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Examining cloud computing adoption intention, pricing mechanism, and deployment model

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ABSTRACT

Cloud computing is a new information technology (IT) paradigm that promises to revolutionize traditional IT delivery through reduced costs, greater elasticity, and ubiquitous access. On the surface, adopting cloud computing requires a firm to address many of the same concerns they face in adopting any enterprise IT. However, cloud technologies also offer new pricing and deployment strategies that are unavailable in traditional enterprise solutions. It is unclear how previous research frameworks of enterprise IT adoption relate to these new adoption strategies. To bridge this gap in the literature, our study uses the technology–organization–environment (TOE) framework of innovation diffusion theory to develop a cloud service adoption model that deals with not only adoption intention, but also pricing mechanisms and deployment models. Our research model has been empirically tested using 200 Taiwanese firms. We found that: (1) Cloud adoption is still at its initial stage, since the adoption rates are very low; (2) the perceived benefits, business concerns, and IT capability within the TOE framework are significant determinants of cloud computing adoption, while external pressure is not; (3) firms with greater IT capability tend to choose the pay-as-you-go pricing mechanism; (4) business concern is the most important factor influencing the choice of deployment model, with higher concerns leading to private deployment options.

1. Introduction

With the advance of computer science and the introduction of the Internet, cloud computing has developed from abstract laboratory sketches into a concrete business paradigm (Armbrust et al., 2010). According to the National Institute of Standards and Technology (NIST), Cloud Computing is defined as, "...a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2009). Cloud computing enables customers to rent IT infrastructure, platform, and software services in the cloud when needed (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009; Dikaiakos, Katsaros, Mehra, Pallis, & Vakali, 2009). Thus, cloud clients can deploy their business applications, store data, and run analyses via the Internet on a pay-per-use basis (Sultan, 2011).

With the special and unique characteristics listed above, cloud computing revolutionizes traditional IT adoption. In the past, expensive IT innovations were usually adopted first by large firms since only they could afford them. Now, it is believed that cloud computing will benefit small and medium-sized enterprises (SMEs), as well as startups, by "eliminating the up-front commitment," and allowing companies to "pay for use of computing resources on a short-term basis (i.e. pay-as-you-go)" (Armbrust et al., 2010; Hofmann & Woods, 2010; Sultan, 2011). Despite the attractive benefits presented above, misgivings about cloud computing remain. A variety of issues, such as "security," "confidentiality," "performance instability," "latency," and "network bottleneck," need to be considered when choosing a cloud computing solution (Hofmann & Woods, 2010; Sultan, 2011; Chang, 2013). With the pros and cons listed above, cloud computing is a somewhat double-edged sword – it is never easy for corporate executives to decide whether they should move their original IT systems onto the cloud. Thus, a thorough investigation on the issue of cloud adoption has been called for by many scholars and practitioners (Armbrust et al., 2010; Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011).

Our study investigating cloud adoption not only responds to this call but also has its uniqueness since cloud computing is

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not merely another enterprise IT adoption issue. Cloud computing has some characteristics that are very different from traditional IT innovations, such as its customer targets (small and medium firms), its pricing mechanism (pay-as-you-go), and its deployment models (public/private), which have seldom been analyzed in previous adoption studies (Böhm, Leimeister, Riedl, & Krcmar, 2011; Kakumanu & Portanova, 2006; Qu, Pinsoneault, & Oh, 2011). When considering enterprise adoption, the most important distinction of cloud technology is that it offers a larger array of adoption strategies than many previous enterprise solutions (such as ERP, SCM, and CRM). Firms can fully or partially host cloud technologies and can distribute costs via different pricing mechanisms. Put another way, cloud technologies offer more than a binary adoption proposition: Firms can adopt cloud at different levels of commitment by choosing different adoption modalities (pricing and deployment). This is very different from previous enterprise IT adoption.

Consequently, our paper's objective is to advance the enterprise IT adoption literature by exploring this multi-modal approach to viewing adoption. We will empirically examine the determinants of cloud adoption through the lens of Technology–Organization–Environment (TOE) framework, which has been extensively used to explain enterprise IT adoption, and ask whether it can appropriately explain not only adoption decisions but also the modalities of adoption (pricing and deployment) offered by cloud platforms. Thus, we could understand what factors can influence companies' preferred pricing mechanism when choosing/considering cloud services from adopters' point of view and what factors will influence companies choice of cloud deployment models (public/private).

2. Theoretical foundation

2.1. Previous studies on cloud adoption

Since cloud computing is a new business model and a trend that involves next-generation application architecture, most existing cloud studies are exploratory, descriptive, or case-based research. For example, studies from Buyya et al. (2009), Sultan (2011), and Marston et al. (2011) focus on the general concepualization and definition of cloud computing, and further discuss some practical issues such as resource management strategy of cloud computing. Furthermore, many previous studies on cloud adoption rely on case study method to qualitatively investigate cloud's benefits and concerns (e.g. Alshamaila, Papagiannidis, & Li, 2013; Brender & Markov, 2013; Lin & Chen, 2012; Wang & He, 2014), hypothetically calculate cloud's benefits based on cloud vendors' price-lists (e.g. Buyya et al., 2009; Khajeh-Hosseine et al.), or propose framworks to help firms achieve cloud design, deployment and services (e.g. Chang, Walters, & Wills, 2013). While the extant literature provides a fundamental understanding of cloud computing, empirical studies that rigorously examine the proposed factors that might affect the adoption of cloud computing is needed (Lin & Chen, 2012; Low, Chen, & Wu, 2011). Though some previous studies have used survey data to quantitatively exam cloud adoption issue (e.g. Garrison, Kim, & Wakefield, 2012; Gupta, Seetharaman, & Raj, 2013; Lee, Chae, & Cho, 2013; Lian, Yen, & Wang, 2014; Wu, Cegielski, Hazen, & Hall, 2013), they mostly focus on a binary cloud adoption proposition. Our study, instead, intends to explain not only the adoption decisions but also the modalities of adoption (pricing and deployment) offered by cloud platforms. Moreover, we found that many of the previous cloud adoption studies do not have a grounded theory to guide their research, and our study will empirically examine the determinants of cloud adoption based on Technology–Organization–Environment (TOE) framework, a rigorous foundation applied by many innovation adoption studies. In Appendix A, we summarize these representative prior cloud adoption studies.

2.2. Technology–organization–environment framework

Diffusion of Innovation theory (DOI) (Rogers, 1995) is a fundamental approach to investigating how a new technology diffuses. DOI theory is concerned with the way that a new technological innovation, progresses from creation to use. It describes the patterns of adoption, explains the mechanism of diffusion, and assists in predicting whether and how a new invention will be successful. Rogers' diffusion of innovation theory posits two categories of factors that influence a firm's adoption of innovations: Innovation Characteristics and Organizational Characteristics. Factors within the Innovation Characteristics category are the "perceived attributes of the innovation" that either encourage or inhibit innovation use. Rogers indicated that five attributes of an innovation (i.e. relative advantage, compatibility, complexity, trialability, and observability) can explain 49–87% of the variance in rate of adoption. While the "Innovation Characteristics" explain a portion of the innovation diffusion, these results are primarily based on studies at the individual decision-making level (Chwelos, Benbasat, & Dexter, 2001). When considering the diffusion of an innovation used at the organizational level, Rogers reported that several Organizational characteristics influence the adoption of innovations, such as centralization, size, slack, formalization and interconnectedness.

Although Rogers' diffusion of innovation theory appears to be most applicable to investigate innovation use, researchers still keep searching other contexts influencing organizational innovativeness and combine them with Rogers' diffusion of innovation theory to provide richer and potentially more explanatory models (Prescott, 1995). Similar to Rogers' framework, Tornatzky and Fleischer (1990) build a framework including three categories – Technology, Organization and Environment (TOE) – to explain a firm's technological innovation decision making behavior. The technological context describes the characteristics of the technologies that will influence decisions about IT adoption, such as technology readiness, perceived benefits, and concerns about the technology. Organizational context addresses the traits and characteristics of the organization that will also influence IT adoption decisions, such as human resources, financial slack and organization size.

