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An Empirical Investigation Into The Impact Of Privacy, Information Control, And Regulatory Expectations On The Adoption Of Cloud Computing

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ABSTRACT

This study develops and tests a model for the adoption of cloud computing. The model draws on the literature on privacy, information control, regulatory expectations, and technology adoption. The results indicate perceived privacy, perceived information control, and perceived regulatory expectations influence the behavioral intentions on using the cloud computing. For cloud computing, the results also validate the relationship between behavioral intention to use cloud computing and the actual use of cloud computing. This study has both theoretical and practical implications.

KEYWORDS: Cloud computing, Privacy, Information control, Regulatory expectations, Technology adoption, Partial least square regression

INTRODUCTION

In the past decade, cloud computing has evolved as an innovative mean for managing, delivering and utilizing information technology (IT) resources (Bhattacherjee & Park, 2014). It represents a significant shift in the paradigm of computing whereby users will engage a third-party internet-hosted computing services, data storage, and software applications rather than resources from their local computers for meeting their computing needs (Battacherjee & Park, 2014). Individual users and firms access the capabilities and services of IT in an on-demand basis over the Internet and bill in accordance of their usage of the services by the cloud providers (Bhattacherjee & Park, 2014; Rahimli, 2013; Zhang et al., 2010). Cloud computing exemplifies a merger between business and personal computing, and Internet technologies. The format of usage and providing the services has change the landscape of how computing programs and solutions are designed, managed, catered and stored for meeting the users demand, needs and expectations (Bhattacherjee & Park, 2014; Marston et al., 2012).

Cloud computing offers many advantages. With only Internet connection, users can access to cloud-hosted IT resources at anytime and anywhere (Marston et al., 2012; Zhang et al., 2010). As IT resources are available on demand and users are billed based on the services provided, cloud computing offers significant cost benefits (Jena and Mahnti, 2010; Zhang et al., 2010). The other benefits of cloud computing include high scalability, portability, flexibility and a huge reduction in business risks and maintenance expenses (Jena and Mahanti, 2010; Marston et al., 2012; Zhang et al., 2010). Despite these, many users are reluctant to accept cloud computing (Bhattacherjee & Park, 2014). The main concerns are privacy and security, and the legal liability for the data that were stored on the cloud systems (Amburst et al., 2010; Marston et al., 2011; Mansfield-Devine, 2008). Though the literature is filled with the benefits (Amburst et al., 2010;

Rahimli, 2013; Zhang et al., 2011) and risk (e.g. Amburst et al., 2010; Marston et al., 2011; Morton & Alford, 2009), and on the attitude, subjective norm, social influence, and usefulness of adopting cloud computing (Behrend et al., 2011; Benlian et al., 2009; Taylor & Hunsinger, 2011), there is little literature that explores the role of privacy, information control, and regulatory guides on the usage of cloud computing.

In this study we draw from literature on privacy, information control, regulatory guidelines, and explore the user acceptance of technology to develop model for understanding cloud computing usage and empirically test the model using survey methodology. The findings of this study will help cloud providers with insight into the users' concerns regarding privacy and ethical issues on cloud computing and will further motivate users to have faith in using cloud computing.

The rest of the paper is organized as follows. The next section reviews the theoretical background on privacy, information control, regulatory agencies, and the adoption of cloud computing and postulates hypotheses for empirical testing. The third section describes the research methodology and data collection strategy. The fourth section presents our data analysis and results. The final section concludes with discussion, limitations, implications and areas for further research.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

Perceived Privacy

Privacy refers to an individual's right to access, control, and to use personal information (Pavolu, 2011). Privacy has always been an important concern in this information age (Dinev et al.,2013; Pavlou, 2011; Raschke et al., 2014). Given the nature of cloud computing whereby cloud services store and process data on machines that users do not own makes privacy a greater concern for anyone who want to adopt cloud computing for their personal or organizational usage (Kim, 2014). Remote storage and processing of data possess additional privacy threats (Pearson, 2009). The cloud providers lower costs by migrating users' cloud data and process from one hardware instantiation to another (Whitley et al., 2013). This migration process could further trigger privacy concerns (Whitley et al., 2013). Further cloud services collect data from different users and store them in a single place (Mansfield-Devine, 2008). Again, sharing a cloud data center among the users may raise the issue on privacy (Whitley et al., 2013) with a possibility that these data could be accidently or in certain cases deliberately compromised with undesirable consequences (Ryan, 2011). In all cases, users value their privacy (Kim, 2013). Thus if the users believe that when they use cloud services their privacy may be at risk, then they may not have a positive attitude towards using cloud computing.

