An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance

Ming-Chin Chen
Department of Accounting, National Chengchi University, Taipei, Taiwan
Shu-Ju Cheng
Audit Services, Deloitte & Touche, Taipei, Taiwan, and
Yuhchang Hwang
School of Accountancy, Arizona State University, Tempe, Arizona, USA

Abstract

Purpose – The purpose of this article is to investigate empirically the relation between the value creation efficiency and firms' market valuation and financial performance.

Design/methodology/approach – Using data drawn from Taiwanese listed companies and Pulic's Value Added Intellectual Coefficient (VAIC™) as the efficiency measure of capital employed and intellectual capital, the authors construct regression models to examine the relationship between corporate value creation efficiency and firms' market-to-book value ratios, and explore the relation between intellectual capital and firms' current as well as future financial performance.

Findings – The results support the hypothesis that firms' intellectual capital has a positive impact on market value and financial performance, and may be an indicator for future financial performance. In addition, the authors found investors may place different value on the three components of value creation efficiency (physical capital, human capital, and structural capital). Finally, evidence is presented that R&D expenditure may capture additional information on structural capital and has a positive effect on firm value and profitability.

Originality/value – The results extend the understanding of the role of intellectual capital in creating corporate value and building sustainable advantages for companies in emerging economies, where different technological advancements may bring different implications for valuation of intellectual capital.

Keywords Intellectual capital, Financial performance, Value added, Taiwan

Paper type Research paper

Introduction

The increasing gap between firms' market and book value has drawn wide research attention to exploring the invisible value omitted from financial statements (e.g. Lev and Zarowin, 1999; Lev, 2001; Lev and Radhakrishnan, 2003). Lev (2001, p. 9) documented that, over the period of 1977-2001, the market-to-book value ratios of US Standard and Poors (S&P) 500 corporations increased from slightly above 1 to over 5, implying that about 80 per cent of corporate market value has not been reflected in financial reporting.

The limitations on financial statements in explaining firm value underline the fact that the source of economic value is no longer the production of material goods, but the

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creation of intellectual capital. Intellectual capital includes human capital and structural capital wrapped up in customers, processes, databases, brands, and systems (Edvinsson and Malone, 1997), and has been playing an increasingly important role in creating corporate sustainable competitive advantages (Kaplan and Norton, 2004, p. 4)[1].

Despite the increasing recognition of intellectual capital in driving firm value and competitive advantages, an appropriate measure of firms' intellectual capital is still in infancy. Instead of directly measuring firms' intellectual capital, Pulic (2000a, b) proposed a measure of the efficiency of value added by corporate intellectual ability (Value Added Intellectual Coefficient (VAIC™)). The major components of VAIC can be viewed from a firm's resource base – physical capital, human capital, and structural capital. VAIC is being increasingly used in business (e.g. Pulic, 1998, 2000a, b) and academic applications (e.g. Firer and Williams, 2003).

The objective of this study is to investigate empirically the relationship between firms' intellectual capital and market-to-book value ratios, using Taiwan's listed companies as our sample. Following Firer and Williams (2003), we also use VAIC as an aggregate measure of corporate intellectual ability. Further, we analyse whether intellectual capital contributes to firms' financial performance and can be used as a leading indicator for future financial performance.

This paper contributes to the literature as follows: first, we present evidence on the relationship between intellectual capital and firms' market value, and the relationship between intellectual capital and firms' current and future financial performance, by using data from listed companies in Taiwan. Our results extend the understanding of the role of intellectual capital in emerging economies. While Firer and Williams (2003) attempted to address similar issues using data from 75 South African publicly traded companies, their empirical findings failed to find any strong association between intellectual capital and firms' profitability (Firer and Williams, 2003, p. 356). Our results, however, support the role of intellectual capital in enhancing firms' value and profitability, suggesting the value of further investigation into the role of intellectual capital in different emerging economies, where different technological advancements may bring different implications for the valuation of intellectual capital.

Second, while Pulic proposes the VAIC as an aggregate, standardised measure of corporate intellectual ability, our empirical results indicate that the three components of VAIC have substantial higher explanatory power for firm market value than does the aggregate measure of VAIC, suggesting that investors may attach different values to the three components of VAIC.

Finally, we present evidence that the VAIC measure for structural capital, SCVA, may not be a complete measure of structural capital, in that SCVA neglects firms' innovative capital. Our empirical results show that after controlling for SCVA, research and development (R&D) expenditure is positively related with firms' market value and profitability, suggesting R&D expenditure may capture additional information on innovative capital that is omitted from the SCVA measure.

The remainder of this paper proceeds as follows: the next section introduces the VAIC measure and presents related empirical research. The following section develops the theoretical framework for our research hypotheses, and depicts empirical procedures and samples used to test our hypotheses. The penultimate section presents and discusses our empirical findings, and the final section concludes with our research results and their implications.