While the Technology and Organization categories are parallel to the two categories in Rogers' model, Tornatazky and Fleisher added a new and important component – Environmental context. The Environment context is the arena in which a firm conducts its business – its industry, competitors, and dealings with government. The environment presents both constraints and opportunities for technological innovation. The TOE framework makes Rogers' innovation diffusion theory more complete in explaining innovation diffusion at the firm level. Furthermore, the TOE framework has been used to examine various technology adoption issues, in order to distinguish adopters from non-adopters. Zhu, Kraemer, and Xu (2006) empirically examined seven TOE factors (i.e. technology readiness, technology integration, firm size, global scope, managerial obstacles, competition intensity, and regulatory environment) that have strong influence on three different stages of e-Business assimilation at the firm level. Kuan and Chau (2001) reported that perceived direct benefits in a technology context; perceived financial cost and perceived technical competence in an organizational context; and perceived industry and governmental pressure in an environmental context have significant influence on EDI adoption in small businesses. Pan and Jang (2008) applied the TOE framework to examine the relationship and influence of ERP adoption in Taiwan's communications firms with the results indicating that technology readiness, size, perceived barriers, and production and

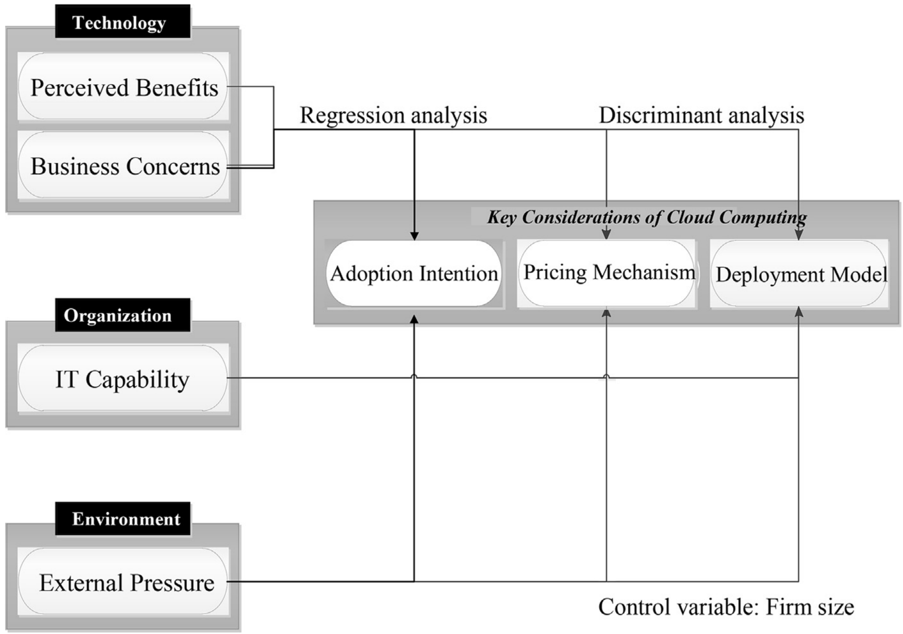

Fig. 1. Research model.

operations improvements are important determinants of the adoption of ERP. Venkatesh and Bala (2012) proposed that TOE factors influence IT-enabled inter-organizational business process standards (IBPS) and found that two factors – expected benefits and relational trust – in technological and organizational contexts had direct effects on IBPS adoption. Based on the support of the TOE framework found in the literature, researchers have concurred with Tornatzky and Fleischer (1990) that the three TOE dimensions influence adoption, but that these dimensions must be uniquely operationalized in each specific innovation context (Baker, 2011). In the following, we developed a conceptual model for cloud computing adoption.

3. Research model and hypotheses

Following the TOE framework, we propose a research model shown in Fig. 1.

3.1. Cloud computing adoption intention

Cloud computing involves scalable and elastic IT-enabled computing capabilities that are delivered as a service to customers using Internet technologies. Cloud computing itself is a complex summation of different service models, and a firm can choose various combinations of distinct service models in order to adopt cloud computing. In general, there are three cloud service models: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). National Institute of Standards and Technology (NIST) defines Software as a Service (SaaS) as: *consumers can access software or applications from various client devices through the Internet, and do not manage or control underlying cloud infrastructure such as servers, operating systems*, etc. (Mell & Grance, 2009). The NIST definition of Platform as a Service (PaaS) is: *consumers can deploy onto the cloud infrastructure their own-created or acquired applications using programming languages and tools supported by cloud vendors* (Mell & Grance, 2009). The NIST definition of Infrastructure as a Service (IaaS) is: *consumers are provided with processing, storage, networks, and other fundamental computing resources from cloud vendors* (Fenn, 2010; Mell & Grance, 2009; Vaquero, Rodero-Merino, Caceres, & Lindner, 2008). In our empirical study, we measured the overall "Cloud Computing Adoption Intention" construct by the summation of the three service models (SaaS, PaaS, and IaaS). For each of the three service models, participants chose from three response options: "Hasn't adopted," "Planning to adopt within 12 months," and "Already adopted." The "Cloud Computing Adoption Intention" is the summation of the degree of SaaS, PaaS, and IaaS adoption.

3.2. Pricing mechanism

After a firm has decided to adopt cloud computing based on its technological, organizational, and environmental benefits, the choice of a pricing mechanism emerges. One of the most distinctive features of cloud computing is its "pay-as-you-go" pricing mechanism. The literature suggests that with this elastic pricing mechanism, compared to a traditional IT/IS pricing mechanism (such as one-time license or monthly plan), a firm will not only eliminate the formidable up-front investment for IT resources but also acquire the ability to quickly scale up and balance an unexpected load surge (Armbrust et al., 2010). By avoiding heavy preliminary investments, choosing pay-as-you-go makes cloud computing attractive to SMEs and startups (Armbrust et al., 2010; Hofmann & Woods, 2010; Leavitt, 2009; Sultan, 2011). Since the elastic pay-as-you-go pricing mechanism is one of the major features of cloud computing, this study will examine how each factor in the TOE framework affects potential cloud adopters' choice of pricing mechanisms.

3.3. Deployment models

The second most innovative concept of cloud computing is its deployment models. According to NIST documents, there are two types of deployment models: Public cloud and Private cloud. Public cloud has the key feature that the infrastructure and computational resources are made available to the general public through the Internet, and it is owned and operated by a cloud provider; also, it is external to the consumer's organization (Jansen & Grance, 2011). Examples of public cloud providers include Amazon, Google, Microsoft, and Rackspace (Li, Yang, Kandula, & Zhang, 2010). In contrast to a public cloud, a private cloud is a deployment model that maintains the computing environment exclusively for a single organization, so granting a firm greater control over the infrastructure and computational resources, as compared to the public cloud (Jansen & Grance, 2011). Private cloud providers include HP, IBM, Novell, and VMware, etc. (Fenn, 2010). Given these characteristics of public and private clouds, firms need to evaluate carefully when facing cloud computing adoption. This research will analyze the collected data to examine the relations through the proposed TOE framework, and distinguish adoption inclinations for different cloud types.

3.4. Technology context

Technology context focuses on how features of the technologies themselves can influence the adoption process (Tornatzky & Fleischer, 1990, p. 153). As shown in the proposed model, there are two factors in the technology context: perceived benefits and business concerns. Support for the importance of the perceived benefits of innovative technology is abundant in the IT adoption literature (Grandon & Pearson, 2004; Venkatesh & Morris, 2000; Zhu, Kraemer, Gurbaxani, & Xu, 2006; Zhu, Kraemer, & Xu, 2006). Perceived benefits refer to the operational and strategic benefits a firm can expected to receive from cloud computing; some of these are mobility, efficient reduction of computing costs, easy installation and maintenance, and easy data analysis over the Internet (Armbrust et al., 2010; Buyya et al., 2009; Dikaiakos et al., 2009). Since cloud computing delivers its service completely through the Internet, employees do not have to be present on site to perform data analyses and other operations. With an Internet connection, mobility is greatly enhanced. Also because of cloud computing, firms no longer need to invest formidable resources to build information systems, because the installation, maintenance, and upgrade routines are now managed by the cloud computing vendor, which further reduces IT-related costs. Based on this reasoning, cloud computing should provide a marked advantage (Hayes, 2008; Vaquero et al., 2008). Thus the argument above leads to the following hypothesis:

H1. A firm that perceives a higher level of cloud benefits is more likely to adopt cloud services.

The importance of business concerns related to innovative technology has been shown in previous studies (Chau & Tam, 1997; Khajeh-Hosseini, Greenwood, & Smith, 2012). Business concerns refer to perceived problems or risks that a firm can encounter adopting innovations. Some of the concerns related to cloud computing include data lock-in, confidentiality, insufficient service quality guarantee, bandwidth bottlenecks, and reliability (Armbrust et al., 2010; Buyya et al., 2009; Dikaiakos et al., 2009; Chang, 2013). Adopting cloud computing means handing over part of a firm's daily operation, equipment, and even critical data to a cloud computing service provider. Once a decision is made to cooperate with a certain cloud provider, the firm needs to upload data and perform operations on the provider's machines; thus, the firm not only relies heavily on the single cloud computing service provider but also runs the risk of breaches of confidentiality. Moreover, since cloud computing relies heavily on the Internet to transfer data and provide services, there are possible bandwidth bottlenecks and infrastructure-level issues that may occur due to different degrees of infrastructure completeness. In the face of all these uncertainties, the service quality guarantees between service providers and firms are difficult to predict, measure, and maintain (Armbrust et al., 2010; Hayes, 2008; Leavitt, 2009). Thus the argument above leads to the following hypothesis:

H2. A firm that perceives higher levels of business concern is less likely to adopt cloud services.

