The effects of IT: from performance to value

Chorng-Shyong Ong and Po-Yen Chen

Information Management, National Taiwan University, Taipei, Taiwan

Abstract

Purpose – The purpose of this paper is to differentiate and define the concepts of firm performance and firm value. Then, the implications of information technology (IT)-enabled firm performance and firm value will be clarified. Finally, the effects of IT capabilities on firm performance and firm value will be compared.

Design/methodology/approach – *InformationWeek*'s IT leader rankings (from 1998 to 2011) are used for analysis in a longitudinal study. Three different test methods (i.e. significant years, significant levels, and adjusted-previous performance) are used.

Findings – It is confirmed that no matter which tests are examined, the contributions of IT capabilities to firm value are all greater than those to firm performance. This also shows that IT contributes to long-term influences more than it does to short-term influences.

Research limitations/implications – This study confirms that firm performance (accounting-based measures) and firm value (financial market-based measures) are two different variables and IT capabilities affect these two parts differently.

Practical implications – Firms should use a long-term viewpoint to deploy their IT strategies. This will create a long-term growth of firm value leading to greater competitiveness, and, ultimately, sustained competitive advantage.

Originality/value – The differences between firm performance and firm value in measurements, characteristics, and implications are specified. The empirical study confirms that IT capabilities contribute more to firm value than to firm performance, although IT capabilities influence both at the same time.

Keywords Firm performance, Firm value, IT capability

Paper type Research paper

1. Introduction

In studies of IT-enabled organization performance, scholars usually use accounting-based measures or financial market-based measures to measure the impact of IT on firms (Bharadwaj *et al.*, 1999). That is, previous studies have used both of these measurement methods to measure organization performance. However, these two methods should be used to measure different concepts and their meanings have not been defined well in previous studies. Therefore, this study further differentiates and defines the concepts of these two measurement methods. Accounting-based measures, including backward-looking measures (Tanriverdi, 2006) and short-term influences (Saeed *et al.*, 2005), are referred to as "firm performance" in this study. Market-based measures, including forward-looking measures (Tanriverdi, 2006) and long-term influences (Saeed *et al.*, 2005), are referred to as "firm value" in this study. It can be seen that obvious differences exist between these two types of measures. These differences are important for both research and practice and should be considered at the same time.

Although some studies have already presented IT to the relation between firm performance and firm value and adopt these two types of indicators to measure the contributions of IT at the same time (Hitt *et al.*, 2002; Ravichandran and Lertwongsatien, 2005; Tanriverdi, 2006), they cannot differentiate these two concepts rigorously and define them clearly. For example, these two types of measurements are considered as representing the same variable (i.e. generalized performance). They are used to strengthen and confirm the effectiveness of IT-enabled firm outcomes. In addition, as shown in the empirical findings of Hendricks *et al.* (2007) and Kohli *et al.* (2012), the results of the two different methods are not the same. This also shows that the two types of measurements should not only represent two different methods, but also represent two totally different variables and mean different things.

Therefore, the implications of IT-enabled firm performance and firm value will also be clarified. And this study believes that IT capabilities simultaneously have effects on two constructs of firms: firm performance (i.e. the short-term influence) and firm value (i.e. the long-term influence). Overall, the importance of this study is to further explore and compare the impact of IT capabilities on firm performance and firm value.

InformationWeek's IT leader rankings are used for analysis in a longitudinal study. Different test methods are used to examine and compare the impact of IT capabilities on firm performance and firm value. Finally, it is confirmed that no matter which tests are examined, the contributions of IT capabilities to firm value are all greater than those to firm performance. This also shows that IT contributes to long-term influences more than it does to short-term influences. Therefore, the firms' considerations about IT adoptions should be re-thought and adjusted.

2. Literature review and research hypotheses
2.1 The differences between firm performance and firm value
Firm performance and firm value are two constructs that have often been adopted to examine IT value in previous studies. However, they have also commonly been confused. In order to clarify the difference between the two constructs, Tam (1998) proposed the hypothesis that IT investment is relevant to firms' business performance ratios and stock market returns in the early years. He suggested that the former represents the ex post evaluation of firm performance and the latter represents the market valuation of return. Later studies have specifically pointed out that scholars usually use accounting-based measures and financial market-based measures to measure the impact of IT on firms' outcomes (Bharadwaj *et al.*, 1999; Dehning and Richardson, 2002; Ravichandran *et al.*, 2009). We further generalize these two types of measures. The characteristics of accounting-based measures can be summarized as historical measures (Bharadwaj *et al.*, 1999), backward-looking measures (Tanriverdi, 2006), measures of firm profitability (Ravichandran *et al.*, 2009), retrospective measures (Kohli *et al.*, 2012), etc. These measures are referred to as "firm performance" in this study. On the other hand, the characteristics of financial market-based measures can be summarized as future measures (Bharadwaj *et al.*, 1999), forward-looking measures (Tanriverdi, 2006), measures of firm valuation (Ravichandran *et al.*, 2009), prospective measures (Kohli *et al.*, 2012), etc. These measures are referred to as "firm value" in this study. In addition, a comparison table (Table I) highlights and summarizes the important differences between firm performance and firm value.

