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UNDERSTANDING THE IMPACT OF IT SERVICE INNOVATION ON FIRM PERFORMANCE: THE CASE OF CLOUD COMPUTING

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Abstract

Recently we have witnessed a new kind of IT advancement. It is a phenomenon where various types of IT capabilities are centralized into data centers to ensure that such resources are available wherever and whenever they are needed. Cloud computing is the latest version of IT service practice reflecting such new IT trends. Although cloud computing is considered a paradigm shift of IT service design and delivery in IS communities and intrigues large amounts of interest from business entities, few studies have examined this new IT and business phenomenon. To better understand the organizational application of cloud computing, the current study aims to investigate economic payoff from cloud computing investment. Employing the event study methodology, we analyze 183 firm-level announcements regarding cloud computing adoption. The results indicate that cloud computing adoption announcements are associated with positive increases in the market value of the firm. In addition, we identified differences in the effect of cloud computing adoption on market returns according to strategic adoption intention, firm size, and industry sector. These results can be used as useful references for the firm's decision-making about whether, when, and how to adopt cloud computing to maximize its business value.

Keywords: Cloud computing, event study, market value of firm, service innovation.

1 INTRODUCTION

In today's highly competitive and global business environment, firms face a difficult set of challenges in their efforts to improve their strategic and technological agility as well as reduce the complexities of their business operations to sustain their business competence. Cloud computing leverages modern information technologies into a new business computing environment in response to the growing need for greater business integration, flexibility, and agility. As such, cloud computing is an innovative way to provide various on-demand IT services to multiple clients by using Internet technologies in a pay-per-use manner (Armbrust et al. 2009; Plummer 2008). Cloud computing is not limited to technology or technical infrastructure; rather, it reflects a new way in which IT can be used more strategically in business value creation. Therefore, initiating cloud computing encourages practitioners and IT researchers to better understand how its potential benefits can be maximized and address the problems inherent in successfully developing and implementing new IT innovation in the organization.

Although the real application of cloud computing in the business environment has recently emerged (Staten 2008), few studies have examined this new IT and business phenomenon. The situation has left many untapped areas of research and will continue to do so as the cloud applications evolve over time. How can we have a better understanding of the application of cloud computing to the business environment? The current study focuses on validating the economic values of cloud computing. For companies which are interested in deploying cloud computing, it is necessary to investigate economic consequences attributed to cloud computing investment. Suspicious opinions have emerged about the economic validity of cloud computing in the industry and academics (Brynjolfsson et al. 2010). From the research perspective, it is critical to clarify the economic salience of deploying this IT service innovation in a real business environment and specify the optimized conditions under which a firm can realize business values from conducting cloud computing practices.

Key research questions motivating the current study are: (1) Does cloud computing investment positively affect the firm's market value? (2) How does cloud adoption differently affect the firm's market value depending on contextual factors (e.g., firm size, industry sector, and strategic intention)? As it is difficult to acquire internal data directly from the firm, one viable alternative is to measure the effect of cloud computing on the market value of the firm in an indirect manner. The basic idea of this approach is based on investigating how investors evaluate the market value of the firm upon its cloud computing deployment (McWilliams and Siegel 1997). Employing the event study methodology, we analyzed 183 firm-level announcements regarding cloud computing adoption. The results indicate that cloud computing adoption announcements are associated with positive increases in the firm's market value. In addition, we found that differences exist in market returns to cloud computing adoption according to the strategic adoption intention, firm size, and industry sector. These results provide useful implications for the firm's decision-making about whether, when, and how to adopt cloud computing to maximize its business value.

The rest of the paper is organized as follows: In Section 2, we discuss the concept of cloud computing including its differentiated characteristics. Section 3 provides the theoretical background of the current study. We develop our hypotheses in Section 4. In Section 5, we discuss the methodology of data collection and describe the event-study methodology. In Section 6, we present our results with hypotheses testing related to the influence of the adoption of cloud computing on firms' market value. In section 7, we discuss research implications from the empirical results. Finally, we present the concluding remarks in Section 8.

2 CONCEPTUALIZATION OF CLOUD COMPUTING

Cloud computing has become one of the most prominent topics in the IT industry (Plummer 2008; Staten 2008). However, the identity of cloud computing remains unclear as cloud computing is just taking off in regard to real applications (or commercialization) for enterprise IT services. Thus, we attempt to identify the essential properties of cloud computing covering the definition of cloud computing and its characteristics.

