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Sectoral Intellectual Capital and Sector Performance in an Emerging Market

DUC HONG VO[1] and NGOC PHU TRAN[2] (***Corresponding author***)

[1] Professor, The CBER – Research Centre in Business, Economics & Resources, Ho Chi Minh City Open University, Vietnam
[2] PhD student at Ho Chi Minh city Open University, Vietnam, e-mail: tranphungoc91@gmail.com

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ABSTRACT

The role of creating long-term competitive advantage of intellectual capital for firms, industries, regions and countries has been widely recognized. However, the measurement of sectoral intellectual capital has largely been ignored in intellectual capital literature. Hence, this study proposes a method to measure sectoral intellectual capital index based on the modified value-added intellectual coefficient model (MVAIC) model. In addition, this paper also examines the contribution of sectoral intellectual capital index to industries performance across 12 industries in the Vietnamese economy from 2011 to 2018. Besides, the dynamic common correlated estimator (DCCE) technique is utilized in this study. Our results strongly confirm that sectoral intellectual capital index makes a positive contribution to both return on assets and return on equity across indutries in Vietnam. In addition, our findings indicate that securities sector has the highest sectoral intellectual capital index, while technology has the lowest. This study shed the light on the role of sectoral intellectual capital on industries performance. In addtion, our study also provides a valuable framework for policy makers in managing and enhancing sectoral intellectual capital within emerging markets.

INTRODUCTION

In the era of knowledge economy, intellectual capital is considered one of the most valuable assets of an organization, region or country (Markhaichuk & Zhuckovskaya, 2019; Ujwary-Gil & Godlewska-Dzioboń, 2022). Tian & Liu (2019) indicate that intellectual capital is the engine that drives economic growth and technological progress. Liu et al. (2021) state that intellectual capital plays the important role of intangible assets, it helps to exploit important knowledge that affects the innovation ability of enterprises, industries and regions. Marcin (2013) emphasizes that intellectual capital is a fundamental resource for value creation at the sectoral, regional and national levels.

In addition, from being one of the poorest countries in the world in the mid-1980s, Vietnam has achieved rapid economic growth and sustainable development goals in the last 10 years (Baum, 2020). These achievements of Vietnam are based on broad-based economic reforms and national development strategies, focusing on five main sectors: education, health, roads, water and electricity infrastructure (Baum, 2020; Duong et al., 2022). Nguyen & Gregar (2018) emphasize the role of knowledge management in innovation of Vietnamese firms. Besides, Tran & Vo (2020) also affirm that intellectual capital has a positive influence on firm's performance in Vietnam. In addition, the financial sector is more efficient in using intellectual capital than the non-financial sector in Vietnam. Dutt (1990) asserts that imbalance between sectors can slow down economic development. In particular, the coronavirus pandemic affects the economies of countries around the world in a "K-shaped recovery". The characteristic of this type of recovery is that some sectors will improve, while others will continue to decline (Nikkei, 2021). Hence, it is necessary to measure and evaluate the efficiency of intellectual capital across sectors in Vietnam and other emerging markets.

Previous studies have measured intellectual capital at the firm (Xi et al., 2023; Soetanto & Liem, 2019), regional (Liu et al., 2021; Marcin, 2013) and country (Vo & Tran, 2022; Lin & Edvinsson, 2011). However, the previous studies have largely ignored to measure intellectual capital at the sector level. Hence, this study proposes a sectoral intellectual capital index to fill this research gap.

This study contributes to knowledge on intellectual capital in the following ways. First, based on MVAIC model, we develop a sectoral intellectual capital index to compare the accumulation of the intellectual capital across industries in Vietnam using a panel data spanning from 2011 to 2018. Second, previous intellectual capital measurements focus on the consideration of sectoral or regional intellectual capital at specific point of time and its relationship with the sectoral performance. This study investigates the long-term effect from the accumulation of the sectoral intellectual capital to the performance of 12 industries.

The rest of this paper is organized as follows. Following this introduction, Section 2 discusses briefly literature on intellectual capital. The development of the sectoral intellectual capital index (SICI) is presented and discussed in section 3. The applications of this newly developed index (SICI) are conducted in section 4. Section 5 of the paper provides concluding remarks and policy implications.

