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Intellectual Capital, Financial Performance and Companies' Sustainable Growth: Evidence from the Korean Manufacturing Industry

Jian Xu [1] and Binghan Wang [2,*]

[1] Department of Management, Qingdao Agricultural University, Qingdao 266109, China; jianxusword@gmail.com
[2] Business School, Lincoln University, Lincoln 7647, New Zealand
* Correspondence: wangbhlincoln@gmail.com

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Abstract: Intellectual capital (IC) is considered to be a wealth generator and driver of financial performance thus creating competitive advantage and sustainability in business. This paper empirically investigates the impact of IC on financial performance and sustainable growth in the Korean manufacturing industry. Multiple regression models are applied with data collected from 390 manufacturing companies listed on the Korean Stock Exchange during 2012–2016. The results of the analysis show that IC has a positive impact on financial performance and companies' sustainable growth. In addition, companies' performance and sustainable growth are positively related to physical capital, human capital (HC), and relational capital (RC). RC is found to be the most influencing factor. Finally, innovative capital captures additional information on structural capital (SC) which negatively affects the performance of Korean manufacturing companies. The results extend the understanding of IC in creating corporate value and building sustainable advantages in emerging economies.

Keywords: intellectual capital; financial performance; sustainable growth; manufacturing industry

1. Introduction

With the rapid growth of technologically advanced companies in the knowledge-based economy, corporate management has put more attention on the importance of intellectual capital (IC) [1]. IC is considered a driver of corporate competitiveness and financial sustainability [2]. Based on the resource-based view (RBV), companies with valuable and scarce resources are more likely to obtain sustainable competitive advantage [3–5]. These resources can enable companies to maintain human capital, improve processes, maintain contact with customers and suppliers, and produce greater innovation [6].

Business sustainability, one of the leading topics in financial management, has attracted many concerns in recent years [7]. The primary goal of the business is to maximize the wealth of its shareholders. The concept of Smith's "invisible hand" leads to constant growth and development, which cannot be infinite with limited resources. Profit can provide power for a business's sustainable development, but its achievement should not be at all costs. Financial management has focused on the link between real business and sustainable financial performance. Studying sustainable financial performance involves an assessment of the future development capability of companies. Although corporate managers can improve firms' financial performance, they are not likely to totally understand firms' long-term sustainable development capability, especially the

effect of IC on sustainable growth [8]. Therefore, it is of great importance to study the IC–business sustainability relationship in the knowledge economy.

Because of significant competition in global manufacturing, the manufacturing industry in emerging economies (e.g., China and South Korea) faces much internal and external pressure, including relating to sustainability [9]. Currently, rising labor costs and fierce international competition are greatly affecting the manufacturing industry in South Korea, an emerging market [10]. In June 2014, the Manufacturing Innovation 3.0 strategy was issued by the Korean government to upgrade competitiveness in the manufacturing industry [11]. The manufacturing industry requires specialized skills and is subject to implicit organizational knowledge and capabilities [12]. Furthermore, the endurance of the manufacturing industry largely relies on the number of skilled employees and the volume of physical capital [13]. This makes the manufacturing sector an attractive industry for IC research [14–16].

The objective of this study is to empirically investigate the relationship between IC and financial performance, and the relationship between IC and sustainable growth, using Korean manufacturing listed companies as our sample. Further, we analyze the impact of individual components of IC.

This paper contributes to the extant literature as follows. First, we provide evidence of the relationship between IC and financial performance of manufacturing listed companies in South Korea for the first time. Most studies conducted have focused on certain industries in developed countries, such as the U.S.A. and European countries. Our findings extend the understanding of IC in the process of value creation in emerging economies. Second, we attempt to explore and investigate the impact of IC on companies' sustainable growth for the first time, which increases the understanding of the impact of IC on sustainable growth from a long-term perspective. Third, we introduce innovative capital and relational capital (RC) into a research model, aspects that have been neglected by a majority of previous IC studies. Finally, understanding the role of IC in enhancing firms' profitability and building sustainable advantages can help corporate managers effectively and efficiently manage and utilize IC investment in emerging economics.

The remainder of this paper proceeds as follows. Section 2 is dedicated to a literature review and research hypotheses. Section 3 presents the research methodology of the study. Section 4 sets out empirical results, which are discussed in Section 5. We conclude by summarizing our research results and their implications in Section 6.

