Intellectual capital and firm performance in Vietnam 2012–2016

Hue Thi Hoang*, Hanh Thi Hai Nguyen and Ngan Hoang Vu

National Economics University,
207 Giai Phong Street,
Hai Ba Trung District, Hanoi, Vietnam
Email: hoanghue@neu.edu.vn
Email: nguyen.hanh@neu.edu.vn
Email: nganvh@neu.edu.vn
*Corresponding author

Anh Hai Le

Foreign Trade University,
91 Chua Lang Street,
Dong Da District, Hanoi, Vietnam
Email: anhlh.93@gmail.com

Hanh Hong Quach

National Economics University,
207 Giai Phong Street,
Hai Ba Trung District, Hanoi, Vietnam
Email: hanhqh.yesneu@gmail.com

Abstract: The aim of the study is to investigate the relationship between intellectual capital and firm performance. We empirically explore how intellectual capital affects firm performance in Vietnam. The data was collected through annual enterprise surveys by the General Statistics Office of Vietnam on a sample of 13,900 Vietnamese firms during 2012–2016. Adopting Pulic's (1998) value-added intellectual coefficient model as later refined, we model a path between intellectual capital and firm performance. Results show that intellectual capital correlated positively with firm performance during the period. Further, human capital correlates positively only with business performance, material capital, and financial capital in the short-term. Among components of intellectual capital efficiency, structural capital efficiency has the greatest positive correlation with short and long-term firm performance. Although there are some limitations to measure intellectual capital quantitatively, this research provides further insight into the effect of intellectual capital on firm performance within a developing country.

Keywords: firm performance; intellectual capital; human capital; relational capital; structural capital; capital employed efficiency.

Reference to this paper should be made as follows: Hoang, H.T., Nguyen, H.T.H., Vu, N.H., Le, A.H. and Quach, H.H. (2020) 'Intellectual capital and firm performance in Vietnam 2012–2016', *Int. J. Learning and Intellectual Capital*, Vol. 17, No. 1, pp.27–46.

Biographical notes: Hue Thi Hoang has been working for National Economics University in Vietnam for tem years as a Lecturer of Human Resource Management Faculty. She holds a Bachelor's and Master's in Human Resource Management. She has authored and co-authored numerous researches in human resource management, human resource development, and business development.

Hanh Thi Hai Nguyen is currently a Lecturer of National Economics University, teaching on a number of programs such as labour economics, human resource management. She holds Bachelor's in Business Administration and Bachelor's in Banking and Finance. She also has a Master's in Science in Management. She has authored and co-authored numerous researches in human resource management, organisational behaviour, and corporate culture.

Ngan Hoang Vu completed her Doctoral Dissertation at Paris Descartes University (Paris V) in France in 1998, and has been working for 28 years at the National Economics University (NEU) in Vietnam as a Lecturer in Human Resource Management, Human Resource Development, Organisational Behaviour and Labour Economics. She is currently the Dean of the NEU Faculty of Human Resource Economics and Management. She has authored and co-authored numerous researches in human resource management, human resource development, labour markets and labour productivity. She also provides short-term training courses and advisory services to enterprises on human resource management.

Anh Hai Le holds a Bachelor's in Business Administration at Foreign Trade University, Vietnam and he is currently working as a Data Analyst. He is keen on researching in supply chain management and business management.

Hanh Hong Quach is currently a student of Faculty of Mathematical Economics, National Economics University in Vietnam. She is interested in researching in business economics and business management.

1 Introduction

Sullivan (2000) suggests that competitive advantage of nations and firms is affected by tangible resources such as land and labour and by other economic assets. Under that resource-based view, resources (especially intangible assets) enhance a firm's performance and sustainability (Eisenhardt and Schoonhoven, 1996). Bradley (1997) argues that firms focus on intangible rather than tangible assets to create competitive advantage.

For two decades, organisations and economists have acknowledged intellectual capital (IC) as an important intangible asset, contributor to firm performance (Teece, 1998; Youndt et al., 2004), and source of competitive advantage (Dean and Kretschmer, 2007; Yaseen et al., 2016). It is important for creating competitive advantage and improving firm performance (Hitt et al., 2001; Khan and Ali, 2017). Businesses operate and develop effectively if they have sufficient IC (Daley, 2001). It is essential to modern organisations and a common element in business platforms (Martínez-Torres, 2006).

Many studies address how IC affects firm performance (Pulic, 1998, 2000, 2004; Firer and Williams, 2003; Clarke et al., 2011; Scafarto et al., 2016; Smriti and Das, 2018; Nadeem et al., 2018). However, most examine developed economies, employ primary data, examine brief periods, or delve into a single field. Vietnam is a developing economy with a quasi-socialist market economy, and the performance effects of IC are largely unexplored.

We applied quantitative methods to the value-added intellectual coefficient (VAIC) model developed by Pulic (1998) as refined in 2000 and 2004 to measure how IC affects performance of 13,900 Vietnamese firms across a range of industries from 2012 to 2016. We modelled the data via regression to assess the impact of IC and its components on performance of Vietnamese firms. We address two questions: How did IC affect their performance? And how did specific components of IC affect performance?