1. REVIEW OF LITERATURE

1.1 Intellectual capital and its components

Soetanto & Liem (2019) point out that there is still no uniformly acceptable definition of intellectual capital. Previous studies have defined and classified intellectual capital and its components in different ways. Brooking (1996) describes intellectual capital as intangible assets that allow a firm to operate. Intellectual capital as knowledge, intellectual property, and information that can be ultilized to create firm's wealth (Stewart, 1997). In addition, Roos et al. (1997) consider that intellectual capital includes all intangible assets, such as trademarks, patents. Besides, Bontis & Fitz-enz (2002) indicate that intellectual capital includes knowledge, information and intellectual property that contribute to increased competitiveness. Furthermore, Dean & Kretschmer (2007) point out that intellectual capital is an intangible asset that contributes to improving the performance of organizations.

In addition, there is no consensus on how to divide the components of intellectual capital. Sveiby (1997) considers intellectual capital based on three aspects: external structure, internal structure and employee competencies. Based on the Saint-Onge model, Westberg & Sullivan (1998) divide intellectual capital into three components: human capital, structural capital and customer capital. Sullivan (2000) indicates that intellectual capital includes 2 main components: human capital and intellectual assets. Intellectual capital includes four aspects: lexical, negative semantic, positive semantic and connotative (Jardon & Martinez-Cobas, 2021).

Although there is no consensus on definition and classification, intellectual capital is still considered as a driving force to create a long-term competitive advantage of an organization, industry, region or country (Liu et al., 2021; Vo & Tran, 2022).

1.2 Intellectual capital measurements beyond the firm level

Previous studies have measured intellectual capital in the firm level (Shehzad et al., 2023; Costa et al., 2014), regional level (Liu et al., 2021; Nitkiewicz et al., 2014) and national level (Vo & Tran, 2022; Lin & Edvinsson, 2011). However, the previous studies have largely ignored to measure intellectual capital at the sector level.

Nitkiewicz et al. (2014) point out that the concept of intellectual capital is mainly applied to firms and organizations. However, this concept is gradually being expanded and one of the directions of development is to define and classify knowledge capital and its components at the sectoral and regional level. Pedro et al. (2018) shows that strategically innovative organizations spread knowledge not only to their own but also to industry, region and country. Thus, through sectoral and regional intellectual capital analysis, public policies can find solutions to improve sectoral and regional intellectual capital to achieve sustainable development (Medina et al., 2007). Countries around the world are increasingly interested in regional as well as sectoral approaches to intellectual capital (Marcin, 2013). At the same time, issues of effective sectoral and regional innovation strategy have become important. Poyhonen & Smedlund (2004) use systemic interpretation of the functioning of inter-organizational networks by using theme-based interviews of 11 mechanical wood processing small firms in the eastern part of Finland. They reveal that innovation network functioned best, while the production network had poorly and insufficient structured information flows.

In addition, Edvinsson & Bounfour (2004) examine Intellectual Capital dynamic Value (IC-dVAI) approach to measure intellectual capital performance at regional level in France. They find that Paris area and Toulouse region are the two regions with the highest intellectual capital, while Corsica lags behind. Xia & Niu (2010) propose a system of 27 indicators to measure regional intellectual capital of 29 provinces and cities of China. They estimate regional intellectual capital level by using principal components analysis (PCA) and cluster analysis. The results show that intellectual capital efficiency of eastern China is higher than western China. Nitkiewicz et al. (2014) utilize data envelopment analysis (DEA) for evaluate regional intellectual capital in across Polish regions. The results show significant differences between Polish regions in terms of intellectual capital efficiency. Pedro et al. (2018) emphasizes the need to develop a new sectoral as well as regional approach to intellectual capital in relation to regional and sectoral development theories. Thereby, contributing to promoting the management of intangible resources in sectors and regions. Based on percolation theory methods, Markhaichuk & Zhuckovskaya (2019) measure regional intellectual captial of 8 Russian federal districts in 2017. They find that intellectual capital is disproportionately distributed between 8 districts. It has a lower level in remote territories while concentrating closer to the capital. Liu et al. (2021) reveal that there are differences in the level of regional intellectual capital in different regions in China. In addition, the regional intellectual capital ranking is largely in line with the province's gross domestic product ranking.

Although there have been many studies measuring intellectual capital at the firm, regional or national level, however, the issue of measuring intellectual capital at the sector level has been largely ignored in previous studies. Based on the modified value-added coefficient (MVAIC) model, this study proposes a sectoral intellectual capital index (SICI) by examining the intellectual capital efficiency of each enterprise in the sector. In addition, the author uses total assets as a weight to create the intellectual capital index of industry.

