Smartphone Banking: The Factors Influencing the Intention to Use

JinBaek Kim[1], Sungmin Kang[2] and Hoon S. Cha[3]
College of Business and Economics, Chung-Ang University
Seoul, Korea
[1] [e-mail: jinbaek@cau.ac.kr]
[2][e-mail: smkang@cau.ac.kr]
[3][e-mail: cha@cau.ac.kr]
*Corresponding author: Sungmin Kang

Received January 29, 2013; revised March 17, 2013; revised May 9, 2013; accepted May 18, 2013; published May 31, 2013

Abstract

In this paper, we investigated the factors affecting the intention to use smartphone banking with a research model based on the Technology Acceptance Model (TAM) extended to include security risk, trust, and self-efficacy. With analysis after controlling factors such as age, gender, and previous experience of smartphone banking that may have effects, we conclude that perceived usefulness, perceived ease of use, security risk, and trust have direct effect on the intention to use smartphone banking, and self-efficacy has indirect effect on the intention to use through mediation of perceived ease of use. We performed a study to check the validity of TAM in the context of smartphone banking, and confirmed that perceived ease of use has both direct and indirect effect on the intention to use.

Keywords: Smartphone banking, technology acceptance model, trust, security risk, self-efficacy

The preliminary version of this paper (won the best paper award) appeared in the APICIST 2012, July 4-7, Jeju Island, Korea. This version includes a concrete further analysis and supporting results with an extended research model.

http://dx.doi.org/10.3837/tiis.2013.05.016

1. Introduction

Influence of telecommunication companies on mobile banking or banking service through mobile phones used to be very strong because mobile banking service needs access to the telecommunications companies' proprietary network and the telecommunication companies controlled the gateway by letting all service providers using their network offer services through the their proprietary service portal. The tension between banks and telecommunication companies in order to gain more benefits from mobile banking was a major reason hindering development and promotion of mobile banking services [1, 2].

Smartphone, a more advanced form of mobile phone typically equipped with higher computing power, larger screen, more intuitive user interfaces, and most importantly Internet connection through Wi-Fi, was the catalyst for mobile banking boom [3]. Because smartphone users can access banking service via the public wireless Internet, the telecommunication companies cannot force the users to go through their portals. Therefore, unlike feature phone-based mobile banking, the influence of telecommunication companies almost disappeared in smartphone-based mobile banking or smartphone banking [4]. Major banks in Korea finally started to believe that smartphone banking would become prevalent as much as Internet banking. As banks began to compete fiercely, smartphone banking in Korea started to grow rapidly since 2009, the year when iPhone was launched in Korea [3, 4].

As can be seen in **Fig. 1**, in 2003, the number of registered mobile banking users in Korea was only 189,000. However, in 2011, the number rose up to 23,720,000, almost 50% of the total population of South Korea. The number of registered customers for smartphone banking, which was only 13,000 in 2009, increased exponentially up to 10,358,000 in 2011, accounting for approximately 44% of the whole mobile banking users. In terms of transactions, the growth of smartphone banking is even more remarkable. As of the end of 2011, the number of smartphone banking transactions accounted for 74% of the total mobile banking transactions [5]. This shows that the smartphone user group uses mobile banking more actively than feature phone user groups. Because the number of smartphone users continues to grow rapidly, smartphone banking is expected soon to be a mainstream online banking service like Internet banking.

However, concerns on smartphone banking are also increasing and, among them, trust on and security of smartphone banking are especially critical. A smartphone is easy to be exposed to hacking and malicious codes because smartphone users can freely download and install various applications and the frequency of wireless Internet access is high. Therefore, trust and security issues are more serious in smartphone banking than other mobile banking [6-9].

The main motivation of our study is that despite the number of smartphone users and use of smartphone for various functions have been increasing drastically, the use of smartphone banking seems to be limited. For example, account transfer transactions using smartphone are not as common as in Internet banking [1]. In this study, we wanted to identify the key factors affecting the use of smartphone banking. In the previous paper [10], we investigated the factors affecting the intention to use smartphone banking using a research model based on the Technology Acceptance Model (TAM) extended with two constructs: security risk and trust. The security risk and trust, as well as the ease of use and usefulness, turned out to be significant factors affecting the intention to use smartphone banking. And based on the comparison on the value of path coefficients, we showed that security risk and trust have greater influence in account transfer transactions than in account check transactions. However,

in the previous paper [10], contrary to what TAM suggests, the effect of perceived ease of use(PEOU) on the intention to use(IU) was observed only indirectly through perceived usefulness(PU), and its direct effect on the intention to use was not significant(p-value 0.556).

In this paper, we further analyzed the data based on the revised research model. The model was extended to include self-efficacy as a construct influencing the perceived ease of use. In addition, other factors such as age, gender, and previous experience that may have effects were controlled. The research model and method are explained in section 3 and 4, and results are presented in section 5. Especially, in section 5.3, we performed a study to check the validity of TAM in the context of smartphone banking, which suggests that perceived ease of use has significant direct effect on the intention to use as well as significant indirect effect through perceived usefulness.

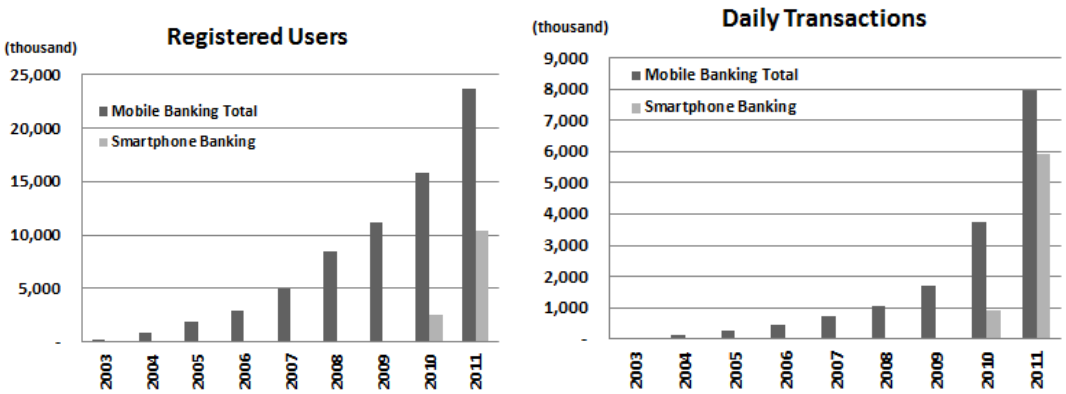


Fig. 1. Trend of mobile banking in Korea: Registered Users and Daily Transactions (source: The Bank of Korea)

2. Literature Review

Many studies to identify the factors influencing the usage intention of mobile banking service were conducted and many of those were based on the Technology Acceptance Model (TAM) by Davis [11]. The Technology Acceptance Model is a general model to explain the user's IT adoption process that is widely used to predict user acceptance of information technology as well as mobile banking. TAM presents two elements – the perceived usefulness and the perceived ease of use- based on Fishbein and Ajzen's Theory of Reasoned Action (TRA) [12]. The model shows that actual behavior is determined by the behavioral intention which is affected by user's attitude and subjective norms.

In the initially suggested TAM by Davis [11], users consider information technology as useful when the result of performing their work using information technology is high, and it is referred as perceived usefulness. As a result, perceived usefulness positively affects the user's intention to use a particular information technology. However, users would not use the information technology if it is difficult to use and it takes a lot of effort and time even thus information technology is perceived as useful. Therefore, perceived usefulness and perceived ease of use directly affects the attitude about information technology and intention to use it. Davis further suggested that perceived usefulness plays a role of indirectly improving the intention to use if the information technology is perceived as useful when the system is easy to use [11, 13].

Such key contents of TAM are recognized for its persuasiveness as it is applied to a variety of research on information technology and system in the Internet and mobile environment, as well as the acceptance of traditional information technology [14-16].

Although many of the existing literature on Korea's mobile banking confirmed that the perceived usefulness affects the usage intention, there were some studies that the perceived ease of use had no significant effect on the usage intention [17, 18]. Also, there were a number of studies related to mobile banking that in addition to the perceived usefulness and ease of use, risk and trust are also other major factors that affect the intention to use.