2 Literature review and hypothesis development

2.1 Firm performance

Performance is a complex and multi-dimensional subject in business policy research (Dess and Robinson, 1984). Armstrong and Baron (2005) define it as an aggregate assessment of benefits organisations generate from resources they employ. Performance is measured by the attainment of goals or efficiency in applying resources to achieve objectives.

Researchers generally use profits to assess business performance, although many use return on assets (ROA) and return on equity (ROE) (Chen et al., 2005; Shiu, 2006; Tan et al., 2007; Chan, 2009; Clarke et al., 2011, Ozkan et al., 2017; Mohammed and Irbo, 2018). We use ROE and ROA to measure performance in accord with longstanding scholarly practice (Maditinos et al., 2011; Clarke et al., 2011; Chen et al., 2005; Chan, 2009).

2.2 Intellectual capital

Increased investment in knowledge indicates firms' ability to manage assets for long-term competitive advantage (Edvinsson and Malone, 1997; Pulic, 2000; Chen et al., 2005; Clarke et al., 2011; Tripathy et al., 2015; Maji and Goswami, 2017; Al-Sartawi, 2018). Theories of IC take four approaches.

The strategic approach links IC to a firm's ability to create and apply its knowledge base (Martín-de-Castro et al., 2011). IC has three characteristics: *invisibility*, *potential for value creation*, and *organisational growth*. Edvinsson and Sullivan (1996) see IC as knowledge that can be transformed into value. Bradley (1997) regards IC as the ability-not merely of firms but of nations – to transform intangible assets like knowledge into wealth-generating resources. Rastogi (2003) proposes that IC is a firm's ability to coordinate, organise, and deploy knowledge to create value in pursuing goals. Subramaniam and Youndt (2005) define IC as the sum of all knowledge used for competitive advantage.

The value approach heralded by Teece et al. (1997) does not define IC explicitly, and its uses of the term oscillate between the narrowly financial and generalities equating IC with intangible resources (Dean and Kretschmer, 2007). Ordóñez de Pablos (2003) calls IC the difference between a company's market value and book value. Brooking (1997) defines it as the difference between a firm's book value and how much someone is willing to pay for it. Petty and Guthrie (2000) treat IC as the economic value of two types of intellectual property – organisational and human capital (HC).

The labour approach, one of the first and best-known efforts to model and measure IC, originated during the 1980s at Skandia, a Swedish financial services company. Edvinsson and Malone (1997) define IC as aspects beyond the HC of a business that remain when employees return home. Roos and Roos (1997) suggest capital is all assets not fully captured on the balance sheet, including what its members know and what remains when they leave.

The synthesis approach to IC presently dominates research and is partitioned into many aspects. Hsu and Fang (2009) define IC as the total value of a firm's ability, knowledge, culture, strategy, processes, intellectual property, and networks that assist in achieving goals. Choong (2008) includes costs of marketing, training, start-ups, research and development (R&D), human resource expenditures, organisational structure, and value from brand names, copyrights, non-compete terms, franchising, future benefits, licenses, operating rights, patents, confidential processes, trademarks, and trade names. Mouritsen et al. (2005) see IC as an enabling mechanism and subsume many assets beneath it, including employees, customers, information technology, work management, and knowledge. Kim and Kumar (2009) suggest IC is a combination of human resources, organisational structures, and relationships. Per Mohammed and Irbo (2018), IC is the knowledge, experience, and brainpower of employees plus knowledge in databases, systems, processes, cultures, and philosophy.

Of those four theoretical approaches, we favour the synthesis approach because it offers the fullest view of IC and most accords with data we collected about Vietnamese firms. We perceive IC as the combination of human resources, structures, processes, and strategies derived from the capital of a business to create value and competitive advantage.

2.3 Components

Although researchers define IC inconsistently, most agree it encompasses HC, relational capital (RC), and structural capital (SC) (Martínez-Torres, 2006; Subramaniam and Youndt, 2005).

HC has been systematically addressed as a component of IC since the 1960s. Schultz (1961) argues that people's skills and knowledge shape HC. Bontis et al. (2000) insist it includes human knowledge, skills, innovation, and competence. Edvinsson and Malone (1997) define HC as the combined knowledge, skills, creativity, and ability of all employees equal to their current jobs.

Martín-de-Castro et al. (2011) analyse two elements of HC. *Knowledge* consists of formal education, specific training, experience, and personal development. *Skill* is the knowledge involved in 'a way of working' (know-how). It coalesces all talent and ingenuity into a foundation derived from experience and practice. Skill consists of four capacities: *self-learning*, *teamwork*, *communication* (knowledge and personal know-how), and *leadership*. Their resultant behaviours include knowing how to motivate people to perform. They are associated with commitment, responsibility, self-motivation, job satisfaction, friendship, flexibility, and creativity.

SC is the organisational link to IC. Organisations have structural knowledge that exists in multitudes of relationships that allow them to operate. Zeghal and Maaloul (2010) define SC as all that remains in the office when employees go home. Whereas HC belongs to employees and is difficult to manage, companies control, own, and manage SC. It is an organisation's framework and linkages for storing, using, developing, and transferring knowledge and business operations (Cabrita and Bontis, 2008).

Capital is technological and organisational.

