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Internet banking adoption in a developing country: an empirical study in Vietnam

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Abstract Internet banking is growing faster than other e-commerce sectors and has emerged as an evolution in applied banking technology. This study investigates the factors influencing customer intention regarding Internet banking services in Vietnam using elements of an extended technology acceptance model and the theory of planned behaviors. We use structured equation modeling to evaluate the strength of the hypothesized relationships. The results of this study indicate that the use of Internet banking services in Vietnam may be motivated by a set of specific factors (i.e., perceived usefulness, perceived ease of use, perceived credibility, perceived behavioral control, subjective norms, and attitude toward use). These results are expected to help banks understand the critical factors influencing Internet banking usage and to contribute to the creation of competitive promotional campaigns in Vietnam.

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1 Introduction

Internet services provide their customers with convenience, interactivity, relatively low costs, the advantage of saving time, and a high degree of personalization. They enhance customer satisfaction and retention more effectively than offline-based services (Khalifa and Liu 2001). Given the importance of Internet services, organizations are investing substantial amounts of money and effort in information systems in order to provide Internet-based services on the Web. The banking industry is no exception. Industry players have launched multiple services via new delivery channels such as electronic banking or "e-banking" (e.g., banking by telephone, Internet, mobile phone, or SMS) in order to offer more choices and features at lower costs to their customers. Internet access was first made available in Vietnam in 1997 and has since, contributed greatly to the development of Vietnamese society. Approximately 27 % of the Vietnamese population uses the Internet frequently; approximately 70 % consider the Internet to be a communication channel and use it to chat; 40 % of users have a blog or an account on a social forum or network like YouTube or Facebook. The Internet also provides online commercial services such as shopping, auctions, and banking.

In Vietnam, most people have never experienced new banking technology products and services such as Internet and mobile banking, which are still being streamlined. Vietnamese banks, especially international banks, now focus on developing products and services using these new technologies. Internet banking has rapidly developed in Vietnam since the State Bank of Vietnam initiated Inter-Bank Electronic Payments. In addition to payments via automated teller machines (ATMs), banks have been instructed by the government to develop other payment channels, such as mobile and Internet banking, in order to encourage customers to reduce their cash transactions. According to the Vietnam Banks Association, Vietnam had 24 million card holders, 48 card issuers, 11,000 ATMs, and 38,000 points of sale nationwide in 2012. Only 15 % of the population aged between 16 and 60 years has used Internet banking, but this figure should be seen in the context of the fact that only 27 % of Vietnam's 89.6 million citizens have personal bank accounts. These statistical data indicate that the demand for banking services is high and represents an opportunity for the Vietnamese banking market, particularly in terms of Internet banking. Most banks maintain websites on which they advertise and provide information about their services. The aggressive competition among Vietnamese banks will ultimately lead to a race to improve services and attract customers, making the launch of Internet banking services inevitable.

Internet banking allows customers to use their banks' websites to perform common banking transactions such as paying bills (e.g., for electricity, water, telephone, or the Internet), transferring funds, printing statements, and inquiring about account balances, exchange rates, or interest rates. Internet banking provides a very convenient and effective method of managing personal finances because it is flexible. Further, the convenience offered by Internet banking is making it increasingly popular among customers, which in turn encourages banks to provide a well-constructed, safe, and efficient Internet banking system for their customers. Internet banking is one of the most significant technological achievements in the use

of the Internet for delivering products and services. This mode of banking has changed the banking industry and has had major effects on banking relationships. Bank customers are no longer required to approach a branch in person to withdraw cash, deposit money, make payments or transfers, find information on investments, or request statements of their accounts. Banks can now offer their products and services to customers worldwide and thus, expand their markets. Owing to the widespread growth of the Internet, customers can use it anywhere in the world to access a bank's network. Internet banking is a radical technological innovation with the potential to change the structure of banking.

Although several studies have examined the banking industry, most of these have focused on traditional banking services such as evaluations of their quality, marketing, and development of new services (Sulieman et al. 2011; Shanka 2012). Some studies have focused on the positive aspects of Internet banking such as its related benefits, trustworthiness, and innovations (Cronin 1998; Han and Baek 2004; Huynh 2007; Nguyen 2008). Although studies on the adoption of Internet banking have been conducted in many developed countries, few studies have examined the factors influencing customers' intention to use Internet banking in developing countries such as Vietnam. One such study was conducted by Chong et al. (2010) who empirically examined the factors (i.e., perceived usefulness, perceived ease of use, trust, and government support) that influence the adoption of online banking in Vietnam. In line with their study, the present study explores the determinants of customers' Internet banking use in order to learn in further detail about customers' perceptions of Internet banking services and thus, help banks improve their Internet services and gain competitive advantage in the industry.

This study examines the factors influencing customers' intention to use Internet banking in Vietnam. Specifically, it investigates the role of perceived usefulness, perceived ease of use, and perceived credibility in influencing customer attitudes toward Internet banking. It further examines the role of perceived credibility, attitude toward use, subjective norms, and perceived behavior control in influencing customer intention to use Internet banking. We seek to discover if the intention model can be applied to Internet banking to help provide better services in Vietnam. Internet banking is an important part of a bank's strategy formulation in an emerging economy like Vietnam. To succeed, Vietnam's banks must improve their services to customers because customers will access only those services with which they are satisfied.