2. METHODOLOGY

2.1 Sectoral intellectual capital index

In order to construct a comprehensive sectoral intellectual capital index, we utilize modified value-added coefficient (MVAIC) model, which is widely used to measure intellectual capital in firm level (Tran & Vo, 2022; Soetanto & Liem, 2019).

Table 1. Modified value-added coefficient model

Variables	*Definition*
MVAIC	HCE + SCE + RCE + CEE
HCE	VA/HC
SCE	(VA-HC)/VA
RCE	RC/VA
CEE	VA/CE
SIZE	Natural logarithm of the total assets

Notes*:* **VA** is calculated as total profit before taxes add employee expenditures; Human capital **(HC)** is defined as employee expenditures; Structural capital **(SC)** is computed as the difference between value-added and human capital. Relational capital **(RC)** is measured as selling, marketing and advertising expenses; Capital employed **(CE)** is estimated by the difference between total assets and the value of intangible assets

Based on MVAIC model, this study proposes the sectoral intellectual capital index (SICI) by examining the intellectual capital efficiency of each firm in the sector. In addition, author uses total assets as the weight to make up the intellectual capital of that sector. SICI is defined as follows:

$$SICI = \sum_{i=1}^{n} w_i Y_i$$

where:

- number of sample firms in the sector.
- w_i is the weight assigned to firm *i* in the sector $\left(w_i = {K_i}/{K}\right)$.
- K and K_i are the total assets of all sample firms in the sector and total assets of each firm, respectively, to which the weight for each firm is calculated.
- Y_i is the intellectual capital efficiency of firm i, calculated by MVAIC.

2.2 Other variables

To measure sector performance, we utilize return on assets (ROA) and return on equity (ROE) to compute sector financial performance, in line with previous studies (Dalwai & Salehi, 2021; Smriti & Das, 2018).

In addtion, this study also utilizes SIZE and LEV as control variable. SIZE is computed as the natural logarithm of total assets. LEV is calculated as the ratio between total debt and total assets. The regression models are calculated as present in Table 2.

Table 2. Regression models

Model	*Regressions*
1	$ROA_{it} = \beta_0 + \beta_1 SICI_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \varepsilon_{it}$
2	$ROE_{it} = \beta_0 + \beta_1 SICI_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \varepsilon_{it}$

2.3 Sample and Data

This study utilizes data collected from the annual reports of listed firms in Vietnam during 2011-2018 period. Firms used must be in continuous operation, without mergers and acquisitions during the research period. After removing the unsatisfactory data, the sample including 150 firms is used. The selected firms are then classified into 12 industries.

3. EMPIRICAL RESULTS AND DISCUSSION

3.1 Descriptive statistics

Table 3 presents the descriptive statistics of all variables. The average ROA and ROE of all sector in Vietnam in 2011-2018 are 0.103 and 0.161, respectively. Food and Pharmaceuticals have higher returns on total assets and equity, while Banking and Service have lower performance. The average SICI is 4.341, in which Energy, Securities, Food and Real estate are higher than average. In addition, the results state that banking has the lowest return on assets, while this industry uses the highest total assets of all industries.

Table 3. Descriptive statistics

Sector	*ROA*	*ROE*	*SICI*	*SIZE*	*LEV*
All sectors	0.103	0.161	4.341	10.871	0.560
Aviation	0.051	0.166	3.677	11.775	0.664
Banking	0.011	0.123	3.321	15.152	0.522
Education	0.109	0.158	3.549	7.378	0.410
Energy	0.063	0.160	6.624	10.882	0.653
Food	0.204	0.329	6.341	11.380	0.453
Insurance	0.031	0.115	4.265	11.489	0.645
Oil and gas	0.108	0.166	2.789	11.767	0.609
Pharmaceuticals	0.182	0.162	3.439	9.206	0.561
Real estate	0.054	0.194	5.435	12.137	0.693
Securities	0.068	0.115	6.578	10.385	0.601
Service	0.104	0.151	3.309	8.596	0.433
Technology	0.250	0.089	2.760	10.309	0.479

Notes: **ROA** denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets of the sector; LEV is calculated as the ratio between total debt and total assets.

