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Charting Intellectual Capital performance of The Gateway to China

Abstract

Purpose – This paper aimed to investigate whether or not intellectual capital ("IC") had an impact on the financial aspects of organizational performance as well as attempting to identify the IC components that are associated with corporate financial performance indicators that signal organizational growth.

Design / methodology / approach – This study drew on financial data from publicly available annual reports of all the constituent companies of the Hang Seng Index of the Hong Kong Stock Exchange for the years 2001 – 2009. Following the VAIC™ methodology, regression models were constructed to examine the relationships between IC and the corporate financial performance indicators.

Findings – Evidence was found to suggest that IC, as measured by VAIC™, was positively associated with profitability of businesses. In particular, structural capital, as a key component of IC, played a notable part in enhancing corporate profitability, and showed a growing trend in its significance. Empirical findings, based on correlation and linear multiple regression analysis, indicated that the components of VAIC™ were strong predictors of corporate financial performance such as return on equity and profitability. In particular, CEE (capital employed efficiency) was a significant predictor of all four corporate financial performance indicators.

Practical implications – The results may extend the understanding of the role of IC in business operation in Hong Kong, and may help to identify the specific IC drivers which may have a direct impact on the financial performance of these companies. In particular, although CEE was a significant predictor of all four corporate finance performance indicators, the increasing contribution of SCE in predicting ROA and ROE was observed. The role that structural capital plays in strengthening business performance warrants further investigation.

Originality / value – There has only been one previous empirical study on the intellectual capital of constituent companies on the Hong Kong Hang Seng Index. This study will add to the literature as the second study in the field. It is the first comparative study across 2 time periods of the above-mentioned data.

Keywords Intellectual capital, China, Hong Kong, value added, VAIC^{TM}, Hang Seng Index, structural capital

Paper type Research paper

1. Introduction

A growing number of leading academics and business practitioners acknowledge that the economy worldwide is being transformed into a "knowledge-based economy", where economic value is seen mainly to be derived from intellectual capital ("IC"), rather than just from physical capital (Sveiby , 1997; Pulic, 1998; Bontis, 2001; Chen *et al.*, 2005). Given this shift in the means of value creation in the new economy, traditional accounting measures may no longer be adequate in reflecting the true performance of these companies.

The gap between a company's market value and its book value, also known as the market to book controversy, has been observed and discussed (Lev & Zarowin, 1999). Different IC models and valuation methods have been proposed to measure intellectual capital or intangible assets in order to reflect better the invisible value not captured in financial statements (Lev & Zarowin, 1999; Edvinsson & Malone, 1997).

Forty-two valuation methodologies for measuring intangible assets have been identified so far (Sveiby, 2010), and it is likely that more methodologies will arise. Among them, the Value Added Intellectual Coefficient™ (VAIC™) (Pulic, 2000a; 2000b) is increasingly being adopted by both academics and practitioners (Pulic & Bornemann, 1997; Firer & Williams, 2003; Chen *et al.*, 2005; Shiu, 2006; Chan, 2009b). Evidence from these studies suggests a relationship between IC and business performance (Firer & Williams, 2003; Chen et al., 2005; Shiu, 2006; Chan, 2009b; Zéghal & Maaloul, 2010). Previous IC studies mostly focused on companies in Europe and North America (Pulic, 2000b; Zéghal & Maaloul, 2010; Nazari & Herremans, 2007; Riahi-Belkaoui, 2003), but emerging economies have been gaining global importance in recent years. Pascal Lamy, the Director-General of the World Trade Organization, recently commented in a special address that a reshuffling of global economic power has been witnessed in the past few years (Lamy, 2010). In fact, China has risen to become the second-largest economy in the world (CIA, 2010a). However, IC studies on Mainland China seem to be lacking.

China's economic development has been fascinating. She is the world's number one exporter, and holds the largest foreign exchange reserves (CIA, 2010a). Hong Kong (formerly a British colony, now a Special Administrative Region of China since July 1997) has thrived as a trade gateway to mainland China for over a century and a half (InvestHK, 2010). Located on the southeast coastline of mainland China, Hong Kong has served as a go-between for the mainland and the Western world since colonial times. To access the world's biggest single market - mainland China's 1.3 billion consumers - thousands of companies overseas have established their beachhead in Hong Kong due to its world-class infrastructure, pro-trade policies, international business environment, stable political environment, sound legal system, and abundant pool of talents (InvestHK, 2010; HSBC, 2010). Despite the small geographical area that Hong Kong occupies (its size is only 0.0115% of the size of mainland China) (CIA, 2010b), Hong Kong alone contributed 41% of China's foreign capital inflows during the period 1979-2005 (Lee *et al.*, 2009). Thus, there is a strong motivation to study IC and its association with corporate financial performance in Hong Kong.

This research investigated the relationship between companies' intellectual capital and their financial performance as well as exploring the general IC development of Hong Kong during the period 2001 to 2009 in relation to Hong Kong's aspiration of becoming a knowledge economy. Empirical evidence, if any, was sought to explore the existence of a relationship between IC and four key traditional indicators of corporate financial performance, namely, market valuation, profitability, productivity and return on equity ("ROE"). The findings extend the understanding of the role of IC in business operation in Hong Kong, as well as helping to identify the specific IC drivers that may have a direct impact on the financial performance of Hong Kong companies.

2. Literature Review

2.1 Intellectual Capital

The concept of intellectual capital first appeared in a book published in 1836 by the economist Nassau William Senior (Marr, 2007). There is no single definition of intellectual capital since it has evolved from different academic disciplines and has become a multi-disciplinary field (Marr, 2007). Sveiby (1997) proposed a tripartite model for IC, comprising human capital, external capital (e.g. relationships with customers and suppliers), and internal capital (e.g. patents, technology and systems). Petty and Guthrie (2000), building on the tripartite IC classification, described intellectual capital as the economic value of structural capital and human capital of a company. Bontis (2000) described human capital as "the individual knowledge stock of an organization as represented by its employees" (p. 87). Bontis *et al.* (2000) defined structural capital as "all the non-human storehouses of knowledge in organizations which include the databases, organizational charts, process manuals, strategies, routines and anything whose value to the company is higher than its material value" (p. 88). Together, they make up the intellectual capital of an organization.

There is as yet no well-accepted methodology for valuing intellectual capital, although numerous valuation methodologies have been developed (Tan *et al.*, 2008). Andriessen (2004) reviewed the 25 methods available at that time to measure the value of intangible assets, and grouped them under four categories: financial valuation, value measurement, value assessment, and measurement. Some of the more well-known methods are highlighted here. Economic value added™, Market-to-book value, and VAIC™ are categorized as financial valuation methods. Balanced scorecard is a value measurement method, while Skandia navigator is a measurement method (Andriessen, 2004). In contrast to the classification proposed in Andriessen (2004), Sveiby (2010) grouped the various methodologies under four categories: direct intellectual capital methods, market capitalization methods, return-on-assets methods, and scorecard methods. Sveiby (2010) considered that each method offered distinct advantages and disadvantages. VAIC™ is best fit under the ROA method category, which can be useful to illustrate the financial value of intangible assets, and can be compared between same-sector companies (Sveiby, 2010). However, Sveiby (2010) commented that these ROA methods may be superficial, and may not be suitable for management review at the departmental level. A more detailed discussion of the methodology can be found in the following section.

2.2 VAIC™ Methodology

Developed by Ante Pulic (Pulic, 2000a), VAIC™ (value added intellectual coefficient) is a valuation methodology to assess the efficiency of key resources in business organizations. Pulic viewed an organization as adding value and creating wealth through employing physical capital, human capital, and structural capital. The key assumption of this model is that human capital is an investment, not a cost. Value-added is thus the difference between output and input. With value-added intellectual coefficient defined through its components of human capital coefficient, structural capital coefficient, and physical capital employed coefficient, business managers have an indicator with which to study and monitor the company's value creation efficiency due to IC. The calculation of VAIC™ involves five steps (Pulic, 2000a; Kujansivu & Lonnqvist, 2007; Chan, 2009a):

1) Calculate value added (VA):

$$VA = \text{Output} - \text{Input}$$

where "Output" represents total income from all the products and services sold on the market, and "Input" contains all the expenses incurred in earning the revenue except manpower costs, as they are treated as investments. VA may also be expressed as

$$\begin{aligned} VA &= R + DD + T + EC + D + A \\ &= OP + EC + D + A \end{aligned}$$

where R = retained earnings; DD = dividends; T = taxes; EC = total employee expenses viewed as investments; D + A = depreciation and amortization; and OP = Operating profit.

