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Evaluating the Role of Trust in Consumer Adoption of Mobile Payment Systems: An Empirical Analysis

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Abstract:

Consumer adoption of mobile payment (m-payment) solutions is low compared to the acceptance of traditional forms of payments. Motivated by this fact, we propose and test a "trust-theoretic model for consumer adoption of m-payment systems." The model, grounded in literature on "technology adoption" and "trust," not only theorizes the role of consumer trust in m-payment adoption, but also identifies the facilitators for consumer trust in m-payment systems. It proposes two broad dimensions of trust facilitators: "mobile service provider characteristics" and "mobile technology environment characteristics." The model is empirically validated via a sample of potential adopters in Singapore. In contrast to other contexts, results suggest the overarching importance of "consumer trust in m-payment systems" as compared to other technology adoption factors. Further, differential importance of the theorized trust facilitators of "perceived reputation" and "perceived opportunism" of the mobile service provider, and "perceived environmental risk" and "perceived structural assurance" of the mobile technology, are also highlighted. A series of post-hoc analyses establish the robustness of the theorized configuration of constructs. Subsequent, sub-group analyses highlight the differential significance of trust facilitators for different user sub-groups. Implications for research and practice emerging out of this study are also discussed.

Keywords: trust, m-payment, technology adoption, risk, structural assurance, Singapore

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I. INTRODUCTION

Along with a remarkable growth in the number of mobile phone users, the past few years have witnessed an increasing computing power of cell phones coupled with the convergence of cellular and Internet Protocol (IP) based networks. Among the myriad mobile commerce (m-commerce) applications, such as mobile advertising, mobile gaming, mobile entertainment services, mobile distance education, and mobile offices, mobile payment (m-payment) systems, which offer the advantage of anytime, anywhere payment services through mobile phones are perhaps the most vital [Coursaris and Hassanein, 2002; Dahlberg et al., 2008; Varshney and Vetter, 2002]. Despite the availability of the enabling technologies and the promising possibilities that m-payment systems offer, their penetration and adoption is relatively low, compared to other recent forms of cashless, noncontact payment modes such as credit cards and e-payment systems [Dahlberg et al., 2008]. It is also intriguing to note that there have been no major m-payment adoption success stories anywhere in the world, except perhaps in Japan and to some extent in South Korea [Bradford and Hayashi, 2007].

While, as early as in 2000, Gartner research predicted the transaction value from m-payments would rise to $15 billion by 2005 in Western Europe alone, and more recently Gartner Dataquest suggested m-payment user numbers would grow to 104 million by 2011, m-payment systems have failed to spark significant interest among most American and European businesses [Adrian, 2002; Shen, 2008]. A similar trend of low adoption rates for m-payment systems have been observed in many Asian countries such as Singapore and Hong Kong. Spurred by the low adoption rates for m-payment services worldwide, a recent report re-evaluated the consumer adoption of m-payment systems and concluded that even until 2012 substantial consumer acceptance of m-payment systems may be quite unlikely in most regions around the world [Jones, 2008].

Despite the potential m-payment adoption benefits and imperative managerial need to examine m-payment adoption issues, research on the subject is relatively sparse. Wareham et al. [2005] drew the attention of the IS community to the under-represented area of m-payments though they are extremely important for the growth of mobile commerce. Current IS studies on payment systems have mostly explored the related field of e-payment systems [Gianluigi, 2006; Plouffe et al., 2001; Varshney, 2002], especially their implementation [e.g., Harle and Beresford, 2005; Huang and Boucouvalas, 2006; Wang et al., 2005]. While e-payment studies serve as a good starting point for understanding m-payment systems, it is important to examine the unique contexts associated with m-payment systems. The presence of a mobile service provider as an additional facilitator for the m-payment transactions coupled with the multiple mobile device limitations, the modalities of m-payment systems may be quite divergent from that of computer based e-payment systems. Moreover, significantly lower adoption rates for m-payment systems as compared to e-payment systems, despite the immense potential opportunities which they offer, calls for a deeper examination of the adoption issues related to m-payment systems. Our research is predicated on this significant managerial and theoretical question.

M-payment, which seems to be a natural progression from e-payment systems, is a form of online payment made over a mobile network where transactions between unknown entities can take place. Some of the reasons identified for the low adoption rates for m-payment solutions are attributed to mobile device and network limitations, low maturity level of m-payment solutions, limited advantages over other payment modes, and requirement of changes in existing consumer behavior [Karnouskos and Fokus, 2004; Mallat, 2004]. User trust, which has been found to be a significant adoption facilitator in multiple IS contexts has not been sufficiently examined in the context of m-payment systems. Hence, similar to other IS contexts, we posit “user trust” manifesting in the m-payment context as “trust of consumers in m-payment systems,” as the key enabler for m-payment adoption. The difference being in the conceptualization of “trust in m-payment systems” from other IS contexts because of unique m-payment specific milieu. For example, the mobile service provider characteristics and the environment in which the mobile service provider operates may have a significant bearing on the level of consumer trust in m-payment systems. Motivated by the imperative need for understanding consumer adoption of m-payment systems, which is the key building block for the m-commerce industry, in this research, taking a trust-theoretic stance, we first theorize and then empirically test the facilitators for consumer trust in m-payment systems. Further, we also examine the role of consumer trust for the adoption of m-payment systems [Luarn and Lin, 2005; Mallat, 2004]. The two specific research questions for this study are:

1. What constitutes “consumer trust in m-payment systems”?
2. Is consumer adoption of m-payment systems related to the level of “consumer trust”?

The study was conducted in Singapore which has one of the world's most mature mobile phone markets, with a mobile phone penetration rate of over 100 percent [Singapore Department of Statistics, 2009]. Singapore also has a very high literacy rate of 96.3 percent among residents aged fifteen years and older [Singapore Department of Statistics, 2009]. Due to these reasons, Singapore provides an excellent context for testing our research problem. There are three primary contributions of the current study. First, we introduce a trust-theoretic model for consumer adoption of m-payment systems. To our knowledge, this is the first study that simultaneously investigates the antecedents and the consequences of "consumer trust" on m-payment "adoption intention." Second, we extend the literature on trust by explicitly dividing the trust-building antecedents for the m-payment context into two broad categories of mobile service provider characteristics and mobile technology characteristics and study relationships of both these categories with consumer trust in m-payment systems. There is again little empirical work of this kind. Third, by conceptualizing the impact of various identified facilitators of trust in m-payment systems; perceived reputation (PR), perceived opportunism (PO), perceived environmental risk (PER) and perceived structural assurance (PSA) on consumer trust for m-payments, we reiterate the need to focus on both reputable mobile service providers as well as reliable mobile technology for consumer trust building in m-payment systems, which would eventually lead to its successful adoption. Specifically, the study delineates significant m-payment adoption related factors thereby making significant contributions to the field of mobile commerce.

II. LITERATURE REVIEW

M-Payment Systems

Any payment transaction which uses a mobile communication device (e.g. mobile phone) to initiate, activate, and confirm the payment can be classified as an m-payment system. In the current scenario, mobile phones are increasingly developing into personal trusted devices (PTD), as they are managed solely by their owners. Further, various security features, such as wireless transport layer security (WTLS) and wireless public key infrastructure (PKI), are being integrated into the mobile phone technology to make m-payment transactions secure [Claessens et al., 2002]. Currently, many variations of m-payment applications are in vogue.

The full range of m-payment applications can be broadly classified into two major categories.

Remote m-payment application. M-payment solutions facilitating transactions that can be performed remotely, independent of the location of the user, are termed *remote m-payment applications.* Such m-payment applications can be used to conduct and make payments for three kinds of transactions. First, m-commerce payments to the mobile service provider for purchases of mobile services and contents, such as ringtones, news, and location information directly purchased from the mobile service provider. Many such low-value payments can be made through "pay-per-view" or "pay-per-click" methods of charging. Second, payments for items purchased online, similar to Internet and television shopping using the web browser in the mobile device. Third, P2P (person to person) m-payment applications that facilitate monetary transmission from one person to another (through the mobile service provider) using mobile devices [Funk, 2004; Karnouskos and Fokus, 2004; Varshney, 2002]. Generally, they are used to transmit money to a specified recipient through the mobile service provider subsequent to due authorization by the m-payment account holder. Examples of such systems are the Orange m-payment system through which mobile subscribers can make credit card payments anytime from anywhere. Paypal Mobile, launched by Paypal, is another such m-payment service for remote transaction. Other examples are Vodafone m-pay in the UK and Mobipay in Spain. It is important to note that in all the three modes of "remote m-payment application" the consumer generally pre-provides her account details to the mobile service provider in order to save the trouble of transmitting secure account information each time through mobile phones, which have a number of device limitations like small size and inconvenient visual display. These m-payments can either be charged to the customer's regular monthly bills or debited directly from the account holder's bank account.

Proximity m-payment application. This category includes applications that facilitate transactions whereby the mobile device locally communicates with point of sales (POS) or an automated teller machine (ATM) using low power wireless connectivity protocols, such as bluetooth and other near field communication technologies. Examples from this category include m-parking payments, payments at POS, or the withdrawal of money from ATMs. Another example of proximity m-payment application is the micro-payment application (similar to POS application) where the mobile device communicates with the vending machine or ticketing kiosks to purchase the desired items [Varshney, 2002]. Monetary value can either be stored in the mobile device as digital cash on a non-contact smart card or can be charged to the credit card of the user through the mobile service provider [Funk, 2004]. SONERA, a Finnish wireless provider was one of the first companies to offer micro-payment solutions for the purchase of soft drinks from a vending machine as early as in 1997.

Consumer Adoption of M-Payment Systems

Adoption of new technological systems, such as m-payment systems, by the intended users is the vital initial step for its acceptance and eventual success. The dynamic nature of emerging technologies and the changing contexts make the fundamental adoption question "What factors make the consumers adopt a new technology?" universally relevant for upcoming nouveau technologies. This basic research question has been examined from multiple perspectives, such as technology characteristics [Heijden et al., 2003; Lee and Turban, 2001; Sarker and Wells, 2003], demographics [Bellman et al., 1999; Sarker and Wells, 2003], and trust [Connolly and Bannister, 2007; Gefen, 2000; Jarvenpaa and Tractinsky, 1999; McKnight et al., 2000]. In general, several theories have been used to explain the adoption of new technologies, such as the theory of diffusion of innovations [Moore and Benbasat, 1991], the theory of reasoned action (TRA) [Fishbein and Azjen, 1975], the technology acceptance model (TAM) [Davis, 1989; Davis et al., 1989], the theory of planned behavior (TPB) [Azjen, 1985; Azjen and Madden, 1986], and the institutional theory [Liang et al. 2007; Teo et al., 2003]. In this research, we use the technology acceptance model (TAM) as the point of departure and integrate it with literature on "trust" to propose a trust-theoretic model for m-payment adoption.