Technological capital is the body of knowledge related to developing the organisation's activities and the functioning of its technical operating systems (Bueno et al., 2003). It includes responsibility to collect new products, services, and processes and to advance the organisational knowledge base needed to develop technological innovations. Technological capital includes R&D, its costs, numbers of personnel involved, and the relative importance of projects. The infrastructure of technological capital includes acquired technology, information, and communications needed for technological innovation. Its assets are intellectual and industrial property, such as legal and non-proprietary scientific and technical knowledge (patents, prototypes, trade secrets, design rights, registered trademarks, and licenses).

Organisational capital has three elements. First is an organisation's *culture*, *values*, and *attitudes*, including the degree of cultural uniformity or cohesion, and their acceptance generally and among managers. Second is the *effective use* of information technology and communications systems to assure the storage, dissemination, transfer, and refinement of information and knowledge. Third is the organisation's *structure*.

RC is the least-studied component of IC (Noordin and Mohtar, 2012), perhaps because it is complex and unlike other intangible assets. In their resource-based view, Acedo et al. (2006) argue that RC helps businesses to grow. The literature takes two views of RC:

The first sees RC as available resources and relationships arising via interactions between organisations or individuals (Kostova and Roth, 2003; Shipilov and Danis, 2006), including customers, suppliers, partners, and competitors. It is a valuable intangible asset that firms 'own' when doing business (Petrash, 1996), and it is influenced by the customer's understanding of the firm. RC reflects social integration with suppliers and customers (Barki and Pinsonneault, 2005).

The second view of RC regards it as social capital, i.e., the value of the company's relationships with society. Social capital includes value created by relationships with all groups inside and outside the organisation (Bontis, 1996; Roos et al., 2001). Taking advantage of social relationships creates resources. RC is knowledge embodied in relationships with customers, suppliers, the industry, associations, or other stakeholders (Bontis, 1998).

2.4 Measurement of IC

Pulic developed VAIC in 1998 and refined it in 2000 and 2004 (Clarke et al., 2011). The VAIC model features three components: *human capital efficiency* (HCE), *structural capital efficiency* (SCE, which includes internal and RC efficiency), and *capital employed efficiency* (CEE, comprised of physical and financial capital) (Clarke et al., 2011).

Most studies show a positive relation between VAIC and measures of business performance (ROA, ROE, ATO, MB) (Chen et al., 2005; Ting and Lean, 2009; Tan et al., 2007; Tripathy et al., 2015; Kamath, 2017; Nawaz, 2019). However, Firer and Williams (2003) and Shiu (2006) find HCE has a significant negative relationship with asset turnover and market-to-book ratio.

Morariu (2014) uses the VAIC™ model to investigate relations between IC and corporate profitability, productivity, and market value in Romania. Results indicate a significant negative relation between VAIC™ and market value, implying firms are generating no value from intellectual, physical, and financial resources that capital markets recognise.

Narwal and Yadav (2017) examine intellectual capital efficiency (ICE) and financial performance of Indian electricity, mining, and asset financing sectors. They model a VAIC™ that Pulic used to evaluate value-added efficiency based on market capitalisation of 60 companies on the Bombay Stock Exchange spanning 2006–2015. They find that IC correlates positively with profitability and negatively with productivity. Singh and Narwal (2018) show that SC has no significant relation to increasing market valuations. They also find that HC and SC correlate negatively with productivity among manufacturers.

Scholarly evidence is inconsistent about relations between IC and firm performance. Thus, our investigation of Vietnamese firms extends the literature in a needed direction.

2.5 Impact of IC (measured by VAIC) on firm performance

Research by Saeed et al. (2016) into the top 100 companies on the Karachi stock exchange empirically confirms that those with better IC resources generate higher ROI, ROE, and productivity. Nawaz's (2019) study of Islamic banks in the UK finds that ICE proxied by VAIC relates positively to financial performance. Kamath (2017) finds that ICE influences profitability of all publicly traded firms in India, especially textile and IT firms. Results also confirm that HCE influences productivity and export performance of all firms. According to Maji and Goswami (2017), the VAIC model supports the positive impact of IC on performance. Hasan and Miah (2018) argue IC resources significantly influence financial performance. Therefore, we propose:

H1(a) VAIC correlates positively with business performance.

2.6 Impact of IC on firm performance

Components of IC have relatively high efficiency effects (Firer and Williams, 2003; Chen et al., 2005; Shiu, 2006; Appuhami, 2007; Chan, 2009; Maditinos et al., 2011; Clarke et al., 2011). In the VAIC calculation, for example, capital structure depends on HC (Nazari and Herremans, 2007), which can influence the relative effects of each component. Tripathy et al. (2015) use Pulic's (1998) VAIC to measure efficiency of IC on financial performance of firms listed on the Bombay Stock Exchange. Findings suggest that physical capital correlates positively with ROA. Saeed et al. (2016) analyse the components of IC and show a positive relation among the efficiency of physical and financial capital, HC efficiency, and performance. Kamath (2017) confirms that HCE influences productivity and export performance.

Therefore, we propose that the components of IC correlate positively with efficiency at different levels:

H1(b) HCE correlates positively with performance.

H1(c) SCE correlates positively with performance.

