Conditions for Consumer Acceptance of Mobile Payment Methods In the United States

Perceived compatibility with existing practices and indicators of individual mobility

Summary

The primary purpose of this study is to investigate conditions of individual consumer adoption of mobile payment methods in the United States. There are a number of different market characteristics shown to affect overall adoption of mobile payment methods within national populations. However, considering the comparatively slow consumer acceptance of mobile payment in the United States, the question arises, do similar individually perceived factors shown to drive consumer adoption of mobile payment in another developed nation such as Germany hold true in the U.S.? To investigate this question, data from the 2009 Survey of Consumer Payment Choice is used to test hypotheses based upon the findings of previous research on the German population. That research showed—through the use a modified Technology Acceptance Model (TAM)—that (1) the *perceived compatibility* of mobile payment methods with existing individual practices and (2) the *mobility* of the individual consumer have the greatest effect on the likelihood of a consumer adopting mobile payment. Based on those findings, this analysis shows that indirect measures of both of those concepts offer evidence that similarly strong positive relationships exist in the U.S. mobile payment market. However, potential biases created by the indirect nature of the measures used in this analysis lead to the conclusion that more direct measurement is needed for the U.S. market in order to control for the effects of potentially endogenous explanatory variables.

1. Introduction and Background

The rapid worldwide adoption of mobile phone technology has facilitated new uses of that technology to connect and communicate in ways previously not imagined possible. For instance, of the approximately 200 countries surveyed by International Telecommunications Union (ITU) [1] as part of the organization's Information and Telecommunications Database (ICT), the average country's mobile penetration went from 16.1 mobile cellular subscriptions per 100 inhabitants in the year 2000 to 90.97 per 100 in 2010 (ITU 2011b). This growth in mobile penetration also appears to have facilitated an increase in methods by which consumers can make point of sale (POS) purchases using mobile payment methods—or more accurately—using their mobile phone as the financial transaction instrument when paying for goods or services (Dahlberg et al. 2008). However, growth in adoption of this new POS payment method has been much slower than optimistic industry projections might have otherwise predicted. For instance, in 2008, of all mobile phone users, only 1% had adopted mobile payment services while projections in 2005 had placed 2008 adoption closer to 8% (Schierz, Schilke, and Wirtz 2010). While the adoption rate of mobile payment services were estimated to be 3% in 2009 among cell phone users in the United States, a number of other developed and nations have seen far better adoption rates (Crowe, Rysman, and Stavins 2010)

Complicating this uncertainty regarding mobile payment adoption are characteristics of individual markets that may have positive or negative effects on consumers' willingness to adopt mobile payment methods. The United States in particular has been slower to adopt mobile payment methods than many other countries (Crowe, Rysman, and Stavins 2010). While there are a number of reasons cited in the literature, market characteristics appear to be at play when considering differences between adoption in *developed* versus *emerging* markets, as well as when considering adoption among different *developed* nations. For instance, when considering differences in market characteristics affecting mobile payment adoption in emerging versus developed markets, accessibility to safe and inexpensive payment services appears to be a commonly cited driver (Greeley and Ombok 2011; Jack and Suri 2011; Jimenez and Vanguri 2010; Pope et al. 2011).[2] However, in the case of adoption among different developed markets, drivers for adoption are not as clearly based on this simple value proposition, primarily because of the availability of other safe and

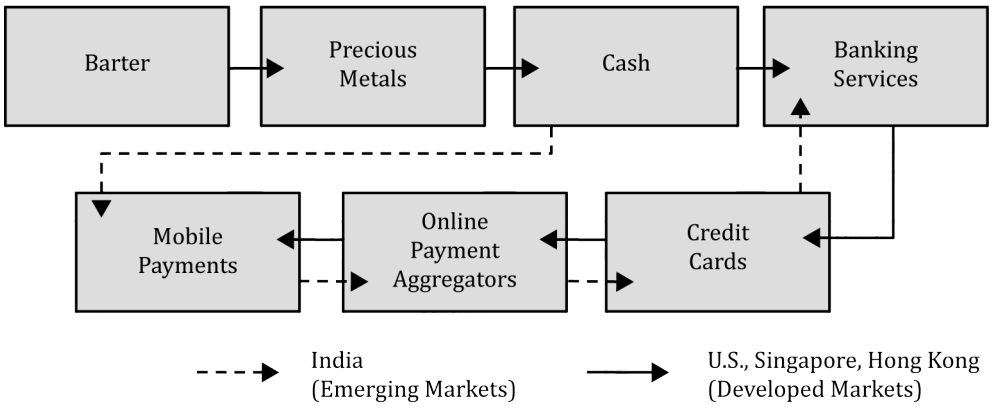
[1] The ITU is a specialized agency of the United Nations (UN) and part of the UN's global statistical system (United Nations 2012; ITU 2011a).

[2] The emerging market example for mobile payment adoption is characterized most notably in the success story of the mobile payment platform MPESA that the company Safaricom pioneered in Kenya in 2007. As of 2011, MPESA was the world's largest mobile payments ecosystem (Jimenez and Prasanna 2011), having previously grown from its creation in 2007 to just over 8 million users by the end of 2009 (Jack and Suri 2011). In the case of MPESA and Kenya—lacking secure or convenient methods for storing, accessing, and transferring money for transactions at both POS as well as across large distances—particular market characteristics coupled with increasing adoption of mobile phone technology made mobile payment an appealing alternative to what was largely a cash economy (Jack and Suri 2011). In that situation, the value proposition of mobile payment adoption was great when compared to limited and largely unappealing alternatives.

convenient payment methods (Crowe, Rysman, and Stavins 2010; Jimenez and Prasanna 2011; Pope et al. 2011).[3]

Building on these different drivers for mobile payment adoption, and through qualitative case-based investigation into four national mobile payment markets, Pope et al. (2011) posit that different sequential forces might be at play in *emerging* versus *developed* markets regarding the path towards mobile payment from previously established payment methods (see *Figure 1*). From an analysis of the three developed markets in their study—the United States, Singapore, and Hong Kong—it is suggested that developed markets, with common access to electronic banking systems, also exhibited a common evolution towards mobile payment as an accepted payment method. However, as suggested by their investigation of the emerging market India, it is possible that the lack of access to electronic banking systems common among much of the population of emerging markets is leading toward a different evolutionary path, in which consumers move from widespread use of cash directly to mobile payments. Then, mobile payment would offer a means by which consumers in these emerging markets might work backwards in payment service acceptance, sequentially opposite of developed market consumers, towards accessible banking services (Pope et al. 2011).

