Information technology capability and value creation: Evidence from the US banking industry

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Abstract

This paper investigates whether the firm Information technology (IT) capability of a firm can create economic value and competitive advantage. In contrast to past research, which generally assumed that IT investment leads to IT capability that in turn leads to competitive advantage, this study examines IT capability directly. Based on a cross-sectional sample of 155 banking firms, I investigated the main and interactive effects of IT capability and human capital investment on five firm-performance measures. The results of this study indicate that both IT capability and human capital investment contribute directly to the overall value-creation performance of banking firms. Further, the study suggests that IT capability and human capital investment can have a negative interactive effect on the firm’s value creation. A firm’s IT capability should be seen as an integral tool for creating economic value instead of a business infrastructure that makes business operations efficient. The results of this study support the resource-based view of the firm.

Keywords: Information technology; Value creation; Banking; Human resources

1. Introduction

Information technology (IT) has become an essential element of firm capability and a source of sustainable competitive advantage. Although it is widely accepted that IT resources contribute to performance and future growth potential of the firm, the empirical results of the relationship between IT capability and firm performance is still ambiguous.
The unavailability of publicly available data, the accelerated pace of IT innovation, the possible interactive effects between IT and human resources, and the intangible nature of IT capability are among the obstacles that hinder an understanding of whether and how IT can create value for a firm. Another explanation for the inconclusiveness in the literature is that most studies dealing with the impact of IT on firm performance fail to explicitly distinguish (1) IT investments from IT capability, and (2) value creation from firm profitability. This paper addresses those issues and investigates whether IT capability of a firm can create economic value and/or enhance profitability.

Researchers and professionals often assume that investment in IT will lead to gains in both profits and productivity, which in turn creates value for the firm. However, this does not seem to be a straightforward line of reasoning. Many empirical studies that examined the relationship between IT investments and various measures of performance produced mixed results [3]. Investments in IT do not necessarily yield results as anticipated.

Before we can further our understanding of IT value, we must clarify some intermingled concepts commonly used in the IT value literature. First, the concepts of IT investments in IT capability can be divided into two different types that result from two streams of studies and must be distinguished. The former is understood simply as the amount of money a firm invests on IT. However, large IT expenditures by a firm may reflect its inefficient IT operations or poor planning rather than a high level of IT innovation or capability [4]. Firms that invest heavily on IT without developing a corresponding IT capability will find themselves at a comparative disadvantage. As to a firm’s IT capability, the definition by Bharadwaj is useful: “its ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities” [5, p. 170]. Firms with superior IT capability enjoy superior financial performance by bolstering their revenues, increasing productivity, and/or decreasing costs.

Second, efficiency performance measures (such as productivity, returns on equity, and Tobin's Q) differ from effectiveness performance measures (such as economic value-added, market value-added, and IT-enabled strategic options). Much of the earlier research examined the correlations between IT expenditures and measures of profitability. Brynjolfsson and Hitt [6] suggest that the value of IT should be measured by intangible dimensions such as improvements in quality, customer service, and new product development. A key issue facing IT researchers and practitioners is the difficulty of realizing the full potential of IT. Bakos and Kemerer [7] identify three different types of IT values: (1) normative value (based on expected values), (2) realist value (based on observed outcomes) and (3) perceived value (based on subjective user evaluations). Research results dealing with different types of IT values should not be confused.

2. IT capability and firm performance

Although the relationship between IT capability and a firm’s performance has long been an important research topic, conclusive evidence about whether IT contributes to a firm’s productivity is not available [8]. On the one hand, several studies find a positive correlation between IT spending and business profitability. Dewan and Min [9] reported that excess returns to IT investment and excess returns on IT investment are associated with other factors of production, labour, and capital. Mitra and Chaya [10] found that higher IT investments are associated with lower costs. Brown et al. [4] showed that the stock market reacts favourably to announcements about firms that have adopted strategic IT, and those
firms were generally found to be more productive and more profitable. On the other hand, several researchers (e.g., [11,12]), after surveying the literature on the effect of IT capability on productivity, concluded that little evidence is available regarding the payoff from IT investments in terms of increased productivity. IT can influence intermediate variables which in turn can affect profitability. If a firm’s IT investments are productive, then more output is realized for a given quantity of input, leading to increased values that can be distributed among IT investors, suppliers, customers, or other economic agents. Brown, Gatian, and Hicks [4] pointed out a problem in the existing literature on IT value: even though a competitive advantage is obtained, it may not be sustainable if the IT innovation is easily copied by competitors.

