

# Do intellectual capitals matter to firm value enhancement? Evidences from Taiwan

Do intellectual capitals matter?

Yensen Ni and Yi-Rung Cheng

*Department of Management Sciences, Tamkang University,  
New Taipei City, Taiwan, and*

Paoyu Huang

*Department of International Business, Soochow University, Taipei City, Taiwan*

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## Abstract

**Purpose** – The purpose of this study is to find evidence of the impact of intellectual capital on firm value, and, in turn, enhance the existing literature which lacks consensus on it. By employing some distinctive proxies for human capital, innovation capital, customer capital and process capital, this study might provide valuable information for firms to make strategic decisions.

**Design/methodology/approach** – This study uses Tobin's Q to represent firm value and various variables to be the proxies for intellectual capitals. By utilizing firm-year observations, this study applies panel data models first, and then Petersen regression models for further investigation to enhance the robustness of the empirical results.

**Findings** – Firm value is affected positively by the average net profit per employee as well as goodwill and intangible assets. This is because firms having employees with abundant knowledge will possess advantage for innovation, and the excellent reputation, a part of goodwill for oriental firms, would encourage people to consume and invest more.

**Research limitations/implications** – The constraint of data resource is the main limitation. With the limited scales and as an emerging market of Taiwan Stock Exchange, it is not confirmed whether the results are appropriate for the developed markets. Nevertheless, firms should make efforts on developing intellectual capital and corporate governance for operating businesses with competitiveness and safety.

**Originality/value** – Since capable employees enhance the innovation, innovation improves customer's satisfaction and good customer relationship increases the sales; this study illustrates that for expanding businesses, firms should make more efforts on developing intellectual capital.

**Keywords** Intellectual capital, Financial performance, Corporate governance, Firm value

**Paper type** Research paper

## 1. Introduction

With the advent of information and virtual economy, the value of intangible assets seems to surpass the value of tangible assets gradually, which results in the issues related to intellectual capital being increasingly important nowadays (Chiucchi and Dumay, 2015; Dumay, 2016; Passaro *et al.*, 2018). Edvinsson and Malone (1997) claim that intellectual capital denotes “the possession of the knowledge, applied experience, organizational technology, customer relationships, and professional skills.” In other words, intellectual capital is the sum of the intangible and knowledge-related resources that an organization utilizes to generate value (Kianto *et al.*, 2017). As a matter of fact, intellectual capital becomes at least as important as financial capital in providing truly sustainable earnings (Pourzamani *et al.*, 2012) and provides some directions for the future development of enterprises (Martín-de Castro, 2014). However, firm performance is mainly measured by tangible assets in traditional accounting, which fail to reflect the value created by intangible assets, such as intellectual capital, in enterprises (Yallwe and Buscemi, 2014). Thus, the company needs to make an effective and comprehensive intellectual capital disclosure, which supports the stakeholders' evaluation process (Giacosa *et al.*, 2017).



The issue of the relationship between intellectual capital and firm value has been discussed, but with no consensus in the existing literature. For example, intellectual capital is found not only to positively influence the profitability and corporate return (Jordão and de Almeida, 2017) but also to play a greater role in creating value, efficiency and financial performance of firms (Chen *et al.*, 2005; Chu *et al.*, 2011; Kamath, 2008; Pal and Soriya, 2012; Powell, 2003; Tan *et al.*, 2007). Even further, Hussinki *et al.* (2017) find that the firms characterized with high levels of intellectual capital and high use of knowledge management practices are likely to have better performances.

On the contrary, numerous papers fail to generate adequate evidences to demonstrate this positive relationship (Chan, 2009a, b; Ghosh and Mondal, 2009; Ozturk and Demirgunes, 2007). Following this line of argument, we investigate the relationships among the impacts of intellectual capital elements on firm value. The purpose of this study is to find the evidence about this issue by employing diversified and even idiosyncratic proxies to enhance the existing literature. Furthermore, this study considers the variables related to corporate governance and financial performance as controlling variables because these two variables might tend to influence firm value, as seem after surveying relevant studies in Section 2.4.

In this study, several important findings are revealed. First, the average net profit per employee positively affects firm value, meaning that the value of human capital would be enhanced if the employees have various skills and abundant knowledge. This finding would be beneficial for the firm to enhance know-hows, technology diffusion and R&D. For the high-tech-centered firms in particular, creative and productive employees are the advantage for innovation and competition. Only the enterprises with capable employees can improve firm values constantly and survive in the highly competitive business world. Second, goodwill and intangible assets have positive impacts on firm value, indicating that goodwill might be beneficial for firms to earn excess profits. Different from the Western companies creating goodwill by merger, most of the oriental Chinese-culture-influenced enterprises believe that good reputation could encourage people to increase consumption and investment. Since the present value of future abnormal profits may be reflected by goodwill and intangible assets, firms would endeavor to create goodwill to enhance their values in return.

This study may contribute to existing literature in several aspects. First, with distinctive variables as the proxies, this study investigates whether various intellectual capital elements, including human, innovation, customer, and process capitals, would affect firm value in somewhat different way from former studies. Eventually, this study provides more solid results to enhance the present literature. Second, each element of intellectual capital would affect firm value in certain way, indicating that intellectual capital is relevant for the enhancement of firm value. Capable employees would enhance the innovation, innovation in product and service would improve the satisfaction of customer, and good customer relationship would increase the sales. Therefore, enterprises should make more efforts in developing the intellectual capital for expanding businesses. Third, this study uses two different models to conduct the empirical tests and reveals more robust empirical results, which might differ from the past studies.