Figure 1: Modified path to mobile payments adoption, emerging versus developed markets, originally adapted from Stone and Kharif 2011 (Pope et al. 2011)



[3] In terms of the individual market differences among developed nations, this too has been shown to have an effect on the rate of adoption of mobile payment among consumers. Most notable is the effect that the existence of large, closed transportation systems have had as a gateway for wider acceptance of mobile payment. For instance, in the cases of Hong Kong, Japan, and the UK, "pay-and-waive" *contactless payment* cards used for public transit were slowly accepted by an increasing number of non-transit merchants and institutions.[3] This appeared to help drive wider consumer acceptance of contactless payment and created an environment in which contactless payment and mobile technology converged towards mobile payment adoption (Crowe, Rysman, and Stavins 2010; Pope et al. 2011; KPMG 2007). In the U.S., this particular strategy for driving wide-scale consumer adoption of mobile payments appears to be missing as a result of the much smaller role played by public transit when compared to many European and developed Asian markets.

These characteristics of mobile payment adoption however, while they offer insight into the differences among markets that affect aggregate adoption of mobile payment, they fail to address perceptions of individual consumers and the effects that those perceptions have on actual acceptance of mobile payment. Therefore, now having established major market differences that might be at play in preventing wide-scale immediate adoption of mobile payment in the U.S. (Crowe, Rysman, and Stavins 2010), the question remains, what common characteristics of current U.S. adopters of mobile payment technology match established characteristics of other populations' mobile payment adopters?

To make greater sense of the factors that influence consumer adoption of mobile payment methods, I will look towards the research of others who have drawn upon conceptual frameworks for computer technology acceptance and have sought to modify those models to identify drivers in consumer perception that are shown to significantly affect likely adoption and use of mobile payment technology. Most common of those models investigated are modifications based upon the core Technology Acceptance Model (TAM) (Davis 1989) and its subsequent revisions TAM2 (Venkatesh and Davis 2000) or TAM3 (Venkatesh and Bala 2008)—demonstrated by the work of Schierz, Schilke, and Wirtz (2010) as well as that of Pousttchi and Wiedemann (2007)—or the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) which was undertaken in the work of Shin (2009). Of this work, that of Schierz, Schilke, and Wirtz is most applicable to this study. Not only does it offer an empirical, statistically-tested analysis based upon data representative of another developed nation's population, that of Germany, but it also represents results based upon a more specific definition of mobile payment services. This definition is more in line with the source data used in this study's analysis and not as technologically specific as the *mobile wallet* definition implied by Shin's study.[4] Using the Schierz, Schilke, and Wirtz study as a conceptual foundation, I will test their findings in the German market to the degree possible using available data representative of mobile payment adoption and use in the U.S.

2. Conceptual Foundations

Terminology and Definitions

For this paper, I will borrow the definition of *mobile payment services* established in Crowe, Rysman, and Stavins (2010), in which *mobile payments* are defined as the use of a mobile phone to make a payment at a physical retail location (POS). This definition holds regardless of whether the phone actually accesses a mobile network during the transaction process. Further, for the purpose of this paper, similar to Crowe, Rysman, and Stavins, mobile payments do not include *mobile banking transactions*, defined by the authors to "involve accessing bank services through a mobile device", thus excluding mobile bill

[4] *Mobile wallets* as defined by Shin (2009) represent "a new application of mobile payment that has functionality to supplant a conventional wallet and more…that includes elements of mobile transaction, as well as other items one may find in a wallet." "It also stores personal and sensitive information like passports, credit card information, PIN codes, …and insurance policies that can be encrypted or password-protected." (Shin 2009, p. 1343)

payment services (Crowe, Rysman, and Stavins 2010, p. 2). This definition is relevant in that it aligns with the nature of the survey data used in the following analysis for U.S. consumer payment adoption (see *Data*) and differs slightly from the previous Schierz, Schilke, and Wirtz study wherein mobile bill payment had been *included* in the definition of mobile payment (Schierz, Schilke, and Wirtz 2010). Also, it is important to note that my definition of *mobile payment* also assumes that no physical form of exchange is made between consumer and payee. Therefore, the payment is made either by sending a particular type of text message, or by waiving or tapping the phone in proximity to some type of vendor provided payment terminal. This implies that *mobile payment* falls within a larger subset of payment methods classified as *contactless payment* instruments.

The second clarification needed for the purpose of this paper regards the term *consumer payment choice*. This loosely refers to a consumers' decision to *adopt* any particular method of paying for goods and services as well as their subsequent decisions to *use* that particular payment method. For instance, cash, check, and credit card represent examples of consumer payment methods. Prior to the *use* of any of these three methods of payment, the consumer must first decide to *adopt* the method of payment. The adoption process for some methods can be more intensive than others. In the case of check payment adoption, the consumer would first need to open a checking account in which they maintain a cash balance. In order to use a credit card, the consumer would first need to apply and be approved for issuance of a credit card; an approval process that is likely based upon their affiliation with a particular banking institution, upon their existing credit history and financial resources, or upon a combination of these and other characteristics. Following a consumer's adoption of a payment method, the other party with whom they are making an actual payment exchange would need to accept their adopted method in order for the consumer to use that method. If the receiving party accepts multiple forms of the consumer's adopted payment methods, the consumer would then need to decide among their *adopted* forms of accepted payment to make an actual payment method *use* decision.[5]

Theoretical Framework

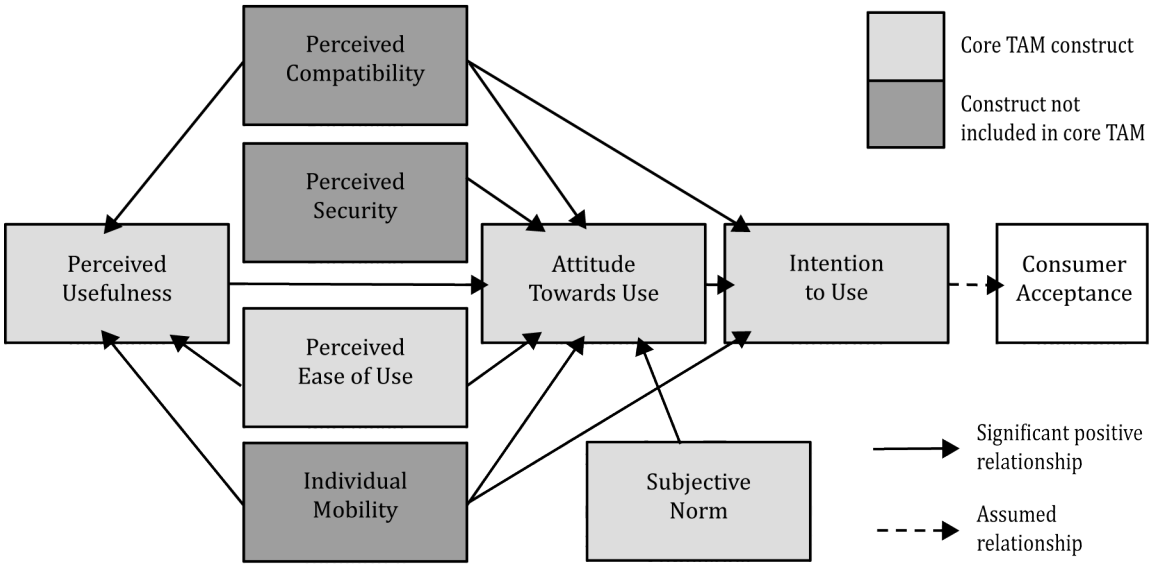
The Technology Acceptance Model (TAM), originally developed to describe computer usage behavior, was inspired by the theory of reasoned action and has been one of the most frequently used models for understanding a user's intention to adopt technologies. TAM has also been demonstrated as valid across a wide range of information technologies and assumes that *perceived usefulness* and *perceived ease of use* are major factors in an individual's intention to use a technology (Davis 1989). In subsequent development of TAM, *subjective norms* have also been shown to be an additional factor influencing intention to use (Venkatesh and Davis 2000). In addition, in Schierz, Schilke, and Wirtz's interpretation of TAM for their investigation into mobile payment adoption in Germany,