In contrast to the ambiguous relationship between IT investment and firm performance, a positive relationship between IT capability and firm performance is consistently reported in the literature. Chircu and Kauffman [13] argue that a firm can obtain a sustainable competitive advantage if it uses IT capability to exploit specific organizational resources that are unique, difficult, or costly to imitate, and if other firms cannot acquire or build them fast enough.

Rooted in the strategy literature, the resource-based view of the firm posits that firms compete on the basis of distinctive core competencies and resources that are valuable, rare, difficult to imitate, and non-substitutable by other resources. A firm with unique organizational resources and capabilities can enjoy superior long-term performance. This view assumes that the strategic resources needed to conceive, choose, and implement strategies different across firms, and the firm differences remain stable over time. Strategic resources cannot be easily imitated while they are protected by several isolating mechanisms such as time compression diseconomies, historical uniqueness, embeddedness, and causal ambiguity. Just like other intangible valuable resources, such as intellectual properties and human capital, the IT infrastructure of the firm, as the most important element of structural capital, is a value driver of the present world.

IT plays an increasingly important role in almost all aspects of the firm’s operations and corporate strategies, and for almost all industries IT is considered a major if not the most important strategic asset. Information systems researchers have identified various other IT-related resources that serve as important sources of competitive advantage [5]. IT capability can increase a firm’s ability to control overdispersed operations, improve information quality for decision making, and better track costs and profits. Sambamurthy, Bharadwaj, and Grover contend that IT investments and capabilities influence the firm’s ability to launch “many and varied competitive actions and that, in turn, these competitive actions are a significant antecedent of firm performance” [14, p. 237]. This enables the firm to achieve scale economies and lower its average total cost per unit output [10]. It is critical to develop the measures of IT capability in order to apply the resource-based approach to assess the impact of IT on firm performance. Bharadwaj [5] reports that firms with high IT capability tend to outperform a control sample of firms on a variety of profit and cost-based performance measures.

Drawing from the literature, the following hypothesis is proposed:

**Hypothesis 1.** A firm’s IT capability should be beneficial to its performance in the long run.

Davern and Kauffman [15] contend that IT value is evaluated in the context of complementary human capital that influences the firm’s realization of IT value. They point
out that there are organizational barriers that can limit the potential value of IT. A firm’s IT strategy should incorporate a human dimension that facilitates organizational learning as a key determinant of IT success. Therefore, it is important to take into account the influential factors of human resources or human capital when evaluating the contribution of IT to a firm’s performance.

People create the value of the firm. Superior value is created by excellent people. Modern firms cannot generate value without the ideas, skills, and leadership of knowledge workers. In today’s economy, value is largely the product of information and knowledge. According to Brockbank, human resources management can proactively create “competitive advantage by creating cultures of creativity and innovation, by facilitating mergers and acquisitions, and by linking internal processes and structures with ongoing changes in the marketplace” [16, p. 337]. To add greater competitive advantage, the human resources function must contribute to the strategic value. It is human capital that is the basis of value, and conventional financial capital has taken the form of generic assets that do not necessarily create value for shareholders [17]. Firms desiring to develop sustainable competitive advantages from core competencies must focus on attracting, developing, motivating, and retaining excellent employees, where “excellence” is defined in terms of performance in the pursuit of a firm’s strategic objectives. Firms should reward employees who have demonstrated superior skills at creating values [18].

Bassi et al. [19] stress the importance of human capital investments, such as training and organizational development, to enhance the firm’s financial performance as economic value becomes increasingly dependent on knowledge-based assets. Recent research highlights the importance of investing in human capital. For example, Hitt et al. [20] find evidence to support the arguments of some management scholars regarding the importance of human capital to firm outcomes [21]. Investments on human resources could enhance returns from employees’ discretionary efforts, which would in turn, lead to economic payoffs that are greater than the relative increase in human resource costs incurred. Several other studies have reported positive associations between human resource efforts and firm performance [22].

Drawing from the literature, the following hypothesis is proposed:

**Hypothesis 2.** A firm’s investments in its human capital should be beneficial to its performance in the long run.

Davern and Kauffman [15] recognize that there are internal and external moderators or “value-conversion contingencies” for IT value. In the same vein, Lejeune and Roehl [23] contend that new hard elements in information systems alone cannot be the competitive advantages of the firm. To take better advantage of hard information technologies, the firm should combine those technologies with their company-wide organizational skills in unique ways. Substitutable and complementary assets must be taken into account when examining the value of IT investments. Human capital investment interacts with IT capability to jointly affect the firm’s value. Although IT rapidly advances and diffuses in almost all industries, there is a substantial heterogeneity among industries in terms of IT infrastructure and IT human capital investment.