3.5. Organizational context

As shown in the proposed model, the organizational context includes IT capability that consists of IT resources and IT employees (Bharadwaj, 2000). IT resources refer to the firm's annual budget for its IT department to install, maintain, and upgrade the company's information systems. The number of IT employees is an indicator to determine whether a firm has sufficient IT employees to support daily operations; perform installation, maintenance and upgrades; and handle emergencies. Most previous studies, as well as the TOE framework, indicate that a firm with a higher level of IT capability is more likely to adopt new technology (Kamal, 2006; Kuan & Chau, 2001). Firms that have successfully implemented information technologies in the past have better technical knowledge, have fostered skills for implementing new IT solutions, and have developed a deeper understanding of the economic and organizational impact of new IT (Cohen & Levinthal, 1990; Zhu, Kraemer, Gurbaxani, et al., 2006). Acquired primarily through learning-by-doing, such skills and capabilities are critical for successful adoption of newer technologies (Cohen & Levinthal, 1990). Nevertheless, when discussing cloud computing, it is believed that firms with lower IT capability may be more likely to adopt cloud computing, a view diametrically opposed to the findings of past studies (Hofmann & Woods, 2010; Sultan, 2011). Since cloud computing is still in its infancy, there is little evidence to support which kinds of firms are more or less likely to adopt the technology. Therefore, this study hypothesizes the following along the lines of the TOE framework and previous innovation adoption studies.

H3. A firm with higher levels of IT capability is more likely to adopt cloud services.

3.6. Environment context

As shown in the model, the external pressure factor is included in the environmental context. There are three perspectives from which to discuss the external pressure: pressure from trading partners, competitive pressure, regulations and government policies (Chwelos et al., 2001; Kuan & Chau, 2001; Zhu, Kraemer, Gurbaxani, et al., 2006; Zhu, Kraemer, & Xu, 2006). Trading partner pressure suggests that perceived pressure from upstream and downstream business partners influences a firm to adopt new technology in order to maintain cooperative relationships. Competitive pressure refers to perceived pressure from business competitors that forces a firm to adopt new technology for the sake of maintaining competitiveness. Regulations and government policies mean that governmental support requires a firm to adopt new technology. Several studies support the idea that the greater the external pressure, the greater the motivation for a firm to adopt information technology (Chwelos et al., 2001; Grandon & Pearson, 2004; Kuan & Chau, 2001; Zhu, Kraemer, Gurbaxani, et al., 2006; Zhu, Kraemer, & Xu, 2006). In recent cloud computing adoption research, Low et al. (2011) mentioned that pressure from trading partners has significant influence on the adoption of cloud computing. Also, Kirkpatrick (2011) reported that competitive pressure can force firms to adopt cloud computing. Therefore, the arguments above leads to the following hypothesis:

H4. A firm facing more external pressure is more likely to adopt cloud services.

As mentioned earlier, a key point of interest regarding cloud technologies is that they offer more than just a binary adoption proposition. Firms can adopt cloud at different levels of commitment by choosing different adoption modalities (pricing and deployment). This is very different from previous enterprise IT adoption. Therefore, our study also aims to advance the enterprise

IT adoption literature by exploring this multi-modal approach to viewing adoption. Consequently, we propose two propositions in the following to understand whether the TOE framework, which has been extensively used to explain enterprise IT adoption, could appropriately explain not only the adoption decision but also the modalities of adoption (pricing and deployment) offered by cloud platforms.

Proposition 1. *The TOE factors are significantly associated with preference for pricing mechanism.*

Proposition 2. *The TOE factors are significantly associated with preference for deployment model.*

4. Methodology

4.1. Data

To test our research model, a survey was designed to collect data on each of the variables in the model. Each items on the survey instrument was reviewed for content validity by an expert panel comprised of faculty whose work focuses on cloud computing, as well as some practitioners and consultants from industry. The initial questionnaires were pilot tested on ten firms randomly selected from the sample frame and, based on the responses received, some items were revised for clarity. After finalizing the survey instrument, we conducted a telephone survey in August of 2010. Our target population was the Top 5000 company list in Taiwan, which is published annually by the largest professional survey company in Taiwan.[1] The businesses selected for our survey were evenly distributed over four sectors of Taiwan's main industries: Information and communications technology (ICT) manufacturing, ICT service, general service, and general manufacturing industry. Anecdotal evidence suggests that firms in the four industries tend to approach cloud computing differently, with ICT industries leading in the use of cloud, while traditional industries appear to be laggards. Thus, the four industries provide appropriate testing fields for our research model. Eligible respondents for our survey are CIOs or senior IT managers in each company. The sampling was a stratified sample by industry and by size (large – 200 or more employees, and small and medium – between 20 and 200 employees).

Our sampling frame comprised 200 Taiwanese firms. In total, 623 potential respondents were contacted with a response rate was 32.1%. Fig. 1 shows the sample's statistics. We found that our surveyed companies were composed of 65% SMEs (<200 employees) and 35% large corporations, which is consistent with statistics indicating most Taiwanese companies are SMEs. Second, although Taiwan is famous for its high-tech industries, the numbers of IT employees and their IT budgets are generally low. Of the companies surveyed, 72% have fewer than 5 IT employees, and 72.5% of the surveyed companies have an annual IT budget of less than 5 million NT dollars (0.17 million USD). Based on this observation, it can be deduced that IT departments in Taiwanese companies serve a supporting function instead of having a core development focus. Given this, it can be predicted that firms in Taiwan having low numbers of IT technicians and low IT budgets may view the adoption of cloud computing services as a reasonable substitute for their original IT systems.

Since all data is self-reported, we used two approaches to examine the quality of our data. First, we compared the profiles of the responding firms with non-responding firms on demographic variables such as firm size and revenue using Chi-square analysis. The results indicated no significant response bias. We also examined common method bias that may potentially occur in survey data. Using Harman's single-factor test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), we found that one general factor cannot account for the data variance, which indicates there is no significant common method bias in our dataset (Table 1).

Table 1
Sample characteristics.

Items	Frequency	Percent
Numbers of employee		
Under 200	130	65
200–500	45	22.5
Above 500	25	12.5
Industry		
ICT Service	53	27
ICT Manufacturing	53	27
General Service	51	25
General Manufacturing	43	21
Employees in IT department		
0–2	80	40
3–5	64	32
6–10	30	15
11–50	19	9.5
Over 50	7	3.5
Annual IT budget		
Under NT. 1 million	63	31.5
NT. 1–5 million	82	41
NT. 5–10 million	22	11
NT. 10–20 million	16	8
Over NT. 20 million	17	8.5

4.2. Descriptive statistics

We report the descriptive statistics of variables used in the research model in the following. As listed in Fig. 2, among those advantages that cloud computing can bring to a firm, "Easy to install/upgrade/maintain," "Off-site backup," and "Reduce IT expenses (e.g. IT devices, IT employees, IT maintenance)" are the top three benefits that most IT managers indicated.

As for the disadvantages of the cloud service listed in Fig. 3, the top three concerns are "Cloud provider cannot deliver quick response," "Unexpected service outages," and "Confidentiality". It can be implied from the data that, due to the overall novelty of cloud services, it is still too risky for decision makers to adopt precipitately. Generally, IT managers in Taiwan maintain a reserved attitude toward cloud computing.

Fig. 4 shows that, when addressing environmental issues, Taiwanese companies are mainly concerning about the readiness of basic Internet infrastructure and the integrity of government regulations. One possible explanation might be that, since cloud computing is mainly distributed through the Internet, the image of highly dependable Internet access predominates in business practitioners' minds (Lin & Chen, 2012). Apart from Internet infrastructure and government legal enforcement, there is less concern about issues like whether other companies, competitors, or business partners already adopted cloud computing services. The respondents' answers indicate a sense of being technology pioneers, who are not easily influenced by others (i.e. peers, competitors, or business partners) when facing new technology adoption issues.

We further investigated firms' intentions to migrate their current information systems to cloud. According to Table 2, the most popular information system already in cloud is the email system, and it also has the highest possibility of being transformed into a cloud-based system within one year. On the other hand, probably due to privacy and confidentiality issues, the IT systems least likely

[1] The survey company is China Credit Information Service, Ltd.

