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ORIGINAL ARTICLE

An analysis of the relationship between quality and user acceptance in smartphone apps

Mi Jin Noh[1] · **Kyung Tag Lee**[2]

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Abstract This study investigates consumer intentions within the smartphone app environment. More specifically, it studies the factors influencing the intention to use banking apps based on the smartphone by employing the information system success model and a revised technology acceptance model. The study examines how quality factors and attitudes toward mobile apps-based banking influence the intention to use banking apps, and whether trust influences the relationship between quality factors and intention to use. In it, we collect data from 520 users and estimate the structural model. The results indicate that attitudes to mobile apps-based banking, as well as information and service quality, affect consumers' intention to use banking apps. We further confirm that three particular quality factors, moderated by trust, affect the intention to use these apps. This study helps to explain consumers' mobile apps-based banking behaviours, by combining the information system success model with a technology acceptance model.

Keywords Mobile app-based banking · Quality · Economic benefit · User friendliness · Trust

✉ Kyung Tag Lee
marketing@ynu.ac.kr

Mi Jin Noh
mynono@daum.net

[1] School of Business Administration, Kyungpook National University, 80 Daehakro, Daegu 702-701, Republic of Korea

[2] School of General Education, Yeungnam University, 280 Daehakro, Gyeongsan, Gyeongbuk 712-749, Republic of Korea

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1 Introduction

Mobile apps-based banking involves the use of innovative systems to facilitate banks' interactions with customers through mobile devices such as smartphones, mobile phones, and personal digital assistants (PDAs). Mobile apps-based banking provides customers with greater convenience in conducting financial transactions, as they can employ banking apps to remit and transfer funds, use their credit cards, and withdraw funds anywhere and at any time. As a result of these benefits, the use of mobile apps-based banking has increased rapidly. By the third quarter of 2013, there were 3.4 million smartphone-based banking app users in South Korea, and within the same quarter, smartphone-based banking accounted for 2230 million transactions (Bank of Korea 2013). Juniper Research has stated that as of the end of 2013, over 590 million mobile phone users had used their devices to obtain banking information, and predicted that the number of global mobile banking app users will exceed 1 billion by 2017 (Juniper Research 2013).

Within the rapidly developing smartphone and mobile app markets, both customers and banks are showing increased interest in mobile apps-based banking. They are particularly concerned about managing and optimising its adoption for several specific reasons. First, mobile apps-based banking is considered to reduce service costs (Xue et al. 2011). Second, the customer adoption of mobile apps-based banking can decentralise banking services into multiple channels. The recent increase in mobile apps-based banking users has inspired growing interest in the role of quality factors in intention to use mobile banking apps. In researching the factors influencing intention to engage in mobile apps-based banking, many studies have employed the DeLone and McLean (1992) model to understand customers' intentions to use new information systems (Chen and Cheng 2009; Chung and Kwon 2009; Singh et al. 2010). DeLone and McLean (1992) proposed their original information system (IS) success model in 1992. They later updated the model by adding in service quality as a new factor (DeLone and McLean 2003). Although theirs is a comprehensive information system model, it clearly needs further validation before it can serve as a model for m-commerce processes such as mobile apps-based banking. Thus far, the DeLone and McLean IS success model has not been empirically validated in the smartphone-based mobile environment and is not fully consistent with the belief-attitude-behaviour chain that is typically used in consumer behaviour studies (Parasuraman and Grewal 2000; Durvasula et al. 2004). Therefore, the further research is required to reconcile the model with an individual behaviour model that explains system use behaviour. The technology acceptance model (TAM) proposed by Davis et al. (1989) was designed to explain a wide range of individual behaviours. The original TAM considered perceived usefulness and ease of use as belief variables. Many researches have demonstrated the validity of the TAM across a wide range of IS (Dickinger and Kleijnen 2008; Suh and Han 2002). The factors contributing to the acceptance of IS are likely to traditional constructs of TAM. Mobile apps-based banking is different from traditional IS, and performs financial activities in virtual space. Mobile apps-based banking involves both actual and perceived concepts. Therefore, this study considers economic values

that imply usefulness, such as transaction fees, and 'friendliness' values that imply ease-of-use, such as transaction processing.

To understand consumer behaviour within the context of mobile apps-based banking, we must consider both the system characteristics of mobile apps-based banking and a consumer behaviour model. Based on existing literature on the IS success model and a revised TAM, this study aims to (1) test the validity of the IS success model within the context of mobile apps-based banking, (2) investigate the relationships between intention to use and three quality factors—user friendliness, economic benefit, and attitude toward mobile banking apps—by combining the IS success model with the TAM, and (3) identify the moderating role of trust in the relationship between the three quality factors and intention to use.

The rest of this paper proceeds as follows. Section 2 presents the study's theoretical background and research model. Section 3 describes the research methodology. Section 4 reports on the testing of the study's hypotheses. Section 5 concludes with discussion and suggestions for further research.