Literature review

While intellectual capital[2] is generally intangible in nature, it is becoming widely accepted as a major corporate strategic asset capable of generating sustainable competitive advantage and superior financial performance (Barney, 1991). Edvinsson and Malone (1997) define the difference between a firm's market value and book value as the value of intellectual capital. A firm's intellectual capital, in a broad sense, is comprised of human capital and structural capital (Bontis, 1996). Human capital is employee-dependent, such as employees' competence, commitment, motivation and loyalty, etc. Although human capital is recognised as being the heart of creating intellectual capital, a distinctive feature of human capital is that it may disappear as employees exit (Bontis, 1999). In contrast, structural capital belongs to firms[3], including innovative capital, relational capital, and organisational infrastructure, etc. Recognising the value of intellectual capital is consistent with the theory of stakeholder view (Donaldson and Preston, 1995), which maintains that stakeholder relationships include all forms of relationship of the company with its stakeholders, e.g. employees, customers, suppliers, and residents of the community.

Given the growing gap between the market and book values of firms, investigation into how to measure firms' intellectual capital and whether capital market is efficient with intellectual capital has been drawing broad research interest. By modelling sales as a function of a firm's organisational capital, net fixed assets, number of employees, and R&D capital, Lev and Radhakrishnan (2003) developed a firm-specific measure of organisation capital. Using a sample of approximately 250 companies[4], they showed that organisational capital estimate contributes significantly to the explanation of the market values of firms, beyond assets in place and growth potential.

Similar to the concept of Skandia Navigator (see Bontis *et al.*, 1999), Pulic (2000a, b) depicted firms' market value as created by capital employed and intellectual capital, which consists of human capital and structural capital. He proposed the VAIC method to provide information about the value creation efficiency of tangible and intangible assets within a company. Instead of valuing the intellectual capital of a firm, the VAIC method mainly measures the efficiency of firms' three types of inputs: physical and financial capital, human capital, and structural capital, namely the Capital Employed Efficiency (VACA), the Human Capital Efficiency (VAHU), and the Structural Capital Efficiency (STVA). The sum of the three measures is the value of VAIC. Higher VAIC value suggests better management utilisation of companies' value creation potential. Using data from 30 randomly selected companies from the (UK) FTSE 250 from 1992 to 1998, Pulic (2000b) also showed that the average values of VAIC and firms' market value exhibit a high degree of correspondence.

Using data from 75 publicly traded companies in South Africa, Firer and Williams (2003) adopted the VAIC method to examine the relationship between intellectual capital and traditional measures of corporate performance, including profitability (returns on assets), productivity (turnover of total assets) and market value (market-to-book value ratio of net assets). Except that the capital employed efficiency has a significantly positive effect on market value of firms, their empirical results failed to find any strong association between the three value added efficiency components and the three dependent variables. Their empirical results, however, merit more research on the role of intellectual capital in emerging economies, because different technological advances across areas of emerging economies may have different implications for intellectual capital in creating firm value and enhancing financial performance.

While the VAIC method provides a convenient measure for firms' intellectual capital, its measure for structural capital may be incomplete. For example, R&D expenditure and advertising expenses, according to conservative accounting standards, are expensed as incurred, and thus are subtracted from the calculation of value added, which is the measure for firms' total output in the VAIC calculation. However, both R&D and advertising expenditures play an increasingly important role in business nowadays. R&D expenditure is generally considered the drive for technological advancements and firms' growth, and advertising expenditure is usually aimed at promoting the brand value of products and firms. Therefore, both expenditures, though expensed in financial reporting, should be viewed as asset-like investments. Empirical research has also documented evidence on the value relevance of both R&D and advertising expenditures. Using samples of 1975-1991 US public companies, Lev and Sougiannis (1996) found a significant inter-temporal association between firms' R&D capital and subsequent stock returns, suggesting either systematic mispricing of the shares of R&D-intensive companies, or compensation for an extra-market risk factor associated with R&D. In addition, Chauvin and Hirschey (1993) also found that advertising and R&D expenditures have consistently had large, positive influences on corporate market value, suggesting investors expect greater future cash flows from firms with greater R&D and advertising intensity, *ceteris paribus*.

Research methods

Research hypotheses

Figure 1 presents the theoretical framework for developing research hypotheses of this study. Conservative accounting practices restrain firms' investment in intellectual capital from being present in financial statements, resulting in the growing divergence between firms' market and book values. However, if the market is efficient, investors will place higher value for firms with greater intellectual capital (Riahi-Belkaoui, 2003; Firer and Williams, 2003). In addition, if intellectual capital is a valuable resource for