Yang et al. [19] classified the perceived risk of mobile banking into performance risk, financial risk, risk on loss of time, and social risk based on the theory of Cunningham [20]. They analyzed the perceived risk by excluding the risk of physical safety and substituting the risk related to the security of mobile banking for performance risk. They reported that financial risk and security risk have the most profound effect on the perceived risk and that time loss and social risk were insignificant.

Moon and Jung concluded that in addition to convenience, discomfort, innovativeness and previous experience, risk has a significant influence on the intention to use [21]. They defined the risk in terms of security, privacy invasion, the possibility of financial loss, and confidence in the result.

Lee et al. compared Internet banking users with mobile banking users [22]. They concluded that trust has a valid effect in both Internet banking and mobile banking. On the other hand, Lee et al. analyzed by adding trust besides the perceived usefulness and ease of use [23]. They verified the hypothesis that trust might have a positive impact on the intention to use was effective in the Internet banking, but it was not in mobile banking.

Kim et al. performed an intensive empirical research to analyze the impact of trust on the adoption of mobile banking services [24]. They classified the types of trust into relational trust for service providers and transactional trust for mobile channels. They considered self-trust to encompass the concept of internal locus of control as another independent type. The result of this analysis showed that self-trust has the most important effect and trust for the mobile channel also has a significant impact. However, the trust for provider did not have a significant effect. They considered that it was because customer's trust in the bank, which is the mobile banking service provider, had already been formed through the offline experience.

Lee et al. reported that in the mobile banking, security (confidentiality, user authentication, data integrity, and non-repudiation) had a valid influence on both the perceived usefulness and attitudes [18]. However, in Internet banking, security affected attitudes but did not have a valid impact on the perceived usefulness. Their report was somewhat conflicting because security had a positive (+) relationship to the perceived usefulness and had a negative (-) relationship to the attitude toward using mobile banking. They conjectured that the reason could be found in complicated security procedures of mobile banking, which might increase usefulness by reducing hacking risk and decrease attitude toward use by causing inconvenience. Their study indicates that security has a significant impact on the usage intention of mobile banking but additional research is required.

Aforementioned research can be summarized as in **Table 1**. In this study, we examined research papers mainly on mobile banking in Korea, considering that technologies and services for mobile banking are different by each country and it is significantly affected by the tendency of user group.

Table 1. Factors affecting the intention to use mobile banking and related empirical research results

	Validity Exists	Validity Does not Exist
Perceived Usefulness	In most research results	
Perceived Ease of Use	In most research results	[17, 18]
Perceived Risk	[19, 21, 25]	
Trust in General	[22, 25-27]	[23]
Trust on the Security of Channel	[18, 24, 28]	

3. Research Model

Over the past five years, technologies which mobile banking is based on rapidly changed. Particularly in Korea, mobile banking has changed from the hardware-centric method, which required dedicated mobile phones and IC chips, to software-oriented method, which is provided through the network of carrier from carrier's portal. Further, since the smartphone gained popularity, mobile banking has changed to more open approach of installing the application and using the service through the Internet. Because of the rapid changes in mobile banking services and technologies, although the research is on the same topic, the meaning of mobile banking could be different depending on the timing of the research.

The perceived usefulness, ease of use, risk, trust, etc. are proven factors that have significant effect on the intention to use mobile banking service from the prior research on mobile banking [17-19, 21-23, 27, 28]. However, the majority of research on mobile banking is done prior to year 2008, and smartphone banking in Korea especially have started to grow rapidly from year 2010. Therefore, the findings from the prior research might not be applied to the case of smartphone banking. There exist significant differences between smartphone banking and mobile banking considered in the previous studies. Comparison of the major differences is as follows.

Perceived Usefulness: Information processing speed of the smartphone is fast since it has high-performance hardware specifications. And, the smartphone can connect to Wi-Fi network as well as the carrier's network. The users can access the information they want more easily and rapidly since smartphone have larger screen sizes than feature phones and provide high resolution and graphics processing power in general.

Perceived Ease of Use: Smartphone is easy to control by anyone from a child to elderly since most smartphones adopt multi-touch and intuitive user interface functions. But, copying the digital certificate from PC to smartphone is required to use smartphone banking in Korea, unlike the case for mobile banking. Thus, in some senses, the registration process for smartphone banking has become more inconvenient, compared to the mobile banking.

Security Risk: A smartphone has the characteristics of frequent application installation and network connection/access. And, we can argue that this raised the security risk of hacking and malicious code execution. Further, there exists a vague anxiety of using the smart phone banking simply due to the fact that not enough time has passed for the smartphone to be proven as a reliable medium. On the other hand, there could be some people who may believe that security level for smartphone banking is raised in comparison with earlier mobile banking as the implementation of additional security technologies are mandated by law, such as PKI-based digital certificate, keyboard security, antivirus vaccine, firewalls, etc.

Self-efficacy: Compared with the prior mobile phone environment, users can select and use service more actively using the smartphone. It means that users passively used pre-installed application by service provider or limited browser-based service in the prior mobile telecommunication environment. But, smartphone users could easily search, select, and use the apps they want. Therefore, smartphone facilitated a platform that helps to receive a diverse service, and self-efficacy in terms of users installing and using the apps emerged as a key factor affecting the service use.

Trust: The trust in the service provider is considered to be the same, since the service provider is the preferred bank for transactions regardless of whether it is for mobile banking or smartphone banking. However, there could be a change in trust in the communication channel since the available wireless networks, to which the smartphone can connect, are extended from the carrier's own network to public Wi-Fi. And, there could be bigger changes in the trust on the policies and regulations related to the smartphone banking as they are immature and still in the process of development.

The research model and hypotheses used in this study are shown in **Fig. 2** and as follows. As can be seen, the research model in this study based on Davis' TAM model. By analyzing the implications of prior research on mobile banking presented in the previous chapter, we also hypothesized that trust and security risk further affect the intention to use.

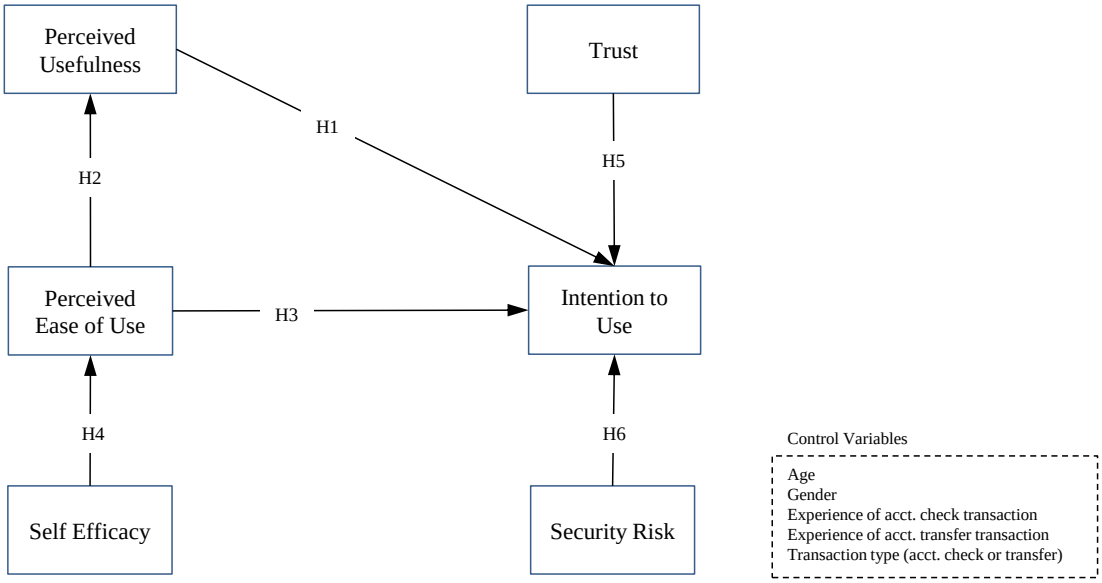


Fig. 2. Research Model

With the surge of smartphone users, attempts to apply the TAM for user's intention to use various smartphone applications are continuing [29, 30]. In Korea, the class of smartphone users became diverse as smartphone users take almost half of overall mobile communication users. Thus, the differences in user's ability to manipulate the smartphone are increasing. It is meaningful to examine whether increasing the perceived ease of use can affect the intention to use as suggested by TAM in that increasing the perceived ease of use can affect the intention to use smartphone banking service by user class which relatively lacks ability to manipulate the smartphone banking application. In this study, hypotheses on the causal relationships among

perceived ease of use, perceived usefulness, and the intention to use smartphone banking are designed as the following based on TAM.