Therefore, we hypothesize that

H1: There exists a positive relationship between perceived privacy and behavioral intention to use cloud computing.

Perceived Information Control

Information control is another major concern regarding the use of cloud computing (Dinev, et al., 2013; Laufer, & Wolfe, 1977). Information control refers to an individual's perception in the control over information released by the cloud providers. Once the data is migrated to the cloud environment, cloud providers have the control over the data on when to release them, who to

release to and how to reveal them (Geczy et al., 2011). Any compromises on security or attacks by the externals could mean a huge loss on the individuals' and firms' confidential information, trade secrets, trademarks and private details (Kalloniatis et al., 2014; Geczy et al., 2011; Hayes, 2008; Reavis, 2012; Whitley et al., 2013). Individuals and firms will have more confidence and trusts if they have the control over their data and information on when, where and how to process, store and release the information. Further, if individuals believe that they have control over their data and information and their use in the cloud then they tend to look more favorably over using cloud computing.

Therefore, we hypothesize that:

H2: There exists a positive relationship between perceived information control and behavioral intention to use cloud computing.

Perceived Regulatory Expectations

Perceived regulatory expectations refer to the belief of cloud computing users that their information is secured and the privacy of their information is protected, and any breach to this security or misuse of information will be promptly handled through legal actions. In the present information age, users own their private information and control the physical housing of information (Marston et al., 2011). However, cloud computing alters the residency and ownership of data and information (Marston et al., 2011). Users basically hand over their data and information to an external party for storage and processing, and in some cases distribution (Marston et al., 2011; Ryan, 2011). The distributions of information in particular to those outside the US may not meet the export control stipulates by the US Federal laws (Marston et al., 2011). So far, there is a lack of a clear set of rules and regulations that defines the responsibilities and liabilities of cloud providers in handling, securing and protecting the privacy of cloud data (Marston et al., 2011; Whitley et al., 2013). Thus if users perceive that their data in the cloud is secured, protected and well handled by professionals and national and international guidelines, and cloud computing providers are subject to criminal and civil liabilities for any failure on their parts, then they are more inclined to use cloud computing.

Therefore, we hypothesize that:

H3: There exists a positive relationship between perceived regulatory expectations and behavioral intention to use cloud computing.