[5] For perspective on the payment situation in the United States during the year 2009, based on survey data gathered by the Consumers Payment Research Center (CPRC) at the Federal Reserve Bank of Boston, researchers have found that the average consumer held 5.0 different payment instruments (*adopted* payment methods) and *used* 3.8 of those adopted instruments during a typical month (Foster et al. 2011, p. 1). To put this in relative perspective with the typical number of transactions that a consumer might make during a month, the average U.S. consumer (statistically average) made 64.5 payments (Foster et al. 2011, p. 1).

they base conclusions on an assumption that equates *intention to use* with *consumer acceptance*, similar to previous work investigating the model (Schierz, Schilke, and Wirtz 2010; Mathieson 1991; Venkatesh and Davis 2000).

In addition to the core TAM constructs—perceived usefulness, perceived ease of use, and subjective norms—Schierz, Schilke, and Wirtz added three (1-3) additional factors to their analysis of mobile payment acceptance in Germany. Based upon previous findings regarding technology acceptance towards electronic services, the authors decided to expand their analysis to include two additional factors believed to increase the predictive power of the model, (1) *perceived compatibility* and (2) *perceived security*. In this case, *perceived compatibility* is defined as encompassing "the reconcilability of an innovation with existing values, behavioral patterns, and experiences." (Schierz, Schilke, and Wirtz 2010, p. 211) Lastly, the authors wanted to account for what they considered to be significant variability in the mobility of individuals by adding (3) *individual mobility* as a final factor, proposing that mobile services, including mobile payment, are an excellent fit for those who live a more *mobile* lifestyle.

Figure 2: Modification of core TAM constructs modeling consumer acceptance of mobile payment services in Germany (Schierz, Schilke, and Wirtz 2010)



In their ensuing analysis the authors found that *perceived compatibility* was the number one driver of consumer acceptance of mobile payment acceptance (accounting for 0.82 of the total effect on intention to use) and an *individual's mobility* (accounting for 0.09) was second most influential within the German population (Schierz, Schilke, and Wirtz 2010, p. 215). Both of these factors—perceived compatibility and individual mobility—because they are not considered in the classic TAM or it's subsequent modifications, are generally not considered by acceptance researchers (Schierz, Schilke, and Wirtz 2010) and therefore of interest for investigation of mobile payment acceptance in the United States. While the

findings of the Schierz, Schilke, and Wirtz findings do not directly measure consumer acceptance of mobile payments in the U.S., they are based upon a survey population comprising all persons in Germany. Thus, those findings do provide insight into perception-based acceptance drivers of mobile payment methods for consumers within a developed market with an accessible assortment of banking and payment services. A diagram outlining significant positive relationships identified in Schierz, Schilke, and Wirtz's findings is given in *Figure 2*.

3. Hypotheses

This study proposes an investigation of Schierz, Schilke, and Wirtz's modified TAM for mobile payment consumer acceptance, but in the context of U.S. consumers. Of particular interest are the two most influential drivers not included in the core TAM, *perceived compatibility* and *individual mobility*. Based on findings of the German market for mobile payment methods, we would expect to see similar positive relationships among consumer mobile payment acceptance and use of other services that would indicate compatible characteristics with mobile payment as well as behaviors that demonstrate a heightened level of mobility. Therefore, two hypotheses are proposed as follows:

> ***H1:*** A U.S. consumer's acceptance of other contactless payment methods will demonstrate a positive relationship with their acceptance of mobile payment methods.
>
> ***H2:*** A U.S. consumer's use of other mobile financial services will demonstrate a positive relationship with their acceptance of mobile payment methods.

For the purpose of this analysis, because mobile payment is defined as falling within the payment method subset of contactless payment methods in which no physical exchange takes place during a payment transaction, it is posited that for a consumer to have adopted other contactless methods of payment, they have familiarity with the *contactless* characteristic of mobile payment. Thus, mobile payment will be positively reconcilable (perceived as compatible) with a current payment behavior pattern they have accepted, leading to the hypothesis in *H1*. Additionally, a consumer's acceptance of other forms of mobile financial services (e.g. mobile banking or mobile bill pay) would also present previous behavior in which experiential parallels—namely the use of mobile technology to manage financial transactions—can be reconciled with mobile payment. The use of mobile financial services may also indicate a heightened level of mobility for an individual consumer. Therefore, it is conceivable that a consumer's acceptance of other mobile financial services might positively relate to consumer acceptance of mobile payment, partly as an effect of their individual mobility and their perceived compatibility of mobile payment with other familiar behaviors (*H2*). However, it is important to note, that while these hypotheses do not measure the key concepts *perceived compatibility* and *individual mobility* directly, they attempt to "make do" with the most closely related measures available through a comprehensive survey of U.S. consumer payment behavior.