This study consists five sections. Section 2 describes the literature review and proposes hypotheses. Section 3 introduces methodology applied in this study. Section 4 shows the empirical findings and analysis. Section 5 reveals the conclusion.

## 2. Literature review and hypotheses proposed

For the objective of familiarity with relevant studies, a survey of relevant literature is established, which relates to firm value, intellectual capital, intellectual capital and firm value, as well as corporate governance, financial statements and firm value in this study.

### 2.1 Firm value

Firm value, which enterprises are striving to increase, is considered the main indicator for evaluating the firm's performance. [Mitton and O'Connor \(2012\)](#) reveal that firms becoming investable experience significant increases in both market values and physical investment. Thus, firm value might be regarded as one of the most significant elements for firms and investors.

After reviewing the previous literature, we find that firm value is related to several aspects. From the corporate governance viewpoint, [Brick and Chidambaran \(2010\)](#) disclose that board activity has a positive impact on firm value. [Basyith et al. \(2015\)](#) argue that managerial ownership, blockholders' ownership and board of directors significantly relate to firm performance which could be a proxy for firm value. [Larcker et al. \(2013\)](#) reveal that firms with central boards of directors generate superior risk-adjusted stock return and higher future return-on-asset growth. However, [Eisenberg et al. \(1998\)](#) show that board size has a negative impact on profitability, Tobin's Q and share return.

With regard to the management, [Jiang et al. \(2017\)](#) find that efficiency positively affects firm value. In fact, the improved transparency and accountability play a role in boosting firm value ([Li et al., 2018](#)). Moreover, firm value might be increased by proper risk management for the firm ([Pérez-González and Yun, 2013](#)). [O'Sullivan and McCallig \(2012\)](#) claim that customer satisfaction has a positive impact on firm value, which is above the impact of earnings on firm value. On the other hand, firms with greater agency and monitoring problems display a negative association between Tobin's Q and derivative usage ([Fauver and Naranjo, 2010](#)).

In addition, from the financial performance aspect, firm value could be represented by stock performance and stakeholders. For stock performance, previous studies show that the price of common stock for a firm tends to drop when the firm issues new public securities ([Billett et al., 1995](#)), which might result in the decrease of firm value. [Nguyen et al. \(2016\)](#) declare a positive relation between stock liquidity and firm value. As for the stakeholders, [Jiao \(2010\)](#) points out that the welfare of stakeholder is associated with positive valuation effects. However, [Konijn et al. \(2011\)](#) find a negative correlation between Tobin's Q and blockholder dispersion.

### 2.2 Intellectual capital

Intellectual capital, a crucial part of asset for a firm, is an intangible and mental asset as well as resource, which is utilized by the organization to generate value by turning it into new processes of products and services ([Madani et al., 2015](#)). In the initial impression, intellectual capital may be defined as the set of all knowledge which has been possessed by the employees as well as the company and builds a competitive advantage ([Bontis, 2001](#)).

The concept of intellectual capital has been categorized in several ways, meaning that various typologies of intellectual capitals are proposed in the present literature ([Hormiga et al., 2011](#)). For instance, [Edvinsson and Malone \(1997\)](#) argue that intellectual capital is classified into human capital, innovation capital, customer capital and process capital. This classification might be the first public and the most representative framework for intellectual capital ([Tseng et al., 2015](#)). Therefore, we follow these categories to conduct this study.

Human capital includes an organization's employees and their attributes, such as knowledge, experience, commitment and motivation ([Bontis, 1998](#)). [Singh and Rao \(2016\)](#) argue that human capital has the most profound effect on learning, integration, reconfiguration and alliance management capabilities. In fact, human capital efficiency is a key driver of corporate reputation, which has a positive relationship between intellectual capital elements and various measures of financial performance ([Ginesti et al., 2018](#)). Even more, [Torres et al. \(2018\)](#) claim that human capital can represent the construct of knowledge management.

With regard to innovation capital, [Woiceshyn and Eriksson \(2014\)](#) point out that innovation capital drives wealth creation, economic growth and human well-being. [Tseng et al. \(2015\)](#) declare that innovation focus drives firms to explore new areas and pursue long-term competitive advantages as well as continuous growth. In general, innovation capital efficiency has a direct impact on firms' productivity and a moderating effect on profitability, meaning that the increase in R&D expenses will lead to the increases of profitability ([Bayraktaroglu et al., 2019](#)). By expanding the investigation, innovation capital is somewhat related to knowledge management. [Donate and Guadamillas \(2011\)](#) demonstrate that knowledge management practices are important for innovation, indicating that they are positively and significantly related to product and process innovation ([Lee et al., 2013](#)). Thus, a firm with a knowledge management capability will be more innovative and perform better ([Darroch, 2005](#)).

As for customer capital, [Chen et al. \(2004\)](#) label customer capital in the form of marketing capability and the severity of market as well as customer loyalty. [Roos and Roos \(1997\)](#) argue that customer capital includes the available knowledge in formal as well as informal relationships, social networks, trust, organization reputation, customer requirements, customer loyalty and interaction with customers, competitors, as well as suppliers.