H1: Perceived Usefulness will positively (+) affect the Intention to Use.
H2: Perceived Ease of Use will positively (+) affect the Perceived Usefulness.
H3: Perceived Ease of Use will positively (+) affect the Intention to Use.

There have been many research conducted on external factors affecting the key variables such as perceived usefulness and perceived ease of use as TAM expanded in various ways [31-34]. Especially, Venkatesh and Davis [35] suggested social influence and cognitive instrument as external factors which affect the perceived usefulness and self-efficacy, facilitating condition, support, etc. as factors which affect perceived ease of use.

In social cognitive theory, self-efficacy means belief about one's ability to select and apply the appropriate set of methods to solve a given problem and perform the assigned duties [36]. Based on this, Compeau and Higgins [37] introduced the notion of computer self-efficacy (CSE) and used it as a factor affecting perceived ease of use in a variety of research to extend the TAM. Marakas et al. [38] has provided an integrated research model and the clear distinction of CSE between special and general business environment by summarizing the research on CSE and related early studies. With the rapid growth of the Internet, Hsu and Chiu [33] defined 'Internet self-efficacy' (ISE) as efficacy for specialized technology, which is used to search the webpages and receive web contents, not just simply using the computers. ISE has been researched as a factor that plays an important role in the user's intention to purchase in the e-commerce environment [39]. Recently, the interest on 'mobile self-efficacy' (MSE) is increasing as portable wireless devices such as smart phones, GPS, PDA, etc. are rapidly advancing with innovations [40-42]. Smartphone banking requires downloading and installing smartphone apps which are still relatively unfamiliar to many people.

Many studies confirmed that self-efficacy acts as a factor that dominates 'intrinsic motivation' in accepting innovative information technology and, especially, it was widely shown that users with high self-efficacy have high level of perceived ease of use [34, 35, 41, 43]. Since smartphone banking is an innovative technology and the key feature of the service is 'banking at anytime and anywhere' [3], we examine self-efficacy as the important external factors that affect users' perceived ease of use. We suggest the following hypotheses about self-efficacy and perceived ease of use for smartphone banking.

H4: Self-efficacy will positively (+) affect the Perceived Ease of Use.

The trust, which a user has about a particular service provider, eventually plays a role of enhancing the intention to use by mitigating the perception of various risks associated with Internet banking. Mayer et al. [44] defined trust as the willingness to reveal vulnerabilities to other party based on the expectation that a trust subject will take the important act regardless of constraining the counterpart under surveillance situation. If we develop trust on a trust subject, we accept the risk of certain degree of loss when positive effect or profit is expected.

In this study, trust is defined based on the findings from the research conducted by Kim et al. [24] and Lee et al. [22], encompassing the concept of self confidence in addition to relational trust and transactional trust. Therefore, we suggest the following hypothesis.

H5: Trust will positively (+) affect the Intention to Use.

Moreover, we suggested a hypothesis that security risk is another key factor that affects the intention to use. Research has been conducted actively on the factors affecting online purchasing decisions as the Internet and mobile technologies advanced and the importance of e-commerce grew. In particular, the perceived risk, which consumers feel, is known to acts as an important inhibiting factor on the purchasing decision [45-47]. Perceived risk is traditionally studied under several classifications such as financial risk, performance risk, social risk, psychological risk, etc. Jarvenpaa and Todd [45] showed that not only the economic, social and performance risks, personal risk, which can incur by providing online information related to credit cards, and privacy risk of leaking personal information play a role of important decision-making factor in the Internet transactions. Similarly, Featherman and Pavlou [48] defined perceived security risk of personal information as user's perception about potential loss which can incur due to leakage of personal information to service provider and showed that it can play a role of suppressing the user's willingness to accept e-service.

The key factors for security risk of personal information include anxiety about computer's IP address, operating system, and past purchase experience, etc. being collected although individual can't be directly classified and concerns that proper control is not applied to prevent the third party access of an individual's collected personal information by service provider without authorization. Further, there is a concern for possibility of personal information being resold to financial firms, advertising firms or government [30, 49].

Especially, in case of smartphone banking, it is likely that financial loss of individuals increase, not just leaking the sensitive personal information. Also, the possibility that financial information of individuals can be identified by malicious attacks and used in crime can't be excluded. Thus, the tendency to use smartphone banking service will decrease as the security risk for personal information related to smartphone banking is high and the hypothesis is suggested as the following.

H6: Security Risks will negatively (-) the Intention to Use

4. Research Methodology

4.1 Data and Sample

In order to test the model and validate the hypotheses, we employed an empirical study using data from online survey responses. To access a suitable sample of smartphone banking users, we purchased the one-time use of a Korean smartphone banking user mailing list in January 2011 from a market research company. The company maintains a large pool of potential participants with a variety of profiles who are periodically rewarded for participation, and its service is trusted by many academic and research institutions in Korea. The market research company sent the invitations to 300 randomly selected smartphone banking users of whom 247 completed the survey, resulting in a response rate of 82.3%. After eliminating observations with missing data and unusable data, 231 observations are used in our analysis, making the effective response rate 77.0%.

The respondents were sixty five percent male and thirty five percent female, and most of the respondents were aged between 30s and 40s. The proportion of having previous experiences of account check transactions (sixty five percent) was slightly higher than that of account transfer transactions (fifty eight percent). The respondents' profile is summarized in **Table 2**.

Table 2. Profile of the Respondents (n = 206)

Characteristics		Frequency	Percentage
Gender	Male	149	65%
	Female	82	35%
Age	20's	34	15%
	30's	123	53%
	40's	53	23%
	50's	17	7%
	60's	4	2%
Smartphone type	iPhone	94	41%
	Android phone	124	54%
	Windows phone	13	6%
Previous banking experiences (include duplications)	Account check transaction	149	65%
	Account transfer transaction	133	58%

Note that each subject responded to the questionnaire for a set of two different types of transactions (account check and account transfer), and the resulting 462 (= 231 X 2) data set was used for analysis.

4.2 Method

We used Structural Equation Modeling (SEM) to analyze the data collected and test the research model. SEM is a statistical technique that incorporates factor analysis (using a measurement model) and path analysis (using a structural model) [50, 51]. The advantages of SEM compared to other statistical techniques include more flexible assumptions (e.g., partial allowance of multi-collinearity) and less measurement error with confirmatory factor analysis (CFA) enabled by multiple indicators per construct.

In particular, to analyze the SEM model, we used Partial Least Square (PLS) method. The sample size required for the PLS analysis is minimum ten times of the number of indicating variables used for the most complex construct in the model that is 4 in the current research model [52]. Therefore, the sample size of 462 (> 40) is more than enough for analysis. In particular, we used the SmartPLS 2.0 software with bootstrapping [51] to test the measurement model and then to test the hypothesized structural model.

5. Results

5.1. Measurement Model Assessment

The internal consistency (reliability) statistics were assessed by Cronbach's alpha and composite reliability (Dillon Goldstein's Rho). The results are summarized in **Table 3**. We eliminate one indicator for each of the perceived usefulness, perceived ease of use, and self-efficacy variables through the measurement model assessment including test of specification error and loadings of each indicator variable. The results in **Table 3** showed that all Cronbach's Alpha and composite reliability values exceeded the recommended reliability threshold of 0.7 [53]. Therefore, all the questionnaire items were deemed reliable. In addition, we tested the convergent validity by examining the average variance extracted (AVE), which measures the percentage of the variance of the measurement items that can be accounted for by the constructs relative to the measurement error. **Table 3** shows that for each construct, the AVE value was greater than the cut-off value of 0.5 [54].

