead to an effective value creation.

Nevertheless, the moderating role of human capital and innovation capital has negative effects with the firm's accounting performance and share price of the Services industry. With the knowledge economy, it does not seem that human

capital strategically contributes to the development of innovation capital with the measures of intangible assets and R&D. According to the resource-based view, it seems that highly skilled staffs are difficult to retain and technology is easy to duplicate, therefore it does not provide any sustainable competitive advantage (Wu, et al., 2006). Arguably, the negative outcome of the interaction of human capital and relational capital confirms that turnover and know-how of employees do not associate with the firm's accounting performance indicator.

6.2.3 Other Business Activities

The integrated model of Other Business Activities analytical test for all performance indicators of ROE, Price and Delta Price is replicated from *Chapter 5* to explain their implications with the management concept of competitive advantage and value creation.



(Source: Author)

In Singapore, Leong (2001) recognise that intellectual capital is a long-term goal in attaining competitive advantage. It is achieved if companies manage well their employees knowledge and competences (Ordóñez de Pablos and Lytras, 2008). It proves that human capital constitute to be the most valuable asset in the value creation process especially in Other Business Activities with positive and significant results in share price and change in share price indicators. However, there is a negative effect in relation to the firm's book value of the accounting performance indicator. Based on its capabilities, skills, knowledge, leadership and motivation of a company's workforce, human capital increases the market value of every business, given that the objective of a successful business is to enhance and maintain a strong competitive position, especially in the Singaporean market (Tseng and Goo, 2005; Sanchez-Gutierrez, et al., 2016). Without competitiveness, companies have to bear negative consequences such as lack of productivity, labour turnover, financial crises that could lead to bankruptcy; but more importantly companies should continuously encourage its workforce (Sanchez-Gutierrez, et al., 2016).

The negative influences of process capital with share price and change in share price indicate that selling, general and administrative expenses including advertising and marketing expenses do not play an important part in the intellectual capital process. As part of the strategy development, implementation, planning and execution of a company, it is in the company's interest to increase value creation by managing the business processes effectively (Shang and Wu, 2013).

Innovation capital gains a positive impact with the accounting performance indicator and firm's book value of Other Business Activities. Researchers recognise that innovation capital is the main driver of competitiveness to increase wealth creation with technological advancement (Petty and Guthrie, 2000; Dumay, et al., 2013; Sanchez-Gutierrez, et al., 2016). With constant changes due to globalisation, rapid emerging technologies and short life cycle of products,

organisations have to remain competitive in the knowledge-based economy. Furthermore, Delgado-Verde, et al. (2011) recognise that leadership, support and coordination are key success factors of a manager to implement new technology in an innovative organisational culture.

Given the positive impacts on relational capital with the accounting performance and change in share price indicators, Martín-de-Castro, et al. (2011) recognise that if a company has a solid organisational knowledge base, any decision-making is very crucial to detect any market trends and technological opportunities to increase its turnover and profitability. They added that relational capital is closely related to the concept of 'dynamic capabilities' developed by Teece, et al. (1997), as it captures wealth creation and encourages management to gain competitive advantage in an increasing demand despite with the rapid changes in the business environment. It also relates to the strategic performance against business goals that are connected to competitive advantage (Shang and Wu, 2013).

Similar to the Services industry, Other Business Activities has a strong positive interaction between human capital and process capital with the accounting performance indicator of the firm's book value, proving that it contributes to the gross profit and brings a competitive edge with professionalism, knowledge and customer relationship skills (Shang and Wu, 2013). Whilst, the negative results between the interaction of human capital and relational capital with accounting performance and share price indicators indicate that human resources such as job demand and job satisfaction can affect value creation and influence firm performance; companies face competitive challenges and threats to develop strategies, boost sale with promotion, advertising and marketing, especially in a dynamic market (Guenzi and Troilo; 2006; Ordóñez de Pablos and Lytras, 2008). Unexpectedly, there are no effects in the interaction of human capital and innovation capital on both indicators of the firm's book and market values.

Having detailed the research implications and results of all three Singaporean sectors with the management concept of competitive advantage, an in-depth and

critical discussion is carried out to find how the drivers of intellectual capital influence other empirical studies.

Exhibit 6.1: Summary of Empirical Results

Accounting Performance:

	MAN	SER	OBA	All Companies	^ Scafarto, et al.: Global Agribusiness	^ Wang & Chang: Taiwanese IT Industry	^ Cheng, et al.: US Healthcare Industry	F-Jardón & Martos: Argentina Wood Industry	Bontis, et al.: Malaysian Services & Non-Services	Cabrita & Bontis: Portuguese Banks	Kamukama, et al.: Ugandan Microfinance Ind.
HC	-ve (1%)	+ve 10%	-ve (1%)	-ve (1%)	-	-	+ve 1%	-		-	+ve 1%
PC	-	-ve (1%)	-	-ve (1%)	+ve 1%	+ve 1%	+ve 1%				
InnC	-	-	+ve 1%	+ve 10%	-ve (1%)	+ve 1%	+ve 1%				
RC	-ve (10%)	-	+ve 1%	-	+ve 1%	+ve 1%	-ve (10%)	-		+ve 1%	+ve 5%
HC x PC	-	+ve 1%	+ve 1%	-	-	+ve 1%					
HC x Innc	-	-ve (1%)	-	-ve (5%)	+ve 5%	-					
HC x RC	+ve 1%	-ve (10%)	-ve (1%)	+ve 5%	-	+ve 1%		+ve 10%	+ve 1%: Services; +ve 1%: Non-Services	+ve 1%	+ve 5%

Share Price:

	MAN	SER	OBA	All Companies	Ferraro & Veltri: Italian Listed Companies	Yu & Zhang: Chinese High-Tech	Liu, et al.: Taiwanese IT industry	Wang: US Electronic Companies	Ozer and Çam: Turkish Industrial Companies
HC	-	-	+ve 5%	+ve 5%	-ve (5%)	+ve 5%	-	+ve 5%	+ve 1%
PC	+ve 1%	-	-ve (5%)	+ve 1%	-ve (5%)	-	+ve 1%	+ve 5%	
InnC	+ve 5%	-	-	-	-	-	+ve 1%	+ve 5%	
RC	-	-	-	-	+ve 1%	+ve 1%	-	+ve 5%	
HC x PC	-ve (1%)	+ve 10%	-	-	+ve 5%				
HC x Innc	-ve (1%)	-ve (10%)	-	-	-				
HC x RC	+ve 1%	-	-ve (1%)	-	-				

Change in Share Price:

	MAN	SER	OBA	All Companies
HC	-ve (1%)	-ve (1%)	+ve 1%	-
PC	-	+ve 1%	-ve (1%)	-ve (1%)
InnC	-ve (1%)	-ve (1%)	-	-ve (1%)
RC	-	+ve 10%	+ve 5%	-ve (10%)

*** 1% level High Significant ** 5% level Significant * 10% level Weak Significant

^ RC changed to PC and vice-versa

Significant at *<0.1; **<0.05; ***<0.01

(Source: Author)

6.3 Critical Discussions and Empirical Research Implications

Having established how the implications of the management concept of competitive advantage contribute to the research findings in *Section 6.2,* in the following sections it critically appraises and discusses the findings of this research with previous empirical studies on the drivers of intellectual capital factors and the interaction of human capital and other intellectual capital components having effects with firm performance and value creation. The book value is represented by the accounting performance indicator, followed by the business's market return represented by the share price at the company's financial year end and finally the change in firm's market value is represented by the change in share price three months after the company's financial year end. In the next section, a detailed comparison and discussion of other empirical research results on the drivers of intellectual capital and the firm's accounting performance indicator are thoroughly analysed. A summary of the empirical results is shown in *Exhibit 6.1*.

6.3.1 Book Value of Intellectual Capital on the Firm's Accounting Performance: Critical Discussions

In this section, a critical discussion is established and compares how the findings of the Singaporean listed companies corroborate with previous empirical studies enhance intellectual capital, value creation and firm performance especially with the accounting performance indicator. Prior studies have operationalised the proxies of intellectual capital components differently. For comparison purposes, adjustments were made in the empirical results in order to get a more comprehensive and consistent results as shown in *Exhibit 6.1*.

Firstly, in the Singaporean listed companies the result of human capital with the accounting performance indicator shows that the Services industry is positive and weakly significant whilst the Manufacturing industry and Other Business Activities are negative and significant. Similar to the Services industry finding, previous empirical studies find that human capital and firm performance exhibit

positive but highly significant effects in the healthcare sector of the listed U.S S&P 500 companies (Cheng, et al., 2008) and in the Ugandan microfinance industry (Kamukama, et al., 2010). However, other researchers did not find any direct impact in the Taiwanese IT industry (Wang and Chang, 2005); Portuguese banks (Cabrita and Bontis, 2008); Argentina wood industry (F-Jardón and Martos, 2009) and global agribusiness (Scafarto, et al., 2016).

In the Singaporean Services industry, process capital is negative and highly significant; and there was no effect in both Manufacturing industry and Other Business Activities. Contrary to this study, empirical studies obtain positive and significant results with process capital and accounting performance indicator in the Taiwanese IT industry (Wang and Chang, 2005), U.S. healthcare listed companies (Cheng, et al., 2008) and in the global agribusiness companies (Scafarto, et al., 2016).

The result of innovation capital with the accounting performance indicator is positive and highly significant in the Singaporean Other Business Activities and therefore corroborates with the two empirical studies of the Taiwanese IT industry (Wang and Chang, 2005) and the U.S healthcare industry (Cheng, et al., 2008). Scafarto, et al. (2016) obtain a negative and highly significant outcome between innovation capital and corporate performance in the global agribusiness industry, however, both Manufacturing and Services industries in Singapore did not have any significant results.

The result of relational capital and the accounting profitability indicator in the Singaporean listed companies have mixed results: positive and highly significant in the Other Business Activities, negative and weakly significant in the Manufacturing industry and no statistical relationship in the Services industry. Similarly with Other Business Activities result, there are positive and significant impacts in the Taiwanese IT industry (Wang and Chang, 2005), Portuguese banks (Cabrita and Bontis, 2008); Ugandan microfinance industry (Kamukama, et al., 2010) and in the global agribusiness (Scafarto, et al., 2016). In contrast, Cheng, et

al. (2008) obtain a negative and weakly significant result between relational capital and profitability in the U.S healthcare equipment companies and also agree with the Manufacturing companies in Singapore.

In the interaction effect of human capital and process capital, the Services industry and Other Business Activities of the Singaporean listed companies both have positive and strong significant with the accounting performance indicator only agree with the Taiwanese IT industry (Wang and Chang, 2005). In contrast both the Singaporean Manufacturing industry and the global agribusiness industry (Scafarto, et al., 2016) find no significant interrelationship.

The interaction of human capital and innovation capital with the accounting performance indicator does not show any positive impact in the Singaporean industries, except the Services industry has a negative and highly significant result. Critically, Scafarto, et al. (2016) key finding proves that human capital is positive and significant with innovation capital especially in the performance of global agribusiness companies when using various performance indicators and R&D expenses as measurement of innovation capital. Nevertheless, the Taiwanese IT industry (Wang and Chang, 2005) and both the Singaporean Manufacturing industry and Other Business Activities have no significant results.

The interaction of human capital and relational capital with accounting profitability indicator results differs within the Singaporean industries: it is positive and highly significant in the Manufacturing industry; both Services industry and Other Business Activities have negative results but significant at different levels. The positive result of the Singaporean Manufacturing industry strongly agrees with previous studies in the Taiwanese IT industry (Wang and Chang, 2005), the Malaysian services and non-services industries (Bontis, et al., 2000) and the Portuguese banks (Cabrita and Bontis, 2008). Whilst, there are also positive but weak significant results in the Argentina SMEs wood manufacturing industry (F-Jardón and Martos, 2009) and the Ugandan microfinance industry (Kamukama, et al., 2010).

Having critically analysed and discussed how the results of this present study are compared with various empirical studies, their discussions and implications in terms of the management theory of competitive advantage are investigated in the following section with the book value of the drivers of intellectual capital on firm's accounting performance.

6.3.2 Book Value of Intellectual Capital on the Firm's Accounting Performance: Empirical Research Implications

The implication of the current study acknowledges that human capital reacts well with the performance of the Services industry in Singapore as it is engaged in hiring highly educated, talented and skilled workers to operate especially in this particular sector rather than other industries. However, the negative outcome of human capital in the Singaporean Manufacturing industry indicates that automation influence its performance. In addition, Cheng, et al. (2010) also emphasize that a good human capital increases customers trust and intellectual capital factors brings competitive advantage to every business. Given the rapid changes towards the knowledge economy, strong competitive forces and technology advancement, Kamukama, et al. (2010) highlight that managers should recognise the importance of their workforce talents and dedication. They suggest in adopting an appropriate management style that could work with a valuation model when the intellectual capital elements are taken into consideration. However, Scafarto, et al. (2016) criticise that when key employees leave the company, it affects the business performance by incurring losses and increase competitiveness risks such as knowledge leakages and corporate intellectual ability. Although, no direct effect was obtained on company's profitability, Wang and Chang (2005) argue that human capital contributes to intellectual capital.

Matthies (2014) criticises that process capital has been treated differently by previous studies. With a positive finding in process capital, competitive advantage theory has extended its association with the value drivers of intellectual capital

(Cheng, et al., 2008). Operating processes contribute to an increase in firm's performance when companies reduce their selling, general, administrative and advertising expenses whilst still maintaining good customer relationships, positioning themselves among competitors and adapting well in any economic situations (Scafarto, et al., 2016). They also recognise that the process of marketing brings intensive knowledge. Wang and Chang (2005) criticise that advertising and marketing did not promote the IT products but product acceptance rate has an effect on performance. Nevertheless, this study also indicates that process capital with accounting performance indicator has a negative effect with the Singaporean Services industry, implying that high advertising, promotion, selling and other expenses have affected the performance of this industry.

This study recognises the importance of innovation capital with intangible assets and by investing in research and development, companies obtain better returns on their investment whereby innovative products and services bring uniqueness in the competitive market, especially in Other Business Activities in Singapore whose various activities are R&D services, engineering, oil and electronics industries among others. According to Wang and Chang (2005), a positive and significant result in innovation capital and firm performance implies that high ratio of R&D leads to good and future profits. They suggest that the rapid development in information technology industry has achieved global competitive capabilities together with the value drivers of intellectual capital (Wang and Chang, 2005; Cheng, et al., 2008). However, the negative implication of innovation capital relates when a company takes more time to recoup R&D investment due to the legislation and regulatory in the seed industry affecting the manufacturing, development and distribution of the latest products (Scafarto, et al., 2016). As R&D is also expensed when incurred, it reduces the current net income thus resulting to an inferior firm performance, causing negative outcome in innovation capital as this specifically occurs during the regulatory approval process in the same industry (Chen, et al., 2005; Scafarto, et al., 2016).

When applying turnover as the proxy of relational capital, the implication on the accounting profitability indicator reveals that when relational capital is negative the Manufacturing industry in Singapore should focus in selling more intellectual capital products. Similar to Other Business Activities in Singapore, Wang and Chang (2005) have a strong positive effect in the Taiwanese IT industry implying that the production process has been improved due to its efficiency. Based on the resource-based view when companies are able to increase their turnover and maintain their customer relationships, this implies that they have a good source of competence (Cheng, et al., 2008).

The implication of this research suggests that the value of human resources brings contribution in process capital in both sectors of Services industry and Other Business Activities in Singapore. This implies that staff with high remuneration spends more on selling, general and administrative expenses such as marketing, promotion and advertising in order to maintain and build customer relationship. In addition, the implication of the interrelationship of human capital and process capital is fundamentally related to customer satisfaction and good qualities of products and services offered by the company (Wang and Chang, 2005). It was perceived that process capital is meaningful on performance than other factors of intellectual capital; but from a company perspective, when it is interlinked with human capital the latter has improved its profits. However, Scafarto, et al. (2016) could not explain why both factors are unable to relate with the performance indicator.

It infers that if companies are willing to invest heavily in human capital, the outcome proves that there will be a gain on return for investing highly on research & development and obviously this may lead to future improvement of firm performance and value creation (Scafarto, et al., 2016). Capabilities and knowledge of employees are good resources to connect with innovation. Apart from relying on a company's input and motivation, the employee's capability is an important factor to link with innovation capital, although the Taiwanese IT

industry did not have any effect of the interaction of human capital and innovation capital (Wang and Chang, 2005).

The moderating effect of human capital and relational capital implies a good human capital with negotiation skills build up strong market orientation and customer's relationship. It is the role of senior managers to establish the importance of sales in the company's culture (Bontis, et al., 2000; Cabrita and Bontis, 2008). Kamukama, et al. (2010) observe that human capital and relational capital are linked to promote growth and create value in the Ugandan microfinance industry. According to F-Jardón and Martos (2009), relational capital is an essential element of human capital, as employees possess the knowledge to communicate, establish and maintain new and existing relationships with customers and external agents. In contrast, Wang and Chang (2005) recognise that the proxy of product acceptance rate brings a positive contribution through human capital to the profitability of a business. Contrary to previous empirical studies, the proxy of relational capital for this study is based on revenue, staffs are encouraged to achieve greater sales and strengthen sales volumes in the Manufacturing industry implying that human capital brings strong competitive advantage as their skills create value and increase firm performance.

The results of the Singaporean industries with other empirical research results are critically examined and compared with the effectiveness of the value relevance of intellectual capital factors and firm's share price in the next section.

6.3.3 Value Relevance of Intellectual Capital on the Firm's Share Price: Critical Discussions

This section summarises and determines how the results of the value relevance of intellectual capital variables influence the market value of a business specifically with share price indicator agree with other empirical studies. Firstly, in the Singaporean Other Business Activities, the result shows that human capital and share price indicator was positive and significant; corroborates strongly with the

Chinese high-tech industry (Yu and Zhang, 2008), but was positive and highly significant in the Turkish industrial companies (Özer and Çam, 2016) and negative and significant in the Italian listed companies (Ferraro and Veltri, 2011). Arguably, this research obtains mixed results in the process capital and firm's share price whereby the positive and highly significant outcomes of the Singaporean Manufacturing industry supports the Taiwanese IT industry (Liu, et al., 2009) and marginally low significant in the U.S electronic companies (Wang, 2008). The negative effect of Other Business Activities companies is consistent with the Italian listed companies (Ferraro and Veltri, 2011) and there was no significant result in the Singaporean Services industry and the Chinese high-tech industry (Yu and Zhang, 2008).