2 Extended TAM and TPB models

2.1 Extended technology acceptance model (TAM)

Since the mid-1980s, research on information technology adoption has focused on developing and testing models to predict the intention to use or the actual usage of information technology by both individuals and organizations (Legris et al. 2003; Olson and Boyer 2003; Pijpers et al. 2001). Among the efforts to understand and predict user acceptance or adoption of information systems, the technology

acceptance model (TAM) introduced by Davis (1986, 1989) is one of the most popular theoretical frameworks. In the TAM, among the models most commonly used to study information system acceptance, actual behavior is determined by measuring perceived usefulness and perceived ease of use as they relate to attitudes toward use and intention to use. Venkatesh and Davis (2000) discovered through empirical studies that the TAM consistently accounts for about 40 % of variance in use intentions and behavior. Cheng et al. (2006) have stated that the TAM is the most influential and widely applied model for predicting the behavioral intention to use and the actual use of information systems. It has recently been developed to anticipate Internet adoption. The TAM, an adaptation of the theory of reasoned action (TRA) formulated by Fishbein and Ajzen (1975), was designed mainly to model the user acceptance of information technology (Davis et al. 1989). The TAM includes five concepts: perceived usefulness, perceived ease of use, attitude toward use, intention to use, and actual use. The TAM posits that attitudes to using a new technology are influenced by both perceived usefulness and ease of use. An attitude is hypothesized to determine the behavioral intention to use technology; behavioral intentions then lead to actual usage.

Perceived usefulness (PU) is defined as the extent to which a person believes that using a system will increase his or her job performance. Perceived ease of use (PEOU) is the degree to which a person believes that using a system will be free of effort (Davis et al. 1989). These factors are common in technology-usage settings and can be applied widely to solve the acceptance problem. The TAM is seen as not only a powerful model for representing the determinants of system usage but also a valuable tool for system planning, as the system designers have a degree of control over easiness and usefulness (Taylor and Todd 1995).

The main value proposition of using TAM is its ability to describe how customer beliefs and attitudes relate to customers' use of something, in this case Internet banking, and to predict whether the system will be used as intended. The TAM also helps senior managers responsible for offering and developing online banking products and information systems to predicate users' behavioral intentions, which can enable modifications to people's Internet banking-related thoughts and behavior (Fig. 1).

Some researchers have improved the TAM by incorporating what have been termed "external variables" to enhance the TAM's viability. One of the most significant external variables is perceived credibility, defined as the degree to which someone believed that using a system would be free of privacy and security threats (Wang et al. 2003). Perceived credibility refers to the two important dimensions (security and privacy) that most studies argue affect users' intention to adopt online transaction systems.

Like many developing countries, policies and laws related to security and privacy issues are still unclear to many users in Vietnam, which will affect whether Internet banking is usefulness and trustworthy to the customers. Many potential Internet banking users are afraid of using Internet banking system due to security and privacy concerns. They think the Internet banking system is not safe enough to protect their entire life savings because anyone who has the ID and password can
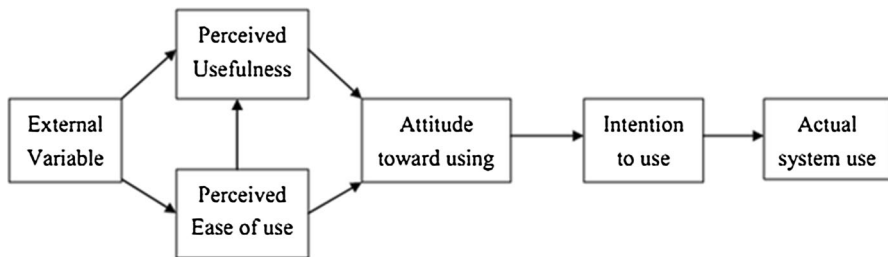
Fig. 1 Modified version of TAM (Davis et al. 1989)

log in the account and they may lose their savings easily. Therefore, those potential users did not dare to apply Internet banking system.

Research on technology acceptance implicitly assumes that successful system use mainly depends on technological aspects and has not considered the role of security or privacy threats. However, the advent of the Internet has introduced risk to system acceptance and use, as people often need to use the Internet to communicate, collaborate, and transact with both individuals and organizations outside of physical, face-to-face interactions. Thus, security is increasingly becoming the underlying determinant of Internet-based system usage. Some studies have found that security and privacy are among the factors affecting the growth and development of information systems. Security refers to the protection of information or systems from the use of an open network. According to Adams and Sasse (1999), security and privacy are necessary conditions for any commercial activities involving sensitive information to take place. Daniel (1999) indicated that customers are afraid of other people being able to easily use their financial information and of having their data become an open book on the Internet. Privacy refers to the protection of various types of data collected (with or without the users' knowledge) during interactions with Internet banking. Many customers are unwilling to divulge private information (e.g., phone numbers, addresses, credit card information) online. Internet users are concerned about security levels when providing sensitive information online (Warrington et al. 2000). Sathye (1999) showed that security concerns and lack of awareness as being the obstacles to the adoption of Internet banking in Australia. Hernandez and Mazzon (2007) found that the security and privacy of consumers' are both influence the adoption of Internet banking in Brazil. Jahangir and Begum (2008) studied on Internet banking adoption in Bangladesh and the results showed that security and privacy are the important factors influencing the adoption of Internet banking. From this aspect, this research views the perceived credibility as an important factor to affect adoption of Internet banking. However, previous TAM researches mainly focus on technology products or information systems which discuss technological aspect and did not put much emphasis on security and privacy issues. Thus, the perceived credibility is incorporated as external variables in this research.