2. Literature Review and Hypotheses Development

2.1. Measuring IC

IC is the dynamic set of resources (e.g., knowledge, capabilities, networks, operation processes, individual and organizational relations) that create firm value [17]. In early studies, IC was comprised of human capital (HC) and structural capital (SC) [18]. HC, the basis of IC, is directly related to employees (e.g., employees' competence, commitment, motivation and loyalty) [19,20]. SC includes innovative capital, RC, and organizational infrastructure [21]. During the last two decades, scholars have achieved a consensus on the components of IC, namely HC, SC and RC [22–26]. RC is the knowledge that belongs to the organization as a whole [27–29]. It is also believed to play an important role in the connection with suppliers and customers [22].

Measuring IC has drawn broad research interest. Many methods have been developed to measure IC, such as the Skandia Navigator [18], the Intangible Assets Monitor [22], the balanced scorecard approach [30], market capitalization methods, and the Value Added Intellectual Coefficient (VAIC™) [31,32]. The VAIC™ model was proposed to measure the efficiency of firms' three types of inputs: physical capital, HC, and SC, namely, capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). The sum of CEE, HCE, and SCE is the value of VAIC.

It is generally believed that the VAIC™ model has been widely used by scholars to measure IC efficiency of the firms in both academic and practical studies [13,21,25,26,33–43]. First, this model is

easy to calculate and standardized, which enables effective comparison across firms and countries [33]. Second, when calculating VAIC, the data used are derived from audited financial statements [33]. Third, this model is more objective and verifiable compared to other measurements as a result of the accurate and reliable data source. However, the VAIC™ model has several weaknesses. First, the model depends on historical data from annual financial reports, and thus might not be an appropriate tool for evaluating firms' future value-creating potential. Second, the synergy effects between different types of tangible and intangible assets are not taken into consideration in this model [44]. Furthermore, its measure for SC might not be complete [21]. For example, in the calculation of VAIC, research and development (R&D) and advertising expenditures are subtracted because they belong to expense items according to accounting standards.

2.2. IC and Financial Performance

Researchers have studied how IC is linked to firms' financial performance. Taking 81 U.S. multinational firms as the sample, Riahi-Belkaoui [27] documented a significant and positive relationship between IC and financial performance. The findings of Firer and Williams [33] showed a positive relationship between IC and the performance of South African firms. Based on the data of listed firms in Singapore, Tan et al. [45] argued that IC can positively improve the firms' present and future performance. In a study of the manufacturing industry in Thailand, Phusavat et al. [46] found a positive relationship between IC and profitability, revenue growth and employee productivity. Nimtrakoon [25] also found consistent results for ASEAN countries. Recently, Sardo and Serrasqueiro [47] argued that companies should take advantage of IC to boost firm's financial performance and market value. Anghel et al. [48] proved that, at the level of 24 biotech companies during 2002–2014, IC (measured by market-to-book ratio) is positively correlated with indicators of financial performance. If IC is a driver of a firm's competitiveness, it will contribute to the firm's financial performance. Therefore, we propose the first hypothesis:

Hypothesis 1 (H1). *Companies with greater IC tend to have better financial performance.*

Investors may place different values on each component of VAIC. CEE is used to measure the physical capital dimension. HCE and SCE are the measurements of the value-added efficiency by HC and SC, respectively [32]. In case studies, Ng [49] found that there exists a relationship between different IC components and business growth for Canadian wireless technology firms. Deep and Narwal [50] found that physical capital has a major impact on the profitability of Indian textile firms. Applying the VAIC™ model, Mavridis [34] concluded that HC has the highest degree of correlation with the performance of Japanese banks. A study by Kamath [51] asserted that HC is more important than physical capital and SC in terms of their impact on the profitability and productivity of the Indian pharmaceutical industry. Using data from Malaysia, the findings of Bontis et al. [52] showed that, regardless of industry, SC positively influences business performance. Smriti and Das [13] and Nimtrakoon [25] also argued that SCE is positively correlated with firms' market value. Ismail and Karem [38] found that CEE and HCE are significantly correlated with bank performance in Bahrain, and that there is no relationship between SCE and financial performance. However, Firer and Williams [33] failed to find any strong relationship between the three IC components and profitability. Thus, based on the above argument, we propose the following set of hypotheses:

Hypothesis 2a (H2a). *Companies with greater CEE tend to have better financial performance.*

Hypothesis 2b (H2b). *Companies with greater HCE tend to have better financial performance.*