2) Calculate human capital efficiency (HCE):
Treating the total employee expenses as investment that captures the total human effort to generate corporate value, HCE is expressed as the amount of value-added generated per monetary unit invested in manpower:

$$HCE = VA / HC$$

where HC represents human capital, may be calculated using "payroll costs" (Pulic, 2000a).

3) Calculate structural capital efficiency (SCE):

$$SCE = SC / VA$$

where SC represents structural capital, which is derived from subtracting human capital from value added (SC = VA – HC). Structural capital efficiency (SCE) is reflected by the proportion of total value added accounted for by structural capital.

4) Calculate capital employed efficiency (CEE):

$$CEE = VA / CE$$

where CE = book value of firm's net assets (such as physical assets and financial capital), which is a proxy for tangible resources.

5) Calculate VAIC™:

$$VAIC^{TM} = HCE + SCE + CEE$$

2.3 Limitations of the VAIC^{TM} methodology

There may be some apparent limitations to the VAIC^{TM} model. The first is the inability of the model to handle companies with negative book value of equity, or negative operating profit, which results in a negative value of "value-added". This would then mean that the company is expending more input resources than its output. The negative sign is carried through in all subsequent indexes, which does not generate meaningful analysis. Furthermore, although it is theoretically sound and in line with the general definition of IC to deduce structural capital by subtracting value-added from human capital, the existence of an inverse relationship between HC and SC (Pulic, 2000a) is not immediately apparent from the model. Such inverse relationship is intuitively valid and reasonable, but may need more empirical support in order to meet a wider audience's appreciation. Another criticism of the VAIC^{TM} model, which may be true of other IC models as well, is that it may not sufficiently identify the synergistic effects for value creation from interactions of different forms of capital (Andriessen, 2004). The VAIC^{TM} methodology depicts clearly how much each component (among human capital, structural capital, and capital employed) contributes to value-added. However, there may be interactions among the components of intellectual capital (Bontis *et al*., 2000), and so it may not be possible to calculate exactly the contribution to value creation from each resource. For example, advances in IT or computer automation (which is an element of structural capital) could sometimes enhance labor productivity (which might then be interpreted as an increase in human capital efficiency). Therefore one may not be able to isolate the weighting of each factor in facilitating an increase in HCE, SCE, or CEE. However, for the purpose of finding an indicator and an objective measurement method of IC, VAIC^{TM} methodology has been applied widely in different contexts due to its ease of administration. It offers an objective and financially-based measure of IC efficiency as it makes use of audited financial data that is readily accessible (Chan, 2009a).

VAIC™ methodology offers a more standardized and objective measurement base compared with other models of IC measurement which require customization to fit characteristics of individual companies (Firer and Williams, 2003).

2.4 Prior research using VAIC™ methodology

Many scholars have applied VAIC™ methodology in studying corporate performance and its relationship with intellectual capital. Zéghal and Maaloul (2010) investigated whether or not there was a correlation between IC and corporate performance in 300 UK businesses using data from the year 2005. They found a positive relationship with economic and financial performance only in high-tech industries. In Taiwan, it was shown that firms' intellectual capital had a positive impact on market value and financial performance (Chen *et al*., 2005). Again, Shiu (2006) demonstrated that VAIC™ had a significantly positive correlation with ROA (return on assets) and MB (market-to-book value), but a negative correlation with ATO (asset turnover). In India, using VAIC™ methodology, Kamath (2007) ranked performance of the surveyed banks by their respective VAIC™ scores. A high correlation between VAIC™ score and business survival was observed. Most of the surveyed banks with low VAIC™ score were subsequently merged, liquated, or even ceased operation.

2.5 Prior Studies of IC in Hong Kong

There have only been a few published studies that focus on the intellectual capital of organizations in Hong Kong. Petty and Cuganesan (2005) conducted content analysis of 250 annual reports collected in three different years (1992, 1998, and 2002), and found that levels of voluntary IC disclosure were low, but grew over time. Furthermore, company financial success was positively correlated with voluntary intellectual capital disclosure. In particular, a higher level of growth was observed in companies which voluntarily disclosed their IC in their annual reports. The authors suggested that there seemed to be a "mutually sustaining" relationship between voluntary ICD and corporate growth rates. The authors suggested expanding the study to cover companies of smaller sizes or those that are less established.

Chan (2009a) laid the groundwork for IC research and developed the framework for the empirical studies on Hong Kong companies in Chan (2009b). The paper found no strong association between IC and four corporate financial indicators in constituent companies of the Hang Seng Index for 2001 - 2005. However, a moderate association was found between the individual components of IC and corporate financial indicators. The author suggested further research in the Greater China region to investigate whether the above-mentioned association varied depending on the level of investors' awareness of IC.

2.6 Gaps in the literature

Hong Kong has long been acknowledged as the geographical and economic gateway to China (Hong Kong Tourism Board, 2008). In fact, Jennie Chok, the Principal Hong Kong Economic and Trade Representative (Tokyo) of the HKSAR Government, commented that Hong Kong was becoming an increasingly more important gateway to mainland China with the advancement of economic integration with the mainland (Hong Kong Information Services Department, 2010). Undoubtedly, mainland China's economy is one of the largest developing and fastest growing economies in the world. As a gateway to this fastest growing economy, a study of IC developments in Hong Kong is both appealing and very necessary. However, no published empirical studies on VAIC™ of companies in Hong Kong have been found other that the one conducted by Chan (2009b) on companies in Hong Kong for the period 2001-2005, which tracked the development of IC quantitatively. This research therefore seeks to fill this gap in the literature and aims to extend the scope covered by Chan (2009b) through investigating the 9-year data on IC in constituent companies of the Hang Seng Index from 2001 – 2009. Furthermore, a comparative study on the association between IC, as measured by VAIC™, and the four corporate financial indicators in two time periods, namely, 2001-2005 and 2006-2009 is conducted.

3. Research Method

3.1 Research Objectives

This study was a quantitative study which investigated the existence of association between IC, as measured by VAIC™, and the four corporate financial indicators in constituent companies of the Hang Seng Index for 2001 – 2009. Comparisons between phase I (years 2001-2005) and phase II (years 2006-2009) were made to highlight any emerging trends, if any. Regression analyses was conducted to investigate if VAIC™, an aggregate measure of corporate intellectual ability, or its components, could be strong predictors of corporate financial success.

3.2 Data Source

The sample of companies surveyed in this study consisted of all Hang Seng Index (HSI) constituent companies over a 9-year period (2001-2009). To be consistent with prior studies (Firer and Williams, 2003; Shiu, 2006; Chan, 2009a; Zéghal and Maaloul, 2010), problematic data and outliers (companies with negative book value of equity, or negative operating profit) were removed from the sample.

In total, 333 company-year observations were collected from published annual reports (Table 1a). Data were grouped into two phases, namely 2001-2005 (Phase I) and 2006-2009 (Phase II). The cutoff point also differentiated between the period without H-shares (Phase I) and the period with H-shares (Phase II) (see Table 1a and Table 1b). H-shares are companies incorporated in Mainland China and listed on the Hong Kong Stock Exchange (“HKSE”). They were first incorporated into the index in 2006, and they have exerted an increasing financial presence in Hong Kong ever since. As of year 2009, H-shares constituted more than 50% of the market capitalization of Hong Kong stock market.