2.2 Theory of planned behavior (TPB)

The theory of planned behavior (TPB) is an extension of the theory of reasoned action (TRA) (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980). The TRA is a widely studied social psychology model concerned with the determinants of consciously intended behaviors. The TRA argues that both behavioral attitudes and subjective norms affect behavioral intention, which in turn affects actual behavior. The TPB suggests that a central factor in human behavior is behavioral intention, which is affected by attitudes to behavior, subjective norms, and perceived behavioral control (Ajzen 1985, 1991, 2002). Using the TPB to underlie the TRA has been proven successful in predicting and explaining human behavior across various information technologies. Subjective norm (SN) is the perceived organizational or social pressure felt by someone who intends to perform a given behavior and is relative to normative beliefs about the expectations of other people. Perceived behavioral control (PBC) is the perception of the ease or difficulty of performing a given behavior, driven by beliefs about the presence of control factors that may facilitate or hinder their performance. Numerous studies have demonstrated both the TPB's applicability to various content domains and its ability to provide a useful theoretical framework for understanding and predicting the acceptance of new information technology. Abundant empirical evidence suggests that the TPB effectively explains individual intentions and behavior concerning the adoption of new information technologies (Figs. 2, 3).

3 Methodology

This study was designed to examine customer intention to use Internet banking in order to understand how key variables affect that customer intention. The study's model is based on the TAM introduced by Davis (1986, 1989) and the TPB formulated by Ajzen and Fishbein (1980), as shown in Fig. 4. Although the original TAM and TPB model construct and discuss the relationship between behavioral intention and actual usage, many previous researches (Mathieson 1991; Venkatesh and Morris 2000) have shown that the two variables, intention to use and actual usage, have strong and significant causal relationship. Using behavioral intention as a dependent variable to examine the acceptance of Internet banking is thus theoretically justifiable.

In addition, feeling secure in doing transactions on the Web is often cited by users as a major factor that addresses their concerns about the effective use of the Internet for making online purchases. We include the "perceived credibility" construct as a predictor of attitude and intention to use, as in earlier studies conducted by Salisbury et al. (2001), Wang et al. (2003), and Cheng et al. (2006). Wang et al. (2003) defined perceived credibility as the extent to which a person believes that online banking will be free of security or privacy threats. Generally, the credibility that people perceive in the system as a way to securely transact while maintaining the privacy of their personal information affects their voluntary acceptance of Internet banking. In this study, perceived credibility is another

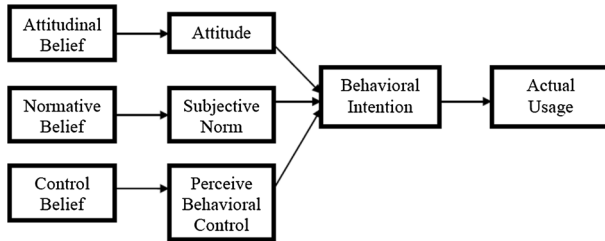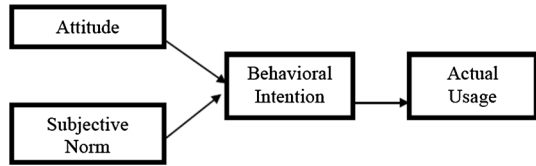**Fig. 2** Theory of reasoned action model (Fishbein and Ajzen 1975)

Fig. 3 Theory of planned behavior model (Ajzen 1985, 1991)
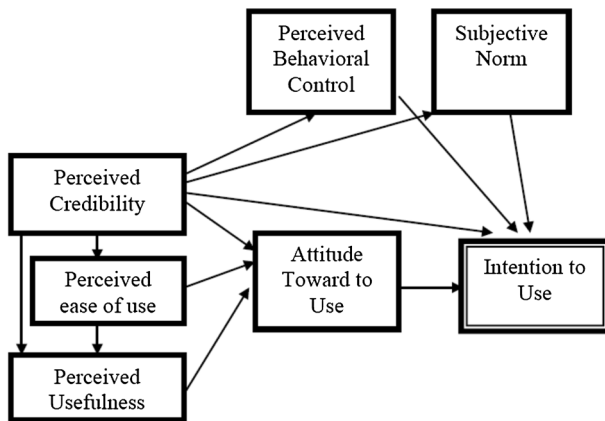

Fig. 4 Models of customer's intention to use Internet banking

important antecedent of attitude, subjective norm, and perceived behavioral control in the TPB model.