Moreover, the innovation capital and share price indicator of the Manufacturing industry presents similar positive and significant result with the U.S electronic companies (Wang, 2008), but in the Taiwanese IT industry there was a positive and highly significant outcome (Liu, et al., 2009). The results of the relational capital with the share price indicator have no effects in any of the three Singaporean industries. In contrast, other empirical studies obtain positive and highly significant outcomes in the Chinese high-tech industry (Yu and Zhang, 2008), and the Italian listed companies (Ferraro and Veltri, 2011), but marginally low significant in the U.S electronic companies (Wang, 2008).

The interrelationship of human capital and other intellectual capital variables have shown tremendous positive results with the Singaporean industries. However, there is limited empirical study to compare these results. The Italian listed companies prove that there is a positive interaction of human capital and process capital (Ferraro and Veltri, 2011), but contrary to the Singaporean Services industry the result is positive and weakly significant; and negative and highly significant in the Manufacturing industry. There are negative effects at different levels with the interaction of human capital and innovation capital in the Singaporean Manufacturing industry and Other Business Activities; however, there was no significant result in the Italian listed companies (Ferraro and Veltri,

2011). Finally, there is a positive and highly significant interaction of human capital and relational capital in the Manufacturing industry but negative and highly significant in Other Business Activities, but again, there was no significant result with the Italian listed companies (Ferraro and Veltri, 2011).

Despite there are some similarities with Wang and Chang (2005) studies to endorse the results of this current research on the drivers of the intellectual capital components with the accounting performance indicator nevertheless it is impossible to make a similar conclusion with the share price of the firm's value as other empirical studies results differ. To summarise, it is important to emphasise that this study is the first research to provide significant implications with the moderating effect of human capital with the rest of intellectual capital variables across the three Singaporean industries: Manufacturing, Services and Other Business Activities, in comparison with the limited empirical study of Ferraro and Veltri (2011).

Having provided a brief summary of the critical discussions of the results, a detailed discussion and implications of empirical studies with the value relevance of intellectual capital on the share price of a company will be addressed in the following section.

6.3.4 Value Relevance of Intellectual Capital on the Firm's Share Price: Empirical Research Implications

Firstly, the research differs when share price is high, human capital is also high showing its strength with value creation of the Other Business Activities in Singapore. Human capital enhances significant competitive advantage to a firm, especially, when companies recruit the right employees, promote and retain talented staff, thus knowledge base continues to develop and improves the company's productivity from the resource-based view perspective. However, Lim, et al. (2010) recognise that human capital is not well communicated to the investors. It is important for management to encourage its workforce by

implementing rewards and compensation policies. A positive effect in human capital and share price is influenced by staff's abilities to work and ensure the business becomes more successful than its competitors in the global market over a long-term period of time (Özer and Çam, 2016). It also relates to the knowledge acquired by staffs during the production process or when creating new ideas (Wang, 2008). In contrast, with a negative result of human capital and market price, Ferraro and Veltri (2011) conclude that high salaries and benefits contribute to a weaker human capital as this may control the stock market's opinions.

The positive implication of process capital and market value reflects how the economy of Singapore is conventional as it indicates that the Manufacturing companies invest heavily in selling, administrative and general expenses. In addition, Wang (2008) implies that employee productivity and efficiency can be enhanced by adequate working procedures, projects and methods, the company's intranet, manuals and specifications can therefore achieve these. She recognises that the positive result of process capital constitutes of a collective knowledge and learning process which influences the staff's productivity and ultimately increase value creation and firm's performance. Furthermore, Liu, et al. (2009) conclude the positive and highly significant outcome of the process capital in the corporate value creation of the Taiwanese IT industry occur when companies invest heavily on staff managerial expenses. In contrast, the other proxy of process capital of years of corporation establishment result is negative due to the innovative capacity and future development, which did not focus on the past operational of the Taiwanese IT firms (Liu, et al., 2009). Likewise, the result of Ferraro and Veltri (2011) corroborates with the results of the Singaporean Other Business Activities and find that process capital is weak with high general and administrative expenses. Nevertheless, in order to achieve an effective and good quality in the process capital, companies should maintain a flexible and smooth operation system (Ferraro and Veltri, 2011).

In this research, the Manufacturing industry has a positive outcome on innovation capital with share price indicator as opposed to the rest of the Singaporean

industry. This implies that automation used in this particular industry invest heavily in technology and relies more on innovative-intensive products for its production in order to achieve better performance and increase value creation. Wang (2008) emphasizes that the positive result relates on how well can an organization create its latest products and services through "*the application of knowledge to produce new knowledge*" (Drucker, 1993 cited in Wang, 2008, p.560) and also refers to an innovative achievement and revolutionary capability. Innovation capital therefore constitutes to the determinant of a long-term survival of a company and is connected to competitiveness and sustainable growth as intellectual capital factor is valuable and represents the real future for generating new ideas (Wang, 2008; Liu, et al., 2009). The innovation capital and share price indicator did not create any value relevance in the Chinese high-tech companies (Yu and Zhang, 2008) and is supported by the Italian listed companies (Ferraro and Veltri, 2011). According to Yu and Zhang (2008), it was due to high risk and lack of investment in R&D. They suggest that the high-tech companies should not only focus on labour cost but creating incentive mechanism to improve the employee's development. Ferraro and Veltri (2011) recognise that the reasons why innovation capital is not supported are: innovation capital cannot be predictable and many companies do not deal with R&D, therefore, the proxy to measure innovation capital was based on intangible assets (García-Meca and Martinez, 2007).

Critically, this research has not encountered any significant results between relational capital and market value in the Singaporean industries. Therefore, the results obtained in this present study do not allow the researcher to compare the arguments of Yu and Zhang (2008) and Ferraro and Veltri (2011), implying when customer loyalty and sales volumes are high, the relational capital is also high, thus influencing the firm's value relevance. In addition, Wang (2008) added that good strategic alliances and ongoing suppliers and customers relationships determine the company's success and performance as these relationships enhance the value-added resources in the supply chain process. However, it may infer that sales do not have any effect in the market share of the Singaporean industries.

Human capital represents a primary element of the sustainable competitive advantage when an indirect effect with the other intellectual capital variables can be linked to a business's market value (Ferraro and Veltri, 2011). It was noted that human capital has a significant and moderating role with the process capital and the Italian's firm market return (Ferraro and Veltri, 2011). In addition, this study observes a positive and significant relationship of the interaction of human capital and process capital with the market value of the Singaporean Services industry; a negative and highly significant relationship in the Manufacturing industry but there is no effect in Other Business Activities. It implies that employees possess special skills and knowledge to serve customers; and selling, general and administrative expenses increase value to the business with strong promotion, advertising and marketing. In order to have a positive relationship, a company should have a good organisational and process in place to help employees carrying out their daily activities efficiently (Matthies, 2014). For example, if a workflow is badly organised, a good staff is unable to perform his task perfectly and consequently, this will affect both performance and value creation of the business. In addition, Bowman and Swart (2007) emphasise that in the resource-based view human capital should integrate with the business's equipment to achieve value creation.

As stated in the resource-based view theory, Barney (1991) acknowledges that resources should be unique, hard to replicate, valuable and sustainable for a business to obtain competitive advantage. In addition, it helps in identifying how the drivers of intellectual capital can generate sustainable competitive advantage with firm capabilities and intangible assets (Delgado-Verde, 2011). The implication of this research proves that the moderating outcome of human capital and innovation capital with share price is negative in both Manufacturing and Services industries in Singapore. The innovative products may be easy to replicate with the knowledge acquired by staff thus did not generate strong sustainable competitive advantage to strengthen the market return of a business. It also infers that the resources may not be accessible to staffs in performing efficiently,

consequently affecting the capability of integrating and transforming staff knowledge into creating innovative products (Agostini, et al., 2017).

Marzo (2014) recognise that relational capital should be examined as a resource factor and human capital as the knowledge resources for value creation. The dynamic concept of relational capital establishes that knowledge resources interact and form part of a firm's structure (Zardini, et al., 2015). In addition, this study implies that high salaries and benefit expenses bring value to businesses in Singapore, as staffs are more productive when achieving sales revenue especially in the Manufacturing industry. The following section discusses how a change in intellectual capital components on firm's change in share price brings contribution to the development of competitive advantage and value creation.

6.3.5 Change in Firm's Share Price on Drivers of Intellectual Capital: Research Implications

The ultimate objective of this current research is to investigate and examine whether value creation and firm performance specifically with a change over time may be contributed by intellectual capital components in the Singaporean listed companies. Having analysed whether a change in intellectual capital factors influence firm performance and would instantly reflect a change in market value over time with an examination of a cross-sectional dynamic panel data regression analysis in *Chapter 5*, this section identifies how this could help management in developing competitive advantage and implementing these values in their companies.

Firstly, the integration of changes in human capital and share price is more robust than its original share price since it is positive and strongly significant in the Other Business Activities, as opposed to other Singaporean industries. As part of the competitive advantage, the positive implication of this result indicates that human capital proves that staff knowledge with high salaries and benefits strongly contribute to the value creation and drive a sustainable increase in market value

with superior result and diversity of Other Business Activities especially in engineering, R&D services, telecommunication, diversified operations, real estate and property developer companies. It may also imply that staff knowledge contributes to achieve the firm's competitive advantage, as they possess the tacit or explicit knowledge including know-how, values, motivation and competence. Martín-de Castro, et al. (2011) also acknowledge that trusted and sustainable relationships are sources of today's knowledge-based view and competitiveness of businesses.

Furthermore, the integration of changes in process capital and market value reflects an additional positive contribution in the Services industry with change over time. Companies are willing to spend more on selling, general and administrative expenses in order to maintain their customer relationships and increase their presence against competitors, which leads to an increase in market share. If companies depend on economies of scale, the resources can be easily imitated, for example, advertising may bring negative effect on share price (Liu, et al., 2009). However, to enhance market competitive advantages and produce positive outcomes, companies should differentiate themselves based on resources that are unique, valuable and hard to replicate (Kamukama, et al., 2011).

Critically, the changes in innovation capital and market price are negatively significant in both Singaporean Manufacturing and Services industries. Negative effects affect companies who are reluctantly to invest heavily in R&D or are unable to repay any investment quickly. Lack of innovative products without imitation or replication limits the company's performance and therefore do not create knowledge-based dynamic capabilities (Denford, 2013).

Contrary to the original share price, the change in relational capital and the change in share price bring a good explanatory contribution. The results of the Singaporean Services industry and Other Business Activities are positive and significant at different levels. Relational capital refers to a corporate relationship with its customers and environment (Martínez-Torres, 2006). The research

implication based on the positive relational capital is mainly contributed to the high sales volumes due to the company's good reputation has led to increase its market value. It infers that resources and capabilities of companies in Singapore have overcome with the threats from other competitors and their surrounding environment, hence enhancing value creation and brings strong sustainable competitive advantage with customers loyalties and corporate brand (Martín-de Castro, et al., 2011; Ferreira and Fernandes, 2017).

6.4 Recommendations to Companies in Singapore

The recommendations to companies in Singapore have principally applied to the main findings of this present research and in specific areas of accounting profitability ROE (book value) with the financial performance indicator of total assets, share price (market value) and one-year change in share price (value creation / market return) having effects on the drivers of intellectual capital variables: human capital, relational capital, process capital and innovation capital; and the interaction of human capital with other intellectual capital factors.

This research identifies that the intellectual capital factors add wealth creation to the Singaporean listed companies. Human capital increases both firm performance and value creation in different sectors. Companies should therefore recognise the importance of highly educated employees and retain competent staff. Additionally, relational capital brings value creation with firm performance and value creation. The book value implies an increase in the profitability of a business while market value is interpreted by a change in share price. This relates from an increase in sales and when revenue is low, firm performance and value creation are affected. In order to take advantage of the process capital by increasing both firm performance and share price in the long run, companies should be willing to spend on selling, general and administrative expenses with intense promotion, distribution, advertising and maintain customer relationship. Another reason why book and market values explain the gap between them is the positive contributions of innovation capital particularly automation is facilitated in

the Manufacturing industry and Other Business Activities recognise the importance of investing heavily in technology and research and development.

A significant recommendation to companies in Singapore is the interrelationship results of human capital and relational capital obtained in the Manufacturing industry. High salaries and benefit expenses encourage staff to become more productive, achieve sales targets, increase profitability and bring wealth into the business. In addition, staffs with special skills and knowledge provide better customer service and gain good sales techniques. Management should view the interaction of human capital and process capital as a complementary process in their investment strategy, which will result to positive impacts to value creation and business financial performance. Critically, the indirect implication of human capital and innovation capital had not brought any contribution to the knowledge-based economy of Singapore as the three industries did not invest heavily in research & development as expected, despite government incentives in human capital, technology, research and development as mentioned in *Chapter 3*. However, staff should be aware about the importance of innovation capital as this is an invisible asset that brings creativity, innovation, increases future performance and wealth creation.

In the context of value creation where market value is identified as one-year change in share price, the research contributes to significant results in the valuation factors of intellectual capital. When staffs are more knowledgeable it brings value creation to the workplace with positive impact of changes in human capital and share price of Other Business Activities. The change in share price has definitely improved the change in relational capital with the sales revenues for both Services industry and Other Business Activities. Both Manufacturing and Services industries are investing heavily in technology, but are more conventional than Other Business Activities, as the latter has been affected with the high level of selling, general and administrative expenses causing a negative impact between change in process capital and one-year change in share price. In contrast, the Services industry presents a positive result, which may result in building a strong

customer relationship with heavily promotion and advertising expenses. Critically with the movement in share prices, the change in innovation capital shows negative evidence in the Singaporean Manufacturing and Services industries, their results may be caused by high innovative investments. These industries have taken high risks during the financial and economic downturns and consequently find it uneasy to repay their debts, generate slow or less return.

6.5 Summary

With the era of the knowledge-based economy, globalisation and due to competitive advantages, firms have to generate more values, exceed expectations and achieve a superior business position in the particular market they operate in. In accordance with the resource-based view theory, Barney (1991) identifies that resources are rare, valuable, difficult to replicate and cannot be replaced easily, would underpin sustainable competitive advantages with good yearly financial performance and increase shareholders wealth (Scafarto, et al., 2016). Importantly, the key factors of competitive advantages bring unique resources to intellectual capital factors (Cheng, et al., 2008). To understand how the differences of book and market values are increasing, this study has investigated how the drivers of intellectual capital bring value creation and increase firm performance for three Singaporean sectors: Manufacturing, Services and Other Business Activities by incorporating three different indicators: accounting performance (book value); share price (market value) and one-year change in share price (value creation / market return).

It concludes that each factor of intellectual capital has good explanatory power to explain the difference of book and market values in different sectors of the Singaporean listed companies. By looking at all the intellectual capital components where positive and significant results are obtained, firms can get an idea on how firm's value creation, performance and competitive advantage can be added within the direct influences of intellectual capital components and interaction of human capital with other factors of intellectual capital. Overall, my

own contribution is further supporting the value relevance of intellectual capital components on the book value (accounting performance), market value (share price) and change in market value (value creation / market return) when analysing the Singaporean industries over a ten-year period.

Chapter 7: Conclusion

7.1 Introduction

The conclusion chapter outlines an overview of this present study by conducting a philosophical reflection on the research aim and objectives. The main findings, limitations and recommendations for future research are being discussed; and finally, it emphasises on the contribution to research on intellectual capital, value creation and firm performance.

7.2 Philosophical Reflection

Having identified the gap in the literature relating the key concepts of intellectual capital, value creation and firm performance, the research aim was developed to address the primary focus of the research and how the researcher achieves the objectives.

7.2.1 Research Aim

The primary aim was to attempt and develop an empirically validated framework linking the intellectual capital (knowledge-based) factors with value creation (market value) and firm performance (book value). A selection of companies quoted in the Singapore Exchange was chosen and sub-categorised into three industries namely manufacturing, services and other business activities.

7.2.2 Research Objectives

In the first research objective, a critical and in-depth review of literature to find out why the book and market values of a business have major difference was conducted covering both theoretical and empirical research in the relevant key areas of intellectual capital, value creation and firm performance. A rigorous valuation model introduced by Ohlson (1995) on an econometric approach was

adopted to test the market value with three different performance indicators. This valuation model explains the difference of book and market values especially when the investor's wealth is evaluated in the capital's market and is shown in the movement of a company's share price.

The second research objective was finalised to reflect and analyse the linkages of the components of intellectual capital: human capital, relational capital, process capital and innovation capital with value creation (market value) and firm performance (book value) with adjustments company specific of gearing and size. In addition, the interaction of human capital with other intellectual capital factors was analysed to find out whether these components have also significant effects. The static panel data regression was applied to estimate the results but the random-effects model (REM) did not produce any good explanatory results and was therefore eliminated. Overall, the fixed-effects model (FEM) results were more favourable and were applied in the course of this present study. It was also classified into three different industries of the Singaporean listed companies namely manufacturing, services and other business activities and as a result they have produced strong explanatory results than the overall listed companies.

Finally, the third objective is to integrate and formulate an equation that links intellectual capital, value creation and firm performance, specifically with change over time. Previous empirical researchers have not yet examined this equation. It therefore brings an original contribution to literature in the intellectual capital context of one-year change in share price (value creation / market return) and a change in intellectual capital variables over time by analysing with the use of the dynamic panel data regression model.

7.3 Main Findings

The aim of this thesis was to ascertain if the components of intellectual capital impact on accounting profitability and market value and then to provide information to corporations on formulating strategies for sustained competitive

advantage. Broadly in financial terms, value added in a firm is attributed to different components of intellectual capital (IC): human capital (the manpower cost), relational capital (a measure of relationships with stakeholders), process capital (selling, general and administration costs) and innovation capital (R&D expenditure and intangibles). The regression models used are similar to those in Ferraro and Veltri (2011) and Scafarto, et al. (2016). The bare variable states its effect on value, while the interacting variable captures the combined effect of human capital, the dominant variable, with other IC variables.