4. Methods

Data

The data used for this analysis comes from the 2009 Survey of Consumer Payment Choice (SCPC) produced by the Federal Reserve Bank of Boston's Consumer Payments Research Center (CPRC). The *population* of the 2009 SCPC study comprises all persons in the United States and was administered to approximately 2,000 respondents (n = 2,173) and measured 1,648 variables (Foster 2009). Sampling weights were constructed characteristic of the U.S. non-institutionalized population, ages 18 and older (Foster et al. 2011). The 2009 SCPC survey is described as:

> *"…the second in a series of annual studies conducted by the Federal Reserve Bank of Boston to comprehensively estimate and study the cash and noncash payment behavior of U.S. consumers. This study contains estimates of adoption rates, incidence of use, and number of payments per month by consumers for nine common payment instruments: cash, checks, money orders, travelers checks, debit cards, credit cards, prepaid cards, online banking bill payments, and bank account number payments. The study also contains a wide range of estimates of consumer activity related to banking, cash management, and payments, along with a rich set of consumer characteristics."* (Foster et al. 2011, pg. 1)

Modeling

The model for this investigation into contactless and mobile payment borrows heavily from the previous work of Schuh and Stavins, who conducted an initial analysis of the 2009 SCPC data in their working paper, "How Consumers Pay: Adoption and Use of Payments" (Schuh and Stavins 2011). However, unlike Schuh and Stavins who focused their analysis on demographics and characteristics leading towards consumer adoption and subsequent use of the nine primary payment methods measured by the study—cash, check, money order, traveler check, credit card, debit card, prepaid card, online banking bill payment (OBBP), and bank account number payment (BAN)—through the use of Heckman two-stage models (one stage for *adoption* and a second for subsequent *use*), this study's analysis will focus specifically on secondary components of the SCPC survey regarding acceptance of *mobile payment* methods. Because *mobile payment* was not a primary point of focus for the 2009 SCPC, consumer perceptions regarding this payment method are not investigated as closely as the nine primary methods listed above. Therefore, the following analysis will not offer as robust or conclusive results as Schuh and Stavins's previous analysis, but will nonetheless offer an initial set of findings regarding consumer acceptance of mobile payment in the U.S. in regards to the acceptance model and factors found significant in Germany. In addition, this study can act as a starting point for further academic investigation into the topic of U.S. consumer acceptance of mobile payment methods.

Differing from Schuh and Stavins's two-stage approach to modeling, this study will focus on the development and analysis of a logit model. For this logit model, the dependent variable *mobile payment adoption* will be measured as a binary outcome: adopted or not adopted.

However, because U.S. consumers have adopted mobile payment in such low numbers—only 2.28% (not weighted) of the 1,974 mobile phone users surveyed in the 2009 SCPC where found to have adopted mobile phone payment methods (see *Table 1*)—*rare event logit* will be the specific logit model used to test my hypotheses. By using *rare event logit*, the predictive ability of the model will be improved over a typical logit model and will more likely overcome the coefficient biases normally created by rare events, wherein $\Pr(Y = 1)$ is underestimated and $\Pr(Y = 0)$ is overestimated (King and Zeng 1999). To accomplish this analysis I will utilize the *rare event logistic regression* (RELOGIT) package developed by Tomz, King, and Zeng for use with Stata statistical software (1999). What follows now is an outline of dependent and independent variables with a brief description of their purpose for inclusion in this model and basic descriptions of the means by which original survey measurements are modified to fit this analysis.

Dependent Variable

Of primary focus is identifying factors associated with likely adoption of mobile payment. For that reason, *acceptance of mobile payment* is the binary dependent variable in this analysis. The 2009 SCPC measures whether any respondent who owns a cell phone has used mobile payment in the past 12 months. Of the 2,173 survey respondents, 89.5% (weighted) of respondents were shown to have *adopted* a cell phone, and of those respondents roughly 3% were also mobile payment adopters. This 3% adoption accounted for those that adopted specifically mobile payment using *SMS/Text* as well as what is termed *contactless mobile* (Crowe, Rysman, and Stavins 2010) by tapping or waiving their phone as described under *Terminology and Definitions*.

Independent Variables

In order to test *H1*, *contactless payment adoption* will be measured as an independent variable. The 2009 SCPC has measured, separately, consumer adoption of contactless (e.g. waive-and-pay) credit, debit, and prepaid cards; contactless electronic toll devices; and contactless payment key fobs. Because of demonstrated differences in adoption characteristics for the traditional forms (e.g. magnetic strip swipe-only) of the three types of payment cards (Schuh and Stavins 2011) and the increasing prevalence of card issuers issuing new cards with added contactless functionality in place of expired swipe-only cards (Morea 2010), there is some evidence to support not aggregating each of these three contactless categories in this analysis. In addition, because electronic toll devices and key fobs represent two additional contactless payment instruments unique in form and function, these too may exhibit adoption characteristics different from the other forms of contactless payment. However, due to lack of supporting findings indicating that each of these contactless instruments may relate differently to acceptance of mobile payment, and to investigate the primary *compatible* use similarities between these payment instruments and contactless mobile payment, acceptance of each of these contactless payment instruments will be aggregated into a single binary variable representing acceptance of a contactless payment method.

In order to test *H2*, *mobile banking adoption* will also be measured as an independent variable. While the 2009 SCPC measured mobile banking adoption according to three separate questions—do they have mobile banking set up for a current bank account, have

they ever set up mobile banking, and have they used mobile banking during the past 12 months—this variable will measure whether or not the respondent has *ever* set up mobile banking as an indicator of the respondent's individual *mobility* and the *compatibility* of mobile financial transaction with a process for which the respondent is already familiar.

Tautological Concerns

As noted in the *Hypotheses* section of this paper, the available variables for use in this analysis are related to the underlying concepts of *perceived compatibility* and *individual mobility*, but they do not measure these characteristics directly. An ideal situation would be one in which survey questions were more carefully calibrated to very specifically measure compatibility and mobility. However, due to the lack of a similarly comprehensive set of available data, *contactless payment adoption* and *mobile banking adoption* have been chosen to indirectly measure these concepts. The use of these variables raise a distinct concern regarding a potentially endogenous relationship between independent and dependent variables, wherein a general willingness to adopt one type of new technology simply reflects a general willingness to adapt another form of new technology. Therefore, proving a significant relationship would only reinforce a tautological argument stating that, *consumers who adopt new technologies are more likely to adopt new technologies*. Taking this potential pitfall of my analysis into consideration, two versions of the rare events logit model will be generated. One containing the two primary independent variables of interest and one with only the control variables listed below to better understand significant relationships otherwise concealed by a potentially endogenous relationship among variables.

Control Variables

In addition to the independent variables listed above, additional variables will be used in this model to control for effects of individual characteristics thought to be influential in payment method and mobile payment adoption. Demographic variables such as *age*, *education*, *race*, and *yearly income* have been shown to affect consumer choices or interest in the adoption of different payment instruments (Higdon and Wannemacher 2010; Schuh and Stavins 2011). For these reasons, the above listed demographic variables will be added to the model: *age*, *education*, and *income* as categorical variables and *race* as a binary variable that identifies the respondent as *white* or *non-white* (see *Table 1* for details). Most notable among these control variables, based on reports of industry reports on mobile payment adoption in the U.S. and other markets, I would expect *age* and *education* to show the strongest relationship to mobile payment adoption (Higdon and Wannemacher 2010; Jack and Suri 2011; First Data and Market Strategies International 2011). A negative relationship for age and a positive relationship for education would be in line with those findings.