TAM has been used extensively to study the IT adoption behavior and is considered to be a seminal theory for technology acceptance and adoption [Lippert, 2007; Gefen et al., 2003b]. It posits that a user's adoption of a new information system is determined by that user's intention to use the system, which in turn is related to the user's beliefs about the system. The basic model purports that perceived usefulness (PU) and perceived ease of use (PEOU) of a new technology are related to the behavioral intention to use the IS, and finally to the actual use of the IS. The general appeal for TAM lies in its empirical soundness, parsimony, and reliable instrument with excellent measurement properties [Pavlou, 2003]. Various IS studies have confirmed the explanatory power of TAM for technology acceptance, and it has been tested for multiple IS types [e.g., Davis, 1989; Davis et al., 1989; Mathieson, 1991; Moore and Benbasat, 1991; Taylor and Todd, 1995; Venkatesh, 2000] and also for predicting user's acceptance of IS in different organizational contexts [Adams et al., 1992; Chin and Todd, 1995; Doll et al., 1998].

The two central belief constructs of PU and PEOU in the TAM may not fully explain the influence of other usage factors that may affect the user's adoption intention [Davis 1989; Moon and Kim, 2001]. Previous IS studies have extended the TAM by adding constructs such as "perceived playfulness" [Moon and Kim, 2001; Teo et al., 1999], "product involvement and perceived enjoyment" [Koufaris, 2002], "computer self-efficacy" [Igbaria and Iivari, 1995; Hong et al., 2001/2002; Chau, 2001], "personal innovativeness" [Agarwal and Karahanna, 2000], "perceived information quality" [Shih, 2004], and "social factors" [Hsu and Lu, 2004]. Few studies have also explored "trust" as an added construct to the Internet shopping [Gefen et al. 2003a; 2003b] and e-Government contexts [Teo et al., 2009]. Pavlou [2003] integrated "trust" and "perceived risk" in the acceptance model to study consumer acceptance of e-commerce. "Consumer trust" which reflects the user's concerns about the reliability of technology enabled transactions [Aldridge et al, 1997; Ratnasingham, 1998; Tan and Thoen, 2000] may be an important concern in the context of m-payment systems given the nature of environmental and mobile service provider related uncertainties. Pavlou [2003] examined user trust as the antecedent of cognitive beliefs for the user acceptance of e-commerce. Drawing from Pavlou's [2003] study we contextualize the trust antecedents to the m-payment situation and propose a trust-theoretic m-payment adoption model.

Consumer Trust in M-Payment Systems

Mayer et al. [1995] described "trust" as the belief of the trustor that the trustee will fulfill the trustor's expectations without taking advantage of the trustor's vulnerabilities. In the online transaction scenario, McKnight et al. [2002] conceptualize trust as the belief which allows consumers to willingly become vulnerable to online vendors for an expected service after duly considering the vendor characteristics. Trust has long been a catalyst in buyer-seller transactions, providing buyers with high expectations of satisfying exchange relationships [Hawes et al., 1989]. Jarvenpaa and Tractinsky [1999] have empirically demonstrated the positive effect of trust on consumer purchase intentions. Gefen [2000] highlighted the importance of trust in the user acceptance of Internet related technologies. Lack of consumer trust has been identified as the most significant long-term barrier for the success of e-commerce and e-payment systems [Keen, 1997]. Although m-payment systems are a progression from the e-payment systems, there are some marked differences, especially in terms of the mobile service provider involvement and mobile device limitations. Despite these differences, similar to e-payment systems, m-payment systems are also faced with a number of operational and environmental uncertainties. In such a scenario, user trust can be one of the mechanisms which assist users in overcoming the uncertainties and realizing the operational usefulness of the system, thereby facilitating its adoption.

Two Dimensions of Consumer Trust in M-Payment Systems

Trust has been identified as a crucial adoption enabler for online transactions, especially for monetary transactions [Brynjolfsson and Smith, 2000; Culnan and Armstrong, 1999]. Past research on online trust has highlighted two

dimensions of trust: trust in trading partners and trust in the enabling infrastructure [Ratnasingham, 1998; Tan and Thoen, 2000; Teo et al., 2009]. These two dimensions have been adapted to different contexts by researchers. Connolly and Bannister [2007] discussed the role of both Internet vendor and external environment in developing trust in Internet shopping. In the milieu of m-payment systems, we again have two major players that need to be trusted by the user: the mobile service provider and the enabling technology. Although, for some m-payment transactions, the online vendor from whom the purchases are made also becomes a trading partner, but considering that bulk users prefer m-payment for relatively less complex jobs,[1] the mobile service provider plays a key role in m-payment transactions. Hence, in the context of m-payments, the two dimensions of consumer trust are trust in mobile service provider and trust in technology facilitated by mobile service provider characteristics and mobile technology characteristics respectively.

Mobile Service Provider Characteristics

Based on previous literature on trust in different contexts, we identified two major categories of mobile service provider characteristics affecting consumer trust viz. *perceived reputation* and *perceived opportunism*.

Perceived reputation (PR) of the mobile service provider (MSP) is defined as the extent to which consumers believe in the MSP's competency, honesty, and benevolence [Doney and Canon, 1997]. Good reputation is a valuable asset that develops over time and generally involves an investment of varied resources and directed effort [Jarvenpaa et al., 2000]. Researchers believe that "reputation" is hard to build but easy to lose if not carefully protected [Kartalia, 2000]. Further, reputation is a valuable asset that can be leveraged by organizations in unrelated situations. Mobile service providers hold a huge consumer base and control the identity of the consumers through subscriber identity module (SIM) of the mobile device, hence their impact on m-payment adoption is undeniably vital [Karnouskos and Fokus, 2004]. Consumer's perceptions of the MSP's reputation may form the basis of their trustworthiness [Doney and Canon, 1997].

Perceived opportunism (PO) of the MSP refers to possible opportunistic behavior of the MSP in relation to the consumer. It refers to the consumer's risk in transacting with MSP who might inappropriately exploit the consumer's vulnerabilities. For most m-payment services, the end consumer needs to provide full access to their checking and savings account to the mobile service provider. Hence in the context of m-payment systems, there are behavioral risks from MSPs as the transactions through the mobile wireless medium rely heavily on the mobile network operators [Ring and Van de Ven, 1994; Karnouskos and Fokus, 2004]. MSPs do have the chance to act in an opportunistic manner and inappropriately exploit the available consumer information.

Mobile Technology Characteristics

Mobile technology characteristics affecting consumer trust have been mainly identified as *perceived environmental risk* and *perceived structural assurance.*

Perceived environmental risk (PER) is the risk associated with the underlying technological infrastructure, which in the current study is the wireless mobile Internet. Environmental risks refer to the transaction security-related risks faced by consumers while using m-payment services through a wireless network. The factor of "anonymity" and "confidentiality" in wireless payment transactions accentuates the possibility of frauds in online transactions [Aldridge et al., 1997]. These technology-driven risks include the risk of financial losses, as well as privacy losses, which cannot be eliminated in the m-payment scenario; nonetheless they can be minimized by systematic application of appropriate technological controls. Various empirical research studies [Pavlou, 2003; Taylor, 1974] have explored the role of perceived risk in the context of consumer behavior. Cox and Rich [1964] defined perceived risk as the overall uncertainty perceived by the consumer in a certain situation which, in the context of m-payment systems, is the technology driven risk or environmental risk [Ring and Van de Ven, 1994; Bensaou and Venkataman, 1996].

Perceived structural assurance (PSA) is the consumer's perception about the institutional environment (here mobile technology including the mobile Internet) that all structures like guarantees, regulations, and promises are operational for safe, secure, and reliable transactions [Zucker, 1986]. The security and privacy controls for online transactions including mobile transactions can be accomplished through various structural assurances such as encryption, authentication, firewalls, digital signatures, privacy seals, and third-party certifications [Aldridge et al., 1997; Garfield and McKeown, 1997; Ratnasingham, 1998]. Emerging technologies such as mobile public key infrastructure (mPKI), biometrics, and mobile digital signatures can also be integrated with the m-payment systems for providing adequate structural assurance [Cassell, and Bickmore, 2000; Karnouskos and Fokus, 2004]. McKnight

[1] Where users have to make payments to known agencies like banks, credit card companies, government agencies, utility service agencies, or clear routine bills. If users have to make an online purchase where they have to browse and choose the preferred items, they prefer computer-based interface for clearer display and convenience. This was revealed during interviews with potential adopters.

et al. [2002] highlighted the importance of institution-based trust, which is a sociological dimension of trust. PSA refers to the perceptions about the efficacy of the institutional environment, which for this study includes structural and legal provisions for ensuring a secure mobile transaction environment.

III. RESEARCH MODEL AND HYPOTHESES

Figure 1 presents the proposed "Trust-theoretic M-payment Adoption Model," which theorizes the role of trust for adoption intention [AI] of m-payment systems and also simultaneously specifies the factors associated with the consumer trust in m-payment systems.

