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Adoption of Mobile Peer-to-Peer Payment: Enabling Role of Substitution and Social Aspects

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ABSTRACT

Despite the growing amount of mobile peer-to-peer (P2P) payment applications available on mobile app stores, these applications are still in their infancy and have yet to see mass adoption. This study aims to explore the factors that influence the adoption of such mobile P2P payment applications by using a large-scale data set based on the tracking of users' actual mobile application usage behavior. Our main findings reveal that the duration of each session that users use of traditional bank application has a significant relationship with their adoption of mobile P2P payment applications. In addition, we explore the social aspect of such mobile P2P payment applications by analyzing their social network applications usage and found that the amount of social network service applications used and usage duration positively impacted one's adoption of mobile P2P payment applications. These findings have important theoretical and practical implications for stakeholders of mobile P2P payment solution providers as well as intermediaries/banks who provide their own payment applications to their customers.

Keywords: Banking Application, Mobile Peer-to-Peer Payments, Money Transfer, Social Effect, Substitution Effect

Ⅰ. Introduction

Mobile payment provides a platform for users to conduct payment services via the use of applications (apps) installed on mobile devices such as smartphones (Au and Kauffman, 2006). Mobile payment has been increasingly adopted as an essential payment channel for online e-commerce transactions and there is a growing demand for mobile e-commerce services. In 2016, mobile e-commerce generated just slightly under US$1 trillion, making up about 52% of total e-commerce transactions. This figure is expected to reach up to US$2.91 trillion and over 70% of total e-commerce transactions by 2020 (eMarketer, 2018). With these estimates, we expect that there is still room for significant growth for mobile payment

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market. New advances in technologies such as QR code, beacon, near-field communication (NFC), and contactless payment systems are opening up new opportunities for mobile payment growth. These technologies enable mobile devices to serve as payment solutions replacing traditional credit cards and cash. The technologies, together with the increased accessibility to mobile devices, especially in emerging markets, open up new types of mobile payment solutions and will lead to wider adoption of mobile payment.

In recent years, a new category of mobile payment solutions has been gaining attention and popularity. Mobile peer-to-peer (P2P) payment is a category of mobile payment solutions which enables users to complete money transfer services via the use of an application installed on the mobile device of the user (Nath, 2017). These payment apps allow users to complete money transfer services to peers, such as friends and family members. Mobile P2P payment apps are poised to reach a transaction volume of US$336 billion in the United States by 2021, with tech giants such as Apple, Google, and Facebook entering this space by offering their own mobile payment apps (Business Insider, 2017; Heggestuen, 2014). Currently, market leaders in mobile P2P payment solutions are Venmo and Square Cash. Venmo, for example, attempts to simplify money transfer services between individuals by allowing users to link a credit card or bank account, creating a digital wallet so that users can send money to others by specifying their personal phone numbers or email addresses. Venmo then monetizes this service by taking a small percentage of the amount (i.e., 3%) sent as part of a transaction fee (Venmo, 2018). Previously, before the advent of such mobile P2P payment solutions, money transfer services were offered as a part of the services provided on traditional mobile banking apps. A difference between the two is that users have to download the banking app of their bank, and in order to transfer money to another individual, the users have to know the specific bank account number of the intended recipient.

Conceptually, mobile P2P payment falls under a specific category of mobile payment solutions. Mobile payment typically refers to person-to-merchant payment in a two-sided platform environment and the stakeholders consist of the intermediary, and both merchant users and cardholder users. As such, there exist intricacies of network externalities and a greater impact of cross-side network effects (i.e., the balance of both sides of the platform) on the adoption and usage (Kazan and Damsgaard, 2013). Mobile P2P payment, on the other hand, consists of the intermediary, users, and participating financial institutions. In the case of mobile P2P payment, the transactions occur mainly between users and do not involve merchants. Therefore, as more users adopt a particular mobile P2P payment service, we should observe greater adoption and overall usage for that particular P2P payment app. Mobile P2P payment, itself, has also gone through significant changes since its inception in 2002. Tracing back to the evolution of P2P payments, the banks in the United States started the P2P money transfer initiatives with services such as CashEdge, which was launched by Citi Bank and Bank of America, however, there was a lack of interest from banks to further develop solutions for these types of money transfer services. Eventually, they gave way to the more popular fintech-led P2P services such as Venmo and Square Cash. Mobile P2P payment took off with Venmo entering the market in 2012. Since then, there is a resurgence of interest from banks to develop mobile P2P payment services as can be seen from new payment solutions such as Zelle, which is a mobile P2P payment app and