2.1 The Evolution of the IT Service Model

From the sourcing perspective, cloud computing is the latest form of the IT service model that provides more standardized and scalable IT resources based on instant access via the Internet and payment by consumption. Cloud computing has evolved from the preceding IT service models and shares some common factors with its precursors such as sharing IT resources located in central computing facilities (mainframe computing), providing IT services by third-party providers (IT outsourcing), and utilizing standardized IT capabilities across the Internet (ASP). In particular, cloud computing shares more similar characteristics with the application service provider (ASP) model. On the other hand, cloud computing presents unique features that set it apart from ASP. Cloud computing refers to both the applications delivered as services over the Internet and the hardware and system software in the data centers that provide those services (Armbrust et al. 2009). Thus cloud computing encompasses the broader concept of using the Internet to allow people to access technology-enabled services located in the layers comprising information systems such as infrastructure, platform, and applications. Table 1 summarizes the trajectory of IT service models, comparing some of their aspects.

IT Service Model	Service Delivery	Contract	Service Diversity	Client-Provider Relationship	Technology Ownership
IT Service Insourcing	On site implementation	Initiating internal IS project	Upon internal request	Little or no business partnership with external service provider	Customer ownership
IT Service Outsourcing	Third-party implementation	Year-round or long-term contract	Upon customer request	1:1 highly customized service	Service provider or partial customer ownership
ASP	Third-party provision	Service provision contract or subscription	S/W	1:N standardized S/W service (mass production)	Service provider
Cloud Computing	Instant access through the Internet	Subscription	Infrastructure, platform, S/W, H/W	N:M diversified service to large customer base (mass customization)	Service provider

Table 1. Comparison of IT Service Models

2.2 Definition and Characteristics of Cloud Computing

Several opinions have been introduced for the definition of cloud computing. They embrace some overlapping notions depicting a universal image of “what cloud computing is.” First of all, cloud computing can be seen as the use of Internet technologies for the provision of IT resources, implying highly adaptable, scalable, and ubiquitous IT services. Another overlapping key notion is that the new IT service practice can be applicable to a wide spectrum of IT service areas covering infrastructure, platform and application. Finally, most existing definitions emphasize the differentiated usage context conceptualized as “pay-by-use billing” and “on-demand service.” Therefore, we define cloud computing with a simplified context as “an innovative way of providing various on-demand IT services for multiple clients using Internet technologies in pay-per-use manners.”

The differentiated features of cloud computing can be broadly defined in four ways: (1) service-oriented design, (2) service delivery over the Internet, (3) flexible use of shared service, and (4) pay-per-use-billing. Within each key attribute, more detailed features of cloud computing are defined (see Table 2 for further details). These features as a whole characterize cloud computing as a new innovative IT service model capable of transforming existing IT operations.

Perspective	Key Attribute	Details
Resource Design	Service-Orientation	<p><i>IT service commoditization</i>: Standard offerings are defined by service providers as “off-the-shelf” items for external customers.</p> <p><i>On-demand self service</i>: Service contents and necessary functions are provided at customers’ request. Customers are free to initiate and terminate services without involving the service providers.</p> <p><i>Technology abstraction</i>: Service providers usually (or mostly) hide complex technology implementations behind service interfaces.</p>
Resource Delivery	Delivery over the Internet	<p><i>Internet technology engagement</i>: Internet technologies deal with multiple customer service requests at a time and provide enriched service contents.</p> <p><i>Availability</i>: Internet-mediated services are highly accessible in any computers connected on-line.</p>
Resource Usage	Flexible Use of Shared Service	<p><i>Computing utility</i>: Service providers own computing resources and supply them as utility products for multi-tenancy.</p> <p><i>Elasticity</i>: More flexible IT capabilities are adjusted to demand fluctuations of IT resources.</p> <p><i>Scalability</i>: Infinite capacity is allowed to scale up resource amount at a desired level.</p>
Resource Payment	Pay-per-Use Billing	<p><i>Subscription model</i>: Billing is based on the amount of service use measured according to CPU hours, data transferred, or data stored. Service providers have usage model to measure the service amount and offer different types of payment plans.</p>

Table 2. Characteristics of Cloud Computing

3 THEORETICAL BACKGROUND

As discussed in the previous section, cloud computing conceptually proposes such potential benefits as cost reduction, IT management flexibility, and technology agility in a broad sense. Such benefits are attributed to differentiated characteristics of cloud computing. For example, service-oriented features of cloud computing enable firms to flexibly utilize various on-demand IT resources without IT capital investments. In addition, commoditized IT services available within the cloud computing environment reduce the lead time required to implement IT systems and improve technology agility to enable business strategies and processes. More fundamentally, these benefits are directly and indirectly associated with the firm’s business performance. Thus, the validation of cloud computing’s economic value is key for firms seeking to adopt this new IT innovation. With this idea in mind, we review IS literature regarding business value of IT to identify previous research outcomes and how to examine the economic value of IT use.