TAM is constructed to investigate the adoption of technology products and systems, and so it is not sufficient to measure the behavioral aspects of usage of the Internet-based system, especially in Internet banking. Therefore, this research applies not only the TAM but also the TPB model to enhance the prediction capability. With the incorporate of TPB model, which includes individual attitude, subjective norm and perceived behavioral control, we can learn a comprehensive overview. The viewpoint is supported by Wu and Chen (2005). Thus, this research extends TAM with TPB model and perceived credibility to explore Internet banking and an empirical case is demonstrated to illustrate the research problem.

3.1 Hypotheses

The research proposes six main hypotheses describing the relationships among the main variables.

3.1.1 Perceived usefulness (PU)

The literature shows that perceived usefulness has significant effects on attitude concerning technology use and has been tested and validated by various researchers in different contexts (Davis 1989; Davis et al. 1989; Gefen et al. 2003; Fusilier and Durlabhji 2005). The more useful the system is seen to be, the more likely it is that the system is also being used. The first hypothesis is thus the following:

H1: Perceived usefulness positively influences the attitude to Internet banking use.

3.1.2 Perceived ease of use (PEOU)

Perceived ease of use, also derived from the model in Davis (1989), is the essential component of the TAM. Perceived ease of use reflects the user's perception of how easy it is to use a system. Legris et al. (2003) and Venkatesh and Davis (2000) indicated that a technology will be more useful if it is easer to use. Many studies of Internet usage also agreed the positive effect of perceived ease of use on perceived usefulness in the TAM (Ngai et al. 2006; Porter and Donthu 2006). If an Internet service is found to be very difficult to use, the customer will choose another way to make transactions. The more difficult the system is to use or learn to use, the less likely it is that the system will be used. Thus, the second hypothesis is the following:

H2a: Perceived ease of use positively influences perceived usefulness.

H2b: Perceived ease of use positively influences attitudes to Internet banking use.

3.1.3 Perceived credibility (PC)

Qureshi et al. (2008) indicated that PU, security, and privacy are the main factors in Internet banking acceptance. Amin (2007) used an extended TAM model to analyze Internet banking adoption and found that PU, PEOU, perceived credibility, and computer self-efficacy were the factors affecting the adoption of Internet banking. Wang et al. (2003) found that perceived credibility had a significantly positive influence on the attitude to use Internet banking. Perceived credibility was also found to have a significantly positive influence on the behavioral intention to use mobile banking (Luarn and Lin 2005). According to these studies, perceived credibility is the extent to which a person believes that using Internet banking will carry no security or privacy threats. Thus, we propose the following hypotheses:

H3a: Perceived credibility positively influences perceived usefulness.

H3b: Perceived credibility positively influences perceived ease of use.

H3c: Perceived credibility positively influences attitudes to Internet banking use (ATU).

H3d: Perceived credibility positively influences customer intention to use (ITU) Internet banking.

H3e: Perceived credibility positively influences perceived behavioral control (PBC).

H3f: Perceived credibility positively influences subjective norm (SN).

3.1.4 Perceived behavioral control (PBC)

Perceived behavioral control is the perception of the ease or difficulty of performing a given behavior and involves control beliefs about the presence of factors that may facilitate or impede the performance (Ajzen 1991, 2002; Liao et al. 2007). Control beliefs include the perception of possessing the necessary skills, resources, or opportunities to successfully perform an activity (Liao et al. 1999). This research considers perceived behavioral control to reflect whether customers believe they have the required knowledge, skills, or ability to use Internet banking services. The literature suggests a positive relationship between perceived behavioral control and intended behavior. In a study of Internet banking, Shih and Fang (2004) confirmed that perceived behavioral control positively affected behavioral intention and concluded that an individual with a confident command of computer skills and a familiarity with the Internet is more inclined to adopt Internet banking. We thus propose the following hypothesis:

H4: Perceived behavioral control positively influences customer intention to use Internet banking.

3.1.5 Subjective norm (SN)

A subjective norm is a social force involving normative beliefs about the expectations of relevant people. This research considers the subjective norm to be how customers feel about the normative expectations of people they view as important (such as family, friends, and colleagues) as they decide whether to use Internet banking services. Many studies have found that subjective norms are valid ways to explain individual intention to use various forms of information technology (Liao et al. 1999; Tan and Teo 2000; Venkatesh 2000; Shih and Fang 2004; Liao et al. 2007). Thus, the following hypotheses are proposed:

H5: The subjective norm positively influences a customer's intention to use Internet banking.

3.1.6 Attitude to use (ATU)

An attitude is a favorable or unfavorable assessment of a given behavior and directly influences the strength of behavioral beliefs about the likely salient consequences.

Liao et al. (1999) found that intention to use virtual banking is dependent upon attitudes towards that use. The results show that an individual's intention towards Internet banking functions is affected by his or her attitude. Thus, the following hypothesis is proposed:

H6: Attitude to use positively influences a customer's intention to use Internet banking.