Table 4 shows Pearson's correlation coefficient matix. The results indicate that correlation coefficient between ROE and SICI is statistically significant at 5 per cent. Besides, we test multicollinearity through variance inflation factor (VIF). The results show that all variables are below 2, which imply that multicollinearity is not a problem in this study.

Table 4. Correlation matrix and the variance inflation factor among variables

Sector	*ROA*	*ROE*	*SICI*	*SIZE*	*LEV*	*VIF*
ROA	1.000					
ROE	0.300***	1.000				
SICI	-0.093	0.389***	1.000			1.06
SIZE	-0.429***	-0.022	0.066	1.000		1.17
LEV	-0.438***	-0.075	0.238**	0.380***	1.000	1.23

Notes: ***, *** significant at 5% and 1% level, respectively*

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets of the sector; LEV is calculated as the ratio between total debt and total assets.

In addition, this study also examines the fluctuations of the sectoral intellectual capital over the years in the period 2011-2018. The results in Figure 1 show that SICI has been relatively stable over the last 4 years. Securities, Energy, Food and Real Estate have higher SICI than the rest. Specifically, the securities industry had the highest SICI and had a strong growth since 2016. Meanwhile, Energy had a strong increase in SICI in the period 2011-2014 but declined in the following years. Especially, Technology has the lowest SICI among 12 industries in Vietnam. The results indicate that there is a difference in the efficiency of using intellectual capital of industries in Vietnam. High intellectual capital-intensive industries such as Banking, Technology (Firer & Williams, 2003) have not yet exploited intellectual capital commensurately.

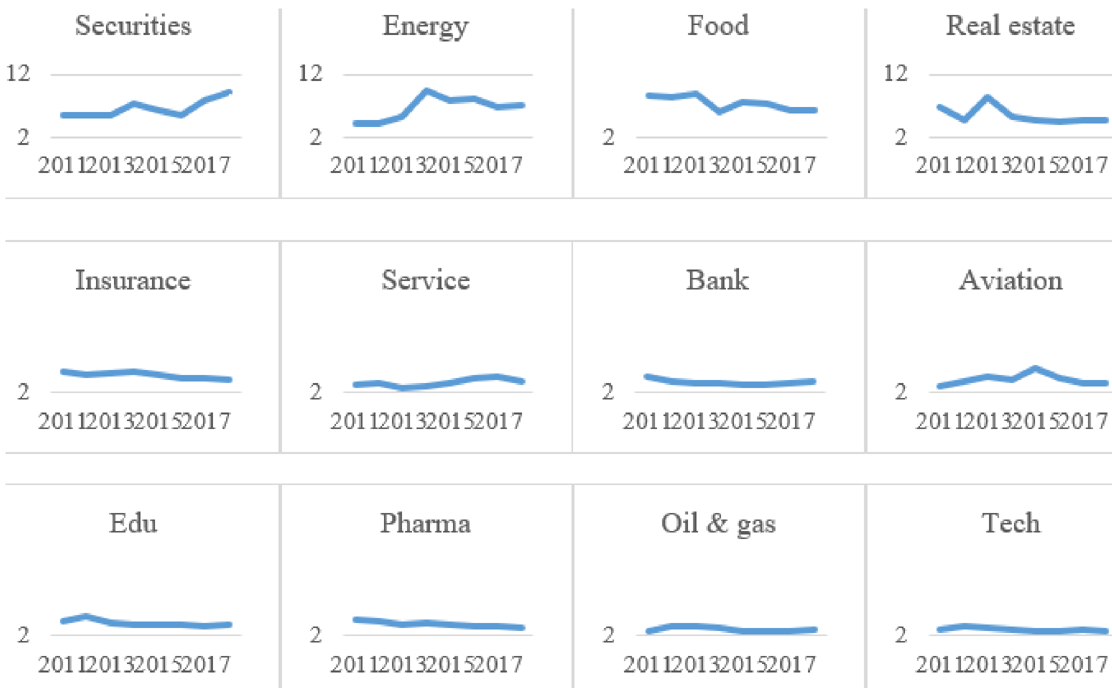


Figure 1. Sectoral intellectual capital index in 2011-2018 period

3.2 Cross-sectional dependence test

Next, this study examines the cross-sectional dependence by employing Pesaran (2015) tests. The results in Table 5 indicate that the null hypothesis of cross-section independence can not be rejected, except SIZE. In other words, the level generation's panel unit root tests should present more reliable inference. In addition, these findings reveal that not disturbance in one sector will not significantly affect the other industries in Vietnam.