On accounting profitability regressions, in the context of industry and cost structure, the interacting variable captures the impact of human capital combined with the other intellectual capital components; if positive it indicates a synergistic effect and if negative vice versa. On market data regressions, the market has its own perception of the combined effect of the human capital component (skills available within the organisation) and other intellectual capital components: when the interacting variable is positive, it means that from a market perception value has been added and vice versa (expenditures on innovation expenditures, stakeholder management or selling, general and administration costs may be considered as excessive and beyond the scope of competent management given the company's set of human skills and experience).

The effects of the impact of the components of intellectual capital on the Manufacturing sector are restated as below:

Manufacturing Industry	ROE	Share Price	Delta Price
HC	-ve (1%)	-	-ve (1%)
RC	-ve (10%)	-	-
PC	-	**+ve 1%**	-
InnC	-	+ve 5%	-ve (1%)
HC x InnC	-	-ve (1%)	
HC x PC	-	-ve (1%)	
HC x RC	**+ve 1%**	**+ve 1%**	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

For Manufacturing industry as the above table shows, human capital (HC) and relational capital (RC) have a negative impact on accounting profitability, but are not significant on the share price, and an increase in human capital has a significant negative effect as well on changes in share price. On the other hand, process capital (PC) and innovation capital (InnC) have a significant effect on share price but not on accounting profitability. The interactions with human capital are negative and significant for innovation capital and process capital but positive for relational capital. These results are consistent with the Manufacturing sector of a knowledge economy as Singapore, where lean management techniques and technological improvements are applied to the full. The interacting coefficients suggest that while the market does not value the interaction of the human capital component on innovation capital and process capital, it does so on good stakeholder relationships (relational capital).

The effects of the impact of the components of intellectual capital on the Services sector are restated as below:

Services Industry	ROE	Share Price	Delta Price
HC	+ve 10%	-	-ve (1%)
RC	-	-	+ve 10%
PC	-ve (1%)	-	**+ve 1%**
InnC	-	-	-ve (1%)
HC x InnC	-ve (1%)	-ve (10%)	
HC x PC	**+ve 1%**	+ve 10%	
HC x RC	-ve (10%)	-	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

When it comes to the Services industry, accounting profitability is higher when human capital is higher but lower when process capital is lower; implying the need for manpower in effectively marketing services and lean management of selling and administration expenses in the Services sector. On accounting profitability, human capital reacts positively with process capital but negatively with innovation capital and relational capital. On share price, the combined impacts of human capital and innovation capital are negative but it is positive for

process capital. On change in share price, changes in human capital and innovation capital have a negative effect, while changes in relational capital and process capital have a positive impact. This points to the need for running a service company efficiently with competent staff.

The effects of the impact of the components of intellectual capital on the Other Business Activities sector are restated as below:

Other Business Activities	ROE	Share Price	Delta Price
HC	-ve (1%)	+ve 5%	**+ve 1%**
RC	**+ve 1%**	-	+ve 5%
PC	-	-ve (5%)	-ve (1%)
InnC	**+ve 1%**	-	-
HC x InnC	-	-	
HC x PC	**+ve 1%**	-	
HC x RC	-ve (1%)	-ve (1%)	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

Other Business Activities combine all others (mix of activities). On accounting profitability in this sector, human capital has a negative effect while relational capital and innovation capital have a positive effect. On share price, human capital is important, but there is a necessity to keep process capital down, and changes in human capital, and relational capital affect share price changes positively, while change in process capital does so negatively. Once again in this sector the importance of managing manpower costs, innovation and stakeholder relationships is clear.

The effects of the impact of the components of intellectual capital overall on Singapore companies (All Companies) are restated as below:

All Companies	ROE	Share Price	Delta Price
HC	-ve (1%)	+ve 5%	-
RC	-	-	-ve (10%)
PC	-ve (1%)	**+ve 1%**	-ve (1%)
InnC	+ve 10%	-	-ve (1%)
HC x InnC	-ve (5%)	-	
HC x PC	-	-	
HC x RC	+ve 5%	-	

(Source: Author)

NB: +ve = Positive Effect or –ve = Negative Effect at 1% level = High Significant or 5% level = Significant or 10% level = Low/Weak Significant.

Overall the analysis conducted highlights the role of different components of intellectual capital in the different sectors of a knowledge economy as Singapore. Looked across the economy, the role of skilled human capital within a knowledge economy is clear: managing manpower and selling, general and administration costs, and keeping up with technological developments is important; while prudence needs to be exercised on changes in these costs. The methodology applied allows the identification of what component is more important for adding value in a particular sector, given its characteristics within the economy. Through conducting such a sectoral analysis in their country, and comparing their own cost structures with those who are operating better than them, in the same business conditions, firms can improve their profitability and formulate strategies for sustained competitive advantage.

7.4 Limitations

The research is mainly produced in the Singaporean context, where the researcher has conducted the analysis and interpretation with a limitation of 90 companies quoted in the Singapore Exchange. Despite it holds over 700 companies, they were not listed consecutively over a ten-year period from 2005 to 2014. The Strait Times Index also presents a disadvantage for the purpose of this research as it has only 30 constituents.

The research presents another limitation with its research methodology based on positivism paradigm, deductive approach and quantitative strategy with limited scope of panel data regression method of analysis. The author could pursue and conduct further research by implementing various financial performance indicators but it could cause time constraint in submitting the thesis.

The data collection obtained from OneSource and Orbis databases through the British Library had influenced the time allocation as a restricted number of five annual reports were permitted to download every week. Despite using these databases, a number of companies did not have their annual reports over a ten-year period neither available on these databases nor on their own website, therefore these companies were disregarded. From data collection to raw data and data analysis process, an overall of eleven to twelve months was spent. The EViews Software presents a limited access due to its subscription cost. To add extra value to the research, other panel data regression models could have been derived on the intellectual capital, value creation and firm performance.

Finally, the key issues of this research area were to identify and compare results from present work with other empirical studies. The limited empirical literature reveals that there are controversial results and further adjustments were required to compare their results. The author further finds that the proxies of intellectual capital components differ from empirical studies. Consequently, the results were not easily comparable.

7.5 Recommendations for Future Research

The identification of the stock market difference of the company's book and market values were derived from intellectual capital, accounting, finance, economics and valuation literatures leading to the conceptual framework was identified, but other areas are yet to be developed for future research and are discussed as follows:

7.5.1 Country & Sector Analysis

The research was restricted to Singapore as a country-wise over a ten-year period. It is worth extending and exploring other emerging and developing countries particularly in the Asia continent especially in the East, for example: China, Malaysia, Thailand, Taiwan, Vietnam among other countries where they are developing very fast due to globalisation. It is also important to examine different sectors in other developed countries such as E.U, Japan, South Korea, U.K and U.S as well for analysis purposes over a longer period of time or focus only in a particular sector if the dataset is large. The new research will definitely bring new findings in the new knowledge-based economy especially human capital is the root of intellectual capital, its interaction is worth analysing with other intellectual capital factors.

7.5.2 Study of Methodology

As the research was primarily based on positivism paradigm, deductive approach and quantitative research strategy, future advanced research could be conducted using a mixed research methodology with both quantitative and qualitative approaches by adding interviews, questionnaires or surveys in addition with a large dataset of companies. The findings could have given a different perspective on how intellectual capital, value creation and firm performance are considered by practitioners and management of companies.

7.5.3 Research Analysis

It is worth considering other intellectual capital measurements to support future research. The operationalization of the intellectual capital factors could be analysed differently by using different proxy variables as no defined theory has yet been established to calculate the variables. Other determinants factors of accounting profitability could also be examined.

7.6 Contribution to Research

The core contribution of this research is the identification of components of intellectual capital and the way they interact with each other towards value addition in various business sectors. The current research covered a limitation of ninety companies in Singapore and data was analysed sector-wise, in addition a meta-analysis combining all sectors was also conducted. Such a sector-wise approach has not been undertaken in previous research. Thus the findings allow corporations in Singapore to analyse their own activities in the context of the research and formulate strategies to build up sustainable competitive advantage and add value for stakeholders.

Singapore is a developed economy with a high component of intellectual capital in its business activities, much like in developed economies in the west. The methodology and classifications of the different components of intellectual capital, followed in the current research allows corporations in other economies to conduct similar studies to clearly identify, business activity wise, the sources of value addition, and therefrom allowing them to recommend and formulate their own strategies on competitive advantage.

7.7 Conclusion

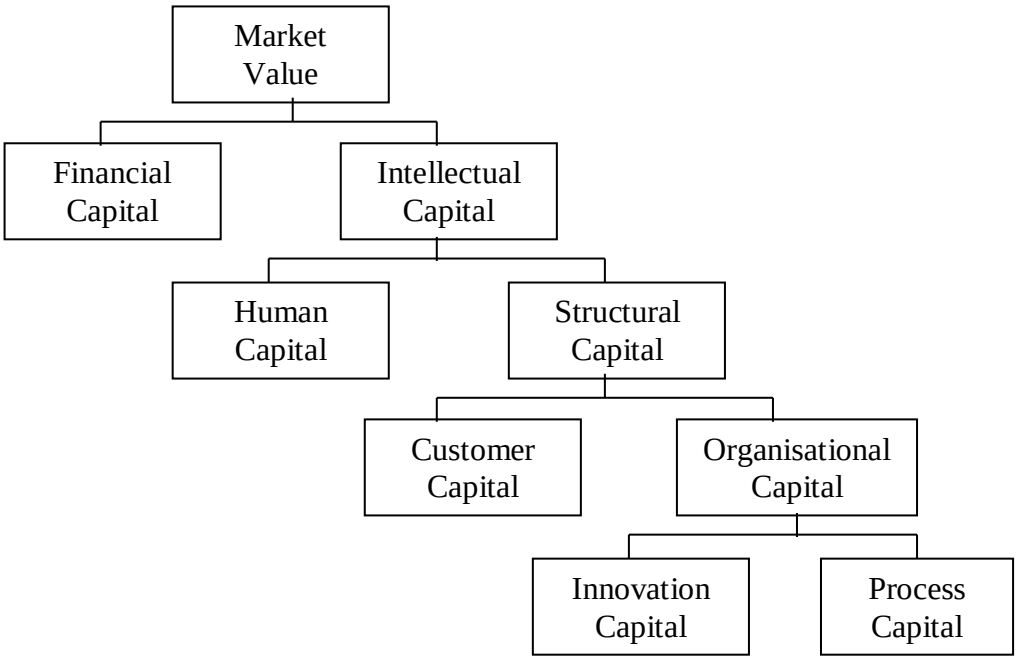
The significance of this study is that it offers a clear understanding and development of a holistic model linking the intellectual capital factors and contribution to value creation and firm performance in the Singaporean industries. This research has thus formulated sustainable competitive advantage strategies that allow companies in Singapore to follow, improve performance and create value for stakeholders; in addition these strategies may also be applied to other companies in both developed and developing countries.

Appendices

Appendix A: Skandia Value Scheme

Skandia (1995) develops the "Skandia Value Scheme" by explaining how the Market Value is subdivided into Financial Capital and Intellectual Capital. They recognise that the knowledge economy contributes to the hidden assets that represent the gap between book value and market value. Intellectual Capital is divided into various factors as shown in the "Skandia Value Scheme" below.

Skandia Value Scheme



(Source: Skandia, 1995, p.5)

Appendix B: Summary of Key Empirical Studies in Chronological Order

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Intellectual Capital and business performance in Malaysian industries	Bontis, et al. (2000)	What are the inter-relationships among intellectual capital measures within the Malaysian business context?	Dependent Var: - Business performance Independent Var: - Human Capital - Structural Capital - Customer Capital	- 64 services industries - 43 non-services industries	- Questionnaire - Cronbach's alpha test - Partial Least Squares	- Relationship bet human capital and customer capital: both positive in both industries - Relationship bet human capital and structural capital: positive but not significant in services industries; positive and significant in non-services industries - Relationship bet customer capital and structural capital: both positive and significant in services and non-services industries - Relationship bet Structural capital and business performance: positive and significant in services industries but less significant in non-services industries - An interplay exist among human, structural and customer capital

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Intellectual capital and performance in causal models	Wang and Chang (2005)	What forms an integral framework with the relationship among intellectual capital elements and the impact of these elements on firms' performance?	Dependent Var: - Performance Independent Var: - Human Capital - Process Capital - Innovation Capital - Customer Capital Performance measures: - Accounting earnings - Stock price - Return on Assets - Return on Equity - Market Value - Market-to-book	- 1997 - 2001 - Taiwan Economy Journal, annual report and prospectus - 131 IT listed firms in Taiwan	- Partial Least Squares	Direct influence on performance: - Innovation capital - Process capital - Customer capital Human capital interaction which in turn affect performance: - Innovation capital - Process capital Innovation capital directly influence process capital
An empirical examination of the value relevance of intellectual capital using the Ohlson (1995) valuation model	Swartz, et al. (2006)	Does intellectual capital, together with information from the financial statements, can explain a firm's market value?	Dependent Var: - Share Price 3 months after the year-end Independent Var: - Book Value - Abnormal Earnings - Abnormal Dividends - VAIC: CEE, HCE, SCE	- 154 firms - 8 years - Johannesburg Securities Exchange - Bureau of Financial Analysis	- Panel Data Least Squares regression - VAIC - Ohlson Model	Positive and significant effects: - Book Value - Abnormal Earnings - Abnormal Dividends - CEE - HCE Negative effect: - SCE

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Intellectual capital and business performance in the Portuguese banking industry	Cabrita and Bontis (2008)	To examine interrelationships among intellectual capital components and business performance and to test interaction effects among intellectual capital components and business performance.	Dependent Var: - Business Performance Independent Var: - Human Capital - Relational Capital - Structural Capital	- 53 banks - 253 respondents	- Partial least squares - Interviews - Questionnaires - SPSS	Human capital effects on: - Structural capital - Relational capital, but also indirectly through Structural capital Human capital influences business performance indirectly: - HC-RC-PERF - HC-SC-PERF - HC-SC-RC-PERF
Does Intellectual Capital Really Create Value?	Yu and Zhang (2008)	What is the relationship between intellectual capital and corporate value in Chinese high-tech industry?	Dependent Var: - Market value (Price) Independent Var: - Book Value - Net Earnings per share - Human Capital: Sales/Total employees - Custom Capital: (a) Sales/outstanding shares (b) Advertising expenses/outstanding shares - Innovation Capital: Intangible assets / outstanding shares	- 41 firms 123 obs - 2003 – 2005 - Shanghai Securities Exchange	- Panel Data OLS regression - Ohlson Model	Positively correlated and significant: - Net Earnings per share - Human Capital - Custom Capital on Advertising expenses Positive and not significant: - Book Value Negatively correlated: - Custom Capital on Sales - Innovation Capital

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Investigating market value and intellectual capital for S&P 500	Wang (2008)	How does the US electronic industry perform from an intellectual capital (IC) perspective? What is the relationship between IC and company market value in the US electronic industry?	Dependent Var: - Market Value Independent Var: - Human Capital - Customer Capital - Innovation Capital - Process Capital - Intellectual Capital (a) Book Value (b) Employee Productivity (c) Advertising Expenditure (d) Net Income (e) No of employees (f) R&D Investment (g) Sales growth rate	- 893 US firms - 1996 – 2005 - US S&P 500 - S&P Compustat database	- Multiple regression statistics - Ohlson model	Positive correlation: - Process Capital - Net Income - No of employees - R&D Investment - Sales growth rate Major determinant: - Innovation Capital Moderating effect: - Customer Capital No strong relationship: - Human Capital Negative correlation: - Book Value - Employee Productivity - Advertising Expenditure

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Intellectual capital and performance in the wood industries of Argentina	F-Jardón and Martos (2009)	Is there an effect of intellectual capital on enterprise performance?	Dependent Var: - Enterprise performance Independent Var: - Human Capital - Structural Capital - Relational Capital	- 113 Wood manufacturer SMEs of Argentina	- Partial Least Squares - Cronbach's Alpha and AVE	- IC affects performance but through Structural Capital - Human Capital affects directly Relational Capital and Structural Capital - Relational Capital has an effect on Structural Capital
The incremental impact of intellectual capital on value creation	Liu, et al. (2009)	What determines the impact of incremental information of intellectual capital on corporate value and value creation?	Dependent Var: - Corporate Value (V) (share price-P model) - Value Creation (VC) (P-BV model) Independent Var: - Financial Capital (Book Value) - Customer Capital - Process Capital - Innovation Capital - Human Capital	- 505 firms - 2001 – 2005 - Taiwan Stock Exchange - Taiwan Economic Journal Data Bank - Taiwan Patent Network - Annual reports	- Multiple and stepwise regression - Ohlson model	Positive and significant on V and VC: - Financial Capital - Process Capital - Innovation Capital - Human Capital No significant on V: - Customer Capital

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
The value relevance of Intellectual Capital on the firm's market value: an empirical survey on the Italian listed firms	Ferraro and Veltri (2011)	How does the impact of firm's IC measured with accounting data, on the share price on the Italian stock exchange market be tested with a simplified version of the Ohlson Model?	Dependent Var: - Market Value (MV) Independent Var: - BVPS - EPS - Human Capital - Relational Capital - Innovation Capital - Process Capital - Asset	- 189 Italian firms 524 obs - 2006 – 2008 - Datastream database - Milan Stock Exchange	- Panel data least square regression - Ohlson model	Positive & significant effect on MV: - BVPS - EPS - Relational Capital Negative & significant effect on MV: - Human Capital - Process Capital Negative & not significant on MV: - Innovation Capital - Asset Human Capital as a moderating effect: a) Positive & significant effect - Process Capital b) Positive effect & not significant - Relational Capital c) Negative effect & not significant - Innovation Capital