Large firms have a greater need for IT than smaller firms because of their higher costs for communication, control, and monitoring. Therefore, larger firms tend to spend more on IT (as a percentage of their revenue) than smaller firms, which derive little benefit from a reduction in such costs. Ang et al. [24] report that large firms pay more than small firms
to IT employees with more education, while small firms pay more than large firms to IT professionals with less education. Brynjolfsson and Hitt [25] consider how investments in IT are linked to productivity enhancement and organizational transformation. They argue that IT enables complementary organizational investments, such as business processes and work practices, and that these investments lead to increased productivity [25].

There are two different views on how human capital can interact with IT capability. On the one hand, IT may be a substitute for ordinary factors of production, such as unskilled labour [9]. IT is taking over operating and administrative tasks that knowledge workers feature in today’s organizations. Bakos and Brynjolfsson [7] point out that IT enhancements give suppliers an incentive to be more responsive and innovative in exchange for a fair share of the surplus generated in IT-enhanced transactions. On the other hand, IT can also be a complement to more specialized factors of production, such as knowledge workers and flexible manufacturing processes [26].

In some cases, firms are unable to realize the full value of their IT investments because they fail to simultaneously invest in the complementary assets that are necessary for obtaining benefits. Brynjolfsson and Hitt [25] suggest that IT investments sometimes require larger and more time-consuming investments in organizational change. Therefore, firms that adopt more IT innovations tend to use more skilled labour. Knowledge workers are the primary consumers of IT [27]. A firm with more knowledge workers is likely to spend more on IT and have more overhead expenses [10]. Wolff [28] states that the effects of IT on labour demand are greater when IT is combined with particular organizational investments, highlighting the importance of IT-enabled organizational change. This line of reasoning suggests that the interaction effects of IT capability and human capital should be positive.

However, there are also arguments to support the negative interaction effects between IT capability and human capital. The growth of IT capability has enabled firms to tap into global labour markets. Ang et al. [24] report that IT-intensive firms pay more than non-IT-intensive firms to IT professionals with IT-specific education. Bresnahan et al. [29] also found that firms adopting IT innovations tend to use more skilled labour, and the effects of IT on labour demand are greater when combined with organizational investments. A firm spending more on IT can achieve lower clerical labour costs than those spending less on IT. Human capital may affect the implementation of firm IT strategies and the relationship may be very complex.

Because the interaction effects between IT capability and human capital are included in the literature, the following two alternative hypotheses are proposed.

**Hypothesis 3A.** There is a positive interaction between IT capability and human capital investment on a firm’s performance.

**Hypothesis 3B.** There is a negative interaction between IT capability and human capital investment on a firm’s performance.

### 3. Methodology

#### 3.1. Data source and sample

The banking industry is very information intensive, and innovative uses of IT can be vital to the success or failure of firms in the industry [30]. The impact of IT capability on
firm performance can vary across industries and countries. My research scope focused mainly on US public banking firms. Yousafzai et al. [31] investigated the importance of IT adoption in the financial services industry by looking into the elements of trust and risk in e-banking. My research subjects are public banks with four-digit standard industrial classification (SIC) codes of either 6021 or 6022. Theories and empirical results can be better compared and validated despite different research frameworks and methods if the same set of data sources are used.

Unfortunately, among the data sources used in the literature that have firm-level IT data, only a few databases are publicly available. My research primarily utilized information publicly available in Information Week’s 500 survey, published annually from 1995 to 1999, as its source of IT capability data. The data are from a survey conducted by Computer Intelligence Info Corp., which ranks among the top 500 corporate users of IT. The rankings are determined based on the number of personal computers, LANs, and mainframe computers currently installed and planned purchases by those firms interviewed. The survey data are probably the most widely used data source for IT performance research [1]. Like other databases, the companies listed in the Information Week 500 vary from year to year. To test the proposed hypotheses, we needed a set of banking firms with IT ranking data. These firms also had to be publicly traded so that their financial data could be obtained using the widely available Compustat database.