2 Theoretical background and the research model

2.1 IS success model and quality

Even though mobile banking technology and applications are available, international usage rates have remained fairly low (Chung and Kwon 2009). In fact, a study carried out by the Bank of Korea in 2014 shows that daily transaction of private mobile banking in South Korea spiked 45.5 % from a year in 2014 because growing number of elderly users started using their smartphone for bank transactions. However, while smartphone apps-based banking accounted for nearly half of Internet banking transaction volume, its value accounted for 5 % of total transaction value (The bank of Korea 2015). Mobile app-based banking adoption is much lower than the adoption rate of other mobile value-added services such as mobile instant messaging, mobile game, and mobile search (Zhou et al. 2010). The reason behind the comparatively low usage rate can be found in the limitations of the system compared with internet banking and uncertainty about the security of wireless transactions.

The previous research has tried to explain mobile user adoption based on user perceptions of the technology such as perceived usefulness and perceived ease of use (Ha et al. 2007; Jung et al. 2009; Mallat et al. 2009). However, simply focusing on user perception of technology may be not enough. The IS success model argues that individuals will adopt a technology based on the information system between the technology characteristics and task requirements (Wang 2008). Compared with Internet-based online banking services, mobile banking is free of spatial constraints. The customers can freely use the mobile banking based on the smartphone at any place, but online banking by a desktop PC. Mobile banking users can acquire real-time account information and make payments at anytime and anywhere. One of the most significant advantages of mobile banking is that it provides users with ubiquitous and real-time services (Dahlberg et al. 2008). Mobile apps-based

banking is designed specifically for smartphone devices, which means customers use own smartphone's built-in features. The information is also properly formatted for display on smartphones to ensure easy navigation. Thus, compared with traditional and Internet-based banking services, mobile apps-based banking is more advantageous for mobile users who are constantly on the go, resulting in a higher task technology fit (Zhou et al. 2010).

It is possible that, although users perceive a technology as being advanced, they do not it if they think this technology is not useful with their online behaviour and cannot improve their performance (Junglas et al. 2008). Therefore, it is necessary to integrates the IS success model and TAM to explain user adoption of mobile apps-based banking from both perspectives including technology perception and technology fit.

The IS success model, which was introduced by DeLone and McLean (1992), is an IS research framework for measuring complex dependent variables. The model includes six major interrelated categories: system quality, information quality, use, user satisfaction, individual impacts, and organisational impacts. The model makes an important contribution to empirical studies of IS success by providing a scheme for categorising the many IS success measures, and by modelling the temporal and causal interrelationships among success categories (Elliot et al. 2013; Sedden 1997; Wang 2008). Although many IS studies have adopted the DeLone and McLean IS success model to measure and confirm complex dependent variables, it usefulness has not been accepted for some IS environments, like that of e-commerce.

DeLone and McLean proposed an updated IS success model in 2003, to which they added service quality as an important dimension of IS success. Their update to the model was designed to increase its usefulness in light of dramatic changes in information technology, and particularly the rapid growth of e-commerce environments (Chen and Cheng 2009). The addition of service quality was made to emphasise the importance of service and the collapsing of the individual and organisational impacts of use factors into a single 'net benefits' factor. DeLone and MeLean (2003) contend that use and intention to use are alternative in their model, and that intention to use may be a more acceptable variable in the context of usage. This new model has made two significant contributions to e-commerce research (Lin and Lee 2006). First, it regards e-commerce success measures as multidimensional constructs, and second, it proposes a research model for the casual relationships among the dimensions involved. Although the model has been updated and many studies have applied it to a variety of information system contexts, including those of e-commerce (DeLone and McLean 2003; Wang 2008; Chen 2012), online shopping (Chen and Cheng 2009), e-learning (Lin 2007), and online communities (Lin and Lee 2006), few studies have examined the updated DeLone and Mclean model within the newest e-commerce or mobile environment contexts. As such, it is important that the model be validated in these new contexts. With this in mind, this study attempts to apply the updated IS success model to mobile apps-based banking to confirm its validity.

System quality is a functional measurement that includes the dimensions of availability, reliability, responsiveness, and adaptability (Ives et al. 1983). On the Internet, however, system quality is a measure of the distinctive characteristics of

information systems, including access speed, convenience, navigation, and response times (Kim et al. 2004; Eom et al. 2012). DeLone and McLean define IS system quality as a system's overall performance, insofar as it can be measured by individual perceptions (DeLone and Mclean 2003). System quality is a multidimensional construct that includes several inconsistent measures. Some studies suggest that a system's quality is reflected in its access speed, response time, ease of use, navigation, and flexibility (DeLone and McLean 2003; Kim et al. 2004). The huge potential offered by smartphone-based mobile banking applications stems from their instantaneity and timeliness. Users can engage in mobile apps-based banking anywhere and at any time. The advantages of mobile apps-based banking include mobility, accessibility, and convenience, meaning that levels of mobility, access speeds, and response times may be critical to their use. This study adopts three measures of system quality.