Hypothesis 2c (H2c). *Companies with greater SCE tend to have better financial performance.*

The VAIC™ model has not included innovative capital and RC in its calculation. SCE only reflects the proportion of value added attributed to SC. Two important forms of SC—innovative capital and RC—may be omitted from the measure of SCE. In businesses, a large amount of money is invested in R&D and advertising activities to achieve technological advancements and promote the brand value of products and firms. In previous studies, researchers have provided evidence on

the value-relevance of R&D and advertising expenditures. Based on the data of U.S. firms, Chauvin and Hirschey [53] concluded that both R&D and advertising expenditures have positive influences on corporate market value. Sullivan [54] found that innovative capital, the core of IC, can provide the base for obtaining competitiveness. Taking Taiwanese listed companies as the sample, Chen et al. [21] argued that R&D expenditure that is excluded in the measure of SC may contain additional information on innovative capital and positively affects firm profitability. Amin and Aslam [55] explored the links among IC, innovation and firm performance by adding R&D expenditure as a measurement of innovation and concluded that IC and innovation have a joint effect on firm performance. Thus, we propose the following hypotheses:

Hypothesis 3a (H3a). *After controlling for SCE of VAIC, companies with greater R&D expenditure tend to have better financial performance.*

Hypothesis 3b (H3b). *After controlling for SCE of VAIC, companies with greater advertising expenditure tend to have better financial performance.*

2.3. IC and Sustainable Growth

In 1977, Higgins [56] proposed the concept of the sustainable growth rate (SGR) to describe optimal growth from a financial perspective assuming a given strategy with clearly defined financial frame conditions. Simply, it is the maximum rate at which a company can use its own internal funds to achieve its growth without borrowing money from banks or financial institutions. Companies who maintain the SGR will ultimately circumvent unprofitable growth. Companies that manage the SGR can avoid straining financial resources and overextending their financial leverage.

In the context of Industry 4.0, innovative capital (e.g., R&D and intellectual property rights) is a determinant of internal resource allocation, new product development, and new market expansion. R&D activities with high risks require companies to establish a solid system guarantee, and SC can provide an environmental guarantee for the growth of manufacturing companies. In addition, stakeholders have an important impact on the survival of a company. The closer the relationship with various stakeholders, the greater impact RC has on the market behaviors of stockholders. For manufacturing companies, HC and SC are unique resources that are difficult to imitate by competitors. Therefore, IC is the main driving force for the sustainable growth of manufacturing companies. The fourth hypothesis can be stated as follows:

Hypothesis 4 (H4). *Companies with greater IC tend to have higher sustainable growth.*

The impact of the three components of IC on companies' sustainable growth may vary. Physical capital (e.g., monetary assets, accounts receivable, and plant and equipment) is not scarce, and companies can quickly and freely obtain these resources from the market. Manufacturing companies generally have a large proportion of investments in physical assets and depend largely on them in their daily operations. Zhang and Yu [57], based on the data of 92 Chinese knowledge-based companies, found that physical capital has a greater impact on sustainable growth than HC and SC. HC is the most important component of IC. SC is created by HC in the long-term operation of a company [18]. The accumulation of SC is also a long-term process. Zhang and Yu [57] also confirmed that the lack of SC is dominant in the initial stage of China's knowledge-based companies. Thus, we propose the following hypotheses:

Hypothesis 5a (H5a). *Companies with greater CEE tend to have higher sustainable growth.*

Hypothesis 5b (H5b). *Companies with greater HCE tend to have higher sustainable growth.*

Hypothesis 5c (H5c). *Companies with greater SCE tend to have higher sustainable growth.*

Technological innovation is the key factor to maintain enterprises' competitiveness and sustainable development [58]. R&D is the source of innovation, which plays an important role in technological innovation. Based on the sustainable growth theory of the firm, Liang and Lu [59] found that electronic manufacturing enterprises should develop new products and change their

organizational structure and culture to maintain sustainable growth. Mudambi and Swift [60] and Demir and Tolga [61] reported that R&D expenditure volatility is positively related to firm growth. Advertising enables companies to establish their reputation by showing the quality and status of products or services, which will stimulate R&D activities. Taking Korean listed companies as a sample, Xu [62] argued that advertising has a positive impact on return on sales (ROS) of large companies. Hence, based on the above discussion, we propose the following hypotheses:

Hypothesis 6a (H6a). *After controlling for SCE of VAIC, companies with greater R&D expenditure tend to have higher sustainable growth.*

Hypothesis 6b (H6b). *After controlling for SCE of VAIC, companies with greater advertising expenditure tend to have higher sustainable growth.*

3. Methodology

3.1. Sample Selection

Table 1 shows the sample selection procedures. We begin with all manufacturing companies listed on the Korean Stock Exchange over the period 2012–2016. After deleting companies with missing data, companies listed after 2012, and companies without December fiscal year-ends, a total of 1950 firm-year observations for 390 manufacturing companies is included in our final sample. Financial data are sourced from the DataGuide database. The regressions are carried out using SPSS Version 20.