I first gathered the financial data of US banking firms from the Compustat database. Only those banking firms with the average total assets larger than $1 billion were selected. The database contained 174 banking firms of that size with an SIC code of 6021 or 6022 during the period 1995–1999. Of those firms, 155 had the completed financial data needed for analysis. Of the 155 firms, 87 firms were in SIC 6021 and 68 firms in SIC 6022. Only 26 had been listed on the Information Week 500 during the same period. Data from those 155 firms were used to test the proposed hypotheses. The average total assets of the data samples were US$ 21.37 billion, and the average number of employees was 6988.

3.2. Dependent variables

Brown et al. [4] argue that studies utilizing single measures in single years are problematic because it is unclear when the economic value of IT investment will materialize. Investing in knowledge capital and IT plays an important role in improving organizational competitiveness. [32] Using multiple performance measures for multiple years is a more reasonable approach to study the value of IT. Value-based measures of performance (i.e., economic profit or residual income and market-to-book value) instead of accounting ratios (such as return on assets) provide a holistic perspective on the value and contribution of intangible assets [33].

There are three categories for measuring IT value creation:

(1) **Profitability**: Return on investment (ROI), return on equity (ROE), and return on assets (ROA) are all closely related and widely accepted profitability measures used by internal management and external analysts to evaluate firm performance.

(2) **Effectiveness**: Commonly used effectiveness measures are Tobin’s Q and market-to-book value.

(3) **Total-amount value created**: Examples are economic value added (EVA) and market value added (MVA).
All three categories will be used in the multiple linear regression models. Five performance measures are included: ROE, MVA, EVA, Tobin’s Q, and market-to-book ratio.

ROE is used because it measures a firm’s ability to generate profits from equity without regard to how those assets are financed.

EVA refers to net operating profit after tax less a capital charge for the invested capital employed in the business [34]. Over the past decade, consultants, the popular business press, a number of companies, and a few investment analysts have lauded the EVA approach to evaluating firm performance. Researchers believe that EVA suits both traditional businesses and knowledge-based businesses [35]. Ehrbar [36] suggests that EVA should be used in financial management and incentive compensation systems to measure performance, shape decisions, and motivate employees. EVA as a performance measure has been adopted by a rapidly growing number of firms and gained acceptance in mainstream finance textbooks [35]. However, most empirical work does support the arguments of EVA proponents that it is the best measure of a firm’s success in adding value to shareholders. Mitra and Chaya [10] also found that larger firms spend more on IT as a percentage of their revenue than smaller firms.

MVA values were calculated as the market value of equity minus invested capital. The EVA values were calculated as net operating profit less adjusted taxes (NOPLAT) minus (invested capital*WACC) where WACC is the sum of the weighted cost of debt (net of taxes) and the weighted cost of equity.

The reactions of stock market investors provide a useful perspective on the value creation and growth potential of IT infrastructure investments [37]. Tobin’s Q and market-to-book value are the two best-known indicators of intellectual capital stock [38]. Accounting-based measures of firm performance tend to ignore IT’s contribution to performance dimensions such as strategic flexibility and intangible value. Therefore, Bharadwaj et al. [1] propose that Tobin’s Q is appropriate for evaluating the results of IT investments since it is a forward-looking measure featuring a firm’s future performance potential. They show that IT investments have a significantly positive association with Tobin’s Q. Market-to-book ratio is another widely used measure of firm performance in the IT and human resources management literature [39]. Tobin’s Q ratio is associated with the quality of investment opportunities. However, Tobin’s Q can give a false indication of overvaluation of knowledge-based firms. A simplified formula for approximating Tobin’s Q requires only publicly available financial and accounting information. Approximate Q can explain at least 96.6% of the variability of Tobin’s Q. Approximate Q is defined as (MVE + PS + DEBT)/TA, where MVE is the product of share price and common stock shares outstanding, PS is the liquidating value of outstanding preferred stocks, DEBT is the value of the firm’s short-term liabilities net of its short-term assets, plus the book value of the firm’s long-term debt, and TA is the total assets of the firm.

3.3. Explanatory and control variables

Well-chosen IT can reduce labour costs by replacing clerical workers in the payroll, order processing, bookkeeping, and purchasing departments. A firm’s employees can collectively be a unique source of competitive advantage that cannot be easily imitated by its competitors. Core human assets often require continual internal development. Therefore, investments in firm-specific human capital can further increase the difficulty
of cross-company imitation. Employees can add value if they help firms lower costs or provide increased benefits to customers. Firm-specific human capital and employee skills often involve idiosyncratic learning processes that the firm is not likely to find in the open labour market.