Table 1: Descriptive statistics for the variables used in this analysis

Variable	Category	Weighted Percent	Not Weighted Obs.	Percent	Mean	Std. Dev.	Min	Max
Mobile Payment Adoption		100.00	1974	100.00	0.023	0.149	0	1
	No	96.74	1929	97.72	0.227			
	Yes	3.26	45	2.28				
Contactless Payment Adoption		100.00	2156	100.00	0.228	0.419	0	1
	No	76.02	1665	77.23				
	Yes	23.98	491	22.77				
Mobile Banking Adoption		100.00	1888	100.00	0.097	0.297	0	1
	No	87.79	1704	90.25				
	Yes	12.21	184	9.75				
Age		100.00	2172	100.00	4.098	1.373	1	6
	Less than 25 years	12.67	95	4.37				
	25-34 years	18.29	231	10.64				
	35-44 years	18.21	320	14.73				
	45-54 years	19.91	615	28.31				
	55-64 years	14.51	543	25.00				
	Greater than 65 years	16.41	368	16.94				
Education		100.00	2173	100.00	3.488	1.041	1	5
	Less than High School	6.11	41	1.89				
	High School	39.00	331	15.23				
	Some College	27.79	779	35.85				
	College	18.01	571	26.28				
	Post-graduate Studies	9.10	451	20.75				
Income		100.00	2167	100.00	3.192	1.620	1	7
	Less than $25,000 per year	18.35	293	13.52				
	$25,000-$49,999 per year	33.67	559	25.80				
	$50,000-$74,999 per year	23.40	544	25.10				
	$75,000-$99,999 per year	12.44	341	15.74				
	$100,000-$124,999 per year	4.81	158	7.29				
	$125,000-$199,999 per year	5.04	185	8.54				
	Greater than $200,000 per year	2.29	87	4.01				
White		100.00	2173	100.00	0.876	0.329	0	1
	No	25.88	269	12.38				
	Yes	74.12	1904	87.62				

5. Findings

As anticipate, both *contactless payment adoption* and *mobile banking adoption* have shown to demonstrate the strongest significant relationship with the dependent variable, *mobile payment adoption* (neither *H1* nor *H2* are rejected). Examining the rare event logit results outlined under *Model 1*, *Table* 2, 297 missing values were generated by the rare event model on the 1,872 observations analyzed. *Contactless payment adoption* demonstrated a positive relationship to *mobile payment* adoption, with a coefficient of 1.864 (Std. Err. 0.447) at a significance of $p < 0.001$. *Mobile banking* also demonstrated a positive

relationship, with a coefficient of 1.445 (Std. Err. 0.459) at a significance of $p < 0.01$. According to the predicted probabilities generated by an un-weighted version[6] of this model (see *Table* 3), a consumer who has adopted other forms of contactless payment has a 0.039 probability of also adopting one of the mobile payment methods measured by the 2009 SCPC (see *Figure 3*). Likewise, a consumer who has not adopted other forms of contactless payment has only a 0.007 probability of adopting one of the mobile payment methods. For mobile banking adoption, the respective predicted probabilities are 0.050 and 0.009 (see *Figure 4*). For these predicted probabilities, all other variables have been held at their mean. Under this model (*Model 1*), no other variables were found to demonstrate a significant relationship ($p < 0.10$) with *mobile payment adoption*.

Table 2: Rare event logistic regression results for both versions of the model analyzed

Independent Variable	Mobile Payment Adoption	
	Rare Event Logitistic Regression Results	
	Model 1	**Model 2**
Contactless Payment Adoption	1.864***	-
	(0.447)	-
Mobile Banking Adoption	1.445**	-
	(0.459)	-
Age	-0.167	-0.333**
	(0.134)	(0.099)
Education	-0.170	-0.133
	(0.248)	(0.249)
Income	0.076	0.081
	(0.159)	(0.150)
White	-0.108	-0.853*
	(0.463)	(0.416)
Intercept	-3.880***	-1.733*
	(0.892)	(0.807)
Observations	1872	1967
Missing Values Generated	297	7

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. *Model 1* and *Model 2* are identical with the exception that the variables *Contactless Payment Adoption* and *Mobile Banking Adoption* are excluded to better understand the effects that the variables have on associations identified among other independent variables. See the section of this paper titled *Tautological Concerns* for more details regarding the reasoning behind this comparison.

[6] Because of computational limitations inherent in the rare events logit model used, the predicted probabilities have been generated based on a version of *Model 1* in which survey weights were not applied. However, because coefficients for the significant variables in the survey-weighted model summarized in *Table* 2 change very little with the weights removed, it is reasonable to proceed with the subsequent predicted probabilities cited in this paper.

Model 2 Results

Based on the *tautological concerns* noted in the earlier section of this paper, a second version of this analysis was conducted, which also utilized rare event logistic regression (see *Model 2*, *Table 2*). In this second model, both *contactless payment adoption* and *mobile payment adoption* were omitted as independent variables, resulting in a model for which 7 missing values were generated with 1,967 observations. Therefore, *Model 2* may help to uncover any significant relationships otherwise concealed by the potential endogeneity of those omitted variables. As a result of omitting these two independent variables, negative significant relationships are demonstrated for the *age* of respondents as well as their identification as *white*. Respectively, these significant variables demonstrate coefficients of -0.333 (Std. Err. 0.099) and -0.853 (Std. Err. 0.416); the first significant at $p < 0.01$, the second at $p < 0.05$. Supporting this relationship, predicted probabilities[7] show decreasing probability for *mobile payment adoption* as *age* increases or a consumer identifies as *white*. The largest drop in predicted probability related to *age* occurs between the age groups of *less than 25 years* (Pr = 0.060) and *25-34 years* (Pr = 0.041). Predicted probabilities continue to decrease to 0.027 at *35-44 years*, 0.018 at *45-55 years*, 0.012 at *55-65 years*, and they reach a minimum of 0.008 for those over *65 years* of age (see *Figure 5*). As for a respondent's identification as *white*, the predicted probability drops from 0.042 to 0.016 (see *Figure 6*).