الانارة للاستشارات

Characteristic	IT-enabled firm performance	IT-enabled firm value	Reference
Definition	Ex post evaluation of firm performance Historical measure Firms' current value Short-term influence Backward-looking measures Retrospective firm performance The past performance of assets	Market valuation of return Future measure Firms' future value Long-term influence Forward-looking measures Prospective measures Firms' future development potential	Tam (1998) Bharadwaj et al. (1999) Saeed et al. (2005) Tanriverdi (2006) Kohli et al. (2012) Bharadwaj et al. (1999), Davis et al. (2003), Ravichandran et al. (2009), Saeed et al. (2005), Tanriverdi (2006)
The difference of measurement methods	Only reflect the past information; not forward-looking Not adjusted for risk Not reflect time lag effects Not record the intangible value of assets	Long-term situations Risk-adjusted measure Reflect time lag effects The intangible value of firms' assets	
The indicators of measurement	Accounting-based measures Business performance ratios Firm profitability (e.g. ROA and ROS); operational performance (e.g. the cost of goods sold)	Financial market-based measures Firm valuation Stock market return (e.g. event study); the multiple of stock price (e.g. the market value to book value ratio and the Tobin's q)	Bharadwaj et al. (1999), Dehning and Richardson (2002), Ravichandran et al. (2009), Tam (1998)
Implication	The effective in using IT to support and enhance its core competencies (i.e. profitability and productivity) (Ravichandran and Lertwongsatien, 2005); management effectiveness (Ravichandran et al., 2009) IT support for firm assets Enhancing operational effectiveness	Strategic resource (McFarlan, 1984); industry structure and competitive advantage (Porter and Miller, 1985); firms' intangible value (Bharadwaj et al, 1999); firms' growth (Mitra, 2005) IT support for business strategy Firm's strategic positioning	– Rivard et al. (2006) Tallon et al. (2000)

Table I.
IT-enabled firm
performance vs
IT-enabled firm value

2.2 The difference between the methods of measurements
As for the characteristics of the methods of measurements themselves, firm performance assesses the past performance of assets (Tanriverdi, 2006). It only reflects the past information and is not forward-looking (Bharadwaj *et al.*, 1999). Moreover, firm performance is not adjusted for risk (Bharadwaj *et al.*, 1999), cannot reflect time lag effects, and does not record the intangible value of assets (Davis *et al.*, 2003). Finally, as firm performance is measured by accounting-based indicators, the indicators of profitability performance (e.g. return on assets (ROA) and return on sales (ROS)) have been used most frequently by in previous studies (Tam, 1998; Dehning and Richardson, 2002; Ravichandran and Lertwongsatien, 2005; Tanriverdi, 2006; Hendricks *et al.*, 2007; Ravichandran *et al.*, 2009; Pérez-López and Alegre, 2012). In addition, some studies (Bharadwaj, 2000; Santhanam and Hartono, 2003; Stoel and Muhanna, 2009; Bayo-Moriones *et al.*, 2013) have also used operational performance (e.g. the cost of goods sold), which is the process-level performance for accessing firms' performance. However, overall, firm performance shows firms' current value and can be classified as a short-term influence (Saeed *et al.*, 2005).

On the other hand, firm value captures firms' future development potential and reflects long-term situations (Bharadwaj *et al.*, 1999; Tanriverdi, 2006; Ravichandran *et al.*, 2009). Furthermore, firm value is a risk-adjusted measure (Bharadwaj *et al.*, 1999; Ravichandran *et al.*, 2009) which implies the intangible value of firms' assets (Bharadwaj *et al.*, 1999; Saeed *et al.*, 2005; Ravichandran *et al.*, 2009). Finally, as firm value is measured by market-based indicators, some studies have used pure market indicators (stock price) to measure firm value. For example, Tam (1998), Davis *et al.* (2003), and Hendricks *et al.* (2007) traced the long-term returns of stock price, and Dos Santos *et al.* (1993), Im *et al.* (2001) and Dehning *et al.* (2003) used event studies to capture the immediate reflections of stock price. Some studies have used mixed indicators (i.e. the firm's market value to the accounting-based ratio) to measure the premium levels of firms' stock price. For example, the market value to book value ratio (Anderson *et al.*, 2006; Wang and Alam, 2007; Muhanna and Stoel, 2010) and the Tobin's q (Bharadwaj *et al.*, 1999; Hitt *et al.*, 2002; Tanriverdi, 2006) have commonly been used to measure firm value. Therefore, overall, firm value shows firms' future value and can be classified as a long-term influence (Saeed *et al.*, 2005).

Many previous studies of IT value cannot clearly make a distinction between these two constructs and cannot consider them at the same time. Some studies have only examined the relationship between IT capabilities and firm performance (Bharadwaj, 2000; Santhanam and Hartono, 2003). And some studies have only examined the relationship between IT capabilities and firm value (Wang and Alam, 2007; Muhanna and Stoel, 2010). Therefore, just as Saeed *et al.* (2005) examined the short-term and the long-term influences of EC competences, this study proposes that both the short-term and the long-term influences of IT capabilities should be taken into consideration. Thus, we simultaneously examine the positively impact of IT capabilities on firm performance and firm value and propose the following hypothesis:

H1. Firms with superior IT capabilities (relative to all the other firms in the same industry) will have more excellent firm performance and firm value.

2.3 The implication of IT-enabled firm performance and firm value
Although some previous studies may have confused accounting-based measures (which represent firm performance) and financial market-based measures

(which represent firm value) and deemed them as broad performance (Bharadwaj *et al.*, 1999; Saeed *et al.*, 2005), the term "firm value" has become increasingly common in recent years (Ravichandran *et al.*, 2009; Kohli *et al.*, 2012). Moreover, according to the above literature review, firm performance and firm value should not only be two different methods of measurements, but also be measurements of two different variables. Moreover, they both mean different things. Therefore, we further generalize the implications that each construct represents. As for firm performance, Venkatraman and Ramanujan (1986) and Saraf *et al.* (2007) defined it as "organizational effectiveness in terms of its financial and operation performance". Discussing IT-enabled performance, Ravichandran and Lertwongsatien (2005) propose that performance is "how effective the firm is in using IT to support and enhance its core competencies". And Ravichandran *et al.* (2009) also point out that performance is "a measure of management effectiveness". Overall, we can adopt profitability and productivity, as mentioned by Ravichandran and Lertwongsatien (2005), to recapitulate the implications of firm performance.