was developed by a consortium of banks in the United States, which currently accepts customers from more than 30 banks, as well as clearXchange (Black et al., 2016; Koren, 2017; Perez, 2017).

Despite the growing amount of mobile P2P payment apps available and more players entering the market, there is still a lack of widespread adoption of mobile P2P payment in mobile-advanced countries such as the United States, China, and South Korea which calls for a need to further understand the adoption factors underlying these apps. In the P2P payment market in the United States, the total volume of P2P payment was US$721 billion in 2018. However, the volume of mobile P2P payments transacted was merely a fraction of that number at US$97 billion (Business Insider, 2017). Although the mobile P2P payment transactions are gradually increasing and those who use mobile P2P payment services are frequent users (Mercator, 2018), according to a survey of Total System Service, 71 percent of consumers in the United States have not tried mobile P2P payments yet (Fitzgerald, 2018). On the other hand, in under-developed countries such as Kenya and other African countries, mobile P2P payment has seen wide success and has high penetration rates (Jain, 2014; Kshetri and Acharya, 2012). For these mobile P2P payment services, they are largely successful due to its necessity considering that these countries have limited financial service access and a high unbanked rate (Black et al., 2016).

In the extant information systems literature, research on mobile payment adoption focuses mainly on the instrumentalization of factors (e.g., perceived ease of use and perceived usefulness) which drive users to adopt and use mobile P2P payment services (Dahlberg et al., 2008). However, in this research stream, few have considered the social aspect, such as social influences and individual sociability, which can be important explanatory variables to the adoption of information technology (Agarwal and Karahanna, 2000; Venkatesh and Morris, 2000). Identifying the adoption factors of mobile P2P payment apps from a social perspective is therefore crucial as mobile money transfers are increasingly seen as social transactions (Acker and Murthy, 2018). As such, we explore the social aspect of mobile P2P payment apps by exploring the relationship between Social Network Services (SNS) apps usage and the adoption of mobile P2P payment apps.

Secondly, banks are adopting an omni-channel approach in their service offerings to their customers. In a consumer study published in the U.K., the use of mobile apps for banking activities is the fastest growing channel and using an app for money transfer is the fastest growing banking activity (TSYS, 2016). This growth is also reflected in a report published by Zelle, where the use of mobile apps is the main means to conduct financial transactions for millennials (Zelle, 2018). In the mobile app space, both traditional mobile banking and mobile P2P payment apps share the same function of money transfer and can be considered as substitutes. With this in mind, we investigate the relationship between the actual traditional banking app usage behavior and mobile P2P payment apps adoption. Furthermore, we also explore the effects of the traditional banking apps used to see if there is a relationship between the banking app used and the users' adoption of mobile P2P payment apps.

The results of our study show that users that use the banking apps for brief sessions at a time are more likely to adopt mobile P2P payment apps. Furthermore, there is a positive relationship between the number of SNS apps used and the duration each time they use these apps with the adoption of mobile P2P payment apps. Also, users who are active on

multiple SNS services are more likely to adopt mobile P2P payment apps as compared to users who are active on only one or a few SNS services. Lastly, our results show that there are inherent differences within the banks which have a relationship with one's adoption of mobile P2P payment apps. Users that are from major banks are less likely to adopt mobile P2P payment apps while users that are from non-major banks are more likely to adopt mobile P2P payment apps. Taken together, we find that mobile P2P payment apps are substitutes for traditional banking apps for users that mainly use these banking apps for shorter sessions. We also find that heavy users of SNS apps are more likely to adopt mobile P2P payment apps, reflecting that mobile P2P payment apps do not just simply share the same money transfer capabilities as traditional banking apps but a social aspect is inherent within these types of apps.