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Intangible assets and performance: Analysis on manufacturing SMEs	St-Pierre and Audet (2011)	Can an explanatory study shed light on the nature of IC in SMEs and how is it linked to specific performance?	Dependent Var: - Change in Sales as performance indicator - ROA - Productivity - Age Independent Var: - Human Capital - Relational Capital - Innovation Capital - Process Capital	- 267 SMEs - Canadian and French manufacturing SMEs - 2000 to 2007	- Multivariate analysis - Partial Least Squares Model	- Human capital influences innovation capital and process capital but not relational capital and performance - Relational capital is significantly linked to performance - Performance is linked with productivity, while growth and ROA are key factors of performance - Innovation capital is not significant on performance - Relational capital is not significant on performance

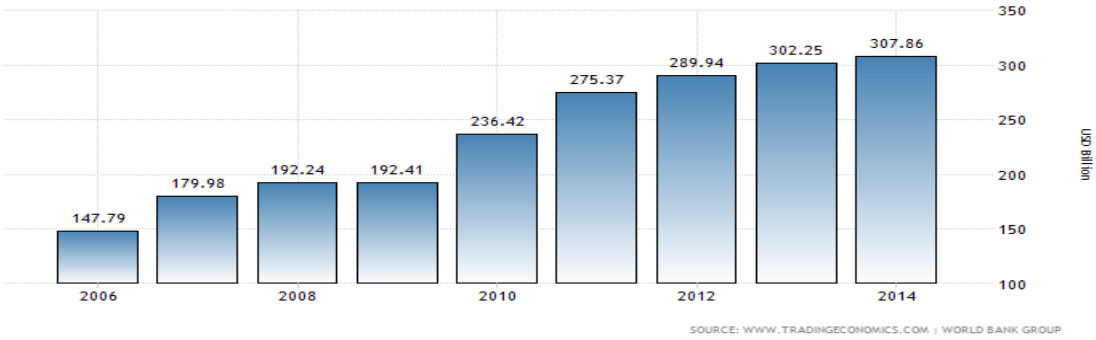
Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
Intellectual Capital and firm performance in the global agribusiness industry: The moderating role of human capital	Scafarto, et al. (2016)	How the relationship between intellectual capital, categorized into HC, RC, InnC and PC and business performance influence the agribusiness industry?	Dependent Var: - ATO - ROA - ROE - ROI Independent Var: - Human Capital - Relational Capital - Innovation Capital - Process Capital - Firm Size - Leverage	-18 international seed and agrochemical cos, 90 obs - 5 year-period - Thomas Reuters Database	- Pearson Correlation Regression - Multiple Regression	Positive effects on ROE, ROI & ROA: - Relational Capital - Process Capital Negative on ROE, ROA & ROI but only significant with ATO: - Innovation Capital No significant with any performance measures: - Human Capital Human Capital as a moderating effect: a) Positive & significant effect - Innovation Capital b) Not significant effect - Relational Capital - Process Capital

Journal Titles	Authors	Research Question	Variables used to test	Data Sources	Methodology	Answer to Research Question
The Role of Human Capital in Firm Valuation: An Application on Borsa Istanbul publicly traded industrial companies (BIST)	Özer and Çam (2016)	Is there any incremental explanatory power and value relevance of HC indicators on firm value of Borsa Istanbul publicly traded industrial companies?	Dependent Var: - Market Value Independent Var: - Book Value - X^a, Abnormal Earnings (residual earnings) Human Capital: - Personnel expenses - Net sales per employee	- Borsa Istanbul publicly traded industrial companies - 2004 to 2014 - Stata and Eviews	- Ohlson Model - Fixed Effects Model - Driscoll Kraay standard errors	Value indicators of HC into OM are positive and significant: - BV and X^a - Personnel expenses and net sales per employees - *F*-value and *P*-value are statistically significant on firm equity value - R^2 reveals the incremental power of HC on market value of firm

(Source: Author)

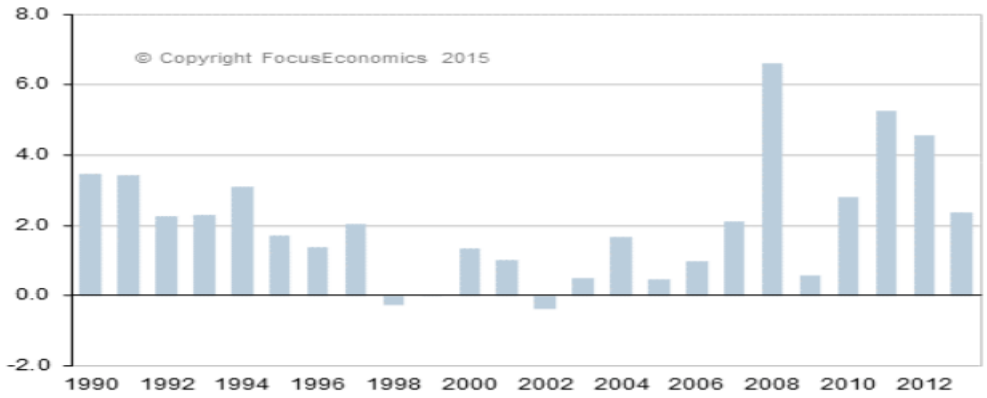
Appendix C: Singapore Economy

Figure C-1: Gross Domestic Product (GDP)



(Source: Trading Economics, 2016)

Figure C-2: Inflation Chart



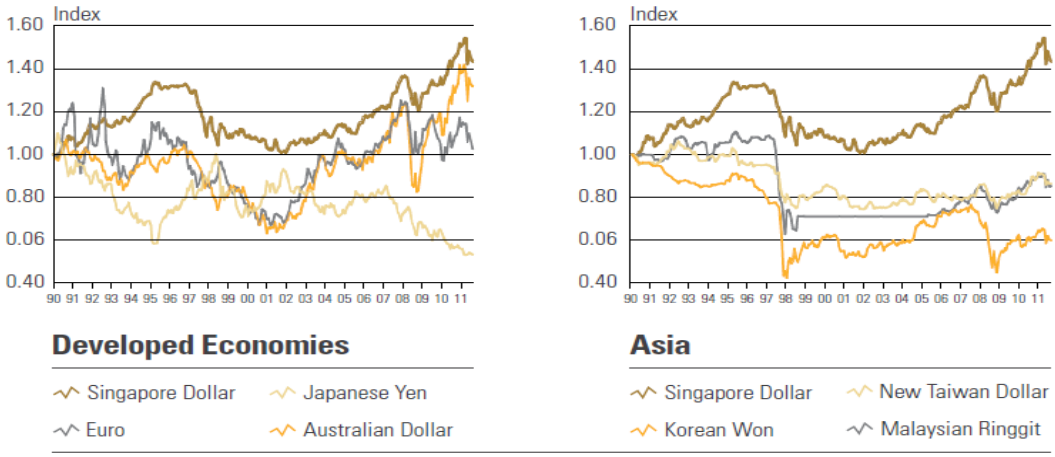
(Source: Focus Economics, 2016b)

Figure C-3: Inflation Data

	2011	2012	2013	2014	2015
Inflation Rate (CPI, annual variation in %)	5.2	4.6	2.4	1.0	-0.5

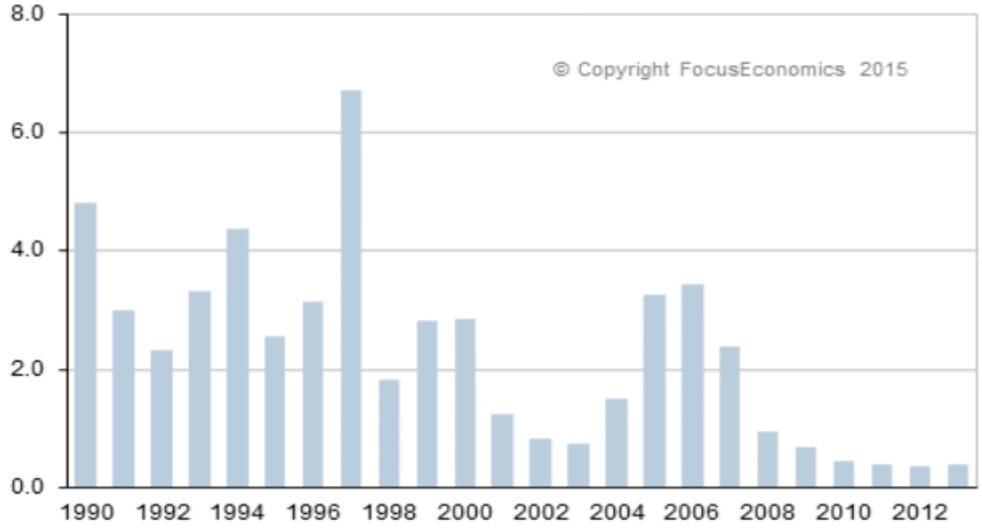
(Source: Focus Economics, 2016b)

Figure C-4: SGD Performance against other currencies



(Source: MAS, 2012)

Figure C-5: Interest Rate Chart



(Source: Focus Economics, 2016c)

Figure C-6: Interest Rate Data

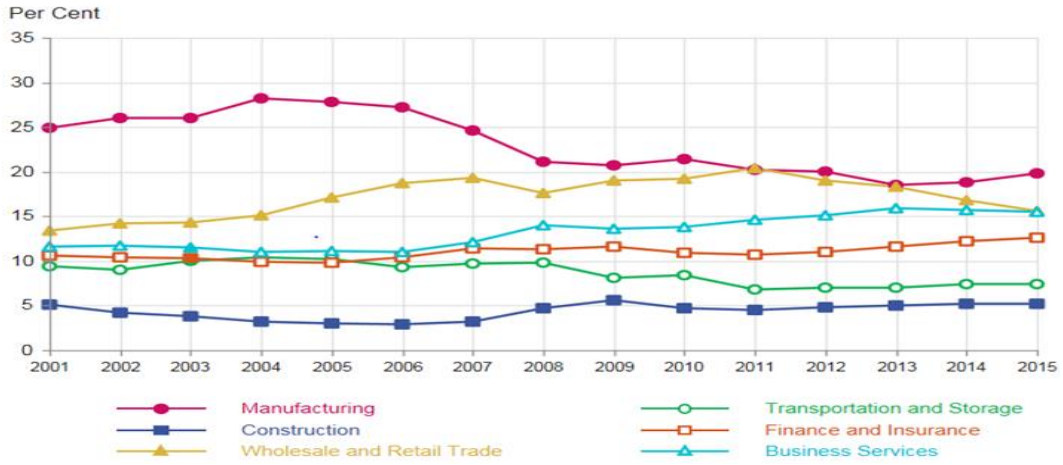
	2011	2012	2013	2014	2015
Policy Interest Rate (%)	0.25	0.25	0.25	0.38	0.88

(Source: Focus Economics, 2016c)

Figure C-7: Government Yield Curve

(Source: Quandl, 2016)

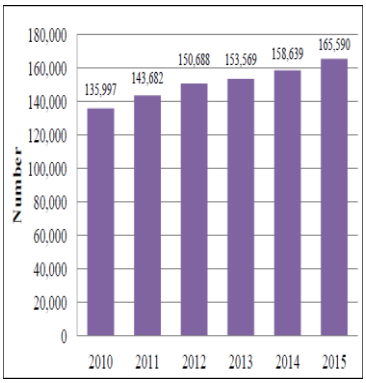
Figure C-8: Share of GDP by Industry



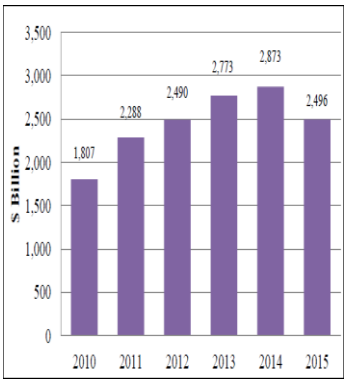
(Source: Department of Statistics Singapore, 2017)

Figure C-9: Services Sector from 2010 to 2015

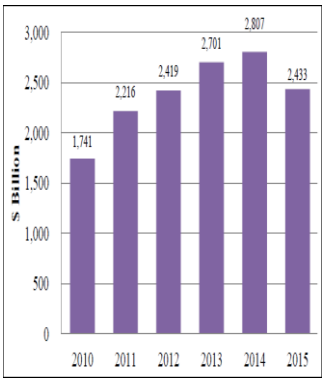
Number of Establishments



Operating Receipts

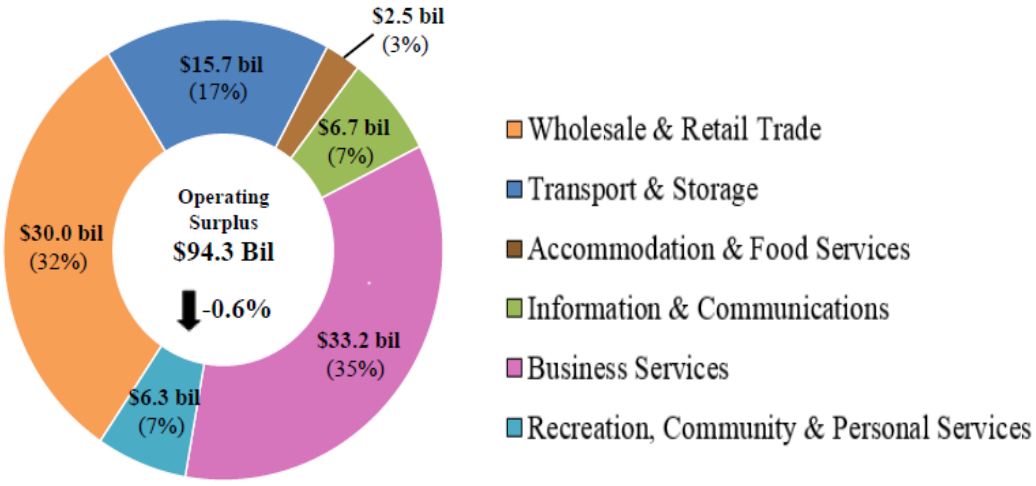


Operating Expenditure



(Source: Department of Statistics Singapore, 2015)

Figure C-10: Key Indicator of the Services Sector in 2015



(Source: Department of Statistics Singapore, 2015)

Appendix D: Singaporean-Listed Companies by Sector Wise

Manufacturing Industry

	Company	Year-End	Activities
1	ABR Holdings Ltd	31-Dec	Food Industry
2	AEI Corporation Ltd	31-Dec	Metal-Aluminium
3	Allied Technologies Ltd	31-Dec	Metal Processors & Fabrica
4	AP Oil International Ltd	31-Dec	Petrochemicals
5	ASL Marine Holdings Ltd	30-Jun	Shipbuilding
6	Aztech Group Ltd	31-Dec	Telecommunication Equip
7	BRC Asia Ltd*	31-Dec & 30-Sep	Steel-Specialty
8	Compact Metal Industries Ltd	31-Dec	Bldg Prod-Doors&Windows
9	Creative Technology Ltd	30-Jun	Computers-Periphery Equip
10	Fischer Tech Ltd	31-Mar	Rubber/Plastic Products
11	Food Empire Holdings Ltd	31-Dec	Food-Misc/Diversified
12	GP Batteries International Ltd	31-Mar	Batteries/Battery Sys
13	Hi-P International Ltd	31-Dec	Rubber/Plastic Products
14	Hoe Leong Corporation Ltd	31-Dec	Auto/Trk Prts&Equip-Repl
15	Hong Leong Asia Ltd	31-Dec	Bldg&Construct Prod-Misc
16	Innovalues Ltd	31-Dec	Office Automation&Equip
17	JEP Holdings Ltd	31-Dec	Semicon Compo-Intg Circu
18	Koda Ltd	30-Jun	Home Furnishings
19	Lee Metal Group Ltd	31-Dec	Steel-Specialty
20	Lereno Bio-Chem Ltd	31-Mar	Energy-Alternate Sources
21	LHT Holdings Ltd	31-Dec	Containers-Paper/Plastic
22	Low Keng Huat (Singapore) Ltd	31-Jan	Building&Construct-Misc
23	Matex International Ltd	31-Dec	Chemicals-Specialty
24	Metal Component Engineering Ltd	31-Dec	Metal Processors&Fabrica
25	Micro-Mechanics (Holdings) Ltd	30-Jun	Mach Tools & Rel Products
26	Miyoshi Precision Ltd	31-Aug	Metal Processors & Fabrica
27	Nippecraft Ltd	31-Dec	Office Supplies & Forms
28	Nobel Design Holdings Ltd	31-Dec	Interior Design/Architect
29	NSL Ltd	31-Dec	Bldg & Construct Prod-Misc
30	Petra Foods Ltd	31-Dec	Food-Confectionery
31	Rotary Engineering Ltd	31-Dec	Engineering Industry
32	Spindex Industries Ltd	30-Jun	Machinery-General Industry
33	Sunningdale Tech Ltd	31-Dec	Rubber/Plastic Products
34	Tat Seng Packaging Group Ltd	31-Dec	Containers-Paper/Plastic
35	Technics Oil & Gas Ltd	30-Sep	Engineering Industry
36	United Engineers Ltd	31-Dec	Building & Construct-Misc
37	Venture Corporation Ltd	31-Dec	Electronic Compo-Misc