Table 3. Assessment of the Measurement Model

Factors	# of initial indicators	# of final indicators	AVE	Composite Reliability	Cronbach's Alpha
1. Perceived usefulness	4	3	0.893	0.962	0.940
2. Perceived ease of use	4	3	0.887	0.959	0.936
3. Intention to use	3	3	0.915	0.970	0.954
4. Self-efficacy	4	3	0.901	0.965	0.945
5. Trust	4	4	0.805	0.943	0.919
6. Security risk	4	4	0.824	0.949	0.941

Further, we tested the discriminant validity by examining whether a latent variable better explains the variance of its own indicators than the variance of other latent variables. To validate this, we compared the square root of AVE for each construct with its cross-correlation with other constructs. The results supported the discriminant validity of our constructs in that in all cases the diagonal elements in the matrix (i.e., the square root of AVE) were higher than the off-diagonal elements in the corresponding rows and columns, as shown in **Table 4**. Lastly, we tested the convergent validity using the factor and cross loadings of all indicator items in relation to their respective latent constructs. The results are summarized in Appendix 2, which indicates that all items loaded i) on their respective constructs with a factor between 0.70 and 0.95 and ii) more highly on their respective constructs than on any other construct. Therefore, we can confirm that these indictor items accurately represent distinct latent constructs [54].

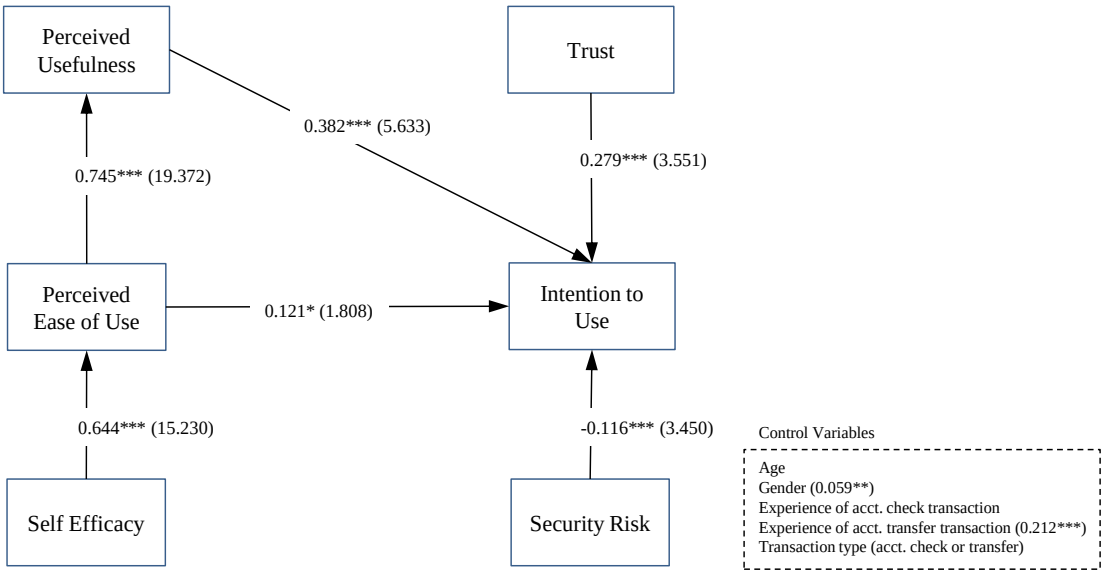
Table 4. Correlation between variables and discriminant validity assessment

	1	2	3	4	5	6	7	8	9	10	11
1. Perceived usefulness	**0.945**										
2. Perceived ease of use	0.745	**0.942**									
3. Intention to use	0.745	0.635	**0.956**								
4. Self-efficacy	0.475	0.644	0.391	**0.949**							
5. Trust	0.736	0.692	0.713	0.481	**0.897**						
6. Security risk	0.033	0.169	-0.093	0.121	0.032	**0.908**					
7. Gender	0.045	0.030	0.075	-0.006	0.038	0.078	**1.000**				
8. Age	-0.078	-0.165	-0.072	-0.084	-0.020	-0.008	-0.073	**1.000**			
9. Exp. of acct. check	0.379	0.282	0.448	0.081	0.368	-0.137	-0.036	0.102	**1.000**		
10. Exp. of acct. transfer	0.340	0.253	0.467	0.101	0.355	-0.110	-0.041	0.066	0.809	**1.000**	
11. Transac. type (acct. check =1)	0.015	0.024	0.063	0.000	0.009	-0.052	0.000	0.000	0.000	0.000	**1.000**

- The principal diagonal (in bold-face) of the inter-correlation matrix represents the square root of the average variance extracted (AVE) per construct.
- Single item variables are control variables including gender, age, and previous experiences of account check transaction, previous experiences of account transfer transaction, and the transaction type.

5.2. Structural Model Assessment

The assessment of structural model includes estimation of the path coefficients and their statistical significance. In particular, to measure the effect of mediation in the research model, later we assessed two separate structural models; the unmediated model and the mediated model.



Note:

- Path coefficients: *: p<0.1, **: p<0.05, ***: p<0.01.
- t-statistics are given inside the parentheses.

Fig. 3. The Results of the Research Model

Table 5. Summary of the Results of the Research Model

Hypotheses	Effect	Coefficient (*β*)	S.E.	t-statistic	p-value
H1	Perceived usefulness-> Intention to use	0.382 ***	0.068	5.633	0.000
H2	Perceived ease of use -> Perceived usefulness	0.745 ***	0.039	19.372	0.000
H3	Perceived ease of use -> Intention to use	0.121 *	0.067	1.808	0.071
H4	Self-efficacy -> Perceived ease of use	0.644 ***	0.042	15.230	0.000
H5	Trust -> Intention to use	0.279 ***	0.079	3.551	0.000
H6	Security risk -> Intention to use	-0.116 ***	0.034	3.450	0.001
Control variable	Transaction type -> Perceived usefulness	-0.002	0.032	0.076	0.939
	Transaction type -> Perceived ease of use	0.024	0.035	0.672	0.502
	Transaction type -> Intention to use	0.046	0.028	1.621	0.106
	Transaction type -> Trust	0.009	0.050	0.181	0.856
	Transaction type -> Security risk	-0.052	0.056	0.924	0.356
	Gender -> Intention to use	0.059 **	0.026	2.321	0.021

	Age -> Intention to use	-0.025	0.024	1.056	0.292
	Experience of acct. check -> Intention to use	-0.017	0.053	0.313	0.754
	Experience of acct. transfer -> Intention to use	0.212 ***	0.051	4.184	0.000

Fig. 3 and **Table 5** show the structural model results with the β values of all path coefficients. Overall, all six hypotheses are well accepted. First, regarding to the first four hypotheses based on TAM, we found that perceived ease of use positively affects both perceived usefulness ($\beta = 0.745$, $t = 19.372$, $p < 0.001$intention to use ($\beta = 0.121$, $t = 1.808$, $p = 0.071$), supporting Hypothesis 2 and 3 respectively. In addition, we found that perceived usefulness significantly affects the intention to use ($\beta = 0.382$, $t = 53633$, $p < 0.001$), which means Hypothesis 1 is well supported as well. The statistically significant relationship among three major factors suggest further analysis of the mediating effect for the perceived usefulness that links perceived ease of use and intention to use. We show these results in the next section. Further, consistent with the previous literature on the external factors of TAM, we found that self-efficacy is positively and significantly related to perceived ease of use (Hypothesis 4; $\beta = 0.644$, $t = 15.230$, $p < 0.001$).

In addition to the TAM based hypotheses, we found the stronger intention to use smart phone banking as the trust level increases ($\beta = 0.279$, $t = 3.551$, $p < 0.001$), and on the other hand, the weaker intention to use as the security risk increases ($\beta = -0.116$, $t = 3.450$, $p = 0.001$). These findings support Hypotheses 5 and 6, respectively.

We controlled several variables in the model such as transaction type, gender, age, and previous smartphone banking experiences. We found that female users are more willing to use the smartphone banking than male users ($\beta = 0.059$, $t = 2.321$, $p = 0.021$), and people who have the experience of using the account transfer transaction shows stronger intention to use than people with no experience ($\beta = 0.212$, $t = 4.184$, $p < 0.001$). However, the experience of using the account check service did not show any difference. Moreover, while we tried to compare the difference between two transaction types (account check or account transfer) by adding a dummy variable and control the effects of perceived usefulness, ease of use, trust, security risk, intention to use, we found no difference.

