International Journal of Information Management 31 (2011) 252–260

Contents lists available at ScienceDirect

International Journal of Information Management

journal homepage: www.elsevier.com/locate/ijinfomgt

An empirical investigation of mobile banking adoption: The effect of innovation attributes and knowledge-based trust

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ARTICLE INFO

Article history:
Available online 21 August 2010

Keywords:
Mobile banking
Innovation diffusion
Knowledge-based trust
Attitude
Behavioral intention

ABSTRACT

Rapid advances in mobile technologies and devices have made mobile banking increasingly important in mobile commerce and financial services. Using innovation diffusion theory and knowledge-based trust literature, this study develops a research model to examine the effect of innovation attributes (perceived relative advantage, ease of use and compatibility) and knowledge-based trust (perceived competence, benevolence and integrity) on attitude and behavioral intention about adopting (or continuing to use) mobile banking across potential and repeat customers. Based on a survey of 368 participants (177 for potential customers and 191 for repeat customers), this study uses a structural equation modeling approach to investigate the research model. The results indicate that perceived relative advantage, ease of use, compatibility, competence and integrity significantly influence attitude, which in turn lead to behavioral intention to adopt (or continue-to-use) mobile banking. Additionally, by using multi-group analysis with *t*-statistics, the results found that the antecedents of attitude toward mobile banking differ between potential and repeat customers. The implications for research and practice and future research directions are discussed.

1. Introduction

In June 2007 in Taiwan, the mobile banking service was offered by three major mobile service providers (Chunghwa Telecom, Far EasTone, and Taiwan Mobile) in partnership with 20 banks (Taiwan Telecommunications Report, 2009). By January 2009, Taiwan had 1.55 million mobile commerce (m-commerce) customers (approximately 7.77% of the total population) (iThome, 2009). However, according to a report of MIC (Market Intelligence Center, Taiwan's leading IT industry analysis and consulting service provider) states that less than 2.3% of banking transactions in Taiwan were conducted through mobile devices (MIC, 2009). Moreover, mobile banking remains in its infancy and international adoption rates are low (Datamonitor, 2009). Therefore, identifying and understanding the factors influencing attitude and behavioral intention toward adopting (or continuing to use) mobile banking is one of the fundamental requisites for development of mobile banking services.

Mobile banking (Internet banking using mobile devices, also known as M-Banking, mbanking, SMS Banking etc.) can perform account balances and transaction history inquiries, funds transfers, and bill payments via mobile devices such as cell phones, smartphones, and PDAs (personal digital assistants) (Laukkanen, 2007a; Turban, King, Viehland, & Lee, 2006). Acceptance and adoption of mobile banking differs from adoption of non-mobile Internet banking is at least two ways. First, the difference between mobile and non-mobile Internet banking is the pace of evolution, with mobile banking evolving much faster than non-mobile Internet banking (Laukkanen, 2007a). Information systems (IS) researchers have proposed that mobile banking can be considered as one of the most significant technological innovation, which is emerging as a key platform for expanding access to banking transactions via mobile or handheld devices, and operating wireless communication technologies (Herzberg, 2003; Kleijnen, Wetzels, & Ruyter, 2004; Laukkanen, 2007b; Laukkanen & Lauronen, 2005). Mallat, Rossi, and Tuunainen (2004) claimed that mobile banking services provide customer value creation due to being inherently time and place independent, as well as their effort-saving qualities. Innovation diffusion theory (Rogers, 1995) posits that perceived innovation attributes (like relative advantage in innovation theory) influence individual usage of an innovation. Technological innovations have been studied using this perspective (e.g., Agarwal & Prasad, 1997; Moore & Benbasat, 1991; Papies & Clement, 2008; Tan & Thoen, 2001; Teo & Pok, 2003). Mobile banking may have new features (such as ubiquity, flexibility and mobility) compared to conventional banking channels (e.g., automated teller machine, phone-banking, non-mobile Internet banking), however, the effects of innovation attributes deserve attention have not been fully understood in the adoption of mobile banking (Sulaiman, Jaafar, & Mohezar, 2007).

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doi:10.1016/j.ijinfomgt.2010.07.006

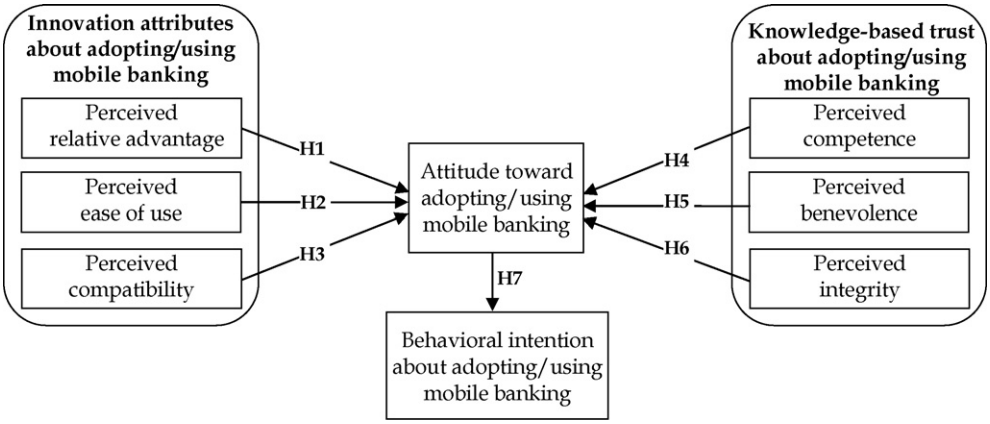

Fig. 1. Research model.