Table 1. Sample selection.

Item	Firm-Years
Listed companies during 2012–2016	2300
Less: companies with missing data or companies listed after 2012	265
Less: companies without December fiscal year-ends	85
Final sample	1950 *

Notes: * 390 firms × 5 years = 1950 firm years.

3.2. Variables

(1) Dependent variables. Guided by the literature [13,21,25,48,55,63–66], return on assets (ROA) and return on equity (ROE) are generally used to measure financial performance (PERF). ROA reflects companies' efficiency in utilizing total assets and is calculated by dividing net income by average total assets. ROE represents returns to shareholders of common stocks and is calculated by dividing net income by average shareholders' equity.

SGR is the rate at which a company can use its own internal funds to achieve its growth without borrowing money from banks or financial institutions. The SGR is widely used to plan sustainable growth in the long run, capital acquisitions, cash flow projections and borrowing strategies. Guided by Higgins [56] and Zhang and Chen [67], the formula is as follows:

$$\text{SGR} = \text{Net profit ratio} \times \text{Asset turnover ratio} \times \text{Retention rate} \times \text{Equity multiplier} \quad (1)$$

(2) Independent variables. VAIC and its three components—CEE, HCE, and SCE—are used as independent variables. The procedures of calculating VAIC are as follows:

$$\text{VA} = \text{C} + \text{D} + \text{A} + \text{OP} \quad (2)$$

$$\text{CEE} = \text{VA}/\text{CE} \quad (3)$$

$$HCE = VA/HC \quad (4)$$

$$SCE = SC/VA \quad (5)$$

where VA is the net value created by a particular firm during the year; C is employee salaries; D is depreciation; A is amortization; OP is operating profit; CEE is the capital employed efficiency; CE is the capital employed (both physical and financial capital), measured by the difference of total assets and total liabilities; HCE is the human capital efficiency; HC is the human capital, measured by salaries and wages of all employees; SCE is the structural capital efficiency; and SC is the structural capital, measured by the difference of VA and HC.

Finally, VAIC is the sum of CEE, HCE, and SCE.

Besides the three components of VAIC, R&D and advertising expenditures are introduced as proxies for innovative capital and RC. Guided by Chen et al. [21], Amin and Aslam [55], Tripathy et al. [64], Nazari and Herremans [68], and Liang et al. [69], innovative capital efficiency (RDE) and relational capital efficiency (RCE) are calculated as follows:

$$RDE = \text{R\&D expenditure/Book value of common stocks} \quad (6)$$

$$RCE = \text{Advertising expenditure/Book value of common stocks} \quad (7)$$

(3) Control variables. Firm size (SIZE), measured as the natural logarithm of total assets at year-end, and debt ratio (LEV), measured by total debt to its total assets, are included, consistent with previous studies [25,57,69,70].

3.3. Models

Model (1) and model (2) are utilized to investigate the relationship between financial performance and the aggregate measure of VAIC and its three components, respectively. In model (3), R&D and advertising expenditures are added as proxies for innovative capital and RC.

$$PERF_{i,t} = \beta_0 + \beta_1 VAIC_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$PERF_{i,t} = \beta_0 + \beta_1 CEE_{i,t} + \beta_2 HCE_{i,t} + \beta_3 SCE_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$PERF_{i,t} = \beta_0 + \beta_1 CEE_{i,t} + \beta_2 HCE_{i,t} + \beta_3 SCE_{i,t} + \beta_4 RDE_{i,t} + \beta_5 RCE_{i,t} + \beta_6 SIZE_{i,t} + \beta_7 LEV_{i,t} + \varepsilon_{i,t} \quad (3)$$