Services Industry

	Company	Year-End	Activities
1	A-Sonic Aerospace Ltd	31-Dec	Commercial Services
2	Beng Kuang Marine Ltd	31-Dec	Marine Services
3	BH Global Corporation Ltd	31-Dec	Electric Products-Misc
4	CapitaLand Ltd	31-Dec	Consultancy Services
5	CEI Contract Manufacturing Ltd	31-Dec	Electronic Compo-Misc
6	Challenger Technologies Ltd	31-Dec	Retail-Computer Equip
7	CWTL	31-Dec	Warehousing & Harbour Trans Serv
8	Dairy Farm Int'l Holdings Ltd	31-Dec	Food-Retail
9	Global Yellow Pages Ltd	31-Mar	Publishing-Periodicals
10	Hanwell Holdings Ltd	31-Dec	Distribution/Wholesale
11	Hotel Grand Central Ltd	31-Dec	Hotels & Motels
12	Isetan (Singapore) Ltd	31-Dec	Retail-Regnl Dept Store
13	King Wan Corporation Ltd	31-Mar	Engineering/R&D Services
14	M1 Ltd	31-Dec	Cellular Telecom
15	Noel Gifts International Ltd	30-Jun	Retail-Misc/Diversified
16	Olam International Ltd	30-Jun	Food-Wholesale/Distrib
17	Osim International Ltd	31-Dec	Consumer Products-Misc
18	Poh Tiong Choon Logistics Ltd	31-Dec	Warehousing & Harbour Trans Serv
19	Raffles Medical Group Ltd	31-Dec	Medical-Hospitals
20	Sakae Holdings Ltd	31-Dec	Retail-Restaurants
21	Samudera Shipping Line Ltd	31-Dec	Transport-Marine
22	Sapphire Corporation Ltd	31-Dec	Steel-Producers
23	SBS Transit Ltd	31-Dec	Transport-Services
24	SIA Engineering Company Ltd	31-Mar	Commercial Services
25	Singapore Airlines Ltd	31-Mar	Airlines
26	Singapore Post Ltd	31-Mar	Transport-Services
27	Singapore Press Holdings Ltd	31-Aug	Publishing-Newspapers
28	Singapore Telecommunication Ltd	31-Mar	Telecom Services
29	Starhub Ltd	31-Dec	Telecom Services
30	Straco Corporation Ltd	31-Dec	Recreational Centers
31	Sunmoon Food Company Ltd*	30-Jun & 31-Dec	Food-Wholesale/Distrib
32	Swissco Holdings Ltd	31-Dec	Marine Services
33	Tye Soon Ltd	31-Dec	Import/Export

Other Business Activities

	Company	Year-End	Activities
1	Abterra Ltd*	30-Jun & 31-Dec	Varied Business Activities
2	City Developments Ltd	31-Dec	Property Developer
3	GSH Corporation Ltd	31-Dec	Distribution/Wholesale
4	Haw Par Corporation Ltd	31-Dec	Diversified Operations
5	Ho Bee Investment Ltd	31-Dec	Real Estate Oper/Develop
6	Hupsteel Ltd	30-Jun	Import/Export
7	Intraco Ltd	31-Dec	Varied Business Activities
8	ISDN Holdings Ltd	31-Dec	Instruments-Controls
9	Metro Holdings Ltd	31-Mar	Retail-Misc/Diversified
10	Moya Holdings Asia Ltd	31-Dec	Water Treatment Systems
11	Nera Telecommunications Ltd	31-Dec	Satellite Telecom
12	Pan Asian Holdings Ltd	31-Dec	Water Treatment Systems
13	Penguin International Ltd	31-Dec	Varied Business Activities
14	RH Petrogas Ltd	31-Dec	Oil Comp-Explor&Prodtn
15	San Teh Ltd	31-Dec	Building Prod-Cement/ Aggregate
16	Second Chance Properties Ltd*	30-Jun & 31-Aug	Retail-Jewellery
17	Stats Chippac Ltd	31-Dec	Electronic Compo-Semicon
18	Top Global Ltd	31-Dec	Property Developer
19	UOL Group Ltd	31-Dec	Real Estate Oper/Develop
20	Wheelock Properties (Singapore) Ltd*	31-Mar & 31-Dec	Real Estate Oper/Develop

***** Accounting year-end has been changed.

Appendix E: Panel Unit Root Test Summary

Variables for estimation of regression models are required to be stationary. The results of the Levin, Lin and Chu panel unit root test on the existence of a common unit root are presented in table below:

Exhibit E-1: Results of the Levin, Lin and Chu panel unit root test on the existence of a common unit root

Method	Statistic	Prob.**
ROE	-8.78880	0.0000
GEAR	-16.2088	0.0000
LNS	-6.94606	0.0000
RELCAP	-8.61682	0.0000
PROCAP	-18.5750	0.0000
HUMCAP	-40.2690	0.0000
INNCAP	-1.97907	0.0239
SPRET	-12.8028	0.0000
Pt+3	-26.7939	0.0000
EPS	-2.22788	0.0129
BVPS	-13.0677	0.0000

**Test assumes asymptotic normality

Appendix F (1): Panel Data Regression Workings for Intellectual Capital Components with Total Assets

Manufacturing Industry – Intellectual Capital with Total Assets

Fixed

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 20:34
Sample: 2005 2014
Periods included: 10
Cross-sections included: 37
Total panel (balanced) observations: 370

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.069045	0.533845	-0.129335	0.8972
HCTA	-1.378694	0.237920	-5.794781	0.0000
RELCTA	-0.072641	0.042260	-1.718920	0.0866
PRCTA	0.212869	0.921042	0.231117	0.8174
INCTA	-0.480058	1.216389	-0.394658	0.6934
GEAR	0.183049	0.104742	1.747621	0.0815
LNS	0.054374	0.043948	1.237231	0.2169
HCTA*INCTA	1.029293	4.732345	0.217502	0.8280
HCTA*PRCTA	-1.957645	2.292468	-0.853947	0.3938
HCTA*RELCTA	0.488345	0.175712	2.779235	0.0058

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.898319	Mean dependent var	0.407501
Adjusted R-squared	0.884197	S.D. dependent var	1.791744
S.E. of regression	0.609728	Akaike info criterion	1.964280
Sum squared resid	120.4528	Schwarz criterion	2.450824
Log likelihood	-317.3919	Hannan-Quinn criter.	2.157540
F-statistic	63.60991	Durbin-Watson stat	2.620265
Prob(F-statistic)	0.000000		

Random

Dependent Variable: ROE
Method: Panel EGLS (Cross-section random effects)
Date: 01/14/17 Time: 20:34
Sample: 2005 2014
Periods included: 10
Cross-sections included: 37
Total panel (balanced) observations: 370
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.304673	0.529589	0.575302	0.5654
HCTA	-1.375886	0.236440	-5.819164	0.0000
RELCTA	-0.076793	0.041366	-1.856421	0.0642
PRCTA	0.446397	0.895365	0.498564	0.6184
INCTA	0.339563	1.189318	0.285511	0.7754
GEAR	0.188252	0.103416	1.820338	0.0695
LNS	0.019802	0.040041	0.494535	0.6212
HCTA*INCTA	0.291600	4.659658	0.062580	0.9501
HCTA*PRCTA	-2.307565	2.245106	-1.027820	0.3047
HCTA*RELCTA	0.510275	0.172481	2.958447	0.0033

Effects Specification

	S.D.	Rho
Cross-section random	1.282420	0.8156
Idiosyncratic random	0.609728	0.1844

Weighted Statistics

R-squared	0.104045	Mean dependent var	0.060587
Adjusted R-squared	0.081646	S.D. dependent var	0.660419
S.E. of regression	0.632884	Sum squared resid	144.1954
F-statistic	4.645111	Durbin-Watson stat	2.210718
Prob(F-statistic)	0.000008		

Unweighted Statistics

R-squared	0.017611	Mean dependent var	0.407501
Sum squared resid	1163.756	Durbin-Watson stat	0.273919

Fixed is better than Random

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	36.864002	9	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
HCTA	-1.378694	-1.375886	0.000702	0.9156
RELCTA	-0.072641	-0.076793	0.000075	0.6310
PRCTA	0.212869	0.446397	0.046639	0.2795
INCTA	-0.480058	0.339563	0.065124	0.0013
GEAR	0.183049	0.188252	0.000276	0.7541
LNS	0.054374	0.019802	0.000328	0.0563
HCTA*INCTA	1.029293	0.291600	0.682672	0.3719
HCTA*PRCTA	-1.957645	-2.307565	0.214908	0.4504
HCTA*RELCTA	0.488345	0.510275	0.001125	0.5133

Cross-section random effects test equation:
Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 20:35
Sample: 2005 2014
Periods included: 10
Cross-sections included: 37
Total panel (balanced) observations: 370

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.069045	0.533845	-0.129335	0.8972
HCTA	-1.378694	0.237920	-5.794781	0.0000
RELCTA	-0.072641	0.042260	-1.718920	0.0866
PRCTA	0.212869	0.921042	0.231117	0.8174
INCTA	-0.480058	1.216389	-0.394658	0.6934
GEAR	0.183049	0.104742	1.747621	0.0815
LNS	0.054374	0.043948	1.237231	0.2169
HCTA*INCTA	1.029293	4.732345	0.217502	0.8280
HCTA*PRCTA	-1.957645	2.292468	-0.853947	0.3938
HCTA*RELCTA	0.488345	0.175712	2.779235	0.0058

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.898319	Mean dependent var	0.407501
Adjusted R-squared	0.884197	S.D. dependent var	1.791744
S.E. of regression	0.609728	Akaike info criterion	1.964280
Sum squared resid	120.4528	Schwarz criterion	2.450824
Log likelihood	-317.3919	Hannan-Quinn criter.	2.157540
F-statistic	63.60991	Durbin-Watson stat	2.620265
Prob(F-statistic)	0.000000		

Services Industry – Intellectual Capital with Total Assets

Fixed

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 21:17
Sample: 2005 2014
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.198649	0.916170	0.216825	0.8285
HCTA	1.446258	0.818815	1.766281	0.0784
RELCTA	0.029808	0.059318	0.502508	0.6157
PRCTA	-3.150203	0.662782	-4.753001	0.0000
INCTA	1.382099	0.961369	1.437637	0.1516
GEAR	0.333431	0.024390	13.67084	0.0000
LNS	-0.014002	0.068062	-0.205724	0.8372
HCTA*INCTA	-8.369500	3.313101	-2.526183	0.0121
HCTA*PRCTA	3.614686	1.116576	3.237296	0.0013
HCTA*RELCTA	-0.207543	0.115024	-1.804352	0.0722

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.619074	Mean dependent var	0.294487
Adjusted R-squared	0.564845	S.D. dependent var	1.200580
S.E. of regression	0.791978	Akaike info criterion	2.489847
Sum squared resid	180.6421	Schwarz criterion	2.973368
Log likelihood	-368.8248	Hannan-Quinn criter.	2.682717
F-statistic	11.41590	Durbin-Watson stat	2.365254
Prob(F-statistic)	0.000000		

Random

Dependent Variable: ROE
Method: Panel EGLS (Cross-section random effects)
Date: 01/14/17 Time: 21:18
Sample: 2005 2014
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.201625	0.321029	0.628059	0.5304
HCTA	0.240878	0.347212	0.693750	0.4883
RELCTA	0.009711	0.038133	0.254663	0.7991
PRCTA	-1.307759	0.437103	-2.991878	0.0030
INCTA	0.111945	0.461642	0.242493	0.8086
GEAR	0.329565	0.019661	16.76227	0.0000
LNS	-0.010583	0.024463	-0.432597	0.6656
HCTA*INCTA	-2.421173	2.368031	-1.022442	0.3073
HCTA*PRCTA	2.838645	0.787242	3.605808	0.0004
HCTA*RELCTA	-0.120080	0.073070	-1.643354	0.1013

Effects Specification		
	S.D.	Rho
Cross-section random	0.150645	0.0349
Idiosyncratic random	0.791978	0.9651

Weighted Statistics

R-squared	0.503284	Mean dependent var	0.252352
Adjusted R-squared	0.489314	S.D. dependent var	1.144615
S.E. of regression	0.817968	Sum squared resid	214.1029
F-statistic	36.02570	Durbin-Watson stat	2.138679
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.528977	Mean dependent var	0.294487
Sum squared resid	223.3678	Durbin-Watson stat	2.049971

Fixed is better than Random

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	30.347037	9	0.0004

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
HCTA	1.446258	0.240878	0.549902	0.1041
RELCTA	0.029808	0.009711	0.002064	0.6583
PRCTA	-3.150203	-1.307759	0.248221	0.0002
INCTA	1.382099	0.111945	0.711116	0.1320
GEAR	0.333431	0.329565	0.000208	0.7888
LNS	-0.014002	-0.010583	0.004034	0.9571
HCTA*INCTA	-8.369500	-2.421173	5.369067	0.0103
HCTA*PRCTA	3.614686	2.838645	0.626991	0.3271
HCTA*RELCTA	-0.207543	-0.120080	0.007891	0.3248

Cross-section random effects test equation:
Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 21:18
Sample: 2005 2014
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.198649	0.916170	0.216825	0.8285
HCTA	1.446258	0.818815	1.766281	0.0784
RELCTA	0.029808	0.059318	0.502508	0.6157
PRCTA	-3.150203	0.662782	-4.753001	0.0000
INCTA	1.382099	0.961369	1.437637	0.1516
GEAR	0.333431	0.024390	13.67084	0.0000
LNS	-0.014002	0.068062	-0.205724	0.8372
HCTA*INCTA	-8.369500	3.313101	-2.526183	0.0121
HCTA*PRCTA	3.614686	1.116576	3.237296	0.0013
HCTA*RELCTA	-0.207543	0.115024	-1.804352	0.0722

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.619074	Mean dependent var	0.294487
Adjusted R-squared	0.564845	S.D. dependent var	1.200580
S.E. of regression	0.791978	Akaike info criterion	2.489847
Sum squared resid	180.6421	Schwarz criterion	2.973368
Log likelihood	-368.8248	Hannan-Quinn criter.	2.682717
F-statistic	11.41590	Durbin-Watson stat	2.365254
Prob(F-statistic)	0.000000		

Other Business Activities – Intellectual Capital with Total Assets

Fixed

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 21:10
Sample: 2005 2014
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.038575	0.194997	-0.197824	0.8434
HCTA	-1.612145	0.399882	-4.031550	0.0001
RELCTA	0.102049	0.023446	4.352579	0.0000
PRCTA	-0.176141	0.121152	-1.453879	0.1478
INCTA	1.896687	0.437468	4.335602	0.0000
GEAR	0.288014	0.041064	7.013791	0.0000
LNS	-0.002703	0.014947	-0.180845	0.8567
HCTA*INCTA	-4.081510	3.094800	-1.318828	0.1890
HCTA*PRCTA	0.572963	0.070180	8.164233	0.0000
HCTA*RELCTA	-0.138412	0.022211	-6.231747	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.696444	Mean dependent var	0.018812
Adjusted R-squared	0.646739	S.D. dependent var	0.387794
S.E. of regression	0.230489	Akaike info criterion	0.036115
Sum squared resid	9.084367	Schwarz criterion	0.514371
Log likelihood	25.38853	Hannan-Quinn criter.	0.229658
F-statistic	14.01152	Durbin-Watson stat	2.146197
Prob(F-statistic)	0.000000		

Random

Dependent Variable: ROE
Method: Panel EGLS (Cross-section random effects)
Date: 01/14/17 Time: 21:12
Sample: 2005 2014
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.023481	0.119035	-0.197265	0.8438
HCTA	-1.575303	0.272165	-5.788045	0.0000
RELCTA	0.096743	0.018889	5.121676	0.0000
PRCTA	0.002408	0.112783	0.021352	0.9830
INCTA	-0.188064	0.211064	-0.891028	0.3740
GEAR	0.063489	0.029553	2.148327	0.0330
LNS	0.007258	0.009305	0.780080	0.4363
HCTA*INCTA	4.452639	2.404506	1.851790	0.0656
HCTA*PRCTA	0.554802	0.059741	9.286808	0.0000
HCTA*RELCTA	-0.144547	0.019871	-7.274327	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	0.072663	0.0904
Idiosyncratic random	0.230489	0.9096

Weighted Statistics

R-squared	0.510986	Mean dependent var	0.013322
Adjusted R-squared	0.487822	S.D. dependent var	0.374427
S.E. of regression	0.267964	Sum squared resid	13.64294
F-statistic	22.05968	Durbin-Watson stat	1.981207
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.466408	Mean dependent var	0.018812
Sum squared resid	15.96852	Durbin-Watson stat	1.692673

Fixed is better than Random

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	75.808520	9	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
HCTA	-1.612145	-1.575303	0.085832	0.8999
RELCTA	0.102049	0.096743	0.000193	0.7024
PRCTA	-0.176141	0.002408	0.001958	0.0001
INCTA	1.896687	-0.188064	0.146830	0.0000
GEAR	0.288014	0.063489	0.000813	0.0000
LNS	-0.002703	0.007258	0.000137	0.3945
HCTA*INCTA	-4.081510	4.452639	3.796141	0.0000
HCTA*PRCTA	0.572963	0.554802	0.001356	0.6219
HCTA*RELCTA	-0.138412	-0.144547	0.000098	0.5364

Cross-section random effects test equation:
Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 21:12
Sample: 2005 2014
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.038575	0.194997	-0.197824	0.8434
HCTA	-1.612145	0.399882	-4.031550	0.0001
RELCTA	0.102049	0.023446	4.352579	0.0000
PRCTA	-0.176141	0.121152	-1.453879	0.1478
INCTA	1.896687	0.437468	4.335602	0.0000
GEAR	0.288014	0.041064	7.013791	0.0000
LNS	-0.002703	0.014947	-0.180845	0.8567
HCTA*INCTA	-4.081510	3.094800	-1.318828	0.1890
HCTA*PRCTA	0.572963	0.070180	8.164233	0.0000
HCTA*RELCTA	-0.138412	0.022211	-6.231747	0.0000

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.696444	Mean dependent var	0.018812
Adjusted R-squared	0.646739	S.D. dependent var	0.387794
S.E. of regression	0.230489	Akaike info criterion	0.036115
Sum squared resid	9.084367	Schwarz criterion	0.514371
Log likelihood	25.38853	Hannan-Quinn criter.	0.229658
F-statistic	14.01152	Durbin-Watson stat	2.146197
Prob(F-statistic)	0.000000		

All Companies – Intellectual Capital with Total Assets

Fixed

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 18:34
Sample: 2005 2014
Periods included: 10
Cross-sections included: 90
Total panel (balanced) observations: 900

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.163033	0.334630	0.487204	0.6262
HCTA	-0.831645	0.196521	-4.231837	0.0000
RELCTA	-0.031399	0.023453	-1.338808	0.1810
PRCTA	-0.695283	0.217934	-3.190341	0.0015
INCTA	0.925574	0.493372	1.876019	0.0610
GEAR	0.305979	0.019018	16.08867	0.0000
LNS	0.018528	0.025785	0.718571	0.4726
HCTA*INCTA	-3.949956	1.962116	-2.013110	0.0444
HCTA*PRCTA	0.026183	0.074895	0.349597	0.7267
HCTA*RELCTA	0.064078	0.030802	2.080330	0.0378