As for firm value, its implications are different from those of firm performance (i.e. profitability and productivity). For example, McFarlan (1984) stated that firms should see IT as a strategic resource and raise it to the firm level when thinking about the strategic position of IT. In doing so, new opportunities could be created. Porter and Miller (1985) generalized three effects produced by IT: changing the industry structure and the rules of competition, creating competitive advantages by giving companies new ways to outperform their rivals, and spawning a whole new business, often from within a company's existing operations. Bharadwaj *et al.* (1999) proposed that IT affects firms' intangible value. Mitra (2005) indicated that IT can enable firms' growth. All of these points can be considered as the scope of the effects of IT on firm value. Therefore, if the impact of IT is considered, we can summarize the influences of firm performance as "IT support for firm assets" (Rivard *et al.*, 2006) and "enhancing operational effectiveness" (Tallon *et al.*, 2000), and summarize the influences of firm value as "IT support for business strategy" (Rivard *et al.*, 2006) and "firm's strategic positioning" (Tallon *et al.*, 2000).

In addition, as the issue of IT-enabled innovation has been raised in recent years (Xue *et al.*, 2012; Kleis *et al.*, 2012), innovation has obviously become an important outcome that IT brings for firms. Xue *et al.* (2012) further distinguished the impact of IT on efficiency and innovation. They mentioned that efficiency means using "exiting knowledge to enhance organizational efficiency" and represents the exploitation process, and innovation means to "search for new knowledge, develop new products and service for emerging customers and markets, and enhance innovation performance" and represents the exploration process. Furthermore, efficiency can be generalized as firm performance and innovation can be generalized as firm value in this study.

2.4 The comparison between IT-enabled firm performance and IT-enabled firm value
According to the above literature review, the different implications of firm performance and firm value are further clarified. Martinsons and Martinsons (2002) proposed that if we rethink the value of IT, we can understand not only how IT can improve performance but also how IT can create opportunities and lead to more business value. This shows that the contribution of IT to firm value has been given more attention in recent years. In addition, if we consider empirical studies, Kohli *et al.* (2012) also

pointed out that IT investment has more influences on firm value than it does on firm performance in the medical industry. As the same time, the behaviors that firms use IT to improve their operations and processes (e.g. modularized ERP systems) are usually similar to their competitors in recent years due to the maturation of IT (Carr, 2004). This study also suggests that it is more and more difficult for firms to strengthen their competitive advantage by only using IT to pursue excellent performance. Similar, Mithas *et al.* (2012) also propose that these IT actives that are based on transaction automation and information sharing (i.e. performance-related IT actives) are easier to deploy and they will also create less advantages.

The advantages that superior IT capabilities bring to firm value still remain to be considered. For example, the impact of IT-enabled firms' innovation and strategic positioning is more significant. These activities are relatively heterogeneous and are hard to be imitated (Wade and Hulland, 2004; Piccoli and Ives, 2005). It is difficult to place them into the same mode of IT-enabled advantages. Therefore, although we propose that IT capabilities contribute to the two constructs (i.e. firm performance and firm value) for firms, we believe that the impact of IT capabilities on firm value is greater than the impact of IT capabilities on firm performance. Thus, we propose the following hypothesis:

H2. Firms with superior IT capabilities (relative to all the other firms in the same industry) will gain more competitive advantage from firm value than from firm performance.

3. Methodology

3.1 The measurement of IT capability

Recent research on IT value usually adopts the resource-based view and use IT (information technology) capabilities as the independent variable to explain the contribution of IT to firms (Bhatt and Grover, 2005; Ong and Chen, 2013). Bharadwaj (2000) and Santhanam and Hartono (2003) also adopted *InformationWeek*'s IT leader rankings as the sample source to select firms with superior IT capabilities. Further, they firmly established that firms with superior IT capabilities to their matched firms demonstrate superior firm performance.

Indeed, *InformationWeek* is an important magazine that surveys the use of IT among US companies (Lichtenberg, 1995; Bharadwaj *et al.*, 1999). Further, its IT leader rankings are recognized by many top IS journals (e.g. *MIS Quarterly*, *Management Science*). Bharadwaj (2000) and Santhanam and Hartono's (2003) also believed that the firms in the IT leaders' lists are the most "effective and efficient users of IT" from the viewpoint of quantification and quality and best represent the firms with superior IT capabilities.

3.2 Sample and data collection

This study also uses *InformationWeek* as the sample source. The top 100 IT leader firms listed by *InformationWeek* every September from 1998 to 2011 were collected. In total, there are 1,400 original records (100 firms × 14 years) in Step (a). Then, we follow Steps (b)-(e) to select the final 869 firms as the effectiveness samples. The detailed procedures are shown in Table II.

Step (b). We use the Compustat financial database to collect these firms' financial and accounting data. Among them, because 355 firms are not included in Compustat,

	(a) Original samples (*InformationWeek*)	(b) Included in compustat	(c) Revenue > 1 billion dollar	(d) Complete financial data	(e) 2-SIC matched
Year					
1998	100	82	78	78	78
1999	100	83	72	64	62
2000	100	82	72	71	67
2001	100	77	71	66	65
2002	100	71	66	62	60
2003	100	81	75	74	73
2004	100	71	65	63	63
2005	100	73	64	62	61
2006	100	81	72	70	68
2007	100	78	68	65	62
2008	100	71	58	57	56
2009	100	69	60	60	58
2010	100	64	56	54	52
2011	100	62	51	46	44
Total	1,400	1,045	928	892	869

Table II.
Sample sizes

1,045 firms are retained. In addition, because *InformationWeek*'s lists were published every September, the time period should be adjusted. That is, although the period of the samples is from 1998 to 2011, the period of the financial data that we actually collected is from 1997 to 2010.