With reference to process capital, [Scafarto et al. \(2016\)](#) argue that process capital includes procedures, systems and techniques adopted by an organization to achieve process quality and operational efficiency. [Ferraris et al. \(2018\)](#) reveal that the firms with the development of big data analytics (BDA) capabilities will increase their performances, and knowledge management orientation certainly plays a significant role in amplifying the effect of BDA capabilities.

Besides, each component of intellectual capital not only independently leads to the creation of intellectual capital but also influences each other ([Sydler et al., 2014](#)). [Manzaneque et al. \(2017\)](#) disclose that recruiting competent human resources and developing mechanisms to capture knowledge, expertise and skills for employees as well as stakeholders are crucial to achieve innovation outputs. [Wang and Chang \(2005\)](#) reveal that the improvement in process capital leads to customer satisfaction and enhancement of customer relationships.

In sum, intellectual capital is a relationship issue, which involves off-balance sheet values; measures the immeasurability; and searches for relationships among people, ideas and knowledge ([Edvinsson, 1997](#)). Hence, intellectual capital is a collective brainpower, which can be the end result of a knowledge transformation process and the knowledge that is transformed into intellectual property ([Stewart, 1997](#)).

### *2.3 Intellectual capital and firm value*

In the recent years, the impact of intellectual capital on firm performance has been examined by many researchers. For example, [Sydler et al. \(2014\)](#) point out that an increase in intellectual capital is associated with a higher return on asset over time. [Zéghal and Maaloul \(2010\)](#) discover that intellectual capital has a positive impact on the economic and financial performance of the company. Moreover, [Hejazi et al. \(2016\)](#) find that intellectual capital positively relates to Tobin's Q and, consequently, can be taken into consideration for improving the performance of firms. Even further, [Abualoush et al. \(2018\)](#) reveal that intellectual capital is related to knowledge management process and organization performance. In sum, intellectual capital, usually referred to as intangible asset, is recognized as a strong driver of firm value ([Wingren, 2004](#)) and relates to financial performance of a firm significantly and positively ([Amin and Aslam, 2017](#)).

Although many studies, such as those mentioned above, report that intellectual capital has a positive impact on firm value, some researchers illustrate different results. For instance, [Meditinos et al. \(2011\)](#) fail to support the hypothesis that companies with higher intellectual capital would have higher rates of market value on book value. [Chan \(2009\)](#) argues that there is no conclusive evidence to support a definitive association between intellectual capital and

financial performance for the companies surveyed in Hong Kong. Ghosh and Mondal (2009) find that the Indian investors are not influenced by the intellectual capital performance of companies and there is no direct association between the productivity and the intellectual capital performance. Moreover, Wang and Chang (2005) find that human capital has been found not directly affecting business performance.

Due to the lack of consistent conclusion from existing literature, we attempt to find more clear evidence for the relationships among intellectual capital elements and firm value by utilizing some distinctive proxies. Hence, we propose the hypotheses as shown below.

- H1. Human capital would have a positive impact on firm value.
- H2. Innovation capital would have a positive impact on firm value.
- H3. Customer capital would have a positive impact on firm value.
- H4. Process capital would have a positive impact on firm value.

#### 2.4 Corporate governance, financial statements and firm value

In general, a strong and positive relation exists between firm-level corporate governance and firm valuation, indicating that governance attributes exhibit positive and significant effects on firm value (Ammann *et al.*, 2011). Firms with better corporate governance would maximize shareholders' wealth and constrain unnecessary investments (Benson *et al.*, 2011). For example, Black *et al.* (2015) declare that better governance not only moderates the negative effect of related-party transactions but also increases the firm profitability due to less tunneling. Cosset *et al.* (2016) reveal that corporate governance is associated with the greater firm value for developing countries. Bae *et al.* (2012) report that Asian firms with weaker corporate governance experienced a larger drop in their share values during the 1997 Asian financial crisis. In conclusion, governance mandates can shorten the value gap between poorly governed and well-governed firms (Aggarwal *et al.*, 2019).

With regard to the ownership structures, Shahveisi *et al.* (2017) show that the firms with ownership concentration have better intellectual capital performance. However, Edmans (2014) argues that blockholders may worsen governance by extracting private benefits of control or pursuing other objectives rather than firm value maximization.

As for the board of the firm, Brick and Chidambaran (2010) claim that a well-functional board structure has a positive impact on firm value. Bird *et al.* (2018) argue that the increased board independence weakens the CEO's power over the board and restrains corporate risk-taking. Therefore, decisions made by firms with more independent boards are less extreme, resulting in less variability of firm performance. Moreover, Al-Najjar (2014) reveals that board independence positively relates to firm and stock performances but board size shows opposite results, meaning that large boards enhance firm profitability but small boards exhibit more efficient stock performance. Conversely, Upadhyay *et al.* (2014) find that board size positively influences firm performance and negatively impacts Tobin's Q when a firm uses more than three monitoring committees. Thus, with the relevant literature surveyed above, corporate governance should not be ignored for evaluating firm value.