3.1 Business Value of IT

Firms’ Investments in information technologies have increased rapidly over the past three decades. These investments have affected firms’ products, services and internal processes (Dos Santos et al. 1993). Today, most organizations recognize that information technologies play an extremely important role in sustaining their business operations. Some previous IS studies have made plausible claims that investments in IT can have important strategic consequences. This literature suggests that IT investment decisions have the potential either to improve a firm’s competitive position or to allow the firm to become more vulnerable to competitive forces (Cash and Konsynski 1985; Ives and Learmonth 1984; Porter and Millar 1985). However, it is also ironic that as organizational investment in IT has increased, evaluating the effectiveness of IT in investments becomes elusive (Im et al. 2001), making it harder for IS researchers to identify the clear link between IT investment and firm performance. Does information technology really pay off? Many attempts by both economists and IS researchers have been made to answer this question. Some studies indicate that IT has been a very important contributor to productivity (Bharadwaj et al. 1999; Brynjolfsson and Hitt 1996, 1998; Brynjolfsson and Yang 1997; Lee and Barua 1999; Menon et al. 2000). Despite these findings, the results of other empirical studies relating IT investments and firm performance have been equivocal

(Hitt and Brynjolfsson 1996; Weill 1992). Given these contradictory results, it has been argued that the intangible benefits of IT, such as improved quality, variety, timeliness, and customization, have not been appropriately measured primarily due to the use of conventional productivity measurement techniques (Brynjolfsson 1993, Brynjolfsson and Hitt 1998). Furthermore, as many factors influence firm performance, it is difficult to establish clear and proprietary causality between IT investments and firm-level performance (Im et al 2001). The review of IT productivity literature demonstrates that the business value of IT is still debated due to equivocal outcomes; the literature further implies that IS researchers have been motivated to apply alternative perspectives to analyze IT's contribution to firm performance.

3.2 Event Study on the Firm's Market Value

To provide a different way of measuring business performance, some IS researchers have adopted a stock market valuation approach based on the event study methodology, which is an efficient way to capture investors' overall assessment of a firm's value (McWilliams and Siegel 1997). The event study usually measures the stock market's reaction to unexpected events (e.g., announcements) to estimate how the event impacts the value of the firm. The underlying assumption is that capital markets are sufficient for evaluating new information about the key event (Fama et al. 1969), including IT investment, which can potentially impact the firm's expected future profits. This methodology has been recently used within IS literature. For example, the impact of unexpected announcements has been studied in regard to IT investment in general (Dos Santos et al. 1993), outsourcing (Peak et al. 2002), ERP system (Hayes et al. 2001), and so on. Considering the recent emergence of cloud computing in the market, it is difficult to acquire internal data directly from the firm. Analyzing stock price movement according to cloud computing event offers a viable alternative to measure the impact of cloud computing on the firm performance. With these ideas in mind, we applied the event study methodology to analyze a number of announcements on cloud computing adoption and explored influencing factors in the positive abnormal returns on stock prices.

4 RESEARCH MODEL AND HYPOTHESES

As previously discussed, one objective of the study is to examine the effect of cloud computing investment on the market value of the firm. Thus, the study's research model conceptually incorporates the overall effect of cloud computing adoption announcements on shareholders' positive abnormal stock returns. In addition to the main effect, this study also seeks to identify conditions under which the influence of cloud computing investment can be modified. These conditions can be conceptualized as contextual factors that represent the firm's organizational and environmental aspects. Reflecting this research setting, firm size, industry sector, and strategic intention are implemented in the research model to investigate their moderating effects on the market value of the firm. Firm size and industry sector, representing organizational and environmental aspects, have frequently been considered salient moderators in numerous event study works (Dehning et al. 2003; Im et al. 2001; Oh et al. 2006; Telang and Wattal 2007). Strategic intention refers to the way in which a firm utilizes cloud computing from the business strategy perspective. A firm's strategic intents for IT can usually be categorized into two objectives: operational efficiency, which attempts to improve work productivity internally, and strategic positioning, which aims to enhance business capabilities in the market (Chatterjee et al. 2001; Tallon et al. 2000). The basic idea incorporating strategic intention as a moderator is that shareholders' evaluation of the market value of the firm can be different depending on business purposes of utilizing cloud computing. Figure 1 illustrates the research model specific to investigating economic payoff from cloud computing investments.