DeLone and McLean (1992, 2003) argue that information quality can be operationalised as the output quality of an information system, measured in terms of information accuracy, timeliness, usefulness, completeness, relevance, and contemporaneity (DeLone and McLean 2003; Lin and Lee 2006). 'Information' can be defined as any content that a firm provides to its customers (Chen and Cheng 2009). In the mobile environment, 'content' is any type of information, including texts, image, and multimedia, provided by a web server through a mobile device. Although mobile apps-based banking technology is widely available, usage rates are low. This may be because users often lack direct experience with the technology, and so must rely on their perceptions of information quality.

In traditional business to consumer (B2C) companies, service quality is reflected by the number of independent programs that companies deliver, and their overall support for these programs. Studies of service quality have been recommended in marketing literature (Parasuraman et al. 1985). Most studies have relied on SERVQUAL to predict and assess customer responses to service quality. Although service quality constructs have often been applied to offline environments, they are also important to online business transactions, which lack the involvement of face-to-face communication. Many studies have indicated that service quality is an important dimension of information system success (Pitt et al. 1995; Liang and Chen 2009). These studies have also used SERVQUAL to measure the quality of IT-based products and services, such as those within e-commerce.

DeLone and McLean (2003) have found that a positive relationship exists between three qualities and factors in intention to use. The system quality, information quality, and service quality of online websites and devices are expected to be determinants of consumer intention to use (Lin and Lee 2006; Chen and Cheng 2009; Khayun et al. 2012; Chen et al. 2013). System quality is specifically reflected text load speed, convenience of information, and access speed in the system capacities perspective. The constraints of mobile platforms, such as their small screens and inconvenient operations, make mobile apps-based banking more complicated.

Chen and Cheng (2009) report that system quality affects the intention to engage in mobile apps-based banking. Here, information quality is reflected by information relevance, accuracy, completeness, and understand ability. Users expect to be able

to access mobile banking apps to acquire their account information anywhere and at any time. When users can easily acquire and use information, they believe their mobile service providers to be capable. Furthermore, high-quality systems help service providers deliver convenient and high-value services to their customers. Previous studies have also suggested that information quality has a positive influence on intention to use an information system (Lin and Lee 2006; Chen and Cheng 2009).

Service quality, in terms of a consumer's overall evaluation of a system provided by a website or provider, is an important dimension of service success in offline channels. It is also regarded as essential to the success of IS in DeLone and McLean's updated model (2003). Despite the ongoing movement toward new technologies and communications channels, customer demand for high service quality shows no signs of abating. Studies have found that intention to use IS is positively influenced by service quality (Lin and Lee 2006).

It is thus clear from extant literature that the level of quality of mobile apps-based banking can be understood in terms of the gap between a customer's expectations of a service and the actual service provided. If the quality of a mobile banking app exceeds a customer's expectations, he or she will be more likely to use it. Thus, we propose the following hypotheses with regard to the relationship between quality of mobile apps-based banking and customer intention to use:

H1 High system quality has a positive effect on customers' intention to engage in mobile apps-based banking.

H2 High information quality has a positive effect on customers' intention to engage in mobile apps-based banking.

H3 High service quality has a positive effect on customers' intention to engage in mobile apps-based banking.

2.2 Economic benefits and user friendliness

Mobile commerce can be defined as the delivery of products and services via wireless internet to enable e-commerce transactions anywhere and at any time (Mennecke and Strader 2001). Mobile banking apps are considered among the most valuable and useful mobile commerce applications, and so understanding how users accept them is important. Consumer adoption of new technologies is a major issue in academic research. Most studies on information system use and adoption are based on models derived from the theory of reasoned action (TRA) and its extensions, such as the theory of planned behaviour (TPB) (Ajzen 1991) and the TAM (Davis et al. 1989).

The TAM is one of the theories most frequently applied to explain why and how users accept new technologies. It has been used to describe consumer adoption in various contexts, such as consumers' intentions to redeem mobile coupons (Dickinger and Kleijnen 2008), users' behaviour toward internet banking (Suh and Han 2002), and factors influencing the intention to use mobile financial service (Lee et al. 2012), and smartphone use (Park and Chen 2007). In this study, we use

the TAM to explain customer acceptance of mobile apps-based banking, by including variables essential to the mobile banking context.

The TAM posits that intentions to use are driven by three variables: attitude, perceived usefulness, and perceived ease of use (Davis et al. 1989). Of these three variables, perceived usefulness and ease of use have been recognised as essential constructs of any TAM. These constructs must be redefined in accordance with research settings, in order to reflect variety among relevant contexts. As such, this study considers usefulness in terms of the economic benefit of using mobile apps-based banking and considers user friendliness in terms of the extent to which an app service is easy to understand of banking information and usage of web navigation. The greater an app's user friendliness, the more positive the consumer's evaluations of it will be.

Some researchers have paid attention to identify the extended TAM affecting new technology using intention and user adoption. Hsu and Lin (2008) found that ease of use, enjoyment, and knowledge sharing was significantly associated with attitude toward blogging which reads to intention to use blogs. As an emerging service, mobile service has been widely adopted by users. Thus extant research has examined mobile service adoption. Lu et al. (2008) reported that personal innovativeness, mobile trust, usefulness, ease of use, and social influences affect intention to accept mobile data services.