With reference to financial statements, Barton and Simko (2002) report that share prices increase when enterprises are able to exhibit improved asset management. Meanwhile, a firm's financial risk declines if the firm has a relatively high current ratio (Borokhovich *et al.*, 2004). Holthausen and Larcker (1992) suggest that high-leveraged firms enhance the financial risks but weaken the performance of share price (Berger and Bouwman, 2013; Cai and Zhang, 2011). In addition, Blanchard and Simon (2001) point out that share prices are less volatile in large-scale firms, which might be beneficial for their firm value enhancement.

### 3. Methodology

#### 3.1 Data

This study utilizes the data of the firms listed on Taiwan Stock Exchange (TWSE) from *Taiwan Economic Journal* (TEJ), over the period from 2009 to 2013 [1], which included 4,892 observations as our sample. Tobin's Q, as the dependent variable, is used to present firm value, and the independent variables are classified into the proxies for various intellectual capitals, the board structure variables and other controlling variables.

Indicators of intellectual capital elements are collected from the literature on the measurement of intellectual capital or factors of business performance. By replacing the background information, such as age, education and work experience, we use average operating revenue per employee (Cheng *et al.*, 2010; Tseng, *et al.*, 2015) and average net profit per employee (Cheng *et al.*, 2008) to stand for human capital because an increase in the revenue per employee means that the employees contribute more to the corporation and enhance the corporate value (Tseng *et al.*, 2015).

Furthermore, this study employs the R&D expense ratio (Tseng *et al.*, 2015) instead of patents or licenses to represent innovation process. In addition, inspired by Ittner *et al.* (2003) – who suggest that non-financial performance measures are better predictors of long-term performance – and OECD (2005) – that reports that an innovation is the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations – we utilize goodwill and intangible assets as the second indicator for innovation capital in this study.

Besides, revenue growth rate (Tseng *et al.*, 2015) and operating expense ratio which is modified from marketing expense ratio (Wang and Chang, 2005) are applied to be the proxies for customer capital rather than utilizing customer relationship-related issues. Moreover, this study exploits current assets turnover ratio (Tseng *et al.*, 2015) and inventory turnover ratio (Cheng *et al.*, 2010; Wang and Chang, 2005) to measure process capital.

In exploring the variables related to ownership and the board, Basyith *et al.* (2015) illustrate that variables, such as board of directors, managerial ownership and blockholders, have significant impact on firm performance. Besides, Guest (2009) reveals that board size has a strong negative effect on Tobin's Q for UK listed firms because of weak monitoring. However, Coles *et al.* (2008) argue that there are certain kinds of firms, specifically where the advisory role of the board is relatively more important, which may benefit from bigger boards. Therefore, this study incorporates the variables of directors' holding ratio, top 10 shareholders' holding ratio, managers' holding ratio, directors' pledge ratio and board size to conduct the empirical test.

With regard to other controlling variables, some researchers argue that the large-scale companies are inclined to hedge risks to reduce stock price volatilities (Berkman and Bradbury, 1996; Jin and Jorion, 2006; Mian, 1996; Nance *et al.*, 1993), which might contribute to stable firm values. Hence, this study employs current ratio, debt ratio, assets turnover ratio, net profit ratio and firm scale as the controlling variables. For a better understanding on the variables used in this study, the definitions of these variables are shown in Table 1.

#### 3.2 Descriptive statistics

The descriptive statistics of proxies for various intellectual capitals and other variables employed in this study, including the number of observations, means, medians, standard deviations, minima and maxima, is presented in Table 2.

Table 2 reports that the mean value of Tobin's Q is 1.25, indicating that most of the firms listed on TWSE have higher market values than their book values. With reference to the average net profit per employee in terms of human capital, the minimum and maximum are

Variables	Definitions
Tobin's Q	Market value of assets over book value of assets
<i>The proxies for human capital</i>	
Average operating revenue per employee	Total revenue over the numbers of employee
Average net profit per employee	Total net profit over the numbers of employee
<i>The proxies for innovation capital</i>	
Goodwill and intangible assets	Book value of total assets excluding tangible assets
R&D expense ratio	R&D expense over total operating income
<i>The proxies for customer capital</i>	
Revenue growth rate	The growth rate of total revenue
Operating expense ratio	Total operating expense over total revenue
<i>The proxies for process capital</i>	
Current assets turnover ratio	Total sales over total current assets
Inventory turnover ratio	Cost of goods sold over inventories
Directors' holding ratio	Total directors' shareholdings over total shares outstanding
Top 10 shareholders' holding ratio	Top ten shareholders' shareholdings over total shares outstanding
Managers' holding ratio	Total managers' shareholdings over total shares outstanding
Directors' pledge ratio	Directors' pledged shares over total directors' shareholdings
Board size	Total number of directors in the board
Independent director dummy	Set to 1 if a firm recruits independent directors; otherwise, set to 0
CEO duality dummy	Set to 1 if the chairman of a firm is the CEO; otherwise, set to 0
Current ratio	Current assets over current liability
Debt ratio	Total debts over total assets
Assets turnover ratio	Total sales over total assets
Net profit ratio	Net profit over total sales
Firm scale	ln (market value)

**Table 1.**  
Definitions of variables

–575,570 and 181348.1, respectively. According to [Tseng et al. \(2015\)](#), an increase in the revenue per employee means that the employees make more contribution to the corporation and enhance the corporate value, which might be the reason for human capital being so important to the firm.