5.3. The Mediation Effect Assessment

Anchored on the analysis above, we further analyze the mediation effect embedded in the model. To do this, we consider the mediated and unmediated models in **Fig. 4** to describe the relationship among perceived usefulness, perceived ease of use, and intention to use, following Baron and Kenny's notation [55-57].

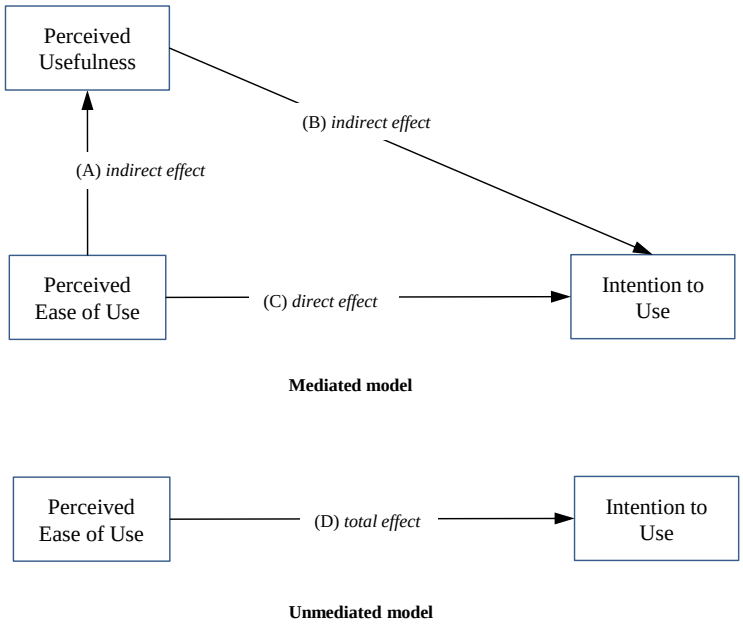


Fig. 4. The total effect vs. direct effect vs. indirect effect

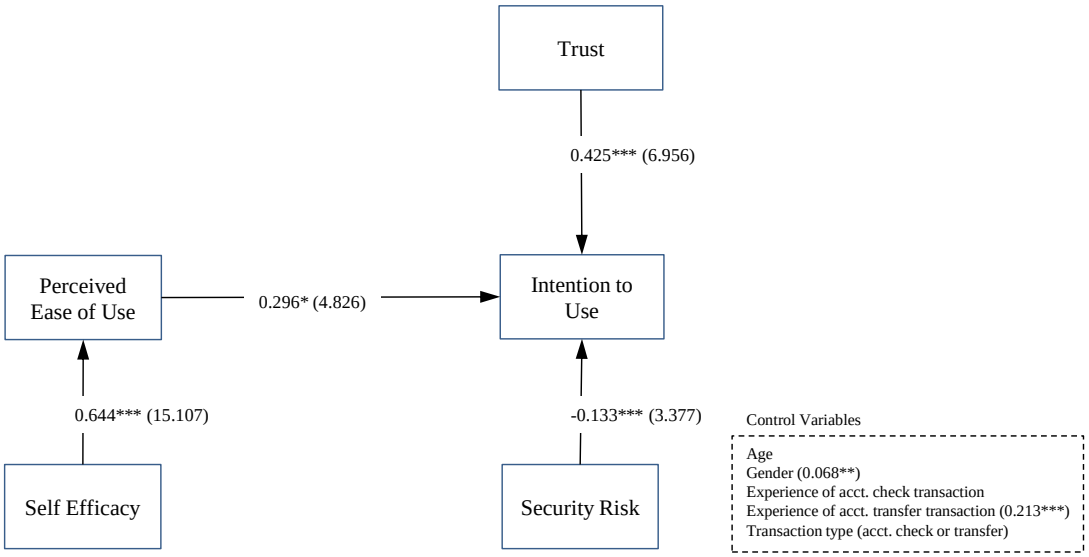
In the unmediated model as shown in the figure below, we posited that perceived ease of use positively influenced intention to use. Path (*D*) in this model is called the *total effect*. On the other hand, in the mediated model also shown in the figure above, we hypothesized that the effect of perceived ease of use on intention to use was mediated by perceived usefulness. Path (*C*) is called the *direct effect*, while the path (*A*) through (*B*) is called the *indirect* effect. Thus, the mediator (perceived usefulness) is the cause of the dependent variable (intention to use), and is at the same time the outcome of the independent variable (perceived ease of use). To establish the effect of the mediator, the following four conditions must be satisfied [55].

- First, the coefficient of path (*D*) (the regression of the perceived ease of use on intention to use) must be statistically significant.
- Second, the coefficient of path (*A*) (the regression of the perceived ease of use on perceived usefulness) must be statistically significant.
- Third, the coefficient of path (*B*) (the regression of the perceived usefulness on intention to use) must be statistically significant.
- Fourth, the coefficient of path (*C*) (the effect of perceived ease of use on intention to use, *controlling for* perceived usefulness) must be less than the coefficient of path (*D*) with no control.

When the above conditions are satisfied and a valid mediator exists, the effect of independent variable on the dependent variable can be divided into *direct effect* and *indirect effect*. That is, the *direct effect* measures the effect of the initial variable (perceived ease of use) on the outcome (intention to use) in spite of the given mediator variable (i.e., path (*C*)), and the *indirect effect* measures the reduction of this effect due to mediator variable that can be expressed as [(*A*)×(*B*)]. The sum of theses *indirect* and *direct effects* is called the *total effect*. Theoretically, the total effect is the same as the path (*D*) in the unmediated model (i.e., *total effect* = (*C*) + (*A*)×(*B*) = (*D*)). If perceived ease of use no longer *directly* affects intention to use (i.e., path (*D*) = 0) after perceived usefulness has been controlled, *complete mediation* exists. When the path (*D*) is reduced in absolute size but is greater than zero, *partial mediation*

exists.

We showed that the model meet the second and third conditions in the previous analysis. Therefore, here we need to assess the unmediated model separately and compare the results with the previous mediated model. They are summarized in **Fig. 5** and **Table 6**.



Note:

- Path coefficients: *: p<0.1, **: p<0.05, ***: p<0.01.
- t-statistics are given inside the parentheses.

Fig. 5. The Results of the Unmediated Model

Table 6. Summary of the Results of the Unmediated Model

Hypotheses	Effect	Coefficient (β)	S.E.	t-statistic	p-value
H3	Perceived ease of use -> Intention to use	0.296 ***	0.061	4.826	0.000
H4	Self-efficacy -> Perceived ease of use	0.644 ***	0.043	15.107	0.000
H5	Trust -> Intention to use	0.425 ***	0.061	6.956	0.000
H6	Security risk -> Intention to use	-0.133 ***	0.039	3.377	0.001
Control variables	Transaction type -> Perceived ease of use	0.024	0.036	0.663	0.508
	Transaction type -> Intention to use	0.046	0.029	1.587	0.113
	Transaction type -> Trust	0.009	0.047	0.194	0.847
	Transaction type -> Security risk	-0.052	0.059	0.886	0.376
	Gender -> Intention to use	0.068 **	0.028	2.461	0.014
	Age -> Intention to use	-0.027	0.029	0.940	0.348
	Experience of acct. check -> Intention to use	0.023	0.056	0.407	0.684
	Experience of acct. transfer -> Intention to use	0.213 ***	0.053	4.014	0.000

We found that without mediation, perceived ease of use significantly affect intention to use (β = 0.296, t = 4.826, p < 0.001), which is matched with the *total effect* shown by path (D) in **Fig. 4**. Further, by comparison, we found that the mediated *direct effect* of perceived ease of use on intention to use (path (*C*); β = 0.121, t = 1.808, p < 0.071) is less than the *total effect* (0.121 < 0.296). As a result, we concluded there is a mediating effect of perceived usefulness.

In general, the existence of mediation can be statistically tested by using a simple test called *Sobel Test*. To do this, the following z value is calculated as a test statistic.

$$z = \frac{ab}{(b^2 SE_a^2) + (a^2 SE_b^2)} \quad (1)$$

where a and b are the coefficients of path (*A*) and (*B*), and SE_a and SE_b are the standard errors of those paths, respectively. We summarize the Sobel Test result (z = 5.389, p < 0.001) in **Table 7**, which also support our previous findings.