While financial services have traditionally been offered in physical environments by retail banks, mobile apps-based banking services have facilitated more efficient services by taking advantage of mobile environments. According to diffusion theory, users are only willing to accept innovations if those innovations provide a unique advantage compared to existing solutions (Rogers 1995). In the context of mobile app banking, this view is reflected by economic benefits construct. Customers of mobile services consider their economic benefits to be the prime advantage of mobile apps-based banking. Schierz et al. (2010) found the effects of perceived usefulness and perceived ease of use on the attitude toward use. And they found a significant and positive relationship between the attitude toward and the intention to use mobile payment. Meanwhile, Dickinger and Kleijnen (2008) have investigated the relationships among economic benefits (i.e. perceived usefulness), redemption efforts (i.e. perceived ease of use), attitudes, and consumers' intention to redeem mobile coupons, and have found that consumers' attitudes affected their intention to redeem mobile coupons. Important aspects related to economic benefits on mobile apps-based banking include, for example, Transaction fee, remittance charge, and incidental expense.

Consequently, smartphone-based mobile banking apps offer a number of features that can be used anywhere and at any time, offering instant access. Customers who are familiar with mobile apps-based banking have a positive attitude to the apps and their benefits. We thus propose the following hypotheses concerning the relationships between economic benefits, user friendliness, and attitudes, on one side, and intention to use, on the other, in the context of apps used in smartphone-based mobile banking.

H4 Economic benefits have a positive effect on attitudes toward mobile apps-based banking.

H5 User friendliness has a positive effect on attitudes toward mobile apps-based banking.

H6 User friendliness has a positive effect on the economic benefits of mobile apps-based banking.

H7 Attitude toward mobile banking apps has a positive effect on intention to engage in mobile apps-based banking.

2.3 Trust

Trust has been studied within many academic disciplines, including the fields of management and information systems. Studies on the role of trust in internet use (which mobile banking transactions involve) have suggested that trust is an important factor in internet purchasing and other online transactions (Alsajjan and Dennis 2010; Lu et al. 2008), largely because of the high uncertainty and risk levels present in online and mobile environments. Previous studies have shown that trust is an important factor in the adoption of new technologies such as internet banking (Nor and Pearson 2007), mobile shopping (Lu and Su 2009), and mobile apps-based banking (Chung and Kwon 2009). Like e-commerce, mobile commerce involves uncertainties connected to mobile hacking, security issues, and the limited amount of information available on mobile apps. In mobile apps-based banking, trust is very important. Because mobile apps-based banking involves weakness such as a narrow screen, slow processing and limited amount of information provided, it must become more objective and trustworthy than general Internet banking in order to overcome such weaknesses. In mobile apps-based banking, customers' trust level is dynamic, rather than static, because customers' trust changes from time to time. Because mobile apps-based banking services include no face-to-face contact, building trust in the banking can be difficult. Once built, however, trust in it can continue. From such a viewpoint, the trust of customers who initially use mobile banking services is a significant factor that influences their attitude towards mobile banking services, as well as their intentions for repeated use in the future (Chung and Kwon 2009). This uncertainty about mobile transactions, including those carried out in mobile apps-based banking, is generally caused by consumers' lack of trust in mobile technologies. Therefore, we must consider how consumers' trust in mobile technology affects their engagement in mobile apps-based banking. Past studies have regarded trust as having both direct and moderating effects (Jarvenpaa et al. 2004). In its moderating role, trust does not directly affect behavioural outcomes but merely influences how people evaluate matters related to their attitudes and behaviours (Jarvenpaa et al. 2004). This study considers trust as a moderator while also attempting to clarify its role in consumer behaviour. Chung and Kwon (2009) have found that trust can play a moderating role in the relationship between the quality of mobile apps-based banking and customer satisfaction. Accordingly, this study proposes the following hypotheses (Fig. 1):

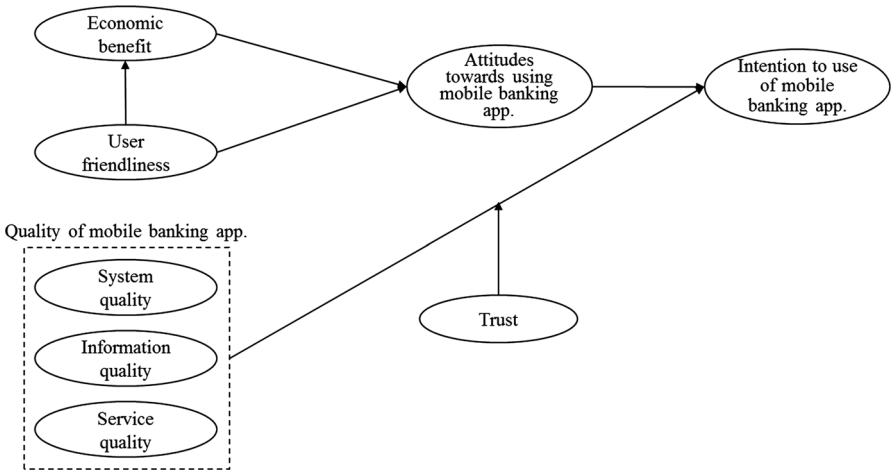

Fig. 1 Research model

H8 Trust in mobile apps-based banking moderates the relationship between system quality and intention to use mobile banking apps on a smartphone.