As for the innovation capital, the range between maximum and minimum values of intangible assets with goodwill included is rather broad, even zero for the minimum. This also occurred for R&D expense ratio. With the aim to achieve innovation, corporations are driven to search for new ideas, pursue for long-term competitive advantages and sustain growth ([Edvinsson and Malone, 1997](#)). Thus, firms with low R&D expense might restrict their ability to create new products and make patents, which would decrease their competitiveness in IT industry and result in low intangible assets.

In addition, concerning the customer capital, the difference of the maximum and the minimum for revenue growth rate is quite huge, with some firms even having a negative rate. Because customers are the driven force for firms to generate revenue, these firms are speculated to develop different customer relationships which might result from the dissimilar operating and marketing strategies.

With regard to the process capital, the average inventory turnover ratio is 51.3465, while the minimum and maximum values are –146.82 and 44311.42, respectively. This large gap might show the differences among different industries. Therefore, to make a comparison might be difficult since the inventory turnover for some industries like the retail industry is rather fast.

Furthermore, the mean of the directors' holding ratio is 22.60%, but the minimum ratio is close to 0. In addition, the maximum directors' pledge ratio is as high as 99.97%, and the

**Table 2.**  
Descriptive statistics

Variables	Obs.	Mean	Median	Min	Max
Tobin's Q	4,829	1.250994	1.050377	0.0078089	9.342747
Average operating revenue per employee	4,829	24746.32	5789.326	0	1.36e+07
Average net profit per employee	4,829	675.0344	260.3152	-575,570	181348.1
Goodwill and intangible assets	4,829	643400.6	25,639	0	5.48e+07
R&D expense ratio	4,829	3.351056	1.34	0	548.08
Revenue growth rate	4,829	109.6337	2.22	-99.64	417465.6
Operating expense ratio	4,829	18.96204	11.8	0.92	7996.64
Current assets turnover ratio	4,829	1.67571	1.5201	0	22.7896
Inventory turnover ratio	4,829	51.3465	5.25	-146.82	44311.42
Current ratio	4,829	292.9445	179.26	14.79	19774.98
Debt ratio	4,829	44.59515	43.97	0.78	332.23
Assets turnover ratio	4,829	0.9203134	0.79	0	7.22
Net profit ratio	4,829	5.279869	4.84	-3412.47	7458.61
Directors' holding ratio	4,829	22.60345	18.66	0	99.71
Top 10 shareholders' holding ratio	4,829	2.946672	0	0	79.02
Managers' holding ratio	4,829	1.074599	0.29	0	44.49
Directors' pledge ratio	4,829	10.08231	0	0	99.97
Board size	4,829	4.929799	4	0	21
Independent director dummy	4,829	0.4539242	0	0	1
CEO duality dummy	4,829	0.2751784	0	0	1
Firm scale	4,829	22.51806	22.38871	17.50439	28.63732

maximum debt ratio reaches 332.23%. Thus, certain firms listed on TWSE are deduced to face the corporate governance issues.

### 3.3 Models

By using STATA [2] software, applying a variety of proxies for intellectual capitals and taking ownership structure, and considering the board as well as financial statements as controlling variables, Models (1)–(4) are set to examine whether firm value is affected by various elements of intellectual capitals, including human, innovation, customer and process capitals, respectively. The specification is shown as follows:

$$\begin{aligned}
 \text{Tobin's } Q_{i,t} = & \beta_0 + \beta_1 X_{1,j,i,t} + \beta_2 X_{2,j,i,t} + \beta_3 \text{Directors' holding ratio}_{i,t} \\
 & + \beta_4 \text{Top 10 shareholders' holding ratio}_{i,t} + \beta_5 \text{Managers' holding ratio}_{i,t} \\
 & + \beta_6 \text{Directors' pledge ratio}_{i,t} + \beta_7 \text{Board size}_{i,t} \\
 & + \beta_8 \text{Independent director dummy}_{i,t} + \beta_9 \text{CEO duality dummy}_{i,t} \\
 & + \beta_{10} \text{Current ratio}_{i,t} + \beta_{11} \text{Debt ratio}_{i,t} + \beta_{12} \text{Assets turnover ratio}_{i,t} \\
 & + \beta_{13} \text{Net profit ratio}_{i,t} + \beta_{14} \text{Firm scale}_{i,t} + \varepsilon_{i,t}, \text{ for } j = 1 \text{ to } 4
 \end{aligned}
 \tag{1} \quad - \quad \tag{4}$$

where  $X_{1,j}$  and  $X_{2,j}$  are average operating revenues per employee and average net profit per employee for  $j = 1$  as Model (1) for representing human capital; goodwill and intangible assets as well as R&D expense ratio for  $j = 2$  as Model (2) for denoting innovation capital; revenue growth rate and operating expense ratio for  $j = 3$  as Model (3) for symbolizing customer capital; and current assets turnover ratio and inventory turnover ratio for  $j = 4$  as Model (4) for indicating process capital.

Moreover, in order to examine the existence of multicollinearity problems for these independent variables, the variance inflation factor (VIF) tests are used in the beginning. The VIF is an indicator of the severity of multicollinearity, which is not considered a severe problem if the VIF value is less than ten (Gujarati, 2009). The results show that all of VIF values are less than three, indicating that multicollinearity issues are not serious in this study.