Models (4)–(6) are applied to examine whether those IC variables affect companies' sustainable growth. Models (4)–(6) are as follows:

$$SGR_{i,t} = \beta_0 + \beta_1 VAIC_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \varepsilon_{i,t} \quad (4)$$

$$SGR_{i,t} = \beta_0 + \beta_1 CEE_{i,t} + \beta_2 HCE_{i,t} + \beta_3 SCE_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LEV_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$SGR_{i,t} = \beta_0 + \beta_1 CEE_{i,t} + \beta_2 HCE_{i,t} + \beta_3 SCE_{i,t} + \beta_4 RDE_{i,t} + \beta_5 RCE_{i,t} + \beta_6 SIZE_{i,t} + \beta_7 LEV_{i,t} + \varepsilon_{i,t} \quad (6)$$

where $i = 1,\ldots n$ and $t = 1,\ldots t$ represent the firm and year, respectively; β_0, β_1, β_2, β_3, β_4, β_5, β_6, and β_7 are the presumed parameters; and ε denotes the measurement error term.

4. Empirical Results

4.1. Descriptive Statistics

Table 2 presents descriptive statistics of the variables in this study. The mean value of ROA and ROE is 0.0221 and 0.0138, indicating that the profitability of Korean manufacturing companies is relatively low. The mean of SGR is 0.0221, indicating that Korean manufacturing companies have relatively lower sustainable growth capability. The mean value of VAIC is 3.4530 with a minimum of

−76.0535 and a maximum of 35.5138. The negative VAIC value suggests that the costs incurred possessing IC are more than its contribution in the process of firm's value creation. The mean value of HCE is the greatest compared with that of CEE and SCE, which suggest HC is the driving force of value creation. It is notable that RDE and RCE are at low levels, with mean values of 0.0155 and 0.0124, respectively. In addition, the mean values of SIZE and LEV are 11.6588 and 0.4566, respectively.

Table 2. Descriptive statistics.

Variable	N	Mean	Max	Min	Standard Deviation
ROA	1950	0.0221	0.4969	−0.4885	0.0686
ROE	1950	0.0138	0.7333	−5.2931	0.2541
SGR	1950	0.0221	0.4295	−0.3335	0.0448
VAIC	1950	3.4530	35.5138	−76.0535	5.2718
CEE	1950	0.1583	29.6439	−3.3873	0.6963
HCE	1950	2.7971	33.7489	−53.3284	4.0468
SCE	1950	0.4976	27.5342	−76.0677	3.0698
RDE	1950	0.0155	0.4075	0	0.0317
RCE	1950	0.0124	0.2354	0	0.0278
SIZE	1950	11.6588	14.4186	9.9909	0.6657
LEV	1950	0.4566	0.9988	0.0316	0.1992

4.2. Correlation Analysis

Table 3 presents correlation analysis for the dependent and independent variables. The correlation analysis shows that ROA and ROE are positively correlated with VAIC, CEE, HCE, and RCE. In terms of SGR, VAIC, CEE, HCE, SCE, and RCE have a positive impact. Furthermore, the ROA–SCE and ROE–SCE relationships are not significant, but RDE is negatively correlated with ROA, ROE, and SGR. We compute the variance inflation factors (VIFs) and find the values of the VIFs to be less than 2, implying that multi-collinearity is not a major issue in our study.

Table 3. Correlation analysis.

Variable	ROA	ROE	SGR	VAIC	CEE	HCE	SCE	RDE	RCE	SIZE	LEV
ROA	1										
ROE	0.737 ***	1									
SGR	0.878 ***	0.465 ***	1								
VAIC	0.437 ***	0.288 ***	0.399 ***	1							
CEE	0.137 ***	0.058 ***	0.081 ***	0.227 ***	1						
HCE	0.524 ***	0.380 ***	0.455 ***	0.803 ***	0.122 ***	1					
SCE	0.029	−0.019	0.068 ***	0.608 ***	0.002	0.033 *	1				
RDE	−0.035 *	−0.076 ***	−0.035 *	0.032 *	0.313 ***	−0.013	0.001	1			
RCE	0.100 ***	0.075 ***	0.078 ***	−0.044 **	0.074 ***	−0.062 ***	−0.011	0.130 ***	1		
SIZE	0.135 ***	0.103 ***	0.067 ***	0.203 ***	0.053 ***	0.231 ***	0.033 *	0.118 ***	0.129 ***	1	
LEV	−0.380 ***	−0.319 ***	−0.428 ***	−0.101 ***	0.069 ***	−0.182 ***	0.051 **	0.156 ***	0.036 *	0.208 ***	1

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.3. Regression Results

The empirical analysis aims to examine how financial performance and sustainable growth depend on the composite component of VAIC and individual VAIC components, along with innovative capital and RC deployed across the companies. The empirical results appear in Table 4 and Table 5.