Table 1a. Constituent companies distribution by share type

	Phase I (2001 – 2005)			Phase II (2006 – 2009)		
Share type	Frequency	Frequency %	Market Cap %	Frequency	Frequency %	Market Cap %
HK Ordinary shares	127	76.05	76.92	98	59.04	42.31
Red Chips	40	23.95	23.08	39	23.49	33.58
H-Shares	-	-	-	29	17.47	24.11
Total	167	100.00	100.00	166	100.00	100.00

Notes: *“Red Chips” refers to mainland Chinese companies incorporated and listed in Hong Kong. “H-shares” refers to mainland Chinese companies incorporated in mainland China, and listed in Hong Kong.*

There was also a dramatic change in sector composition (i.e. Commerce and Industry, Finance, Properties, and Utilities), an official classification of sectors in the Hang Seng Index. In terms of distribution, commerce and industry is the largest sector based on both the number of companies and market capitalization. Comparing the two phases, there was a sharp drop in market capitalization of properties and utilities companies covered by Hang Seng Index (Table 1b).

Table 1b. Distribution of HSI constituents by industry

	Phase I (2001 – 2005)			Phase II (2006 – 2009)		
Sector	Frequency	Frequency %	Market Cap %	Frequency	Frequency %	Market Cap %
Commerce and Industry	96	57.49	41.88	91	54.82	44.76
Finance	19	11.38	40.05	39	23.49	43.45
Properties	37	22.16	11.99	23	13.86	8.28
Utilities	15	8.98	6.08	13	7.83	3.51
Total	167	100.00	100.00	166	100.00	100.00

3.3 Research Hypotheses

Previous VAIC™ studies in different regions have found associations between IC components and corporate performance (Kamath, 2007; Chan, 2009b; Shiu, 2006). Intellectual capital has been recognized as an increasingly important resource in creating corporate sustainable competitive advantages (Kaplan & Norton, 2004). We expected intellectual capital to be positively associated with corporate value and financial performance. Using VAIC™ as an aggregate measure for corporate intellectual ability, the first set of hypothesis was proposed as follows:

H1a. Companies with greater intellectual capital tend to have higher market valuation.
H1b. Companies with greater intellectual capital tend to have higher profitability.
H1c. Companies with greater intellectual capital tend to have higher productivity.
H1d. Companies with greater intellectual capital tend to have higher return on equity.

VAIC™ can be broken down into three efficiency components: human capital efficiency (HCE), structural capital efficiency (SCE), and physical capital efficiency (CEE). In an attempt to identify the specific IC drivers which may have a direct impact on financial performance, the following three sets of hypotheses were proposed to examine the existence of positive association between corporate performance and each component of VAIC™:

H2a. HCE is positively associated with market valuation.
H2b. HCE is positively associated with profitability.
H2c. HCE is positively associated with productivity.
H2d. HCE is positively associated with return on equity.
H3a. SCE is positively associated with market valuation.
H3b. SCE is positively associated with profitability.
H3c. SCE is positively associated with productivity.
H3d. SCE is positively associated with return on equity.
H4a. CEE is positively associated with market valuation.
H4b. CEE is positively associated with profitability.
H4c. CEE is positively associated with productivity.
H4d. CEE is positively associated with return on equity.

3.4 Regression analysis

To test whether intellectual capital (as measured by VAIC™ or its components) was a significant driving factor of corporate success (as measured by corporate financial indicators such as MB, ROE, ATO, ROA), regression analysis similar to that found in previous studies (Chan, 2009b; Chen *et al.*, 2005; Shiu, 2006) was used.

Independent variables

VAIC™ provides an easy-to-calculate, standardized, and consistent measurement (Firer & Williams, 2003, Chan, 2009b; Chen *et al.*, 2005; Shiu, 2006). Data used in the calculation was extracted from published and audited financial statements. The independent variables included HCE, SCE, CEE, and VAIC™ (their mathematical formulae are summarized below).

$$\begin{aligned} VA &= OP + EC + D + A \\ HCE &= VA / HC \\ SCE &= (VA - HC) / VA \\ CEE &= VA / CE \\ VAIC^{TM} &= HCE + SCE + CEE \end{aligned}$$

Dependent and control variables

Corporate performance was measured by traditional accounting indicators of market valuation (Market-to-Book value), profitability (Return on Assets), productivity (Asset Turnover) and return on equity. Their mathematical formulae are listed below:

MB (Market-to-Book value) = Market capitalization / Book value of common stocks
ROA (Return on Assets) = Operating income / Total assets
ATO (Asset Turnover) = Total revenue / Total assets
ROE (Return on Equity) = Net Income / Shareholders' equity

To be consistent with prior studies in Hong Kong, South Africa and Taiwan (Chan, 2009a; Chen *et al.*, 2005; Firer & Williams, 2003; Shiu, 2006), firm size and firm leverage were included in regression as control variables to minimize their interactions with dependent variables.

Firm Size (FSIZE) = Log (Market capitalization)
Firm Leverage (DEBT) = Total debt / Total assets

Models 1-4 examined the association between VAIC™ and the four financial performance indicators, while models 5-8 replaced the aggregate IC measure with three components of VAIC™. The firm size and leverage were included as control variables in all models.

Model	Regression equation
1	$MB_i = \beta_i + \beta_1$VAIC™ + β_2FSIZE+ β_3DEBT + ε_i
2	$ROA_i = \beta_i + \beta_1$VAIC™ + β_2FSIZE+ β_3DEBT + ε_i
3	$ATO_i = \beta_i + \beta_1$VAIC™ + β_2FSIZE+ β_3DEBT + ε_i
4	$ROE_i = \beta_i + \beta_1$VAIC™ + β_2FSIZE+ β_3DEBT + ε_i
5	$MB_i = \beta_i + \beta_1 HCE + \beta_2 SCE + \beta_3 CEE + \beta_4 FSIZE + \beta_5 DEBT + \varepsilon_i$
6	$ROA_i = \beta_i + \beta_1 HCE + \beta_2 SCE + \beta_3 CEE + \beta_4 FSIZE + \beta_5 DEBT + \varepsilon_i$
7	$ATO_i = \beta_i + \beta_1 HCE + \beta_2 SCE + \beta_3 CEE + \beta_4 FSIZE + \beta_5 DEBT + \varepsilon_i$
8	$ROE_i = \beta_i + \beta_1 HCE + \beta_2 SCE + \beta_3 CEE + \beta_4 FSIZE + \beta_5 DEBT + \varepsilon_i$

4. Empirical results

4.1 Descriptive Statistics

Presented in Table 2 are values of VAIC™ and its 3 components (HCE, SCE, CEE) for Hang Seng Index constituent companies for the years 2001-2009. The figures across the nine years show some fluctuation with no evident trend.

Table 2. Descriptive statistics of the independent variables by year from 2001 - 2009

		2001 (N=32)	2002 (N=34)	2003 (N=33)	2004 N=33)	2005 (N=35)	2006 (N=39)	2007 (N=43)	2008 (N=42)	2009 (N=42)
VAIC	**Mean**	**6.250**	**5.889**	**5.902**	**6.904**	**7.434**	**6.795**	**7.392**	**6.646**	**6.514**
	SD	4.491	3.758	4.320	5.611	6.738	5.119	4.761	4.999	4.559
	Median	4.970	4.684	4.681	5.118	5.109	5.700	6.329	5.159	5.268
	Minimum	2.198	2.711	2.377	2.698	2.591	2.053	2.508	1.658	1.733
	Maximum	19.968	18.109	21.976	31.214	39.220	30.575	24.625	27.581	23.684
HCE	**Mean**	**5.401**	**5.020**	**5.036**	**5.994**	**6.523**	**5.895**	**6.470**	**5.773**	**5.646**
	SD	4.354	3.641	4.188	5.507	6.618	4.993	4.647	4.863	4.436
	Median	4.133	3.857	3.915	4.304	4.253	4.637	5.460	4.361	4.381
	Minimum	1.633	1.794	1.689	1.891	1.807	1.394	1.741	1.375	1.424
	Maximum	18.862	16.876	20.734	29.941	37.865	29.273	23.384	26.296	22.615
SCE	**Mean**	**0.717**	**0.718**	**0.704**	**0.739**	**0.747**	**0.734**	**0.771**	**0.730**	**0.734**
	SD	0.161	0.140	0.154	0.146	0.149	0.168	0.137	0.170	0.164
	Median	0.758	0.741	0.745	0.768	0.765	0.784	0.817	0.771	0.772
	Minimum	0.388	0.443	0.408	0.471	0.447	0.282	0.426	0.273	0.298
	Maximum	0.947	0.941	0.952	0.967	0.974	0.966	0.957	0.962	0.956
CEE	**Mean**	**0.132**	**0.151**	**0.161**	**0.171**	**0.164**	**0.166**	**0.150**	**0.144**	**0.135**
	SD	0.128	0.162	0.159	0.176	0.174	0.151	0.138	0.145	0.134
	Median	0.075	0.088	0.103	0.108	0.122	0.139	0.118	0.094	0.108
	Minimum	0.013	0.015	0.019	0.020	0.013	0.013	0.016	0.009	0.011
	Maximum	0.494	0.724	0.674	0.834	0.910	0.750	0.693	0.653	0.599

Table 3, 4 and 5 show the key descriptive statistics of independent, dependent and control variables, presented separately in three columns, representing phase I (2001-2005), phase II (2005-2009) and the entire time span (2001-2009).