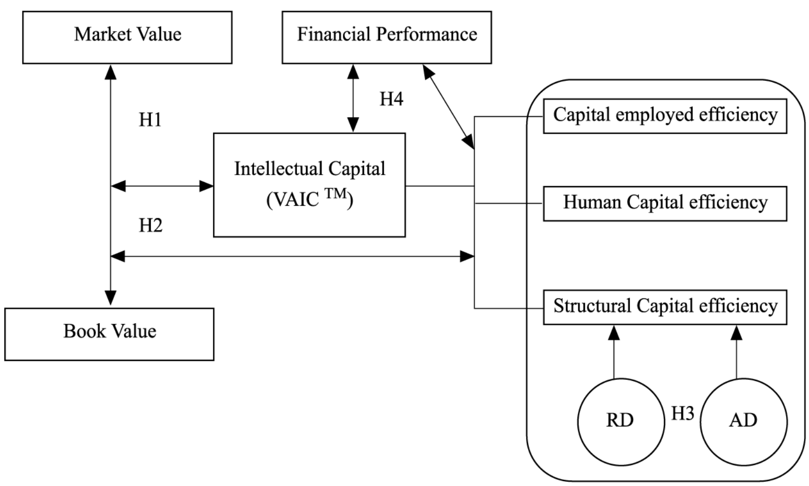

Figure 1.
Theoretical framework of research hypotheses

firms' competitive advantages, it will contribute to firms' financial performance. Therefore, we expect intellectual capital to play an important role in enhancing both corporate value and financial performance. Using VAIC as a measure for corporate intellectual ability, we propose our first hypothesis as follows:

H1a. Companies with greater intellectual capital tend to have higher ratios of market-to-book value, *ceteris paribus*.

Although VAIC is an aggregate measure for corporate intellectual ability, if investors place different values for the three components of VAIC, the model using the three components of VAIC will have greater explanatory power than the model using the aggregate one. Therefore, we propose the following hypotheses to examine the relationship between firm value and each component of VAIC:

H2-1a. Companies with greater physical capital efficiency tend to have higher market-to-book value ratios, *ceteris paribus*.

H2-2a. Companies with greater human capital efficiency tend to have higher market-to-book value ratios, *ceteris paribus*.

H2-3a. Companies with greater proportions of structural capital in the creation of value added tend to have higher market-to-book value ratios, *ceteris paribus*.

Unlike human capital that may disappear as employees exit, structural capital is the knowledge that belongs to the organisation as a whole (Riahi-Belkaoui, 2003, p. 217)[5]. However, SCVA, the structural capital efficiency of VAIC, only reflects the proportion of value added by structural capital. Two of the important forms of structural capital may be missed from the measure of SCVA – innovative capital and relational capital. Therefore, we propose the following hypotheses to investigate whether R&D and advertising expenditures capture additional information on structural capital that is omitted from SCVA, i.e. innovative capital and relational capital, after controlling for VAIC:

H3-1a. After controlling for the structural capital efficiency of VAIC, companies with greater R&D expenditure tend to have higher market-to-book value ratios, *ceteris paribus*.

H3-2a. After controlling for the structural capital efficiency of VAIC, companies with greater advertising expenditure tend to have higher market-to-book value ratios, *ceteris paribus*.

Using data from two industry sectors[6] in Malaysia, Bontis *et al.* (2000) conclude that, regardless of industry, the development of structural capital has a positive relationship with business performance. Based on the resource-based and stakeholder views, Riahi-Belkaoui (2003) documented a significant positive relationship between intellectual capital and financial performance, using 81 US multinational firms.

In addition to examining the relationship between intellectual capital and firms' value, we also explore the relationship between intellectual capital and firms' financial performance and whether intellectual capital may be indicative of firms' future financial performance (Bontis and Fitz-enz, 2002).

H4-1a. Companies with greater intellectual capital tend to have better financial performance contemporaneously, *ceteris paribus*.

H4-2a. Companies with greater intellectual capital tend to have better financial performance in the following years, *ceteris paribus*.

Regression models

Model 1 and model 2 examine the relationship between market-to-book value (M/B) ratios and the aggregate measure of intellectual capital VAIC, and its three major components, VACA, VAHU, and STVA, respectively. In model 3, we add two variables, R&D and advertising expenditures, as proxy for innovative and relational capital to examine whether the two additional variables increase explanatory ability for M/B. Our regression models are as follows:

$$M/B_{it} = \alpha_0 + \alpha_1 \mathrm{VAIC}_{it} + \varepsilon_{it} \tag{1}$$

$$M/B_{it} = \alpha_0 + \alpha_1 \mathrm{VACA}_{it} + \alpha_2 \mathrm{VAHU}_{it} + \alpha_3 \mathrm{STVA}_{it} + \varepsilon_{it} \tag{2}$$

$$M/B_{it} = \alpha_0 + \alpha_1 \mathrm{VACA}_{it} + \alpha_2 \mathrm{VAHU}_{it} + \alpha_3 \mathrm{STVA}_{it} + \alpha_4 \mathrm{RD}_{it} + \alpha_5 \mathrm{AD}_{it} + \varepsilon_{it}. \tag{3}$$

In addition to the dependent variable M/B, this study also examines whether intellectual capital is associated with firms' financial performance and can be a leading indicator for firms' future performance. Therefore, we also use model (1)-(3) to examine whether those intellectual capital variables are associated with firms' financial performance. The dependent variables for financial performance are returns on equity (ROE), returns on assets (ROA), growth in net sales (GR), and net value added per employee (EP).

Variable definitions

Dependent variables:

(1) *Market-to-book value ratios of equity (M/B)*. M/B is measured by the market value divided by the book value of common stock:

$$\text{Market value of common stock} = \text{number of shares outstanding} \times \text{stock price at end of the year.}$$

$$\text{Book value of common stocks} = \text{book value of stockholders' equity} - \text{paid-in capital of preferred stocks.}$$

(2) *Financial performance*. The four financial performance variables are defined as follows:

- Return on equity (ROE) = pre − tax income ÷ average stockholders' equity.