Table 4. Regression results of model (1)–(3).

Variable	Predicted Sign	Model (1)		Model (2)		Model (3)	
		ROA	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**
Constant		−0.101 ***	−0.382 ***	−0.067 ***	−0.277 ***	−0.052 **	−0.246 ***
		(−4.392)	(−4.097)	(−3.030)	(−3.010)	(−2.354)	(−2.667)
VAIC	+	0.005 ***	0.011 ***				
		(19.287)	(10.918)				
CEE	+			0.010 ***	0.013 *	0.010 ***	0.017 **
				(5.648)	(1.759)	(5.497)	(2.257)
HCE	+			0.007 ***	0.019 ***	0.007 ***	0.020 ***
				(22.331)	(14.152)	(23.093)	(14.517)
SCE	+			0.001	−0.001	0.001 *	−0.001
				(1.598)	(−0.841)	(1.684)	(−0.812)
RDE	+					−0.080 **	−0.527 ***
						(−1.960)	(−3.076)
RCE	+					0.310 ***	0.904 ***
						(6.946)	(4.854)
SIZE	+	0.014 ***	0.047 ***	0.010 ***	0.034 ***	0.009 ***	0.031 ***
		(6.974)	(5.675)	(5.202)	(4.218)	(4.350)	(3.758)
LEV	-	−0.128 ***	−0.409 ***	−0.114 ***	−0.362 ***	−0.112 ***	−0.350 ***
		(−19.225)	(−15.133)	(−17.484)	(−13.351)	(−17.231)	(−12.931)
Adj. R^2		0.321	0.180	0.376	0.215	0.391	0.227
F		308.117 ***	143.896 ***	236.205 ***	108.039 ***	180.015 ***	82.651 ***
D.W.		1.376	1.376	1.277	1.333	1.296	1.335
N		1950	1950	1950	1950	1950	1950

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *t*-values are in parentheses.

Table 5. Regression results of model (4)–(6).

Variable	Predicted Sign	Model (4)	Model (5)	Model (6)
Constant		−0.011	0.005	0.015
		(−0.701)	(0.306)	(0.982)
VAIC	+	0.003 ***		
		(17.641)		
CEE	+		0.004 ***	0.003 ***
			(3.198)	(2.707)
HCE	+		0.004 ***	0.004 ***
			(18.432)	(19.056)
SCE	+		0.001 ***	0.001 ***
			(4.001)	(4.096)
RDE	+			−0.008
				(−0.306)
RCE	+			0.174 ***
				(5.771)
SIZE	+	0.006 ***	0.004 ***	0.003 **
		(4.196)	(2.885)	(2.047)
LEV	-	−0.092 ***	−0.086 ***	−0.085 ***
		(−21.224)	(−19.585)	(-19.464)
Adj. R^2		0.317	0.340	0.351
F		302.044 ***	202.052 ***	151.419 ***
D.W.		1.087	1.021	1.031
N		1950	1950	1950

Notes: ** $p < 0.05$, *** $p < 0.01$. *t*-values are in parentheses.

In model (1), the coefficients on VAIC are significantly positive, indicating that firms with greater IC perform better in terms of profitability. This result lends support to H1. In model (2), two components of VAIC, CEE and HCE, are also significantly positive, while the coefficients on SCE are not significant at the 5% level, consistent with Chen et al. [21]. It is physical capital and HC that matter in impacting the firms' ROA and ROE in South Korea. Therefore, H2a and H2b are supported, while H2c is rejected. Notably, the adjusted R^2 values in model (2) are greater than those in model (1). The results corroborate that the three components of VAIC measures are better than the aggregate VAIC measure in explaining financial performance.

After controlling for SCE, the adjusted R^2 values increase to 0.391 and 0.227 in model (3), respectively. These findings also imply that investors would place greater importance on the components of VAIC. The coefficients on RDE are significantly negative in model (3), similar to the findings of Chen et al. [21] and Tripathy et al. [64]. This may be caused by the fact that R&D expenditure belongs to an expense item and should be expensed as incurred, which lowers firm's current profit and results in contemporaneous and inferior financial performance. Thus, H3a is not supported. We also find evidence supporting H3b since the coefficients on RCE are significant and positive, suggesting that RC has the greatest positive influence on firms' financial performance. These results indicate that R&D and advertising expenditures may contain additional information on innovative capital and RC.