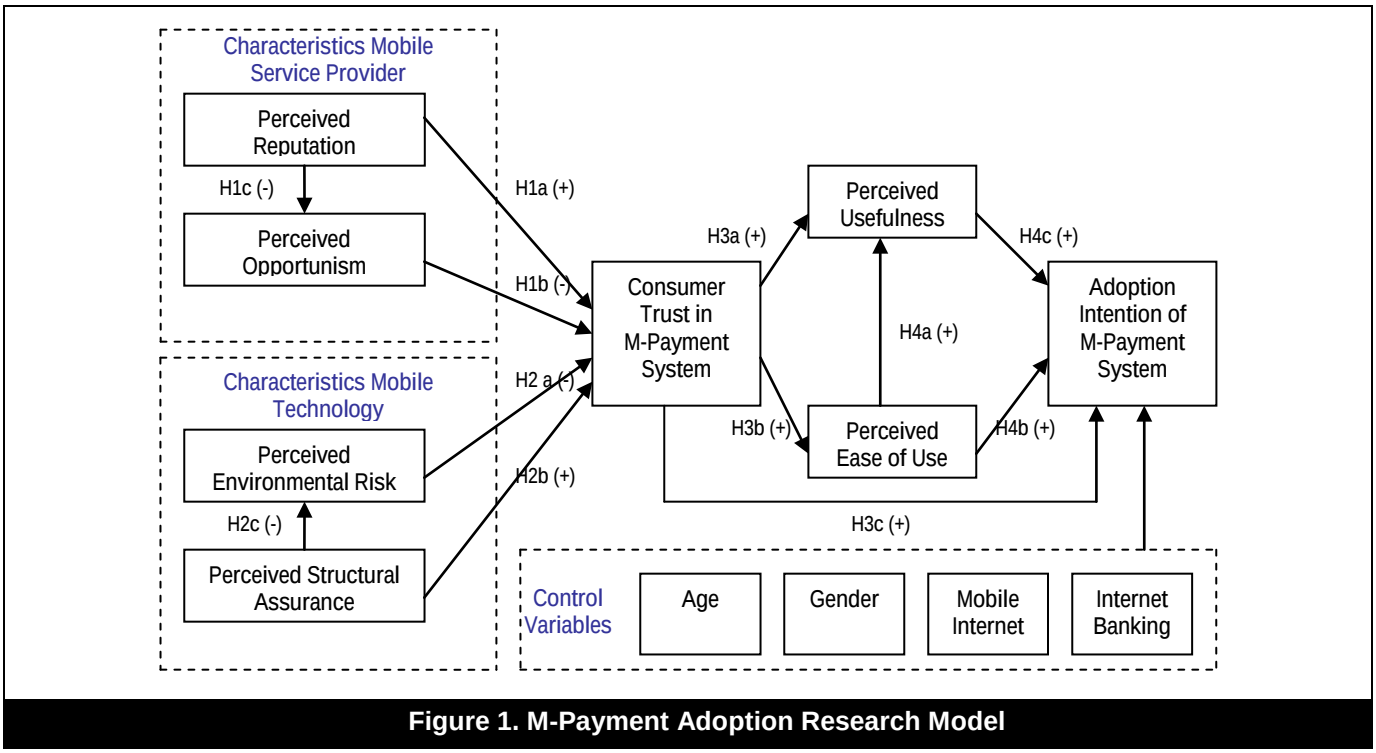

Figure 1. M-Payment Adoption Research Model

Mobile Service Provider [MSP] Characteristics

The relationship between MSP characteristics and consumer trust in mobile payment system can be explained by taking recourse in the concept of "halo effect" [Nisbett and Wilson, 1977]. Halo effect states that perceptions or beliefs about a person or a product are influenced by perceptions of their former traits in the sequence of interpretations leading to a cognitive bias. For example, in terms of halo effect we can explain that the success of iPod has led to a positive influence on Apple's other products [Wilcox, 2008]. Thus, perceptions of fairness and honesty of the MSP translates to trusting beliefs for the m-payment system managed by the MSP. Various researchers have shown significant positive relationship between perceived reputation of vendors and consumer trust [Jarvenpaa et al., 2000; Jarvenpaa and Tractinsky, 1999]. Following from the "halo effect," the perceived reputation of the service provider leads to trusting beliefs in consumers. Hence reputation of MSP is related to level of consumer trust. Thus, we hypothesize,

H1[a]: Perceived reputation of the mobile service provider is positively associated with the level of consumer trust in m-payment systems.

Opportunism is defined as a deceitful violation of implicit and explicit promises about a pre-determined role or behavior [John, 1984]. In a traditional buyer-seller exchange, transaction success is related to perceptions of opportunism [Morgan and Hunt, 1994]. Opportunism occurs in the presence of the self-interest of the transacting partner due to which the consumer trust is violated. In m-payment transactions, where the MSP plays a key role, MSP opportunism may translate to deceitful activities such as distorting or modifying information, disclosing private information, or failing to fulfill promises and obligations. Hence, perceived opportunism will lower the consumer trust for m-payment transactions. Hence we hypothesize,

H1[b]: Perceived opportunism of mobile service provider is negatively associated with the level of consumer trust in m-payment systems.

Firms with good reputation are perceived to be reluctant to jeopardize their reputation by acting in an opportunistic manner [Chiles and McMackin, 1996]. Thus, an MSP wanting to maintain a good reputation would not act opportunistically as it would dent the firm's image of fairness and honesty. Hence, a higher perceived reputation for an MSP may be related to a lower perceived opportunism.

H1[c]: Perceived reputation of mobile service provider is negatively associated with the level of its perceived opportunism.

Mobile Technology Characteristics

Research suggests that concerns of security and privacy in online and wireless environments hinder the adoption of these channels for commercial transactions [Aldridge et al., 1997; Bhimani, 1996]. The online information is in a shared domain which consumers may not be willing to adopt until they have confidence in the security features of the underlying technology [Rose et al., 1999]. Swaminathan et al. [1999] highlighted the consumers' reservations in sharing their credit card information over the Internet with the transacting partner. In the context of m-payment systems, consumers need to entrust not just their credit card information, but in most cases their full account information, to MSPs and other players in m-payment systems. Consumers perceive environmental risks due to the lack of consumer control and uncertainties involved in m-payment transactions. Pavlou [2003] suggested that the consumers' perception of lack of control over potentially uncertain transactions would increase consumer perception of risk from the environment, thereby decreasing the trusting belief. Hence we hypothesize,

H2[a]: Perceived environmental risk is negatively associated with the level of consumer trust in m-payment systems.

As already discussed, m-payment systems require consumers to share their personal and confidential information with unknown players. In contrast to traditional payment methods, m-payment systems use open technological infrastructure for transactions which pose the threat of uncertainties related to technology. Structural assurance for mobile Internet can be developed by building the institution-based trust which can be achieved by developing adequate legal and technological safeguards. This can be done by using technological techniques such as data encryption and other legal measures that prevent privacy and financial losses [McKnight et al., 2002]. Tan and Thoen [2000] suggested that the perception of security and privacy control through building of structural assurance helps in developing consumer trust for making online transactions. Hence we hypothesize:

H2[b]: Perceived structural assurance is positively associated with the level of consumer trust in m-payment systems.

The lack of appropriate security and privacy safeguards may lead to various environmental risks resulting in privacy and financial losses. Jarvenpaa and Tractinsky [1999] have shown that reducing the transactional risk would result in increasing the probability of consumers adopting the transaction medium. Structural assurances serve as guarantees for mitigating the technology related risks associated with m-payment systems. Hence, consumers who perceive structural assurances of the mobile Internet providing them security and reliability during payment processes will perceive lesser risks in the m-payment services [Bhimani, 1996; Cockburn and Wilson, 1996; Pavlou, 2003]. Thus, we hypothesize,

H2[c]: Perceived structural assurance is negatively associated with the perceived environmental risk in m-payment.

Consumer Trust in M-Payment Systems for Adoption Intention

Research has shown that trust is related to the perceptions of ability of an IS to accomplish a pre-defined task [Jarvenpaa et al., 1998; Mayer and Davis, 1999; Teo et al. 2009]. In the context of m-payment systems, ability refers to the competence belief which means that the consumer should believe that the m-payment system is useful in achieving the desired goals and thus meets the perceived performance level. Various researchers have demonstrated the significant relationship of trust with perceived usefulness (PU) and perceived ease of use (PEOU) in the context of online transactions [Gefen, 1997; Gefen and Straub, 2003; Pavlou, 2003]. Similar to other online contexts, consumer trust is a significant determinant of perceived usefulness in the m-payment scenario due to the impersonal nature of the mobile Internet environment and the uncertainties involved in such transactions. Hence we hypothesize:

H3[a]: Consumer trust in the m-payment systems is positively associated with the perceived usefulness of the m-payment systems.

In the mobile environment, the interaction of the users with the parties involved for m-payment is through the mobile device using the mobile Internet. Drawing from Pavlou's [2003] argument, we posit that the consumer's trust in the m-payment systems would reduce consumer's need to understand and monitor their use, thereby making the m-payment process simple and easy. On the other hand, if the consumer trust in the system is low, the consumers will be concerned with the operational aspects of the transaction [Teo et al., 2009]. This will lead them to spend extra time and effort in understanding the system, resulting in making the system harder to use [Pavlou, 2003; Ring, and Van de Ven, 1994]. Hence,

H3[b]: Consumer trust in m-payment systems is positively associated with the perceived ease of use of m-payment systems.

Hoffman et al. [1999] argued that lack of consumer trust would prevent consumers from adopting online transactions mainly because the consumers are concerned with the uncertainties involved in the technological infrastructure. Trust has been shown to be related to positive attitudes, which are more likely to influence the consumer's intention to adopt the technology [Gefen, 1997; Jarvenpaa et al., 2000; Jarvenpaa and Tractinsky, 1999]. Following TRA [Fishbein and Ajzen, 1975], which posits that beliefs lead to attitudes, which in turn lead to behavioral intentions, trust is an important behavioral belief that creates positive attitudes and which finally affects adoption intention for m-payment systems. Hence we hypothesize:

H3[c]: Consumer trust in m-payment systems is positively associated with the adoption intention for m-payment systems.

Teo et al. [1999] suggested that IS which are perceived to be easy to use and less complicated to operate have a greater likelihood of being adopted and are also perceived as useful. Numerous studies over the past decade have validated the significant relationship of PEOU with the AI [Davis et al., 1989; Venkatesh, 2000; Davis and Venkatesh, 2004]. Hence m-payment systems which are easy to use will not only be perceived as useful but will also be adopted by consumers. Thus, we have:

H4[a]: Perceived ease of use of the m-payment systems is positively associated with the perceived usefulness of m-payment systems.

H4[b]: Perceived ease of use of the m-payment systems is positively associated with the adoption intention for the m-payment systems.

The relationship between PU and AI for various IS has also been validated in many empirical studies [Davis et al., 1989; Venkatesh, 1999, 2000; Venkatesh and Davis, 1996, 2000]. M-payment systems offer multiple benefits to consumers related to location and time independent transactions. All these benefits result in more efficient payment transactions by the consumers. This leads us to expect that consumers will adopt m-payment systems if they perceive m-payment to be useful in achieving their desired outcomes in a more efficient way. Hence, we propose the following hypothesis:

H4[c]: Perceived usefulness of the m-payment systems is positively associated with the adoption intention for the m-payment systems.

IV. RESEARCH METHOD, DATA AND ANALYSES

We adopted a sequential multi-method approach to test the proposed research model. In the first step we tested the research model via a survey of potential adopters followed by one-to-one interviews for better understanding the results obtained through survey. The survey instrument was developed by identifying appropriate measurements from a comprehensive literature review. In order to ensure content validity, the scales for various measures from prior studies were adapted to the context of m-payment systems as shown in Appendix A. We also included four control variables in the study. These variables are characteristics of the potential adopters which might impact their adoption of mobile payment systems. Controls used in this study are age, gender, experience with mobile Internet and experience with Internet banking. The designed questionnaire was pilot tested with three doctoral students whose comments about the readability of the survey items were incorporated in the final instrument.