  ROE represents returns to shareholders of common stocks, and is generally considered an important financial indicator for investors.

- Return on total assets (ROA) = pre − tax income ÷ average total assets.
  ROA reflects firms' efficiency in utilising total assets, holding constant firms' financing policy.
- Growth in revenues (GR) = (current year's revenues ÷ last year's revenues) − 1) × 100%.
  GR measures the changes in firms' revenues. Increases in revenues usually signal firms' opportunities for growth.
- Employee productivity (EP) = pre − tax income ÷ number of employees.
  EP is a measure for the net value added per employee, reflecting employees' productivity.

Independent variables:

(1) *VAIC and VACA, VAHU and STVA*. We use VAIC as a measure for corporate intellectual ability (Pulic, 2000b)[7]. Firer and Williams (2003) pointed out two advantages of VAIC, which were that VAIC provides an easy-to-calculate, standardised, and consistent basis of measure, enabling effective comparative analyses across firms and countries; and data used in the calculation of VAIC are based on financial statements, which are usually audited by professional public accountants. The procedures calculating VAIC are as follows:

- *Calculate value added (VA)*:

$$\mathrm{VA} = \mathrm{OUTPUT} - \mathrm{INPUT}.$$

Based on the stakeholder view (Donaldson and Preston, 1995), we adopt a broader definition in calculating VA. The stakeholder view maintains that any group that can affect or be affected by the achievement of a firm's objectives should have a "stake" in the firm. These stake groups include stockholders, employees, lenders, government, and society; therefore, in measuring firm performance, a broader measure of value added by stakeholders is better than accounting profit that only calculates returns to stockholders.

Consistent with Riahi-Belkaoui (2003), the calculation of value added can be expressed as equation (4):

$$R = S - B - \mathrm{DP} - W - I - \mathrm{DD} - T \tag{4}$$

where: R is changes in retained earnings; S is net sales revenues; B is bought-in materials and services (costs of goods sold); DP is depreciation; W is wages (employee salaries); DD is dividends; and T is taxes.

Equation (4) can be re-arranged as equation (5) and (6):

$$S - B = \mathrm{DP} + W + I + \mathrm{DD} + T + R \tag{5}$$

$$S - B - \mathrm{DP} = W + I + \mathrm{DD} + T + R. \tag{6}$$

Equation (5) is the gross value added approach, whereas equation (6) is the net value added approach. The left-hand side of the equations calculates the gross (or net) value added, and the right-hand side of the equations represents the distribution of the value created by firms, including employees, debt-holders, stockholders, and governments. We define VA as the net value created by firms during the year, and because DD plus R is equal to net income under the clean surplus assumption, equation (6) can be expressed as follows:

$$\mathrm{VA} = S - B - \mathrm{DP} = W + I + T + \mathrm{NI} \tag{7}$$

where: NI is after-tax income.

- *Calculate CE (capital employed), HU (human capital), and SC (structural capital)*. Following Pulic (2000a, b) and Firer and Williams (2003), the three major components of firm resources CE, HU and SC are, by definition, as follows:

$$\mathrm{CE} = \text{physical capital} + \text{financial assets}$$

$$= \text{Total assets} - \text{intangible assets}$$

$$\mathrm{HU} = \text{total expenditure on employees}$$

$$\mathrm{SC} = \mathrm{VA} - \mathrm{HU}.$$

Dividing firms' resources into CE and HU is consistent with the resource-based view of the firm (Riahi-Belkaoui, 2003). The resource-based view of the firm maintains that firms' resources are the main drive behind competitiveness and firm performance. These resources include both tangible and intangible assets. CE is a proxy for firms' tangible resources and HU is a measure of major intangible resources.

- *Calculate VAIC and its three components*. By definition, the three components of VAIC are calculated as follows:

$$\mathrm{VACA} = \mathrm{VA} \div \mathrm{CE}$$

$$\mathrm{VAHU} = \mathrm{VA} \div \mathrm{HU}$$

$$\mathrm{STVA} = \mathrm{SC} \div \mathrm{VA}$$

where: VACA is indicator of VA efficiency of capital employed; VAHU is indicator of VA efficiency of human capital; STVA: indicator of VA efficiency of structural capital.

VACA and VAHU can be viewed as the value-added by a dollar input of physical assets and human capital, respectively. STVA represents the proportion of total VA accounted for by structural capital. Finally, VAIC is the sum of the three components of VA efficiency indicators.