Table 3: Predicted probabilities and 95% confidence intervals for each significant variable in *Model 1* and *Model 2* illustrated in *Table 2*

Model	Independent Variable	Level	Predicted Probability Mobile Payment Adoption	95% Confidence Interval	
				Lower Bound	Upper Bound
Model 1					
	Contactless Payment Adoption	No	0.007	0.004	0.013
		Yes	0.039	0.024	0.061
	Mobile Banking Adoption	No	0.009	0.006	0.015
		Yes	0.050	0.026	0.096
Model 2					
	Age	Less than 25 years	0.060	0.036	0.098
		25-34 years	0.041	0.028	0.061
		35-44 years	0.028	0.020	0.039
		45-54 years	0.019	0.013	0.026
		55-64 years	0.013	0.008	0.019
		Greater than 65 years	0.008	0.005	0.015
	White	No	0.040	0.021	0.072
		Yes	0.016	0.011	0.024

[7] Similar to *Model 1*, predicted probabilities for *Model 2* were also calculated using a version of the rare events logistic model in which survey weights were not applied. Once again, there was little difference among relevant coefficients in each version of the model, prior to calculation of the resulting predicted probabilities.

6. Concluding Remarks

This study is meant to act as a starting point to better understand and investigate drivers of consumer acceptance of mobile payment in the United States, a country otherwise lagging in the rate of mobile payment adoption well below the many optimistic projections for growth (Crowe, Rysman, and Stavins 2010). This is particularly relevant in relation to the initial empirically based acceptance models used to better understand drivers of consumer acceptance in other similarly situated developed-economies, such as Germany or other European and Asian nations. For instance, in the otherwise fragmented mobile payment market of the U.S., drivers such as *perceived compatibility* and *individual mobility* can help inform and direct the strategic decisions of mobile payment firms as they make important infrastructure decisions in their efforts to create a more robust and compelling mobile payment ecosystem that bridges mobile payment with current consumer practices and behaviors (Contini et al. 2011; Sawers 2012).

The major downside to this study, however, has been a lack of available data meant to specifically investigate the concepts of *perceived compatibility* and *individual mobility*. As a result, indirect measures from the 2009 Survey of Consumer Payment Choice (SCPC), administered by the Federal Reserve Bank of Boston were used. Those measures—*adoption of other contactless payment methods* and *mobile banking adoption*—create an analysis at risk for measuring endogenous variables and resulting in findings that offer neither academic insight into consumer mobile payment adoption in the U.S. nor useful strategic insights for firms competing in the U.S. mobile payments market. Therefore, while both *contactless payment adoption* and *mobile banking adoption* were shown to have the most significant effect on *mobile payment adoption* among U.S. consumers, it would be advisable to consider the other significant variables such as *age* and *race* that might otherwise be concealed by potentially ill-suited explanatory variables. In order to create more reliable and relevant results, it would be beneficial for the SCPC to measure *mobile payment instruments* with the same dimensionality and concern as other primary payment instruments measured by the survey, or to develop representative surveys that measure, more directly, very specific drivers thought to influence mobile payment adoption in other markets.

Figure 3: Predicted probability of mobile payment Adoption based upon use of other contactless payment methods

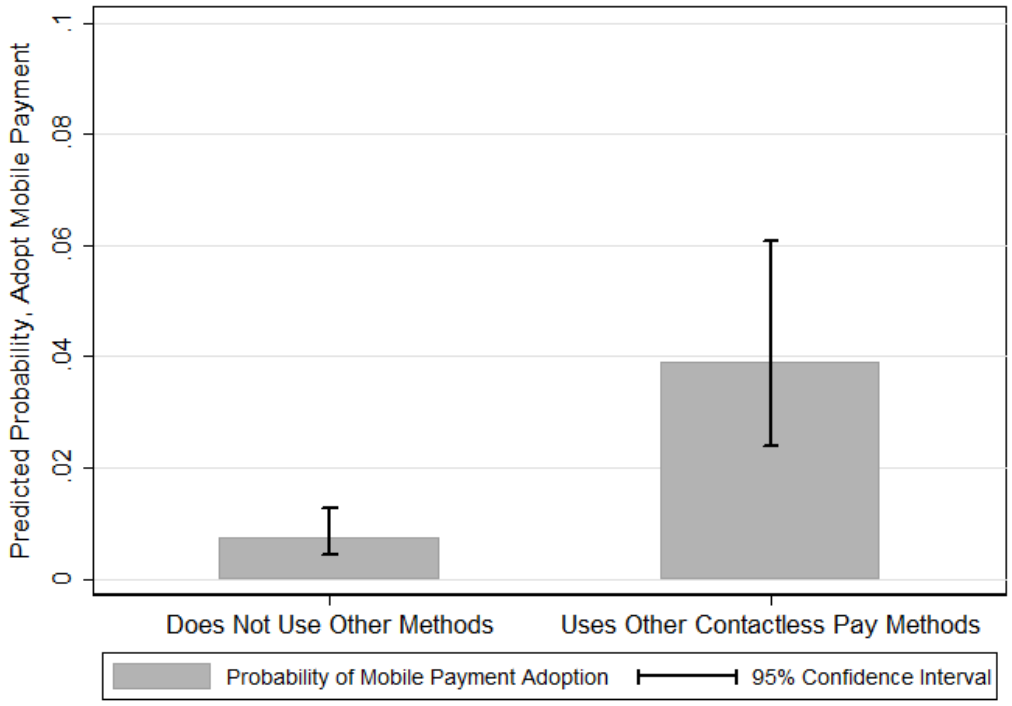


Figure 4: Predicted probability of mobile payment adoption based upon use of mobile banking