H1(d) CEE correlates positively with performance.

IC may affect firm performance eventually but not immediately. For example, a new manager (HC) might not generate more profit if he is untrained and inexperienced. New systems (SC) and new plant and equipment (CE) take time to adjust to. Thus, Chen et al. (2005), Shiu (2006) and Tan et al. (2007) propose a lagged variable, namely VAIC and its components that correlate positively with subsequent performance. We hypothesise:

H2(a) The previous year's VAIC correlates positively with current year performance.

H2(b) The previous year's HCE correlates positively with current year performance.

H2(c) The previous year's SCE correlates positively with current year performance.

H2(d) The previous year's CEE correlates positively with current year performance.

3 Method

3.1 Instrumentation

We adopted Pulic's (1998) method of measuring IC with a VAIC index to assess relations between IC and operational efficiency of Vietnamese enterprises. Maji and Goswami (2017) commend Pulic's VAIC model as widely used for measuring IC and examining links between IC and performance. This model measures the added value of IC along with its individual components (HC, SC, physical capital, and finance).

Accordingly, VAIC has three components: HCE, SCE (capital structure effectiveness) and CEE (effective use of physical and financial capital) (Nazari and Herremans, 2007). HCE and SCE constitute ICE. Pulic (2004) argues that a complete picture of IC's value creation must consider financial and physical capital measured by the CEE index. VAIC is based on financial reporting, asset valuation, and efficiency of IC, making it useful in guiding managers' decisions. Pulic's (1998) model determines the size and efficiency of IC instead of quantity and price. Pulic (2004) criticises other IC measurement models for lacking similarity and scope.

Ståhle et al. (2011) and Iazzolino and Laise (2013) document the imitations of the VAIC model, especially as they concern measurement and structural methods. Nonetheless, it produces the best measures of IC for statistical analysis. Its results are quantifiable, objective, and verifiable (Maji and Goswami, 2017). Many alternate models are customised to specific businesses and lack comparability between businesses (Firer and Williams, 2003). All data applied and calculated by VAIC are audited and verifiable (Pulic, 1998, 2000). Many private and commercial researchers use VAIC to measure the effectiveness of IC (Firer and Williams, 2003; Tan et al., 2007; Chan, 2009; Ting and Lean, 2009; Clarke et al., 2011; Purohit and Tandon, 2015; Bontis et al., 2015).

3.2 Sampling and data collection

To assess the impact of IC on firm performance in Vietnam, we accessed secondary data spanning 2012–2016 for 13,900 firms from annual enterprise surveys by the General Statistics Office of Vietnam (GSO) (Table 1).

Table 1 Sample

Industries year	*2012*	*2013*	*2014*	*2015*	*2016*
Minerals	5	6	5	5	6
Agriculture and forestry	13	14	14	15	14
Processing	888	892	891	896	885
Electricity and gas	4	4	4	4	4
Transportation and warehouses	195	201	198	202	200
Construction	271	280	286	282	277
Real estate	85	82	82	90	94
Finance, banking, insurance	66	66	67	66	64
Other services	1,253	1,235	1,233	1,220	1,236
Total	*2,780*	*2,780*	*2,780*	*2,780*	*2,780*
			13,900 observations		

3.3 Research models

We constructed two regression models to investigate how IC affects performance of Vietnamese enterprises. Model 1 captures the direct impact of IC on performance following Clarke et al. (2011):

$$PERFORM_{i,t} = \alpha_0 + \alpha_1 VAIC_{i,t} + \alpha_2 VAIC_{i,t-1} + \alpha_3 CONTROL_{i,t} + \varepsilon_i$$

Model 2 captures how the components of IC indirectly affect performance:

$$\begin{aligned} PERFORM_{i,t} = {} & \alpha_0 + \alpha_1 HCE_{i,t} + \alpha_2 HCE_{i,t-1} + \alpha_3 CEE_{i,t} + \alpha_4 CEE_{i,t-1} \\ & + \alpha_5 SCE_{i,t} + \alpha_6 SCE_{i,t-1} + \alpha_7 CONTROL_{i,t} + \varepsilon_i \end{aligned}$$

Variables in both models are described as follows:

- *PERFORM is measured by ROA and ROE:* ROA measures the profitability of assets, calculated as ROA = net profit / total assets. ROA reveals the after-tax returns generated by invested capital (or amount of assets) – for example, how much profit is made after-tax per investment in assets. The higher the ROA, the more efficient are the firm's assets.

  ROE indicates profit earned after investment in business capital, calculated as ROE = net profit / total equity. ROE provides information about after-tax returns generated by the amount of equity invested and how much after-tax profit is generated by owners' equity. The higher the ROE, the more efficient is owners' equity.

- *VAIC:* VAIC is calculated from Pulic's (1998) model to ascertain the firm's ability to generate added value (VA) as the difference between inputs and output. Results encompass costs of all non-labour inputs used in earning revenue as a value-creating entity (Tan et al., 2008). VA also is defined as net value generated (Chen et al., 2005) and can be expressed by:

  $$VA = S - B = NI + T + DP + I + W \quad (1)$$

  S is net revenue (output). B is material and services purchased (cost of goods sold, inputs). NI is net income after-tax. T is tax. DP is depreciation. I is cost. W is salaries. The VA in equation (1) is exemplifies the 'value-added' approach (Riahi-Belkaoui, 2003) and is the method we use.