The sampling frame of "potential adopters" was comprised of the "mobile phone and Internet users who have previously not used m-payment services." We believed that, for being a potential adopter, the respondent should have some experience of using both mobile phones and the Internet. This was indicated as the qualifying criteria for the respondents of this survey, the rationale being that the users of these two technologies will be more amenable to adopt a related technological system. In addition to informing the potential respondents about the qualifying criteria, we had a check question in the survey to verify this aspect. Further, we wanted to have adequate representation

from the two groups of mobile phone users (1) users who have experience with "mobile phone Internet" and (2) users who have not previously used "mobile phone Internet." We believed that previous experience of using Internet on mobile phones may significantly influence their adoption intention. Hence, we used a "stratified sampling" method so as to have an adequate representation of both user and non-user groups of mobile phone Internet. Using these criteria, we distributed paper-based survey questionnaires to 278 Singapore residents. In the instructions given to the respondents, we asked them to respond to the questions with respect to their perceptions about remote m-payment services (where the mobile service provider has an important role to play). We also instructed them to visualize their preferred mobile service provider (MSP) when responding to the questions related to MSP characteristics. The potential respondents were given reminders over the phone by the researchers for completing the surveys. Subsequently, we had responses from 121 respondents (response rate of 43.5 percent), out of which we considered only 109 for data analysis. Incomplete questionnaires and questionnaires that did not fulfill the qualifying criteria for potential adopters were not included in the analyses.

The proposed theoretical model was then tested using the partial least squares (PLS) method which makes minimal demands in terms of sample size, measurement scales, and residual distributions, as compared to other structure equation modeling (SEM) techniques (such as LISREL, EQS, or AMOS) [Chin 1998; Srivastava and Teo, 2007; Teo et al. 2009]. PLS analysis has the added advantages of being more robust over against other data structural problems, such as skew distributions and omissions of regressors [Cassel et al., 1999], and is particularly suitable for examining complex relationships [Liang et al., 2007]. Various IS studies have employed PLS and have found it to be an effective method of analysis [Liang et al., 2007; Subramani, 2004; Teo et al., 2009]. Specifically, we used SmartPLS 2.0 to analyze the data in this study [Ringle et al., 2005; Vance et al., 2008]. To supplement the survey results and analyses, we also conducted thirty-two face to face semi-structured interviews with "potential adopters" of mobile payment systems. The aim of the interviews was to gather additional qualitative information about the perceptions of m-payment adoption related issues.

V. RESULTS

Demographics

The demographics of the survey respondents are provided in Table 1. The sample was comprised of 55 percent males and 45 percent females, with an adequate representation from the "young" (<30 years) and the "not so young" (>/=30 years) populations. Further, as seen in Table 1, 78.6 percent of the respondents had some form of university education, 79.8 percent of the respondents had prior experience with Internet banking, and 45.9 percent of the respondents had used the mobile Internet.

Table 1: Demographic Profile of Survey Respondents

Demographic Variable	Category	Frequency [N=109]	Percent
Gender	Male	60	55.0
	Female	49	45.0
Age	Below 20yrs	5	4.6
	20–below 30 yrs	23	21.1
	30–below 40 yrs	62	56.9
	Over 40 yrs	19	17.4
Education Level	Secondary	6	5.5
	College	17	15.6
	University	86	78.6
Use Mobile Internet	yes	50	45.9
	no	59	54.1
Use Internet Banking	yes	87	79.8
	no	22	20.2

Measurement Model

Following the recommended two-stage analytical procedure [Anderson and Gerbing, 1988; Hair et al., 1998], in the first stage confirmatory factor analysis was conducted to examine the measurement model and was followed by an examination of the structural relationships. In order to assess the measurement model, three types of validity were tested: content validity, convergent validity, and discriminant validity. Content validity was examined by checking for consistency between the measurement items and the existing literature, followed by pilot-testing the instrument [Bock et al., 2005; Srivastava and Teo, 2007]. Convergent validity refers to the extent to which the various items under each construct are actually measuring the same concept [Srivastava and Teo, 2007]. Convergent validity was

tested by examining the composite reliability (CR) and the average variance extracted (AVE: the ratio of the construct variance to the total variance among indicators) for the measures [Hair et al., 1998]. Many studies using PLS have taken 0.5 as the threshold for CR of the measures; however, 0.7 is the suggested threshold for reliable measurement [Chin, 1998]. As seen in Appendix B, the CR values ranged from 0.946 to 0.995. For the AVE a score of 0.5 is the recommended threshold [Fornell and Larcker, 1981]. Appendix B shows that the AVE ranged from 0.814 to 0.943, which are all above the acceptable values.

Finally, we verified the discriminant validity of the constructs by checking the square root of the AVE, as recommended by Fornell and Larcker [1981]. The result, shown in Table 2, confirms discriminant validity. The values of the square root of the AVE (reported on the diagonal in Table 2) are all greater than the inter-construct correlations (the off-diagonal entries in table) exhibiting satisfactory convergent and discriminant validity. Discriminant validity was also established by considering both loadings and cross-loadings, as shown in Appendix C. We also tested for multi-collinearity among the independent variables by examining the variance inflation factor (VIF). The resultant variance inflation factor (VIF) values for all of the constructs were between 1.332 and 2.847, which are all below the conservative acceptable value of 5 [Allison, 1999; Belsley et al., 1980; Srivastava and Teo, 2008].

Table 2: Descriptives and Correlations

	PR	PO	PER	PSA	TR	PU	PEOU	AI
PR	**0.970**							
PO	-0.405	**0.924**						
PER	-0.261	0.575	**0.922**					
PSA	0.539	-0.436	-0.558	**0.990**				
TR	0.553	-0.410	-0.524	0.756	**0.949**			
PU	0.251	-0.223	-0.174	0.487	0.284	**0.902**		
PEOU	0.239	-0.047	-0.109	0.241	0.308	0.351	**0.916**	
AI	0.454	-0.183	-0.244	0.548	0.539	0.561	0.310	**0.971**

Key: PR: Perceived Reputation
PO: Perceived Opportunism
PER: Perceived Environmental Risk
PSA: Perceived Structural Assurance
TR: Consumer Trust
PU: Perceived Usefulness
PEOU: Perceived Ease of Use
AI: Adoption Intention

The numbers in bold in the shaded cells of the diagonal row are the square roots of the average variance extracted.

Common Method Bias

As the data on all the variables for this study is self-reported and collected from single respondents, there is a potential for common method bias. We performed statistical analysis to assess the severity of common method bias in the data. First, we performed Harman's one factor test [Podsakoff and Organ, 1986]. The test indicated the presence of eight factors accounting for a total of 89.9 percent of the variance, of which the first factor accounted for merely 16.3 percent of the variance. Since a single factor did not emerge and one general factor did not account for most of the variance, we concluded that common method bias is not a significant problem with the data [Podsakoff et al., 2003]. Second, we adopted the technique recommended by Liang et al. [2007] using PLS to assess the magnitude of common method bias in the data. This we did by introducing a "common method factor" whose indicators included all the principal constructs' indicators and calculated each indicator's variances substantively explained by the corresponding "principal construct" and also the "common method factor." As exhibited in Appendix D, the average substantively explained variance of the indicators is 0.883, whereas the average method based variance is only 0.004. The ratio of substantive construct variance to common method variance is about 220: 1. Further, most method factor loadings are not significant, indicating that common method is not a serious concern for this research [Liang et al., 2007]. These tests helped us preclude the possibility of common method bias contaminating the results from this research.

Structural Model

After validating the measurement model, the proposed hypotheses were tested using PLS. The results of the analysis are depicted in Figure 2.

Assessing the two trust-building antecedents in the category of "mobile service provider characteristics," we find that perceptions about the "reputation of mobile service provider" has a significant relationship with "consumer trust" (path = 0.21, t = 2.22, $p < 0.05$), thus supporting H1[a]. However, the relationship between perceptions of "opportunism of the mobile service provider" and "consumer trust" was not found to be significant (path = 0.07, t =

0.88, ns), thereby not supporting H1[b]. We also examined the relationship between the "perceived reputation" and "perceived opportunism" and found a significant negative relationship between the two constructs (path = –0.32, t = 3.38, p < 0.01), supporting H1[c].

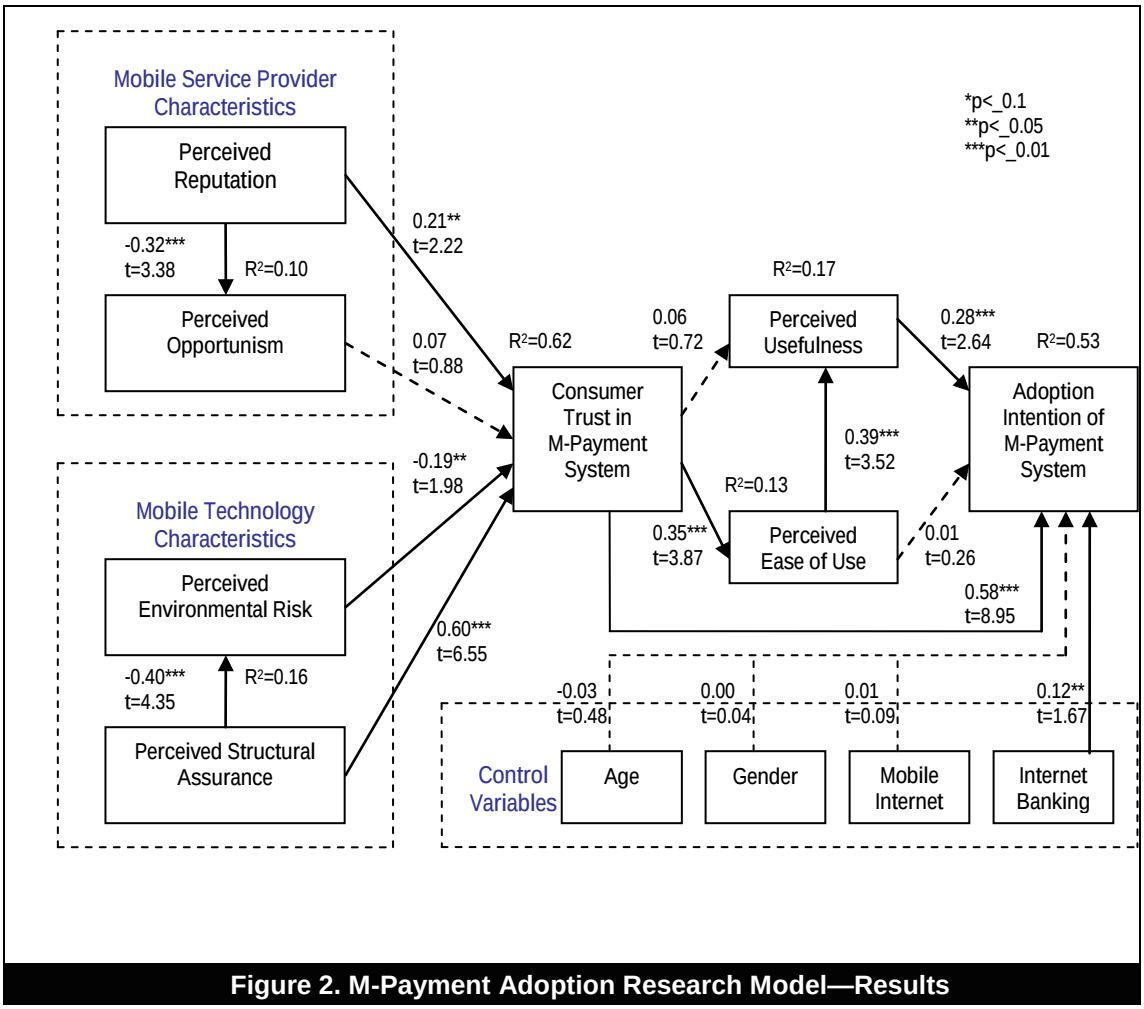

Figure 2. M-Payment Adoption Research Model—Results

Next, we examined the results for the other two trust-building antecedents identified and grouped in the category of the "mobile technology characteristics." We find that "perceived environmental risk," has a negative relationship with "consumer trust" (path = –0.19, t = 1.98, p < 0.05), supporting H2[a]. The relationship of "perceived structural assurance" with "consumer trust" was also highly significant (path = 0.60, t = 6.55, p < 0.01), strongly supporting H2[b]. Further we find that "perceived structural assurance" has a strong significant negative relationship with "perceived environmental risk" (path = –0.40, t = 4.35, p < 0.01), thereby strongly supporting hypothesis H2[c]. The four trust-building antecedents divided into two categories of mobile service provider characteristics and mobile technology characteristics explain 62 percent of the variance in "consumer trust." This suggests the high explanatory power of the theorized antecedents of consumer trust, providing empirical validation for the proposed research model.