Step (c). The criteria that *InformationWeek* used to select leader firms changed. In order to control for the factor of firm scale, the criteria should be consistent. Therefore, we only selected the firms whose revenues were over 1 billion dollars. After this step, a total of 928 firms were retained.

Step (d). Firms without complete data were removed. This step removed 36 firms (most due to no stock related data) with 892 usable leader firms retained.

Step (e). To match control groups, Santhanam and Hartono's (2003) selection method (i.e. firms without superior IT capabilities) was followed. First, all firms that were included in Compustat during the sample period were regarded as the possible samples. Second, the firms that were on the leader lists once during this period and the firms whose revenues were under 1 billion dollars were removed from the possible samples. Third, the remaining firms were assigned to sub-groups according to their industry types (firms whose 2-SIC code is the same are regarded as being in the same industry), and the median of the sub-groups' financial indicators was calculated. Fourth, the leader samples were matched one-to-one to the sub-groups of the control samples according to 2-SIC code. Firm scales and industry types were controlled by these procedures. It was confirmed that the firm scale and the industry structure of the two groups are similar. Finally, the firms that could not be matched by the above method were removed. In total, there are 869 pairs of leader and control firms. These pairs are further examined in the subsequent empirical procedures. In addition, the descriptive statistics are provided in Table III.

3.3 Measures
As mentioned in the literature review, firm performance can be classified as accounting-based measures and firm value can be classified as

Year	Group	Asset		Revenue		Market value	
		Mean	Median	Mean	Median	Mean	Median
1998	Leader	23,451.50	4,433.45	10,934.04	5,405.50	15,325.89	5,945.95
	Control	7,368.14	1,927.80	3,027.39	2,392.02	3,298.87	2,716.46
1999	Leader	37,091.29	10,409.35	19,559.66	7,309.59	31,779.97	8,226.80
	Control	8,022.66	2,110.90	2,776.10	2,356.89	3,178.51	2,047.18
2000	Leader	42,566.94	9,060.26	19,394.08	8,640.00	46,312.19	7,984.17
	Control	7,200.28	2,135.04	2,798.83	2,367.75	2,668.79	1,833.53
2001	Leader	30,168.21	9,201.00	23,438.72	10,080.00	39,829.54	6,723.74
	Control	6,566.93	2,836.95	2,935.32	2,380.58	2,699.48	1,674.05
2002	Leader	39,548.47	10,085.76	17,587.48	7,569.25	25,354.36	11,277.61
	Control	7,166.66	3,084.43	2,949.98	2,347.42	3,210.14	2,713.79
2003	Leader	35,757.88	7,977.00	15,150.68	6,356.00	13,765.57	6,166.60
	Control	9,961.32	3,176.10	3,121.52	2,593.00	2,767.92	2,233.60
2004	Leader	69,754.36	15,463.00	17,541.80	8,194.90	20,498.48	9,986.22
	Control	13,972.76	4,021.50	3,178.32	2,845.78	4,938.64	3,664.00
2005	Leader	66,531.30	12,228.00	17,408.92	8,345.26	20,179.36	10,767.81
	Control	9,803.99	3,227.85	3,182.53	2,604.12	4,359.42	3,490.98
2006	Leader	64,602.57	10,807.90	16,967.19	8,322.65	23,493.12	10,243.30
	Control	9,817.86	3,370.19	2,943.25	2,538.35	4,308.71	3,759.58
2007	Leader	92,168.24	14,923.80	25,851.79	9,650.60	32,622.91	13,106.36
	Control	10,983.56	3,327.97	3,242.42	2,794.92	5,252.75	3,881.02
2008	Leader	45,859.21	12,821.25	17,389.71	8,037.42	24,893.78	9,713.06
	Control	15,651.43	5,838.25	4,420.97	3,176.20	5,390.98	4,098.34
2009	Leader	86,123.25	21,247.25	26,909.96	12,701.65	27,315.76	8,629.42
	Control	16,650.87	3,677.89	4,066.93	3,295.29	3,156.30	2,166.60
2010	Leader	33,106.93	11,847.37	24,823.75	9,593.55	21,645.27	7,914.59
	Control	12,898.34	3,941.63	3,940.24	2,920.97	4,256.27	3,494.93
2011	Leader	114,424.63	12,703.05	32,017.72	10,503.24	28,593.78	12,102.01
	Control	20,214.45	3,449.75	3,722.11	3,119.96	4,512.84	3,371.09

Table III.
Descriptive statistics
(million dollar)

marketing-based measures. Furthermore, for firm performance, ROA and ROS are adopted in this study. These indicators have been commonly used in previous studies (Dehning and Richardson, 2002).

As for the measurement of firm value, the concept of comparing firms' market value and book value has been mentioned most often (Anderson *et al.*, 2006). The market to book value ratio is also the calculation concept of Tobin's q[1] (Hitt *et al.*, 2002). Therefore, this study adopts the market to book ratio to represent firm value. However, two calculation methods are applied at operational level to strength the verification. The first is the market stock price to book stock price (short for PBE). The second is the market value of equity plus liability to book assets (short for PBA). PBE is used to calculate firm value from the viewpoint of pure shareholder value (i.e. equity value). PBA is used to add the concept of liability and adopts the viewpoint of total assets to calculate firm value.