- *HCE:* HC includes all employees' factor endowments. The VAIC model defines HC as wages over time (Pulic, 1998). Higher wages for skilled workers add more value to the company than lower wages. HCE represents how much money spent on employee salaries and is calculated as:

  $$HCE = VA / HC$$

  where HC is total salaries and wages.

  If salaries are low and VA high, firms are using HC effectively. If VA is related to low wages, HC is not used effectively, and HCE will be low. HCE that exceeds the effective use of HC increases value through operating profit.

- *Structured capital efficiency (SCE):* SC consists of strategies, organisational networks, patents, and brand names. Pulic (1998) calculates SC as follows:

  $$SC = VA - HC$$

  VA is influenced by HC and SC. SC depends on HC, and larger values of HC translate into improved internal structures (Nazari and Herremans, 2007). HC and SC are inversely related (Tan et al., 2008), which is logically incompatible with the definition of SC. To correct this problem, Pulic (1998) calculates SCE as:

  $$SCE = SC / VE.$$

  The equation for each co-value increases, how much SCE is produced, and SCE increases when HCE increases. If HCE and SCE are calculated in VA above the numerator, discrepancies arise (Pulic, 1998).

- *CEE:* CEE measures efficiencies that SCE and HCE do not capture. Pulic (1998) argues that IC itself cannot create value and must be combined with use of physical and financial capital (CE). Therefore, CE is calculated as total assets minus intangible assets, and CEE is determined as follows:

  $$CEE = VA / CE$$

  where CE is the company's book value.

  CEE says how much co-value will be used in capital.

  Value-added intelligence (VAIC):

$$\text{VAIC} = \text{HCE} + \text{SCE} + \text{CEE}$$

- *Control denotes control variables:* We used three control variables. Leverage (debt ratio) = total debt / total assets; an index denoting size of the business. Size = log (total capital). Grouping denotes the firm's main business activity. To clarify:
  a. Leverage: A high debt ratio can lead to a focus exclusively on creditors. This is inconsistent with assumptions made about VA and VAIC by stakeholders. Debt-laden companies also may discourage investors and have higher interest payments that affect degree of risk and profit. This control variable appears in Firer and Williams (2003), Shiu (2006), and Chan (2009).
  b. Enterprise size: Enterprise size is the quantity and variety of the firm's production capacity (or service supply) per Mule et al. (2015). Amato and Wilder (1990) show that size affects performance in several ways. It can be seen that size and performance are closely related. Shiu (2006) uses this control.
  c. Industry: Resource requirements, objectives, and strategies for improving efficiency differ among industries. The model separately evaluates performance of each industry segment, in part to avoid interfering with estimating the effects of each independent variable in the model. Kujansivu and Lönnqvist (2007) find that efficiency of IC varies by industrial sector. Chen et al. (2005) and Tan et al. (2007) divide VAIC and the regression model into productive industries and find significant difference in explanatory power across sectors. Firer and Williams (2003) also use industry as a control variable.

4 Results

4.1 IC and performance of Vietnamese firms

Table 2 presents the descriptive statistics of the variables by year, which gives an overview of data usage. Values of variables in the model are calculated over the years indicated in Table 2.

Table 2 Mean values of ROA, ROE, VAIC, HCE, CEE, SCE 2012–2016

Year	*ROA*	*ROE*	*VAIC*	*HCE*	*CEE*	*SCE*	*Leverage*	*Size*
2012	0.05	0.0876	3.0251	2.1817	0.5290	0.3143	0.4170	10.8832
2013	0.046	0.0792	2.6925	1.9395	0.4915	0.2616	0.4062	10.9958
2014	0.0443	0.0793	2.8434	2.0259	0.5471	0.2704	0.4006	11.0175
2015	0.0445	0.0791	2.8511	2.0337	0.5452	0.2721	0.4011	11.1072
2016	0.0482	0.0803	2.9656	2.1281	0.5598	0.2777	0.4013	11.1720

In Table 2, two indicators representing the dependent variable are ROA and ROE. Their arithmetic means range between 0.05 and 0.08. The VAIC, HCE, CEE, and SCE indexes fluctuate between 2012 and 2013 and rise slightly during 2014–2016. Leverage tends to decline. IC is distributed unevenly and fluctuates continuously during the years studied.

For large data usage patterns, Leverage variables are considered normal distributions (rule of large numbers). Fluctuating observed values do not affect the sample significantly.