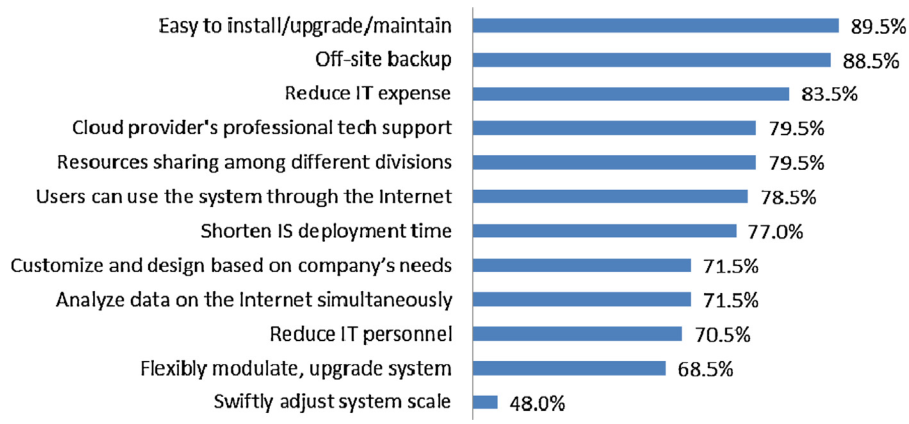

Fig. 2. Perceived benefits.

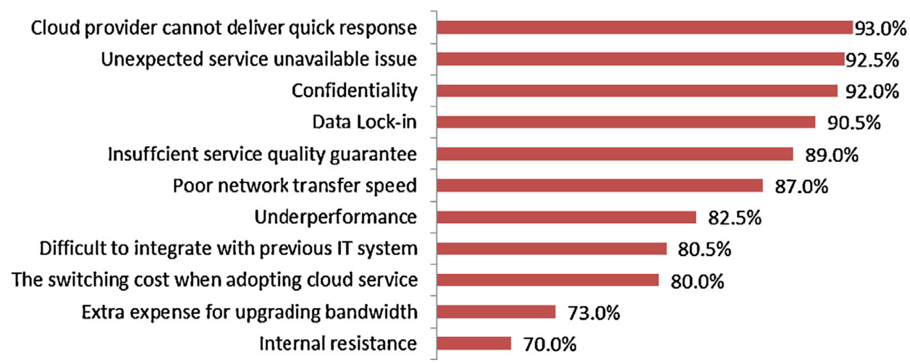

Fig. 3. Business concerns.

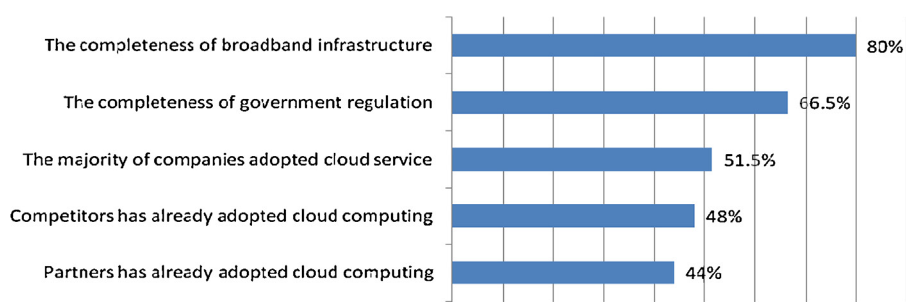

Fig. 4. Environment issues.

to be migrated to the cloud are Human Resources, Supply Chain Management (SCM), and Project Management systems.

The survey items were based on 5-point Likert scales. Table 3 shows descriptive statistics for these items in more detail. We noted that the mean values of items in "Business Concerns" are generally higher, indicating firms are very cautious about the possible problems of using cloud computing. These problems include "confidentiality," "vendor lock-in," and "service outages".

In Table 4, our results show that cloud adoption is still in its initial stage since the adoption rate is very low (SaaS adoption rate = 30%; PaaS adoption rate = 5%; IaaS adoption rate = 13%). Most Taiwanese companies are still conservative when considering

Table 2
Firms' intention to migrate current information systems onto cloud.

	Already used cloud	Will migrate to cloud in one year	No intention to migrate to cloud
Email system	18%	26%	56%
ERP	10%	13%	78%
Human resource system	8%	9%	84%
Information security system	8%	22%	71%
Video conferencing system	7%	25%	68%
CRM	4%	24%	73%
e-Business	3%	21%	76%
Project management system	3%	18%	80%
SCM	1%	17%	82%

Table 3
Descriptive statistics.

Constructs	Items	Code	Mean	Std. Dev.
Perceived Benefits (PB)	Customization	PB1	3.82	1.022
	Easily analyze data on Internet	PB2	3.79	0.982
	Reduce deployment time	PB3	3.87	1.007
	Reduce IT costs	PB4	4.13	0.968
	Reduce IT employees costs	PB5	3.74	0.971
	Ubiquitous access	PB6	4.03	0.959
Business Concerns (BC)	Confidentiality	BC1	4.68	0.808
	Incompatibility	BC2	4.4	0.946
	Insufficient service quality guarantee	BC3	4.24	0.969
	Internet Bottleneck	BC4	4.2	0.985
	Service Outages	BC5	4.67	0.809
	Underperformance	BC6	4.3	1.086
	Vendor lock-in	BC7	4.68	0.808
IT Capability (IC)	Number of IT employees	IC1	3.05	1.191
	Annual budget for IT department	IC2	2.21	1.214
External Pressure (EP)	Competitors Pressure	EP1	3.03	1.261
	Government policy support	EP2	3.91	1.105
	Partners pressure	EP3	3.12	1.285
	Regulations	EP4	3.68	1.272

Table 4
Distribution of SaaS, PaaS, and IaaS adoption.

	SaaS adoption		PaaS adoption		IaaS adoption	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
No intention	57	28.5	176	88	161	80.5
Will adopt within 12 months	83	41.5	14	7	13	6.5
Already adopted	60	30	10	5	26	13

Table 5
Pricing mechanism.

	Mechanisms	Code	Frequency	Percent
Pricing mechanism (PM)	Pay-as-you-go	PM1	40	20
	License	PM2	27	14
	Fixed monthly fee with unlimited access	PM3	132	66

cloud adoption, even though cloud has been discussed intensively over the past few years. Furthermore, when combining “planning to adopt” and “already adopted,” we found that the SaaS solution has a relatively higher acceptance rate over the PaaS and IaaS solutions, which indicates that, at this early stage of cloud computing, firms are more willing to give SaaS application a chance to test cloud computing.

As for pricing mechanisms, the data indicated that the choice of fixed monthly fee with unlimited access was the most widely preferred, with 132 firms (66%) choosing that option (Table 5).

We also asked about the possible deployment type of cloud computing that each company would choose. In Table 6, only 7% of the companies chose public cloud, which indicates that concerns about issues such as information leakage and data lock-in are still prevalent among business practitioners. As such, 93% of respondents chose private cloud to maintain more control of their crucial business-related data. Consistent with Gartner’s latest report on “Hype cycle for emerging technologies”, private cloud computing has overtaken more general-cloud computing (i.e. public cloud) at the top of the peak, and private cloud computing is among the highest interest areas across all cloud computing (Gartner, 2012).

Table 6
Deployment model.

Type	Frequency	Percent
Public cloud	14	7
Private cloud	186	93

4.3. Instrument validation

Constructs and measurement items used in this research are adapted from previously validated measures, or are developed on the basis of literature review. Details of the constructs and items are listed in Appendix B. The processes of instrument validation are discussed below.

In order to test construct reliability, the preferred composite reliability (CR) measurement is applied to examine internal consistency. The suggested cut-off value for CR for better research quality is greater than 0.70 (Fornell & Larcker, 1981). The reflective construct used in our model, IT capability, has a composite reliability of 0.881, indicating high reliability and internal consistency (Table 7). *Convergent validity* is verified through the *t*-statistic for each factor loading. As shown in Table 7, all factor loadings are greater than the typical cutoff value of 0.7 and significant at the $p < 0.01$ level.

We formatively measured the “perceived benefits”, “business concerns”, and “external pressure” constructs because their

Table 7
Reliability of reflective constructs.

Construct	Code	Loadings	CR
IT Capability (IC)	IC1	0.815***	0.881
	IC2	0.955***	

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

Table 8
Validity of formative constructs.

Construct	Code	Weights	VIF	Perceived Benefits (cross loadings)	Business Concerns (cross loadings)	External Pressure (cross loadings)
Perceived Benefits (PB)	PB1	0.263	1.476	**0.54**	0.25	0.20
	PB2	0.363***	1.620	**0.62**	0.08	0.12
	PB3	0.532***	1.532	**0.56**	0.22	0.11
	PB4	0.371***	1.376	**0.67**	0.07	0.02
	PB5	0.600***	1.387	**0.53**	0.18	0.10
	PB6	0.332***	1.414	**0.74**	0.22	0.19
Business Concern (BC)	BC1	0.262***	1.466	0.30	**0.53**	0.06
	BC2	0.649***	1.491	0.23	**0.68**	0.16
	BC3	0.158	1.438	0.28	**0.63**	0.17
	BC4	0.365***	1.759	0.24	**0.55**	0.10
	BC5	0.859***	1.626	0.18	**0.79**	0.19
	BC6	0.308***	1.909	0.24	**0.58**	0.15
	BC7	0.332***	1.895	0.26	**0.55**	0.08
External Pressure (EP)	EP1	0.239	1.296	0.12	0.10	**0.54**
	EP2	0.897***	1.328	0.15	0.20	**0.96**
	EP3	0.352***	1.449	0.23	0.11	**0.56**
	EP4	0.67***	1.517	0.17	0.11	**0.58**

Bold indicates significant at *** $p < 0.01$ level.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

measurement items are not parallel. Cenfetelli and Bassellier (2009) and Petter, Straub, and Rai (2007) suggest that items of well-specified formative constructs have significant weights. Non-significant weights may be caused by multicollinearity, indicated by a high variance inflation factor (VIF above 3.33). In the absence of multicollinearity, items with nonsignificant weights should be retained in the model. Table 8 shows acceptable construct validity.