A 5.5% increase in the mean of VAIC™ (from 6.485 to 6.841) was observed from phase I to phase II, which was driven by the 6.2% rise in human capital efficiency (HCE from 5.604 to 5.950) and 2.3% increase in structural capital efficiency (SCE from 0.725 to 0.742), but offset by a 5.1% decrease in physical capital efficiency (CEE from 0.156 to 0.148). Firer and Williams (2003) argued that physical capital was the most basic factor influencing business performance for an emerging market in their study of companies in South Africa. Interestingly, Hong Kong companies appeared to be placing less reliance on traditional physical capital and to be starting to shift their attention to intellectual capital (comprised of both human capital and structural capital) in value generation. Market-to-book ratio widened from 2.266 to 3.227 over the two periods studied. ROE also increased from .134 to .163 (Table 4). FSIZE and DEBT also increased over the period (Table 5).

Table 3. Descriptive statistics of the independent variables

	VAIC™			HCE			SCE			CEE		
	I	II	I + II	I	II	I + II	I	II	I + II	I	II	I + II
Mean	6.485	6.841	6.662	5.604	5.950	5.776	0.725	0.742	0.734	0.156	0.148	0.152
SD	5.091	4.826	4.957	4.972	4.702	4.835	0.149	0.160	0.155	0.160	0.141	0.151
Median	4.937	5.445	5.130	4.089	4.584	4.304	0.755	0.782	0.768	0.094	0.109	0.098
Minimum	2.198	1.658	1.658	1.633	1.375	1.375	0.388	0.273	0.273	0.013	0.009	0.009
Maximum	39.220	30.575	39.220	37.865	29.273	37.865	0.974	0.966	0.974	0.910	0.750	0.910
N	167	166	333	167	166	333	167	166	333	167	166	333

Notes: *I refers to Phase I (2001 – 2005). II reefers to Phase II (2006 – 2009). I + II refers to the 9-year period from 2001 to 2009.*

Table 4. Descriptive statistics of the dependent variables

	MB			ROA			ATO			ROE		
	I	II	I + II	I	II	I + II	I	II	I + II	I	II	I + II
Mean	2.266	3.227	2.745	0.077	0.076	0.077	0.518	0.449	0.484	0.134	0.163	0.148
SD	2.261	3.753	3.129	0.072	0.075	0.073	0.897	0.626	0.774	0.096	0.113	0.105
Median	1.322	1.979	1.769	0.050	0.056	0.053	0.166	0.172	0.166	0.113	0.142	0.132
Minimum	0.190	0.545	0.190	0.006	0.002	0.002	0.020	0.016	0.016	0.002	0.000	0.000
Maximum	12.456	28.183	28.183	0.419	0.371	0.419	4.686	3.085	4.686	0.584	0.736	0.736
N	167	166	333	167	166	333	167	166	333	167	166	333

Notes: *I refers to Phase I (2001 – 2005). II reefers to Phase II (2006 – 2009). I + II refers to the 9-year period from 2001 to 2009.*

Table 5. Descriptive statistics of the control variables

	FSIZE			DEBT		
	I	II	I + II	I	II	I + II
Mean	10.726	11.231	10.978	0.401	0.524	0.462
SD	0.470	0.548	0.569	0.225	0.258	0.249
Median	10.642	11.099	10.892	0.355	0.436	0.380
Minimum	9.774	10.249	9.774	0.044	0.017	0.017
Maximum	12.172	12.752	12.752	0.949	0.960	0.960
N	167	166	333	167	166	333

Notes: *"I" refers to Phase I (2001 – 2005). "II" refers to Phase II (2006 – 2009)." I + II" refers to the 9-year period from 2001 to 2009.*

4.2 Correlation Analysis

Table 6a and b present Pearson pairwise correlation results for the dependent and independent variables as the initial exploration of their relationships. CEE was significantly positively correlated with all four financial indicators, namely MB, ROA, ATO and ROE (p<0.01) in both phases (during the entire nine years), reflecting the importance of traditional physical capital in business operation. HCE was not significantly correlated with MB and the relationship between SCE and MB became insignificant in 2006-2009. VAIC™ and HCE were found to be significantly positively correlated with the two key profitability indicators ROA and ROE, and the correlation between HCE and ROE strengthened from Phase I (p<0.05) to Phase II (p<0.01). Interesting changes were noted in SCE over the two phases, whose correlation with ROA and ROE changed from inconclusive to positive and small (correlation coefficient of .24 and .26 respectively) and significant (p<0.01), implying the increasing important role that structural capital plays in business management.

Table 6a. Correlation analysis of independent and dependent variables - *Phase I (2001-2005)*

	HCE	SCE	CEE	VAIC	MB	ROA	ATO	ROE
HCE	1.000							
SCE	0.732**	1.000						
CEE	0.046	-0.260**	1.000					
VAIC	1.000**	0.736**	0.068	1.000				
MB	-0.084	-0.258**	0.665**	-0.068	1.000			
ROA	0.341**	0.048	0.897**	0.363**	0.620**	1.000		
ATO	-0.191*	-0.443**	0.589**	-0.181*	0.656**	0.485**	1.000	
ROE	0.191*	0.005	0.638**	0.206**	0.823**	0.708**	0.522**	1.000

Table 6b. Correlation analysis of independent and dependent variables - *Phase II (2006-2009)*

	HCE	SCE	CEE	VAIC	MB	ROA	ATO	ROE
HCE	1.000							
SCE	0.713**	1.000						
CEE	0.060	-0.131	1.000					
VAIC	0.999**	0.723**	0.083	1.000				
MB	0.030	0.085	0.352**	0.042	1.000			
ROA	0.388**	0.242**	0.860**	0.411**	0.414**	1.000		
ATO	-0.182*	-0.391**	0.706**	-0.212*	0.248**	0.434**	1.000	
ROE	0.204**	0.260**	0.402**	0.219**	0.823**	0.545**	0.179*	1.000

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

4.3 Regression Results

Ordinary Least Squares regressions were used to estimate models 1 to 8 over 3 time periods: Phase I (2001–2005), Phase II (2006–2009), and Phase I+II (2001-2009).

Standardized regression coefficients (β**)** and explanatory power (adjusted R-square) are presented so that the predictive strength of independent variables and the explanatory power of the models may be observed. A test for collinearity was applied and with a cut-off value of Variance Inflation Factors (VIF) less than 5 (Oxford Journals, n.d.), no multicollinearity among the variables were detected in all the models. The statistical significance of correlation was represented by p-value, which is reported as follows:

*** Indicates a very high significant level of p<0.001
** Indicates a high significant level of p<0.01
* Indicates a significant level of p<0.05

4.3.1 The association between VAIC™ and four financial indicators

Table 7 and 8 summarize the linear regression results for Model 1 to 4. The results of hypothesis testing related to the association between VAIC™ and corporate performance, measured by MB, ROA, ATO and ROE, are presented in Table 9.