When a new innovative service such as mobile banking is introduced, customers may feel fearful about using it for banking transactions. Luarn and Lin (2005) also emphasized that the main concern regarding mobile banking adoption and use is wireless transaction security, including lack of encryption of SMS (short message services) messages and customer fear of distributing personal data. Trust helps reduce these fears and potential risks and facilitate business transactions under uncertainty (Corritore, Kracher, & Wiedenbeck, 2003; Jarvenpaa, Tractinsky, & Vitale, 2000; Lee, 1998). Knowledge-based trust is a function of individual perceptions of the competence, benevolence and integrity of a product, service, or person (Mayer, Davis, & Schoorman, 1995). In the context of mobile banking, the customer is able to form knowledge-based trust concerning whether or not mobile banking firms (including banks, telocs and other financial institutions) have the ability to provide the banking services properly and conveniently (i.e., is competence), and whether mobile banking firms are willing to deliver benevolent services (i.e., has benevolence) and make good-faith agreements (i.e., has integrity) regarding banking transactions. Customer trust may play an essential role in explaining and solving the problems of adopting mobile banking. This perspective has been strengthened by several recent studies (Gu, Lee, & Suh, 2009; Kim, Shin, & Lee, 2009; Lee & Chung, 2009). However, few studies have empirically examined the relationship between knowledge-based trust (perceived competence, benevolence and integrity) and customer behavior in the mobile banking context.

Attracting potential customers and retaining existing customers is crucial to the long-term business success of mobile banking firms (Gu et al., 2009). However, the relative importance of innovation attributes and knowledge-based trust regarding mobile banking may differ between potential and repeat customers. In the context of mobile banking, there is little empirical research comparing the relative importance of factors which influence adoption (or continue-to-use) decisions in the case of potential and repeat customers. As a result, deeper understanding is necessary of what innovation attributes and knowledge-based trust facilitate adopting (or continuing to use) mobile banking across potential and repeat customers. Motivated by these issues, this study examines the effect of innovation attributes (perceived relative advantage, ease of use and compatibility) and knowledge-based trust (perceived competence, benevolence and integrity) on attitude and behavioral intention about adopting/using mobile banking. Moreover, this study has theoretical and managerial implications. Theoretically, drawing upon innovation diffusion theory and knowledge-based trust literature, this study aims to provide a model that capable of understanding the determinants of customer adoption (or continue-to-use) mobile banking. From a managerial perspective, the findings should provide further insight into the significance of multifaceted strategies for understanding and managing potential and current mobile banking customers.

2. Theoretical background and research model

This study focuses on perceived innovation attributes and knowledge-based trust as explanatory and predictive variables for attitude and behavioral intention about adopting/using mobile banking. The research model is proposed to address this issue (see Fig. 1). All variables hypothesized in this study and natures of their expected relationships with customer attitude toward adopting (or continuing to use) mobile banking are discussed next.

2.1. Innovation attributes and attitude

Mobile banking can be treated as a technological innovation because it allows customers to conduct banking transactions without constraints of time and place and to connect banking services easily and quickly with mobile devices (Laukkanen, 2007b). The importance of innovation attributes has also been documented in the literature (Rogers, 1995). Several studies indicated user perceptions of the innovation influencing their adoption decisions towards Internet-based IS (e.g., Lean, Zailani, Ramayah, & Fernando, 2009; Papies & Clement, 2008; Tan & Thoen, 2001; Teo & Pok, 2003). The innovation diffusion theory provides a set of innovation attributes that may affect adoption decisions (Rogers, 1995). These innovation attributes include relative advantage (the degree which an innovation can bring benefits to the organization), ease of use (opposite of complexity, the degree to which an innovation is easy to use), compatibility (the degree to which an innovation is consistent with existing values, beliefs and experiences of the adopters), observability (the degree to which an innovation is visible to others), and trialability (the degree to which an innovation may be experimented with) (Rogers, 1995). Among these innovation attributes, relative advantage, ease of use, and compatibility were found to be the most frequently identified factors for adoption and diffusion of Internet-based technologies (Liao, Shao, Wang, & Chen, 1999; Papies & Clement, 2008; Vijayasarathy, 2004). Hence, this study examines the extent to which these three perceived innovation attributes can predict attitude toward adopting (or continuing to use) mobile banking.