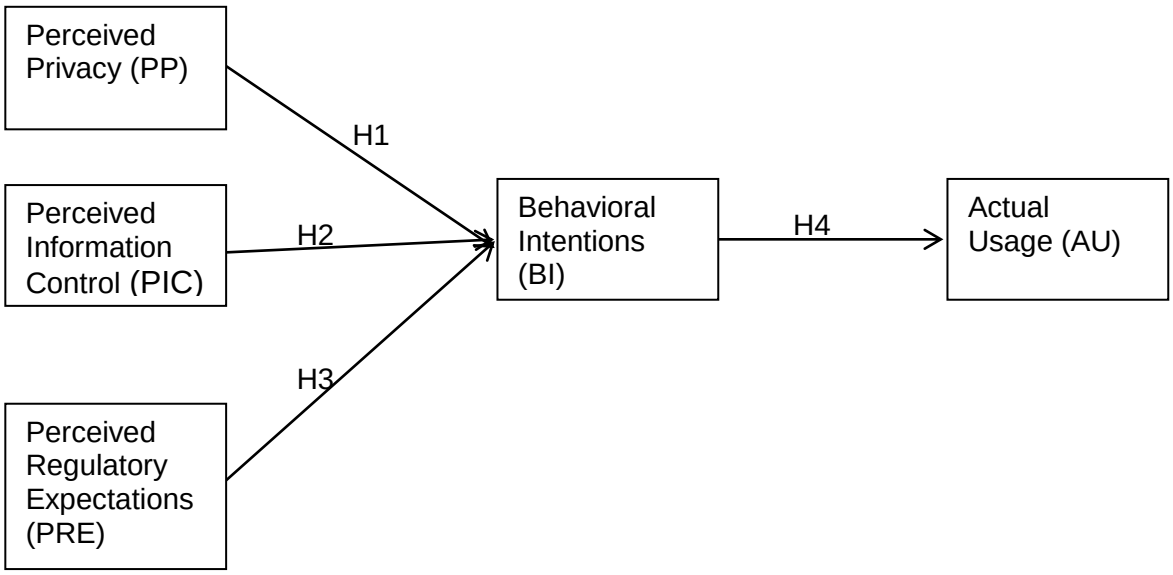
Behavioral Intention

Behavioral intention is defined as "a person's subjective probability that he will perform some behavior" (Fishbein & Ajzen, 1975, p. 288). In Technology Acceptance Models (TAM), behavioral intention is operationalized to understand an individual's intentions in using a specific technology or information (Venkatesh et al., 2003). Prior research has shown a strong link between behavioral intention and actual usage (Davis et al., 1989; Venkatesh et al., 2003; Wu & Du, 2012). Actual usage is perceived as "a user's employment of a system to perform a task" (Burton-Jones & Gallivan, 2007, p. 659). Extending the relationship between behavioral intention and actual usage within the cloud computing context, we hypothesize that:

H4: There exists a positive relationship between behavioral intention to use cloud computing and the actual usage of cloud computing.

Figure 1 gives an illustration of our research model.

Figure 1: Research Model



RESEARCH METHODOLOGY AND DATA COLLECTION

A survey methodology is used to test our model. A convenient sampling is used. The respondents are graduate and undergraduate students from a Historically Black University and College (HBCU) situated in the southwest of US. The constructs were operationalized and the survey items were established by determining appropriate measurements from a review of existing literature on privacy, information control, regulatory expectations, and technology acceptance. The items for measuring perceived privacy, perceived information control, and perceived regulatory expectations were adapted from Dinev et al. (2013) and modified to suit the context of cloud computing. Items for measuring behavioral intention and actual usage constructs were adapted from TAM literature. We use a five point Likert scale with a (1) indicating “strongly disagree” and a (5) indicating a “strongly agree.” to measure the extent of variable impact upon the overall results.

DATA ANALYSIS AND RESULTS

We used PLS path modelling to evaluate the proposed model and test the hypotheses. PLS offer many advantages over other statistical techniques such as analysis of variance and regression. PLS has the ability to estimate series of interdependent relationships simultaneously (Ramakrishnan et al., 2012). It further is robust to violations of homogeneity and normal distributions of the data set (Chin, 2003). Furthermore, although not a remedy for very small sample sizes, PLS can handle smaller sample size much better than other multivariate techniques (Marcoulides & Saunders, 2006). The recommended minimum sample size that can be efficiently handled by PLS is one that is at least ten times the number of independent variables influencing a single dependent variable (Chin, 1998; Wixom & Watson, 2001). Our model has three independent variables that influence a single dependent variable. These

variables are perceived privacy (PP), perceived information control (PIC), and perceived regulatory expectancy (PRE). In our study, we have altogether 123 usable samples. This has met the minimum required sample size of 30.

We used SmartPLS2.0 (Ringle et al., 2005) to analyze our research model. PLS provides the analysis for measurement and structural model. The measurement model looks into how well the observed indicators describe the latent construct (Komiak & Benbasat, 2005). This is done by evaluating the reliability and validity of the measures (Ramakrishnan et al., 2012). The structural model examines the relationships between the latent constructs (Tenenhaus et al., 2005).

Measurement Model

The constructs were assessed for reliability of the data using Cronbach's alpha (Cronbach, 1951). All the constructs had Cronbach's alpha greater than 0.70, indicating they had adequate reliability (Nunnally, 1978). Refer to Table 1.

The constructs were assessed for validity through convergent and discriminant validity (Hair et al., 1998). We assessed the convergent validity by examining the average variance extracted (AVE) and the composite reliability of the constructs (Hu et al., 2004). The AVE is the amount of variance explained by the indicators of the latent construct relative to the amount of variance captured due to measurement error (Chin, 1998). The composite reliability measures "the internal consistency of the constructs and the extent to which each item indicates the underlying construct" (Moores & Chang, 2006, p. 173).

An adequate model should have an AVE greater than 0.5 and a composite reliability greater than 0.7 (Komiak & Benbasat, 2005). The results of AVE scores and composite reliability are given in Table 1. All the constructs in the model had an AVE score greater than 0.5 and composite reliability greater than 0.7, thus exhibiting adequate convergent validity.