From the results in the "consequences" part of the research model, we observe that "consumer trust" in an m-payment system does not have a significant relationship with PU (path = 0.06, t = 0.72, ns), thereby not supporting H3[a]. This surprising non-significant result calls for a deeper investigation. Next, the study also shows a strong support for H3[b], specifying a significant relationship between "consumer trust" in m-payment systems and PEOU (path = 0.35, t = 3.87, p < 0.01]. As shown in Figure 2, "consumer trust" is positively associated with the "adoption intention" for m-payment system (path = 0.58, t = 8.95, p < 0.01), thereby rendering a strong support for H3[c]. Next, we observe that although PEOU has a strong relationship with PU (path = 0.39, t = 3.52, p < 0.01), supporting H4[a], PEOU has a non-significant relationship with the intention to adopt m-payment systems (path = 0.01, t = 0.26, ns); hence H4[b] is not supported. In this study, PU is also a significant predictor of behavioral "intention for adopting m-payment systems" (path = 0.28, t = 2.64, p < 0.01), thereby strongly supporting H4[c]. Although, Davis [1989] argued that ease of use may act indirectly on intentions to use through usefulness, this is indeed an anomalous result and requires deeper investigation to understand the reasons for the differential importance of PU and PEOU in the

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context of m-payment systems. Among the control variables only "experience with Internet banking" had a significant relationship with adoption intention (path = 0.12, t = 1.67, $p < 0.05$).

Post-hoc Analyses

From the results in the previous section, we observe that a few issues remain unresolved. First, a surprising result is the non-significant relationship of "trust" with PU. A plausible explanation for this perceived anomaly is the possibility of the relationship between "consumer trust" and PU being fully mediated through PEOU. Second, the relationship between PEOU and AI is not significant, despite past research establishing this as a significant relationship in other contexts [Gefen, 1997; Pavlou, 2003]. This also requires further investigation. Third, it will be interesting to examine differences in the adoption behavior of the sub-groups of potential adopters based on their usage of the related technologies of "mobile Internet" and "Internet banking." In the following section, we conduct post-hoc analyses to further explore these important questions to have a better understanding of m-payment adoption.

Relationship Between Trust and Perceived Usefulness

To understand the intriguing non-significant relationship between "consumer trust" and PU, we tested another model in which PEOU does not have a direct path to PU [Table 3, Alternative Model 1]. In the absence of the link from PEOU to PU, the path between "trust" and PU becomes significant (path = 0.20, t = 2.40, $p < 0.01$) suggesting the fully mediating role of PEOU in the path from "trust" to PU. This analysis removes the notion of a non-significant relationship between "trust" and PU (Figure 2) rather it demonstrates the path through which trust impacts the adoption intention. Although, in the revised model the path from "trust" to PU becomes significant, the variance explained in PU dropped significantly from 17 percent to 4 percent. Hence, we conclude that the hypothesized mediated model provides a better explanation of the relationships between the theorized constructs.

Table 3: Comparison of Hypothesized Model with Alternative Models 1 and 2

	Hypothesized Model			Alternative Model 1			Alternative Model 2		
Paths	β	t	R^2	β	t	R^2	β	t	R^2
PR→TR	0.21**	2.22	0.62	0.21**	2.24	0.62	0.21**	2.18	0.62
PO→TR	0.07	0.88	0.62	0.07	0.89	0.62	0.07	0.88	0.62
PR→PO	–0.32***	3.38	0.10	–0.32***	3.45	0.10	–0.32***	3.33	0.10
PER→TR	–0.19**	1.98	0.62	–0.19**	1.98	0.62	–0.19**	1.98	0.62
PSA→TR	0.60***	6.55	0.62	0.60***	6.78	0.62	0.60***	6.41	0.62
PSA→PER	–0.40***	4.35	0.16	–0.40***	4.53	0.16	–0.40***	4.48	0.16
TR→PU	0.06	0.72	0.17	**0.20*** **	**2.18**	**0.04**	0.06	0.76	0.17
TR→PEOU	0.35***	3.87	0.13	0.36***	4.15	0.13	0.35***	3.81	0.13
TR→AI	0.58***	8.97	0.53	0.58***	8.85	0.53			
PEOU→PU	0.39***	3.52	0.17				0.39***	3.73	0.17
PEOU→AI	0.01	0.26	0.53	0.02	0.22	0.53	**0.13***	**1.14**	**0.25**
PU→AI	0.28***	2.64	0.53	0.28***	2.71	0.53	0.31***	2.66	0.25

*p < 0.1; **p < 0 .05; ***p < 0.01; R2 values of the paths are for the target variables.

Note: Alternative Model 1 has no direct link from PEOU to PU; Alternative Model 2 has no direct link from Trust to AI
Key: PR: Perceived Reputation, PO: Perceived Opportunism, PER: Perceived Environmental Risk, PSA: Perceived Structural Assurance, TR: Consumer Trust, PU: Perceived Usefulness, PEOU: Perceived Ease of Use, AI: Adoption Intention.

Relationship Between TRUST-AI

Although numerous studies have empirically exhibited that the relationship between "consumer trust" and AI is mediated through PEOU [Gefen, 1997; Pavlou, 2003], the results (Table 3, Hypothesized Model) do not exhibit this phenomenon. In fact, in the hypothesized research model, the relationship between PEOU and AI is not significant (path = 0.01, t = 0.26, ns) but the direct path from "trust" to AI is significant (path = 0.35, t = 3.87, $p < 0.01$). To test if there is any relationship of "trust" with AI through PEOU (in the absence of the direct path from "trust" to AI), we tested a revised model (Table 3, Alternative Model 2) in which the direct path from "trust" to AI is dropped. In the revised model, the path from PEOU to AI becomes marginally significant (path = 0.13, t = 1.17, $p < 0.1$), but the R^2 value of AI drops significantly from 0.53 (in the hypothesized model) to 0.25 (in the alternative model 2). The non-significant path from PEOU to AI can be for two reasons (1) the variance in AI is predominantly explained by the direct path from "trust" to AI, and (2) PEOU affects AI through PU (as seen in the previous post hoc analysis). The analyses together highlight the key role that "trust" plays in m-payment adoption. Further, we observe that in the revised model, variance drops significantly, hence we conclude that the hypothesized m-payment adoption model

presents the preferred configuration of relationships. We have highlighted these differences across the alternative models by using bold-faced font in Table 3.

Sub-Group Analyses

Sub-group analyses were performed to understand differences in m-payment adoption intention by different user groups, specifically three user groups viz. "users of Internet banking," "users of mobile Internet" and "non-users of mobile Internet."[2] The results, given in Table 4, exhibit some remarkable differences between the groups which help us better understand the m-payment adoption. We have highlighted these significant differences across the various sub-groups by using bold-faced font in Table 4.

Table 4 :Sub-Group Analyses: Comparing Hypothesized Model Internet Banking Users and Users/Non Users of Mobile Internet

	Hypothesized Model			Use Internet Banking			Use Mobile Internet			Not Use Mobile Internet		
Paths	β	t	R^2	β	t	R^2	β	t	R^2	β	t	R^2
PR→TR	0.21**	2.22	0.62	0.16*	1.64	0.66	**0.10**	**0.92**	**0.71**	0.28**	2.34	0.61
PO→TR	0.07	0.88	0.62	–0.05	0.42	0.66	–0.05	0.36	0.71	**–0.34****	**1.78**	**0.61**
PR→PO	–0.32***	3.38	0.10	–0.42***	4.19	0.17	–0.53***	5.72	0.28	**–0.07**	**0.39**	**0.04**
PER→TR	–0.19**	1.98	0.62	**–0.08**	**0.74**	**0.66**	–0.24**	1.74	0.71	–0.19*	1.34	0.61
PSA→TR	0.60***	6.55	0.62	0.67***	7.53	0.66	0.59***	4.52	0.71	0.51***	4.22	0.61
PSA→PER	–0.40***	4.35	0.16	–0.44***	4.55	0.20	–0.55***	5.13	0.30	**–0.23**	**1.46**	**0.05**
TR→PU	0.06	0.72	0.17	**0.12***	**1.48**	**0.17**	0.08	0.52	0.38	–0.04	0.31	0.05
TR→PEOU	0.35***	3.87	0.13	0.32***	2.63	0.10	0.35***	2.98	0.12	0.31**	2.29	0.10
TR→AI	0.58***	8.97	0.53	0.58***	7.88	0.47	0.71***	9.13	0.52	0.54***	6.80	0.59
PEOU→PU	0.39***	3.52	0.17	0.36***	2.86	0.17	0.59***	3.43	0.38	0.22*	1.54	0.05
PEOU→AI	0.01	0.26	0.53	0.04	0.45	0.47	0.09	0.77	0.52	0.03	0.33	0.59
PU→AI	0.28***	2.64	0.53	0.28**	2.20	0.53	**0.10**	**0.74**	**0.52**	0.52***	4.94	0.59

*p < 0.1; **p < 0.05; ***p < 0.01; R2 values of the paths are for the target variables

Key: PR: Perceived Reputation
PO: Perceived Opportunism
PER: Perceived Environmental Risk
PSA: Perceived Structural Assurance
TR: Consumer Trust
PU: Perceived Usefulness
PEOU: Perceived Ease of Use
AI: Adoption Intention