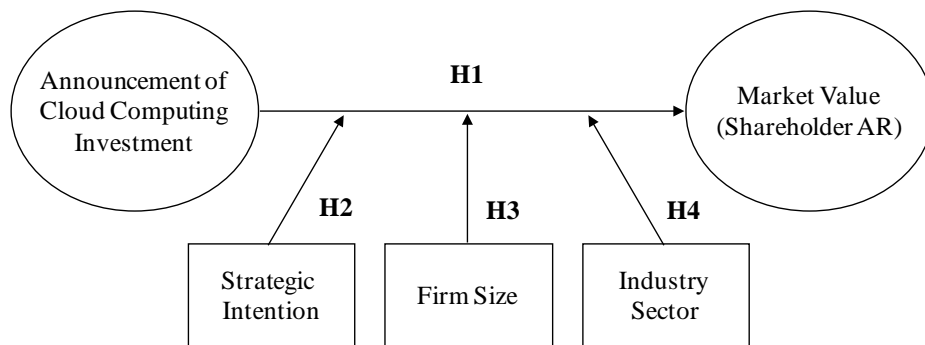


Figure 1. Research Model

4.1 Cloud Computing Adoption and Market Value

Cloud computing allows organizations to outsource various types of IT resources by renting them through the Internet. In addition to the benefits of a low initial cash investment, cloud computing provides customers with a certain degree of flexibility (Ranganathan and Brown 2006). More importantly, because companies can obtain a broad range of IT capabilities through cloud computing, they can concentrate on the core competencies of their businesses in the market. This, coupled with access to advanced technology, can positively affect organizational performance. Announcements of cloud computing adoption are a way for organizations to communicate favorable information to investors and stakeholders by leveraging their new technological innovations. Thus, we expect that firms announcing cloud computing adoption will likely achieve significant strategic and operational advantages in the near future; investors should interpret the announcements positively, thereby resulting in a positive abnormal stock market return. This leads to our first hypothesis:

Hypothesis 1: Cloud computing adoption announcements produce positive abnormal shareholder returns.

4.2 Strategic Intention and Market Value

Business strategy can be characterized as having two key objectives; operational effectiveness, which attempts to reduce costs and increase productivity and speed, and strategic positioning, which aims to extend the existing market by providing customer access and better market practices. This has been used to link firms' strategic intents for IT (Chatterjee et al. 2001; Tallon et al. 2000). In operations-focused firms, IT is implemented primarily to improve efficiency and effectiveness of the organizational processes, whereas in market-focused firms IT is used to enhance their strategic positioning. Firms that favor strategic positioning over operational effectiveness should achieve superior levels of firm performance; in addition, previous event studies found that the market reacts more positively to announcements of innovative and transformative investments than non-innovative ones (Dos Santos et al. 1993). Thus, we may recognize that the stock market would react to firms' cloud computing announcements in different ways based on their strategic intention as shareholders and investors can usually evaluate the future value of the firm through the cloud events. This leads to:

Hypothesis 2: Cloud computing adoption announcements produce a significantly different level of abnormal shareholder returns according to strategic intention.

4.3 Firm Size and Market Value

We also examine how the stock market reactions are affected by firm size. Traditional IT outsourcing is mainly targeted toward large companies since the up-front investments and maintenance costs are substantial (Meng and Lee 2007). However, the cloud computing business model has potential for small and medium-size enterprises (SMEs) that want to focus their resources on building their businesses rather than making significant IT investments (Plummer 2008; Staten 2008). Supply-side economies of the scale make the cloud computing model a viable and affordable option for SMEs, which generally struggle to acquire sufficient IT resources. SMEs find that the lower up-front

investment and range of applications provided are particularly attractive. Considering such relative advantages of cloud computing for SMEs, we can anticipate that market returns to firms' cloud computing adoption can be different based on whether the customer of cloud computing is a large firm or SME. This leads to:

Hypothesis 3: Cloud computing adoption announcements produce a significantly different level of abnormal shareholder returns according to firm size.

4.4 Industry Sector and Market Value

Despite the fact that IT has been a major factor in changing business practices, its role differs according to industry (Melville et al. 2004). Especially in information-intensive industries, IT is altering the dynamics of the industry and changing the requirements for competitive success. Thus, it is critical to understand the impact of IT on different industries. Previous studies have argued that the financial service industry was likely to have more information-intensive processes than the manufacturing industry (Dos Santos et al. 1993; Im et al. 2001; Oh et al. 2006). As a result, the outcomes of IT investments may differ across industry sectors. For example, the service industry, which requires more information-intensive capabilities, tends to be affected to a greater degree than the manufacturing sector during cloud computing adoption (Porter and Millar 1985). This leads to:

Hypothesis 4: Cloud computing adoption announcements produce a significantly different level of abnormal shareholder returns according to industry sector.