Table 3 Descriptive statistics of variables in model 1

Variable	*Obs*	*Mean*	*Std. dev.*	*Min*	*Max*
VAIC	13,900	2.8755	2.5606	–0.4958	30.318
vaic_lag1	11,120	2.8530	2.5325	–0.4958	30.318
ROA	13,900	0.0468	0.0934	–0.7137	1.7975
roe	13,900	0.0811	0.1589	–1.9307	1.7975

Table 4 Descriptive statistics of variables in model 2

Variable	*Obs*	*Mean*	*Std. dev.*	*Min*	*Max*
HCE	13,900	2.0618	2.2814	0.5	28.8194
HCE_lag1	11,120	2.0452	2.2577	0.5	28.8194
CEE	13,900	0.5346	0.4224	0.0006	1.9993
CEE_lag1	11,120	0.5282	0.4179	0.0006	1.9986
SCE	13,900	0.2792	0.3361	–1	0.9653
SCE_lag1	11,120	0.2796	0.3327	–1	0.9653
ROA	13,900	0.0468	0.0934	–0.7137	1.7975
roe	13,900	0.0811	0.1589	–1.9307	1.7975

4.2 Differences in IC and performance of by economic sector

To better describe datasets and variables, we used the Kruskal-Wallis test for differences among nine economic sectors. Descriptive results show that values differ by sector. Kruskal-Wills test results also show differences among ROA, ROE, VAIC, HCE, CEE, and SCE ratios across all sectors during the period.

4.3 Correlation between IC and performance

ROA and VAIC are correlated (coefficient is 0.386), which indicates the same relationship between these two variables. The coefficient for ROE and VAIC is positive and significantly correlated with ROA (coefficient 0.4003). For last-period VAIC variables, ROA and ROE are related (coefficients 0.2788 and 0.2848, respectively). This finding coincides with Chen et al. (2005), Shiu (2006), Chan (2009), and Clarke et al. (2011).

ROA and CEE and ROE and CEE correlate significantly and positively. Given calculations of ROA, ROE, and CEE, that relationship is expected. This finding endorses the significant positive relationships in all performance models in Chen et al. (2005).

Table 5 Correlation matrix in model 1

	VAIC	*vaic_lag1*	*ROA*	*roe*
VAIC	1			
vaic_lag1	0.6082	1		
ROA	0.3860	0.2788	1	
ROE	0.4003	0.2848	0.8618	1

Table 6 Correlation matrix in model 2

	HCE	*hce_lag1*	*hce_lag2*	*CEE*	*CEE_lag1*	*SCE*	*SCE_lag1*	*ROA*	*roe*
HCE	1								
hce_lag1	0.6036	1							
hce_lag2	0.5522	0.6031	1						
CEE	0.0346	–0.0287	–0.0331	1					
CEE_lag1	–0.0245	0.0339	–0.0357	0.7048	1				
SCE	0.6340	0.4571	0.4357	0.0758	0.0122	1			
SCE_lag1	0.4501	0.6303	0.4550	–0.0208	0.0737	0.6173	1		
ROA	0.3096	0.2280	0.1984	0.3074	0.2217	0.4528	0.2967	1	
ROE	0.3078	0.2210	0.1960	0.3858	0.2848	0.4758	0.3103	0.8618	1

4.4 Impact of IC on performance

We conducted fixed-effects modelling (FEM) and random factor modelling (REM). Hausman test results:

H0 The REM – random factor model is appropriate

Table 7 Hausman test results

Hausman test result	*Model ROA_1*	*Model ROA_2*	*Model ROE_1*	*Model ROE_2*
Chi-squared	26.19	131.01	23.89	117.82
Df	11	15	11	15
Prob	0.0061	0.0000	0.0132	0.0000

Thus, in both models, ROA-dependent variables and ROEs use FEM.

Results in Table 8 indicate model 1 captures the direct impact of IC on efficiency:

$$\begin{aligned} ROA_{i,t} &= 0.0287 + 0.0116 * VAIC_{i,t} + 0.0017 * VAIC_{i,t-1} - 0.0694 * LEVE_{i,t} \\ &-0.0005 * SIZE_{i,t} + 0.0181 * PI - 0.0815 * Extractive + 0.0214 * AnF \\ &-0.0261 * FnBnI + 0.0011 * ToW - 0.0028 * Build + 0.0105 * OS \end{aligned}$$

$$\begin{aligned} ROE_{i,t} &= -0.0175 + 0.02 * VAIC_{i,t} + 0.0014 * VAIC_{i,t-1} - 0.0136 * LEVE_{i,t} \\ &+0.0019 * SIZE_{i,t} + 0.0451 * PI - 0.1776 * Extrative - 0.0647 * AnF \\ &-0.0202 * FnBnI + 0.0351 * ToW + 0.0079 * Build + 0.037 * OS \end{aligned}$$

First, VAIC enhances ROA and ROE. When VAIC increases 1 unit, ROA increases 0.0116 units and ROE 0.02 units. These results are consistent with Chen et al. (2005), Shiu (2006), Chan (2009), and Clarke et al. (2011).

Second, lagged IC (VAIC_lag1) correlates positively with ROA (0.0017) and ROE (0.0014). This result again supports Chen et al. (2005), Clarke et al. (2011), Chan (2009), who find significant relationships between previous period VAIC and ROA, ROE. Shiu (2006) produces similar results with ROA.

Third, coefficients of Leverage are negative in models featuring ROA (–0.0694) and ROE (–0.0136). However, the coefficient of leverage and ROE is not statistically significant.

Fourth, the control variable size in model 1 is not statistically significant for ROA (0.0287) and ROE (–0.0175).

Fifth, model 1 shows no clear distinctions in performance among industries.

Sixth, the intercept coefficients of ROA (0.0287) and ROE (–0.0175) are not statistically significant.