4. Results
4.1 Parameter test
First, a correlation table (Table IV) is provided, which shows that there are indeed some differences between this study's constructs, and each indicator's mean and

| | Leader | | | | Control | | | |
| | Performance | | Value | | Performance | | Value | |
	ROA	ROS	PBA	PBE	ROA	ROS	PBA	PBE
Leader								
Performance								
ROA	1.00							
ROS	0.97	1.00						
Value								
PBA	0.08	0.07	1.00					
PBE	0.06	0.06	0.33	1.00				
Control								
Performance								
ROA	0.05	0.01	0.18	0.05	1.00			
ROS	0.00	0.12	−0.17	−0.02	0.02	1.00		
Value								
PBA	0.03	0.00	0.30	0.10	0.62	−0.05	1.00	
PBE	0.02	0.03	0.24	0.11	0.47	0.17	0.87	1.00

Table IV.
Correlation table

median is shown in Table V. Next, the independent parameter test (Wilcoxon Rank Sum Test) is used to examine the year-by-year differences between the leader groups and the control groups. This method focuses on comparing the relative value of the two groups' ratios rather than the absolute average of two groups' ratios. The results are shown in Table VI.

In Table VI, for firm performance, 26 of all 28 tests of the performance indicators are positive and only two tests (i.e. ROA in 2008; ROS in 2011) are negative but not significant. However, only seven tests of the 26 positive tests are positively significant. This shows that the impact of IT capabilities on firm performance does not meet our expectation. Next, for firm value, all 28 tests are positive and up to 20 tests are significant. Among them, 12 tests are even highly significant (i.e. p-value $<$ 1 percent). Therefore, *H1* is partially confirmed. That is, although IT capabilities positively affect firm performance and firm value at the same time, the relationship between IT capabilities and firm performance is weak.

As for *H2*, the frequencies of the positively significant tests (significant years) are first compared. Obviously, of all the tests of firm value, 20 are significant while only seven of the tests of firm performance are significant. *H2* is preliminarily supported. Next, the levels of significance are discussed and shown in the last column of Table VI. When the levels of significance (p-value) of the two indicators of firm value (i.e. PBA and PBE) are both superior to those of firm performance (i.e. ROA and ROS), this column shows "true". Otherwise, it shows "false". Therefore, it is shown that 11 years out of a total 14 of years are "true" (i.e. IT capabilities contribute to firm value more than firm performance). Moreover, in the other three years (i.e. 2004, 2008 and 2011), the levels of significance of firm value and firm performance are equal.

4.2 Regression test
In addition, in order to further confirm our hypotheses, we use an alternate regression test to examine the overall effects of IT-enabled firm performance and firm value. This approach is similar to Santhanam and Hartono's (2003) method. They proposed that

| | | Firm performance | | | | Firm value | | | |
| | | ROA | | ROS | | PBA | | PBE | |
Year	Group	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)
1998	Leader	4.87	4.68	4.92	4.31	222.36	163.21	381.00	306.23
	Control	4.30	4.94	4.79	4.31	152.78	146.49	245.62	247.15
1999	Leader	4.15	4.24	5.02	5.00	235.98	136.16	482.96	293.76
	Control	3.66	4.36	4.93	4.06	139.12	130.02	222.79	207.25
2000	Leader	5.91	5.53	6.87	5.55	260.75	149.81	354.84	283.23
	Control	3.83	3.79	4.68	4.21	139.90	117.17	205.98	184.29
2001	Leader	4.70	3.86	4.96	4.86	233.15	139.29	426.01	255.69
	Control	3.27	3.38	4.31	4.08	129.32	124.38	186.62	172.26
2002	Leader	− 0.34	3.45	− 0.60	3.79	225.84	161.85	421.11	272.55
	Control	1.99	2.10	2.94	2.39	137.07	130.44	205.87	194.69
2003	Leader	2.50	2.30	3.73	3.15	159.81	125.15	244.94	182.09
	Control	2.22	1.85	3.90	2.84	120.05	110.66	162.65	154.03
2004	Leader	22.25	3.08	20.87	5.30	171.11	138.76	299.25	250.76
	Control	2.83	2.96	5.80	4.56	137.44	133.04	216.04	210.78
2005	Leader	5.34	4.47	8.40	7.34	170.52	146.76	307.87	261.96
	Control	4.26	4.17	6.75	6.80	146.43	140.80	229.59	202.40
2006	Leader	4.28	4.46	6.65	6.77	181.74	156.99	317.09	255.51
	Control	4.35	4.89	7.40	6.85	150.54	151.88	228.98	205.55
2007	Leader	5.89	5.39	8.88	8.08	191.68	156.14	314.16	256.30
	Control	4.78	5.16	7.38	6.15	148.33	142.52	222.88	214.99
2008	Leader	2.36	3.70	6.12	7.17	164.69	126.63	365.45	202.54
	Control	4.03	3.88	6.76	6.70	139.49	129.80	214.34	206.07
2009	Leader	2.88	3.27	4.49	4.59	153.45	131.16	− 54.25	182.22
	Control	3.22	4.05	4.05	4.17	114.37	112.78	136.22	129.77
2010	Leader	6.81	4.58	9.12	6.29	157.93	146.50	297.83	211.10
	Control	3.49	3.14	4.89	5.06	132.34	131.74	183.04	179.05
2011	Leader	4.24	4.38	7.04	5.96	146.57	130.75	263.00	175.18
	Control	3.80	4.09	6.58	5.82	133.05	132.75	179.72	182.11

Table V.
Mean and median

the current performance can be influenced by the prior performance (i.e. a halo effect) and used a more conservative method (regression test) to adjust the previous performance. The model can be stated as:

$$\text{Firm Performance (Value)}_{(t)} = \beta_0 + \beta_1 \text{ Firm Performance (Value)}_{(t-1)} + \beta_2 \text{ Time}_{(dummy)} + \beta_3 \text{ Group}_{(dummy)} + \varepsilon$$

The results are shown in Table VII. Overall, the results is similar to that obtained by our parameter tests. The p-value of the two indicators of firm value is significant (PBA: 0.0129; PBE: 0.0038). But the p-value of the two indicators of firm performance is insignificant (ROA: 0.2820; ROS: 0.2392). The results also show that although IT capability can positively affect both firm performance and firm value, the significant level of IT-enabled firm value is higher than that of IT-enabled firm performance. That is, IT capability's effect on firm value is more observable. Firm value is a better indicator that can more appropriately capture the influence of IT.