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.800364	Mean dependent var	0.279687
Adjusted R-squared	0.775939	S.D. dependent var	1.378562
S.E. of regression	0.652544	Akaike info criterion	2.087589
Sum squared resid	341.0765	Schwarz criterion	2.615852
Log likelihood	-840.4150	Hannan-Quinn criter.	2.289389
F-statistic	32.76836	Durbin-Watson stat	2.479747
Prob(F-statistic)	0.000000		

Random

Dependent Variable: ROE
Method: Panel EGLS (Cross-section random effects)
Date: 01/14/17 Time: 18:35
Sample: 2005 2014
Periods included: 10
Cross-sections included: 90
Total panel (balanced) observations: 900
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.285662	0.311623	0.916691	0.3596
HCTA	-0.831471	0.189990	-4.376386	0.0000
RELCTA	-0.027923	0.022765	-1.226586	0.2203
PRCTA	-0.547165	0.202645	-2.700120	0.0071
INCTA	0.885030	0.460259	1.922898	0.0548
GEAR	0.299316	0.018567	16.12091	0.0000
LNS	0.005926	0.022627	0.261901	0.7935
HCTA*INCTA	-2.042486	1.833394	-1.114046	0.2656
HCTA*PRCTA	0.051829	0.073596	0.704247	0.4815
HCTA*RELCTA	0.048840	0.030173	1.618677	0.1059

Effects Specification

	S.D.	Rho
Cross-section random	1.034723	0.7155
Idiosyncratic random	0.652544	0.2845

Weighted Statistics

R-squared	0.260372	Mean dependent var	0.054700
Adjusted R-squared	0.252893	S.D. dependent var	0.762378
S.E. of regression	0.658964	Sum squared resid	386.4678
F-statistic	34.81197	Durbin-Watson stat	2.209627
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.121292	Mean dependent var	0.279687
Sum squared resid	1501.264	Durbin-Watson stat	0.568820

Fixed is better than Random

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

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	26.599060	9	0.0016

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
HCTA	-0.831645	-0.831471	0.002524	0.9972
RELCTA	-0.031399	-0.027923	0.000032	0.5377
PRCTA	-0.695283	-0.547165	0.006430	0.0647
INCTA	0.925574	0.885030	0.031577	0.8195
GEAR	0.305979	0.299316	0.000017	0.1057
LNS	0.018528	0.005926	0.000153	0.3081
HCTA*INCTA	-3.949956	-2.042486	0.488567	0.0064
HCTA*PRCTA	0.026183	0.051829	0.000193	0.0649
HCTA*RELCTA	0.064078	0.048840	0.000038	0.0139

Cross-section random effects test equation:
Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/14/17 Time: 18:57
Sample: 2005 2014
Periods included: 10
Cross-sections included: 90
Total panel (balanced) observations: 900

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.163033	0.334630	0.487204	0.6262
HCTA	-0.831645	0.196521	-4.231837	0.0000
RELCTA	-0.031399	0.023453	-1.338808	0.1810
PRCTA	-0.695283	0.217934	-3.190341	0.0015
INCTA	0.925574	0.493372	1.876019	0.0610
GEAR	0.305979	0.019018	16.08867	0.0000
LNS	0.018528	0.025785	0.718571	0.4726
HCTA*INCTA	-3.949956	1.962116	-2.013110	0.0444
HCTA*PRCTA	0.026183	0.074895	0.349597	0.7267
HCTA*RELCTA	0.064078	0.030802	2.080330	0.0378

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.800364	Mean dependent var	0.279687
Adjusted R-squared	0.775939	S.D. dependent var	1.378562
S.E. of regression	0.652544	Akaike info criterion	2.087589
Sum squared resid	341.0765	Schwarz criterion	2.615852
Log likelihood	-840.4150	Hannan-Quinn criter.	2.289389
F-statistic	32.76836	Durbin-Watson stat	2.479747
Prob(F-statistic)	0.000000		

Appendix F (2): Panel Data Regression Workings for Intellectual Capital Components with Share Price

Manufacturing Industry – Intellectual Capital with Share Price

Price 3 Fixed

Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/16/16 Time: 23:24
Sample: 2005 2014
Periods included: 10
Cross-sections included: 37
Total panel (balanced) observations: 370

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.137013	0.569592	1.996191	0.0468
BVPS	0.235758	0.126450	1.864442	0.0632
EPS	-0.168290	0.184998	-0.909686	0.3637
HUMCAP	1.167829	0.819360	1.425294	0.1550
RELCAP	-0.029664	0.026517	-1.118690	0.2641
PROCAP	1.441243	0.344737	4.180707	0.0000
INNCAP	1.403769	0.573772	2.446562	0.0150
HUMCAP*INNCAP	-2.569985	0.589033	-4.363059	0.0000
HUMCAP*PROCAP	-2.334097	0.372965	-6.258220	0.0000
HUMCAP*RELCAP	0.159059	0.055843	2.848321	0.0047
LNS	-0.062622	0.047404	-1.321029	0.1874

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.917046	Mean dependent var	0.887156
Adjusted R-squared	0.905232	S.D. dependent var	1.903044
S.E. of regression	0.585841	Akaike info criterion	1.886668
Sum squared resid	110.8569	Schwarz criterion	2.383789
Log likelihood	-302.0336	Hannan-Quinn criter.	2.084129
F-statistic	77.62414	Durbin-Watson stat	1.552288
Prob(F-statistic)	0.000000		

Price 3 Random

Dependent Variable: PT_3
Method: Panel EGLS (Cross-section random effects)
Date: 04/16/16 Time: 23:25
Sample: 2005 2014
Periods included: 10
Cross-sections included: 37
Total panel (balanced) observations: 370
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.699935	0.235687	-2.969763	0.0032
BVPS	0.674073	0.080833	8.339038	0.0000
EPS	-0.004526	0.175648	-0.025765	0.9795
HUMCAP	-0.790126	0.405750	-1.947322	0.0523
RELCAP	-0.101799	0.018612	-5.469576	0.0000
PROCAP	-0.136888	0.229754	-0.595800	0.5517
INNCAP	3.370699	0.438870	7.680413	0.0000
HUMCAP*INNCAP	-2.375391	0.515107	-4.611451	0.0000
HUMCAP*PROCAP	-1.318047	0.248133	-5.311851	0.0000
HUMCAP*RELCAP	0.202507	0.045538	4.446988	0.0000
LNS	0.079726	0.020101	3.966275	0.0001

Effects Specification	S.D.	Rho
Cross-section random	0.147439	0.0596
Idiosyncratic random	0.585841	0.9404

Weighted Statistics			
R-squared	0.783128	Mean dependent var	0.694155
Adjusted R-squared	0.777087	S.D. dependent var	1.564261
S.E. of regression	0.738545	Sum squared resid	195.8161
F-statistic	129.6354	Durbin-Watson stat	0.971399
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.836989	Mean dependent var	0.887156
Sum squared resid	217.8418	Durbin-Watson stat	0.873182

Fixed is better than Random

Correlated Random Effects - Hausman Test
Equation: PRICE3RANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	221.542851	10	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
BVPS	0.235758	0.674073	0.009455	0.0000
EPS	-0.168290	-0.004526	0.003372	0.0048
HUMCAP	1.167829	-0.790126	0.506718	0.0059
RELCAP	-0.029664	-0.101799	0.000357	0.0001
PROCAP	1.441243	-0.136888	0.066056	0.0000
INNCAP	1.403769	3.370699	0.136608	0.0000
HUMCAP*INNCAP	-2.569985	-2.375391	0.081624	0.4958
HUMCAP*PROCAP	-2.334097	-1.318047	0.077533	0.0003
HUMCAP*RELCAP	0.159059	0.202507	0.001045	0.1789
LNS	-0.062622	0.079726	0.001843	0.0009

Cross-section random effects test equation:
Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/17/16 Time: 10:17
Sample: 2005 2014
Periods included: 10
Cross-sections included: 37
Total panel (balanced) observations: 370

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.137013	0.569592	1.996191	0.0468
BVPS	0.235758	0.126450	1.864442	0.0632
EPS	-0.168290	0.184998	-0.909686	0.3637
HUMCAP	1.167829	0.819360	1.425294	0.1550
RELCAP	-0.029664	0.026517	-1.118690	0.2641
PROCAP	1.441243	0.344737	4.180707	0.0000
INNCAP	1.403769	0.573772	2.446562	0.0150
HUMCAP*INNCAP	-2.569985	0.589033	-4.363059	0.0000
HUMCAP*PROCAP	-2.334097	0.372965	-6.258220	0.0000
HUMCAP*RELCAP	0.159059	0.055843	2.848321	0.0047
LNS	-0.062622	0.047404	-1.321029	0.1874

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.917046	Mean dependent var	0.887156
Adjusted R-squared	0.905232	S.D. dependent var	1.903044
S.E. of regression	0.585841	Akaike info criterion	1.886668
Sum squared resid	110.8569	Schwarz criterion	2.383789
Log likelihood	-302.0336	Hannan-Quinn criter.	2.084129
F-statistic	77.62414	Durbin-Watson stat	1.552288
Prob(F-statistic)	0.000000		

Services Industry – Intellectual Capital with Share Price

Price 3 Fixed

Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/16/16 Time: 22:23
Sample: 2005 2014
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.299968	0.919872	2.500313	0.0130
BVPS	-0.042397	0.149961	-0.282718	0.7776
EPS	2.029260	0.402948	5.036038	0.0000
HUMCAP	-0.408472	1.133367	-0.360406	0.7188
RELCAP	-0.000097	0.049201	-0.001962	0.9984
PROCAP	1.814475	1.977939	0.917357	0.3597
INNCAP	0.416866	0.566292	0.736134	0.4623
HUMCAP*INNCAP	-1.911360	1.104643	-1.730297	0.0847
HUMCAP*PROCAP	2.600359	1.351493	1.924063	0.0553
HUMCAP*RELCAP	0.017033	0.066845	0.254814	0.7990
LNS	-0.073070	0.069304	-1.054334	0.2926

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.945301	Mean dependent var	1.872458
Adjusted R-squared	0.937296	S.D. dependent var	2.959616
S.E. of regression	0.741109	Akaike info criterion	2.359656
Sum squared resid	157.6324	Schwarz criterion	2.854690
Log likelihood	-346.3433	Hannan-Quinn criter.	2.557118
F-statistic	118.0929	Durbin-Watson stat	1.191299
Prob(F-statistic)	0.000000		

Price 3 Random

Dependent Variable: PT_3
Method: Panel EGLS (Cross-section random effects)
Date: 04/16/16 Time: 22:24
Sample: 2005 2014
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.179940	0.601873	-1.960447	0.0508
BVPS	0.585049	0.086980	6.726232	0.0000
EPS	1.539821	0.364591	4.223414	0.0000
HUMCAP	1.552433	0.617324	2.514779	0.0124
RELCAP	-0.055388	0.037041	-1.495324	0.1358
PROCAP	0.868298	0.949982	0.914015	0.3614
INNCAP	-0.033650	0.482403	-0.069756	0.9444
HUMCAP*INNCAP	-0.871512	1.079705	-0.807175	0.4202
HUMCAP*PROCAP	3.314664	0.906036	3.658426	0.0003
HUMCAP*RELCAP	-0.071135	0.047768	-1.489188	0.1374
LNS	0.130321	0.047320	2.754033	0.0062

Effects Specification

	S.D.	Rho
Cross-section random	0.721119	0.4863
Idiosyncratic random	0.741109	0.5137

Weighted Statistics

R-squared	0.585898	Mean dependent var	0.578740
Adjusted R-squared	0.572917	S.D. dependent var	1.236619
S.E. of regression	0.808150	Sum squared resid	208.3408
F-statistic	45.13425	Durbin-Watson stat	0.954828
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.830974	Mean dependent var	1.872458
Sum squared resid	487.1014	Durbin-Watson stat	0.408395

Fixed is better than Random

Correlated Random Effects - Hausman Test
Equation: PT_3SRANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	70.324262	10	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
BVPS	-0.042397	0.585049	0.014923	0.0000
EPS	2.029260	1.539821	0.029440	0.0043
HUMCAP	-0.408472	1.552433	0.903432	0.0391
RELCAP	-0.000097	-0.055388	0.001049	0.0877
PROCAP	1.814475	0.868298	3.009776	0.5855
INNCAP	0.416866	-0.033650	0.087974	0.1288
HUMCAP*INNCAP	-1.911360	-0.871512	0.054472	0.0000
HUMCAP*PROCAP	2.600359	3.314664	1.005633	0.4763
HUMCAP*RELCAP	0.017033	-0.071135	0.002187	0.0594
LNS	-0.073070	0.130321	0.002564	0.0001

Cross-section random effects test equation:
Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/17/16 Time: 10:44
Sample: 2005 2014
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.299968	0.919872	2.500313	0.0130
BVPS	-0.042397	0.149961	-0.282718	0.7776
EPS	2.029260	0.402948	5.036038	0.0000
HUMCAP	-0.408472	1.133367	-0.360406	0.7188
RELCAP	-9.66E-05	0.049201	-0.001962	0.9984
PROCAP	1.814475	1.977939	0.917357	0.3597
INNCAP	0.416866	0.566292	0.736134	0.4623
HUMCAP*INNCAP	-1.911360	1.104643	-1.730297	0.0847
HUMCAP*PROCAP	2.600359	1.351493	1.924063	0.0553
HUMCAP*RELCAP	0.017033	0.066845	0.254814	0.7990
LNS	-0.073070	0.069304	-1.054334	0.2926

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.945301	Mean dependent var	1.872458
Adjusted R-squared	0.937296	S.D. dependent var	2.959616
S.E. of regression	0.741109	Akaike info criterion	2.359656
Sum squared resid	157.6324	Schwarz criterion	2.854690
Log likelihood	-346.3433	Hannan-Quinn criter.	2.557118
F-statistic	118.0929	Durbin-Watson stat	1.191299
Prob(F-statistic)	0.000000		

Other Business Activities – Intellectual Capital with Share Price

Price 3 Fixed

Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/16/16 Time: 23:41
Sample: 2005 2014
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.773952	0.554935	1.394670	0.1649
BVPS	0.525555	0.081771	6.427116	0.0000
EPS	0.551709	0.517110	1.066909	0.2875
HUMCAP	6.659404	3.190098	2.087524	0.0383
RELCAP	0.358214	0.246391	1.453845	0.1478
PROCAP	-8.205264	3.346621	-2.451806	0.0152
INNCAP	2.121035	1.395344	1.520081	0.1303
HUMCAP*INNCAP	-17.71194	11.89807	-1.488639	0.1384
HUMCAP*PROCAP	3.936832	9.866214	0.399022	0.6904
HUMCAP*RELCAP	-2.793487	0.956021	-2.921992	0.0040
LNS	-0.005453	0.042827	-0.127317	0.8988

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.951658	Mean dependent var	1.523000
Adjusted R-squared	0.943412	S.D. dependent var	2.772943
S.E. of regression	0.659637	Akaike info criterion	2.143227
Sum squared resid	73.97055	Schwarz criterion	2.637974
Log likelihood	-184.3227	Hannan-Quinn criter.	2.343443
F-statistic	115.4006	Durbin-Watson stat	2.065522
Prob(F-statistic)	0.000000		

Price 3 Random

Dependent Variable: PT_3
Method: Panel EGLS (Cross-section random effects)
Date: 04/16/16 Time: 23:42
Sample: 2005 2014
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.023165	0.339315	0.068270	0.9456
BVPS	0.658098	0.040075	16.42183	0.0000
EPS	0.410602	0.377322	1.088201	0.2779
HUMCAP	5.650358	1.882613	3.001337	0.0031
PROCAP	-4.517236	1.770193	-2.551833	0.0115
RELCAP	0.191655	0.141514	1.354323	0.1773
INNCAP	1.714664	0.821588	2.087012	0.0382
HUMCAP*INNCAP	-18.37530	9.350438	-1.965181	0.0509
HUMCAP*PROCAP	28.19564	5.930597	4.754267	0.0000
HUMCAP*RELCAP	-3.510059	0.766513	-4.579257	0.0000
LNS	-0.003670	0.029909	-0.122699	0.9025

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.659637	1.0000

Weighted Statistics			
R-squared	0.941995	Mean dependent var	1.523000
Adjusted R-squared	0.938926	S.D. dependent var	2.772943
S.E. of regression	0.685281	Sum squared resid	88.75639
F-statistic	306.9346	Durbin-Watson stat	1.964864
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.941995	Mean dependent var	1.523000
Sum squared resid	88.75639	Durbin-Watson stat	1.964864

Fixed is better than Random

Correlated Random Effects - Hausman Test
Equation: PRICE3ORANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	27.902259	10	0.0019

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
BVPS	0.525555	0.658098	0.005081	0.0630
EPS	0.551709	0.410602	0.125031	0.6898
HUMCAP	6.659404	5.650358	6.632490	0.6952
RELCAP	0.358214	0.191655	0.040682	0.4089
PROCAP	-8.205264	-4.517236	8.066288	0.1941
INNCAP	2.121035	1.714664	1.271978	0.7186
HUMCAP*INNCAP	-17.711937	-18.375301	54.133412	0.9282
HUMCAP*PROCAP	3.936832	28.195644	62.170197	0.0021
HUMCAP*RELCAP	-2.793487	-3.510059	0.326435	0.2098
LNS	-0.005453	-0.003670	0.000940	0.9536

Cross-section random effects test equation:
Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/17/16 Time: 10:57
Sample: 2005 2014
Periods included: 10
Cross-sections included: 20
Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.773952	0.554935	1.394670	0.1649
BVPS	0.525555	0.081771	6.427116	0.0000
EPS	0.551709	0.517110	1.066909	0.2875
HUMCAP	6.659404	3.190098	2.087524	0.0383
RELCAP	0.358214	0.246391	1.453845	0.1478
PROCAP	-8.205264	3.346621	-2.451806	0.0152
INNCAP	2.121035	1.395344	1.520081	0.1303
HUMCAP*INNCAP	-17.71194	11.89807	-1.488639	0.1384
HUMCAP*PROCAP	3.936832	9.866214	0.399022	0.6904
HUMCAP*RELCAP	-2.793487	0.956021	-2.921992	0.0040
LNS	-0.005453	0.042827	-0.127317	0.8988