## 4. Empirical findings and analysis

### 4.1 Panel data models

Due to employing firm-year observations in this study, panel data models would be more appropriate than traditional regression models. Panel data usually denotes data comprising time series observations of a number of individuals (Hsiao, 2007). Typically, panel data provide researchers a large number of data points with reducing collinearity among explanatory variables, which improve the efficiency of econometric estimates (Hsiao, 2014). Hence, this study applies panel data models to explore whether firm value would be affected by various intellectual capitals after concerning board structure, financial statement, as well as other controlling variables; the results are presented in Table 3.

Table 3 shows that intellectual capitals do have a positive relationship with firm value. For human capital, the average operating revenue per employee is positively related to firm value, which is in line with prior studies. As Kianto *et al.* (2017) revealed, human capital is the most significant element of intellectual capitals and the main driving forces of value creation (Dženopoljac *et al.*, 2016; Young *et al.*, 2009). With the contribution to organizational wealth creation, human knowledge and intellect has become a key organizational asset (Craneand and Bontis, 2014; Ramadan *et al.*, 2017). Due to the fact that a critical portion of knowledge and skills is used by individuals (Subramaniam and Youndt, 2005) and developing new knowledge requires some level of existing knowledge (De Winne and Sels, 2010), employees' skills and expertise are important for organization. In sum, by improving the capabilities of employees, firms might create more revenue and then their values could be enhanced consequently (Tseng *et al.*, 2015).

As for innovation capital, the goodwill and intangible assets have significantly positive impacts on firm value, indicating that goodwill might be beneficial for firms to earn excess profits because firms with more goodwill and intangible assets are likely to have higher firm value. In addition, R&D expense significantly affects firm value, representing that firms would benefit with an increase in R&D expense ratio because corporations are driven to search for new ideas and pursue for long-term competitive advantages to achieve innovation (Edvinsson and Malone, 1997). As for process capital, the current assets turnover ratio impacts firm value positively. In other words, the improvement of current assets turnover, such as sales, might increase the profit and raise firm value simultaneously.

Moreover, the top 10 shareholders' holding ratio also has a significantly positive influence on firm value, implying that higher shareholding of top 10 shareholders would increase firm value as well. This result seems to be consistent with that of the concentrated-ownership firms which are able to propose appropriate strategies to improve operating system and to control the firms effectively (Bolton and Thadden, 1998). In addition, blockholders would have more incentives for collecting information to examine if top managers really protect the interests of shareholders by supervising top managers. However, firm value might be weakened when top 10 shareholders or blockholders engage in insider trading at the expense of general investors. Meanwhile, CEO duality has a significantly positive impact on firm value because the CEO of a firm would endeavor to create better financial performance for the personal interest if he is also the chairman of the firm.

Dependent variable: Firm value					
Independent variables	Human capital (1A)	Innovation capital (1B)	Customer capital (1C)	Process capital (1D)	
Average operating revenue Per employee	1.27e-07*** (4.38e-08)				
Average net profit per employee	8.60e-07 (8.55e-07)				
Goodwill and intangible assets		2.82e-09*** (3.22e-09)			
R&D expense ratio		0.0043423*** (0.0014852)			
Revenue growth rate			-5.10e-07 (1.31e-06)		
Operating expense ratio			0.0001176 (0.0000985)		
Current assets turnover ratio				0.0196439* (0.0106452)	
Inventory turnover ratio				-2.22e-06 (8.80e-06)	
Current ratio	-2.53e-06 (0.0000114)	-5.14e-06 (0.0000129)	-4.15e-06 (0.0000115)		-9.08e-06 (0.0000125)
Debt ratio	0.0010015** (0.0004363)	0.000276 (0.0005695)	0.0010994*** (0.000435)		0.0001026 (0.0005236)
Assets turnover ratio	-0.016941 (0.0127727)	0.0091261 (0.0144379)	-0.0144022 (0.0127842)		-0.0210376 (0.0180493)
Net profit ratio	0.0000282 (0.0000619)	0.0000256 (0.0000635)	-0.0000481 (0.0000916)		0.0000112 (0.0000631)
Directors' holding ratio	-0.0001635 (0.0005757)	0.0007439 (0.0006495)	-0.000016 (0.0005747)		0.0001368 (0.0006165)
Top10 shareholders' holding ratio	0.0024317** (0.001025)	0.003001*** (0.0011432)	0.0026841*** (0.0010224)		0.002515** (0.0010748)
Managers' holding ratio	0.0020269 (0.0036834)	0.0013764 (0.0039944)	0.0017832 (0.0036823)		0.0023214 (0.0038083)
Directors' pledge ratio	-0.0005712 (0.0004502)	-0.0006418 (0.0005219)	-0.0006378 (0.0004497)		-0.0006498 (0.0004862)
Board size	-0.0009624 (0.0044677)	-0.0034515 (0.0051895)	-0.0018171 (0.0044555)		-0.0068173 (0.0048684)
Independent director dummy	0.0123953 (0.0176992)	-0.013214 (0.0199006)	0.0097165 (0.0176091)		-0.0086239 (0.0188518)
CEO duality dummy	0.0665406*** (0.0187734)	0.0865243*** (0.0204461)	0.070286*** (0.0187328)		0.0820817*** (0.019408)
Firm scale	0.005489 (0.0060592)	0.0057697 (0.0070128)	0.0070309 (0.0059828)		0.005884 (0.006241)
Constant	1.068407*** (0.1346007)	1.055632*** (0.1580529)	1.031223*** (0.1335337)		1.095561*** (0.1402481)
Adj. R <sup>2</sup>	0.0116	0.0067	0.0082		0.0089
Coefficient estimates	Panel data	Panel data	Panel data	Panel data	Panel data
Standard errors	Random effect	Fix effect	Random effect	Random effect	Fix effect

**Note(s):** This study explores whether diverse intellectual capitals would affect firm value; the results are shown in columns (1A) – (1D). The *t*-statistics are based on the standard errors adjusted for either fix effects or random models depended on the statistics of Hausman tests for columns (1A) – (1D). Statistical significance values at the 10%, 5% and 1% levels are denoted by \*, \*\* and \*\*\*, respectively.