	Firm performance		Firm value		Value >
Year	ROA	ROS	PBA	PBE	performance
1998	0.2913	0.4282	0.0078^{***}	$<0.0001^{***}$	True
1999	0.1262	0.2547	0.0230^{**}	0.0002^{***}	True
2000	0.0309^{**}	0.0460^{**}	0.0039^{***}	0.0012^{***}	True
2001	0.0398^{**}	0.2003	0.0038^{***}	0.0008^{***}	True
2002	0.0485^{**}	0.1975	0.0047^{***}	0.0015^{***}	True
2003	0.2061	0.4571	0.1084	0.0333^{**}	True
2004	0.2196	0.0886^{*}	0.3101	0.0256^{**}	False
2005	0.2471	0.1315	0.0911^{*}	0.0182^{**}	True
2006	0.1884	0.3803	0.1122	0.0611^{*}	True
2007	0.1085	0.1724	0.0618^{*}	0.0066^{***}	True
2008	(0.4698)	0.3483	0.4537	0.3504	False
2009	0.2662	0.1724	0.0062^{***}	0.0046^{***}	True
2010	0.0101^{**}	0.0412^{**}	0.1132	0.0699^{*}	True
2011	0.4173	(0.4469)	0.3723	0.3819	False

Table VI.
The results of the
parameter test

Notes: Significance at: *10, **5 and ***1 percent; the value indicates the single tailor p-value of the independent parameter test

		Performance$_{(t-1)}$ or Value$_{(t-1)}$		Time$_{(dummy)}$		Group$_{(dummy)}$	
Variable	Adj-R^2	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Performance							
ROA	0.025	0.6496	$<0.0001^{***}$	0.0008	0.6315	0.0139	*0.2820*
ROS	0.046	0.5512	$<0.0001^{***}$	0.0015	0.2459	0.0122	*0.2392*
Value							
PBA	0.772	0.7906	$<0.0001^{***}$	(0.0119)	0.0003^{***}	0.0660	*0.0129^{**}*
PBE	0.065	0.2550	$<0.0001^{***}$	(0.0735)	0.0465^{**}	0.8484	*0.0038^{***}*

Table VII.
The results of the
alternate regression test

Note: Significant at: *10, **5 and ***1 percent

5. Discussion

This study's empirical findings are similar to the findings of Kohli *et al.* (2012), which also show that IT investment contributes more to firms' market value than do accounting measures. Specifically, their findings show that the impact of IT investment is not significant on the accounting measures. Compared to their study, this study's sample covers various industries and the sample period is longer. This also supports the argument that IT consistently contributes more to firm value than it does firm performance in recent studies. In particular, this study uses different methods to examine the contributions of IT capabilities to firm performance and firm value, and attains consistent conclusions. That is, IT brings about firm value (long-term influences) rather than firm performance (short-term influences) for firms.

In addition, the impact of IT capabilities on firm performance, indeed, does not meet our expectation. Possible reasons may be the limited sample selection, including the small sample sizes, the criteria of 1 billion dollars and the binary data of IT capabilities.

Nonetheless, the impact of IT on firm performance and firm value is compared under the same criteria. The more important thing is to confirm that the effects of firm value are greater than the effects of firm performance.

5.1 Research contributions

As for the academic contributions, this study first reviews independent variables that previous studies adopted in IT value field, clarifies differences between firm performance and firm value, and then generalizes the implications that they represent. Although many studies (Bharadwaj *et al.*, 1999) also adopt different measure methods (i.e. accounting-based and market-based measures) to investigate this issue, they seldom differentiate these methods and measures clearly. This study further clarifies these issues and attempts to confirm that firm performance and firm value are two different concepts and that IT capabilities affect these two variables differently. In addition, this study also compare the implications of IT-enabled firm performance and firm value, and the empirically examine them.

In recent years, of all the capital investments made by US corporations, IT investment has accounted for more than 50 percent (Laudon and Laudon, 2012). The issue of how IT contributes to firms is more and more important. Will IT contribute to firms' short-term performance or long-term value? In contrast to previous studies which only discuss whether IT makes contributions or not, this study further provides a comparison of different contributions. Our empirical results show that IT capabilities contribute more to firm value than to firm performance and suggest that firm value can capture IT-enabled effects well. If firms only use firm performance to capture their IT's contributions, it may be underestimated. Firms should consider these two influences complementally.

5.2 Practical implications

This study uses the secondary data to trace and compare IT-enabled firm performance and IT-enabled firm value over a long period. According to empirical findings, there are two important implications. First, although the effects of IT on firm performance is not significant as our expectation, IT capabilities indeed bring two influences (i.e. IT-enabled firm performance and firm value). If these two influences can be considered complementally, the overall contributions of IT will be more appropriate. Further, only by doing so can we avoid underestimating or wrongly estimating the effects of IT on a firm.

Second, the effects of IT capabilities on firm value is greater than that on firm performance. This argument provides some additional insight for re-thinking the IT value. Firms are encouraged to engage value-related IT activities or projects rather than performance-related IT activities or projects. More specifically, IT strategy role view suggests that IT will enable value only when firms' IT role is "transformative" (not when firms' IT role is "automated" or "informative") (Dehning *et al.*, 2003; Anderson *et al.*, 2006). Therefore, when firms use IT to improve their operational effectiveness (i.e. "automated" and "informative" activities), these advantages will fade as competitors learn and imitate. These improvements are similar to our concept of IT-enabled firm performance. Otherwise, firms should use a long-term viewpoint to deploy their IT strategies (i.e. "transformative" role), which can refer to our concept of IT-enabled firm value. This will create a long-term growth of firm value leading

to greater competitiveness, and, ultimately, sustained competitive advantage. Overall, understanding the differential effects of these two constructs can help practice personage allocate resources among IT activities and projects that differ with respect to these two influences (Mithas *et al.*, 2012).