Table 7. Multiple regression results of Models 1 & 2

	Independent Variables					
	MB (Model 1)			ROA (Model 2)		
	Phase I (2001-2005)	Phase II (2006-2009)	Phase I+II (2001-2009)	Phase I (2001-2005)	Phase II (2006-2009)	Phase I+II (2001-2009)
VAIC™	**-0.034**	**0.112**	**0.043**	**0.341*****	**0.287*****	**0.316*****
	-0.428	1.358	0.763	4.535	3.955	6.079
	(0.669)	(0.176)	(0.446)	(0.000)	(0.000)	(0.000)
FSIZE	**-0.036**	**0.020**	**0.044**	**0.006**	**0.131**	**0.093**
	-0.420	0.247	0.731	0.073	1.800	1.672
	(0.675)	(0.805)	(0.465)	(0.942)	(0.074)	(0.095)
DEBT	**0.200***	**0.248****	**0.228*****	**-0.151**	**-0.361*****	**-0.273*****
	2.368	2.905	3.754	-1.904	-4.811	-4.891
	(0.019)	(0.004)	(0.000)	(0.059)	(0.000)	(0.000)
Adjusted R^2	**0.022**	**0.044**	**0.052**	**0.138**	**0.259**	**0.200**

Notes: *Standardized coefficients are bolded, followed by t values and p values in parentheses.*
H1a. Companies with greater intellectual capital have higher market valuation;
Model 1: MB = β1 VAIC™ + β2FSIZE+ β3DEBT (Standardized)
H1b. Companies with greater intellectual capital have higher profitability;
Model 2: ROA = β1 VAIC™ + β2FSIZE+ β3DEBT (Standardized)

Results for Model 1 presented in Table 7 show no conclusive association between VAIC™ and market valuation (MB) to substantiate hypothesis H1a. Moreover, the adjusted R^2 for Model 1 across all phases were too small, thus showing weak model validity.

Despite the fact that firm leverage denoted by DEBT became highly influential in Model 2 for phase II, VAIC™ was found to be a predictor with very high significance and positive association with ROA. Model 2 was able to explain 20.0% of the variance in corporate profitability for 2001-2009, which is considered a small effect size (effect size of .2 is small, .5 is medium, .8 is large) (Cohen, 1988, p. 198). Model 2 showed increasing strength from phase 1(13.8%) to phase 2 (25.9%).

Table 8. Multiple regression results of Models 3 & 4

	Independent Variables					
	ATO (Model 3)			ROE (Model 4)		
	Phase I	Phase II	Phase I+II	Phase I	Phase II	Phase I+II
VAIC™	**-0.124**	**-0.208***	**-0.155****	**0.234****	**0.303*****	**0.264*****
	-1.575	-2.521	-2.717	3.004	3.773	4.785
	(0.117)	(0.013)	(0.007)	(0.003)	(0.000)	(0.000)
FSIZE	**-0.214***	**-0.038**	**-0.130***	**0.017**	**-0.052**	**0.007**
	-2.551	-0.462	-2.146	0.207	-0.650	0.122
	(0.012)	(0.645)	(0.033)	(0.836)	(0.517)	(0.903)
DEBT	**0.122**	**-0.150**	**0.000**	**0.226****	**0.262****	**0.252*****
	1.469	-1.754	-0.014	2.747	3.143	4.258
	(0.144)	(0.081)	(0.989)	(0.007)	(0.002)	(0.000)
Adjusted R^2	**0.054**	**0.037**	**0.039**	**0.079**	**0.087**	**0.100**

Notes: *H1c. Companies with greater intellectual capital have higher productivity;*
Model 3: ATO = β1 VAIC™ + β2FSIZE+ β3DEBT (Standardized)
H1d. Companies with greater intellectual capital have higher return on equity;
Model 4: ROE = β1 VAIC™ + β2FSIZE+ β3DEBT (Standardized)

Table 8 shows that VAIC™ was negatively associated with productivity indicator ATO with high significance as indicated by *p*-value for the entire nine-year period; however, the explanatory power of Model 3 was too low (Cohen, 1988) (adjusted R-square = 3.9%) for any conclusive comments to be made.

VAIC™ was positively associated with ROE with β=.264 (p<0.001) for the combined phase I and II period. Model 4 (with DEBT as a significant control variable) showed an R-square of 10.0% for the period 2001-2009, indicating a low explanatory power of the model. Moreover, VAIC™ and DEBT both exerted similar degrees of influence on ROE as their β-values were similar, hence diminishing the strength of Model 4. Overall, the results of hypothesis testing for models 1-4 are summarized in Table 9.

Table 9. Summary of hypothesis testing results based on nine-year (Phase I + II) regression

	Hypothesis substantiated?	Model	Explanatory power (%)	Control variables	Remarks
H1a. Companies with higher VAIC™ have higher MB	No	1	5.2	DEBT***	DEBT is the only significant predictor
H1b. Companies with higher VAIC™ have higher ROA	Yes	2	20.0	DEBT***	VAIC™ is a significantly positive predictor
H1c. Companies with higher VAIC™ have higher ATO	No	3	3.9	FSIZE*	VAIC™ is a negative predictor with high significance
H1d. Companies with higher VAIC™ have higher ROE	No	4	10.0	DEBT***	VAIC™ and DEBT have similar influence on ROE

4.3.2 The association between the components of VAIC™ and four performance indicators

The regression results of Models 5 to 8 are summarized in Table 10 and 11 which examine the association between VAIC™ components, namely human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE), with corporate performance. The hypotheses testing results are presented in Table 12.

Compared with previous regressions using VAIC™ as an aggregate measurement (Models 1-4), the explanatory power of models using the three VAIC™ components (Models 5-8) showed substantial increases, suggesting that stakeholders and managers may have placed different emphases on the three components of VAIC™, referred to as HCE, SCE and CEE (Chen *et al.*, 2005). The explanatory power of the models 5, 6, 7 and 8 was 33.9%, 89.1%, 48.3% and 46.8% respectively for the nine-year period, which were considered to be highly significant in predicting the selected financial indicators. Physical capital efficiency (CEE) appeared to be the strongest predictor for all four performance measurements with p<0.001.

Results for Model 5 presented in Table 10 show a strong association between VAIC™ components (especially SCE and CEE) and market valuation (MB) to substantiate hypothesis H3a and H4a, which was able to explain 33.9% of the variance in market valuation for 2001- 2009. HCE was not a significant predictor for market valuation in both 2001-2005 and 2006-2009 analyses, and its association with MB was found to be negatively significant for the entire nine-year period.

Noticeable changes occurred during the nine years for the structural capital efficiency (SCE), whose predictive power for MB strengthened as indicated by p-value and its substantial increase in regression coefficient. On the other hand, regression coefficient of physical capital efficiency (CEE) diminished from phase I to phase II.

Table 10. Multiple regression results of Model 5 & 6

	Independent Variables					
	MB			ROA		
	Phase I	Phase II	Phase I+II	Phase I	Phase II	Phase I+II
HCE	**-0.132**	**-0.143**	**-0.169***	**0.190*****	**0.165*****	**0.167*****
	-1.529	-1.502	-2.514	5.041	4.153	6.121
	(0.128)	(0.135)	(0.012)	(0.000)	(0.000)	(0.000)
SCE	**0.070**	**0.406*****	**0.287*****	**0.127****	**0.210*****	**0.177*****
	0.763	3.978	3.993	3.174	4.932	6.057
	(0.447)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
CEE	**0.715*****	**0.564*****	**0.593*****	**0.917*****	**0.867*****	**0.892*****
	11.624	7.823	12.035	34.090	28.765	44.520
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FSIZE	**-0.008**	**-0.087**	**-0.012**	**0.038**	**0.058**	**0.058****
	-0.132	-1.175	-0.237	1.394	1.876	2.709
	(0.895)	(0.242)	(0.813)	(0.165)	(0.062)	(0.007)
DEBT	**0.260*****	**0.488*****	**0.387*****	**-0.072****	**-0.047**	**-0.071****
	4.203	6.180	7.262	-2.678	-1.422	-3.261
	(0.000)	(0.000)	(0.000)	(0.008)	(0.157)	(0.001)
Adjusted R^2	0.503	0.306	0.339	0.905	0.879	0.891

Notes: *Standardized coefficients are bolded, followed by t values and p values in parentheses.*
H2a. HCE is positively associated with market valuation; H3a. SCE is positively associated with market valuation; H4a. CEE is positively associated with market valuation;
Model 5: MB = β1HCE + β2SCE + β3CEE + β4FSIZE+ β5DEBT (Standardized)
H2b. HCE is positively associated with profitability; H3b. SCE is positively associated with profitability; H4b. CEE is positively associated with profitability;
Model 6: ROA = β1HCE + β2SCE + β3CEE + β4FSIZE+ β5DEBT (Standardized)

Results of Model 6 presented in Table 10 show a very strong positive association between all VAIC™ components (HCE, SCE and CEE) and return on assets (ROA) to substantiate hypothesis H2b, H3b, H4b. Model 6 was able to explain 89.1% of the variance in corporate profitability for the years 2001-2009, and its explanatory power was the highest among all models tested.