Therefore, this study measured human capital investment as a firm’s labour and related expense divided by the number of its employees. The Information Week 500 ranking of the focal firm was taken directly as the proxy for reverse IT capability, whereas those firms not on the ranking list were coded as 700. Then I standardized the 5-year average of the two variables as explanatory variables to test the proposed hypotheses. The control variable, total assets, was taken directly from the Compustat database to control the possible variance caused by differences in firm size.

4. Results

Of the 154 banking firms, eight firms had missing values in market/book ratios. Human capital investment and reverse IT capability were standardized with a zero mean and a unity standard deviation. Table 1 shows the descriptive statistics and the correlation matrix for the sample. In general, correlation coefficients are moderate and do not violate the assumption of independence between explanatory variables. Table 2 presents the results of five multiple linear regression models. Models 1 and 2 include two total-amount value measures, MVA and EVA, as the independent variables measuring firm performance. The two performance measures, Tobin’s Q and market-to-book ratio, were used as independent variables in Models 3 and 4, respectively. In Model 5, the profitability performance measure, ROE, is the independent variable of the model. The five models were also used to test the previously proposed hypotheses and the results were compared.

The F-statistics of Models 1 and 2 are 136.38 and 255.04 with R² values of 0.784 and 0.872, respectively. The F-statistics of Models 3 and 4 are 6.39 and 10.84 and the R² values are 0.146 and 0.233, respectively. The F-statistic of Model 5 is 7.45 and the R² value is 0.165. In general, the five models achieve a satisfactory level of explanatory power of the corresponding performance measures. Models 1 and 2 have relatively higher R² value because the control variable, total assets, is positively associated with MVA and EVA and accounts for the largest portion of variance. Models 3 and 4 show that the relationship between total assets and effectiveness performance is negative. In Model 5, this

<p>| Table 1 |
| Descriptive statistics and correlation table |</p>
<table>
<thead>
<tr>
<th>N = 155</th>
<th align="right">Mean</th>
<th align="right">Std.</th>
<th align="right">(1)</th>
<th align="right">(2)</th>
<th align="right">(3)</th>
<th align="right">(4)</th>
<th align="right">(5)</th>
<th align="right">(6)</th>
<th align="right">(7)</th>
<th align="right">(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) ROE</td>
<td align="right">14.19</td>
<td align="right">3.39</td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
</tr>
<tr>
<td>(2) Market/book</td>
<td align="right">2.50</td>
<td align="right">0.85</td>
<td align="right">0.70</td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
</tr>
<tr>
<td>(3) MVA</td>
<td align="right">2195</td>
<td align="right">4963</td>
<td align="right">0.35</td>
<td align="right">0.31</td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
</tr>
<tr>
<td>(4) EVA</td>
<td align="right">246.68</td>
<td align="right">651.93</td>
<td align="right">0.27</td>
<td align="right">0.13</td>
<td align="right">0.79</td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
</tr>
<tr>
<td>(5) Tobin’s Q</td>
<td align="right">1.11</td>
<td align="right">0.07</td>
<td align="right">0.66</td>
<td align="right">0.89</td>
<td align="right">0.25</td>
<td align="right">0.02</td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
<td align="right"></td>
</tr>
<tr>
<td>(6) Total assets</td>
<td align="right">21,374</td>
<td align="right">59,985</td>
<td align="right">0.21</td>
<td align="right">0.07</td>
<td align="right">0.86</td>
<td align="right">0.93</td>
<td align="right">−0.03</td>
<td align="right"></td>
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<td align="right"></td>
</tr>
<tr>
<td>(7) IT capability (RIT)</td>
<td align="right">0.00</td>
<td align="right">1.00</td>
<td align="right">0.23</td>
<td align="right">0.22</td>
<td align="right">0.58</td>
<td align="right">0.58</td>
<td align="right">0.12</td>
<td align="right">0.58</td>
<td align="right"></td>
<td align="right"></td>
</tr>
<tr>
<td>(8) Human capital investment</td>
<td align="right">0.00</td>
<td align="right">1.00</td>
<td align="right">0.38</td>
<td align="right">0.44</td>
<td align="right">0.46</td>
<td align="right">0.41</td>
<td align="right">0.29</td>
<td align="right">0.43</td>
<td align="right">0.40</td>
<td align="right"></td>
</tr>
<tr>
<td>(9) HC × IT</td>
<td align="right">0.40</td>
<td align="right">1.64</td>
<td align="right">0.12</td>
<td align="right">0.12</td>
<td align="right">0.44</td>
<td align="right">0.53</td>
<td align="right">−0.02</td>
<td align="right">0.59</td>
<td align="right">0.67</td>
<td align="right">0.39</td>
</tr>
</tbody>
</table>
relationship is insignificant. These results suggest that economy of scale to firm size may not exist in all the performance measures after considering the effects of human capital and IT capability. I, therefore, surmise that the benefits derived from human capital investment and IT capability can be the major sources of competitive advantage for large banking firms instead of their size.