Table 9 provides the correlation matrix to examine *discriminant validity*, which indicates the degree to which the constructs diverge from each other. The square root of the Average Variance Extracted (AVE) (listed on the diagonal in bold) should be larger than other correlations to indicate that all the constructs are distinct. The constructs we used in the model meet this criterion.

Furthermore, the relative importance of size as a predictor of organizational innovativeness and the direction and nature of the causal influence of size on innovativeness is a persistent controversy in the IS and organizational research literature (Ettlie & Rubenstein, 1987). In most IS literature, firm size is treated as a proxy variable for financial resources, which refer to the ability of a firm to pay for installation cost, integration cost, employees' training cost and maintenance cost (Rogers, 1995; Zhu, Kraemer, & Xu, 2006). IS researchers believe that larger firms usually have more available financial resources to be better equipped and implement innovations (Rogers, 1995). However, some researchers in organizational and strategic area argue that large firms are more bureaucratic and less flexible, are unable to change quickly, and have higher structural inertia to adopt innovation (Whetten, 1987). Yet, firm size has consistently been found to be positively related to IS innovation use in empirical research. For example, Premkumar, Ramamurthy, and Crum's (1997), Zhu and Kraemer's (2002), and Thong's (1999) studies report positive relationship between firm size and IS innovation use. Thus, we include firm size into the model to understand its effect.

5. Data analysis and results discussion

5.1. Cloud adoption level

The results of the structural model are shown in Fig. 5. Among the four factors listed in the proposed model, Perceived Benefits, Business Concerns, and IT Capability significantly influence cloud computing adoption, while External Pressure is not a significant factor.

Perceived Benefits has a significant ($p < 0.05$) and positive coefficient, and it is the most influential factor (0.219) when firms consider cloud adoption. It indicates that, at this stage, IT managers are instilled with knowledge that cloud computing technology can be beneficial to their organization (e.g. reduces IT expense, easy to install/upgrade/maintain, etc.) and the more benefits they perceive the greater the level of cloud computing adoption. Thus, Hypothesis H1 is supported.

As for Business Concerns, our results show that it has a significant ($p < 0.1$) but negative connection with the cloud computing adoption. Although slightly weaker than the influence of Perceived Benefits, it still indicates that, at this early stage of cloud computing, business concerns, such as confidentiality, service outages, and vendor lock-in, will hinder firms from adopting innovative cloud services. In other words, the more Business Concerns a firm perceives, the less likely they are to adopt cloud computing technology. Therefore, Hypothesis H2 is supported.

The third factor, IT Capability, is also significant ($p < 0.05$), and "positively" influences the adoption of cloud computing technology. This result supports our Hypothesis H3: a firm with higher level of IT capability is more likely to adopt cloud. This result is contradict to many IT experts' predictions and cloud vendors' propaganda based on the cloud computing's economic premise that firms with lower IT capability will have higher intention to adopt

Table 9
Correlation matrix.

	Mean	SD	PB	BC	IC	EP
Perceived Benefit (PB)	3.81	0.903	**0.677**	–	–	–
Business Concerns (BC)	4.44	0.656	0.331	**0.686**	–	–
IT Capability (IC)	2.60	1.077	0.045	−0.035	**0.888**	–
External Pressure (EP)	3.10	1.660	0.154	0.199	−0.022	**0.692**

Note: SD means standard deviation.

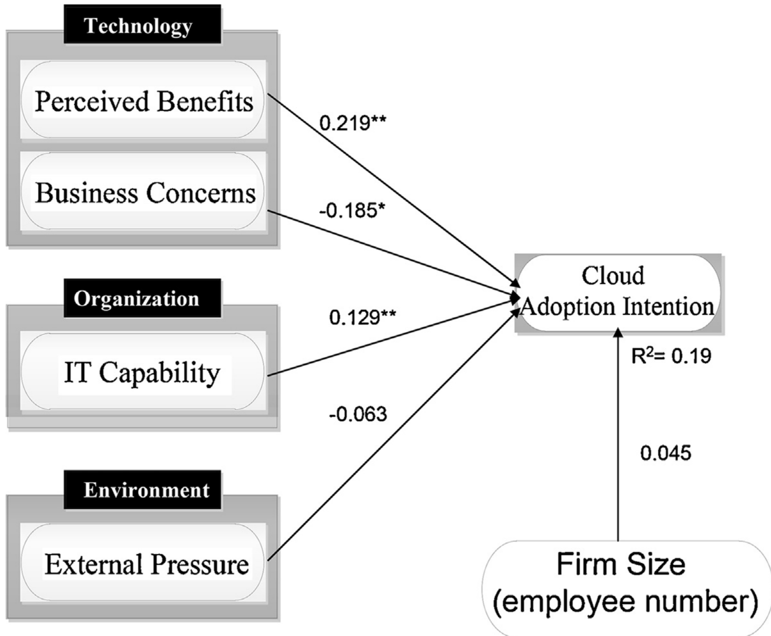

Fig. 5. Results of structural model (*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$).

cloud. Our result indicates that firms with higher IT capability (more IT employees and greater IT budget) prefer cloud computing, perhaps because these firms are more familiar with the latest information technology, and keep up with dynamic IT trends. Also, greater familiarity with information technology infers a higher level of knowledge to use in the operation of newer information technology; thus, greater IT capability might allow for better management of, unpredicted turbulence brought by cloud, without undue economic impact. Two recent qualitative studies (Brender & Markov, 2013; Lin & Chen, 2012) interviewing IT professionals in Taiwan and in Switzerland respectively, in regard to their firms' intentions to adopt cloud yielded similar findings. A firm's IT capabilities, such as existing knowledge and skills among personnel and the company's experiences, are the keys when considering cloud computing adoption (Brender & Markov, 2013; Lin & Chen, 2012). Our empirical results confirm their qualitative finding.

The fourth factor, External Pressure, is not significant ($p > 0.1$) and what is noteworthy is that, at this initial stage of cloud computing, external pressures from other companies, business partners, or even competitors and government regulations are not seen as important factors when considering cloud adoption. A possible explanation is that current cloud adopters somehow share the "innovators" and "early adopters" characteristic in the innovation diffusion lifecycle (Rogers, 1995), which describes the adoption of innovation according to the demographic and psychological characteristics of defined adopter groups. According to Rogers (1995), these innovators and early adopters tend to embrace novel technologies and are not easily affected by other people. They lead the trend instead of being led. Therefore, external pressure is not a significant factor, which is quite different from previous innovation diffusion studies focusing on more mature technologies.

In addition, our research model includes firm size to investigate its effect on cloud adoption intention. We tried three approaches to understand whether there are any significant differences between small and medium businesses (SMEs) and larger companies when adopting cloud services. First, firm size, measured by employee number, is added into the model to understand the difference, but we found it did not significantly affect cloud adoption intention. Then, we measured firm size by revenue and re-ran analysis. Still, we found revenue did not affect firms' cloud adoption intention significantly. Third, we split our data into two sub-samples, large firms ($N = 72$) and SMEs ($N = 128$) and ran the structural model on the two subsamples, respectively. Results shown in Fig. 6 demonstrate a difference between large firms and SMEs. We found that for large firms, perceived benefits, business concerns, and IT capability are significant factors influencing cloud adoption intention; yet for SMEs, perceived benefits and IT capability turn out to be non-significant. We further tested the difference between the two subsamples by comparing each path in the structural model for large firms with the corresponding path coefficient for SMEs. The significance of this difference was examined by a *t-test* (Venkatesh & Morris, 2000). The two paths that differed significantly between the two subsamples were from perceived benefits to cloud adoption intention ($t = 22.6$, $p < 0.001$) and from IT capability to cloud adoption intention ($t = 17.91$, $p < 0.001$). Therefore, the results from the three different approaches indicate that size effect on cloud adoption may be more complex than we earlier expected. In approach 1 and 2, we found that large firms do not have different cloud adoption intention from SMEs. However, when we go further step to split our sample, we found that though firm size does not directly affect cloud adoption intention, firm size affects how firms perceive cloud's benefits, and their importance on affecting cloud adoption. Also, firm size affects IT capability's importance on cloud adoption intention.