(2) *R&D expenditures (RD) and advertising expenditures (AD)*. Besides the three VA efficiency indicators, we also include R&D and advertising expenditures to proxy for innovative and relational capital. To account for the size effect, we use

the same denominator of the dependent variable, book value of stockholders' equity, as the scaling variable for RD and AD:

$$RD = R\&D \text{ expenditures} \div \text{book value of common stocks}$$

$$AD = \text{Advertising expenses} \div \text{book value of common stocks.}$$

Data and sample selection. Table I outlines the sample selection procedures. We begin with all firms listed on the Taiwan Stock Exchange (TSE) during 1992-2002. After deleting 64 firms missing data on the selected variables and firms with negative value of stockholders' equity, our final sample consists of a total of 4,254 firm-year observations. Tables II and III divide the sample by year and industry, respectively. The number of sample firms increased over the sample period, reflecting the trend of increasing numbers of listed companies in Taiwan. The major composition of our sample is electronics firms (about 28.1 per cent of total observations), consistent with the fact that Taiwan plays an important role in the global supply chain of the electronics industry and that the electronics industry is the most important industry in Taiwan.

Empirical results

Tables IV and V present descriptive statistics and correlation analyses for the dependent and independent variables. The mean M/B is about 1.96, indicating that nearly 50 per cent of firms' market value is not reflected on financial statements. The correlation analyses show that, under the univariate correlation, M/B is positively

	Firm-years
Listed companies during 1992-2002	4,320
Less: firms missing data on selected variables	62
Less: firms with negative book value	2
Less: firms with negative R&D or advertising values	2
Final sample	4,254

Table I. Sample selection and sample firms' profile – sample selection procedures

Year	Firm-years	Percentage of sample
1992	192	4.51
1993	216	5.08
1994	241	5.67
1995	284	6.68
1996	322	7.57
1997	363	8.53
1998	416	9.78
1999	482	11.33
2000	540	12.69
2001	579	13.61
2002	619	14.55
Total	4,254	100

Table II. Sample selection and sample firms' profile – sample distribution by year

Industry	Firm-years	Percentage of sample
Cement	85	2.00
Foods	225	5.29
Plastics	200	4.70
Textiles	469	11.02
Electric and machinery	194	4.56
Electric appliances and cable	145	3.41
Chemicals	235	5.52
Glass and ceramics	71	1.67
Paper and pulp	73	1.72
Steel and iron	206	4.84
Rubber	92	2.16
Automobile	45	1.06
Electronics	1,195	28.10
Construction	247	5.81
Transportation	144	3.39
Tourism	55	1.29
Finance	178	4.18
Wholesale and retail	115	2.70
Conglomerate	11	0.26
Others	269	6.32
Total	4,254	100

Table III.
Sample selection and sample firms' profile – sample distribution by industry

Variable	Average	Std dev.	Minimum[a]	Maximum[b]
M/B	1.959	1.439	0.191	7.870
VAIC	5.495	7.324	−20.391	33.207
VACA	0.080	0.084	−0.184	0.324
VAHU	4.627	7.255	−21.213	31.890
STVA	0.788	0.555	−1.598	3.688
RD	0.016	0.025	0	0.123
AD	0.007	0.016	0	0.100
ROE	1.315	4.379	−20.462	11.734
ROA	1.018	2.134	−6.388	7.652
GR	10.623	29.980	−55.93	143.52
NP	420.27	2,232	−13,071	8,809

Notes: [a] Minimum value is restrained to the 1 per cent percentile value; [b] Maximum value is restrained to the 99 per cent percentile value

Table IV.
Descriptive statistics for selected variables

Variable	VAIC	VACA	VAHU	STVA	RD	AD	M/B
VAIC	1.000						
VACA	0.584*	1.000					
VAHU	0.997*	0.591*	1.000				
STVA	0.073*	−0.164*	−0.001	1.000			
RD	0.056*	0.214*	0.052*	0.022	1.000		
AD	−0.129*	0.084*	−0.124*	−0.100*	0.046*	1.000	
M/B	0.329*	0.497*	0.327*	−0.021	0.301*	0.023	1.000

Note: * Indicates correlation is significant at the 0.01 level in the two-tailed test

Table V.
Correlation analysis of selected variables

related with VAIC, VACA, and VAHU, suggesting that firms' market value is positively associated with corporate intellectual ability and its two components, capital employed efficiency and human capital efficiency. Furthermore, the M/B-STVA relationship is not significant, but the M/B-RD relationship is significantly positive, supporting our argument that R&D expenditure may capture additional information on firms' innovative capital, an important component of structural capital.

Tables VI-VIII present the results of the three regression models on dependent variable M/B. Tables VI and VII show the coefficient on VAIC is significantly positive in the model 1, and that all three components of VAIC are also significantly positive in the model 2. The results support *H1* and *H2* hypotheses that investors place higher value on firms with greater intellectual capital, and that all three components of VAIC are recognised as valuable intellectual capital. Noticeably, the adjusted R^2 substantially increases from 0.1077 in the model 1 to 0.2515 in the model 2, suggesting investors may place different value on the three components of VA efficiency, and thus the explanatory power for firm value in model 2 is substantially greater than that in model 1.