3.2 Variable measurement and questionnaire design

After developing the research framework, we conducted a series of personal interviews divided into seven sections (perceived usefulness, perceived ease of use, perceived credibility, perceived behavioral control, subjective norm, attitude to use, and intention to use) to assess the external validity of the model. We then developed a questionnaire based on the literature review and the comments gathered from the interviews. We used reliability and validity questionnaire items from previous studies. Subjective norms and perceived behavior control were measured based on the instructions of Ajzen (1991), Ajzen and Fishbein (1980), and Wu and Chen (2005). Perceived usefulness, perceived ease of use, and perceived credibility were measured by the items used by Davis (1989), Cheung and Lee (2000), and Ranganathan and Ganapathy (2002). Attitude towards using and intention to use were measured based on the instructions of Lederer et al. (2000) and Davis and Venkatesh (1996) (Table 1).

4 Data analysis and results

The respondents were asked about their gender, age, education level, career, and monthly income. These characteristics were described in order to evaluate the adequacy of the samples. This division into five characteristics can be regarded as reasonable and representive of customers in Vietnam. A descriptive summary of the respondents is provided in Table 2.

4.1 Construct reliability and validity

Content validities should be relatively acceptable since the various parts of questionnaire were all adapted from the literature and have been reviewed carefully by practitioners. To verify the proposed model of customer intention to use Internet banking in Vietnam, we used a reliability analysis to examine the internal consistency of the factors and a factor analysis to examine the underlying relationships among the variables. Exploratory factor analysis using SPSS was conducted on the survey data. The rotated factor matrix, resulting from a principal component extraction of the independent variables using the 1.0 eigenvalue cut-off criterion, is shown in Table 3, which indicates that seven factors emerged and reports their factor loadings. All factor loadings were larger than 0.5, that mean the component's level of validity is high and hence the analysis indicated

Table 1 Variables and their measurement items

Variables	Item content	Adapted from
Perceived usefulness	I think that using Internet banking enables me to utilize banking service more quickly	Davis (1989)
	I think that using Internet banking improves my performance of utilizing banking services	
	I think that using an internet bank for my banking services increases my productivity	
	I think that using an internet bank enhances my effectiveness of utilizing banking services	
	Overall, I think that using Internet banking is useful for me to utilize banking services	
Perceived ease of use	I think that learning to use Internet banking would be easy for me	Davis (1989)
	I think that interaction with Internet banking would be clear and understandable	
	I think that using Internet banking does not require a lot of mental effort	
	I think that doing what I want via Internet banking would be easy	
	It is easy for me to become skillful at using Internet banking service	
	Overall, I think that using Internet banking would be easy	
Perceived credibility	I trust in the ability of Internet banking to protect my privacy	Cheung and Lee (2000)
	I think my transactions by using the Internet banking service system would not divulge my personal information	Ranganathan and Ganapathy (2002)
	I trust in the Internet banking systems secure in conducting my banking transactions	
Perceived behavioral control	I had the resources, knowledge, and ability to use Internet banking	Ajzen and Fishbein (1980)
	I would be able to use Internet banking well	Wu and Chen (2005)
	Using Internet banking was entirely within my control	
Subjective norm	Most people who are important to me would think that using Internet banking is a good idea	Wu and Chen (2005)
	Most people who are important to me would think I should use Internet banking	
	My family who are important to me would think that using Internet banking is a good idea	
	My family who are important to me would think I should use Internet banking	
Attitude towards using	I think that using Internet banking is a good idea	Lederer et al. (2002)
	In my opinion, it is desirable to use Internet banking	
	I think that using Internet banking is pleasant	
Intention to use	Assuming that I have access to the internet banking services, I intend to use them for my banking needs	Davis and Venkatesh (1996)
	I am willing to use Internet banking for handling my banking transactions (transfer, payment, etc....) in the future	
	Overall, my general intention to use Internet banking is very high	

Table 2 Sample demographics

Gender	%	Age	%	Education	%	Career	%	Income	%
Female	56	<30	26.0	Below high school	16	Student	10.9	<5 million VNDs	14.0
Male	44	30–39	38.0	College or university	82	Worker	20.9	5–10 million VNDs	32.0
		40–49	24.9	Graduate school	2	Business	61.4	10–15 million VNDs	38.9
		>50	11.1			Others	6.9	>15 million VNDs	15.1

convergent validity of the measures, all questionnaire items were retained for further analysis.

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. Internal consistency describes the extent to which all the items in a test measure the same concept or construct. Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items. As Table 3 shows, for the 350 valid questionnaires, the construct reliability (Cronbach's alpha) for all factors in our measurement model ranged from 0.84 to 0.982. Each item was evaluated individually to ensure item reliability. Thus, all factors in the measurement model had adequate reliability indicating sufficient strength for further analysis. Messick (1989) defines that discriminant validity is evidence that a measure is not unduly related to other similar constructs. Correlation coefficients between measures of different constructs are usually given as evidence of discriminant validity. If the correlations are low to moderate, this shows that the measure has discriminant validity. The results showed in Table 3 demonstrated that none of the construct correlations contained a high value, indicating the discriminate validity of the measures. Measurement reliabilities and validity were satisfactory in this study.