Furthermore, the adjusted *R*-square of our research model is 0.19 when the full sample is used, 0.38 and 0.22 for the large firms sample and the SMEs sample, respectively. Though it is assumed that the higher the value of R-square, the greater the explanatory power of the research model, many scholars indicated that power analysis and effective size are also crucial when interpret a model's explanatory power (Baroudi & Orlikowski, 1989; Cohen, 1988). Power analysis tests whether the *r*-square of the proposed research model is significantly larger than zero (Cohen, 1988). Following Cohen (1988, pp. 407–465), we calculated the statistical power of our research model, which is 0.999, indicating that our proposed model has significant power to explain the phenomenon. Furthermore, the effect size measures the effectiveness of a research model to explain or predict empirical observations (Webster & Starbuck, 1988). The effective size of our proposed model is 0.23. According to Cohen (1988), who suggests interpreting this effective size as small

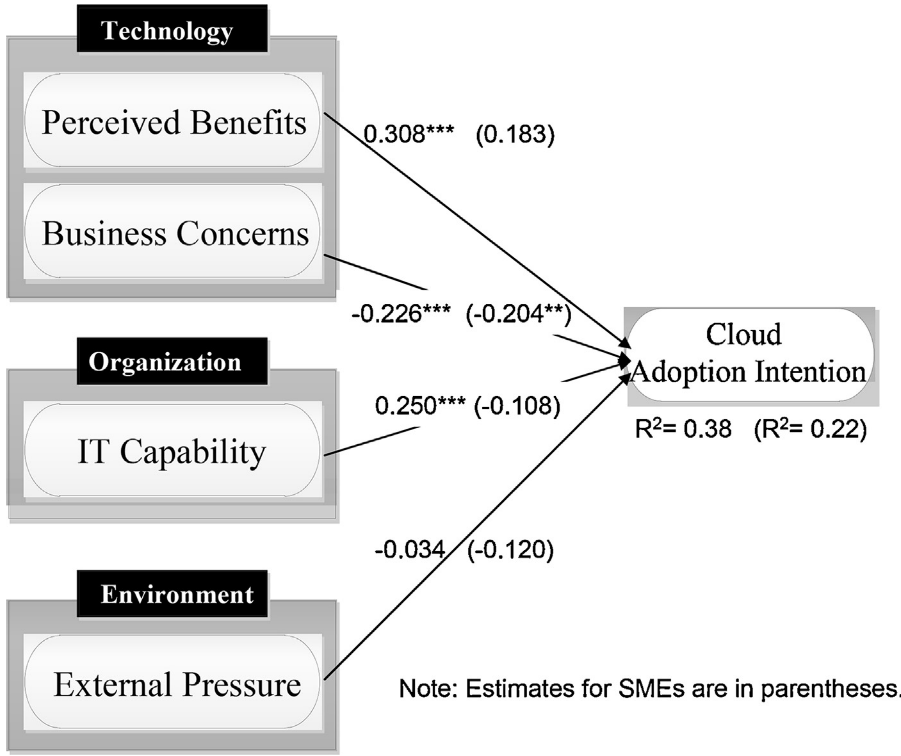

Fig. 6. Results of sample split: large firms vs. SMEs.

Table 10
SaaS, PaaS, and IaaS adoption intention analysis.

	Dependent variables (adoption intention)		
	SaaS	PaaS	IaaS
Perceived Benefits	0.154*	0.187*	0.214**
Business Concerns	−0.130*	−0.216**	−0.191**
IT Capability	0.114	0.051	0.133**
External Pressure	−0.150	0.143**	−0.084
Firm Size	−0.043	0.042	0.115*

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

(0.02), medium (0.15), and large (0.35), our proposed model has medium influence compared to other possible influence of untested factors.

Lastly, we did a post hoc analysis by separating SaaS, PaaS, and IaaS as three dependent variables, and re-ran our model three times. In specific, we want to understand whether firm size, IT capability will affect the type of cloud adoption since in general, organizations adopting IaaS and PaaS may require considerable levels of technical expertise. Our results show that while perceived benefits and business concerns are consistently significant determinants affecting SaaS, Paas, and IaaS adoption, IaaS adoption intention is associated with IT capability and firm size. In other words, larger firms with stronger IT capability have higher intention of adoption IaaS (Table 10).

Table 12
Standardized canonical discriminant function coefficients and Structure Matrix.

Function	Variables	Standardized canonical discriminant function coefficients	Structure Matrix
1	Perceived Benefits	–.063	–.002
	Business Concerns	–.331	–.277
	IT Capability	**.924**	**.908**
	External Pressure	.333	.210

Bold indicates significant at $^{***}p < 0.01$ level.

5.2. Pricing mechanism

Since the Pricing Mechanism is a categorical variable (1 = Pay-as-you-go, 2 = License, 3 = Unlimited access with fixed monthly fee.), we used discriminant analysis in order to understand the discriminant power of the four independent/predictor variables: Perceived Benefits, Business Concerns, IT Capability, and External Pressure on the dependent variable (Pricing Mechanism). According to Table 11, when setting the four variables as predictor variables, the discriminant analysis generates two discriminant functions and the first discriminant function is significant ($p = 0.002 < 0.05$), which indicates that it has discriminant power. The second discriminant function is non-significant and is dropped ($p = 0.21 > 0.05$).

Standardized Canonical Discriminant Function Coefficients (Table 12) are used to examine the contribution of the predictor variables to the discriminant function, and the Structure Matrix

Table 11
Summary of canonical discriminant functions.

Function	Eigenvalue	% of variance	Canonical correlation	Wilks' lambda	Chi-square	Sig.
1	.123	82.4	.331	.867	24.810	**.002**
2	.026	17.6	.160	.974	4.525	.210

Bold indicates significant at $^{***}p < 0.01$ level.

Table 13
Classification results.

Pricing mechanism			Predicted group membership			Total
			Pay-as-you-go	License	Unlimited access	
Original	Count	Pay-as-you-go	8	0	28	36
		License	2	0	23	25
		Unlimited	5	0	113	118

shows the correlations of each variable with each discriminate function (Lachenbruch, 1975). For the standardized canonical discriminant function coefficients, "IT Capability" has the largest coefficient, which can strongly predict choice of Pricing Mechanism (i.e. "Pay-as-you-go," "License," or "Unlimited Access").

An additional way of interpreting discriminant analysis results is to describe each group in terms of its profile, using the group means of the predictor variables (Lachenbruch, 1975). Cases with scores near to a group mean, or centroid, are predicted as belonging to that group. The centroid for Pay-as-you-go is 0.683; the positive and highest standardized canonical discriminant function coefficient is "IT Capability" (0.924). Together, we can interpret the results as: the higher level of IT Capability a firm possesses, the higher possibility of choosing the pay-as-you-go pricing mechanism. The classification results (Table 13) shows that, overall, 73.8% of the original grouped cases were correctly classified. This result indicates that the discriminant function has acceptable predictive power.

5.3. Deployment model

Since the dependent variable, "Deployment Model," is also a categorical variable (1 = Public Cloud, 2 = Private Cloud), we applied discriminant analysis again in order to understand the discriminant power of the four independent/predictor variables: Perceived Benefits, Business Concerns, IT Capability and External Pressure toward the dependent variable "Deployment Model". According to Table 14, when setting four variables as predictor variables, the discriminant analysis generates a discriminant function and its significance level (0.059) is close to the cut-off value of 0.05, which indicates that the discriminant function has discriminating power.

For the standardized canonical discriminant function coefficients listed in Table 15, "Business Concerns" with the largest coefficient stands out and can strongly predict the choice of Public Cloud or Private Cloud. Perceived Benefits, IT Capability, and External Pressure were less successful predictors.

The Centroid for Private Cloud is 0.061; therefore, the positive and highest standardized canonical discriminant function coefficient: "Business Concerns" (0.803) is the key discriminant function coefficient. That is, the higher level of Business Concerns a firm possesses the greater the possibility of choosing the Private Cloud deployment model. The classification result (Table 16) shows that, overall, 93.3% of original grouped cases were correctly classified, which indicates the discriminant function has great predicting power.

Table 14
Summary of canonical discriminant function.

Function	Eigenvalue	Canonical correlation	Wilks' lambda	Chi-square	Sig.
1	.053	.224	.950	9.098	.059

Table 15
Standardized Canonical Discriminant function coefficients and Structure Matrix.

Function	Variables	Standardized canonical discriminant function coefficients	Structure Matrix
1	Perceived Benefit	.221	.590
	Business Concern	**.803**	**.908**
	IT Capability	.322	.321
	External Pressure	.099	.383

Bold indicates significant at $^{***}p < 0.01$ level.