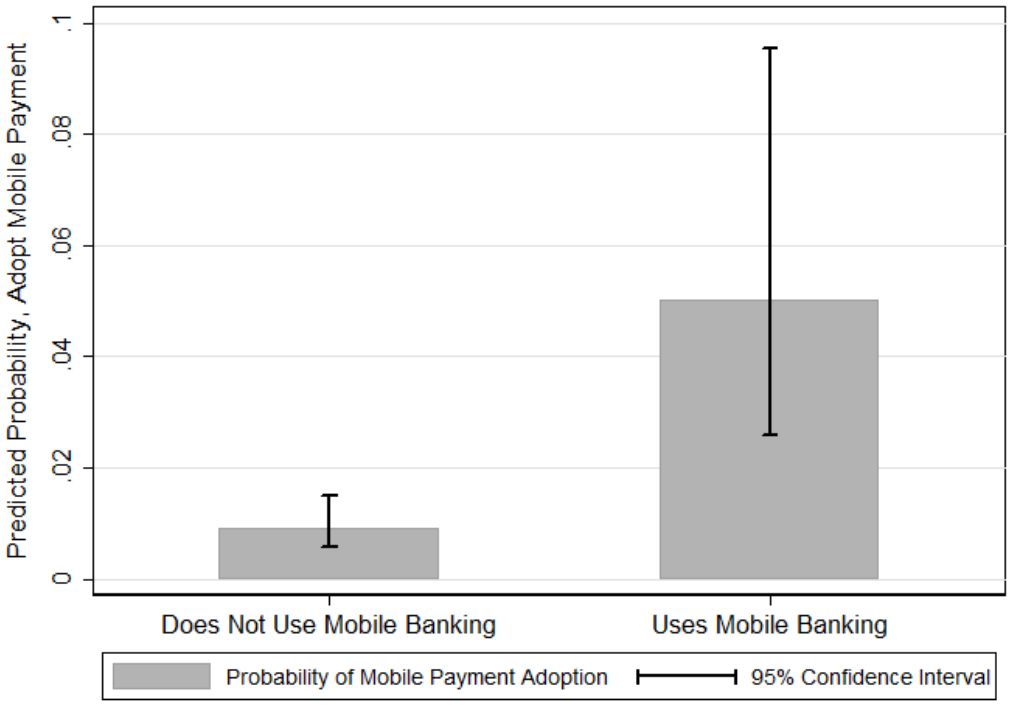


Figure 5: Predicted probability of mobile payment adoption based upon age

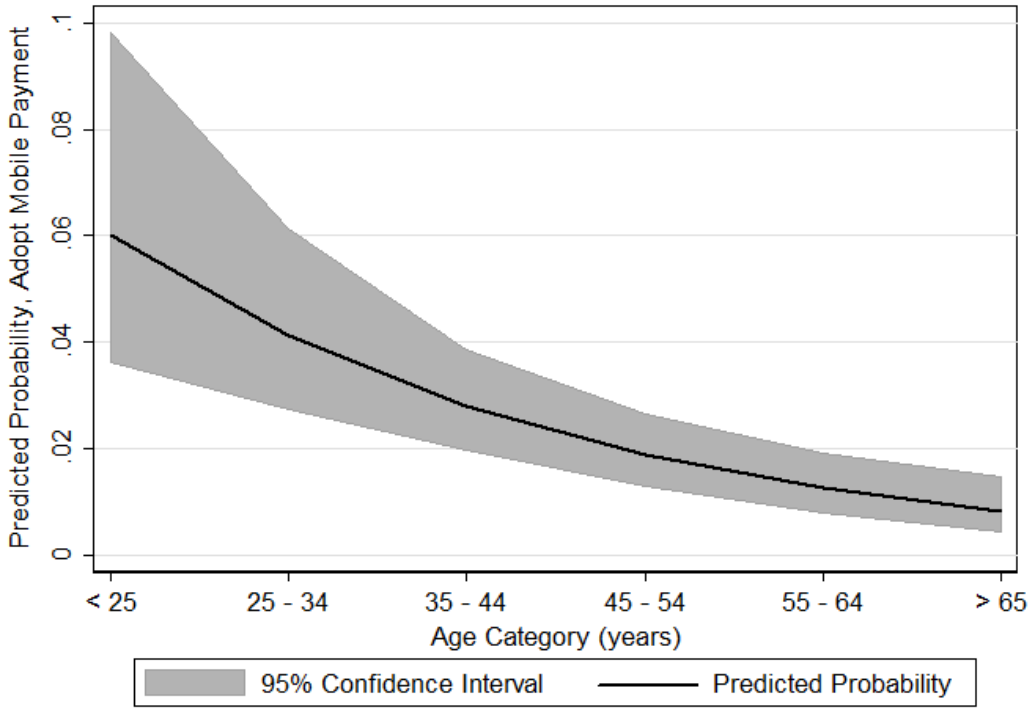
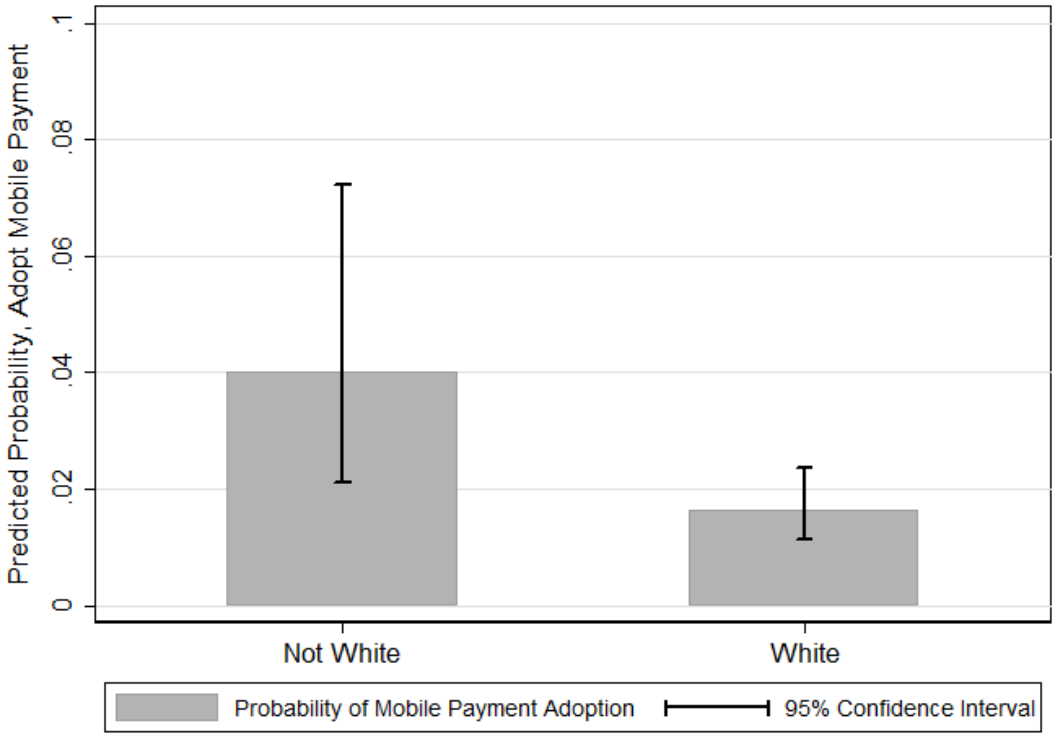


Figure 6: Predicted probability of mobile payment adoption based upon identification as white or non-white



References

Contini, Darin, Marianne Crowe, Cynthia Merrit, Richard Oliver, and Steve Mott. 2011. "Mobile Payments in the United States: Mapping Out the Road Ahead". Federal Reserve Bank of Boston. http://www.bos.frb.org/bankinfo/firo/publications/bankingpaypers/2011/mobile-payments-mapping.pdf.

Crowe, M., M. Rysman, and J. Stavins. 2010. "Mobile Payments in the United States at Retail Point of Sale: Current Market and Future Prospects." *Public Policy Discussion Paper* (10-2). http://www.bos.frb.org/economic/ppdp/2010/ppdp1002.pdf.

Dahlberg, Tomi, Niina Mallat, Jan Ondrus, and Agnieszka Zmijewska. 2008. "Past, Present and Future of Mobile Payments Research: A Literature Review." *Electronic Commerce Research and Applications* 7 (2): 165–181. doi:10.1016/j.elerap.2007.02.001.