4.2 SEM for extended TAM, TPB and the integrated and trimmed models

In order to identify the relationships within the research model used in this study, structured equation modeling (SEM) and the AMOS statistical 7.0 package software with the maximum likelihood estimation were used. The SEM can be used to examine whether the model set in a study is useful and to identify its fitness. The SEM includes one or more linear regression equations that describe how the endogenous constructs depend upon the exogenous constructs. We examined the causal structure of the extended TAM, TPB, and integrated model. The results of the parameter estimates and the goodness of fit for the models are reported in Table 4. Two relative fit indices are used in this study, including the Bollen's Incremental Fit Index (IFI) and the Bentler–Bonett Normed Fit Index (NFI). The IFI is proposed by Bollen (1990) and is shown that it is relative unaffected by sample size (Bentler 1990; Gerbing and Anderson 1993; Hu and Bentler 1995). The NFI, the first measure of fit to be proposed (Bentler and Bonett 1980), is incremental. These two fit indices are computed by using ratios of the model Chi square and the null model Chi square taking into account their degrees of freedom.

Table 3 Validity, reliability and factor correlations

Construct	Mean (standard deviation)	Factor loading	Cronbach's alpha (reliability)	Factor correlations						
				PU	PEOU	PC	PBC	SN	ATU	ITU
PU	3.34 (0.98)	0.868–0.912	0.974	–	0.59**	0.42**	0.42**	0.38***	0.86**	0.54**
PEOU	3.27 (0.96)	0.752–0.861	0.973		–	0.50**	0.45**	0.60**	0.82**	0.67**
PC	3.62 (1.09)	0.908–0.921	0.982			–	0.39**	0.36**	0.49**	0.43**
PBC	3.02 (0.85)	0.845–0.883	0.944				–	0.51**	0.51**	0.73**
SN	2.89 (0.97)	0.876–0.910	0.974					–	0.52**	0.82**
ATU	2.92 (0.90)	0.581–0.649	0.849						–	0.69**
ITU	2.48 (0.83)	0.567–0.607	0.840							–

There are seven constructs: perceived usefulness (PU), perceived ease of use (PEOU), perceived credibility (PC), perceived belief control (PBC), subjective norm (SN), attitude to use (ATU) and intention to use (ITU) ** Indicates significance at 99 %

4.2.1 SEM of extended TAM

The findings suggested that the extended TAM model was a good fit for the data and achieved an overall good fit. We used two determiners of goodness-of fit indices, NFI and IFI, as shown in Table 4. The fit statistics indicated that the extended TAM model was adequate (NFI = 0.906, IFI = 0.918). The standardized path coefficients are all significant at the 0.01 levels, except for the paths from PC to ATU. This result explains the direct impact of only two factors (PU and PEOU) on ATU. We therefore accept hypotheses 1, 2a, 2b, 3a, 3b, and 3d. As the extended TAM of Table 4 shows, PU and PEOU are the major determinants of customer attitude to use (ATU) Internet banking; PC is mediated through PU and PEOU instead of exerting a direct impact on ATU. Thus, security and privacy inflence the customer's perceived usefulness (PU) and perceived ease of use (PEOU) and indirectly affect customers' attitude to use (ATU). These results differ from those in Wang et al. (2003), who found that perceived credibility had a significantly positive influence on the attitude to use Internet banking in Taiwan. For Vietnam's Internet banking customers, high security and privacy levels will increase perceived usefulness and perceived ease of use, enhancing their attitudes to Internet banking.

4.2.2 SEM of TPB

The findings suggested that the TPB model was a good fit for the data and achieved an overall good fit. The fit statistics indicated that the TPB model was adequate (NFI = 0.918, IFI = 0.930). The standardized path coefficients are all significant at the 0.01 level, explaining how ATU, PBC, and SN impact ITU. We therefore accept hypotheses 4, 5, and 6.

4.2.3 SEM of integrated model

The findings suggested that the integrated model was a good fit for the data and achieved an overall good fit. The fit statistics indicated that the integrated model was adequate (NFI = 0.850, IFI = 0.873). The standardized path coefficients are all significant at the 0.01 level except for the paths from PC to ATU and the paths from PC to ITU.

Concerning specific path coefficients, the effects of PC on ATU and ITU were no longer significant when other factors were controlled simultaneously. This result explains two factors' direct impact on ATU and three factors' direct impact on ITU. Collectively, the analyses provided support for 1, 2a, 2b, 3a, 3b, 3e, 3f, 4, 5, and 6 but not for 3c. As the Integrated Model of Table 4 shows, PBC, SN, and ATU are the major determinants of customer intention to use (ITU) Internet banking; PC is perfectly mediated through PBC and SN instead of exerting a direct impact on ITU (compare with the extended TAM and the integrated model: the effect of PC on ITU is significant when PBC and SN are not controlled but not significant when PBC and SN are controlled, while the effects of PBC and SN on ITU are also significant). These results differ from the results in Luarn and Lin (2005), who suggested that perceived credibility has a significantly positive influence on the behavioral