In summary, the respondents in our survey tend to choose private cloud against public cloud based on Business Concerns. This finding is a further discovery of the aforementioned result of cloud computing adoption. In the previous section, Business Concerns is a significant factor that negatively affects a firm's adoption level due to confidentiality, service outages, vendor lock-in, etc. However, if a firm decides to adopt cloud computing due to other factors (e.g. pressure or incentives), the firm will tend to adopt private cloud. Some firms are very cautious about the Business Concerns issue since cloud computing is still an immature market. Service outages, such as Amazon Web Services (AWS) or Gmail downtime, happen from time to time, which can result in millions of dollars in damages (Lee, 2012; Perez, 2012; Samson, 2011). That may be the reason why the results of structural model indicate a tendency to choose a private cloud deployment model with more control instead of the public cloud.

6. Discussion

Cloud computing is a new technology paradigm that requires a careful and thorough examination when considering firm-level adoption. This empirical research, with 200 respondents, systematically examined cloud computing adoption, pricing mechanisms, and deployment models through the lens of the TOE framework. The results indicate that when talking about cloud adoption intention, three factors significantly influence the final decision: "Perceived Benefits" and "IT capability" are positively related, while "Business Concerns" is negatively related to cloud computing adoption. Among the three significant determinants, "perceived benefits" has the strongest effect, and this result provides empirical evidence to support previous qualitative cloud adoption studies: early cloud adopters appear to place more emphasis on the perceived benefits of technology (Lin & Chen, 2012).

Our study also found that it is not firm size but firms' IT capability that significantly affects their cloud adoption intention. Our results indicated that firms with higher IT capability (i.e. more IT employees and greater IT budget) prefer cloud computing, perhaps because these firms are more familiar with the latest information technology, and keep up with dynamic IT trends. Also, greater familiarity with information technology infers a higher level of knowledge to use in the operation of newer information technology. Thus, greater IT capability might allow for better management of, unpredicted turbulence brought by cloud, without undue economic impact.

Table 16
Classification results.

Deployment model			Predicted group membership		Total
			Public	Private	
Original	Count	Public	1	11	12
		Private	1	167	168

Recent qualitative studies investigating cloud adoption (e.g. Lin & Chen, 2012; Brender, and Markov) yielded similar findings. A firm's IT capabilities, such as existing knowledge and skills among personnel and the company's experiences, are the keys when considering cloud computing adoption (Lin & Chen, 2012). However, we should note that though firm size does not directly affect cloud adoption intention, firm size affects how firms perceive cloud's benefits, and their importance on affecting cloud adoption. Also, firm size affects IT capability's importance on cloud adoption intention. It is very likely that size is an antecedent of TOE factors.

As for Pricing Mechanism, the strongest determinant is IT Capability, and the results indicate that firms with greater IT capability, show a greater probability of choosing the Pay-as-you-go pricing mechanism. Lastly, the deployment model is mainly determined by the Business Concerns factor, and the results illustrate that firms with higher levels of Business Concerns tend to choose private cloud over public cloud.

6.1. Theoretical contribution

To study adoption of general technological innovations, Tornatzky and Fleischer (1990) developed the technology–organization–environment (TOE) framework, which identified three aspects of a firm's context that influence the process. As a generic theory of technology diffusion, the TOE framework can be used for studying the adoption of IS innovations. Cloud computing is being enabled by technology development, requires organizational enablers and entails necessary business reconfiguration, and may shape (and be shaped by) industry environments. Thus, upon theoretically examining adoption contexts, and cloud computing features, we believe that the three contexts in the TOE framework are well suited for studying cloud adoption. However, while the TOE framework has been examined by a number of empirical studies on various IS domains and has consistent empirical support, specific measures identified within the three contexts vary across different studies or settings.

Thus, this study provides a theoretical contribution to the IT adoption literature by showing that when applying the well-developed TOE framework to examine mature technologies vs. immature technologies (such as cloud computing), there are noteworthy differences. For example, External Pressure is considered as a critical factor in adoption of many mature technologies (Chwelos et al., 2001; Tornatzky & Fleischer, 1990; Zhu, Kraemer, Gurbaxani, et al., 2006; Zhu, Kraemer, & Xu, 2006), but it is regarded as an insignificant factor when examining adoption of immature technology, such as cloud computing. As we shown in Table 4, currently, only 30% of our surveyed companies adopted SaaS, 5% of them adopted PaaS, and 13% of them adopted IaaS. Therefore, current cloud adopters somehow share the "innovator" and "early adopter" characteristic in the innovation diffusion lifecycle. We attempt to explain the phenomenon using the viewpoint of the innovation diffusion curve (Rogers, 1995): current cloud adopters are innovators who are adventurous, dare to attempt new things, and to lead the crowd. These pioneers embrace the latest technologies and are not easily affected by pressure from other people. Instead, they will affect the general public later. This finding indicates that, in the early stage of innovation adoption, historically important factors may have only limited impact. Furthermore, we found that IT Capability has an inverse impact that contradicts cloud experts' predictions and vendor propaganda. Our results show that current cloud adopters are firms with higher IT capability, in terms of having more IT employees and higher IT budgets.

Third, the most important distinction of cloud technology is that it offers a larger array of adoption strategies than many previous enterprise solutions. Cloud computing offer more than a binary adoption proposition, and firms can adopt cloud at different levels of commitment by choosing different adoption modalities (pricing and deployment). This is very different from previous enterprise IT adoption. Our study advances the enterprise IT adoption literature by exploring this multi-modal approach to viewing adoption. We use the TOE framework, which has been extensively used to explain enterprise IT adoption, and ask whether it can appropriately explain not only the adoption decision but also the modalities of adoption (pricing mechanisms and deployment model) offered by cloud platforms.

6.2. Managerial insights

According to the above findings, this research also provides some managerial insights. First, we suggest cloud service providers focus more on promoting and validating cloud benefits when marketing their services to potential early adopters, since perceived benefits is the most influential determinant of cloud adoption at this time. Second, we found that current cloud adopters are not SMEs with limited IT capability as most vendors and practitioners predicted. Instead, current cloud adopters have strong IT capability. If cloud vendors can attract more innovators that have strong IT capability to use cloud service and generate successful stories, these innovators' experiences may have a network effect on other firms later on. Innovators, or early adopters, frequently serve as opinion leaders who persuade others to adopt the innovation by providing evaluative information (Rogers, 1995). As noted by many IT professionals in Lin and Chen's (2012) interviews, "*most businesses won't invest in something where its benefits are not apparent (from other firms' using experience),*" and "*our firm would only consider adopting cloud when others are happy with it.*" These may explain why cloud computing is still not taking off even it has been discussed intensively over the years. Other than examining the adoption issue, this research contributes to practitioners by further testing the relationships between firms' characteristics and their choice of Pricing Mechanism and Deployment Model. Firms with more IT capability prefer a pay-as-you-go pricing mechanism and firms with more business concerns tend to adopt the private cloud. Our results provide cloud service vendors strategic insights, such as choosing target costumers and designing promotion strategies.

6.3. Limitation and future research

Our study has some limitations and, therefore, we suggest some directions for future research. First, our data collection was conducted at the very initial stage of cloud computing; many firms were actually still at the imagination stage rather than the use stage of cloud. Thus, bias could have occurred when participants were responding to the questionnaire. When cloud computing services grow into a more mature stage and have more actual users, it would be appropriate to replicate the study for the sake of understanding the different adoption behaviors at a different development stage. Second, though we are very confident that each of the three factors (perceived benefits, business concerns, and IT capability) make a significant contribution to explaining cloud adoption intention, the individual contribution they make appears to be marginal as the magnitudes of path coefficient are not very large. Therefore, while our research model can explain a portion of the variance of firms' cloud adoption decision, there are still many other factors that well worth future research. Also, our data is limited to Taiwan, which may be a reason that the R-square value of our model is not very high. Although we have further conducted a power analysis and checked effective size, and the results both indicated that our research model has significant power to predict the cloud adoption phenomenon, future research is encouraged to collect data from other countries to understand cloud computing adoption better. Third, cloud computing service is a new technology that is going to develop rapidly. There are many types of cloud services: SaaS, PaaS, and IaaS; Private and Public cloud. Different types of cloud services may have different determinants influencing their adoption intention, rate, or behavior. As one IT practitioner commented in Lin and Chen's interview (2012): "*from the user point of view cloud is easy to use, but from the developer's point of view cloud is very complicated*." Similar findings can also be found in other qualitative studies (e.g. Brender & Markov, 2013). Therefore, determinants affecting the adoption of SaaS (which is for users) may be different from those affecting PaaS (which is for IT developers). Though we have conducted a post analysis to preliminarily understand their differences, future research could proceed by including different factors into research model. Fourth, the relationship between preferred adoption options (pricing and deployment) and the antecedent factors of the TOE framework could be quite complex. On the one hand, the availability of different pricing and deployment strategies can influence a firm's concerns about adopting cloud technologies. On the other hand, firms can choose pricing and deployment strategies to address previous concerns about cloud technology, meaning that their preferred choice of adoption strategies would be determined by their concerns. We made an effort in our study to lean our measurement of preferred pricing and deployment strategies toward being adoption strategies. However, choosing between these two causal perspectives of how pricing and deployment should be related to TOE could be an issue worth future research's effort.