H9 Trust in mobile apps-based banking moderates the relationship between information quality and intention to use mobile banking apps on a smartphone.

H10 Trust in mobile apps-based banking moderates the relationship between service quality and intention to use mobile banking apps on a smartphone.

3 Research methodology

3.1 Data

We developed the questionnaire for this study by selecting appropriate items from previous research and revising their wording as needed. In this study, we collected data through online survey. Respondents were informed that they should have had the experience of using mobile apps-based banking. The survey was conducted for 2 months from November 1th to December 30th, 2013, and was collected from 535 people. A total of 788 Korean mobile apps-based banking users were contacted during the online survey, 541 agreed to participate. Respondents were asked to indicate whether they continue to use mobile apps-based banking before taking the survey. We were left with 520 valid responses. Their responses concerned the form of mobile apps-based banking that they most frequently used. Among them, 68.5 % were female and 31.5 % were male. Most of the respondents were between 20 and 29 years old, 80.2 % held a university degree, and 6.5 % held a graduate degree or higher (see Table 1).

Table 1 Demographic characteristics of respondents

	Demographic background	n	%
Gender	Female	356	68.5
	Male	164	31.5
Age	20–29	334	64.2
	30–39	123	23.7
	40–49	30	5.8
	>50	33	6.3
Education	High school or less	69	13.3
	University	417	80.2
	Graduate school or higher	34	6.5

3.2 Measurement

All measurements were taken using a seven-point Likert scale ranging from one ('strongly disagree') to seven ('strongly agree'). We selected the items for each construct based on a comprehensive literature review, and reformulated them to fit the context of mobile apps-based banking. We measured system quality by using items from Lin et al. (2011), as well as Zhou (2011). Information quality was measured by using four items drawn from the work of DeLone and McLean (2003) and Lin and Lu (2000). Service quality was measured with four items adopted from DeLone and McLean (2003), Parasuraman et al. (1985) and Pitt et al. (1995). User friendliness was measured by using four items taken from Liao and Cheung (2002) and Ellahi and Bokhari (2013). Economic benefit was measured with four items adopted from Yang and Jolly (2009) and Lee (2009). Attitude to mobile apps-based banking was measured with three items adopted from Davis et al. (1989). Items measuring intention to use were adopted from Lin and Lu (2000). Trust was measured through four items from Suh and Han (2002). Trust was defined as the subjective probability according to which banks believe that a mobile banking app will be capable of facilitating transactions in a consistent manner with their expectations (see Table 2).

4 Research methodology

4.1 Measurement model

We estimated the structural and measurement models by using AMOS. To determine the fit of the measurement model, we considered X^2, the root mean square error of approximation (RMSEA), the goodness-of-fit index (GFI), the adjusted GFI (AGFI), the normed fit index (NFI), and the comparative fit index (CFI). The measurement model was found to have a good fit to the data ($X^2 = 441.004$, df = 244 [X^2/df = 1.807], RMSEA = 0.039, GFI = 0.936, AGFI = 0.915, NFI = 0.942, CFI = 0.973). We also assessed the measurement model for construct reliability and validity (see Table 3). The results for all constructs

Table 2 Measurement items and researchers

Factors	Measurement items	Researchers
System quality	Mobile banking app quickly loads all the text and graphics	Lin et al. (2011)
	Mobile banking app is easy to access in the system capacity perspective	Zhou (2011)
	I could use mobile banking apps at anytime, anywhere I want	
Information quality	Mobile banking apps provide valuable information to me	DeLone and McLean (2003)
	Mobile banking apps provide necessary information to me	
	Mobile banking apps provide accurate information to me	Lin and Lu (2000)
	Mobile banking apps provide relevant information to me	
Service quality	I can receive an immediate service if any problem occurs when I use mobile banking apps	DeLone and McLean (2003)
	Mobile banking apps provided by banks are excellent services, such as after-services	Parasuraman et al. (1985)
	Mobile banking apps provide the services promised	Pitt et al. (1995)
	Mobile banking app support staffs make continuous efforts to improve services	
User friendliness	It is easy for me to operate this mobile banking app	Liao and Cheung (2002)
	It is easy to become skilful at using this mobile banking app	
	Interactions with this mobile banking app are flexible	Ellahi and Bokhari (2013)
	It is easy to use the comprehensive help menus of this mobile banking app	
Economic benefit	I think that using a mobile banking app can make banking transactions cheaper than other banking transactions	Yang and Jolly (2009)
	I think that using a mobile banking app can offer me a wider range of banking products, services, and investment opportunities	Lee (2009)
	I think that using a mobile banking app can help me save the transaction handling fees of banking transactions	
	I think that the cost arising from using a mobile banking app is reasonable	
Attitude to mobile banking apps	Using a mobile banking app is a good idea	Davis et al. (1989)
	Using a mobile banking app is wise	
	Using a mobile banking app is beneficial	
Intention to use	I intend to continue using mobile banking apps in the future	Lin and Lu (2000)
	I will use mobile banking apps because of their convenience	
	Given the opportunity, I will continually use mobile banking apps	
Trust	Mobile banking apps are trustworthy	Suh and Han (2002)
	I trust in the benefits of mobile banking apps	
	Mobile banking apps keeps customers' best interests in mind	
	I trust mobile banking apps	