Perceived relative advantage refers to the degree to which an innovation provides more benefits than its precursor. Relative advantages manifests as increased efficiency, economic benefits, and enhanced status (Rogers, 1995). Moore and Benbasat (1991)

found that perceived relative advantage of an innovation is positively related to the rate of adoption. Correspondingly, the potential of mobile banking reported obvious benefits such as immediate, convenient and affordable to customers (Laukkanen, 2007a). In general, when customers perceive clear advantages offered by mobile banking, they are more likely to have a positive attitude toward adopting (or continuing to use) mobile banking. The following hypothesis thus is proposed.

H1. Perceived relative advantage has a positive effect on attitude toward adopting (or continuing to use) mobile banking.

Perceived ease of use is the degree to which mobile banking is perceived as easy to understand and operate. To prevent the problem of a useful system remaining "under-used", customers do not need to expend significant effort on using mobile banking. Due to mobile banking services having very user friendly interfaces, customers are likely to see them as easy to use, and hence to have positive attitudes towards them. Hence, the following hypothesis is proposed:

H2. Perceived ease of use has a positive effect on attitude toward adopting (or continuing to use) mobile banking.

Perceived compatibility is the degree to which an innovation fits the values, previous experiences and needs of the potential adopter (Rogers, 1995). Greater compatibility between individual needs and technological innovation is preferable, because it allows innovation to be interpreted in a more familiar context (Ilie, van Slyke, Green, & Lou, 2005). Perceived compatibility has been identified as the best perception-based indicator of attitude towards online transactions (Vijayasarathy, 2004). Therefore, this study expects that customers perceive mobile baking as compatible with their lifestyle and preferences, and thus adopt a favorable attitude towards adopting (or continuing to use) mobile banking. The following hypothesis is proposed.

H3. Perceived compatibility has a positive effect on attitude toward adopting (or continuing to use) mobile banking.

2.2. Trust in mobile banking

Since mobile banking is relatively new electronic delivery channels being offered by banks, people may choose not to adopt mobile banking because of security or privacy concerns (Laforet & Li, 2005; Lee, McGoldrick, Keeling, & Doherty, 2003). The lack of trust is one of the most frequently cited reasons for customers not using mobile banking (Kim et al., 2009; Lee & Chung, 2009). Previous studies suggested that a greater degree of trust is required in an online transaction environment than in a face-to-face transaction environment (Grabner-Krauter & Kaluscha, 2003; Lee & Turban, 2001). Aladwani (2001) also argued that trust is a key future challenge of online banking transactions, because such transactions lack the physical presence of a physical branch, as well as face-to-face interaction between bank personnel and the customer. To cope with uncertainty in a mobile transaction environment, trust helps reduce fraud and potential risk and increase the likelihood of customers adopting mobile banking.

Knowledge-based trust is a trust belief, and is often defined as the belief of an individual in the trustworthiness of others as determined by their perceived competence, benevolence and integrity (Mayer et al., 1995; McKnight, Choudhury, & Kacmar, 2002). Knowledge-based trust has been found to be a necessary element for shaping online user behaviors (Gefen, 2002). Moreover, the integrated model of trust proposed by Mayer et al. (1995) argues that knowledge-based trust involves deliberate cognitive assessment of relevant trustee attributes. Mayer et al. (1995) and McKnight et al. (2002) identified and validated three main elements of knowledge-based trust: competence (the ability of the trustee to meet the needs of the trustor), benevolence (the trustee caring and being motivated to act in the interest of the trustor) and integrity (trustee honesty and promise keeping). In the context of mobile banking, competence belief refers to individual perceptions that mobile banking firms have the ability, skills, and expertise to understand their needs in relation to manage personal finances, benevolence belief refers to individual perceptions that mobile banking firms care about them and acts in their interest, and integrity belief refers to individual perceptions that mobile banking firms follows a set of principles (e.g., honesty and keeping promises) generally accepted by adopters (Mayer et al., 1995; McKnight et al., 2002). Perceived competence, benevolence and integrity of mobile banking firms may play an important role in determining individual attitudes toward the use of mobile banking. Hence, examining the relationship between knowledge-based trust and attitude about adopting (or continuing to use) mobile banking becomes an important issue needing to be addressed.

Muir and Moray (1996) posited that trust in an automated system is based primarily on customer perceptions of capabilities of the automated system. Pennington, Wilcox, and Grover (2003) suggested that customers perceive the technical competence of a website in terms of their understanding of the underlying processes governing the online transactions. If customers believe mobile banking firms offer the ability, skills, and expertise to provide appropriate transactional services, then they will be more likely to evaluate mobile banking favorably. Thus, perceived competence is posited to result in more positive attitude toward adopting (or continuing to use) mobile banking, leading to the following hypothesis:

H4. Perceived competence has a positive effect on attitude toward adopting (or continuing to use) mobile banking.

Benevolence is important to trust because it indicates the extent to which an individual is believed to feel interpersonal care and concern for others, and to be willing to strive to do well for reasons other than ego and profits (Robert, Dennis, & Hung, 2009). Bhattacherjee (2002) contended that a benevolent trustee would help a trustor, even when not required to or rewarded for doing so. If customers believe that mobile banking firms are benevolent, they are more likely to use mobile banking. Thus, perceived benevolence is likely to be associated with positive attitude toward adopting (or continuing to use) mobile banking. This results in the following hypothesis.