We find that the sub-group "users of Internet banking" is essentially similar to the hypothesized model except that the "trust in m-payment systems" is not dependent on the mobile technology characteristic of "environmental risk." The relationship from PER to "trust" (path = –0.08, t = 0.74, ns) is not significant. Members of the sub-group also have some concerns about the reputation of the MSP (PR to "trust" [path = 0.16, t = 1.64, p < 0.1]), possibly because of limited experience with the mobile Internet. In contrast, for the "users of mobile Internet," the reputation of MSP is not an important concern (PR to "trust" [path = –0.10, t = 0.92, ns, whereas technological riskiness emerges as an important issue in the mobile environment consistently for this group (PER to "trust" [path = –0.24, t = 1.74, p < 0.05] and PSA to "trust" [path = 0.59, t = 4.52, p < 0.01]). Thus, even experienced "users of mobile Internet" perceive m-payment systems as having significant technological risks. Also for this group of users, "trust" explains the maximum variance in the AI for m-payment systems, thereby highlighting the importance of building consumer trust even for the past users of mobile Internet. Non-users of mobile Internet, in contrast to the hypothesized model, have concerns about the opportunism of the MSP (PO to "trust" [path = –0.34, t = 1.78, p < 0.05]), but for them reputation and opportunism are not related (PR to PO [path = –0.07, t = 0.39, ns]). We also observe that, similar to the hypothesized model, this category of users has concerns about the environmental risks (PER to "trust" [path = –0.19, t = 1.34, p < 0.1]) and perceive "structural assurance" to be a strong trust-building factor (PSA to "trust" [path = 0.51, t = 4.22, p < 0.01]). However, in contrast to the hypothesized model, the relationship between "structural assurance" and "environmental risk" (PSA to PER [path = –0.23, t = 1.46, ns]) is not significant, signifying the different roles of these two constructs. As this category of users is not sufficiently exposed to mobile Internet technology, they perceive mobile payment systems to be risky and prefer adequate "structural assurance" to protect them.

[2] We did not conduct sub-group analyses for non-users of Internet banking, as this sub-group had only twenty-two such users, and it was not a sufficient sample size for testing the hypothesized research model. Ringle and Henseler [2008] have prescribed that the sample size for PLS should be at least ten times the number of maximum number of arrows pointing to any latent construct in the research model.

In summary, building sufficient trust in m-payment systems is imperative for the adoption of m-payment systems for all groups of users. Moreover, both the "MSP characteristics" and "mobile technology characteristics" are important for building trust in m-payment systems for all groups except the "users of mobile Internet." For the past users of mobile Internet only, "mobile technology characteristics" are significant for building their trust in m-payment systems leading to subsequent adoption.

VI. DISCUSSION

Results identify "reputation of mobile service provider" as an important trust building factor in the context of m-payment adoption. The only exception is the sub-group of "mobile Internet users," people who have an already established assessment of the MSP's reputation based on their past experience. The result is in consonance with previous studies in the context of online shopping which have proposed reputation of the vendor as an antecedent of initial trust for potential consumers [Jarvenpaa et al., 2000; McKnight et al., 2002]. The difference being the existing "users of mobile Internet" for whom the reputation of MSP is not an important concern for mobile payment adoption. Perhaps users of mobile Internet, since they have a choice of service provider, may choose a provider that they are comfortable with, and, consequently, the issues of perceived reputation and trust may be less salient.[3] Most interviewed respondents highlighted the preponderance of "reputation of mobile service provider" for developing trust in m-payment systems. In this context, one interview respondent remarked:

> *Trust in mobile operators is extremely important. Their reputation and brand name would assure us and minimize the risks involved in m-payment transactions.*

Another respondent commented:

> *Reputation of the mobile service provider is very important for developing my trust in m-payment systems. I would prefer a known mobile company that should be global, public sector firm, with good security systems.*

Although, in the context of online shopping, vendor's opportunism has a significant negative relationship with consumer trust in online transactions [Pavlou et al., 2007], results indicate a non-significant relationship between consumer perceptions of "opportunism of the mobile service provider" and consumer trust. This is true for all subgroups except the "non-users of mobile Internet." A plausible reason for the non-significant relationship may be the fact that the study was conducted in Singapore, where law-enforcement is pretty strict. Perceived opportunism of the mobile service provider in Singapore may not be a significant factor related to trust in m-payment systems. Another plausible reason can be that the role of mobile service provider as a facilitator of payment transaction may not provide much opportunity or incentive for vendor to engage in opportunism as it may deter users from using m-payment system and consequently reduce a source of revenue for mobile service providers.[3]

One respondent commented:

> *I believe mobile service providers will be verified by government regulations and third party endorsements so I need not worry about the opportunistic behavior of the mobile service provider.*

In addition, our results suggest a significant negative relationship between perceived reputation and perceived opportunism, which is in line with the past literature [Chiles and McMackin, 1996]. Commenting on this issue, one interview respondent remarked:

> *I do not worry about the opportunistic behavior of the mobile company as I plan to adopt the mobile payment services offered only by reputed well-known mobile companies who are established entities in providing mobile services.*

Further, the study suggests a negative relationship between perceived environmental risk and trust, which is strengthened by the views put forth by many interviewees. The related views of two respondents are mentioned below:

> *I am worried about the reliability, stability, and security of the technology supporting the mobile payment systems.*

> *I do not trust mobile payment systems, as I will have to make payments through the mobile Internet and it is not traceable….. I will not know from where to retrieve it.*

[3] We thank the associate editor for making these suggestions.

The results from the subgroup analysis indicate that past users of Internet banking have lesser concerns about environmental risk but surprisingly environmental risk is a significant adoption issue for past users of mobile Internet. This indicates that mobile technology underlying the m-payment systems is generally perceived to be riskier than Internet technology for online transactions. Hence, for the adoption of mobile payments it is essential that technological features mitigating risks in m-payments need be properly highlighted to potential users.

Next, the findings indicate "structural assurance" as the stronger trust building antecedent among the two identified "mobile Internet characteristics." In fact, we observe that perceptions of structural assurances have by far the strongest relationship with trust in m-payment systems among the four theorized antecedents of consumer trust. One respondent commented:

> *Security is very important to me for transactions over mobile network, which I can get through third party endorsements and other technological assurances to improve trust in m-payment systems.*

In addition, the study finds a strong negative relationship of structural assurance with risk. This implies that one way to reduce perceived risk in m-payment systems is to develop adequate structural assurance (institutional trust). One way of doing this is by involving known financial and social institutions acting as guarantors for m-payment systems [Salam et al., 2003]. One respondent commented:

> *I am a little skeptical about monetary transactions through wireless medium due to hackers. But trusted parties and government regulations can assure me that transactions are secure.*

The results in the "consequences" part of the research model indicate strong significant relationships of "consumer trust" with both adoption intention and PEOU but a non-significant relationship with PU. This leads us to believe that for m-payment systems "consumer trust" may not necessarily be a significant factor in determining usefulness of m-payment systems. It contradicts the findings from past studies that have empirically demonstrated consumer trust as a significant determinant of PU [Gefen et al., 2003a, Pavlou, 2003]. To understand this anomaly, another alternative model was tested where PEOU did not have a direct path to PU (Table 3, Alternative Model 1). Results show that PEOU explains greater variance in PU as compared to "trust" alone and also confirms the full mediation of the path from "trust" to PU through PEOU thereby emphasizing the significant role of PEOU in the m-payment adoption model. Similar to some other studies, in the m-payment context PEOU impacts AI through PU [Adams et al., 1992; Davis and Venkatesh 2004; Moore and Benbast, 1991]. Hence, users will perceive m-payment systems to be "useful" if they find it "easy to use" which can be attained by developing adequate "trust" in these systems. Commenting on the role of trust, PEOU and PU an interview respondent remarked:

> *If the m-payment system is trustworthy, convenient, and easy to use, and I am able to easily understand the process of transaction and be comfortable with it, then only will I find it useful and consider adopting it.*

Findings highlight the greater significance of PEOU for adoption intention as compared to PU, whereby PEOU influences AI through PU. Gefen and Straub [2000] suggested that PU, rather than PEOU, may influence user's intention to adopt and use new technology. However, in the context of m-payment systems, our research suggests that PEOU is a stronger determinant of AI, but acts through PU. The small screen in mobile phones may make the issue of PEOU more salient that PU. If PEOU is not achieved, the issue of PU may not even be an issue, since PEOU motivates users to try out the system, especially in the case of m-payment which is still relatively new. However, once users try out the system, the issue of PU becomes more salient, which would help to explain the insignificant relationship between PEOU and adoption intention.[4]

The differential importance of PU and PEOU in the context of m-payment systems was further investigated by an alternative model in which the direct path from "trust" to AI was dropped [Table 3, Alternative Model 2]. We observe that, in such a situation, the path from PEOU to AI becomes significant. Combined results suggest two interesting insights unique for m-payment systems: first, consumer trust is directly and strongly related to the AI and second, the mediating role of PEOU in the relationship between "trust" and AI is not as significant as in other IS contexts. This research establishes the important relationship of consumer trust with AI as well as highlights the fact that in the presence of "consumer trust," which explains the maximum variance, the relationships of PEOU and PU with AI become relatively less important. Legris et al. [2003] showed that PEOU and PU explain approximately 40 percent of the variance in new technology usage. However, in the context of m-payments where the transactions are between unknown entities and involve multifarious uncertainties and risks, consumer trust emerges as the single most significant predictor for its adoption. Thus we find that trust is a significant antecedent for the adoption of m-payment

[4] We thank the associate editor for making this suggestion.

systems and needs to be carefully considered in any research on the adoption of m-payment systems [Gefen, 2000; Jarvenpaa and Tractinsky, 1999]. In this context one respondent remarked:

> *Users should be educated to use the m-payment system easily, but trust is foremost. If user trust is there, then users will eventually develop an interest in the system as a preferred mode of payment.*

Thus, the results from post-hoc analyses show that "trust" is related to AI of m-payment systems in two ways, first, it has a direct relationship to AI, and, second, it is related to PEOU, which in turn is related to PU and, consequently, PU co-varies with the AI. The results and post-hoc analyses together not only establish the important role of "trust" for adoption of m-payment, but also show the mechanisms through which "trust" is related to adoption intention. From the sub-group analyses for the three groups—users of Internet banking, users of mobile Internet, and non-users of mobile Internet—we find that users of Internet banking have lesser concerns about "mobile technology characteristics" than those who have not used it. One such respondent, who is a non-user of Internet banking, commented:

> *I am scared of the risks involved in these transactions. As the SMS [Short Message Service] are lost sometimes and untraceable, the payments and transactions can also get lost. The system might fail and cause losses to me.*

An important finding is that while, for users of Internet banking, the mobile technology characteristics related to environmental risk (PER) are not related to their level of "trust" in the m-payment systems, for users of mobile Internet this relationship is significant. This finding highlights the inherent perceived riskiness of the mobile payment systems, even by the users of mobile Internet. Hence, the feasibility of secure m-payment transactions has to be communicated to potential adopters. In summary, the sub-group analyses shows that, for different types of users, the relationships among the factors determining user trust will be different, suggesting that future research should incorporate types of users in examining the adoption intention for m-payment systems.