indicate sufficient convergent validity. Finally, as shown in Table 4, we determined that the square root of the average variance extracted (AVE) exceeded all correlations, demonstrating sufficient discriminant validity between the constructs.

Table 3 Descriptive statistics for scales

Factors	Items	Estimate	*t* value	Cronbach's alpha	Internal consistency	Convergent validity (AVE)
System quality	SY1	1.000	–	0.738	0.764	0.532
	SY2	0.984	15.297			
	SY3	0.629	10.091			
Information quality	IQ1	1.000	–	0.906	0.901	0.695
	IQ2	0.962	26.383			
	IQ3	0.853	22.859			
	IQ4	0.775	20.605			
Service quality	SQ1	1.000	–	0.852	0.867	0.622
	SQ2	0.999	22.026			
	SQ3	0.847	16.412			
	SQ4	0.815	18.784			
Economic benefit	EB1	1.000	–	0.866	0.882	0.757
	EB2	0.818	16.687			
	EB3	0.977	21.876			
	EB4	0.999	19.184			
User friendliness	PF1	1.000	–	0.701	0.831	0.571
	PF2	0.960	8.252			
	PF3	0.949	8.720			
	PF4	0.998	8.307			
Attitude	AT1	1.000	–	0.818	0.898	0.620
	AT2	0.734	15.023			
	A3	0.972	20.623			
Intention to use	IU1	1.000	–	0.848	0.847	0.649
	IU2	0.969	21.497			
	IU3	0.768	17.651			

Table 4 Correlations and square root of the AVE

	System quality (SYQ)	Information quality (INQ)	Service quality (SEQ)	Economic benefit (EB)	User friendliness (UF)	Attitude (AT)	Intention to use (IU)
SYQ	0.729						
INQ	0.244**	0.834					
SEQ	0.335**	0.254**	0.789				
EB	0.353**	0.448**	0.469**	0.870			
UF	0.372**	0.288**	0.213**	0.383**	0.755		
AT	0.288**	0.316**	0.400**	0.438**	0.312**	0.787	
IU	0.301**	0.478**	0.394**	0.514**	0.335**	0.590**	0.806

Values along the diagonal indicate the square root of the AVE

** $p < 0.01$

4.2 Structural model

The structural model was found to have a good fit to the data ($X^2 = 435.711$, df = 224 [X^2/df = 1.945], RMSEA = 0.043, GFI = 0.933, AGFI = 0.910, NFI = 0.942, CFI = 0.971). The results provide support for all hypotheses except H1 and H10. First, H1 was not supported (β = 0.030, t = 0.680), and thus rejected H1. However, information quality (β = 0.229, t = 7.103) and service quality (β = 0.090, t = 2.379) had significant positive effects, supporting H2 and H3, respectively. These results suggest that information and service quality can be important features that provide mobile apps-based banking with a competitive advantage over other services, such as internet and offline banking.

Second, as is consistent with previous findings, we determined that economic benefit (β = 0.511, t = 7.665) and user friendliness (β = 0.330, t = 5.179) had significant effects on attitudes toward mobile apps-based banking, supporting H4 and H5. This result suggests that, because mobile apps-based banking users are familiar with smartphone features and how to use them, they are likely to have favourable attitudes to mobile apps-based banking.

Third, user friendliness had a positive effect on economic benefit (β = 0.876, t = 7.640), while attitude had a positive effect on intention to engage in mobile apps-based banking (β = 0.410, t = 9.363), supporting H6 and H7. Intention to engage in mobile apps-based banking was largely explained by attitudes toward mobile banking apps, implying that positive attitudes about mobile banking apps were the most important determinant of the intention to use them (see Fig. 2).