Table 11. Multiple regression results of Model 7 & 8

	Independent Variables					
	ATO			ROE		
	Phase I	Phase II	Phase I+II	Phase I	Phase II	Phase I+II
HCE	**0.039**	**-0.007**	**0.001**	**0.038**	**-0.067**	**-0.038**
	0.424	-0.099	0.010	0.451	-0.794	-0.636
	(0.672)	(0.921)	(0.992)	(0.653)	(0.428)	(0.526)
SCE	**-0.284****	**-0.284*****	**-0.260*****	**0.209***	**0.584*****	**0.417*****
	-2.937	-3.573	-4.081	2.328	6.447	6.453
	(0.004)	(0.000)	(0.000)	(0.021)	(0.000)	(0.000)
CEE	**0.516*****	**0.684*****	**0.590*****	**0.723*****	**0.645*****	**0.676*****
	7.929	12.152	13.539	11.952	10.074	15.292
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FSIZE	**-0.153***	**0.000**	**-0.084**	**0.029**	**-0.200****	**-0.073**
	-2.344	0.005	-1.826	0.473	-3.044	-1.554
	(0.020)	(0.996)	(0.069)	(0.637)	(0.003)	(0.121)
DEBT	**0.125**	**0.046**	**0.085**	**0.301*****	**0.549*****	**0.443*****
	1.906	0.745	1.804	4.953	7.841	9.268
	(0.058)	(0.457)	(0.072)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.443	0.578	0.483	0.520	0.453	0.468

Notes: *H2c. HCE is positively associated with productivity; H3c. SCE is positively associated with productivity; H4c. CEE is positively associated with productivity;*
Model 7: ATO = β1HCE + β2SCE + β3CEE + β4FSIZE+ β5DEBT (Standardized)
H2d. HCE is positively associated with return on equity; H3d. SCE is positively associated with return on equity; H4d. CEE is positively associated with return on equity;
Model 8: ROE = β1HCE + β2SCE + β3CEE + β4FSIZE+ β5DEBT (Standardized)

Results for Model 7 presented in Table 11 show no conclusive association with HCE and productivity (ATO), and strong negative association between SCE and ATO, which failed to sustain hypothesis H3c (since the hypothesis was written in the opposite direction). Table 11 also shows a strong positive association between CEE and ATO, thus substantiating hypothesis H4c. Model 7 was able to explain 48.3% of the variance in corporate profitability for 2001- 2009.

Results for Model 8 presented in Table 11 show a strong positive association between both SCE as well as CEE in relation to return on equity (ROE) to substantiate hypothesis H3d, and H4d. Model 8 was able to explain 46.8% of the variance in corporate profitability for year 2001-2009. It is a much stronger model than Model 4 (using the aggregate VAIC™ with an adjusted R-square in the range of 10%). Noticeably, the regression coefficient for SCE increased significantly from phase I to phase II, and SCE gained significance in Model 8 in 2006-2009 as implied by *p*-value.

Table 12 summaries the results of hypothesis testing for Models 5-8. The explanatory power of these models was generally higher than that in Models 1-4, implying that the VAIC™ components may be a better predictor than the aggregate VAIC™ index in predicting corporate performance.

Table 12 Summary of hypothesis testing results based on nine-year (Phase I + II) regression

	Hypothesis substantiated	Model	Explanatory power (%)	Control variables	Remarks
H2a. HCE is positively associated with MB	No	5	34.9	DEBT***	CEE is the strongest predictor, HCE is negatively associated with MB with significance
H2b. HCE is positively associated with ROA	Yes	6	89.2	FIZE** DEBT**	CEE is the strongest predictor, HCE is a positive predictor for ROA with very high significance
H2c. HCE is positively associated with ATO	No	7	49.0	-	CEE is the strongest predictor in Model 7
H2d. HCE is positively associated with ROE	No	8	47.6	DEBT***	CEE is the strongest predictor in Model 8
H3a. SCE is positively associated with MB	Yes	5	34.9	DEBT***	CEE is the strongest predictor, SCE is positively associated with MB with very high significance
H3b. SCE is positively associated with ROA	Yes	6	89.2	FIZE** DEBT**	CEE is the strongest predictor, SCE is a positive predictor for ROA with very high significance
H3c. SCE is positively associated with ATO	No	7	49.0	-	CEE is the strongest predictor in Model 7, SCE is negatively associated with ATO with very high significance
H3d. SCE is positively associated with ROE	Yes	8	47.6	DEBT***	CEE is the strongest predictor in Model 8, SCE is a positive predictor for ROE with very high significance
H4a. CEE is positively associated with MB	Yes	5	34.9	DEBT***	CEE is the strongest predictor for MB
H4b. CEE is positively associated with ROA	Yes	6	89.2	FIZE** DEBT**	CEE is the strongest predictor for ROA
H4c. CEE is positively associated with ATO	Yes	7	49.0	-	CEE is the strongest predictor for ATO
H4d. CEE is positively associated with ROE	Yes	8	47.6	DEBT***	CEE is the strongest predictor for ROE

5. Discussion of key findings and implications

5.1 An emerging trend from the two phases

Correlation studies and regression analysis of Phase I data were consistent with the findings in Chan (2009b) in that no association was found between VAIC™ and the four corporate financial indicators for constituent companies in the Hang Seng Index for years 2001-2005. In addition, phase I results from regression models of the four corporate financial indicators using HCE, SCE, and CEE as independent variables were comparable to those in Chan (2009b), except for one discrepancy concerning hypothesis H2b. Standardized coefficient for HCE in Model 6 was 0.19 (*p*<.001) in this study, whereas that in Chan (2009b) was -.137 (*p*=.052). Such a discrepancy may be due to a minor difference in the sample inclusion criteria. In this study, companies on the Hang Seng Index for only a partial year were included in the study, while in Chan's (2009b) study, companies on the index for the entire year were included.

Regression models involving the three VAIC™ components had a much higher explanatory power than models using VAIC™ as an aggregate IC measurement, which was consistent with prior studies conducted by Chan (2009a, b) and Chen *et al.* (2005) and suggests that stakeholders may have emphasized various aspects or components of IC differently (Chen *et al.*, 2005, Firer & Williams, 2003).

Historic values of ROE is generally viewed by investors as one of the most important indicators in making investment decision as it accounts for profits that are attributable directly to shareholders. When VAIC™ was split into its three components, and put into the regression equation to predict ROE (Model 8; shown in Table 11), the adjusted R^2 increased to 0.468 for the 9-year period, making it a moderately strong model. By including the three VAIC™ components in the regression, Model 8 was able to explain around 50% of the variance in return on equity. Human capital had not been found to be significantly associated with ROE for the entire period 2001-09. This reflects that investors may have consistently regarded expenditure incurred in cultivating human resources as cost with no short-term benefits and reacted negatively towards firms with high employee-related expenditure (Model 5 in Table 10).

In contrast, structural capital, such as proprietary computer systems, databases, routines and procedures, appeared increasingly crucial to corporate profit generation as the association between SCE and return on equity became highly significant from 2001-2005 to 2006-2009. Physical capital was always the strongest predictor for ROE, although its dominating impact on profitability diminished with the increasingly prominent role of structural capital in predicting ROE (as shown in Model 8 in Table 11).

Hong Kong listed companies appeared to be relying on both physical capital and structural capital (a key component of IC), as a way to enhance return for shareholders. Regression results also revealed the significant positive association between firm leverage and return on equity (Model 4 & 8), which may imply companies utilizing credit or borrowing to maintain a high level of investment in physical and structural capital to generate satisfactory returns to investors. Investors, in response, may also have viewed companies with higher borrowing level as more flexible and capable of capturing business opportunities to generate profit, which may be a possible interpretation for the strong positive association observed between firm leverage and market valuation in Model 1 & 5.