**Table 3.**  
Empirical results of  
panel data models

#### 4.2 Petersen regression models

Although regression models and panel data models are commonly used for analyzing panel data sets (e.g. data sets that contain observations on multiple firms in multiple years) in finance, [Petersen \(2009\)](#) point out that the ways in which researchers have addressed possible

biases in the standard errors vary widely and in many cases is incorrect. The literature has used diversified methods to estimate standard errors in panel data sets, but the chosen method is often incorrect. As a result, Petersen proposes modified regression models which have been adopted afterward by many researchers (Bartov *et al.*, 2018; Bolton *et al.*, 2016; Faulkender *et al.*, 2019; Fracassi, 2017; Gulen and Ion, 2016; Shipman *et al.*, 2017, etc.). Therefore, this study also utilizes Petersen models for grasping the relative accuracy, which would be beneficial for the robustness of the empirical results; the results are shown in Table 4.

Similar to the results revealed in the panel data models, the results of Petersen regression models show that the average operating revenue per employee positively impacts firm value. According to Tseng *et al.* (2015), mentioned in Section 4.1, we argue that the higher the operating value per employee, the higher the firm value is. In addition, the goodwill and intangible assets as well as R&D expense would also affect firm value significantly and positively, which indicates that firm value would be enhanced if it has more intangible assets and R&D expense since corporations are driven to search for new ideas and pursue for long-term competitive advantages (Edvinsson and Malone, 1997).

On the basis of the different findings from the results disclosed in panel data models, Petersen models expose that the inventory turnover ratio has a significantly positive impact on firm value. Cheng *et al.* (2010) point out that efficient operating processes can improve corporate value, and this study also reveals that efficient process capital as a result of high inventory turnover ratio is likely to improve firm value.

In general, firms with higher asset turnover ratio would have better firm values; however, this study reports the opposite outcome. The result of asset turnover ratio is negatively related to firm value; from this it might be inferred that many firms would reduce selling price for sales because they are OEM [3] firms with low gross margin. As a result, the firms with higher asset turnover ratios might not generate higher firm values.

For other financial ratios, the current ratio negatively relates to firm value, implying that firms might not find it easy to increase the firm value with higher current ratio if the high liquidity ratio stemmed from excessive inventory or idle cash. In addition, the firm with a higher pledge ratio would not enhance firm value, which is quite consistent with the public cognition.

## 5. Conclusion

As Petty and Guthrie (2000) argued, the issues related to intellectual capital are paid much more attention nowadays. The knowledge-based intellectual capital, including intangible assets and goodwill, might be regarded as the driving force for economy development. Nevertheless, no consensus has been brought out for the relationship between intellectual capital and firm value. Therefore, we were motivated to conduct this study and expect to enhance the existing literature on this issue. By using various and even particular variables as the proxies for elements of intellectual capitals, we reveal some concrete findings.

This study discloses that the average net profit per employee positively affects firm value, which suggests that firms should make more efforts to improve their human capital. With different skills and abundant knowledge of employees, the know-hows, the technology diffusion and the R&D performance might be enhanced, which is advantageous for innovation and competition. Therefore, the enterprises with capable employees can generate firm values constantly and survive in the highly competitive business world. Besides, the goodwill and intangible assets have significant and positive impact on firm value. After all, the excellent reputation of a firm, regarded as a part of goodwill for the oriental enterprises influenced by Chinese culture, could stimulate customers and investors to increase consumption and investment. Since the present value of future abnormal profits may be