Table 7. Sobel Test Result

Path	Coefficient	S.E.	p-value	Sobel test	Mediation Type
(A)	0.745	0.039	0.000	z = 5.389 (p < 0.001)	Partial mediation
(B)	0.382	0.068	0.009		
(C)	0.121	0.067	0.071		
(D)	0.296	4.826	0.000		

Lastly, using the coefficients in **Table 7** for the path (*A*), (*B*), and (*C*) we found

- Indirect effect = (*A*) × (*B*) = 0.745 × 0.039 = 0.285
- Direct effect = (*C*) = 0.121
- Total effect = Indirect effect + Direct effect = 0.285 + 0.121 = 0.406.

Note that the calculated total effect exactly same as the coefficient for (*D*) if we use structural equation modeling without latent variables and the same covariates are in all the equations. However, the two are only approximately equal for structural equation modeling with latent variables and the inclusion of trust, security risk, and self-efficacy may also contribute this difference. For such models, the total effect is recommended to be inferred as the sum (*A*) × (*B*) and (*C*) instead of directly computed from (*D*) [55]. In conclusion, we found that significant portion of the effect of perceived easy of use on intention to use is mediated through the perceived usefulness.

5. Conclusion

In this paper, we presented a further analysis of our preliminary paper [10]. In order to improve accountability, we extended the research model by adding self-efficacy as a construct influencing perceived ease of use. In addition, we controlled various factors such as age, gender, experience of previous mobile banking, and transaction types, in order to reach a more rigid conclusion.

The results of the previous study were mostly confirmed in the sense that perceived usefulness, perceived ease of use, trust, security risk turned out to be significant factors affecting the intention to use smartphone banking. As in the previous study, security risk had a

negative effect on the intention to use, while trust had a positive effect on the intention to use. The effect of trust (standard coefficient: 0.279) is greater than the effect of security risk (standard coefficient: - 0.116).

In the preliminary paper, we saw that the perceived ease of use had significant influence on the perceived usefulness, but its significant direct effect on the intention to use was not observed (p-value: 0.556). Because this result is inconsistent with what TAM suggests, in this paper we further investigated the effect of perceived ease of use. We controlled other factors including age, gender, previous experience, and transaction types. Then, we extended the research model by adding self-efficacy as a construct affecting perceived ease of use. After these steps, we could observe that both direct and indirect effects of ease of use on the intention to use are significant.

As explained in section 2, there were studies on mobile banking that reported direct effect of ease of use on the intention to use is insignificant [17, 18], raising questions on validity of TAM in the mobile banking context. The result of this paper recommends to control other factors such as gender and previous experience when examining the intention to adopt new technology based service like mobile banking through TAM. Furthermore, our result indicates that self-efficacy may be a missing factor of importance in those studies.

Since the direct effect of perceived ease of use on the intention to use turned out to have a relatively high p-value (0.071) even after controlling other variables, in section 5.3, we performed a further analysis on the mediation effect of perceived ease of use by Baron and Kenny's method [55] in order to reach a more rigorous conclusion. Our investigation confirms that the basic argument of TAM, perceived ease of use has both significant direct effect on the intention to use and indirect effect through perceived usefulness, holds in the context of smartphone banking. Of course, it should be noted that, beside the basic constructs in TAM, we needed to add self-efficacy, trust and security risk in the overall structure.

To summarize, the main contribution of this paper can be stated as twofold. First, we investigated people's perception and behaviors in a relatively new phenomenon with growing importance, smartphone banking. In the history of mobile phones, smartphone takes only small and recent portion of the time span. Thus, most literature on mobile banking did not assume smartphone as a major device for banking. Smartphone is a newly emerged device, in many aspects, closer to a computer than a phone, and we focused on investigating a specific type of mobile banking, or smartphone banking, with a validated and proper research model, TAM. Second, we not only confirmed the validity of TAM in the context of smartphone banking, but also investigated the effects of other important factors such as trust, security, and self-efficacy on the intention to use. Further, we illustrated one general way to improve research based on the TAM based model by obtaining a more rigorous result after controlling certain factors (especially gender and previous experience) and considering self-efficacy, which were not considered in many studies in mobile banking.

Practical implication of our study to bank managers is that they should pay attention to the fact that large part of the effect from perceived ease of use on the intention to use is indirect through perceived usefulness. In other words, when bank managers try to boost smartphone banking by improving usability, they should focus on the factors especially contributing to usefulness of their services. For example, since smartphone banking is fulfilled through much smaller screen than Internet banking, in order to improve usability, smartphone banking homepage cannot offer a full set of menu items in Internet banking homepage. If only 5 to 8 buttons should be placed on the smartphone banking homepage, the criteria of choosing these buttons should include maximizing perceived usefulness of users. Also, when displaying account information on the smartphone screen or collecting information through touch screen

for account transfer transactions, bank managers should carefully examine the ways of improving usefulness, while accepting additional constraints on ease of use in smartphone banking.

Another practical implication is that building-up trust and decreasing security risk are critical for increasing use of smartphone banking. The security issue in smartphone banking is as serious as or even more serious than in Internet banking. Smartphones users are often exposed to the risk of hacking and malicious code infection when they connect to unknown Wi-Fi network. It is not very difficult for the malicious attackers to steal ID/password and digital certificate stored in the smartphone. As shown in this study, while users are very concerned about security threats, there seems to be considerable amount of improvement in the security measures implemented by banking industry and government. For proliferation of smartphone banking services, it will be critical to implement various preventive actions such as offering free mobile vaccine or security vulnerability monitoring apps, and mandating upgrade of apps and mobile OS, etc.

Further, although it is the perceived usefulness that has the highest impact on the intention to use, the way to improve perceived usefulness is not just in improving usefulness itself, but also in increasing self-efficacy of users or attracting users with high self-efficacy. In other words, having informed and educated users are as much critical as providing secured and trusted infrastructure in growth of smartphone banking services. In this sense, it is reasonable for the banks to offer special products only through smartphone banking in order to encourage customers to experience and self-educate smartphone banking.

As in most survey based research, this study has the limit of having potential bias caused by sampling. In addition, because smartphone banking is a relatively new phenomenon, the perception of the survey participants may not be as mature as other types of banking services such as Internet banking. As smartphone banking develops, we will continue to monitor the coming up issues. Especially, we have a plan to further examine security and trust issues in smartphone banking, since trust and security can be further classified into various types.

References

[1] Bank of Korea, "Encyclopedia of Electronic Banking," 2009. Article (CrossRef Link).
[2] KDB Economic Research Institute, "Trends and Prospect in Mobile Banking," *KDB ERI Report*, 2008. Article (CrossRef Link).
[3] Hana Financial Research Institute, "Impact of Smartphones on the Financial Markets," *Hana Industry Information,* 2010. Article (CrossRef Link).
[4] J. B. Kim, "Research Issues in Mobile Banking in the Smart Phone Era: Korean Case and Literature Survey, "*Entrue Journal of Information Technology,* vol. 10, pp. 223-238, 2011. Article (CrossRef Link).
[5] Bank of Korea, "Usage Status of Domestic Internet Banking Service in 2010," 2011. Article (CrossRef Link).
[6] Y. Choi and D. Cho, "Building Trust in Smartphone Environment - Focused on the Undergraduate Students in Busan," *Journal of Korea Contents Association,* vol. 12, pp. 352-362, 2012. Article (CrossRef Link).
[7] E. Chin, A. P. Felt, V. Sekar, and D. Wagner, "Measuring user confidence in smartphone security and privacy," in *Proc. of the Eighth Symposium on Usable Privacy and Security*, Washington, D.C., 2012. Article (CrossRef Link).
[8] Y. Wang, K. Streff, and S. Raman, "Smartphone Security Challenges," *Computer,* vol. 45, pp. 52-58, 2012. Article (CrossRef Link).
[9] A. Susanto, Y. Chang, H. Zo, and M. C. Park, "The role of trust and security in Smartphone banking continuance," in *Proc. of Systems, Man, and Cybernetics (SMC), 2012 IEEE International*