5.2 Intellectual capital with market valuation

Empirical findings failed to find a strong association between VAIC™ and corporations' market valuation (Model 1 shown in Table 7), which was contrary to expectations and the argument of Pulic (2000b), the inventor of the VAIC™ method, who confirmed the close positive relationship between value creation efficiency of the resources and market value of companies (through studying sample companies listed on London and Vienna Stock Exchanges). Market valuation reflects the perspectives of investors in assessing valuations of companies. Various aspects of performance may be examined by investors when assessing companies, which may be weighted differently by different capital markets and investor groups.

The overall low explanatory power of Model 1 and the lack of association between VAIC™ and market valuation discovered in Hong Kong may suggest certain variables important to investors' decision making process that were not captured by the regression. At the same time, information on corporate efficiency in utilizing intellectual capital as measured by VAIC™ may not have received the appropriate level of attention from Hong Kong investors that it deserves due to the fact that the overall IC indicator was not readily available to external investors as intellectual capital disclosure (ICD) is currently voluntary for listed companies in Hong Kong.

Although investors were unable to obtain an IC indicator measuring the overall corporate intellectual ability, they may have found proxies for human capital (i.e. employee payroll, training hours), structural capital (i.e. expenditure on R&D, software, and patents) and physical capital (i.e. plant and equipment, financial capital) from published financial reports, and placed different emphases on the three types of resources. Therefore investors may have been subtly analyzing IC without consciously categorizing them as IC components.

As shown in Table 10, in examining the predictive power of three VAIC™ components on MB, Model 5 demonstrated moderate positive association between market valuation and physical capital, which implies that Hong Kong investors tend to favor companies that are perceived to generate higher return from deploying physical materials and financial capital (in line with the study conducted by Firer and Williams [2003]). On the other hand, human capital was found to be a negative predictor for MB for the entire nine years, reflecting the negative reaction of investors towards companies that incur relative high employee-related expenditure, as the expenditure is treated as cost instead of investment that may bring enduring future benefit.

5.3 Intellectual capital with profitability

The empirical results of Model 2 in Table 7 reveal that VAIC™ was positively associated with profitability measured by ROA and 20% of the variance in ROA can be explained by Model 2 during the nine year period. A substantial increase in explanatory power from Phase 1 (adjusted R-square = 13.8%) to Phase 2 (adjusted R-square = 25.9%) was observed, which may indicate the increasingly prominent impact of IC on corporate financial performance. Model 6 (shown in Table 10) recorded the highest explanatory power (adjusted R-square = 89.2%) and all three VAIC™ components were found to be very highly significant and positively associated with ROA. Phase I and Phase II comparison further corroborated the previous discussion about structural capital becoming increasingly important to business value-added process as indicated by the increased value of regression coefficient.

Both ROA and ROE may be viewed as a measure of corporate profitability, however, the denominator of ROA is the sum of liabilities and shareholders' equity, while that of ROE only includes shareholders' equity. The differences as revealed in regression models of IC indicators with ROA (Model 2 & 6) and ROE (Model 4 & 8) are worth noticing. Firstly, the explanatory power of ROA regressions was around twice as high as that of ROE models using VAIC™ and the three components as independent variables. Secondly, human capital, which has been found to be strongly associated with ROA, showed no significant relationship with ROE. HCE emerging as a significant factor in predicting ROA but not ROE maybe explained by the fact that ROA reflects the effectiveness of a company in utilizing all sources of funding (both debts and equities). A company usually borrows loans to develop innovative projects which puts high demands on human capital for intelligent planning and execution. Thus this may explain why HCE was a significant predictor of ROA.

5.4 Intellectual capital with productivity (Model 3 and Model 7)

Association between VAIC™ and ATO was inconclusive as the explanatory power of Model 3 (Table 8) was too low. Model 7 (in Table 11), which was able to explain nearly 50% of variance in ATO, revealed that physical capital efficiency was also the strongest predictor among the independent variables of financial performance in terms of productivity. Human capital appeared to have no impact on productivity, and structural capital was negatively associated with ATO with very high significance.

Productivity indicator ATO is defined as the ratio of total revenue to book value of total assets, while profitability measurement ROA is computed as the ratio of operating income to book value of total assets. Comparing the impact of VAIC™ components on ATO and ROA from the empirical results, Model 7 and Model 6 revealed interesting findings. Structural capital being increasingly crucial to enhance corporate operating profit (ROA) was found to be significantly and negatively affecting firms' revenue to assets ratio (ATO).

Investment in structural capital is regarded as important for efficiency enhancement as demonstrated by the strong predicting power of SCE on ROA. However, the significantly negative association between SCE and ATO seems to suggest that Hong Kong companies may not be able to apply their structural capital to extract more revenue sources and justify the increase in total assets, or the denominator of ATO.

The contradictive role that structural capital plays may suggest that Hong Kong companies mainly rely on structural capital, such as computer systems, routines and automated procedures to improve operating efficiency and reduce costs incurred in operations, rather than on capturing additional sales opportunities and bringing in more revenue to enhance asset turnover (ATO). Specifically, companies in Hong Kong may tend to invest in structural capital with the intention to automate labor-intensive operations. As a result, human capital expenditure is reduced, but may not be large enough to offset the asset investment in infrastructure development.

The implication may be important for academics, professionals and policy makers. Information technology has long been viewed as important in enhancing efficiency. In schools, students are generally taught to use IT from the perspective of making work processes and knowledge sharing more efficient. However, motivation to exploit IT and its applications innovatively in order to derive new sources of income may be lacking. More R&D initiatives for exploring structural capital for revenue generation should perhaps be encouraged by professionals and promoted by policy makers to improve the productivity of industry and the economy, to which innovation is the key.

6. Conclusion

Empirical findings, based on correlation and linear multiple regression analysis, indicate that the associations between VAIC™ and traditional corporate performance indicators are mixed. Corporate intellectual capital performance, as measured by VAIC™, was found to have a small impact on profitability. However, when VAIC™ was split into its three components (i.e., HCE, SCE, CEE), and put into the regression equation to predict corporate financial performance, the strength of the models increased significantly. In addition, the individual intellectual capital components were stronger predictors of corporate financial performance than VAIC™ alone. For example, by including the three VAIC™ components in the regression equation, Model 8 was able to explain around 50% of the variance in return on equity.

The increase in predicting power across two phases may imply that certain improvement in IC management occurred in Hong Kong during the nine years studied. Managers may have recognized the importance of intellectual capital in profit generation over the studied period. The dominant role of physical capital diminished as companies were able to utilize structural capital effectively to generate higher return, as evident from a higher regression coefficient on SCE from phase I to phase II in all models.

Pulic (2008) argued that human capital can be viewed as a pool of knowledge which can bring enduring future benefits and the key assumption of VAIC™ is that expenditure on employees is treated as investment. The study has revealed a tendency for the development of tangibles to continue to take priority over IC development (although the situation was improving in the samples surveyed mainly by means of structural capital enhancement) for the purpose of boosting corporate performance such as ROE. There may be risks in managers focusing solely on generating return for equity owners, as this would result in underinvestment in cultivating human resources, and hinder further development in competitiveness.

Hong Kong has long been the regional hub for financial services in Asia. In fact, Hong Kong has been ranked third on the Global Financial Centres Index for the last two years (Z/Yen Group, 2010). To strengthen Hong Kong's leadership in the global financial services sector, accelerating developments in IC measurement and reporting is a top priority. Moreover, as indicated in Petty & Cuganesan, (2005), since the level of IC disclosure on annual reports is associated with corporate growth rates, there is a strong incentive for businesses to acquire consultancy services on IC reporting, thus further fueling the growth of financial services sector in the region.