Seventh, R^2 values in both models are moderately acceptable (21.26% and 19.5%, respectively).

Table 8 Regression results models 1 and 2

Independent variable		*ROA*		*ROE*	
		Coefficients	*t-statistic*	*Coefficients*	*t-statistic*
Panel data A (include VAIC, VAIC_lag1, Leve, ROA, ROE)	Model 1	FEM		FEM	
	Const	0.0287	1.35	–0.0175	–0.48
	VAIC	0.0116***	30.51	0.02***	30.51
	VAIC_lag1	0.0017***	4.35	0.0014**	2.2
	Leve	–0.0694***	–12.92	–0.0136	–1.47
	Size	–0.0005	–0.12	0.0019	0.28
	Indust				
	Processing industry (PI)	0.0181	1.35	0.0451*	1.95
	Other services (OS)	0.0105	0.87	0.037*	1.79
	Extractive	–0.0815	–1.64	–0.1776**	–2.08
	Agriculture and forestry (AnF)	0.0214	0.62	–0.0647	–1.08
	Distribution of electricity, gas (DoEG)	0	Rejected	0	Rejected
	Finance, banking and insurance (FnBnI)	–0.0261	–0.99	–0.0202	–0.44
	Transportation of warehouses (ToW)	0.0011	0.06	0.0351	1.06
	Build	–0.0028	–0.21	0.0079	0.33
	R-square	0.2126		0.195	
	Obs	11,120		11,120	
	T	11		11	
Panel data B (include HCE, HCE_lag1, CEE, CEE_lag1, SCE, SCE_lag1, Leve, ROA, ROE)	Model 2	FEM		FEM	
	Const	–0.0425**	–2.11	–0.1464***	–4.28
	HCE	0.0012***	2.73	0.0008	1.08
	HCE_lag1	0.001**	2.24	–0.0002	–0.22
	CEE	0.0657***	24.65	0.1184***	26.14
	CEE_lag1	0.0001	0.06	0.003	0.74
	SCE	0.0978***	31.54	0.1796***	34.11
	SCE_lag1	0.0079***	2.58	0.0146***	2.82
	Leve	–0.111***	–20.65	–0.0896***	–9.79
	Size	0.0122***	3.23	0.0243***	3.79

Table 8 Regression results models 1 and 2 (continued)

Independent variable		*ROA*		*ROE*	
		Coefficients	*t-statistic*	*Coefficients*	*t-statistic*
Panel data B (include HCE, HCE_lag1, CEE, CEE_lag1, SCE, SCE_lag1, Leve, ROA, ROE)	Indust				
	Processing industry (PI)	0.0116	0.93	0.0325	1.55
	Other services (OS)	0.0122	1.01	0.0401**	2.13
	Extractive	–0.0603	–1.32	–0.14	–1.80
	Agriculture and forestry (AnF)	0.0484	1.52	–0.0156	–0.29
	Distribution of electricity, gas (DoEG)	0	Rejected	0	Rejected
	Finance, banking and insurance (FnBnI)	–0.0169	–0.7	–0.0031	–0.08
	Transportation of warehouses (ToW)	0.0065	0.37	0.0445	1.48
	Build	0.0001	0.00	0.0129	0.61
	R-square	0.4369		0.4424	
	Obs	11,120		11,120	
	T	15		15	

Model 1 validates H1(a) (VAIC positively impacts business performance) and H2(a) (previous period VAIC positively affects performance).

Results also show a difference between the expected (positive) and actual (negative) signs for leverage, but the difference are not statistically significant. The model cannot verify how firm size affects productivity.

Model 2 evaluates how components of IC influence performance.

$$\begin{aligned}\mathrm{ROA}_{i,t} = {} & -0.0425 + 0.0012 * \mathrm{HCE}_{i,t} + 0.001 * \mathrm{HCE}_{i,t-1} + 0.0657 * \mathrm{CEE}_{i,t} + 0.0001 \\ & * \mathrm{CEE}_{i,t-1} + 0.0987 * \mathrm{SCE}_{i,t} + 0.0079 * \mathrm{SCE}_{i,t-1} - 0.111 * \mathrm{LEVE}_{i,t} + 0.0122 \\ & * \mathrm{SIZE}_{i,t} + 0.0116 * \mathrm{PI} - 0.0603 * \mathrm{Extrative} + 0.0484 * \mathrm{AnF} - 0.0484 \\ & * \mathrm{AnF} - 0.0169 * \mathrm{FnBnI} + 0.0065 * \mathrm{ToW} + 0.0001 * \mathrm{Build} + 0.0122 * \mathrm{OS}\end{aligned}$$

$$\begin{aligned}\mathrm{ROE}_{i,t} = {} & -0.1464 + 0.0008 * \mathrm{HCE}_{i,t} - 0.0002 * \mathrm{HCE}_{i,t-1} + 0.1184 * \mathrm{CEE}_{i,t} \\ & + 0.003 * \mathrm{CEE}_{i,t-1} + 0.1796 * \mathrm{SCE}_{i,t} + 0.0146 * \mathrm{SCE}_{i,t-1} - 0.0896 * \mathrm{LEVE}_{i,t} \\ & + 0.0243 * \mathrm{SIZE}_{i,t} + 0.0325 * \mathrm{PI} - 0.14 * \mathrm{Extrative} - 0.0156 * \mathrm{AnF} - 0.0031 \\ & * \mathrm{FnBnI} + 0.0445 * \mathrm{ToW} + 0.00129 * \mathrm{Build} + 0.0401 * \mathrm{OS}\end{aligned}$$