Table VIII shows that, after controlling for STVA, the coefficient on RD is significantly positive in the model 3, and that the adjusted R^2 increases to 0.2916. The

Model 1: $\text{M/B}_{it} = \alpha_0 + \alpha_1 \text{VAIC}_{it} + \varepsilon_{it}$

Independent variable	Coefficient	*t*-statistic
Intercept	1.605	61.59*
VAIC	0.065	22.68*

Notes: * Indicates significant at $\alpha = 0.05$ level; Adjusted $R^2 = 0.1077$; F-value = 514.16 (p-value < 0.0001)

Table VI. Regression results of firm value model – independent variable – VAIC

Model 2: $\text{M/B}_{it} = \alpha_0 + \alpha_1 \text{VACA}_{it} + \alpha_2 \text{VAHU}_{it} + \alpha_3 \text{STVA}_{it} + \varepsilon_{it}$

Independent variable	Coefficient	*t*-statistic
Intercept	1.142	28.30*
VACA	8.242	28.64*
VAHU	0.009	2.62*
STVA	0.151	4.30*

Notes: * Indicates significant at $\alpha = 0.05$ level; Adjusted $R^2 = 0.2515$; F-value = 477.29 (p-value < 0.0001)

Table VII. Regression results of firm value model – independent variables – components of VAIC

Model 3: $\text{M/B}_{it} = \alpha_0 + \alpha_1 \text{VACA}_{it} + \alpha_2 \text{VAHU}_{it} + \alpha_3 \text{STVA}_{it} + \alpha_4 \text{RD}_{it} + \alpha_5 \text{AD}_{it} + \varepsilon_{it}$

Independent variable	Coefficient	*t*-statistic
Intercept	1.053	25.82*
VACA	7.221	24.69*
VAHU	0.013	4.02*
STVA	0.112	3.25*
RD/BV	11.781	15.57*
AD/BV	−0.823	−0.70

Notes: * Indicates significant at $\alpha = 0.05$ level; Adjusted $R^2 = 0.2916$; F-value = 351.13 (p-value < 0.0001)

Table VIII. Regression results of firm value model – independent variables – components of VAIC, R&D, and advertising expenditures results lend support to *H3-1*, that STVA may not fully capture structural capital, and R&D expenditure may contain additional information on innovative capital. We, however, do not find evidence supporting *H3-2* since the coefficient on AD is not significant. The insignificant result on AD may be due to the fact that advertising expenses may not be a good proxy for relational capital.

We further conduct in-depth analysis by industry of the three regression models on firm value. The results are summarised in Table IX. Of the 20 industries, model 1 has significant overall explanatory power for 14 industries, model 2 for 17, and model 3 for 19. The average adjusted R^2 of the 20 industries also increases from 0.1061 in model 1, to 0.247 in model 2, and 0.296 in model 3. The results of industry analyses corroborate that the three components of VA measures are better than the aggregate measure VAIC in explaining firm value, and that R&D and advertising expenditures capture additional intellectual capital and thus improve the model's explanatory power.

Table X presents the results of the three regression models for current-year financial performance. Panel A of Table X shows that the coefficient on VAIC is significantly positive in the four financial performance models, suggesting firms with greater intellectual capital perform better in terms of profitability and revenue growth. Panel B of Table X shows that both VACA and VAHU are positively associated with the four financial performance measures, while STVA is only significantly positive in the ROE model. Similar to the results of Tables VI-VIII, adjusted R^2s are substantially greater in the model 2 than those in the model 1. For example, in the ROE and ROA models, adjusted R^2s increase from 0.4394 and 0.4684 to 0.7286 and 0.8423, respectively.

Panel C of Table X, however, shows that adding R&D and advertising expenditures to the regression model only marginally improves the models' explanatory power. The coefficients on RD are significantly positive in the ROA and GR models, but insignificant in the ROE and NP models. The coefficient on AD is significantly negative in both ROE and ROA models and insignificant in the GR and NP models. These results may be due to the fact that according to accounting standards, both R&D and advertising expenditures are expensed when incurred and thus reduce the current-year's net income, resulting in contemporaneous, inferior financial performance.

Table XI presents the results of regressing lagged independent variables on the four financial performance variables. Because we use lagged independent variables to analyse dependent variables, our sample is reduced by one firm-year's observations for using each lagged period, resulting in a sample size of 3,626, 3,028, and 2,491 observations for lagged one-, two-, and three-year samples, respectively. The results of model 1 and model 2 in Table XI show that, in all three lagged period samples, VAIC and VACA are positively associated with the four financial performance variables, suggesting intellectual capital efficiency is related to firms' future profitability, revenue growth and employee productivity. Of the three VAIC components, VACA is the most significant variable related to firms' financial performance. This finding is consistent with the fact that most Taiwan firms are manufacturers, and thus the efficiency with which they utilise capital assets is an important factor for financial performance. The results of model 3 in Table XI shows that, after controlling for STVA, the coefficient on RD remains positively with ROE, ROA and GR in all three lagged period models, suggesting that, although R&D expenditure is expensed as incurred, it is important for firms' future profitability and revenue growth. Overall, our