Table 5. Cross-section dependence test results

Variables	*ROA*	*ROE*	*SICI*	*SIZE*	*LEV*
CD test	-0.902	0.212	0.310	19.808***	-0.836
p-value	0.367	0.832	0.757	0.000	0.403

Notes: *** significant at 1% level, respectively

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets of the sector; LEV is calculated as the ratio between total debt and total assets.

3.3 Slope homogeneity test

Besides, we also explore the slope homogeneity by using Pesaran & Yamagata (2008) technique. As presented in Table 6, we can reject the null hypothesis of slope homogeneity. This mean that we should consider to deal with slope homogeneity issues.

Table 6. Slope homogeneity test results

	Slope homogeneity test	
	Δ	Δ_{adj}
Equation (1)	2.726*** (0.006)	5.099*** (0.000)
Equation (2)	1.767* (0.077)	3.306*** (0.001)

Notes: *, *** significant at 10% and 1% level, respectively.

3.4 Panel unit root test

In the next step, the study also utilizes unit root tests as proposed by Pesaran (2003). This test explores the stationarity and to detect the integration order of concerned variables. The results in Table 7 suggest that all variables are stationary at the first-difference generation. The results imply that long-run co-integrating relationship among the variables is possible utilized in this study.

Table 7. Panel unit root test results

Variables	*Level*		*First Difference*		*Order of Integration*
	Constant (1)	*Constant and Trend (2)*	*Constant (3)*	*Constant and Trend (4)*	
ROA	-0.118	8.530	-4.355***	-3.611***	I (1)
ROE	11.116	-2.984***	-5.254***	-5.054***	I (1)
SICI	0.368	-2.911***	-5.569***	-3.472***	I (1)
SIZE	11.116	-1.755**	-4.057***	-2.354***	I (1)
LEV	2.992	0.349	-1.590*	-2.438***	I (1)

Notes: **, **, *** significant at 10%, 5% and 1% level, respectively. The Z[t-bar] is shown.*

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms

3.5 Panel cointegration test

In addtion, this study explore the nature of the long-run relationship among the variables by using the Kao (1999); Pedroni (1999; 2004); and Westerlund (2005) cointegration test. The results in Table 8 support a view that long-run relationship between sectoral intellectual capital and industry performance should be considered in the study.

Table 8. Results of the cointegration test

	Model 1	*Model 2*
Kao		
Modified Dickey-Fuller t	-2.079**	0.637
Dickey-Fuller t	-7.725***	-4.118***
Augmented Dickey-Fuller t	-2.821***	-2.418***
Unadjusted modified Dickey-Fuller t	-3.298***	-3.557***
Unadjusted Dickey-Fuller t	-8.174***	-7.289***
Pedroni		
Modified Phillips-Perron t	4.717***	4.213***
Phillips-Perron t	-3.896***	-6.375***
Augmented Dickey-Fuller t	-5.580***	-6.213***
Westerlund		
Variance Ratio	2.104**	6.026***

Notes: **, *** significant at 5% and 1% level, respectively

3.6 Dynamic common correlated estimator

Table 9 presents dynamic common correlated estimator results. The results in both models show that sectoral intellectual capital has a positive impact on industry performance. In particular, an increase in the sectoral intellectual capital will increase the level of return on assets and return on equity in these industries. In addition, total assets has a negative impact on sector performance in these industries. Meanwhile, we consider that the ratio between total debt and total assets does provide a strong and significant impact on industries performance in Vietnam.

Table 9. Dynamic Common Correlated Estimator (DCCE) results

Variables	*Model 1 (ROA)*	*Model 2 (ROE)*
SICI	0.017*	0.102*
SIZE	-0.174***	-0.044
LEV	0.203	1.083*
Number of observations	84	84
R^2 (Mean group)	0.76	0.35

Notes: *, *** significant at 10% and 1% level, respectively.

ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms.