First, HCE is significant at 1% only in the model with ROA as the dependent variable and statistically insignificant when ROE is the dependent variable. HC has a clearer association with ROA than ROE, a finding consistent with Chen et al. (2005) and Ting and Lean (2009). However, these results are not consistent with firms in South Africa (Firer and Williams, 2003), Taiwan (Shiu, 2006), and Hong Kong (Chan, 2009). Those locales exhibit a significantly negative relationship between HCE and performance.

Second, HCE_lag1 is statistically significant in the model featuring ROA as the dependent variable. This finding supports Chen et al. (2005) and Clarke et al. (2011).

Third, CEE has a positive impact on ROA and ROE at 1% in accord with results of Chen et al. (2005), Ting and Lean (2009), and Clarke et al. (2011). An increase of 1 unit of CEE is associated with a raise of 0.0657 units in ROA and 0.1184 more units of ROE.

Fourth, CEE_lag1 shows no significant association with dependent variables ROA and ROE.

Fifth, SCE exhibits a positive association with dependent variables ROA and ROE, a finding consistent with Chen et al. (2005).

Sixth, the association of SCE_lag1 is positive and significant at 1% for both dependent variables. This result is not consistent with Clarke et al. (2011) when they point out that SCE_{t-1} is negatively related to ROE and ROA.

Seventh, unlike model 1, leverage exhibits a negative relation to ROA and ROE at 1% significance.

Eighth, size in model 2 has a significant relation at 1% significance.

Ninth, for subgroup transformations in the enterprise sector, the sample shows no clear associations across sectors. Only the other category estimated by model 2 with ROE as dependent variable is statistically significant.

Tenth, in model 2 the intercept with both dependent variables is negative and statistically significant.

Eleventh, the R^2 is moderately high, ROA is 45.11%, and ROE is 46.22%. The change in components of IC which includes CEE, HCE, SCE shows 45.11% change in ROA and 46.22% change in ROE.

Results from model 2 validate the following hypotheses:

H1(b) HCE positively impacts business performance.

H2(b) HCE in the previous period correlates positively with performance during the current period.

H1(c) SCE correlates positively with business performance.

H2(c) SCE in the previous period correlates positively with performance in the current period.

H1(d) CEE correlates positively with business performance.

H2(d) CEE in the previous period correlates positively with business performance of enterprises that are not been verified in our data sample.

Results also show a difference similar to model 1 between expected and calculated signs for leverage. However, model 2 shows a positive relation of firm size on efficiency. HCE_t and HCE_{t-1} in model 2 lose statistical significance for dependent variable ROE, but it is statistically significant for ROA. Results depend on measures of performance. Results from the sample show that among constituents of VAIC capital, the efficiency of SCE financial capital substantially influences efficiency. With the data collected, the theory has not been fully explained. Future studies should extend the variables or collect additional data.

5 Discussion

Drawing upon 13,900 observations of firms in different industries spanning 2012–2016, results from random and fixed-effects models show that IC correlates positively with performance of enterprises in Vietnam. The result echoes Chen et al. (2005), Shiu (2006), Chan (2009), Clarke et al. (2011), Tan et al. (2007), Appuhami (2007), and Ting and Lean (2009) and fits Vietnam's quasi-socialist business environment.

Among components of ICE, SCE has the greatest positive association with short and long-term performance. This finding disputes those of Clarke et al. (2011), Ting and Lean (2009), and Shiu (2006) and shows that Vietnam's economic environment differed from those of Australia and China during the period studied. HCE shows no significant impact on the sample of data used (estimation coefficient is tiny and perplexing). This finding is consistent with Clarke et al. (2011) and Chen et al. (2005). CEE_lag 1 exhibits no significant relation to business efficiency. Results suggest it is important to observe the effective use of physical and financial capital over a longer period entailing more observations.

6 Conclusions

Our empirical results have shown a positive relation between IC and performance of Vietnamese firms during 2012–2016. HC (expressed by HCE) correlated positively with business performance and material and financial capital (expressed by CEE) in the short-term but not in the long-term.

SC (expressed in SCE) exhibits the greatest short and long-term impact on firm performance. The value of enterprises today depends not only on basic capital but also on intangible assets of which IC is an important component. The relation between IC and firm performance is a relatively new study and a new concept in Vietnam that attracts few researchers. Further, few studies examine relations between business performance and IC using VAIC. This study is one of few to address IC and firm performance in Vietnam and to measure IC through the VAIC.

The study delineated numerous components of IC and documented relationships between IC and business performance useful to businesses, investors, and economists. The study also measured IC via the VAIC model (Pulic, 1998) while assessing the relationship between IC and business performance. In addition, our use of arithmetic arrays overcomes the paucity of variables, yielding better results when evaluating relationships.

Acknowledgements

This research is funded by National Economics University, Hanoi, Vietnam.

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