Table IX. Regression results of firm value model – by industry

Items		Model 1		Model 2		Model 3	
		$M/B_{it} = \alpha 0 + \alpha_1 VAIC_{it} + \varepsilon_{it}$		$M/B_{it} = \alpha_0 + \alpha_1 VACA_{it} + \alpha_2 VAHU_{it} + \alpha_3 STVA_{it} + \varepsilon_{it}$		$M/B_{it} = \alpha_0 + \alpha_1 VACA_{it} + \alpha_2 VAHU_{it} + \alpha_3 STVA_{it} + \alpha_4 RD_{it} + \alpha_5 AD_{it} + \varepsilon_{it}$	
Industry	*n*	Adj. R^2	*F*	Adj. R^2	*F*	Adj. R^2	*F*
Cement	85	0.392	55.17*	0.638	50.37*	0.632	29.82*
Foods	225	0.016	4.55*	0.061	5.84*	0.066	4.16*
Plastics	200	0.103	23.85*	0.234	21.27*	0.245	13.93*
Textiles	469	0.110	59.03*	0.189	37.25*	0.194	23.52*
Electric and machinery	194	0.196	48.00*	0.417	46.92*	0.414	28.26*
Electrical appliances and cable	145	−0.006	0.14	0.059	4.00*	0.049	2.48*
Chemicals	235	0.080	21.26*	0.329	39.18*	0.346	25.8*
Glass and ceramics	71	0.132	11.63*	0.535	27.84*	0.603	22.27*
Paper and pulp	73	−0.005	0.64	−0.009	0.79	0.268	6.27*
Steel and iron	206	0.135	32.99*	0.242	22.78*	0.243	14.14*
Rubber	92	−0.011	0.06	0.031	1.97	0.318	9.50*
Automobile	45	0.157	9.17*	0.171	4.03*	0.154	2.60*
Electronics	1,195	0.148	208.95*	0.292	165.5*	0.336	121.76*
Construction	247	0.091	25.48*	0.144	14.79*	0.319	24.01*
Transportation	144	0.011	2.65	0.264	18.11*	0.259	11.01*
Tourism	55	−0.003	0.83	0.028	1.51	0.033	1.37
Finance	178	0.023	5.14*	0.057	4.55*	0.098	4.83*
Wholesale and retail	115	0.000	1.03	0.138	7.07*	0.177	5.92*
Conglomerate	11	0.529	12.22*	0.901	31.48*	0.912	21.79*
Others	269	0.025	7.81*	0.229	27.58*	0.257	19.56*
Average adj. R^2		0.106		0.247		0.296	

Note: * Indicates significant at $\alpha = 0.05$ level

Table X.
Regression results for financial performance

	Dependent variables							
	ROE		ROA		GR		NP	
Independent variables	*n*	*t*-statistic	*n*	*t*-statistic	*n*	*t*-statistic	*n*	*t*-statistic
Panel A: model 1								
Intercept	−0.863	−13.73*	−0.078	−2.61*	3.151	5.81*	−1,402	−17.89*
VAIC	0.396	57.73*	0.199	61.23*	1.360	22.97*	308	36.00*
Adjusted R^2	0.439		0.468		0.110		0.233	
F-value	3,332*		3,749*		527*		1,295*	
Panel B: model 2								
Intercept	−2.187	−29.58*	−0.953	−34.70*	−0.118	−0.13	−1,362	−10.37*
VACA	34.309	65.07*	19.335	98.73*	68.600	10.36*	6,736	7.19*
VAHU	0.169	28.04*	0.070	31.36*	0.904	12.27*	267	24.98*
STVA	−0.027	−0.42	0.129	5.39*	1.367	1.74	−153	−1.34
Adjusted R^2	0.729		0.842		0.133		0.247	
F-value	3,807*		7,574*		218*		466*	
Panel C: model 3								
Intercept	−2.036	−26.72*	−0.905	−32.32*	−1.291	−1.38	−1,344	−9.85*
VACA	35.210	64.41*	19.473	96.87*	56.151	8.38*	6,932	7.08*
VAHU	0.158	25.74*	0.066	29.31*	0.968	12.88*	266	24.23*
STVA	−0.057	−0.88	0.103	4.35*	0.965	1.23	−147	−1.28
RD/BV	−1.255	−0.89	2.885	5.55*	132.811	7.67*	−2,096	−0.83
AD/BV	−17.931	−8.20*	−9.016	−11.21*	11.922	0.45	−170	−0.04
Adjusted R^2	0.733		0.848		0.144		0.247	
F-value	2,334*		4,739*		144*		279*	

Note: * Indicates significant at $\alpha = 0.05$ level

Table XI. Regression results for financial performance – using lagged independent variables