5.3 Limitations and future research

First, the data of the independent variable was collected from *InformationWeek* and the IT capabilities are binary data type. The information that the data itself provides is not particularly rigorous. For example, the *InformationWeek*'s IT leader may have some biases because this ranking can be influenced by the market value, firm performance, and other factors. However, the secondary data also provide an opportunity to observe the contributions of IT capabilities in the long-term and in various industries. We also attempt to control some important control variables (e.g. firms' scale, industry type, and prior firm performance or value). In addition, three different test methods are used to compare the contributions of firm performance and value. The purpose is to strengthen the effectiveness of the empirical findings.

Next, because firms with revenues exceeding 1,000 million dollars are considered in this study, the empirical findings do not reflect the situation for small firms. Although these SMEs may use IS more effectively, this issue should also be noted as a limitation.

Overall, this study shows the different effects of IT capabilities on firm performance and firm value. However, the independent variable (i.e. IT capabilities) is designed as an integral construct due to the data sources. If overall IT capabilities can be further divided into different types, for examples, IT infrastructure, IT technical and managerial knowledge, and IT integration (Perez-Arostegui *et al.*, 2012), we can further understand which types of IT are more relevant to firm value. Then, firms can adjust their allocation strategy of resources to create more IT-enabled value.

Note

1. Tobin's q has been usually used to measure firm value. Its definition is firm's market value/firm's book's value. The high ratio indicates that stock market is rewarding the firm. Further, firms with high ratio are usually believed that they have more intangible value and growth opportunities. The more details can refer to Bharadwaj *et al.* (1999) and Kohli *et al.* (2012).

References

Anderson, M.C., Banker, R.D. and Ravindran, S. (2006), "Value implications of investment in information technology", *Management Science*, Vol. 52 No. 9, pp. 1359-1376.

Bayo-Moriones, A., Billón, M. and Lera-López, F. (2013), "Perceived performance effects of ICT in manufacturing SMEs", *Industrial Management & Data Systems*, Vol. 113 No. 1, pp. 117-135.

Bharadwaj, A.S. (2000), "A resource-based perspective on information technology capability and firm performance: an empirical investigation", *MIS Quarterly*, Vol. 24 No. 1, pp. 169-196.

Bharadwaj, A.S., Bharadwaj, S.G. and Konsynski, B. (1999), "Information technology effects on firm performance as measured by Tobin's q", *Management Science*, Vol. 45 No. 7, pp. 1008-1024.

Bhatt, G.D. and Grover, V. (2005), "Types of information technology capabilities and their role in competitive advantage: an empirical study", *Journal of Management Information Systems*, Vol. 22 No. 2, pp. 253-277.

www.man

Carr, N.G. (2004), *Does IT Matter? Information Technology and the Corrosion of Competitive Advantage*, Harvard Business School, Boston, MA.

Davis, L., Dehning, B. and Stratopoulos, T. (2003), "Does the market recognize IT-enables competitive advantage?", *Information & Management*, Vol. 40, pp. 705-716.

Dehning, B. and Richardson, V.J. (2002), "Return on investments in information technology: a research synthesis", *Journal of Information Systems*, Vol. 16 No. 1, pp. 7-30.

Dehning, B., Richardson, V.J. and Zmud, R.W. (2003), "The value relevance of announcements of transformational information technology investments", *MIS Quarterly*, Vol. 27 No. 4, pp. 637-656.

Dos Santos, B., Peffers, K. and Mauer, D.C. (1993), "The impact of information technology investment announcements on the market value of the firm", *Information Systems Research*, Vol. 4 No. 1, pp. 1-23.

Hendricks, K.B., Singhal, V.R. and Stratman, J.K. (2007), "The impact of enterprise systems on corporate performance: a study of ERP, SCM, and CRM system implementations", *Journal of Operations Management*, Vol. 25, pp. 65-82.

Hitt, L.M., Wu, D.J. and Zhou, X. (2002), "Investment in enterprise resource planning: business impact and productivity measures", *Journal of Management Information Systems*, Vol. 19 No. 1, pp. 71-98.

Im, K.S., Dow, K.E. and Grover, V. (2001), "Research report: a reexamination of IT investment and the market value of the firm – an event study methodology", *Information Systems Research*, Vol. 12 No. 1, pp. 103-117.

Kleis, L., Chwelos, P., Ramirez, R.V. and Cockburn, I. (2012), "Information technology and intangible output: the impact of IT investment on innovation productivity", *Information Systems Research*, Vol. 23 No. 1, pp. 42-59.

Kohli, R., Devaraj, S. and Ow, T.T. (2012), "Does information technology investment influence a firm's market value? The case of non-publicly traded healthcare firms", *MIS Quarterly*, Vol. 36 No. 4, pp. 1145-1163.

Laudon, K.C. and Laudon, J.P. (2012), *Management Information Systems*, Pearson Press, Upper Saddle River, NJ.

Lichtenberg, F.R. (1995), "The output contributions of computer equipment and personnel: a firm-level analysis", *Economics of Innovation and New Technology*, Vol. 3, pp. 201-217.

McFarlan, F.W. (1984), "Information technology changes the way you compete", *Harvard Business Review*, Vol. 63 No. 3, pp. 98-103.

Martinsons, M.G. and Martinsons, V. (2002), "Rethinking the value of IT, again", *Communication of the ACM*, Vol. 45 No. 7, pp. 25-26.