H5. Perceived benevolence belief has a positive effect on attitude toward adopting (or continuing to use) mobile banking.

Perceived integrity indicates adherence to a set of acceptable principles. Integrity is critical because it instills the confidence of trustors in trustee behavior, and reduces uncertainty and potential risks (Bhattacherjee, 2002). In the context of mobile banking, rules governing integrity include providing accurate and timely information, maintaining customer commitment, and maintaining confidentiality of personal information. Such rules of integrity convey an image of objectivity and encourage customers to see mobile banking firms as having high integrity. Mobile banking firms are considered to exhibit high integrity when customers believe mobile banking firms exhibit strong justice, honesty, and objectivity. Therefore, customers with high integrity belief in mobile banking firms are more likely to have positive attitude toward adopting (or continuing to use) mobile banking. This leads to the following hypothesis.

H6. Perceived integrity belief has a positive effect on attitude toward adopting (or continuing to use) mobile banking.

2.3. Attitude and behavioral intention

Intentions-based models have been successful in investigating attitude as a mediator between beliefs and intentions (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Fishbein & Ajzen, 1975; Taylor & Todd, 1995). Attitude toward adopting (or continuing to use) the particular system is generated by individual salient beliefs about the consequences of adopting (or continuing to use) the particular system and evaluation of these consequences (Karahanna, Straub, & Chervany, 1999). Individual attitude towards system use is expected to influence system use intention. Existence of this relationship has been supported in a variety of situations, including in the workplace using enterprise resource planning (ERP) and knowledge management programs (Calisir, Gumussoy, & Bayram, 2009; Wu & Li, 2007) and virtual settings using technology such as Internet services (Lee, Choi, Kim, & Hon, 2007; Schubert, 2002). This study expects this relationship to hold in mobile banking context. Specifically, potential customers (or repeat customers) attitude toward mobile banking reflects feelings of favorableness and unfavorableness towards mobile banking and therefore predicts adoption (or continued post-adoption usage) intentions. The following hypothesis is formulated:

H7. Customer attitude has a positive effect on behavioral intention about adopting (continuing to use) mobile banking.

2.4. Differences between potential and repeat customers

With regard to IS, Karahanna et al. (1999) argued that the model used to test IS usage and impact across different users (e.g., inexperienced users versus experienced users) might result in new insights. Furthermore, several studies on online shopper behavior have identified differential effects of the antecedents of the adoption of retail websites that affect potential adopters and experienced users (Elliott & Speck, 2005; Gefen, Karahanna, & Straub, 2003; Kim, Xu, & Koh, 2004). Marler, Fisher, and Ke (2009) examined differences between the determinants of initial adoption and subsequent continued usage of employee self-service technology.

The above discussion motivated this study to examine the antecedents of customer attitudes based on the extent of their experience with mobile banking. Empirically, few studies have examined whether the antecedents of attitude toward mobile banking differs between potential and repeat customers. Consequently, few are aware of the differences that exist in individual salient beliefs and attitudes toward mobile banking across potential and repeat customers. The same antecedents of attitudes toward mobile banking may exhibit differential effects between potential and repeat customers. The following hypothesis is proposed.

H8. The strength of the antecedents of attitude toward mobile banking differs between potential and repeat customers.

3. Research method

3.1. Data collection

Data for this study was collected by the means of a survey conducted in Taiwan in 2009. The paper-based questionnaires were distributed to a total of 500 participants with NTD100 (about $3 US) incentive; 368 usable respondents were obtained. This study's main sample comprised 368 respondents drawn from two populations. The first sample was selected from students (including undergraduate and graduate students) because they are current cell phone customers and will, in all likelihood, be mobile banking customers after graduation. The second sample consisted of mobile banking customers provided by one public and three private banks. Out of the 220 students, 190 respondents were obtained (86% response rate). Out of the 280 mobile banking customers, 178 respondents were obtained (64% response rate).

Table 1
Profile of the respondents.

Demographics	Potential customers (n_1 = 177)		Repeat customers (n_2 = 191)	
	Frequency	%	Frequency	%
Gender				
Female	70	39.5	93	48.7
Male	107	60.5	98	51.3
Age (years)				
<20	14	7.9	1	0.5
20–30	77	43.5	48	25.1
30–40	42	23.7	102	53.4
>40	44	24.9	40	21.0
Education				
High school or below	16	9.0	8	4.2
University	111	62.7	113	59.1
Graduate school or above	50	28.3	70	36.7
Current profession				
Student	70	39.6	32	16.8
Part-time employee	25	14.1	17	8.9
Full-time employee	72	40.7	118	61.8
Home-makers	2	1.1	5	2.6
Self-employed	5	2.8	17	8.9
Unemployed	3	1.7	2	1.0

Based on self-reported use of mobile banking, the sample was split between potential customers and repeat customers. Participants, who had knowledge of mobile banking but have not yet used them, were classified as potential customers, whereas participants who had continued to use mobile banking were classified as repeat customers. The final sample consisted of 368 respondents, of which 177 were potential customers and 191 were repeat customers. Table 1 shows the demographic information of respondents in terms of gender, age, education, and current profession.