Davis, Fred D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." *MIS Quarterly* 13 (3): 319–340.

First Data, and Market Strategies International. 2011. *Meeting the Needs of the New Financial Consumer: A Snapshot of Six Customer Segments*. White Paper. New Consumer and Financial Behavior. First Data Corporation. http://www.firstdata.com/downloads/thought-leadership/fi-segmentation-wp.pdf.

Foster, Kevin. 2009. "The 2009 Survey of Consumer Payment Choice: Data Users Manual". Federal Reserve Bank of Boston. http://www.bos.frb.org/economic/cprc/SCPC/2009%20Data/2009_SCPC_Data_User_Manual.pdf.

Foster, Kevin, Erik Meijer, Scott Schuh, and Michael Zabek. 2011. *The 2009 Survey of Consumer Payment Choice*. Public Policy Discussion Papers. Federal Reserve Bank of Boston. http://www.bostonfed.org/economic/ppdp/2011/ppdp1101.pdf.

Greeley, Brendan, and Eric Ombok. 2011. "In Kenya, Keeping Cash Safe on a Cell Phone." *Bloomberg Businessweek* (4245): 55–56.

Higdon, Emmett, and Peter Wannemacher. 2010. *US Consumers Continue To Show Limited Interest In Mobile Payments: Consumer Interest Is Rising Slightly, But Mainstream Adoption Is Still Far Of*. For Consumer Product Strategy Professionals. Cambridge, Mass.: Forrester Research, Inc.

Holland, Nick. 2011. "The Mobile Payment Tightrope Walk: Enabling Security Without Squandering Consumer Trust". Yankee Group Research, Inc. http://www.rsa.com/products/consumer/ar/11527_The_Mobile_Payment_Tightrope_Walk.pdf.

ITU. 2011a. "ITU Data Collection." *International Telecommunications Union*. http://www.itu.int/ITU-D/ict/datacollection/.

———. 2011b. "World Telecommunication/ICT Indicators Database: 2000-2010". International Telecommunications Union. http://www.itu.int/ITU-D/ict/publications/world/world.html.

Jack, William, and Tavneet Suri. 2011. "Mobile Money: The Economics of M-PESA." *National Bureau of Economic Research Working Paper Series* No. 16721. http://www.nber.org/papers/w16721.

Jimenez, Alberto, and Vanguri Prasanna. 2011. *Mobile Payments Adoption in Developed Markets*. White Paper. IBM Global Business Services. IBM Corporation. http://www-935.ibm.com/services/us/gbs/pdf/GBW03136-USEN-00.pdf.

Jimenez, Alberto, and Prasanna Vanguri. 2010. *Cash Replacement Through Mobile Money in Emerging Markets: The FISA Approach*. White Paper. IBM Global Business Services. United States of America: IBM Corporation. http://www-935.ibm.com/services/us/gbs/pdf/GBW03122-USEN-02.pdf.

King, Gary, and Langche Zeng. 1999. "Logistic Regression in Rare Events Data". Department of Government, Harvard University. http://GKing.Harvard.Edu.

KPMG. 2007. *Mobile Payments in Asia Pacific*. Information, Communications & Entertainment. Hong Kong: KPMG. http://www.kpmg.com/CN/en/IssuesAndInsights/ArticlesPublications/Documents/moblie_payments_aspac_0709.pdf.

———. 2011. "2011 KPMG Mobile Payments Outlook - a Golden Opportunity for Cross-industry Partnerships". KPMG International. http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/mobile-payments/Documents/2011-mobile-payments-outlookv2.pdf.

Morea, Dom. 2010. *Contactless Payments: The "Tipping Point" Is at Hand*. A First Data White Paper. First Data Corporation. http://www.firstdata.com/downloads/thought-leadership/fd-contactless-payment-wp.pdf.

Pope, Meiling, Ryan Pantages, Nadeshda Enachescu, Ryan Dinshaw, Corey Joshlin, Robert Stone, P. Albert Austria, and Kala Seal. 2011. "Mobile Payments: The Reality on the Ground in Selected Asian Countries and the United States." *International Journal of Mobile Marketing* 6 (2) (December): 88–104.

Pousttchi, Key, and D.G. Wiedemann. 2007. "What Influences Consumers' Intention to Use Mobile Payments?" In *New Matrices for Understanding User Behavior: Testbeds, Observational Studies, Surveys and More: What Is the State of the Art?*, 16. Los Angeles, CA: University of Southern California Marshall. http://classic.marshall.usc.edu/assets/025/7534.pdf.

Sawers, Paul. 2012. "The Future of Online Banking." *The Next Web*, March 1. http://thenextweb.com/insider/2012/03/01/the-future-of-online-banking/.

Schierz, Paul Gerhardt, Oliver Schilke, and Bernd W. Wirtz. 2010. "Understanding Consumer Acceptance of Mobile Payment Services: An Empirical Analysis." *Electronic Commerce Research and Applications* 9 (3) (May): 209–216. doi:10.1016/j.elerap.2009.07.005.

Schuh, S., and J. Stavins. 2011. *How Consumers Pay: Adoption and Use of Payments*. Working Paper. Working Papers. Federal Reserve Bank of Boston. http://www.bos.frb.org/economic/wp/wp2012/wp1202.pdf.

Shin, Dong-Hee. 2009. "Towards an Understanding of the Consumer Acceptance of Mobile Wallet." *Computers in Human Behavior* 25 (6) (November): 1343–1354. doi:10.1016/j.chb.2009.06.001.

Stone, Brad, and Olga Kharif. 2011. "Pay as You Go with Smartphones." *BusinessWeek: Magazine*, July 14. http://www.businessweek.com/magazine/pay-as-you-go-with-smartphones-07142011.html.

Tomz, Michael, Gary King, and Langche Zeng. 1999. *RELOGIT: Rare Events Logistic Regression*. Cambridge, Mass.: Harvard University. http://gking.harvard.edu/.

United Nations. 2012. “Structure and Organization.” http://www.un.org/en/aboutun/structure/.

Venkatesh, Viswanath, and Hillol Bala. 2008. “Technology Acceptance Model 3 and a Research Agenda on Interventions.” *Decision Sciences* 39 (2) (May): 273–315. doi:10.1111/j.1540-5915.2008.00192.x.

Venkatesh, Viswanath, and Fred D. Davis. 2000. “A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies.” *Management Science* 46 (2) (February): 186.

Venkatesh, Viswanath, Michael G. Morris, Gordon B. Davis, and Fred D. Davis. 2003. “User Acceptance of Information Technology: Toward A Unified View.” *MIS Quarterly* 27 (3): 425–478.