5 RESEARCH METHOD

5.1 Event Study

In this study of investigating economic payoff from cloud computing investment, event study is applied as a primary research methodology. As previously discussed, IT productivity studies that use conventional productivity measurement techniques generally fail to consider many of the intangible benefits brought about by IT, such as faster service, more varied products and services, and better access to business information (Im et al. 2001). To complement these weak points, IS researchers have recently become interested in the event study methodology, which is a powerful tool that can help IS researchers assess the business performance of IT investments using such market-based measures as stock price or trading volume. The methodology draws upon the efficient market hypothesis (Fama et al. 1969) that capital markets are efficient mechanisms to process available information on firms. The logic underlying the hypothesis is the belief that investors in capital markets process publicly available information on firm activities to assess the impact of such activities; not only on current performance but also on the firm performance in future periods (Subramani and Walden 2001).

The key procedure of event study analysis is calculating abnormal returns responding to firms' cloud computing announcements. To measure the impact of a cloud computing adoption event, we need to estimate the normal return of the stock as it would have been had the event not occurred. The approach produces the following regression:

$$R_{s,t} = \alpha_s + \beta_s R_{m,t} + \epsilon_{s,t} \quad (1)$$

where $R_{s,t}$ is the return of stock s on day t , and $R_{m,t}$ is the market return on day t . α_s and β_s are firm-dependent coefficients to be estimated. The $\epsilon_{s,t}$ is a random error term for stock s on day t .

Using this equation, we can derive the abnormal return (AR), which indicates the difference between the expected returns based on general market movement and the actual returns shown as following:

$$AR_{s,t} = R_{s,t} - (\alpha_s + \beta_s R_{m,t}) \quad (2)$$

where α_s and β_s are the coefficients of the parameters obtained from ordinary least squares (OLS). In turn, the abnormal returns are simply the prediction errors of the model in equation (1).

The stock's abnormal return provides an estimate of the economic worth of the event (Brown and Warner 1980). Once abnormal returns of sample cloud investment announcements are calculated, a cumulative abnormal return (CAR) can also be calculated by aggregating all sample abnormal returns across the event window, which is defined as plus and minus a certain number of days from the event date (e.g., ± 5 days or ± 10 days). In order to avoid confounding effects due to the wide range of the event window (McWilliams and Siegel 1997), a narrow event window such as ± 1 day from the event is applied in the study. CAR for all sample abnormal returns usually represents the overall effect of cloud computing investment on the firm's market value. Finally, CAR is examined to verify its statistical significance using *t*-test with the null hypothesis that CAR is equal to zero.

5.2 Data

In the study, the event is defined as a public announcement of a firm's cloud computing initiative in the media. The event study methodology aims to investigate the causal relationship between such an event and the variance of a firm's market value. Thus, the methodology is based on searching a large range of news reports and rigorously analyzing their contents. We followed a procedure for a sample selection as suggested by McWilliams and Siegel (1997) and used by Dos Santos et al. (1993). We collected the data from a full text search of news sources such as PR Newswire and Business Wire within the Lexis-Nexis academic search engine over the period from 2005 to 2010. Considering the search string structure, our research keyword contained the noun technology, the company name, and the company ticker symbol. The exemplified combination of search keywords is (cloud computing or SaaS or PaaS or HaaS) and (S&P firm name or ticker symbol). More than 1000 news articles were filtered based on the following sampling criteria: (1) announcements in daily publications; (2) announcements by firms within major security exchanges; (3) announcements containing confounding effects such as dividends, earnings, and mergers and acquisition (Im et al. 2001; Oh et al. 2006). In particular, to control for the confounding effect, we eliminated the firms from the sample on the day that they had experienced confounding events (McWilliams and Siegel 197); this sampling procedure yielded 223 cloud computing announcements. In addition, in the analysis step, we eliminated cloud computing announcements with extremely high or low abnormal returns (outliers) using Cook's distance analysis. Outlier analysis ultimately yielded 183 corporate cloud computing adoption announcements from 2005 to 2010.

The daily stock returns of the individual firms were retrieved from the Center for Research on Security Prices (CRSP) database. We also used a commercial Web portal like "Yahoo Finance" and a specialized Web search engine like "Lexis-Nexis Company Dossier" to retrieve daily stock returns not offered from CRSP (particularly, stock returns dated after January 2010). We used the list of firms in the S&P 500 index to collect announcements. As a result, the announcements were mostly for firms in the S&P 500. Therefore, we applied the S&P 500 index for the market return regression. Our analytical methods are consistent with prior studies using daily stock returns. For the analysis, we used an estimation period of 120 days and calculated the CARs over one primary event window: a 3-day interval, ranging from 1 day before to 1 day after the event. The length of the estimation period and the event windows used are consistent with prior studies of capital market responses (Subramani and Walden 2001). Table 3 summarizes the profiles for sample announcements used in the study.