In terms of control variables, firm size positively affects companies' performance, whereas LEV has a significantly negative impact. Overall, our results offer evidence that the more a company creates and possesses IC, the better it outperforms in the market.

In model (4), the coefficient on VAIC is significant and positive (β = 0.003, t = 17.641), supporting H4. The results in model (5) show that all three components of VAIC are also significantly positive. Similar to the results in Table 4, the adjusted R^2 value is greater in model (5) than that in model (4). For example, the adjusted R^2 value increases from 0.317 to 0.340. In model (5), CEE, HCE, and SCE have significant and positive impacts on SGR. Therefore, H5a, H5b, and H5c are supported. Additionally, the coefficients on CEE and HCE are greater than the coefficient on SCE.

Adding RDE and RCE to model (6) marginally improves the model's explanatory power. The coefficient on RDE is not significant (β = -0.008, t = −0.306). The coefficient on RCE is significantly positive (β = 0.174, t = 5.771), indicating that, although advertising expenditure is expensed as incurred, it is the most important for companies' sustainable growth. Therefore, H6a is not accepted and H6b is fully supported. In addition, SIZE has a significant and positive impact on SGR, while LEV has a significant and negative impact.

4.4. Robustness Check

We consider gross profit margin (GPM), measured by the ratio of gross profit to revenues, and net profit margin (NPM), measured by the ratio of net profit to revenues, to be the alternative measures of financial performance. Model (1)–(3) are re-estimated. Table 6 presents the results of a robustness check. The regression results are consistent with the basic results, which suggests that the conclusion of this paper is robust.

Table 6. Regression results of robustness check.

Variable	Predicted Sign	Model (1)		Model (2)		Model (3)	
		GPM	NPM	GPM	NPM	GPM	NPM
Constant		0.149 **	−0.258 ***	0.193 ***	−0.204 ***	0.415 ***	−0.191 ***
		(2.512)	(−5.277)	(3.297)	(−4.236)	(8.908)	(−3.933)
VAIC	+	0.005 ***	0.008 ***				
		(7.277)	(14.932)				
CEE	+			0.023 ***	0.015 ***	0.001	0.016 ***
				(4.908)	(3.823)	(0.154)	(3.852)
HCE	+			0.008 ***	0.012 ***	0.010 ***	0.012 ***
				(8.864)	(16.854)	(15.148)	(17.054)
SCE	+			−0.001	0.001	−0.001	0.001
				(−1.313)	(1.509)	(−1.237)	(1.540)
RDE	+					0.920 ***	−0.135
						(10.636)	(−1.500)
RCE	+					3.001 ***	0.319 ***
						(31.865)	(3.258)
SIZE	+	0.009 *	0.028 ***	0.004	0.021 ***	−0.020 ***	0.020 ***
		(1.708)	(6.380)	(0.727)	(4.976)	(−4.754)	(4.578)
LEV	-	−0.173 ***	−0.164 ***	−0.158 ***	−0.141 ***	−0.164 ***	−0.138 ***
		(−10.063)	(−11.526)	(−9.122)	(−9.928)	(−11.999)	(−9.661)
Adj. R^2		0.084	0.194	0.112	0.229	0.451	0.233
F		60.490 ***	156.911 ***	49.921 ***	117.012 ***	229.689 ***	85.732 ***
D.W.		0.554	1.433	0.555	1.333	0.667	1.339
N		1950	1950	1950	1950	1950	1950

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. t-values are in parentheses.

5. Discussion

This study's aim is to analyze the influence of IC and its elements on financial performance and sustainable growth of manufacturing companies listed on the Korean Stock Exchange during 2012-2016. Empirical findings from the analysis enable us to put forward some preliminary arguments about the relationship between IC, financial performance, and sustainable growth.

First of all, findings of model (1) suggest that VAIC has a positive impact on firm performance indicators (ROA and ROE), stating that IC can positively enhance firms' financial performance and generate wealth in South Korea, an emerging market. These results validate the RBV in the Korean context, consistent with the findings of most researchers.