Table 1: AVE, Composite Reliability, and Cronbach's Alpha Scores

CONSTRUCTS	AVE	COMPOSITE RELIABILITY	CRONBACHS ALPHA
Perceived Privacy (PP)	0.825	0.934	0.897
Perceived Information Control (PIC)	0.676	0.893	0.846
Perceived Regulatory Expectations (PRE)	0.739	0.894	0.840
Behavioral Intentions (BI)	0.885	0.959	0.935
Actual Usage (AU)	0.808	0.927	0.885

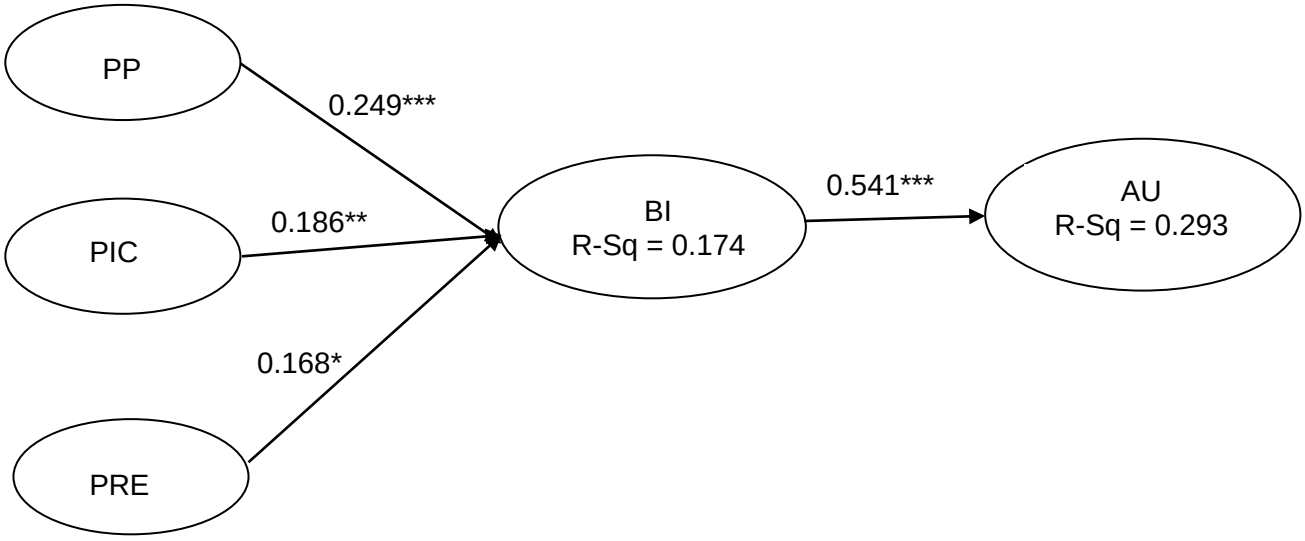
Discriminant validity is assessed by examining the relationship between the correlation among the latent variables and the square root of the AVEs of those latent variables (Gefen & Straub, 2005). For the constructs to exhibit adequate discriminant validity, the correlation among the latent constructs must be lesser than the square root of AVEs of the latent constructs. The relationship between the correlation among the latent constructs and the square roots of the AVEs for this study is shown in the table 2. The correlation among the latent constructs (non-diagonal elements) is lesser than the square root of the AVEs (diagonal elements). This suggests that all the constructs in this study exhibit satisfactory discriminant validity.

Table 2: Square Root of AVEs and Correlation among Latent Constructs					
	PP	PIC	PRE	BI	AU
PP	**0.909**				
PIC	0.592	**0.822**			
PRE	0.002	-0.111	**0.859**		
BI	0.361	0.317	0.148	**0.941**	
AU	0.179	0.260	0.054	0.541	**0.899**

Structural Model (Hypotheses Testing)

In PLS, the relationship between the theoretical constructs is represented by the structural model. Figure. 2 represents a graphical depiction of the structural model.

Figure 2: Structural Model *p<0.1; **p<0.05; ***p<0.01



To obtain the t-values for estimating the significance of the path coefficients a recommended 500 random samples of 123 responses were generated using the bootstrapping procedure in SmartPLS (Majchrzak et al., 2005). A one-tailed t-test was used to assess the hypotheses as they are unidirectional in nature. The path coefficients, t-values, and their respective p-values for the hypotheses are given in Table 3.