3.2. Measurement

Two questionnaires were developed, one for mobile banking potential customers and one for repeat customers. All research variables were measured using multiple-item scales and adapted from previous studies with minor wording changes to tailor them to the mobile banking context. The scales for three innovation attributes (perceived relative advantage, ease of use and compatibility) were measured using items adapted from Karahanna et al. (1999) and Moore and Benbasat (1991), perceived relative advantage by four items, perceived ease of use by four items, and perceived compatibility by three items. The items to assess perceived competence, benevolence and integrity beliefs were based on McKnight et al. (2002), containing three items for each construct. Attitude and behavioral intention were adapted from the measurements defined by Taylor and Todd (1995), containing three items for each construct. Intention of adoption assessed the likelihood of potential customers to adopt mobile banking in the future. Intention of continued use assessed the likelihood of repeat customers to continue using mobile banking in the future. All items were coded on seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7). Appendix includes the resulting questionnaire items for the study. Identical questions were asked on both potential customer and repeat customers questionnaire; the wording was modified to reflect either adoption or continued use behavior.

Table 2
Results of construct reliability and validity.

Model and construct	Range of standardized path loadings[a]	Composite reliability	Discriminant validity							
			1	2	3	4	5	6	7	8
Potential customers (normed χ^2 = 2.008; GFI = 0.820; CFI = 0.965; NNFI = 0.955; RMSEA = 0.076)										
1. Relative advantage	0.555–0.891	0.851	0.593							
2. Ease of use	0.776–0.982	0.939	0.172	0.799						
3. Compatibility	0.787–0.907	0.866	0.047	0.147	0.719					
4. Competence	0.884–0.925	0.927	0.284	0.144	0.085	0.810				
5. Benevolence	0.860–0.893	0.904	0.179	0.175	0.081	0.489	0.757			
6. Integrity	0.836–0.940	0.932	0.267	0.188	0.131	0.355	0.464	0.824		
7. Attitude	0.733–0.979	0.874	0.404	0.303	0.216	0.401	0.336	0.331	0.701	
8. Behavioral intention	0.755–0.990	0.924	0.028	0.104	0.077	0.019	0.024	0.046	0.139	0.799
Repeat customers (normed χ^2 = 2074; GFI = 0.817; CFI = 0.969; NNFI = 0.959; RMSEA = 0.079)										
1. Relative advantage	0.721–0.851	0.869	0.626							
2. Ease of use	0.921–0.977	0.968	0.540	0.884						
3. Compatibility	0.715–0.951	0.863	0.296	0.275	0.682					
4. Competence	0.821–0.883	0.895	0.487	0.285	0.130	0.740				
5. Benevolence	0.819–0.900	0.900	0.272	0.126	0.139	0.446	0.752			
6. Integrity	0.809–0.933	0.926	0.341	0.244	0.232	0.295	0.449	0.752		
7. Attitude	0.747–0.960	0.879	0.538	0.558	0.285	0.347	0.234	0.466	0.708	
8. Behavioral intention	0.597–0.889	0.806	0.143	0.169	0.125	0.189	0.059	0.109	0.194	0.587

[a] All standardized loadings are significant at $p < 0.01$ level. Diagonal elements represent the average variance extracted (AVE), while off-diagonal elements represent the square correlations. For adequate discriminant validity, diagonal elements should be greater than corresponding off-diagonal elements.

The survey was pilot tested with 18 respondents (8 for potential customers and 10 for repeat customers) to validate the instrument. They were asked to comment on the meaningfulness, relevance, and clarity of the scales. Therefore, the instrument has confirmed content validity.

4. Data analysis and results

The research model was tested using the structural equation modeling (SEM) facilitates of LISREL (Joreskog & Sorbom, 1996). LISREL software (version 8.8) was chosen primarily because of its emphasis on the overall variance-covariance matrix and the overall model fit (Fornell & Bookstein, 1982). As the first step of the Anderson and Gerbing (1988) procedure, the measurement model was estimated using confirmatory factor analysis (CFA) to test reliability and validity of the constructs. Then, the structural model was analyzed to examine the associations hypothesized in the research model.

4.1. Analysis of the measurement model

For the measurement model to have sufficiently good model fit, the overall model fit was assessed in terms of five common measures: normed χ^2 (the ratio of χ^2 to the degree of freedom), goodness-of-fit index (GFI), comparative fit index (CFI), non-normed fit index (NNFI), and root mean square error of approximation (RMSEA). A very good fit is normally deemed to exist when normed χ^2 is smaller than 3 (Bagozzi & Yi, 1988), GFI is greater than 0.8 (Etezadi-Amolo & Farhoomand, 1996), CFI and NNFI are greater than 0.9 (Bagozzi & Yi, 1988), and RMSEA is around 0.1 (Browne & Cudeck, 1993).