Regarding IC components, model (2) clearly shows that physical capital and HC have a positive impact on ROA and ROE, supporting H2a and H2b. Further, the positive coefficients on CEE also indicate that tangible assets are the main driving force behind the firm performance in Korean manufacturing firms, which is in line with the findings of Nadeem et al. [71]. The analysis in model (2) also shows that SC is the least-developed element of IC. This is consistent with the findings of Smriti and Das [13]. Korean companies lack management competences and tend to over-rely on informal management mechanisms, which leads to deficiencies in internal management processes. However, companies who are able to efficiently utilize SC will have a special advantage due to its rarity. Conversely, Bontis et al. [52] concluded that SC is the element with the greatest influence among IC components that affect financial performance in non-service companies.

In model (3), the negative relationship between RDE and performance indicators (ROA and ROE) confirms that R&D expenditure does not help translate Korean companies' profitability in the short run. However, Amin and Aslam's study [55] confirmed a positive relationship between innovation and firm performance of pharmaceutical firms listed on the London Stock Exchange. Additionally, RCE has a statistically significant impact and the positive relationship supports our H3b, contrary to Andreeva and Garanina [15], who stated that RC might be a prerequisite for being a factor in the Russian context, but is not sufficient to outperform others. In the case of South Korea,

strength of strong ties of social networks is more beneficial for coordinating activities [72]. RC is observed to be the element with the greatest influence for telecommunications companies [73], as clients usually judge the performance of these companies according to their profitability.

Results from model (4) show that IC positively affects companies' sustainable growth. This provides evidence for H4, consistent with the findings of Smriti and Das [13] and Chen et al. [21] who stated that IC has a positive impact on revenue growth.

H5a, H5b, and H5c are supported by the regression results as shown in model (5), indicating that CEE, HCE, and SCE have a significant and positive influence on companies' sustainable growth. Physical capital and HC make equal contributions to companies' sustainable growth. However, sustainable growth depends less on SC. The accumulation of SC is a long-term process, and companies should establish long-term strategies of investment in SC.

Considering the effect of RDE and RCE on sustainable growth, the regression analysis from model (6) shows that companies' sustainable growth is positively correlated only by RCE, whereas RDE has insignificant influence on sustainable growth. This is due to the fact that investments in SC need a long period to bring competitive advantages to Korean manufacturing companies. Thus, H6a is supported and H6b is rejected.

Overall, CEE, HCE, and RCE are found to make major contributions to value added for Korean manufacturing listed companies.

6. Conclusions

IC is increasingly recognized as a major driver of corporate competitiveness and sustainability. This study corroborates earlier findings and expands the understanding of IC in enhancing financial performance and sustainable growth. By using data from Korean manufacturing listed companies, the main conclusions of this study are as follows:

(1) Korean manufacturing companies with better IC efficiency achieve greater profitability and higher sustainable growth;

(2) Physical capital, HC and RC positively affect financial performance, while innovative capital negatively affects financial performance. RC is found to be the most significant variable related to the performance of Korean manufacturing companies;

(3) Physical capital, HC, SC, and RC have positive impacts on companies' sustainable growth, but the impact of innovative capital is not significant. Additionally, the impact of RC is greater than that of the other variables used.

Our findings may have some important implications in practice.

(1) Korean manufacturing companies should maintain awareness of the importance of IC and invest more in IC in order to sustain competitive advantage. Recognizing the roles of IC components, companies also need to develop strategies to invest in different components of IC by reasonably allocating their limited knowledge-based resources.

(2) We empirically find an insignificant impact of SCE on firm's financial performance. Korean manufacturing companies should establish a positive corporate culture and develop the right management control systems to support internal business processes.

(3) With regard to innovative capital, the negative impact should attract the attention of corporate managers in the Korean manufacturing sector. Korean manufacturing companies should construct technological innovation networks in order to increase technological innovation performance. Managers should develop strategies to build strong information technology capabilities through various initiatives.

(4) It should be stressed that RC has the greatest influence on financial performance indicators, as well as the SGR. Therefore, in the present business environment, Korean manufacturing companies should keep close ties with their suppliers and customers in order to establish corporate reputation and maintain consumer loyalties [74].

(5) Korean manufacturing companies should also maintain their scale of liabilities at a reasonable level when financing intellectual assets in order to ensure corporate long-term and sustainable development.

There are some limitations in this study. First, we have focused on listed companies from the manufacturing industry of an emerging economy, and have not included other industries in this study. Second, this study could also be compared with other sectors or other countries. These limitations signal the scope for future research.

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