### 4.1. Tests of Hypothesis 1

Hypothesis 1 predicts that the relationship between IT capability and firm performance will be positive. Results from all five models support this hypothesis. The regression coefficients of reverse IT capability of those five models are negative with t-statistics of $3.696$, $2.387$, $2.14$, $2.057$, and $1.559$, respectively. Except for the coefficient of Model 5, which is negative but insignificant, all coefficients have reached a significance level of 0.05. Reverse IT capability is a reverse index of a firm’s IT capability. Therefore, the IT capability of banking firms positively contributes to firm performance as measured by different performance indicators. The technical IT infrastructure of telecommunications, computers, software, and data should be integrated and interconnected so that the information can be routed efficiently and effortlessly through the communication network and redesigned processes. The positive relationship between IT capability and firm performance is consistent with recent studies by Chatterjee et al. [37]. That is, the general theme of the present study and several recent studies is that a firm with superior IT capability exhibits superior current and sustained firm performance.

### 4.2. Tests of Hypothesis 2

Hypothesis 2 predicts that the relationship between human capital investment and firm performance will be positive and results from all the five models strongly support this hypothesis.

### Table 2
Regression models for the value creation performance of banking firms

<table>
<thead>
<tr>
<th>Performance measures</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersect</td>
<td>1002.6**</td>
<td>46.75*</td>
<td>1.118***</td>
<td>2.57***</td>
<td>14.24***</td>
</tr>
<tr>
<td></td>
<td>−4.77</td>
<td>−2.19</td>
<td>−192.12</td>
<td>−36.94</td>
<td>−50.67</td>
</tr>
<tr>
<td>Total assets</td>
<td>0.068**</td>
<td>0.0099***</td>
<td>−2.39 × 10$^{-7}$</td>
<td>−2.82 × 10$^{-6}$</td>
<td>3.98 × 10$^{-6}$</td>
</tr>
<tr>
<td></td>
<td>−16.48</td>
<td>−23.466</td>
<td>(−2.077)</td>
<td>(−2.084)</td>
<td>−0.712</td>
</tr>
<tr>
<td>Human capital Investment (HC)</td>
<td>538.36*</td>
<td>4.364</td>
<td>0.025***</td>
<td>0.404***</td>
<td>1.18***</td>
</tr>
<tr>
<td></td>
<td>−2.253</td>
<td>−0.202</td>
<td>−4.251</td>
<td>−5.789</td>
<td>−4.12</td>
</tr>
<tr>
<td>IT capability (ITC)</td>
<td>994.8***</td>
<td>65.06*</td>
<td>0.0159*</td>
<td>0.171*</td>
<td>0.563</td>
</tr>
<tr>
<td></td>
<td>−3.696</td>
<td>−2.387</td>
<td>−2.14</td>
<td>−2.057</td>
<td>−1.559</td>
</tr>
<tr>
<td>HC × ITC</td>
<td>−682.8***</td>
<td>−29.32+</td>
<td>−0.0083+</td>
<td>−0.047</td>
<td>−0.356</td>
</tr>
<tr>
<td></td>
<td>(−4.153)</td>
<td>(−1.761)</td>
<td>(−1.822)</td>
<td>(−0.383)</td>
<td>(−1.62)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.784</td>
<td>0.872</td>
<td>0.146</td>
<td>0.233</td>
<td>0.165</td>
</tr>
<tr>
<td>$N$</td>
<td>155</td>
<td>155</td>
<td>155</td>
<td>147</td>
<td>155</td>
</tr>
<tr>
<td>F-statistic</td>
<td>136.38</td>
<td>255.04</td>
<td>6.393</td>
<td>10.84</td>
<td>7.449</td>
</tr>
</tbody>
</table>

$+p<0.1$  $*p<0.05$  $**p<0.01$  $***p<0.001$. 