Dependent variable: Firm value					
Independent Variables	Human capital (2A)	Innovation capital (2B)	Customer capital (2C)	Process capital (2D)	
Average operating revenue per employee	2.19e-07** (9.96e-08)				
Average net profit per employee	1.66e-06 (2.04e-06)				
Goodwill and intangible assets		9.55e-09** (3.96e-09)			
R&D expense ratio		0.0061706* (0.003705)			
Revenue growth rate			8.28e-08 (2.73e-07)		
Operating expense ratio			0.000141 (0.0001219)		
Current assets turnover ratio					-0.0018524 (0.0211535)
Inventory turnover ratio					0.0000113*** (4.17e-06)
Current ratio	-0.0000142 (0.0000107)	-0.0000153** (6.24e-06)	-0.00001480 (0.0000104)	-0.0000177** (6.85e-06)	
Debt ratio	0.0011951* (0.0007075)	0.0012669 (0.0008354)	0.0013768** (0.0006255)	0.0009919 (0.0007544)	
Assets turnover ratio	-0.0353756** (0.017227)	-0.0187116 (0.0146706)	-0.0319334** (0.0157052)	-0.0239228 (0.0203436)	
Net profit ratio	0.0000702 (0.0000535)	0.0000857** (0.0000348)	-0.0000176 (0.0001121)	0.0000616 (0.0000546)	
Directors' holding ratio	-0.0012742 (0.0012814)	-0.0003174 (0.0011884)	-0.0010722 (0.0012756)	-0.0011116 (0.0013182)	
Top10 shareholders' holding ratio	0.0025042 (0.002388)	0.0038446* (0.0023214)	0.0028985 (0.0022941)	0.0032255 (0.0021215)	
Managers' holding ratio	0.0008916 (0.00589)	0.00078 (0.0054054)	0.000633 (0.0059263)	0.0006161 (0.0064837)	
Directors' pledge ratio	-0.0011074*** (0.0003187)	-0.0012623** (0.0005637)	-0.001167*** (0.0003069)	-0.0015406*** (0.0005486)	
Board size	-0.0015114 (0.0042392)	-0.0040632 (0.0068554)	-0.0029395 (0.0053412)	-0.0040974 (0.0045108)	
Independent director dummy	0.0220602 (0.0688504)	-0.0111115 (0.0770632)	0.0178337 (0.0665326)	0.0060301 (0.072457)	
CEO duality dummy	0.0449647 (0.0338835)	0.0524177 (0.032371)	0.0503448 (0.0332598)	0.0532109 (0.0351516)	
Firm scale	-0.0058738 (0.0139271)	-0.0082759 (0.0141183)	-0.0028979 (0.0155654)	-0.0047452 (0.0148887)	
Constant	1.366173*** (0.3575116)	1.389083*** (0.3504193)	1.295839*** (0.3880591)	1.362346*** (0.3597564)	
Adj. $R^2$	0.0102	0.0103	0.0065	0.0066	
Coefficient estimates	OLS	OLS	OLS	OLS	
Standard errors	CL – F&T	CL – F&T	CL – F&T	CL – F&T	

**Table 4.**  
Empirical results of  
Peterson regression  
models

**Note(s):** This study explores whether diverse intellectual capitals would affect firm value; the results are shown in columns (2A) – (2D). The  $t$ -statistics are based on the standard errors adjusted by the two-way clusters existed in firm and year (Peterson, 2009) for columns (2A) – (2D). Statistical significance values at the 10%, 5% and 1% levels are denoted by \*, \*\*, and \*\*\*, respectively.

reflected by goodwill and intangible assets, firms would endeavor to create goodwill to enhance their values in return.

Compared to the previous papers, this study generates some distinctive results which might contribute to the existing literature. First, this study adopts creative proxies and takes

corporate governance as controlling variables to investigate the relationship between intellectual capital and firm value, which are dissimilar from former studies. As expected, this study provides more concrete results to enhance the present literature. Second, intellectual capital does matter to the enhancement of firm value. Capable employees would enhance the innovation; innovation in product and service would improve the satisfaction of customer; and good customer relationship would increase the sales. Therefore, for expanding businesses, enterprises should make more efforts on developing the intellectual capital. Third, with the usage of panel data models and Petersen regression models, this study pioneers to produce more robust results.

This study has two valuable implications. First, due to the fact that intellectual capital relates to a firm's financial performance significantly and positively (Amin and Aslam, 2017; Hejazi *et al.*, 2016), enterprises should make more efforts for the development of intellectual capital. With strong intellectual capital, enterprises can operate their businesses with competitiveness which is the key element for firm value enhancement. Second, corporate governance is also an important issue. Many scandals explode due to the ill-functioning corporate governance. For instance, firm value might be weakened by the higher directors' pledge ratio. When this ratio is high, directors might be speculated by hollowing out of the money from enterprises which causes firm to bear higher risk and even suffer huge losses for investors.

As with all papers, this study has some limitations, which suggest future line of research. First, due to the limited availability of data resource, this study employs the data of TWSE listed firms instead of other large international stock indices. Since the scales of TWSE listed firms are not large enough, the values of these firms might be somewhat affected by temporary large capital inflows or outflows from large financial institutions. In such a case, the revealed results of this study might be likely twisted in some ways. Second, as an emerging market of TWSE, we are not sure whether the results are also appropriate for the developed markets. For future researches, we would endeavor to break out the data restrictions. Additionally, we should attempt to find more factors that could influence firm value. With the usage of representative data and accurate variables, we might generalize more comprehensive outcomes in the future.

### Notes

1. This study uses the data over the period 2009–2013 due to 2008 stock market crisis. Additionally, this study also applies the data from 2009 to 2016 because of the updated concern, and the results are almost similar to the results employed in the data period 2009–2013.
2. The empirical analyses are carried out by adopting STATA software and cluster2.ado (stata code) provided by the website of Professor Petersen at Finance Department, Northwestern University ([https://www.kellogg.northwestern.edu/faculty/petersen/htm/papers/se/se\\_programming.htm](https://www.kellogg.northwestern.edu/faculty/petersen/htm/papers/se/se_programming.htm)).
3. An original equipment manufacturer (OEM) is a company that produces parts and equipment that may be marketed by another manufacturer.

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**Corresponding author**

Yi-Rung Cheng can be contacted at: [yirungcheng@gmail.com](mailto:yirungcheng@gmail.com)

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