	Sample Category	Announcement
Total sample size		183
By firm size	Large	115
	Small and medium	68
By industry sector	Communication	14
	Finance	23
	Manufacturing	74
	Retail/Whole sale	28
	Service	33
	Others	11
By intention	Internal focus	116
	External focus	67

Table 3. Sample Description

6 RESULTS OF THE STUDY

Table 4 presents the results of the average cumulative abnormal return (ACAR) for the 183 cloud computing adoption announcements. The table also indicates the test results for the significance of the effect. As we mentioned in the previous section, the main event window used for the study is ± 1 day in order to avoid confounding effects. As the results in the table indicate, Hypothesis 1 is supported. The overall ACAR over the 3-day ($-1 \sim +1$) event window of all firms releasing adoption announcements was found to be significant at the 1% level (ACAR = 0.834%, $t = 3.59$, $p < 0.01$). This indicated that investors or shareholders favorably evaluate firms' cloud computing adoption initiatives within the short period of event windows.

	ACAR (± 1)	<i>t</i> -value
Overall Abnormal Returns ¹	0.834%	3.59**

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

Table 4. Abnormal Returns to Cloud Computing Adoption Announcement

In order to compare the effect according to strategic intention to adopt cloud computing, we divided the sample into two groups: firms with an internal focus and those with an external focus. According to Table 5, the ACAR for external focus was found to be positive and significant at the 5% level (ACAR = 0.719%, $t = 2.57$, $p < 0.05$). Furthermore, we found that the ACAR for internal focus across the ± 1 event window is positive and statistically significant at the 5% level (ACAR = 1.041%, $t = 2.50$, $p < 0.05$). Although the ACAR for the external focus is lower than that for the internal focus, the difference between the ACARs is not significant (difference = -0.323%, $t = -0.67$, not significant). Thus, the results do not support Hypothesis 2, which indicates that firms announcing the adoption of cloud computing with an external focus cloud have a higher positive abnormal return than firms with an internal focus would have.

¹ In this study, we also calculated ACAR for ± 5 and ± 10 days of event windows. ACAR for the ± 5 day event window was significant at the 1% level (ACAR = 1.284%, $t = 2.76$, $p < 0.01$). Similarly, ACAR for the ± 10 day event windows turned out to be positive and significant at the 5% level (ACAR = 1.293%, $t = 2.05$, $p < 0.05$).

Sample Category	ACAR (± 1)	t-value
<i>Breakdown by Strategic Intention</i>		
External Focus (n=116)	0.719%	2.57*
Internal Focus (n=67)	1.041%	2.50*
Difference (External – Internal)	-0.322%	-0.67

+p < 0.1, *p < 0.05, **p < 0.01

Table 5. Abnormal Returns by Strategic Intention

In the next round of analyses, we sought to examine the cloud effect according to firm size. We split the sample into two groups: large firms and small and medium enterprises (SMEs). Large firms were members of S&P 500 index while SMEs were members of S&P SmallCap 600 and S&P MidCap 400 indices. Table 6 presents the ACAR for each group across the ± 1 event window. As the results in Table 6 indicate, we found that the ACAR for large firms is found to be positive and significant at the 5% level (ACAR = 0.578%, $t = 2.21$, $p < 0.05$). Similarly, the ACAR for SME across the ± 1 event window is found to be positive and statistically significant at the 1% level (ACAR = 1.275%, $t = 2.88$, $p < 0.01$). The difference in ACARs between large firms and SME turned out to be statistically insignificant (difference = -0.697%, $t = -0.67$, not significant). In sum, the results indicate that investors or shareholders perceive firms' cloud computing adoption in favorable manners for both large firms and SME. Thus, Hypothesis 3 is not supported by the data.

Sample Category	ACAR (± 1)	t-value
<i>Breakdown by Firm Size</i>		
Large Firms (n=115)	0.578%	2.21*
Small and Medium Enterprises (n=68)	1.275%	2.88**
Difference (Large – SME)	-0.697%	-0.67

+p < 0.1, *p < 0.05, **p < 0.01

Table 6. Abnormal Returns by Firm Size

To test Hypothesis 4, we group sample cloud announcements into two broad industry sectors based on the SIC code index: the manufacturing sector and the non-manufacturing sector. According to Table 7, for the firms in the manufacturing sector, the overall ACAR from cloud computing adoption announcements is not significant. Contrary to such results, the firms in the nonmanufacturing sector, the overall ACAR on cloud computing announcement was found to be significant at the 1% level (ACAR = 1.142%, $t = 3.42$, $p < 0.01$). Thus, these results support Hypothesis 4, indicating that cloud computing adoption announcements produce a significantly different level of abnormal shareholder returns across industry sectors.