7. Further Study

The contradictive role that structural capital plays in improving profitability and productivity may suggest that although investment in structural capital is increasingly being regarded by Hong Kong companies as crucial to reducing operating expenses and improving efficiency, these companies may have limited ability to apply computer systems and procedures to capture additional business opportunities and explore revenue sources. This study found that SCE had an increasingly prominent role in predicting corporate financial performance, thus signifying the importance of structural capital. As the gateway to the world's fastest growing economy, will Hong Kong companies be able to invest more in their structural capital in order to drive profitability? The Hong Kong economy is dominantly service-based – the service sectors accounted for 91.9% of GDP as a whole in 2008 (Census and Statistics Department, HKSAR, 2009). Service sectors have been found to be less capable of transforming human capital into structural capital than their non-service counterparts (Bontis *et al.*, 2000). Hence further research on IC will be essential in strengthening the economic development of Hong Kong. A more in-depth qualitative study on IC in Hong Kong companies is warranted. The above results also identify a significant trend in the development of structural capital, which needs to be further examined in relation to the dynamics of how it interacts with corporate performance, information technology and innovation.

References

Andriessen, D. (2004), *Making sense of intellectual capital: designing a method for the valuation of intangibles*, Elsevier Butterworth-Heinemann, Burlington, MA.

Bontis, N., Keow, W. and Richardson, S. (2000), "Intellectual capital and business performance in Malaysian industries", *Journal of Intellectual Capital*, Vol. 1 No. 1, pp. 85-100.

Bontis, N. (2001), "Assessing knowledge assets: a review of the models used to measure intellectual capital", *International Journal of Management Reviews*, Vol. 3 No.1, pp. 41-60.

Census and Statistics Department, HKSAR (2009), *Hong Kong social and economic trends – 2009 edition*. Census and Statistics Department, HKSAR.

Central Intelligence Agency (2010a), "East & Southeast Asia: China", *The World Factbook,* available at: https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html (accessed 25 November 2010).

Central Intelligence Agency (2010b), "East & Southeast Asia: Hong Kong", *The World Factbook*, available at: https://www.cia.gov/library/publications/the-world-factbook/geos/hk.html (accessed 25 Novemeber 2010).

Chan, K, H. (2009a), "Impact of intellectual capital on organizational performance: An empirical study of companies in the Hang Seng Index (Part 1)", *The Learning Organization*, Vol. 16 No. 1, pp. 4-12.

Chan, K, H. (2009b), "Impact of intellectual capital on organizational performance: An empirical study of companies in the Hang Seng Index (Part 2)", *The Learning Organization*, Vol. 16 No. 1, pp. 22-39.

Chen, M., Cheng, S. and Hwang, Y. (2005), "An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance", *Journal of Intellectual Capital*, Vol. 6 No.2, pp. 159-176.

Cohen, J. (1988), *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum, New Jersey.

Edvinsson, L. and Malone, M.S. (1997), *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*, Harper Business, New York, NY.

Firer, S. and Williams, M. (2003), "Intellectual capital and traditional measures of corporate performance", *Journal of Intellectual Capital*, Vol. 4 No. 3, pp. 348-360.

Hong Kong Information Services Department (2010), "Hong Kong as major gateway to China", available at: http://www.info.gov.hk/gia/general/201002/25/P201002250146.htm (accessed 8 September 2010).

Hong Kong Tourism Board (2008). "Gateway to China and key Asian markets", available at: http://www.discoverhongkong.com/mice/eng/html/exhibitions/exhibitions-china-gateway.html (accessed 8 September 2010).

HSBC (2010), "Hong Kong – the Gateway to China", available at: http://www.hsbc.com.hk/1/PA_1_3_S5/content/greaterchina/pdf/gateway2china.pdf (accessed 24 November 2010).

InvestHK – The Government of the Hong Kong Special Administrative Region (2010), "Gateway to Mainland China", available at: http://www.investhk.gov.hk/default_bodies/whyhk/en_gateway.html (accessed 23 November 2010).

Lamy, P. (2010), "Reshuffling the Deck of Global Economic Cards", Special Address for the Bahrain Global Forum at the IISS Geo-economic Strategy Summit, Manama, Bahrain, available at: http://www.iiss.org/conferences/bahrain-global-forum/bahrain-global-forum-2010/speeches/special-address/special-address-pascal-lamy/ (accessed 25November 2010).

Lee, Lin and Tsui (2009), "Home country effects of foreign direct investment: from a small economy to a large economy", *Economic Modelling*, Vol. 26 No. 5, pp. 1121-1128.

Lev, B. and Zarowin, P. (1999), "The boundaries of financial reporting and how to extend them", *Journal of Accounting Research*, Vol. 37 No. 2, pp. 353-385.

Marr, B. (2007), "What is intellectual capital?", in L. A. Joia (Ed.), *Strategies for information technology and intellectual capital,* Idea Group Pub., Hershey, PA, pp. 1-9.

Nazari, J. and Herremans, I. (2007), "Extended VAIC model: measuring intellectual capital components", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 595-609.

Kamath, G. B. (2007), "The intellectual capital performance of Indian banking sector", *Journal of Intellectual Capital,* Vol. 8 No. 1, pp. 96-123.

Kaplan, R. and Norton, D. (2004), *Strategy maps: converting intangible assets into tangible outcomes*, Harvard Business School Publishing Corporation, Boston, MA.

Kujansivu, P. and Lonnqvist, A. (2007), "Investigating the value and efficiency of intellectual capital", *Journal of Intellectual Capital*, Vol. 8 No. 2, pp. 272-287.

Oxford Journals (n.d.), "Regression Diagnostics", *Research Methods II: Multivariate Analysis*, available at: http://www.oxfordjournals.org/our_journals/tropej/online/ma_chap5.pdf (accessed 10 June 2010).

Petty, R., and Guthrie, J. (2000), "Intellectual capital literature review – measurement, reporting and management", *Journal of Intellectual Capital*, Vol. 1 No. 2, pp. 155-176.

Petty, R., and Cuganesan, S. (2005), "Voluntary disclosure of intellectual capital by Hong Kong companies: Examining size, industry and growth effects over time", *Australian Accounting Review*, Vol. 15 No. 2, pp. 40-50.

Pulic, A. (1998), "Measuring the performance of intellectual potential in knowledge economy", paper presented at the 2nd McMaster World Congress on Measuring and Managing Intellectual Capital by the Austrian Team for Intellectual Potential, February 1998, available at: http://www.vaic-on.net/download/Papers/Measuring%20the%20Performance%20of%20Intellectual%20Potential.pdf (accessed 17 February 2010)

Pulic, A. and Bornemann, M. (1997), "The physical and intellectual capital of Austrian banks", available at: http://www.vaic-on.net/download/Papers/Physical%20and%20intellectual%20Capital%20of%20Austrain%20Banks.htm (accessed 18 February 2010)

Pulic, A. (2000a), "VAIC – an accounting tool for IC management", *International Journal of Technology Management*, Vol. 20 Nos. 5-8, 702-714.

Pulic, A. (2000b), "MVA and VAIC analysis of randomly selected companies from FTSE 250", available at: http://www.vaic-on.net/download/ftse30.pdf (accessed 17 February 2010)

Pulic, A. (2008), "The principles of intellectual capital efficiency – a brief description", available at: http://www.vaic-on.net/download/Casestudies/principles_2008.pdf (accessed 26 March 2011)

Riahi-Belkaoui, A. (2003), "Intellectual capital and firm performance of US multinational firms – a study of the resource-based and stakeholder views", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 215-226.

Shiu, H. (2006), "The application of the value added intellectual coefficient to measure corporate performance: evidence from technological firms", *International Journal of Management*, Vol. 23 No. 2, pp. 356-65.

Sveiby, K. E. (1997), *The new organizational wealth: managing and measuring knowledge based assets*, Berrett-Koehler, San Francisco, CA.

Sveiby, K. E. (2010), "Method of measuring intangible assets", available at: http://www.sveiby.com/articles/IntangibleMethods.htm (accessed 9 August 2010)

Tan, H., Plowman, D. and Hancock, P. (2008), "The evolving research on intellectual capital", *Journal of Intellectual Capital*, Vol. 9 No. 4, pp. 585-608.

Zéghal, D. and Maaloul, A. (2010), “Analysing value added as an indicator of intellectual capital and its consequences on company performance”, *Journal of Intellectual Capital*, Vol. 11 No. 1, pp. 39-60.
Z/Yen Group (2010), *Global Financial Centres 7,* City of London, London.