For this study, we conducted a multi-group analysis using AMOS 7.0 to investigate the moderating effect of trust on the relationships between the quality of mobile banking apps and customers' intention to use them. A multi-group analysis is a hierarchical approach in which two sub-groups are compared. Respondents were

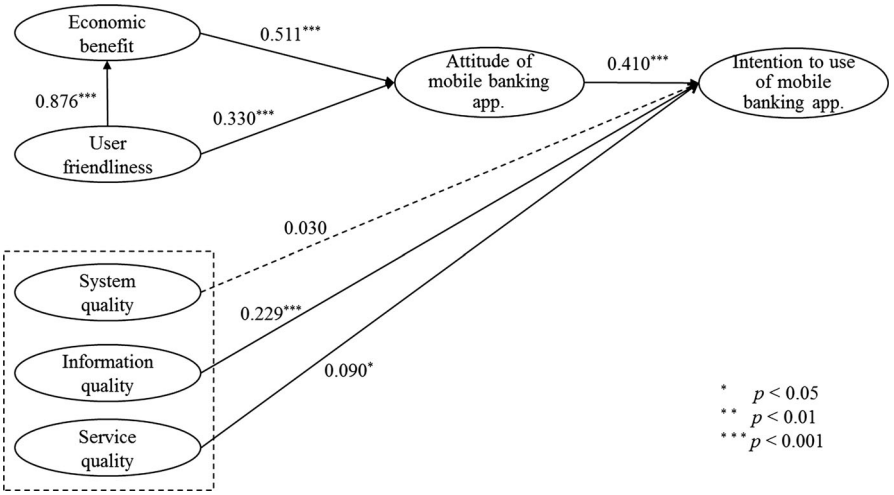

Fig. 2 Results of research model

Table 5 The moderating effects

Path	Estimate		X^2		X^2 difference	Decision
	High trust group	Low trust group	Free model	Constraint model		
H8						
System quality → Intention to use toward mobile banking apps	0.175*	−0.015		833.239	8.911***	Accept
H9						
Information quality → Intention to use toward mobile banking apps	0.256***	0.209***	842.150	839.476	2.674	Reject
H10						
Service quality → Intention to use toward mobile banking apps	0.136**	0.085		837.006	5.144**	Accept

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

divided in two groups [a high trust group (n = 247) and a low trust group (n = 273)] obtained based on the median split of the moderating variables (m = 3.25; Chandrashekaran and Grewal 2003). A comparison was made between a group with a high level of trust in mobile banking apps and a group with a low level of trust. This study examined whether there was a difference between the two groups through χ^2 difference test. The results of each test were explained by the change in the χ^2 value. Our results revealed that H8 was supported, as the χ^2 difference was statistically significant at $\alpha = 0.01$. Members of the group with a high level of trust in mobile banking apps felt that system quality had a positive effect on attitudes to these apps, and so H10 was also supported, although H9 was not. The results concerning the moderating effects are shown in Table 5.

5 Conclusion

By taking advantage of mobile devices, mobile apps-based banking can provide customers with financial services anywhere at any time. Mobile banking apps are considered to be among the most innovative mobile services, and their quality is expected to improve substantially in the future. However, users of mobile apps-based banking often face inconveniences such as complex account inputs and certification procedures. To eliminate these, banks have enhanced the quality of mobile apps-based banking through means such as service improvements and system development. This study examined the relationship between the quality of mobile apps-based banking (i.e. system, information, and service quality) and customer intention to engage in mobile apps-based banking. We also analysed the

direct and indirect effects of economic benefits and user friendliness on the intention to engage in mobile apps-based banking, based on the TAM.

Our results show that intention to use is positively affected by information quality and service quality. Information quality had a significantly positive effect on the intention to participate in mobile apps-based banking, which is consistent with previous findings on online shopping (Chen and Cheng 2009). Service quality also had a significantly positive effect on the intention to engage in mobile apps-based banking. By employing the TAM, Cheng (2012) has similarly demonstrated that service quality is an antecedent of e-learning acceptance.

Furthermore, we found that attitudes toward mobile apps-based banking are essential factors determining intention to use, and are positively affected by economic benefits and user friendliness. Schierz et al. (2010) found the positive relationships between the perceived usefulness (i.e. economic benefits) and perceived ease of use (i.e. user friendliness) attitude toward using mobile payment services. Most research on innovative products indicates that relative advantage is the most important factor in consumer evaluation (Kleijnen et al. 2007). In contrast, this study shows that user friendliness is the main attitude factor. Many studies have applied the TAM to discover that engagement in internet shopping is significantly related to usefulness, ease of use, and attitude (Dickinger and Kleijnen 2008; Hsu, and Lin 2008; Schierz et al. 2010; Shih 2004). However, the literature is not yet decisive about the comparative judgement of various kinds of banking including ATM, phone banking, Internet banking, and mobile banking. There is a mixed kind of arguments about the similarity and dissimilarity among several service or alternatives. Among the few studies investigating the selection between several alternatives applied TAM to explore choice behaviour between two or three banking services. Curren and Meuter (2005) showed that usefulness was a significant predictor for attitudes toward both ATM and bank by phone but not for Internet banking. Ease of use was a significant predictor for attitudes toward ATM, but not for attitudes toward bank by phone or Internet banking. Khan and Khan (2012) also applied the TAM to compare Internet banking to mobile banking and found that the effect of usefulness in mobile banking is the same as Internet banking, but the two banking are not same in the usefulness. Despite these results, TAM is an appropriate model for measuring smartphone users' adoption of mobile apps-based banking.