VII. LIMITATIONS AND FUTURE DIRECTIONS

Though this study makes significant contributions, there are a few limitations. First, exploring factors affecting m-payment adoption is a relatively new area in IS research. The findings and their implications were obtained from one single study that targeted a specific set of potential consumers in Singapore. Hence, generalizability of results is an issue. Despite the issue of generalizability, the research does highlight the significant role of trust for adoption intention of m-payment systems, even among a sample,[5] that it is more amenable to m-payment adoption. Certainly, more research is needed in the emerging field of m-payment systems in different contexts. Second, though we have identified a few variables that are related to the adoption intention of m-payment systems, future studies may explore additional variables in order to improve the predictive capability of the model. It might be reasonable to add perceived financial cost, perceived institutional pressures, and the perceived cost of changing the existing payment system as additional decision variables. For example, many developed countries and banking institutions have invested heavily in Internet and card-based payment systems and may not be motivated enough to change to an m-payment system [Porteous, 2006]. Future research can explore this technological opportunity for developing countries, which have so far not invested heavily in other electronic payment infrastructure. Third, the proposed research model is cross-sectional in nature, i.e., it measures perceptions and intentions at a single point in time. However, perceptions change with time and experience of users and may effect subsequent adoption of new technology [Mathieson et al., 2001; Venkatesh and Davis, 1996]. A dynamic model that would predict behavioral intention of users over time may be more appropriate to study the acceptance of m-payment systems and can be an agenda for future research. Fourth, for certain types of remote m-payment systems which are similar to the web-based online shopping scenario, the role of vendors from whom the purchases are made is also important. Hence a full model for such a scenario should include them also. However, in this research we did not model the role of online vendors. Future, research can explore the combined role of online vendors and mobile service providers for such m-payment scenarios.

VIII. IMPLICATIONS

Despite the astronomical increase in the number of cell-phone subscriptions, and the potential benefits that can be derived from m-payment systems, there is limited acceptance of m-payment systems around the world [Jones, 2008]. Past literature suggests "usefulness" and "ease of use" of the new technology as important factors for its adoption. However, in the context of m-payment systems, the associated uncertainties and lack of consumer control make the role "consumer trust" significant for its acceptance. It is not only important to understand the role of trust for the adoption of m-payment systems but also how can trust be fostered among potential adopters. This research

[5] Sample respondents as users of both "mobile phones" and "the Internet" ascertain their propensity for related technology adoption.

is predicated on this significant theoretical and practical problem related to the issue of m-payment adoption. The current study examines the role of trust in m-payment adoption systems and simultaneously investigates the facilitators for consumer trust in m-payment systems by conceptualizing two dimensions facilitating consumer trust viz. mobile service provider characteristics and mobile technology characteristics. In addition to being one of the first studies addressing this vital contemporary research problem, the paper delineates some important implications for research and practice.

Implications for Research

This article offers several implications for research. First, we present a trust-theoretic model for adoption of m-payment systems. We test the robustness of the model by conducting post-hoc analyses. The validated model presented in Figure 2 can be used as a point of reference for future research on m-payment adoption. The study highlights the key role that consumer trust plays in the adoption of m-payment systems. Trust is directly and significantly related to adoption intention of m-payment systems for all the sub-groups analyzed in this study (Table 4). There is a need to foster trust even among the past "users of mobile Internet." We also observe that in the context of m-payment, the traditional "technology adoption factors" of PU and PEOU are relatively less important as compared to "consumer trust." Future research on technology adoption can explore the different contextual factors in which "trust" becomes the vital consideration and explains most variance in the final dependent variable of adoption intention. The article demonstrates a significant and clear case for the "trust theoretic model" for the adoption of m-payment systems and extends the literature on m-payments. It will be instrumental in increasing the interest of future researchers in understanding deployment, implementation, and management of m-payment technologies.

Second, results highlight the greater significance of PEOU for AI as compared to PU whereby PEOU affects AI through PU. Post-hoc analysis in this study helps us establish the mediating role of PEOU (Table 3). A simple conclusion based on the results in Figure 2 would have highlighted the not so significant role of PEOU for AI. Through a careful post-hoc analysis we demonstrate not only the relatively greater importance of PEOU but also the way in which it impacts the AI through PU, thereby opening fresh avenues for future research. Though in some past studies, PU has been found to be more significant for technology adoption; in the context of m-payments, PEOU has a greater significance and is related to AI through PU. Future studies can further explore this differential importance of PEOU and PU, thus extending the research agenda on the adoption of upcoming new technologies.

Third, in the proposal for the m-payment adoption model, the theorized antecedents of "consumer trust" (mobile service provider characteristics and mobile technology characteristics) explain a significantly high percentage of variance (63.4 percent) in "consumer trust," highlighting the importance of both facilitators of "consumer trust." Sub-group analyses (Table 4) highlight the differential importance of the hypothesized facilitators for different groups of users. We extend the literature on trust by presenting a framework that provides a theoretical basis for understanding the antecedents of consumer trust in the context of m-payment systems. Future research can study these characteristics in greater detail to expand the list of facilitators of consumer trust. The study can also be useful in understanding development of "user trust" in other related new technologies.

Fourth, by investigating the characteristics of mobile service provider in addition to the underlying mobile technology for consumer trust-building, we highlight the need for understanding the role of players (other than technology) for consumer trust-building and subsequent adoption of m-payment technology. Future research can examine the impact of other pressures that may influence adoption of m-payment systems, e.g., institutional pressures [Liang et al., 2007; Teo et al., 2003], regulatory pressures and legal provisions [Porteous, 2006].

Fifth, by examining the differences in the factors influencing user trust for the different user groups (Table 4), we highlight the differences in adoption of the same technology by different user categories highlighting the differences in group-level sense-making of new technologies leading to multiple interpretations of the same technology. Future research can examine the trust building factors in relation to the group-level sense making facilitating technology adoption for different types of users.

Implications for Practice

In addition to having implications for research, the study has several important implications for m-payment practitioners, system designers and IS technologists. First, the study unambiguously highlights "consumer trust" as the key driver for adoption of m-payment systems and exhorts practitioners, m-payment system designers, and technologists to seriously consider "consumer trust-building" for the consumer acceptance of m-payment systems. Past studies have emphasized the role of user-friendliness for adoption of new IS, which can be effected by focusing on "ease of use" and "usefulness" in accomplishing the stated task. However, for m-payment services in which the financial transactions are in virtual space and involve a great deal of uncertainty and risk, "trust" has major role in increasing the acceptability of m-payment systems. Even in the sub-group analyses (Table 4) we observe that "trust"

is consistently the most important facilitator for adoption of m-payment systems for all user groups. Thus, m-payment practitioners and executives have to recast and build on their conceptualization for technology adoption, specifically in the context of m-payments.

Second, the post-hoc analyses in the study highlights the fully mediating role of PEOU in the relationship from "trust" to PU. Thus, for m-payment systems the "usefulness" of m-payment system is dependent on its "ease of use." Hence when the users will find the system trustworthy, their "ease of use" of such systems will increase, which would further help them to realize the "usefulness" of m-payment systems. Thus, m-payment designers and practitioners should pay special attention to "ease of use" in addition to "trust" for facilitating adoption of m-payment systems [Chin et al., 1988; Shneiderman, 1987; Teo et al. 2008].

Third, the results from this study provide concrete guidelines for m-payment systems practitioners and designers on the means to foster "consumer trust" in m-payment systems for their successful adoption.

Results in general, indicate the need for "reputable mobile service providers" in addition to having "reliable and secure mobile technology environment" for alleviating the uncertainties associated with m-payment systems. A secure mobile transaction environment can be provided by putting in place user-controlled transactions which remain anonymous. Further, technologies such as mPKI, biometrics, and mobile digital signatures can be integrated in m-payment systems to provide greater structural assurance [Karnouskos and Fokus, 2004]. The results from sub-group analyses demonstrate the need to have a differential adoption strategy for different users groups. For example, existing mobile Internet users do not have concerns about the mobile service provider's reputation but they do wish to have a secure mobile technology environment. For non-users of mobile Internet, in addition to the reputation of the mobile service provider, the perceived opportunism of the MSP is also a key concern for adoption. Similarly, the group of Internet banking users has different adoption related issues. The results in Table 4 provide an actionable segmentation of different target groups for m-payment adoption, and corresponding strategies can be formulated so as to have a directed approach to m-payment adoption depending on the user group. In summary, it is important for m-payment practitioners, executives, and designers to proactively consider the characteristics of both "mobile service providers" and "mobile technology," as well as the target user group to devise effective trust fostering strategies leading to adoption of m-payment systems.

IX. CONCLUSION

The research proposes and tests a "trust-theoretic m-payment adoption model" which can serve as an initial step in the direction of effective consumer adoption of m-payment systems. In contrast to earlier research on technology adoption which stresses the need for having "usefulness" and "ease of use" of the new technological system, this article highlights the key role of "consumer trust" facilitating m-payment adoption. The series of post-hoc analyses in this study establishes confidence in the results and reiterates the vital role of "consumer trust" for m-payment adoption. The conceptualization of factors facilitating trust in m-payment systems provides guidance to practitioners and researchers to focus not only on the "mobile technology characteristics," but also on the "mobile service provider characteristics," as mobile service providers play a key function in the conduct of m-payment processes. Further, sub-group analyses put forth the importance of formulating differential strategies for different user groups with a view to fostering adequate "trust for m-payment systems" in these groups. The results of the sub-group analyses can serve as a starting point for formulating group specific strategy for different potential adopter groups of "users of Internet banking," "users of mobile Internet," and "non-users of mobile Internet." In addition to providing an empirical validation for a "trust prime technology adoption model" for m-payment systems, the paper provides a number of directions for future research to continue the ongoing agenda regarding the adoption, implementation, and impact of a potentially beneficial wireless m-payment technology.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web, can gain direct access to these linked references. Readers are warned, however, that:

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APPENDIX A. SCALES AND ITEMS

Perceived Reputation (Cronbach Alpha = 0.968; Jarvenpaa el al. [2000], Jarvenpaa and Tractinsky [1999], Doney and Canon [1997])

1. I believe this MOBILE SERVICE PROVIDER has a good reputation.
2. I believe this MOBILE SERVICE PROVIDER has a reputation for being fair.
3. I believe this MOBILE SERVICE PROVIDER has a reputation for being honest.

Perceived Opportunism (Cronbach Alpha = 0.915; John [1984])

1. I believe that this MOBILE SERVICE PROVIDER may use customer information without permission.
2. I believe that this MOBILE SERVICE PROVIDER might alter information in its own self interest.
3. I believe that this MOBILE SERVICE PROVIDER may promise things without actually doing them.