Conference on, 2012, pp. 2133-2138. Article (CrossRef Link).
[10] J. B. Kim and S. Kang, "A Study on the Factors Affecting the Intention to Use Smartphone Banking: The Differences between the Transactions of Account Check and Account Transfer," *International Journal of Multimedia and Ubiquitous Engineering,* vol. 7, pp. 87-95, 2012. Article (CrossRef Link).
[11] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly,* vol. 13, pp. 319-340, 1989. Article (CrossRef Link).
[12] M. Fishbein and I. Ajzen, *Belief, attitude, intention, and behavior : an introduction to theory and research*. Reading, Mass.: Addison-Wesley Pub. Co., 1975. Article (CrossRef Link).
[13] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly,* vol. 27, pp. 425-478, 2003. Article (CrossRef Link).
[14] J. A. Castañeda, F. Muñoz-Leiva, and T. Luque, "Web Acceptance Model (WAM): Moderating effects of user experience," *Information & Management,* vol. 44, pp. 384-396, 2007. Article (CrossRef Link).
[15] T. T. Gao, F. Sultan, and A. J. Rohm, "Factors influencing Chinese youth consumers' acceptance of mobile marketing," *Journal of Consumer Marketing,* vol. 27, pp. 574 - 583, 2010. Article (CrossRef Link).
[16] P. G. Schierz, O. Schilke, and B. W. Wirtz, "Understanding consumer acceptance of mobile payment services: an empirical analysis," *Electronic Commerce Research and Applications,* vol. 9, pp. 209-216, 2010. Article (CrossRef Link).
[17] K. Y. Kwhk and Y. J. Lee, "A Study on the Factors Affecting the Usage Intention of Mobile Banking Service in the Digital Convergence Age," *Information Systems Review,* vol. 7, pp. 85-100, 2005. Article (CrossRef Link).
[18] D. H. Lee, S. H. Kwhk, and K. S. Whang, "A Study of Comparison between Internet Banking and Mobile Banking by Extending the TAM," *Korean Journal of Technology Innovation, The Korean Society for Innovation Management & Economics,* vol. 14, pp. 201-225, 2006. Article (CrossRef Link).
[19] J. Y. Yang, J. H. Ahn, and C. W. Pak, "The Effect of Perceived Risk on the Intention to Adopt Mobile Banking Services," *Journal of Technology Innovation, The Korean Society for Innovation Management & Economics,* vol. 14, pp. 183-208, 2006. Article (CrossRef Link).
[20] S. Cunningham, "The Major Dimensions of Perceived Risk," in *Risk Taking and Information Handling in Consumer Behavior*, Ed. I. J. Cox, Boston: Harvard University, Graduate School of Business Administration, pp. 82–108, 1967. Article (CrossRef Link).
[21] Y. E. Moon and E. J. Jung, "A Study on the Determinants of Intention to Use Mobile Banking," *Journal of Information Systems, The Korean Society of Management Information Systems,* vol. 13, pp. 89-117, 2004. Article (CrossRef Link).
[22] Y. K. Lee, P. S. Lee, N. H. Chung, and J. H. Park, "The Comparative Analysis on Channel Preference between Internet and Mobile Banking: Transaction Costs Theory Perspective," *Journal of e-Business, Global e-Business Association,* vol. 9, pp. 25-46, 2008. Article (CrossRef Link).
[23] S. C. Lee, J. C. Gu, and Y. H. Suh, "The Impact of Trust on User Acceptance of Mobile Banking: An Empirical Study on Comparison with Internet Banking Users of Wooribank," *Journal of Quality Management, The Korean Society for Quality Management,* vol. 33, pp. 59-70, 2005. Article (CrossRef Link).
[24] G. M. Kim, S. M. Nam, and H. G. Lee, "Customer Adoption of Emerging IT Services and Trustee Types," *Information Systems Review, The Korean Society of Management Information Systems,* vol. 9, pp. 67-83, 2007. Article (CrossRef Link).
[25] H. R. Choi and J. S. Shin, "The Impact of Users' Technology Readiness on the New Services Acceptance: Focus on Mobile Banking Services," *Journal of Industrial Economics, Korean Industrial Economic Association,* vol. 19, pp. 131-155, 2006. Article (CrossRef Link).
[26] N. J. Cho, K. H. Park, and H. K. Lim, "A Comparison of Influential Factors for Media Selection: Personal Banking Transaction Context," in *Proc. of Korean Society of Digital Policy & Management* 2006, pp. 337-354. Article (CrossRef Link).

[27] S. I. Han, "Determinants of the User's Intention to Use of Mobile Banking," *Journal of e-Business Studies, The Korean Society for e-Business Studies,* vol. 10, pp. 135-157, 2005. Article (CrossRef Link).
[28] M. C. Kim, S. W. Kim, and M. S. Kim, "An Exploratory Study on Factors Influencing 'Use of Mobile Banking Service," *Journal of Service Management, Korean Society of Service Management,* vol. 9, pp. 109-126, 2008. Article (CrossRef Link).
[29] R. Unni and R. Harmon, "Perceived Effectiveness of Push vs. Pull Mobile Location-Based Advertising," *Journal of Interactive Advertising,* vol. 7, pp. 28-40, 2007. Article (CrossRef Link).
[30] H. Xu, H.-H. Teo, B. Tan, and R. Agarwal, "The Role of Push-Pull Technology in Privacy Calculus: The Case of Location-Based Services," *J. Manage. Inf. Syst.,* vol. 26, pp. 135-174, 2009. Article (CrossRef Link).
[31] R. Agarwal and J. Prasad, "The Role of Innovation Characteristics and Perceived Voluntariness in the Acceptance of Information Technologies," *Decision Sciences,* vol. 28, pp. 557-582, 1997. Article (CrossRef Link).
[32] D. Gefen, E. Karahanna, and D. W. Straub, "Trust and TAM in online shopping: an integrated model," *MIS Quarterly,* vol. 27, pp. 51-90, 2003. Article (CrossRef Link).
[33] M.-H. Hsu and C.-M. Chiu, "Internet self-efficacy and electronic service acceptance," *Decision Support Systems,* vol. 38, pp. 369-381, 2004. Article (CrossRef Link).
[34] V. Venkatesh, G. M. Morris, B. G. Davis, and F. D. Davis, "User Acceptance of Information Technology: Toward A Unified View," *MIS Quarterly,* vol. 27, pp. 425-478, 2003. Article (CrossRef Link).
[35] V. Venkatesh and F. D. Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science,* vol. 46, pp. 186-204, 2000. Article (CrossRef Link).
[36] A. Bandura, "Self-efficacy: Toward a unifying theory of behavioral change," *Advances in Behaviour Research and Therapy,* vol. 1, pp. 139-161, 1978. Article (CrossRef Link).
[37] D. Compeau and C. Higgins, "Computer self-efficacy: Development of a measure and initial test," *MIS Quarterly,* vol. 19, pp. 189-211, 1995. Article (CrossRef Link).
[38] G. M. Marakas, M. Y. Yi, and R. D. Johnson, "The Multilevel and Multifaceted Character of Computer Self-Efficacy: Toward Clarification of the Construct and An Integrative Framework for Research," *Info. Sys. Research,* vol. 9, pp. 126-163, 1998. Article (CrossRef Link).
[39] J. C. Park and K. H. Jung, "Effects of Internet Banking Perception on Usefulness, Ease of Use and Intention to Use," *Korea Internet e-Commerce Research,* vol. 8, pp. 1-14, 2008. Article (CrossRef Link).
[40] M. J. Keith, J. S. Babb, C. P. Furner, and A. Abdullat, "The Role of Mobile Self-Efficacy in the Adoption of Location-Based Applications: An iPhone Experiment," in *Proc. of System Sciences (HICSS), 2011 44th Hawaii International Conference on*, 2011, pp. 1-10. Article (CrossRef Link).
[41] J.-C. Gu, S.-C. Lee, N.-H. Kim, and Y.-H. Suh, "Factors Affecting User Acceptance in Mobile Banking: An Empirical Study Using Extended TAM and Trust," *Asia Pacific Journal of Information Systems,* vol. 16, pp. 159-181, 2006. Article (CrossRef Link).
[42] A. Serenko and N. Bontis, "A Model of User Adaption of Mobile Portals," *Quarterly Journal of Electronic Commerce,* pp. 69–98, 2004. Article (CrossRef Link).
[43] W. J. Lee, C. S. Lee, T. U. Kim, and T. Y. Paik, "User Acceptance of the Mobile Internet Services," *Asia Pacific Journal of Information Systems,* vol. 14, pp. 61-87, 2004. Article (CrossRef Link).
[44] R. C. Mayer, J. H. Davis, and F. D. Schoorman, " An Integrative Model of Organizational Trust," *Academy of Management Review,* vol. 20, pp. 709-734, 1995. Article (CrossRef Link).
[45] S. L. Jarvenpaa and P. A. Todd, "Consumer Reactions to Electronic Shopping on the World Wide Web," *Journal of Electronic Commerce,* vol. 1, pp. 59-88, 1997. Article (CrossRef Link).
[46] S. L. Jarvenpaa and N. Tractinsky, "Consumer Trust in an Internet Store: A Cross-Cultural Validation," *Journal of Computer-Mediated Communication,* vol. 5, pp. 1-35, 1999. Article (CrossRef Link).
[47] D. H. McKnight, V. Choudhury, and C. Kacmar, "Developing and Validating Trust Measures for e-Commerce: An Integrative Typology," *Information Systems Research,* vol. 13, pp. 334-359,