Mithas, S., Tafti, A., Bardhan, I. and Goh, J.M. (2012), "Information technology and firm profitability: mechanisms and empirical evidence", *MIS Quarterly*, Vol. 36 No. 1, pp. 205-224.

Mitra, S. (2005), "Information technology as an enabler of growth in firms: an empirical assessment", *Journal of Management Information Systems*, Vol. 22 No. 2, pp. 279-300.

Muhanna, W.A. and Stoel, M.D. (2010), "How do investors value IT? An empirical investigation of the value relevance of IT capability and IT spending across industries", *Journal of Information Systems*, Vol. 24 No. 1, pp. 43-66.

Ong, C.S. and Chen, P. (2013), "Information technology capability-enabled performance, future performance, and value", *Industrial Management & Data Systems*, Vol. 113 No. 5, pp. 669-682.

Perez-Arostegui, M.N., Benitez-Amado, J. and Tamayo-Torres, J. (2012), "Information technology-enabled quality performance: an exploratory study", *Industrial Management & Data Systems*, Vol. 112 No. 3, pp. 502-518.

Pérez-López, S. and Alegre, J. (2012), "Information technology competency, knowledge processes and firm performance", *Industrial Management & Data Systems*, Vol. 112 No. 4, pp. 644-662.

Piccoli, G. and Ives, B. (2005), "Review: IT-dependent strategic initiatives and sustained competitive advantage: a review and synthesis of the literature", *MIS Quarterly*, Vol. 29 No. 4, pp. 747-776.

Porter, M.E. and Miller, V.E. (1985), "How information gives you competitive advantage", *Harvard Business Review*, Vol. 63 No. 4, pp. 149-160.

Ravichandran, T. and Lertwongsatien, C. (2005), "Effect of information systems resources and capabilities on firm performance: a resource-based perspective", *Journal of Management Information Systems*, Vol. 21 No. 4, pp. 237-276.

Ravichandran, T., Liu, Y., Han, S. and Hasan, I. (2009), "Diversification and firm performance: exploring the moderating effects of information technology spending", *Journal of Management Information Systems*, Vol. 25 No. 4, pp. 205-240.

Rivard, S., Raymond, L. and Verreault, D. (2006), "Resource-based view and competitive strategy: an integrated model of the contribution of information technology to firm performance", *Journal of Strategic Information Systems*, Vol. 15 No. 1, pp. 29-50.

Saeed, K.A., Grover, V. and Hwang, Y. (2005), "The relationship of e-commerce competence to customer value and firm performance: an empirical investigation", *Journal of Management Information Systems*, Vol. 22 No. 1, pp. 223-256.

Santhanam, R. and Hartono, E. (2003), "Issues in linking information technology capability to firm performance", *MIS Quarterly*, Vol. 27 No. 1, pp. 125-153.

Saraf, N., Langdon, C.S. and Gosain, S. (2007), "IS application capabilities and relational value in inter-firm partnerships", *Information Systems Research*, Vol. 18 No. 3, pp. 320-339.

Stoel, M.D. and Muhanna, W.A. (2009), "IT capabilities and firm performance: a contingency analysis of the role of industry and IT capability type", *Information & Management*, Vol. 46 No. 4, pp. 181-189.

Tallon, P.P., Kraemer, K.L. and Gurbaxani, V. (2000), "Executives' perceptions of the business value of information technology: a process-oriented approach", *Journal of Management Information Systems*, Vol. 16 No. 4, pp. 145-173.

Tam, K.Y. (1998), "The impact of information technology investments on firm performance and evaluation: evidence form newly industrialized economies", *Information Systems Research*, Vol. 9, pp. 85-98.

Tanriverdi, H. (2006), "Performance effects of information technology synergies in multibusiness firms", *MIS Quarterly*, Vol. 30 No. 1, pp. 57-77.

Venkatraman, N. and Ramanujan, V. (1986), "Measurement of business performance in strategy research: a comparison of approaches", *Academy of Management Review*, Vol. 11 No. 4, pp. 801-815.

Wade, M. and Hulland, J. (2004), "Review: the resource-based view and information systems research: review, extension, and suggestions for future research", *MIS Quarterly*, Vol. 28 No. 1, pp. 107-142.

Wang, L. and Alam, P. (2007), "Information technology capability: firm valuation, earnings uncertainty, and forecast accuracy", *Journal of Information Systems*, Vol. 21 No. 2, pp. 27-48.

Xue, L., Ray, G. and Sambamurthy, V. (2012), "Efficiency or innovation: how do industry environments moderate the effects of firms' IT assets portfolios", *MIS Quarterly*, Vol. 36 No. 2, pp. 509-528.

Further reading

Mata, F.J., Fuerst, W.L. and Barney, J.B. (1995), "Information technology and sustained competitive advantage: a resource-based analysis", *MIS Quarterly*, Vol. 19 No. 4, pp. 487-505.

About the authors

Chorng-Shyong Ong is a Professor of information management at National Taiwan University (NTU), Taiwan. He holds a Master's degree in management science and policy studies at TSUKUBA University in Japan. He received his PhD in business administration from NTU. His research interests include IS service quality, web-based services, electronic commerce and strategic management of e-business. He has published papers in *Decision Support Systems*, *Technovation*, *Information & Management*, *Computers in Human Behavior*, *Government Information Quarterly*, and other journals.

Po-Yen Chen is a PhD student of information management at National Taiwan University (NTU). He has ever severed as a senior consultant at PriceWaterHouseCoopers (PwC), Taiwan. He received his MBA in information management for National Taiwan University. His current research interests include IT value, strategic management, e-business, and electronic commerce. He has published papers in *Industrial Management & Data Systems*. Po-Yen Chen is the corresponding author and can be contacted at: poyen.taiwan@gmail.com