Independent variables	Lagged one-year results ($n = 3,626$)				Lagged two-year results ($n = 3,028$)				Lagged three-year results ($n = 2,491$)			
	ROE	ROA	GR	NP	ROE	ROA	GR	NP	ROE	ROA	GR	NP
Intercept	−0.31*	0.18*	8.35*	−429*	0.63*	0.18*	6.86*	−406*	0.72*	0.15*	3.81*	−338*
VAIC	0.23*	0.12*	0.14*	129*	0.09*	0.09*	0.21*	100*	0.08*	0.06*	0.49*	63*
Adjusted R^2	0.13	0.16	0.01	0.14	0.02	0.07	0.01	0.06	0.01	0.03	0.01	0.02
F-value	561*	671*	4.37*	577*	75.6*	232*	6.96*	196*	34.74*	80.08*	26.87*	41.37*
Intercept	−1.64*	−0.60*	5.71*	−632*	−0.22	0.64*	4.83*	−799*	−0.03	−0.51*	1.47	−725*
VACA	27.1*	14.9*	38.0*	5,717*	15.3*	13.4*	27.6*	7,331*	15.45*	12.13*	29.13*	8,474*
VAHU	0.06*	0.02*	−0.11	94*	0.01	0.01	0.04	57*	−0.01	−0.01	0.32*	18
STVA	0.15	0.13*	1.07	17	0.09	0.18*	0.87	79	−0.16	−0.02	1.38	−103
Adjusted R^2	0.30	0.39	0.01	0.16	0.09	0.25	0.01	0.10	0.08	0.17	0.01	0.05
F-value	529*	765*	10.66*	235*	101*	330*	6.48*	105*	77.48*	171*	12.51*	47.39*
Intercept	−1.61*	−0.59*	5.41*	−611*	−0.23	−0.63*	4.66*	−757*	−0.03	−0.54*	0.83	−721*
VACA	26.9*	14.7*	28.4*	5,806*	14.3*	13.0*	17.40*	7,375*	14.66*	11.13*	15.91	8,058*
VAHU	0.05*	0.02*	−0.10	92*	0.01	0.01	0.05	54*	−0.01	0.01	0.40*	19
STVA	0.11	0.10*	0.39	9.02	0.01	0.14*	0.14	53	−0.22	−0.08	0.86	−136
RD/BV	8.06*	6.52*	153*	545	15.1*	8.33*	149.3*	2,740	11.52*	11.74*	135*	6,052*
AD/BV	−10.68*	−6.44*	−96.55*	−3,083	−8.24*	−6.58*	−72.7*	−6,314*	−7.00	−3.19	−1.92	−3,627
Adjusted R^2	0.31	0.40	0.03	0.16	0.10	0.26	0.02	0.10	0.09	0.18	0.02	0.06
F-value	322*	474*	19.82*	142*	66.24*	209*	13.23*	64.55*	49.34*	113*	12.96*	29.69*

Note: * Indicates significant at $\alpha = 0.05$ level

results support the viewpoint that intellectual capital efficiency may be an indictor for firms' future financial performance.

Conclusions

Intellectual capital is increasingly recognised as an important strategic asset for sustainable corporate competitive advantages. Our study provides empirical evidence that investors place higher value on firms with better intellectual capital efficiency, and that firms with better intellectual capital efficiency yield greater profitability and revenue growth in both the current and the following years. Our results underline the importance of intellectual capital in enhancing firm profitability and revenue growth. Although generally-accepted accounting standards restrain most intellectual capital from being recognised in financial statements, investors still grasp the invisible value of intellectual capital.

By using data from Taiwanese listed companies, our findings have important implications for developing countries. Intellectual capital is being increasingly recognised as the major driver of corporate and national growth. As illustrated by Kaplan and Norton (2004, p. 4):

> [...] some countries such as Venezuela and Saudi Arabia have high natural resource endowments but have made poor investments in their people and systems. As a consequence, they produce far less output per person, and experience much slower growth rates, than countries such as Singapore and Taiwan that have few natural resources but invest heavily in human and information capital and effective internal systems[8].

While stimulating investments is an urgent task common amongst governments of developing countries, our results also show that developing intellectual capital is no less important than capital investments for companies in developing countries in order to create value and sustainable advantages. Therefore, governments of developing countries should balance resources in investing in intellectual capital and physical investments.

Notes

1. Kaplan and Norton (2004, p. 4) documented that about 75 per cent of market value of US firms comes from intangible assets.
2. There is no universal definition of intellectual capital and its classification until today. To conserve space, this study will not review the definitions and classifications of intellectual capital in prior literature.
3. Roos *et al.* (1997, p. 42) describe structural capital as "what remains in the company when employees go home for the night".
4. Their samples are drawn from firms that appeared in the *Information Week* 500 list between 1991 and 1997.
5. Examples of structural capital include technologies, inventions, data, publications, strategy and culture, structures and systems, organisational routines and procedures.
6. They used data surveyed from part-time MBA students. The two industry sectors include service industries (e.g. financial services, entertainment, software) and non-service industries (e.g. construction, production, mechanical engineering).
7. Firer and Williams (2003, p. 353) listed some examples of studies that referred to or used VAIC: IBEC (2002); Williams (2001); Nova Kreditna banka Mariba (2000).

8. In 1970, Saudi Arabia's and Venezuela's gross domestic product (GDP) per capita were (US) \$7,624 and \$10,672 respectively; while Taiwan's and Singapore's GDP per capita were \$2,987 and \$4,438, respectively. However, in 1998, Taiwan's and Singapore's GDP per capita increased to \$15,012 and 22,643 respectively, surpassing Saudi Arabia's and Venezuela's \$8,225 and \$8,965, respectively. (Statistics are based on Kaplan and Norton (2004, p. 16).)

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