Table 4 Parameter estimates (SEM) and goodness of fit

	Extended TAM	TPB	Integrated model	Trimmed model
PEOU ← PC	0.428** (10.07)		0.449** (10.42)	0.448** (10.38)
PU ← PEOU	0.527** (10.12)		0.528** (9.92)	0.529** (9.96)
PU ← PC	0.148** (3.50)		0.146** (3.22)	0.144** (3.20)
ATU ← PC	−0.023 (−1.33)		−0.009 (−0.60)	–
ATU ← PEOU	0.487** (17.57)		0.460** (16.68)	0.455** (17.34)
ATU ← PU	0.531** (18.60)		0.543** (18.99)	0.541** (19.19)
ITU ← PC	0.086** (2.73)		−0.018 (−0.393)	–
ITU ← ATU	0.555** (10.75)	0.253** (9.69)	0.199** (7.73)	0.187** (8.11)
PBC ← PC			0.321** (7.97)	0.319** (7.94)
SN ← PC			0.329** (7.27)	0.328** (7.26)
ITU ← PBC		0.307** (11.99)	0.341** (12.06)	0.337** (12.53)
ITU ← SN		0.409** (14.50)	0.410** (15.07)	0.410** (615.4)
Goodness of fit indices				
NFI	0.906 (satisfactory fit)	0.918 (satisfactory fit)	0.857 (acceptable fit)	0.850 (acceptable fit)
IFI	0.918 (satisfactory fit)	0.930 (satisfactory fit)	0.873 (acceptable fit)	0.866 (acceptable fit)

t value in parentheses; ** significant at $p < 0.01$

intention to use mobile banking. Security and privacy influence customers' perceived belief control (PBC) and subjective norm (SN) and indirectly affect intention to use (ITU) Internet banking. Vietnamese banks must ensure that they have the highest levels of security, by using tools such as the secure socket layer (SSL) and secure electronic transaction (SET), to foster normative beliefs, encourage adoption, build confidence, and safeguard their customers from online threats.

4.2.4 SEM of trimmed model

Given the non-significant coefficient of both PC with ATU and PC with ITU, the study further estimated the integrated model by trimming the paths between PC to ATU and PC to ITU. The results indicated that the integrated model, without estimating the path from PC to ATU and ITU, is preferred. Figure 5 displays the results from the trimmed structural model.

When customers perceive Internet banking as a useful and easy-to-use tool, their attitude to it is more positive. Therefore, bank customers' likelihood of using Internet banking is dependent upon their attitudes to its usefulness. Bank customers anchor their Internet banking adoption intention to the beneficial outcomes and ease-of-use of the online system. Although Internet banking provides a very convenient and effective method of managing personal finances, customers are still reluctant to use it because of the potential risk (e.g., lack of privacy, insecure systems). The results of the extended TAM model show that perceived usefulness and perceived ease of use mediate between perceived credibility and consumer attitudes to using Internet banking. This empirical result reveals that the attitudes of Internet banking users are influenced indirectly by perceived credibility in Vietnam, a nation in the beginning stages of Internet utilization. Thus, when an Internet bank designs their online banking website, they should make their customers feel their information and privacy is secure, so that the customers will consider the online banking website useful and easy to use. In the integrated model, we also find that PC is a determinant of customers' Internet banking adoption but is perfectly mediated through PBC, SN, and ATU instead of exerting a direct impact on intention. Furthermore, the trimmed model could explain why people more concerned with perceived credibility (the degree to which someone believes that using a system is free of privacy and security threats) do not always intend to adopt Internet banking: the characteristics of an online banking system, such as usefulness, ease of use, perceived behavioral control, and subjective norm also dominate attitude and adoption decision making.

One practical implication of these results is that banks need to highlight the benefits of Internet banking and make their system useful and easy to use by enhancing its security and privacy and thus improve credibility with the customers. Banks can highlight the benefits of Internet banking, such as its convenient interface, simple process, and safety, in their promotional and advertising activities. Banks also need to engage in security and privacy enhancement activities to improve customers' control beliefs, perceived facilitation, and evaluation of related social groups, and thus increase their intention to use Internet banking.
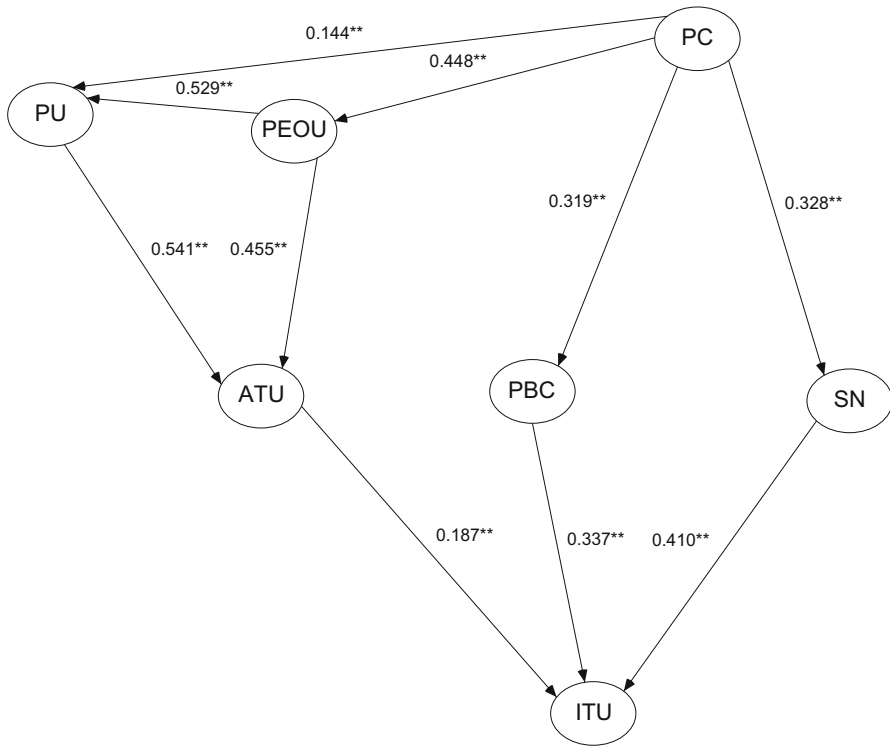
Fig. 5 Solution of the trimmed structural model. **$p < 0.01$