The regression coefficients of reverse IT capability of those five models are negative with t-statistics of $3.696$, $2.387$, $2.14$, $2.057$, and $1.559$, respectively. Except for the coefficient of Model 5, which is negative but insignificant, all coefficients have reached a significance level of 0.05. Reverse IT capability is a reverse index of a firm’s IT capability. Therefore, the IT capability of banking firms positively contributes to firm performance as measured by different performance indicators. The technical IT infrastructure of telecommunications, computers, software, and data should be integrated and interconnected so that the information can be routed efficiently and effortlessly through the communication network and redesigned processes. The positive relationship between IT capability and firm performance is consistent with recent studies by Chatterjee et al. [37]. That is, the general theme of the present study and several recent studies is that a firm with superior IT capability exhibits superior current and sustained firm performance.

### 4.2. Tests of Hypothesis 2

Hypothesis 2 predicts that the relationship between human capital investment and firm performance will be positive and results from all the five models strongly support this hypothesis.
The regression coefficients of reverse IT capability of the five models are negative with $t$-statistics of 2.253, 0.202, 4.251, 5.789, and 4.12, respectively. Except for the coefficient of Model 2, which is positive but insignificant, all regression coefficients have reached at least a significance level of 0.05. Especially for Tobin’s Q, market-to-book value, and ROE, the impact of human capital investment is highly significant ($p < 0.001$). One way to interpret the positive relationship is that high-quality employees generate high economic value to the firm. For example, Bassi et al. [19] stress the importance of human capital investment, such as training and organizational development, for improving the firm’s performance as economic value becomes increasingly dependent on knowledge-based assets. On the other hand, one can also argue that employees receive better salaries and benefits because banking firms are making money. Although I could not confirm the causal relationship between investments in human capital and firm performance, human capital investment, at least, is positively associated with firm performance measured by a variety of performance indicators. The positive relationship is consistent with several earlier studies that found human resource investments and efforts were positively associated with firm performance. For instance, Hitt et al. [20] found evidence to support the arguments of some management scholars about the importance of human capital to firm outcomes [21]. Investments in human resources can enhance the return from employees’ discretionary efforts, which would in turn lead to economic payoffs that are greater than the relative increase in human resource costs incurred. Successful acquisitions require managers with experience and ability to acquire information and then do effective planning for transactions [40].

4.3. Tests of Hypotheses 3A and 3B

Alternative Hypotheses 3A and 3B predict the possible interaction effects of IT capability and human capital investment on firm performance. Results from Models 1, 2 and 3 support Hypothesis 3B.

Actually, the regression coefficients of interaction term, $HC \times C2RIT$ are positive in all five models with $t$-statistics of 4.153, 1.761, 1.822, 0.383, and 1.62, respectively. Except for the coefficient of Model 1, the regression coefficients of the interaction term did not reach the significance level of 0.05. Reverse IT capability is a reverse index of a firm’s IT capability. Therefore, there is a negative interaction effect between human capital investment and IT capability. This means that IT and human capital can, to some degree, substitute for each other. The marginal benefits of IT capability decrease when the firm has high-quality human capital. Both are important sources of intangible capital and can be seen as long-term investments in intangible assets, which reflect the firm’s market value. The negative relationship between IT capability and human capital investment may also reflect the fact that valuable knowledge assets of the firm are not easily codified and replaced with IT. Another interpretation of the negative interaction effect can be the benefits of increasing human capital investment, which will be lower when the firm has high IT capability. The interaction terms in Models 4 and 5 are not significant and have a sign that is consistent with Hypothesis 3B. That is, Hypothesis 3B is partially supported, whereas there is no evidence supporting Hypothesis 3A. Therefore, the interaction effect of human capital investment and IT capability is possibly negative.
5. Conclusion

The results of this study have implications, both theoretical and practical, for the field of strategic IT management. First, the findings help to substantiate the view that a firm’s IT capability is crucial for its competitive advantage. Specifically, the evidence showed that IT capability contributes to the total-amount and effectiveness measures of value-added over a 5-year period. Lawler [18] contends that the growth of knowledge and IT has increased performance pressures on organizations. Li and Collier [41] also find that IT directly affects the quality and financial performance of hospitals. However, Tam [42] uses data from four newly industrialized economies to develop a market-valuation model based on Tobin’s Q, and the results suggest that IT investments are not correlated with return to shareholders. This study distinguishes IT investments from IT capability. A firm that invests heavily in IT may be reflecting its ineffectiveness in IT management. By adopting the IT 500 ranking provided by Information Week, a professional IT magazine, it may be possible to reconcile many of the inconsistent empirical findings in the IT management literature (such as Bharadwaj et al. [1]). Based on my findings, I believe that IT capability forms the basis of competition for firms in information-intensive industries like banking, retailing, and high-tech manufacturing.