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.951658	Mean dependent var	1.523000
Adjusted R-squared	0.943412	S.D. dependent var	2.772943
S.E. of regression	0.659637	Akaike info criterion	2.143227
Sum squared resid	73.97055	Schwarz criterion	2.637974
Log likelihood	-184.3227	Hannan-Quinn criter.	2.343443
F-statistic	115.4006	Durbin-Watson stat	2.065522
Prob(F-statistic)	0.000000		

All Companies – Intellectual Capital with Share Price

Price3 Fixed

Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/17/16 Time: 09:45
Sample: 2005 2014
Periods included: 10
Cross-sections included: 90
Total panel (balanced) observations: 900

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.343830	0.392775	3.421373	0.0007
BVPS	0.294323	0.057052	5.158870	0.0000
EPS	0.264352	0.175810	1.503624	0.1331
HUMCAP	1.395106	0.572494	2.436893	0.0150
RELCAP	0.002444	0.023307	0.104877	0.9165
PROCAP	1.578660	0.265785	5.939605	0.0000
INNCAP	-0.144223	0.358280	-0.402543	0.6874
HUMCAP*INNCAP	-0.619970	0.392577	-1.579230	0.1147
HUMCAP*PROCAP	-0.168377	0.327314	-0.514419	0.6071
HUMCAP*RELCAP	0.008262	0.038279	0.215825	0.8292
LNS	-0.058531	0.030939	-1.891825	0.0589

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.928686	Mean dependent var	1.389732
Adjusted R-squared	0.919860	S.D. dependent var	2.566629
S.E. of regression	0.726585	Akaike info criterion	2.303517
Sum squared resid	422.3406	Schwarz criterion	2.837116
Log likelihood	-936.5825	Hannan-Quinn criter.	2.507355
F-statistic	105.2317	Durbin-Watson stat	1.282664
Prob(F-statistic)	0.000000		

Price 3 Random

Dependent Variable: PT_3
Method: Panel EGLS (Cross-section random effects)
Date: 04/17/16 Time: 09:47
Sample: 2005 2014
Periods included: 10
Cross-sections included: 90
Total panel (balanced) observations: 900
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021691	0.341695	0.063482	0.9494
BVPS	0.464633	0.044390	10.46707	0.0000
EPS	0.366306	0.171387	2.137307	0.0328
HUMCAP	2.124776	0.429055	4.952220	0.0000
RELCAP	0.000350	0.020834	0.016804	0.9866
PROCAP	1.299201	0.243250	5.341021	0.0000
INNCAP	0.345885	0.322899	1.071185	0.2844
HUMCAP*INNCAP	-0.615201	0.353904	-1.738326	0.0825
HUMCAP*PROCAP	-0.055375	0.304858	-0.181642	0.8559
HUMCAP*RELCAP	-0.038488	0.033680	-1.142762	0.2534
LNS	0.020674	0.026556	0.778506	0.4365

Effects Specification	S.D.	Rho
Cross-section random	0.965660	0.6385
Idiosyncratic random	0.726585	0.3615

Weighted Statistics

R-squared	0.396082	Mean dependent var	0.321688
Adjusted R-squared	0.389288	S.D. dependent var	0.981439
S.E. of regression	0.766975	Sum squared resid	522.9550
F-statistic	58.30532	Durbin-Watson stat	1.041396
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.667362	Mean dependent var	1.389732
Sum squared resid	1969.963	Durbin-Watson stat	0.276453

Fixed is better than Random

Correlated Random Effects - Hausman Test
Equation: PRICE3RANDOM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	111.584323	10	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
BVPS	0.294323	0.464633	0.001284	0.0000
EPS	0.264352	0.366306	0.001536	0.0093
HUMCAP	1.395106	2.124776	0.143661	0.0542
RELCAP	0.002444	0.000350	0.000109	0.8411
PROCAP	1.578660	1.299201	0.011472	0.0091
INNCAP	-0.144223	0.345885	0.024100	0.0016
HUMCAP*INNCAP	-0.619970	-0.615201	0.028869	0.9776
HUMCAP*PROCAP	-0.168377	-0.055375	0.014196	0.3429
HUMCAP*RELCAP	0.008262	-0.038488	0.000331	0.0102
LNS	-0.058531	0.020674	0.000252	0.0000

Cross-section random effects test equation:
Dependent Variable: PT_3
Method: Panel Least Squares
Date: 04/17/16 Time: 09:52
Sample: 2005 2014
Periods included: 10
Cross-sections included: 90
Total panel (balanced) observations: 900

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.343830	0.392775	3.421373	0.0007
BVPS	0.294323	0.057052	5.158870	0.0000
EPS	0.264352	0.175810	1.503624	0.1331
HUMCAP	1.395106	0.572494	2.436893	0.0150
RELCAP	0.002444	0.023307	0.104877	0.9165
PROCAP	1.578660	0.265785	5.939605	0.0000
INNCAP	-0.144223	0.358280	-0.402543	0.6874
HUMCAP*INNCAP	-0.619970	0.392577	-1.579230	0.1147
HUMCAP*PROCAP	-0.168377	0.327314	-0.514419	0.6071
HUMCAP*RELCAP	0.008262	0.038279	0.215825	0.8292
LNS	-0.058531	0.030939	-1.891825	0.0589

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.928686	Mean dependent var	1.389732
Adjusted R-squared	0.919860	S.D. dependent var	2.566629
S.E. of regression	0.726585	Akaike info criterion	2.303517
Sum squared resid	422.3406	Schwarz criterion	2.837116
Log likelihood	-936.5825	Hannan-Quinn criter.	2.507355
F-statistic	105.2317	Durbin-Watson stat	1.282664
Prob(F-statistic)	0.000000		

Appendix F (3): Panel Data Regression Workings for Intellectual Capital Components with One-Year Change in Share Price

Manufacturing Industry – Intellectual Capital with One-Year Change in Share Price

Price 3 Diff

Dependent Variable: DPT_3
Method: Panel Generalized Method of Moments
Transformation: First Differences
Date: 04/16/16 Time: 23:27
Sample (adjusted): 2009 2014
Periods included: 6
Cross-sections included: 37
Total panel (balanced) observations: 222
White period instrument weighting matrix
White period standard errors & covariance (d.f. corrected)
Instrument specification: @DYN(DPT_3,-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPT_3(-1)	-0.352211	0.010432	-33.76133	0.0000
DPT_3(-2)	-0.448912	0.007773	-57.75223	0.0000
DEPS	-0.090321	0.015262	-5.918130	0.0000
DBVPS	0.688870	0.012235	56.30413	0.0000
DHUMCAP	-0.833650	0.257950	-3.231829	0.0014
DRELCAP	0.054748	0.038083	1.437591	0.1520
DPROCAP	0.200535	0.243942	0.822061	0.4120
DINNCAP	-1.895199	0.048098	-39.40257	0.0000
DLNS	-0.923744	0.062010	-14.89670	0.0000

Effects Specification

Cross-section fixed (first differences)

Mean dependent var	0.086776	S.D. dependent var	1.039898
S.E. of regression	0.990444	Sum squared resid	208.9485
J-statistic	23.44788	Instrument rank	27
Prob(J-statistic)	0.173961		

Regression of residuals at 2 lags

Dependent Variable: RESID02
Method: Panel Least Squares
Date: 04/16/16 Time: 23:28
Sample (adjusted): 2011 2014
Periods included: 4
Cross-sections included: 37
Total panel (balanced) observations: 148

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.057276	0.063184	0.906496	0.3662
RESID02(-2)	0.019333	0.059366	0.325653	0.7452

R-squared	0.000726	Mean dependent var	0.059934
Adjusted R-squared	-0.006119	S.D. dependent var	0.759912
S.E. of regression	0.762233	Akaike info criterion	2.308292
Sum squared resid	84.82585	Schwarz criterion	2.348795
Log likelihood	-168.8136	Hannan-Quinn criter.	2.324748
F-statistic	0.106050	Durbin-Watson stat	2.790664
Prob(F-statistic)	0.745153		

Services Industry – Intellectual Capital with One-Year Change in Share Price

Price 3 Diff

Dependent Variable: DPT_3
Method: Panel Generalized Method of Moments
Transformation: First Differences
Date: 04/16/16 Time: 22:38
Sample (adjusted): 2009 2014
Periods included: 6
Cross-sections included: 33
Total panel (balanced) observations: 198
White period instrument weighting matrix
White period standard errors & covariance (d.f. corrected)
Instrument specification: @DYN(DPT_3,-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPT_3(-1)	-0.204311	0.028922	-7.064293	0.0000
DPT_3(-2)	-0.092584	0.029845	-3.102152	0.0022
DEPS	1.867465	0.208857	8.941367	0.0000
DBVPS	0.714254	0.091384	7.815938	0.0000
DHUMCAP	-9.713908	0.628653	-15.45193	0.0000
DRELCAP	0.295993	0.152468	1.941341	0.0537
DPROCAP	12.98423	2.994901	4.335446	0.0000
DINNCAP	-2.482009	0.645491	-3.845147	0.0002
DLNS	-1.868551	0.444163	-4.206907	0.0000

Effects Specification

Cross-section fixed (first differences)

Mean dependent var	0.112471	S.D. dependent var	0.906161
S.E. of regression	1.492560	Sum squared resid	421.0421
J-statistic	19.73469	Instrument rank	27
Prob(J-statistic)	0.347953		

Regression of residuals at 2 lags

Dependent Variable: RESID02
Method: Panel Least Squares
Date: 04/16/16 Time: 22:39
Sample (adjusted): 2011 2014
Periods included: 4
Cross-sections included: 33
Total panel (balanced) observations: 132

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.159311	0.133474	1.193571	0.2348
RESID02(-2)	-0.137014	0.110585	-1.238986	0.2176

R-squared	0.011671	Mean dependent var	0.150473
Adjusted R-squared	0.004068	S.D. dependent var	1.534436
S.E. of regression	1.531312	Akaike info criterion	3.705162
Sum squared resid	304.8391	Schwarz criterion	3.748841
Log likelihood	-242.5407	Hannan-Quinn criter.	3.722911
F-statistic	1.535086	Durbin-Watson stat	2.291237
Prob(F-statistic)	0.217583		

Other Business Activities – Intellectual Capital with One-Year Change in Share Price

Price 3 Diff

Dependent Variable: DPT_3
Method: Panel Generalized Method of Moments
Transformation: First Differences
Date: 04/17/16 Time: 11:01
Sample (adjusted): 2009 2014
Periods included: 6
Cross-sections included: 20
Total panel (balanced) observations: 120
White period instrument weighting matrix
White period standard errors & covariance (d.f. corrected)
Instrument specification: @DYN(DPT_3,-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPT_3(-1)	-0.271967	0.048341	-5.625978	0.0000
DPT_3(-2)	-0.309283	0.019044	-16.24084	0.0000
DEPS	0.163729	0.538514	0.304038	0.7617
DBVPS	0.767593	0.057810	13.27774	0.0000
DHUMCAP	9.953015	2.137770	4.655793	0.0000
DRELCAP	1.683093	0.766760	2.195073	0.0302
DPROCAP	-13.45277	5.025833	-2.676724	0.0086
DINNCAP	-3.772564	5.509741	-0.684708	0.4950
DLNS	-0.018215	0.037912	-0.480453	0.6319

Effects Specification

Cross-section fixed (first differences)

Mean dependent var	0.140667	S.D. dependent var	1.487595
S.E. of regression	1.272043	Sum squared resid	179.6083
J-statistic	13.19739	Instrument rank	20
Prob(J-statistic)	0.280620		

Regression of residuals at 2 lags

Dependent Variable: RESID04
Method: Panel Least Squares
Date: 04/17/16 Time: 11:02
Sample (adjusted): 2011 2014
Periods included: 4
Cross-sections included: 20
Total panel (balanced) observations: 80

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.48E-05	0.120383	-0.000372	0.9997
RESID04(-2)	-0.004332	0.088181	-0.049131	0.9609

R-squared	0.000031	Mean dependent var	-0.000685
Adjusted R-squared	-0.012789	S.D. dependent var	1.063632
S.E. of regression	1.070412	Akaike info criterion	2.998646
Sum squared resid	89.37092	Schwarz criterion	3.058196
Log likelihood	-117.9458	Hannan-Quinn criter.	3.022521
F-statistic	0.002414	Durbin-Watson stat	3.259613
Prob(F-statistic)	0.960941		

All Companies – Intellectual Capital with One-Year Change in Share Price

Price 3 Diff

Dependent Variable: DPT_3
Method: Panel Generalized Method of Moments
Transformation: First Differences
Date: 04/10/16 Time: 16:36
Sample (adjusted): 2009 2014
Periods included: 6
Cross-sections included: 90
Total panel (balanced) observations: 540
White period instrument weighting matrix
White period standard errors & covariance (d.f. corrected)
Instrument specification: @DYN(DPT_3,-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DPT_3(-1)	-0.315644	0.029589	-10.66746	0.0000
DPT_3(-2)	-0.197072	0.018538	-10.63060	0.0000
DEPS	0.700831	0.126317	5.548195	0.0000
DBVPS	2.674675	0.251161	10.64924	0.0000
DHUMCAP	-0.402150	0.777343	-0.517339	0.6051
DRELCAP	-0.133462	0.072171	-1.849259	0.0650
DPROCAP	-1.690554	0.624190	-2.708398	0.0070
DINNCAP	-4.829884	0.475347	-10.16076	0.0000
DLNS	0.046889	0.070919	0.661160	0.5088

Effects Specification

Cross-section fixed (first differences)

Mean dependent var	0.108173	S.D. dependent var	1.110183
S.E. of regression	1.633158	Sum squared resid	1416.285
J-statistic	17.42409	Instrument rank	27
Prob(J-statistic)	0.494152		

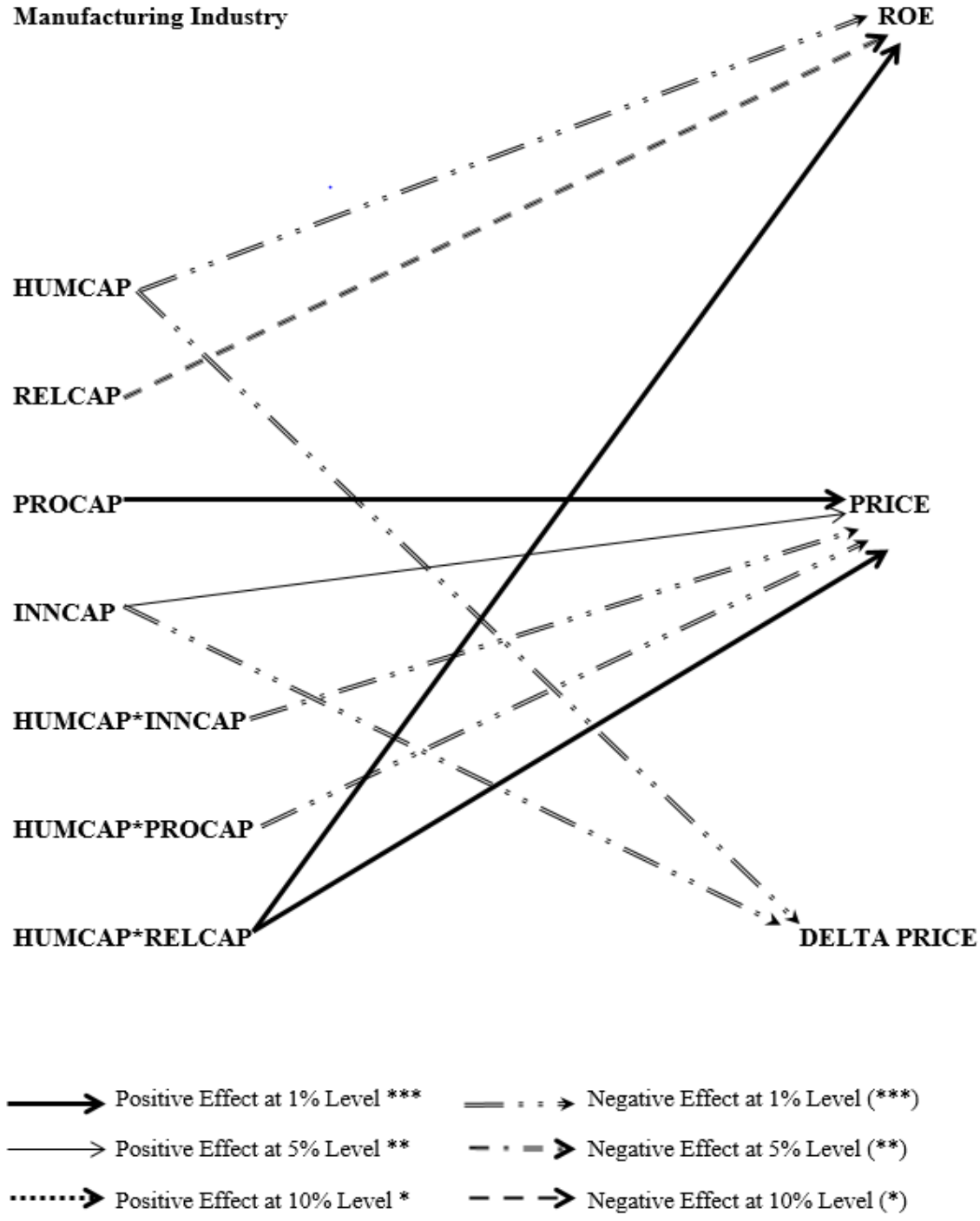
Residual regression at 2 lags

Dependent Variable: RESID06
Method: Panel Least Squares
Date: 04/10/16 Time: 23:24
Sample (adjusted): 2011 2014
Periods included: 4
Cross-sections included: 90
Total panel (balanced) observations: 360