7. Conclusion

This study is interested in how cloud adoption intention, pricing and deployment options are derived from the TOE framework. In particular, we believe that the preferred pricing strategy results in part from a cost–benefit analysis, and the deployment strategy results in part from risk analysis, are important issues that previous cloud studies have seldom investigated. Therefore, we believe that our study is highly related to the prior cloud adoption studies; meanwhile, it also contributes to cloud adoption literature by investigating the multifaceted nature (i.e. adoption intention, pricing mechanism, and deployment model) of cloud.

Appendix A. Previous studies on cloud adoption

	Article	Theory	Sample/methodology	Main results
1	Buyya et al., *Future Generation Computer Systems*, 2009	No specific theory is used.	• Overview of cloud computing	Definition, characteristics, resource management strategy, platforms, pricing and adoption of cloud computing.
2	Lin and Chen *International Journal of Information Management*, 2012	TOE framework	• Interview of 19 Taiwanese IT professionals	While the benefits of cloud computing such as its computational power and ability to help companies save costs are often mentioned in the literature, the primary concerns that IT managers and software engineers have are compatibility of the cloud with companies' policy, IS development environment, and business needs.
3	Chang, Walters, and Wills *International Journal of Information Management*, 2013	CCBF model	• Case study	CCBF is proposed to help organizations achieve good Cloud design, deployment, migration and services.
4	Wang and He *International Journal of Information Management*, 2014	No specific theory is used.	• Case study of a small e-learning service provider and its four clients in Taiwan	The service strategies of small cloud service providers are individually differentiated in order to survive in the competitive cloud computing market.
5	Sultan *International Journal of Information Management*, 2011	No specific theory is used.	• Case study of a British SME	Cloud computing is likely to be an attractive option for many SMEs, particularly in the current global economic crisis, due to its flexible cost structure and scalability.
6	Brender and Markov *International Journal of Information Management*, 2013	No specific theory is used.	• Case study of Swiss companies	The adoption of cloud services depend on the company's size with larger and more technologically advanced companies being better prepared for the cloud.
7	Khajeh-Hosseini, Greenwood, and Sommerville, *Working paper*	No specific theory is used.	• Case study of a UK SME	The results show that the system infrastructure in the case study would have cost 37% less over 5 years on cloud computing, and using cloud computing could have potentially eliminated 21% of the support calls for this system. These findings seem significant enough to call for a migration of the system to the cloud but there are significant risks associated with this.
8	Alshamaila, Papagiannidis, and Li *Journal of Enterprise Information Management*, 2013	TOE framework	• Semi-structured interviews in 15 different SMEs and service providers in England • Using Rogers' adopter categorisation	The main factors that were identified as playing a significant role in SME adoption of cloud services were: relative advantage, uncertainty, geo restriction, compatibility, trial ability, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support.
9	Etro *Review of Business and Economics*, 2009	Macroeconomic theory and DSGE model	• Macroeconomic data	The European Union with the creation of a few hundred thousands new SMEs and a significant contribution to growth. Governments could enhance these benefits by subsidizing the adoption of cloud computing solutions.
10	Lian, Yen, and Wang *International Journal of Information Management*, 2014	TOE framework and HOT-fit model	• Survey of 106 CIOs of hospitals • ANOVA	The 5 most critical factors are data security, perceived technical competence, cost, top manager support, and complexity.
11	Lee, Chae, and Cho *International Journal of Information Management*, 2013	Herzberg's two-factor theory	• Survey of 24 Korea IT consultants. • AHP analysis	According to the PEST analysis, social, economic and political factors inhibited SaaS adoption.

	Article	Theory	Sample/methodology	Main results
12	Gupta, Seetharaman, and Raj *International Journal of Information Management*, 2013	No specific theory is used.	• Survey of 211 SMEs/SMBs • PLS	Firstly, ease of use and convenience is the biggest favorable factor followed by security and privacy and then comes the cost reduction. The fourth factor is reliability. The last one is sharing and collaborating.
13	Garrison, Kim, and Wakefield *Communications of the ACM*, 2012	Resource-based theory	• Survey of 314 IT managers • Structural-equations model	Cloud-vendor relationships characterized by trust are critical for cloud deployment and the promise of gaining advantage in a competitive market.
14	Wu, Cegielski, Hazen, and Hall *Journal of Supply Chain Management*, 2013	Innovation diffusion theory	• Survey of 289 managers or executives • Regression analysis	Business process complexity, entrepreneurial culture and the degree to which existing information systems embody compatibility and application functionality significantly affect a firm's propensity to adopt cloud-computing technologies.
15	Our study	TOE framework	• Survey of 200 Taiwanese firms • PLS and discriminant analysis	The study investigates not only cloud adoption intention, but also pricing mechanisms and deployment model. Perceived benefits, business concerns, and IT capability are significant determinants of cloud computing adoption, while external pressure is not. Firms with greater IT capability tend to choose the pay-as-you-go pricing mechanism. Business concern is the most important factor influencing the choice of deployment model.

Appendix B. Research questionnaire

First, we want to learn your opinion about Cloud Service. On a scale of 1–5, where "1" means "not important at all", and "5" means "very important", how does the following factors affect your decision on Cloud Services adoption.

Perceived Benefits of cloud

1. Cloud services can be customized and designed based on company's needs	[PB1]
2. Cloud services can analyze data on the Internet simultaneously	[PB2]
3. Cloud services can shorten IS deployment time	[PB3]
4. Cloud services can reduce IT expense (ex: IT devices, IT maintenances, etc.)	[PB4]
5. Cloud services can reduce IT personnel	[PB5]
6. Once connected to the Internet, users can use the system (Mobility)	[PB6]

References: Armbrust et al., 2010; Buyya et al., 2009; Dikaiakos et al., 2009.

Business Concerns of using cloud

1. Customer or confidential information leakage	[BC1]
2. Difficult to integrate with previous IT systems	[BC2]
3. Cannot provide solid quality guarantee	[BC3]
4. Poor network transfer speed	[BC4]
5. Unexpected service outages	[BC5]
6. Underperformance of the software and hardware	[BC6]
7. Confined to a particular provider, difficult to switch (Data Lock-in)	[BC7]

References: Armbrust et al., 2010; Buyya et al., 2009; Dikaiakos et al., 2009.

External Pressure

1. Cloud adoption of competitors	[EP1]
2. Government policy	[EP2]
3. Cloud adoption of business partners	[EP3]
4. Government regulation	[EP4]

References: Chwelos et al., 2001; Zhu, Kraemer, Gurbaxani, et al., 2006; Zhu, Kraemer, & Xu, 2006.

Then, we would like to know your company's IT status.

IT Capability

1. How many IT employees are there in your company?	[IC1]
(1 = 0–2 employees, 2 = 3–5 employees, 3 = 6–10 employees, 4 = 11–50 employees, 5 = over 50 employees)	
How much was the budget for the IT division of your company in 2009?	[IC2]
(1 = Below 1 million, 2 = Between 1 and 5 million, 3 = Between 5 and 10 million, 4 = Between 10 and 20 million, 5 = Over 20 million)	

References: Bharadwaj, 2000; Zhu, Kraemer, & Xu, 2006.

Cloud Adoption

What is the possibility of changing your current Information System into cloud services within 12 months?

	Already used cloud based systems	Will migrate to cloud in one year	No intention to use
1. CRM	☐	☐	☐
2. ERP	☐	☐	☐
3. SCM	☐	☐	☐
4. e-Business	☐	☐	☐
5. Information Security system	☐	☐	☐
6. Email	☐	☐	☐
7. Video conferencing system	☐	☐	☐
8. Project Management system	☐	☐	☐
9. Human Resource system	☐	☐	☐

What is the possibility of adopting PaaS service for your company (ex: Google App Engine services)?
(1 = No intention to use, 2 = Will migrate to cloud in one year, 3 = Already in use).
What is the possibility of adopting IaaS service for your company (ex: Amazon EC2 services)?
(1 = No intention to use, 2 = Will migrate to cloud in one year, 3 = Already in use).

Deployment Model
What kind of cloud model would you choose if your company decided to adopt cloud computing?
1. Public Cloud
2. Private Cloud

Pricing Mechanism
What kind of payment option would you choose if your company decided to adopt cloud computing?
1. Pay-as-you-go
2. License
3. Unlimited access with monthly fee

References: Armbrust et al., 2010; Mell & Grance, 2009.

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