Perceived Environmental Risk (Cronbach Alpha = 0.956; Bhimani [1996], Cockburn and Wilson [1996], Sweeney et al. [1999])

1. Information about my mobile payment transactions would be known to others.
2. I believe mobile payment transactions may be modified or deleted by others.
3. I believe there is a high probability of losing a great deal in using mobile payment systems.
4. I would label adopting mobile payment systems as a potential loss.
5. I believe that overall riskiness of mobile payment systems is high.

Perceived Structural Assurance (Cronbach Alpha = 0.994; Mc Knight et al. [2002])

1. I believe mobile technology has enough safeguards to make me feel comfortable using it to make mobile payments.
2. I feel assured that legal and technological structures adequately protect me from problems on the mobile technology.
3. I feel confident that encryption and other technological safeguards on the mobile technology make it safe for me to make mobile payments.
4. In general, the mobile technology provides robust and safe environment to perform mobile payments.

Trust (Cronbach Alpha = 0.969; Gefen [2000], Jarvenpaa [1999], Schneider [1998])

1. I trust mobile payment systems to be reliable.
2. I trust mobile payment systems to be secure.
3. I believe mobile payment systems are trustworthy.
4. I trust mobile payment systems.
5. Even if the mobile payment systems are not monitored, I'd trust them to do the job correctly.

Perceived Usefulness (Cronbach Alpha = 0.942; Davis [1989])

1. Using mobile payment systems would enable me to accomplish financial tasks and payments quickly.
2. Using mobile payment systems would improve my performance in making payments.
3. Using mobile payment systems would enhance my effectiveness in making payments.
4. Using mobile payment systems would make it easier for me to manage and make payments.
5. Overall, I find that mobile payment systems are useful for making payments.

Perceived Ease of Use (Cronbach Alpha = 0.952; Davis [1989])

1. Learning to use mobile payment systems would be easy for me.
2. It would be easy to get mobile payment system to do what I want it to do.
3. My interaction with mobile payment system would be clear and understandable.
4. It would be easy for me to become skilful at using mobile payment system.
5. Overall, I would find mobile payment systems to be easy to use.

Adoption Intention (Cronbach Alpha = 0.969; Davis [1989], Davis et al. [1989], Venkatesh and Davis [2000])

1. Given a chance, I intend to adopt mobile payment systems in the future.
2. Given a chance, I predict that I will frequently use mobile payment systems in the future.
3. I will strongly recommend others to use mobile payment systems.

APPENDIX B. INDICATOR VARIABLES: STATISTICS

Construct [CR] [AVE]	Indicator	Mean	SD	Loading	T-value
Perceived Reputation [0.979] [0.941]	PR1	1.90	1.05	0.953	20.162
	PR2	2.08	1.13	0.974	33.129
	PR3	2.06	1.14	0.982	29.057
Perceived Opportunism [0.947] [0.857]	PO1	4.40	2.05	0.901	4.225
	PO2	4.79	1.81	0.939	7.382
	PO3	4.59	1.86	0.937	5.947
Perceived Environmental Risk [0.966] [0.850]	PER1	3.97	1.93	0.896	8.671
	PER2	4.27	1.88	0.948	8.733
	PER3	4.37	1.90	0.921	7.932
	PER4	4.68	1.69	0.886	8.870
	PER5	4.31	1.94	0.957	11.172
Perceived Structural Assurance [0.995] [0.982]	PSA1	3.24	2.09	0.993	89.721
	PSA2	3.28	2.04	0.991	62.107
	PSA3	3.24	2.08	0.989	43.256
	PSA4	3.34	2.04	0.991	79.836
Trust [0.978] [0.900]	TR1	3.11	1.68	0.967	40.842
	TR2	3.18	1.81	0.976	46.738
	TR3	3.11	1.66	0.976	47.522
	TR4	3.25	1.70	0.970	37.670
	TR5	3.75	1.93	0.849	18.617
Perceived Usefulness [0.956] [0.814]	PU1	2.20	1.25	0.904	7.981
	PU2	2.53	1.48	0.902	10.079
	PU3	2.61	1.41	0.885	11.288
	PU4	2.35	1.36	0.918	10.056
	PU5	2.48	1.41	0.902	4.676
Perceived Ease of Use [0.963] [0.839]	PEOU1	2.07	1.27	0.879	6.868
	PEOU2	2.49	1.34	0.935	9.510
	PEOU3	2.28	1.22	0.860	6.750
	PEOU4	2.18	1.35	0.939	10.704
	PEOU5	2.26	1.38	0.962	12.955
Adoption Intention [0.980] [0.943]	AI1	3.06	1.63	0.964	36.137
	AI2	3.26	1.74	0.985	56.737
	AI3	3.44	1.78	0.966	43.628

Note: CR: Composite Reliability, AVE: Average Variance Extracted

APPENDIX C. INDICATOR VARIABLES: LOADINGS AND CROSS LOADINGS

	AI	PEOU	PER	PO	PR	PSA	PU	TR
AI1	0.964	0.322	–0.344	–0.240	0.440	0.541	0.391	0.652
AI2	0.985	0.313	–0.366	–0.243	0.455	0.540	0.415	0.631
AI3	0.966	0.337	–0.350	–0.255	0.448	0.546	0.367	0.647
PEOU1	0.240	0.879	–0.145	–0.064	0.147	0.112	0.284	0.233
PEOU2	0.428	0.935	–0.184	–0.095	0.284	0.309	0.416	0.441
PEOU3	0.233	0.860	–0.228	–0.128	0.121	0.214	0.382	0.285
PEOU4	0.242	0.939	–0.146	–0.080	0.200	0.176	0.373	0.259
PEOU5	0.325	0.961	–0.164	–0.063	0.247	0.214	0.386	0.341
PER1	–0.326	–0.188	0.896	0.489	–0.151	–0.424	–0.188	–0.352
PER2	–0.305	–0.136	0.948	0.495	–0.120	–0.360	–0.109	–0.322
PER3	–0.297	–0.172	0.921	0.470	–0.045	–0.306	–0.148	–0.378
PER4	–0.347	–0.178	0.886	0.577	–0.093	–0.326	–0.251	–0.385
PER5	–0.390	–0.197	0.957	0.525	–0.223	–0.421	–0.125	–0.469
PO1	–0.179	–0.052	0.456	0.901	–0.292	–0.320	–0.209	–0.186
PO2	–0.242	–0.043	0.526	0.939	–0.277	–0.303	–0.246	–0.285
PO3	–0.270	–0.152	0.548	0.937	–0.317	–0.318	–0.161	–0.341
PR1	0.372	0.193	–0.100	–0.305	0.953	0.486	0.123	0.420
PR2	0.463	0.264	–0.160	–0.298	0.975	0.523	0.166	0.559
PR3	0.493	0.201	–0.150	–0.328	0.982	0.554	0.145	0.558
PSA1	0.561	0.243	–0.407	–0.312	0.519	0.993	0.306	0.761
PSA2	0.542	0.247	–0.398	–0.325	0.511	0.991	0.301	0.751
PSA3	0.555	0.198	–0.377	–0.326	0.561	0.988	0.314	0.747
PSA4	0.556	0.243	–0.413	–0.377	0.546	0.991	0.302	0.754
PU1	0.285	0.345	–0.173	–0.193	0.071	0.174	0.904	0.080
PU2	0.319	0.362	–0.176	–0.140	0.070	0.209	0.902	0.178
PU3	0.388	0.327	–0.243	–0.295	0.122	0.324	0.885	0.180
PU4	0.314	0.319	–0.114	–0.196	0.090	0.296	0.918	0.129
PU5	0.462	0.452	–0.104	–0.167	0.270	0.351	0.902	0.271
TR1	0.622	0.361	–0.396	–0.316	0.536	0.733	0.148	0.967
TR2	0.637	0.351	–0.427	–0.296	0.474	0.748	0.154	0.976
TR3	0.627	0.348	–0.406	–0.287	0.521	0.729	0.160	0.976
TR4	0.642	0.323	–0.417	–0.259	0.493	0.751	0.204	0.970
TR5	0.614	0.292	–0.333	–0.266	0.508	0.640	0.270	0.849

Note: PR: Perceived Reputation, PO: Perceived Opportunism, PER: Perceived Environmental Risk, PSA: Perceived Structural Assurance, TR: Consumer Trust, PU: Perceived Usefulness, PEOU: Perceived Ease of Use, AI: Adoption Intention.

APPENDIX D. COMMON METHOD BIAS ANALYSIS

Construct	Indicator	Substantive Factor Loading [R1]	$R1^2$	Method Factor Loading [R2]	$R2^2$
Perceived Reputation	PR1	1.000***	1.000	–0.094**	0.009
	PR2	0.940***	0.884	0.049*	0.002
	PR3	0.954***	0.910	0.041*	0.002
Perceived Opportunism	PO1	0.943***	0.889	0.061	0.004
	PO2	0.945***	0.893	0.009	0.000
	PO3	0.890***	0.792	–0.066	0.004
Perceived Environmental Risk	PER1	0.868***	0.753	–0.042	0.002
	PER2	1.000***	1.000	0.082*	0.007
	PER3	0.966***	0.933	0.070	0.005
	PER4	0.865***	0.748	–0.034	0.001
	PER5	0.905***	0.819	–0.078*	0.006
Perceived Structural Assurance	PSA1	0.990***	0.980	0.003	0.000
	PSA2	1.000***	1.000	–0.016	0.000
	PSA3	1.000***	1.000	–0.023	0.001
	PSA4	0.961***	0.924	0.036	0.001
Trust	TR1	0.983***	0.966	–0.017	0.000
	TR2	1.000***	1.000	–0.029	0.001
	TR3	1.019***	1.038	–0.049	0.002
	TR4	0.978***	0.956	–0.009	0.000
	TR5	0.743***	0.552	0.118	0.014
Perceived Usefulness	PU1	0.958***	0.918	–0.096*	0.009
	PU2	0.925***	0.856	–0.039	0.002
	PU3	0.849***	0.721	0.068	0.005
	PU4	0.944***	0.891	–0.054	0.003
	PU5	0.824***	0.679	0.127	0.016
Perceived Ease of Use	PEOU1	0.946***	0.895	–0.108	0.012
	PEOU2	0.852***	0.726	0.136*	0.018
	PEOU3	0.841***	0.707	0.015	0.000
	PEOU4	0.978***	0.956	–0.065	0.004
	PEOU5	0.954***	0.910	0.011	0.000
Adoption Intention	AI1	0.956***	0.914	0.009	0.000
	AI2	0.999***	0.998	–0.019	0.000
	AI3	0.958***	0.918	0.010	0.000
Average		0.937	0.883	0.000	0.004

*p < .1; **p < .05; ***p < .01

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