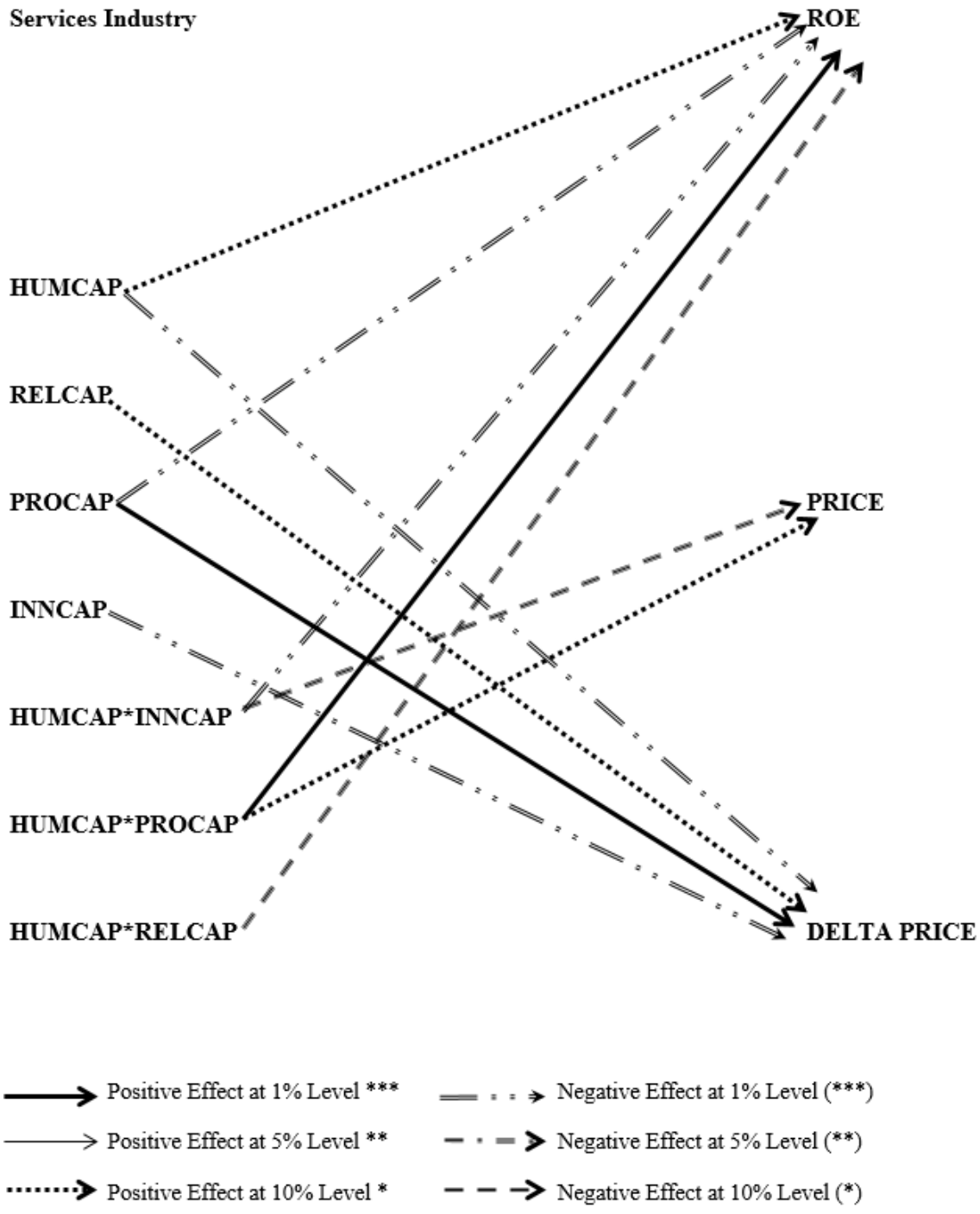
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.013405	0.080656	0.166194	0.8681
RESID06(-2)	-0.007914	0.047107	-0.168007	0.8667

R-squared	0.000079	Mean dependent var	0.012478
Adjusted R-squared	-0.002714	S.D. dependent var	1.524690
S.E. of regression	1.526757	Akaike info criterion	3.689710
Sum squared resid	834.4939	Schwarz criterion	3.711299
Log likelihood	-662.1477	Hannan-Quinn criter.	3.698294
F-statistic	0.028226	Durbin-Watson stat	3.636318
Prob(F-statistic)	0.866672		

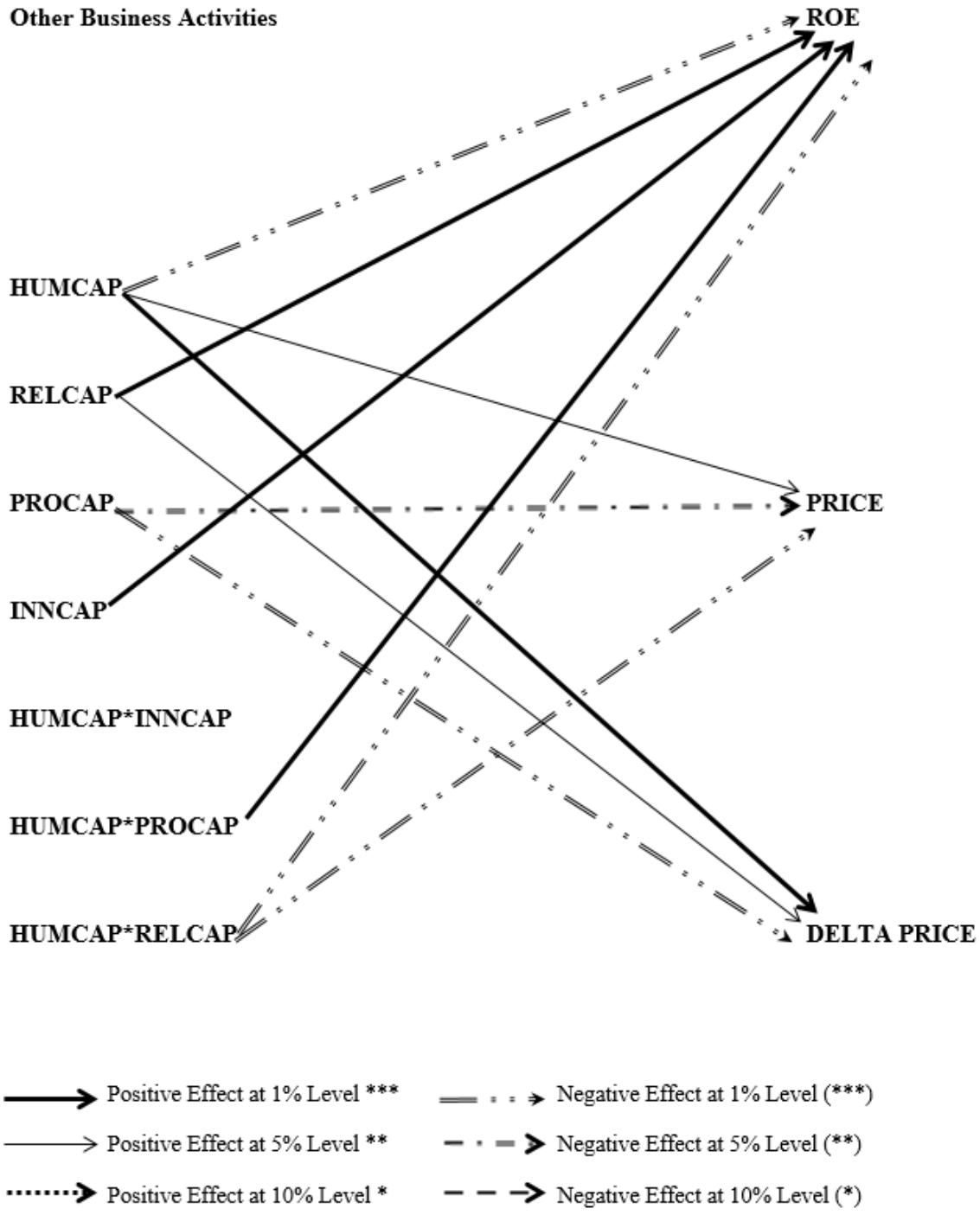
Appendix G: Validity Models Summaries Per Industry with the Relationships of ROE, Price and Delta Price



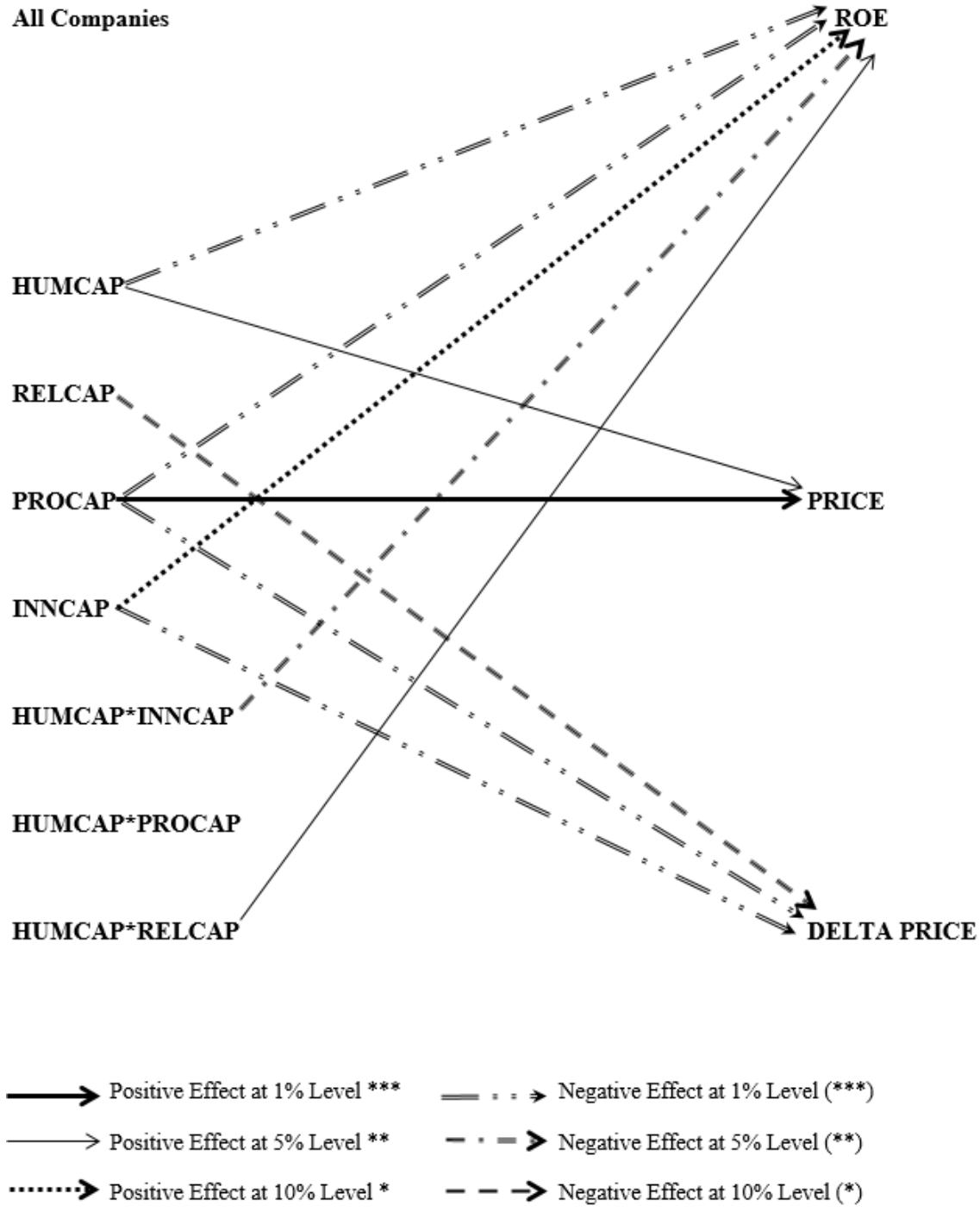
(Source: Author)



(Source: Author)



(Source: Author)



(Source: Author)

Appendix H (1): Estimation Results of ROE with Static Panel Data Model Regression

	Manufacturing Industry		**Services Industry**		**Other Business Activities**		**All Companies**	
	Fixed	**Random**	**Fixed**	**Random**	**Fixed**	**Random**	**Fixed**	**Random**
Intercept	-0.0690	0.3047	0.1986	0.2016	-0.0386	-0.0235	0.1630	0.2857
HCTA	-1.3787***	-1.3759***	**1.4463***	0.2409	-1.6121***	-1.5753***	-0.8316***	-0.8315***
RELCTA	-0.0726*	-0.0768*	0.0298	0.0097	**0.1020*****	0.0967***	-0.0314	-0.0279
PRCTA	0.2129	0.4464	-3.1502***	-1.3078***	-0.1761	0.0024	-0.6953***	-0.5471*
INCTA	-0.4801	0.3396	1.3821	0.1119	**1.8967*****	-0.1881	**0.9256***	0.8850*
GEAR	**0.1831***	0.1883*	**0.3334*****	0.3296***	**0.2880*****	0.0635**	**0.3060*****	0.2993***
LNS	0.0544	0.0198	-0.0140	-0.0106	-0.0027	0.0073	0.0185	0.0059
HCTA*INCTA	1.0293	0.2916	-8.3695***	-2.4212	-4.0815	4.4526*	-3.9500**	-2.0425
HCTA*PRCTA	-1.9576	-2.3076	**3.6157*****	2.8386***	**0.5730*****	0.5548***	0.0262	0.0518
HCTA*RELCTA	**0.4883*****	0.5103***	-0.2075*	-0.1201	-0.1384***	-0.1445***	**0.0641****	0.0488
R^2	**0.8983*****	0.1040	**0.6191*****	0.5033	**0.6964*****	0.5110	**0.8004*****	0.2604
F-Statistic	**63.6099*****	4.6451***	**11.4159*****	36.0257***	**14.0115*****	22.0597***	**32.7684*****	34.8120***
Hausman Test	X^2 (9) 36.8640***		X^2 (9) 30.3470***		X^2 (9) 75.8085***		X^2 (9) 26.5991***	
No. of firms	37		33		20		90	
Observations	370		330		200		900	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Fixed-effects model is better than random-effects model in overall and sub-categories as the Hausman test results indicate that *p*-values in all the Singaporean industries are less than 5%.

Appendix H (2): Estimation Results of Share Price with Static Panel Data Model Regression

	Manufacturing Industry		**Services Industry**		**Other Business Activities**		**All Companies**	
	Fixed	**Random**	**Fixed**	**Random**	**Fixed**	**Random**	**Fixed**	**Random**
Intercept	**1.1370****	-0.6999***	**2.3000****	-1.1799*	0.7740	0.0232	**1.3438*****	0.0217
BVPS	**0.2358***	0.6741***	-0.0424	0.5850***	**0.5256*****	0.6581***	**0.2943*****	0.4646***
EPS	-0.1683	-0.0045	**2.0293*****	1.5398***	0.5517	0.4106	0.2644	0.3663**
HUMCAP	1.1678	-0.7901*	-0.4085	1.5524**	**6.6594****	5.6504**	**1.3951****	2.1299***
RELCAP	-0.0297	-0.1018***	-0.0001	-0.0554	0.3582	0.1917	0.0024	0.0004
PROCAP	**1.4412*****	-0.1369	1.8145	0.8683	-8.2053**	- 4.5172**	**1.5787*****	1.2992***
INNCAP	**1.4038****	3.3707***	0.4169	-0.0337	2.1210	1.7147*	-0.1442	0.3459
HUMCAP*INNCAP	-2.5700***	-2.3754***	-1.9114*	-0.8715	-17.7119	-18.3753*	-0.6200	-0.6152*
HUMCAP*PROCAP	-2.3341***	-1.3180***	**2.6004***	3.3147***	3.9368	28.1956***	-0.1684	-0.0554
HUMCAP*RELCAP	**0.1591*****	0.2025***	0.0170	-0.0711	-2.7935***	-3.5101***	0.0082	-0.0385
LNS	-0.0626	0.0797***	-0.0731	0.1303*	-0.0055	-0.0037	-0.0585*	0.0207
R^2	**0.9170*****	0.7831	**0.9453*****	0.5859	**0.9517*****	0.9412	**0.9287*****	0.3961
F-Statistic	**77.6241*****	129.6354***	**118.0929*****	45.1343***	**115.4006*****	306.9346***	**105.2317*****	58.3053***
Hausman Test	X^2 (10) 221.5429***		X^2 (10) 70.3243***		X^2 (10) 27.9023***		X^2 (10) 111.5843***	
No. of firms	37		33		20		90	
Observations	370		330		200		900	

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Fixed-effects model is better than random-effects model in overall and sub-categories as *p*-values are less than 5%.

Appendix H (3): Estimation Results of One-Year Change in Share Price with Dynamic Panel Data Model Regression

	Manufacturing Industry	**Services Industry**	**Other Business Activities**	**All Companies**
DPT_3 (-1)	-0.3522***	-0.2043***	-0.2720***	-0.3156***
DPT_3 (-2)	-0.4489***	-0.0926***	-0.3093***	-0.1971***
DEPS	-0.0903***	**1.8675*** **	0.1637	**0.7008*** **
DBVPS	**0.6889*** **	**0.7143*** **	**0.7676*** **	**2.6747*** **
DHUMCAP	-0.8337***	-9.7140***	**9.9530*** **	-0.4022
DRELCAP	0.0547	**0.2960***	**1.6831** **	-0.1335*
DPROCAP	0.2005	**12.9842*** **	-13.4528***	-1.6906***
DINNCAP	-1.8952***	-2.4820***	-3.7726	-4.8299***
DLNS	-0.9237***	-1.8686***	-0.0182	0.0469
Sargan *p* value of J-Statistic	23.4479	19.7347	13.1974	17.4241
AR (2) Stat (F-Value)	0.1061	1.5351	0.0024	0.0282
No. of firms	37	33	20	90
Total panel (balanced) observations	222	198	120	540

(Source: Author)

NB: *0.05 > P < 0.10 (10%); **0.01 > P < 0.05 (5%); *** P < 0.01 (1%), P > 0.1 (Nil) = No Star means not significant.

* Based on Dynamic Panel Data Regression (DPD).

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