The initial measurement model was first evaluated using the subgroup of potential customers. As shown in Table 2, all model-fit indices exceeded their commonly accepted levels, demonstrating that the measurement model exhibited a good fit with the data collected. The measurement model was further assessed for construct reliability and validity (see Table 2). The composite reliabilities of the constructs ranged between 0.851 and 0.939, which exceeds the recommended cut-off level of 0.70 (Nunnally & Bernstein, 1994). Moreover, all constructs in the model satisfied the requirements for convergent validity (standardized path loadings greater than 0.5 and significant at $p < 0.01$) (Gefen, Straub, & Boudreau, 2000; Hair, Anderson, & Tatham, 1998) and discriminant validity (average variance extracted greater than each square correlation) (Fornell & Larcker, 1981), suggesting adequate reliability, convergent validity, and discriminant validity.

Secondly, the measurement model was evaluated using the subgroup of repeat customers. As shown in Table 2, all model-fit indices were acceptable, suggesting that the measurement model provides a good fit with the data in the subgroup of repeat customers. Subsequently, the results presented in Table 2 demonstrate adequate reliability, convergent validity, and discriminant validity for the subgroup of repeat customers.

4.2. Analysis of the structural model

The path coefficients and significance levels in the structural model (including potential and repeat customers) are shown in Fig. 2. Among innovation attributes, perceived relative advantage ($\gamma_{potential} = 0.303$, $p < 0.001$; $\gamma_{repeat} = 0.270$ $p < 0.001$), ease of use ($\gamma_{potential} = 0.110$, $p < 0.05$; $\gamma_{repeat} = 0.353$ $p < 0.001$) and compatibility ($\gamma_{potential} = 0.208$, $p < 0.001$; $\gamma_{repeat} = 0.092$ $p < 0.05$) have significant and positive paths to attitude toward adopting (or continuing to use) mobile banking. Regarding knowledge-based trust, perceived competence ($\gamma_{potential} = 0.329$, $p < 0.001$; $\gamma_{repeat} = 0.084$ $p < 0.05$) and integrity ($\gamma_{potential} = 0.102$, $p < 0.001$; $\gamma_{repeat} = 0.252$ $p < 0.001$) have significant and positive paths to attitude toward adopting (or continuing to use) mobile banking, while perceived benevolence ($\gamma_{potential} = 0.048$, $p > 0.05$; $\gamma_{repeat} = 0.009$ $p > 0.05$) has an insignificant path to attitude. Therefore, all hypotheses (expect hypothesis H5) dealing with attitude toward adopting (or continuing to use) mobile banking are supported. Subsequently, the hypothesized relationship between attitude and behavioral intention ($\beta_{potential} = 0.196$, $p < 0.001$; $\beta_{repeat} = 0.070$ $p < 0.05$) is found to be statistically significant, supporting hypothesis H7.

4.3. Cross-subgroup comparison – potential customers versus repeat customers

The differences between potential and repeat customers are further examined through multi-group analysis with *t*-statistics, that is, by the statistically comparing each path coefficient for potential customers with the corresponding path coefficient for repeat customers (Chin, 1998). This statistical comparison was carried out

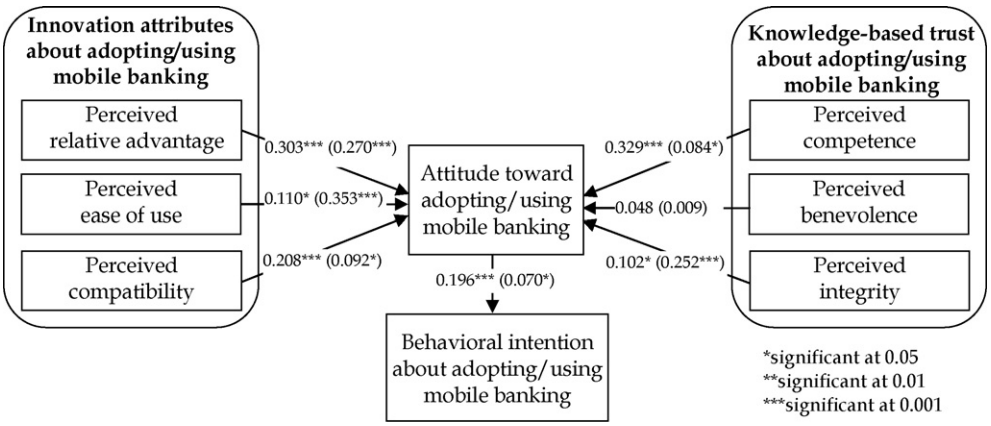

Fig. 2. Empirical results for potential and repeat customers (estimates on the repeat customers are shown in parentheses).

Table 3
Statistical comparison for potential and repeat customers.