Sample Category	ACAR (± 1)	t-value
<i>Breakdown by Industry</i>		
Manufacturing (n=74)	0.387%	1.31
Non-manufacturing (n=109)	1.142%	3.42**

+p < 0.1, *p < 0.05, **p < 0.01

Table 7. Abnormal Returns by Industry Sector

The results presented across the tables collectively indicate that cloud computing announcements significantly improves shareholders' abnormal returns at a specific time period, increasing the market value of the firm. However, the results do not justify the moderating role of some factors in modifying the level of cloud computing effect on the firm's market value (e.g., strategic intention and firm size). Such facts encourage us to perform further analysis in order to identify the moderating role of the hypothesized factors—particularly strategic intention and firm size—in the different contexts of cloud computing announcements. The basic idea of the further analysis draws upon one of the fundamental features of cloud computing—namely, that cloud computing usually delivers various types of on-

demand and service-based IT capabilities, including software, hardware, and platform (Armbrust et al. 2008, 2010; Plummer 2008). Firms can select different types of cloud computing services with heterogeneous business purposes and reflect the choices in their public announcements to the market. Thus, we split the sample into two different contexts of cloud computing announcements according to cloud computing service types: (1) announcements for software cloud computing services (SaaS announcements); (2) for hardware and platform cloud services (Non-SaaS announcements). We empirically examined the magnitude of the moderating factors (i.e., strategic intention, firm size, and industry sector) within the two types of cloud computing announcements.

Sample Category	SaaS Announcement			Non SaaS Announcement		
	n	ACAR (± 1)	t-value	n	ACAR (± 1)	t-value
Full Sample ²	114	0.876%	2.65**	69	0.772%	2.63*
<i>Strategic Intention</i>						
External Focus	65	0.631%	1.47	51	0.830%	2.54*
Internal Focus	49	1.201%	2.32*	18	0.606%	0.93
<i>Firm Size</i>						
Large Firms	65	0.522%	1.40	50	0.649%	1.82+
SMEs	49	1.346%	2.30*	19	1.094%	2.16*
<i>Industry Sector</i>						
Manufacturing	49	0.226%	0.65	44	0.704%	1.25
Non-Manufacturing	65	1.367%	2.67**	25	0.811%	2.42*

+p < 0.1, *p < 0.05, **p < 0.01

Table 8. Results of Further Analysis

Table 8 summarizes the results of further analysis for SaaS and Non-SaaS announcements. As seen in the table, the cloud effect for SaaS announcements on shareholders' abnormal returns was statistically significant at the 1% level (ACAR = 0.876%, $t = 2.65$, $p = 0.01$). In addition, 69 announcements of Non-SaaS (hardware and platform) cloud computing adoption show positive abnormal return at the 5% significance level (ACAR = 0.772%, $t = 2.63$, $p < 0.05$). These results indicate that investors (shareholders) favorably perceive firms' cloud computing adoption initiatives for both software and non-software (hardware and platform) IT resources. According to the table, the salience of strategic intention differs across cloud announcement types. For SaaS announcements, firms with internal focus demonstrated more significant cloud effect (ACAR = 1,201% $t = 2.32$, $p < 0.05$) than firms with an external focus. Non-SaaS announcements that represent cloud service for IT infrastructure presented opposite outcomes. According to the results in the table, the ACAR for firms with an external focus was significant at the 5% level (ACAR = 0.830%, $t = 2.54$, $p < 0.05$). A further analysis also presented different results regarding the cloud effect according to firm size. In the initial analysis, cloud announcements positively affected shareholders' abnormal returns for both large firms and SMEs at the 5% and 1% significance levels respectively. In this further analysis, the ACARs for SME were significant at the 5% level for both SaaS and Non-SaaS announcements. However, the ACARs for large firm turned out to be insignificant for SaaS announcements and significant at the marginal level (10%) for non-SaaS announcements. Finally, as indicated in the table, the ACARs for non-manufacturing were significant for SaaS (at 1% level) and Non-SaaS announcements (at the 5% level). These results are consistent with those of the initial analysis explained earlier.