Table 3: Path Coefficients, T-Values, P-values for Hypotheses testing			
Hypothesis	Beta Coefficient	T-Test	Significance
H1	0.249	2.334	0.01***
H2	0.189	1.907	0.03**
H3	0.168	1.668	0.05**
H4	0.541	6.698	0.00***

Hypothesis H1 suggests that there exists a positive relationship between perceived privacy and behavioral intention to use cloud computing. Hypothesis H2 suggests that there exists a positive relationship between perceived information control and behavioral intention to use cloud computing. Hypothesis H3 suggests that there exists a positive relationship between regulatory expectations and behavioral intention to use cloud computing. Hypothesis H4 suggests that there exists a positive relationship between behavioral intention to use cloud computing and actual use of cloud computing. We found evidence to support hypothesis H1 at 0.05 significance level, hypothesis H2 at 0.1 significance level, and hypotheses H3 & H4 at 0.01 significance level. The summary of the results of the hypotheses testing is given in Table 4.

Table 4: Results of Hypotheses Testing

	Hypotheses	Result
H1	There exists a positive relationship between perceived privacy and behavioral intention to use cloud computing.	Supported
H2	There exists a positive relationship between perceived information control and behavioral intention to use cloud computing.	Supported
H3	There exists a positive relationship between perceived regulatory expectations and behavioral intention to use cloud computing.	Supported
H4	There exists a positive relationship between behavioral intention to use cloud computing and behavioral actual usage of cloud computing.	Supported

DISCUSSION AND IMPLICATIONS

In this study we develop and test a model to understand factors that influence individuals' use of cloud computing technology. We draw on research from technology acceptance and privacy to expand and test the existing model. All our hypotheses were statistically significant. In line with prior research on technology acceptance, this study suggests the intention to use cloud computing is a strong predictor of actual usage of cloud computing. Further, the results indicate that perceived privacy, perceived information control, and perceived regulatory expectations play important roles in our intention to use cloud computing technology. Our proposed model accounts for 29.25% of the variance in the actual usage of cloud computing and 17.43% of the variance in the intention to use cloud computing suggesting adequate explanatory power. The results have both theoretical and practical implications.

From a theoretical perspective, this study augments the existing research in cloud computing. Prior literature on cloud computing focuses mainly on the benefits, risks, and cloud computing architecture (Armburst et al., 2010; Marston et al., 2011). This study indicates that apart from risks and benefits there may be other factors that influence adoption of cloud computing. Factors such as regulatory expectation, control/ownership of information, and privacy issues may play an important role in users' to adoption of cloud computing. Further, prior empirical studies have examine factors such as attitude, subjective norm, and behavioral control (Bhattacherjee & Park, 2014) for the adoption of cloud computing. This study suggests perceived privacy, perceived information control, and perceived regulatory expectations play an important role in influencing these attitudes in cloud computing adoption.

From a practical perspective, the results suggest that cloud vendors can motivate users' to adopt cloud computing by reducing their concerns over the issue on privacy. Further, there is a need for a reliable and stringent guidelines on the part of cloud providers. The providers need to offer assurance on ownership, control and accessibility of the clients' information on a convenient and reliable setting. Providers need to constantly communicate with users on their

internal policies regarding their staffs' continuing education programs and training, and compliance requirements with regulatory requirements on data protections. These will help increasing users' confidence in using cloud computing.

LIMITATIONS AND FUTURE RESEARCH

Although the data supports the proposed model, the findings of our study should be assessed in light of its limitations. This study looks into privacy, control, and regulatory expectations with respect to the adoption of cloud computing for individual users. Privacy, control, and regulatory expectations on cloud services may vary from users to users. Further a convenient sample with student population was used to conduct this study. Thus, there is a need to conduct further research that includes larger and diverse sample size, focus group discussions (Chong, 2008), with a wide range of users and providers who could help in better understanding the implications and relationships between privacy and regulatory requirements, between privacy and ethical perspective of using cloud computing. The search for answers remains in our agenda.

Further, other factors such as the benefits of cloud computing, switching cost from client-hosted machine to cloud computing, performance expectancy, effort expectancy, facilitating conditions, social influence, and role of cyber security (Chong & Opara, 2009) that are germane to the adoption of cloud computing were not examined in this study. The purpose of this study was to develop and test a model to examine the influence of privacy, information control, and regulatory expectations. Therefore, future research is required to examine these factors and also examine additional predictors to expand the scope and explanatory power of our proposed model.

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