3.7 Panel Granger causality test

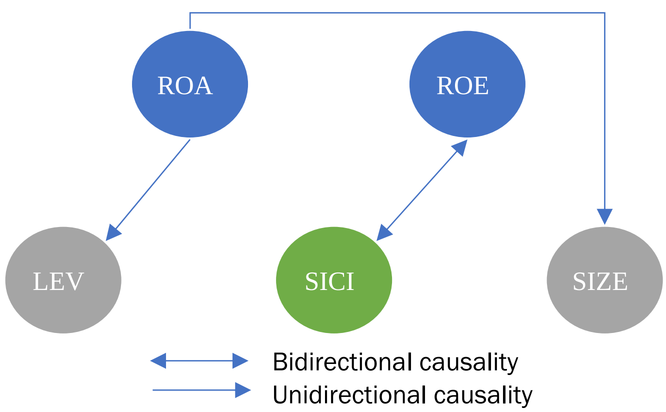
Finally, the study explores the causality between sectoral intellectual capital and industry performance by using a panel Granger causality method (Engle & Granger, 1987). As presented in Table 10, the results confirm bidirectional causality relationship between SICI and ROE. In addition, the causality relationship between SICI and ROA is not statistically significant. The results of these causal relationships between sectoral intellectual capital and industry performance are summarized in Figure 2.

Table 10. Results of panel causality test

Hypothesis	*F-statistic*	*Conclusion*
ROA → SICI	0.156	There is no causal relationship between sectoral
SICI → ROA	0.525	intellectual capital and return on assets.
ROA → SIZE	2.444*	Unidirectional causality from return on assets to total
SIZE → ROA	1.313	assets.
ROA → LEV	2.488*	Unidirectional causality from return on assets to financial
LEV → ROA	1.139	leverage.
ROE → SICI	2.593*	Bidirectional causality between sectoral intellectual
SICI → ROE	2.945*	capital and return on equity.
ROE → SIZE	0.051	There is no causal relationship between total assets and
SIZE → ROE	0.582	return on equity.
ROE → LEV	0.262	There is no causal relationship between financial leverage
LEV → ROE	0.564	and return on equity.
SICI → SIZE	0.760	There is no causal relationship between sectoral
SIZE → SICI	0.905	intellectual capital and total assets.
SICI → LEV	0.008	There is no causal relationship between sectoral
LEV → SICI	0.785	intellectual capital and financial leverage.
SIZE → LEV	0.380	There is no causal relationship between total assets and
LEV → SIZE	0.626	financial leverage.

Notes: * significant at 10% level.

A → B indicates unidirectional Granger causality running from A to B.
ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms



ROA denotes the return on assets; **ROE** denotes the return on equity; **SICI** denotes sectoral intellectual capital index; **SIZE** denotes the natural logarithm of the total assets; **LEV** denotes the ratio between total debt and total assets of firms

Figure 2. Causal relationships between all variables

CONCLUDING REMARKS AND POLICY IMPLICATIONS

The important role of intellectual capital as the long-term competitive advantage has been confirmed in previous studies (Tian & Liu, 2019). Measuring intellectual capital at various levels including at firms, regions, and nations have also been conducted (Liu et al., 2021; Vo & Tran, 2022). However, previous studies appear to have largely neglected to measure the intellectual capital at the industry level. Based on the modified value-added intellectual coefficient model (MVAIC), this study develops a sectoral intellectual capital index (SICI). Besides, this study also examines the impact of SICI on return on the performance of the industries, which is proxied by return on total assets (ROA) and return on equity (ROE), for 12 industries in Vietnam using the dynamic common correlated estimator (DCCE). Findings from this study indicate that Securities, Energy, and Food industries have accumulated the relatively higher level of the intellectual capital in Vietnam in comparsion with other industries during the research period. Meanwhile, Banking and Technology industries have been ranked very low in relation to the intellectual capital efficiency. The findings imply that these two industries have not yet fully recognised the important role of intellectual capital. In addition, our empirical results confirm the positive and significant impact of the sectorail intellectual capital on the performance of the Vietnamese industries using both ROA and ROE.

Policy implications have emerged based on the above findings for regulators and policymakers. Empirical evidence in this study indicates that significant differences in the level of intellectual capital across industries are confirmed. Banking and Technology industries, which are generally considered the intellectual-capital-intensive industries. However, it appears that these two industries have not effectively utilized intellectual capital properly. Firms in these two industries should focus on investing in intellectual capital. Improving human capital efficiency and training, and improving the professionalism for employees. Besides, firms also need to better utilise a structural capital. Specifically, processes, facilities, and intellectual property should be invested and utilised more effectively to improve the efficiency of intellectual capital. In addition, our results confirm the positive effect of financial leverage on industry performance. Hence, firm managers need to consider an optimal debt structure to add value to the business.

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