5 Conclusions

Based on an assessment of the relevant literature, this study used SEM methodology and empirically examined the determinants of customer intention to use Internet banking in order to learn more about customers' perceptions of Internet banking services. We employed the TPB and the TAM in an integrated model to predict consumer intention to use Internet banking systems, which have become available only recently in Vietnam. This study examined two factors influencing attitudes to Internet banking use—perceived usefulness, and perceived ease to use. Customers who perceived a higher level of usefulness in Internet banking tended to be more willing to adopt it. In addition, perceived ease of use had a significantly positive effect on customer attitudes to adopting Internet banking. Perceived credibility does not have a direct impact on attitudes to Internet banking use, although it affects perceived usefulness and the perceived ease of use, which in turn affect customer attitudes to Internet banking. The study also examined several factors influencing intentions to use Internet banking—attitude to use, perceived behavioral control, and subjective norm. Perceived credibility also has no direct impact on intention to use Internet banking but does affect perceived behavioral control and subjective norm, which in turn lead to a higher intention to use Internet banking. Most results

were consistent with those of prior studies that have applied the TAM and TPB, the most popular theoretical frameworks for information system adoption. Extending perceived credibility and the TAM with the TPB would offer a more comprehensive understanding of the behavioral intention to use Internet banking. This study offers important practical implications for banks that are either providing Internet banking services or plan to do so. First, when planning or developing Internet banking, software developers should pay attention to practical functions and expand the key features that customers frequently require. Bank websites should also be designed better to meet customer demands and be more user-friendly. Making their services more useful is the second priority that bankers cannot ignore. Accordingly, technological and security issues are both important factors to consider when seeking to increase customer intention to use Internet banking. This study also indicates that social influences play an important role in customer decisions. Thus, an expensive marketing campaign using media or the press may influence customers' intention to use Internet banking. Finally, banks offering Internet banking services should launch campaigns to raise public awareness of the initiative.

We suggest that it is important to incorporate new (information technology) IT concepts such as service-oriented architecture (SOA) when developing Internet banking services. SOA focuses on service outcomes and service-based developments and is an approach for addressing the difficulties of IT architecture. It combines various business processes and represents an appropriate architectural model for composite services and combinations of a variety of independently developed services to form distributed software-intensive systems (Erl 2007; Immonen and Pakkala 2014). An important challenge for developing efficient SOA is to maintain Quality of Services (QoS) attributes because of the compositional and dynamical environment. In software engineering, QoS includes (among others) quality attributes as security, performance, reliability, availability, and scalability, which are both functional and non-functional. Giakoumis et al. (2014) introduce novel web service accessibility assessment techniques through a unified QoS context to enable future QoS-aware service selection systems so as to allow their consumption from end-user applications, used by people with disabilities.

There are several limitations to this empirical study. First, the adoption of Internet banking in Vietnam is still in an early stage, so the number of people using online banking is relatively small. But the country's rapid development and economic growth together with the popularity of Internet banking implies that the number of Internet banking users will also increase sharply. Therefore, research is required to find ways of promoting its usage; this limits the study's generalized findings to the nation's population. So future research can apply the model used in this study to other developed countries to construct and compare the factors affecting Internet banking adoption between developing and developed countries, and to examine if users in countries at different stages of economic development have different attitudes toward Internet banking. Second, the variables selected in this study may not include all variables that affect the adoption of Internet banking. Using additional variables (or control variables) such as Internet experience, computer self-sufficiency, and information quality would improve our ability to

predict attitudes toward use and intention to use more accurately. Third, if only one type of survey questionnaire is administered to a single cohort of respondents and the questionnaire contains both the antecedents and outcome variables, then it is very likely that this research suffers a methodological problem termed common method variance (CMV). CMV may explain more about the observed relationship than about the true relationship. A study having a significant common method bias is one in which the majority of variance can be explained by a single factor. The present study has used the Harman's single factor test and finds that a total of five factors have emerged with an Eigen value >1, which suggests that the existing common method bias is not overwhelming. But we also suggest that researchers must understand that Harmon's single factor test to test the effect of CMV is not a rigorous method. Therefore, a more effective solution is to design a comprehensive research procedure which put the CMV problem in consideration in advance. It is better than any post hoc action taken after data collection.

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