7 DISCUSSION

The research findings in the study provide some implications for research and practice. As a wrap-up for the paper, we present a summary of our results and implications associated with the findings. First, the advantages of cloud computing still seem to be controversial (Brynjolfsson et al. 2010). However,

² As a full sample, both SaaS and Non-SaaS announcements showed statistically significant ACARs; however, the difference between the ACARs was found to be insignificant (difference = 0.104%, $t = 0.24$, not significant).

our results indicate that, overall cloud computing adoption announcements are positively associated with enhancing the market value of firms and generate value for shareholders. The findings in the study are consistent with previous studies in financial return on IT investment (Bharadwaj et al. 1999; Brynjolfsson and Hitt 1996, 1998; Brynjolfsson and Yang 1997). The positive overall ACAR indirectly implies investors' growing interest in firms' attempt to utilize up-to-date information technologies for higher operational efficiency and better market competence.

Second, a number of previous IS studies have emphasized the role of IT as a tool for saving operational costs. However, the results of the current study indicate that cloud computing adoption is likely to provide sustainable benefits when firms focus on using cloud computing to enhance market competence as well as operational excellence (see Tables 5 and 8 for details). Investors' favorable reaction to market-oriented use of cloud computing implies that cloud computing has the potential to provide additional benefits when manipulated for value-added service to customers and better collaboration with suppliers and partners.

Third, conceptually, cloud computing promises third-party vendors' provision of IT resources for enterprise customers. Thus, one of the major benefits that cloud computing claims is that by using cloud computing, organizations can access various types of on-demand IT resources without initial capital investment. In such an environment, if implemented appropriately, cloud computing leads to the transition of IT capital into operational cost, providing the chance for small and medium firms to utilize the needed IT resources with affordable prices as well as utilize the slack resources saved from using cloud computing for core business. Following this line of thought, our results that are favorable to SMEs (see Table 6 and 8 for details) imply that cloud computing is a plausible choice to small and medium firms seeking to maximize the returns of their investment in IT. However, the insignificant result for large firms shown in Table 8 (in the case of using SaaS cloud service) implies that future benefits from using cloud computing in large firms will be possibly smaller than such benefits for SMEs or not necessarily be realized. As large firms have already invested relatively a large amount of IT resources, it is hard for them to enjoy additional benefits by adopting cloud computing, which would be possibly implemented for limited business processes. Since cloud computing is still in its infancy of commercialization in the market, many cases justifying the utilities of cloud computing for large firms will be introduced in the market as cloud computing evolves.

Finally, some results of the current study indicate a significant industry difference in abnormal returns to cloud computing adoption announcements especially between manufacturing and non-manufacturing (see Tables 7 and 8 for details). The results imply that the benefits of cloud computing can differ according to the nature of each industry. The study also implies that future return to cloud computing adoption can be relatively rapidly realized in more customer-interactive and competition-intensive industries—characteristics of the non-manufacturing industry sector. Thus, managers considering the introduction of cloud computing for their organization need to consider the firm and industry-specific characteristics that can affect the success of cloud computing adoption and determine the appropriate timing for introduction.

8 CONCLUSION

Business value creation through the adoption of technology innovation is one of the most critical topics in IS literature because investing in a technology can only be justified by the returned values the technology generates. As a new trend of IT service innovation, cloud computing has recently indicated several potential advantages, such as cost reduction, IT management flexibility, and technology agility. Although cloud computing is considered a paradigm shift of IT service design and delivery in IS communities and has generated significant interest among business entities, little research has been conducted for this new IT and business phenomenon. The current study seeks to advance the argument on how the application of cloud computing can enhance a firm's market value and which conditions are favorable to the cloud computing's value-creating role.

Specifically, the study examined the influence of cloud computing adoption on the market value of the firm and explored contextual factors in positive abnormal returns. In analyzing a sample of 183 cloud computing adoption announcements, we found that cloud computing adoption announcements

are associated with positive increases in the firm's market value, which implies that investors and shareholders favorably evaluate cloud computing initiatives as future benefits. This study is one of the first to assess economic payoffs of cloud computing adoption based on empirical validation. This study makes several contributions to the IS literature. First, the study extends the boundary of IS literature toward new IT and business phenomena and maintains academic attention to the latest issues in IT industry. Second, the study continues the debate about the business value of IT with a new IT service innovation—namely, cloud computing. Finally, this exploratory study provides a research foundation for the economic analysis of cloud computing, which can be applied to further study of cloud computing.

For the next step to further elaborate upon the current study, some additional works are required. First, to enhance the applicability of the research findings to real business environments, further efforts need to be devoted to collect more cloud computing-related announcements, analyze them, and derive more robust findings from more diversified sample announcements. Second, the study results argue the positive effect of cloud computing adoption on firm performance using a stock-market based approach. Thus, other aspects of firm performance, such as return on asset (ROA) and sales, need to be applied to validate the consistency of the results of this study.

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