2002. Article (CrossRef Link).
[48] M. S. Featherman and P. A. Pavlou, "Predicting e-services adoption: a perceived risk facets perspective," *International Journal of Human-Computer Studies,* vol. 59, pp. 451-474, 2003. Article (CrossRef Link).
[49] T. Dinev, P. Hart, and M. R. Mullen, "Internet privacy concerns and beliefs about government surveillance – An empirical investigation," *The Journal of Strategic Information Systems,* vol. 17, pp. 214-233, 2008. Article (CrossRef Link).
[50] I. Qureshi and D. Compeau, "Assessing Between-Group Differences in Information Systems Research: A Comparison of Covariance-and Componet-based SEM," *MIS Quarterly,* vol. 33, pp. 197-214, 2009. Article (CrossRef Link).
[51] M. Wetzels, G. Odekerken-Schroder, and C. v. Oppean, "Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration," *MIS Quarterly,* vol. 33, pp. 177-195, 2009. Article (CrossRef Link).
[52] D. Gefen, D. W. Straub, and M.-C. Boudreau, "Structural Equation Modeling and Regression: Guidelines for Research Practice," *Communications of the AIS,* vol. 4, pp. 1-79, 2000. Article (CrossRef Link).
[53] C. R. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *Journal of Marketing Research,* vol. 18, pp. 39-50, 1981. Article (CrossRef Link).
[54] Y. Yoo and M. Alavi, "Media and group cohesion: relative influences on social present, task participation, and group consensus," *MIS Quarterly,* vol. 25, pp. 371-390, 2001. Article (CrossRef Link).
[55] R. M. Baron and D. A. Kenny, "The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations," *Journal of Personality and Social Psychology,* vol. 51, pp. 1173-1182, 1986. Article (CrossRef Link).
[56] P. A. Frazier, A. P. Tix, and K. E. Barron, "Testing Moderator and Mediator Effects in Counseling Psychology Research," *Journal of Counseling Psychology,* vol. 51, pp. 115-134, 2004. Article (CrossRef Link).
[57] P. E. Shrout and N. Bolger, "Mediation in experimental and non-experimental studies: New procedures and recommendations," *Psychological Methods,* vol. 7, pp. 422-445, 2002. Article (CrossRef Link).

Appendix 1. List of Item Variables and Survey Questions

Factors	Questionnaire
1. Perceived Usefulness	Using smartphone banking will make it easier for me to conduct **account check** transactions.
	Using smartphone banking will make it quicker for me to conduct **account check** transactions.
	Using smartphone banking will improve my performance in conducting **account check** transactions.
2. Perceived Ease of Use	It would be easy for me to learn how to use smartphones for **account check**.
	It would be easy for me to become skillful at using smartphones for **account check**.
	I would clearly understand how to use smartphones for **account check**.
3. Intention to Use	If I have a chance, I intend to use smartphones for **account check.**
	I would use smartphones for **account check** in near future.
	I would keep using smartphones for **account check**.
4. Self-efficacy	It would be easy for me to be accustomed to installing the smartphone banking app.
	The instruction for installing the smartphone banking app would be clear and easy to understand for me.
	Over all, I would not consider it difficult to install the smartphone banking app.
5. Trust	**Account check** transactions through smartphones will be accurately processed.
	I trust smartphone banking service offered by my primary bank for **account check** transactions.
	I believe I can quickly and accurately perform **account check** through smartphone banking.
	I trust smartphone banking for **account check**.
6. Security Risk	Security systems for smartphone banking may not fully protect my account information during **account check** transactions.
	My privacy information or transactional information may be leaked during **account check** transactions through smartphone.
	A malicious third party may utilize my account if I use smartphone banking for **account check**.
	I worry about security in general when I use smartphone banking for **account check**.
5. Gender	What is your gender?
6. Age	What is your age?
7. Experience	Have you ever used smartphones for **account check**?

Note:

- Questionnaire for account check (as for account transfer, bold faced “account check” was replaced by “account transfer”)
- Likert 7 scale was used for measurement (1 – Do not agree at all, 7 – Strongly agree)

Appendix 2. The Cross-loading Matrix

	1. Perceived usefulness	2. Perceived ease of use	3. Intention to use	4. Self -efficacy	5. Trust	6. Security risk
1-1	**0.945**	0.709	0.713	0.433	0.711	0.021
1-2	**0.951**	0.736	0.703	0.493	0.686	0.064
1-3	**0.939**	0.666	0.697	0.420	0.689	0.008
2-1	0.683	**0.945**	0.579	0.604	0.647	0.144
2-2	0.743	**0.947**	0.628	0.618	0.656	0.180
2-3	0.677	**0.933**	0.585	0.597	0.652	0.152
3-1	0.699	0.604	**0.951**	0.386	0.674	-0.104
3-2	0.705	0.600	**0.964**	0.382	0.667	-0.071
3-3	0.733	0.619	**0.954**	0.356	0.703	-0.090
4-1	0.484	0.594	0.405	**0.947**	0.461	0.092
4-2	0.437	0.627	0.353	**0.960**	0.451	0.144
4-3	0.433	0.611	0.358	**0.940**	0.458	0.107
5-1	0.648	0.565	0.614	0.390	**0.886**	0.067
5-2	0.677	0.647	0.645	0.451	**0.918**	0.016
5-3	0.672	0.683	0.612	0.485	**0.879**	0.086
5-4	0.645	0.592	0.683	0.404	**0.906**	-0.044
6-1	0.004	0.150	-0.106	0.101	0.010	**0.948**
6-2	0.058	0.163	-0.080	0.137	0.040	**0.935**
6-3	0.044	0.163	-0.061	0.104	0.054	**0.905**
6-4	0.111	0.219	0.000	0.121	0.082	**0.839**

JinBaek Kim is an assistant professor of Management Science at College of Business and Economics, Chung-Ang University. He received his M.S. and Ph.D. in Industrial Engineering and Operations Research from University of California at Berkeley. He holds B.S. in Electrical Engineering from Seoul National University. Before joining Chung-Ang University, he worked at Samsung Electronics Inc. and was an assistant professor at Concordia University in Montreal, Canada. His research interests include supply chain management, information technology ecosystem, and decision making. His work has appeared in Decision Support Systems, Journal of Group Decision and Negotiation, Journal of Korean Society of Production and Operations Management, etc.

Sungmin Kang is a professor of MIS at College of Business and Economics, Chung-Ang University. He graduated from Carnegie Mellon University, earning his B.S. and MBA in business administration. He received his Ph.D. in information systems from the University of Texas at Austin. His research interests include the electronic commerce, business value of Internet related information technologies, adoption/diffusion of information technologies, and organizational impact of information technologies. His research papers appeared in a number of journals such as Expert Systems with Applications, Springer-Verlag's Lecture Notes in Computer Science, etc.

Hoon S. Cha is an associate professor in the College of Business and Economics at Chung-Ang University. He holds a M.S. and Ph.D. in Management Information Systems from the University of Arizona and a B.S. in Material Sciences and Engineering from Seoul National University. He worked for Samsung for three years as an information technology consultant. His research interests are IT outsourcing, IT investment, and IT personnel management. His work has appeared in MIS Quarterly, Communications of the ACM, Journal of Management Information Systems, Information Technology and People, and International Journal of Knowledge Management.