Second, the results also suggest that human capital is a valuable form of intellectual assets that contribute positively to firm performance over the long term. These findings are consistent with several recent studies published in the literature on human capital. Several other studies have also reported positive associations between human resource efforts and firm performance [22]. In this study, I use the ratio of labour and related expense divided by the number of employees as a proxy for human capital. The results that are consistent with the literature strengthen the usefulness of the proxy of human capital.

Third, the findings partially support the view that IT capability and human capital investment can jointly affect firm performance, and the interaction effect is negative. The results parallel with those of Dewan and Min [9]—that IT increasingly displaces other inputs in the production of goods and services. There might be a trade-off between the two types of intellectual capital, IT capability and human capital. Furthermore, after considering the effects of IT capability and human capital investment, the effect of firm size on shareholder value (measured by Tobin’s Q and market-to-book value) becomes significantly negative. Therefore, I surmise that the economy of scale observed in the banking industry can largely reflect that larger banking firms are in a better position to tap into advanced IT and high-quality human capital. In addition to traditional explanations such as the effect of risk pooling and sharing of fixed costs, the results shed new light on how large banking firms can enjoy competitive advantage.

This study has some important managerial implications. The results confirm the resource-based view that firms compete on the basis of distinctive core competencies and resources that are valuable, rare, difficult to imitate, and non-substitutable by other resources. IT capability and human capital are the two most important strategic resources for firms in information-intensive industries. Managers must resort to internal intellectual capital for competitive advantage in the face of deregulation, escalating customer expectations, and global competition. IT investments might fluctuate due to environmental forces and the firm’s profitability. Human capital investment is a relatively stable form of value added to an organization’s capability [43]. IT capability and human capital are powerful strategic weapons, which managers should not overlook although it might take a
long time to harvest such investments. In order to create premium value in knowledge-intensive industries, firms should invest continually in both technology and human resources. Therefore, a long-term perspective is required for corporate IT and human capital strategies. Managers also need to consider the potential trade-offs between the two important resources.

My research complements the existing work on IT capability (investments) and human capital. To the best of my knowledge, it is one of the first few studies that attempts to link the two streams of research. The results point to an interesting direction for research on how to integrate IT and human capital into a successful corporate competitive strategy.

6. Further research

The data used in this study has some distinct advantages. It informs understanding of the importance of IT capability and human capital investment for large banking firms. Perhaps some of the most fruitful future opportunities for IT and human resources management may lie in further research on IT capability and value-creation evaluation.

The most obvious drawback of using the present sample of banking firms is that it raises questions about the generalizability of these findings to smaller financial firms. Although the results of this study are statistically significant, they might be even stronger with the use of a larger sample of the entire population of IT-intensive firms. In addition to a restricted performance range, large banking firms obviously have far greater financial resources and more legitimacy than do the average IT-based firms.

Although the use of collected archival data has benefited this paper, it is also a major limitation on investigating the possible impacts of organizational and non-financial factors on firm performance. Future research is needed to investigate the details implied by the results of this study. For example, reasonable assumptions were made that firms investing heavily on IT and human capital were creating advantages in firm-specific capabilities. Research using case studies and primary data with questionnaire surveys can shed light on the IT and human-capital strategy formulation and implementation process. Differences related to national culture as well as corporate strategic intention should be further scrutinized. Differences related to the nature of information systems should be another interesting research topic. Richer data might shed additional light on the importance of how firms can use IT and e-business technologies to leverage their intellectual capital. Future research may also try extending the scope of IT capability considered beyond the overall IT resources. Consequently, future research can be directed towards IT and human-capital strategy formulation processes as well as towards political, cultural, structural, or other institutional influences on a firm’s intellectual capital investments.

Another interesting future research direction would be the social impacts of IT and human capital. For example, research on how IT and human capital investments impact on employee communication networks, inter-firm relationships, and customer satisfaction deserve more attention. This paper contributes to the IT management and human capital literature by providing evidence of a strong relationship between the strategic use of IT and human capital and value creation. It supports the resource-based theory and lays the groundwork for future empirical research on IT capability and human capital investment.
References

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