Path	Potential customers (n_1 = 177)		Repeat customers (n_2 = 191)		Statistical comparison of paths (t-statistic)
	Path coefficient	Standard error	Path coefficient	Standard error	
H1: RA → ATT	0.303	0.079	0.270	0.081	0.292
H2: EOU → ATT	0.110	0.065	0.353	0.077	−2.399*
H3: CO → ATT	0.208	0.062	0.092	0.055	1.408
H4: CM → ATT	0.329	0.096	0.084	0.075	2.033*
H5: BE → ATT	0.048	0.096	0.009	0.078	0.318
H6: IN → ATT	0.102	0.085	0.252	0.072	−1.357
H7: ATT → BI	0.196	0.050	0.070	0.046	1.449

Notes: RA = relative advantage, EOU = ease of use, CO = compatibility, CM = competence, BE = benevolence, IN = integrity, ATT = attitude, BI = behavioral intention.
* $p < 0.05$

using the procedure suggested by Chin (2000) to develop a multi-group analysis, which was as follows:

$$t = \frac{p_{\text{potential}} - p_{\text{repeat}}}{\left[\sqrt{((n_1-1)^2 \times SE^2_{\text{potential}} + (n_2-1)^2 \times SE^2_{\text{repeat}})/(n_1 \times n_2 - 2)}\right] \times \left[\sqrt{1/n_1 + 1/n_2}\right]}$$

where $p_{\text{potential}}$, path coefficient in structural model (potential customers); p_{repeat}, path coefficient in structural model (repeat customers); n_1, sample size of potential customers; n_2, sample size of repeat customers; $SE_{\text{potential}}$, standard error of paths in structural model (potential customers); SE_{repeat}, standard error of paths in structural model (repeat customers); t, t-statistic with $n_1 + n_2$-2 degree of freedom.

Table 3 shows the comparison of path coefficients between potential and repeat customers. It turns out that perceived ease of use and competence show statistical differences between the two subgroups ($p < 0.05$). Perceived ease of use has a significantly greater effect for repeat customers, while perceived competence has a significantly greater effect for potential customers. These results indicate differential effects of innovation attributes and knowledge-based trust on attitudes toward adopting (or continuing to use) mobile banking, contingent on different customer experience with mobile banking. This result also provides supports for the effects of prior experience as proposed in hypothesis H8.

5. Conclusion

5.1. Findings and implications

This research represents an important contribution to theory by integrating two theoretical perspectives to identify factors that influence mobile banking adoption (or continue-to-use) decisions. It draws upon innovation diffusion theory and knowledge-based trust literature concerning mobile banking. To the best of our knowledge, this study is the first study to theoretically specify or empirically test the effect of innovation attributes and knowledge-based trust on attitude and behavioral intention about adopting (or continuing to use) mobile banking across potential and repeat customers. In the context of mobile banking, this study fills a theoretical gap by developing the research model and evaluating it using an empirical data set comprising potential and repeat customers.

The empirical analysis demonstrated several major findings. Interpretations based on these findings and implications are discussed below. First of all, the findings of this study strongly support the appropriateness of using innovation attributes to predict customer attitude toward adopting (or continuing to use) mobile banking. Perceived relative advantage and ease of use were observed to have significant effects on attitude. Customers who have more positive beliefs about the perceived relative advantage of mobile banking, formed more favorable attitude toward adopting (or continuing to use) mobile banking. Moreover, if customers find mobile banking easy to use, they become more willing to use them to conduct banking transactions. Therefore, mobile banking firms should focus on designing both useful and easy-to-use mobile banking. Moreover, customer perceptions about the compatibility of mobile banking with their values, experiences, and needs appear to be a predictor of attitude. This finding implies that customers who enjoy conducting wireless banking transactions may find mobile banking congruent with their lifestyle and preferences. Therefore, to attract and keep customers, it is imperative that mobile banking firms do not ignore the compatibility of mobile banking (and related services) with individual lifestyle and preferences.

Second, perceived competence and integrity have significant effects on attitude, while perceived benevolence is insignificant. If customers believe the mobile banking firm is able to develop effective service delivery strategies and provide adequate protection from fraud and violation of privacy, then adoption (or continue-to-use) intentions will increase. For mobile banking firms, the implications are clear. Since mobile banking is relatively new, associated perceptions of competence are important, and mobile banking firms should focus their abilities on improving the reliability and convenience of such services. To attract customers, mobile banking firms must emphasize the importance of securing customer confidence in service safety and reliability. However, inconsistent with the hypothesis, the relationship between perceived benevolence and attitude is statistically insignificant. One possible explanation is that customer benevolence perceptions of mobile banking firm are relatively intangible, resulting in the appraisal of the value received being much more subjective. Another possible explanation is that mobile banking deployments utilize message-based implementations (rather than session-based implementations, as prevalent in Internet banking), leading to the criteria for evaluating mobile banking firms being less well articulated.

Third, consistent with intention based models, the results from the two subgroups show a significant and positive linkage from attitude to behavioral intention to adopt (or continue-to-use) mobile banking. This result may be an indication that customer behavioral intentions regarding adopting (or continuing to use) mobile banking tend to be based on their attitude. Moreover, attitude is predicted jointly by innovation attributes and knowledge-based trust. Although previous researchers have suggested that the inclusion of attitude is not meaningful (Hong, Thong, Wong, & Tam, 2001), this study suggests that attitude should continue to be used in subsequent mobile banking research.