In addition, our results show that system quality has not effect on the intention to use of mobile banking apps, even though previous studies have suggested that system quality is an essential factor determining intention to use new technology. By integrating the TAM and three quality factors, Xu (2013) found that system quality is an important antecedent of intention to use an e-service.

These inconsistent results are due to the ubiquitous features of mobile technology. System quality reflects the access speed and app connectivity on mobile app devices. Thus, the evaluations of Information and service quality are determined by mobile app quality itself, whereas system quality has relevance to both mobile app and mobile service provider. Mobile apps require an access to the internet, and most users prefer wi-fi networks which are free to use (Park et al. 2014). Most users of wireless networks know that the access of mobile apps using wi-fi doesn't guarantee the stable connection. Therefore, system quality may not be

an important consideration with regard to intention to engage in mobile apps-based banking.

Another area that we explored was the moderating effect of trust on the relationship between quality of mobile banking apps and intention to use. The results show that trust can moderate the relationship between quality and intention to use, but that its moderating effect on information quality is not significant.

The theoretical implications are as follows. First, this study aimed to confirm the validity of the belief-attitude-behaviour structure and apply the IS success model and the TAM to mobile apps-based banking. Its findings suggest that belief (i.e. the three quality factors, user friendliness, and economic benefits), attitude, and behaviour (i.e. intention to use), as structured in the proposed IS success model and the TAM for the mobile context, are consistent with IS acceptance and the consumer behaviour model, as applied to the online system and e-commerce contexts. Mohammadi (2015) focused on the system capabilities such as service quality, system quality, and information quality with perceived usefulness and perceived ease of use. Li, Duan, Fu, and Alford (2012) proposed a hybrid research model based on TAM and IS success model. They integrated hybrid model aims to examine the factors that affect a user's behavioural intention to reuse an e-learning system. This study also successfully combined the IS success model with the individual behaviour model and applied the resulting combination to mobile apps-based banking. Our study thus contributes to existing literature by combining the quality factor in the IS success model with the TAM, in order to predict the intention to engage in mobile apps-based banking.

Second, this study examined an integrated model of IS success model and TAM to investigate users' perceptions and system characteristics about mobile apps-based banking, and analysed the quality features affecting users' intentions. In order to understanding of users' behaviour patterns in the mobile apps context, this study includes economic benefit and user friendliness. This model also explained the system features based on the D & M model. Thus, the finding provides useful information on the users' patterns with the quality features based on the system about mobile apps-based banking.

Third, we empirically evaluated the relationship between IS success model and TAM, and showed that the integrated model was supported in the mobile apps context. IS is essential to achieve success in the organization; thus D & M IS success model can provide a framework to assist the success of the business. The organization can also understand customers' behaviours to make business profits based on the results of this study. This study provides the integrated framework to understand in the customer and organization perspective.

Finally, the information quality and service quality emerges as a critical determinant of the intention to use of mobile banking apps. This shows that mobile apps-based banking is important from users' perspectives such as information and service. In order to conduct researches of banking, researchers have to consider factors about information and services.

The managerial implications are as follows. First, previous research has found that intention to use is the most important IS adoption factor. Our results suggest

that mobile apps-based banking providers should focus on increasing intention to use by developing app systems with high levels of information and service quality.

Second, our findings suggest that information quality is more influential than service quality with regard to the intention to use mobile banking apps. Thus, the information quality of mobile banking apps is more important to consumers than any other quality. Banks should therefore build systems that provide valuable, necessary, accurate, and relevant information, in order to increase intention to use.

Third, this study has proposed that economic benefits and user friendliness have both direct and indirect effects on attitudes toward mobile apps-based banking. The results show the importance of building up consumers' favourable attitudes concerning both economic benefits and user friendliness. As economic benefits do not totally mediate the influence of user friendliness on attitudes toward mobile apps-based banking, banks should consider both factors.

Finally, we have considered trust as a moderating variable in the relationship between quality and intention to use. Our findings show that trust indeed plays such a moderating role. Thus, in order to increase customers' intention to use mobile banking apps, banks should work to maintain their trust.

Although our study has important implications for mobile apps-based banking, it has several limitations. First, we collected data only in South Korea, one of the highest growth sectors for mobile apps-based banking. Evaluating the validity of our model requires further research that could be generalised to other countries in which mobile apps-based banking is used. Second, this study focuses on intention rather than actual behaviour. Further research should consider the inclusion of measures of behaviour. Mobile apps-based banking is still in its early stages. Even though many people join a mobile apps-based banking, they simply use it to inquire account balance. It is certain to change as a result of consumer pressure. Such changes might significantly affect attitudes toward and intention to use mobile banking apps. Thus, further research that considers consumers' experiences with mobile apps-based banking is needed. Finally, future study should be applied to the intention to use and use of other different technologies used to provide banking services. Comparison of the each banking service reveals that salient antecedents change the intention to use and the adoption process.

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