Fourth, although the path coefficients of perceived ease of use appear to be significant in both subgroups, more sophisticated analysis (multi-group analysis) reveals that it is relatively more important for repeat customers. Perceived ease of use contributes to a positive evaluation of mobile banking, especially by more experienced customers. This finding is consistent with Chau and Lai (2003). They argued that user feelings of self-competence and determination increase with ease of use of the website. Repeat customers usually navigate and access information concerning the latest transactions first, making easier navigation and information update extremely important in the context of mobile banking. Moreover, retaining existing customers is important since acquiring new customers may be five times as costly as retaining existing customers (Pathasarathy & Bhattacherjee, 1998). From a practical perspective, to retain repeat customers, mobile banking firms must focus on creating an easy-to-navigate interface to increase the accessibility of mobile banking services to customers.

Finally, this study finds that the relationship between perceived competence and attitude is greater for potential customers than for repeat customers. For potential customers, under high behavioral uncertainty, customer competence perceptions of mobile banking firms may become primary considerations. For example, if potential customers see the mobile banking firm as sufficiently competent (expert or skilled) to provide banking services properly and conveniently, they view such services more positively. To increase potential customer competence perceptions of mobile banking firms, it is recommended that advertising materials include customer interview scripts and reviews or survey reports. Mobile banking firms should also pay attention to practical solutions and provide advanced functionalities (e.g., intelligent agent-based portfolio management and financial planning services) to enhance competence beliefs regarding mobile banking firms, subsequently reducing the risk of losing potential customers.

5.2. Limitations and suggestions for further research

As in most empirical research, this study has several limitations. First, the conclusions drawn from this study are based on cross-sectional data. As a result, the posited causal relationships could only be inferred rather than proven. A stricter test of the research model can use a longitudinal study to assess this aspect. By adopting a longitudinal study, future works can examine the research model in different time periods and make comparisons, thus providing greater insight into the adoption of mobile banking. Second, this study focuses on Taiwan, which is a small island economy compared with many others, some with far more banking institutions. Future research can explore the antecedents and consequences of attitude towards adopting (or continuing to use) mobile banking for different countries. Third, other than innovation attributes and knowledge-based trust included in this study, there could still be other factors influencing customer attitude and behavioral intention about mobile banking. Yiu, Grant, and Edgar (2007) presented risk as a factor that influences the acceptance of Internet-based banking services. Lee and Chung (2009) verified empirically that three quality factors (e.g., system quality, information quality, and interface design quality) had an effect on user satisfaction with mobile banking. Further research considering these factors could enhance an understanding of success determinants for mobile banking. Finally, future research efforts can explore alternate models and theories of innovation diffusion in the interests of understanding additional antecedents and constructs shaping customer attitudes and intentions to use mobile banking.

Acknowledgement

The author thanks Ms. Wen-Chien Ling and Mei-Tsen Lin for their great help in this study's empirical data collection.

Appendix A. Measurement items (Adoption)

1. Perceived relative advantage:
   (1) Adopting mobile banking will allow me to conduct banking transactions more efficiently.
   (2) Adopting mobile banking will enable me to accomplish banking transactions more quickly.
   (3) Adopting mobile banking is a convenient way to conduct banking transactions.
   (4) Adopting mobile banking is useful for managing my finances.
2. Perceived ease of use:
   (1) Learning to operate mobile banking is easy for me.
   (2) It is easy to adopt mobile banking to accomplish banking transactions.
   (3) Interaction with mobile banking does not require a lot of mental effort.
   (4) Overall, I believe that adopting mobile banking is easy to use.
3. Perceived compatibility:
   (1) Mobile banking is compatible with my lifestyle.
   (2) Adopting mobile banking fits well with the way I like to manage my finances.
   (3) Adopting mobile banking to conduct banking transactions fits into my working style.
4. Perceived competence:
   (1) I think that mobile banking firms have the ability to understand my needs about managing my finances.
   (2) I think that mobile banking firms have the expertise to understand my needs about managing my finances.
   (3) I think that mobile banking firms have good knowledge about managing my finances.

5. Perceived benevolence:
   (1) I think that mobile banking firms put my interest first.
   (2) If I required help, I believe that mobile banking firms will do its best to help me.
   (3) I think that mobile banking firms are interested in my well-being, not just its own.
6. Perceived integrity:
   (1) I think that mobile banking firms are honest.
   (2) I think that mobile banking firms will keep their commitments.
   (3) I think that mobile banking firms provide unbiased information about banking transactions.
7. Attitude:
   Adopting mobile banking is
   (1) Bad . . . good.
   (2) Negative . . . positive.
   (3) Dislike . . . like.
8. Behavioral intention:
   (1) I am very likely to adopt mobile banking in the future.
   (2) I plan to adopt mobile banking in the future.
   (3) I believe it is worthwhile for me to adopt mobile banking.

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