Ⅱ. Literature Review

Prior works on mobile payment have mainly focused on the following three streams of research: (1) the technologies behind mobile payments, (2) mobile payment strategy and ecosystems, and (3) consumer adoption of mobile payments (Dahlberg et al., 2015).

Studies on the technologies behind mobile payments focus on the key technologies such as NFC and contactless payment systems and how they can support mobile payments. For example, Ondrus and Pigneur (2009) assess the impact of NFC on future mobile payment services and find that NFC will further aid the development of mobile payment services. In addition, research in this stream also focuses on the technologies behind security and privacy issues such as the protocols and encryption across the different types of mobile payment services (Konidala et al., 2011; Ou and Ou, 2007).

The second stream of research focuses on the strategy and ecosystems of mobile payment. Studies in this stream mainly focuses on understanding the underlying strategies and qualities of mobile payment solutions on the market. Ondrus and Pigneur (2005) use a framework called a technology environment assessment framework to understand and assess the present and future conditions associated with mobile payments. Other studies in this stream also focus on understanding the entire ecosystem of mobile payments based on factors such as key market actors and economic factors and attempt to develop a framework to analyze mobile payments (Au and Kauffman, 2006; Dahlberg et al., 2008; Ondrus and Pigneur, 2009)

The last stream of research focuses on the consumer's mobile payment adoption, and aims to understand the underlying reasons to explain the adoption behavior based on factors such as the preferences of consumers. Many studies have attempted to adopt information system (IS) theories such as the technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT) to explain why consumers adopt mobile payment services (Bigne et al., 2007; Chen, 2006; Slade et al., 2015). However, there are a number of studies that only consider these well-grounded IS theories while only few scholars have explored other factors such as security and cost, and their findings show that these factors do have an influence on mobile payment adoption (Dahlberg et al., 2003). In this line, we aim to complement the studies that have considered these well-grounded IS theories by exploring other factors that may affect the adoption of mobile P2P payment. Additionally, very few of these consumer adoption studies differentiate the systematic differ-

ences between the different types of mobile payment systems and define mobile payment services loosely without considering the payment scenarios. The result of this is that much the extent literature focused on person-to-merchant type mobile payment services rather than P2P mobile payment services. Further, there are some research that document the successful use case of these payment services in under-developed countries in Africa. These studies report the widespread adoption of mobile P2P payment services in emerging markets such as Kenya and other African countries (Jain, 2014; Kshetri and Acharya, 2012). M-PESA, a mobile P2P payment service launched by a Kenyan telecom company, allows users to send and receive money via text message and the adoption rate of M-PESA was reported to be as high as up

<Table 1> Summary of Mobile Payment Research

Category	Research	Technology	Methods	Key Findings
Mobile Payment Technologies	Ondrus and Pigneur (2009)	NFC	MCDM Model	NFC performs much better than other mobile technologies for mobile payments
	Ou and Ou (2007)	Payment Protocol	Protocol Systems Design	Designed and proposed a non-repudiation protocol for mobile payment transactions
	Konidala et al. (2011)	NFC	Payment Model Design	Designed and proposed a payment model to protect the privacy of customers
Mobile Payment Strategy and Ecosystems	Ondrus and Pigneur, (2005)	Mobile Payment	Case Study	Identified and provided an analysis of two possible disruptions within the mobile payment industry
	Au and Kauffman (2006)	Mobile Payment	Case Study	Mobile payment industry will face many challenges before mass adoption
	Dahlberg et al. (2008)	Mobile Payment	Literature Survey	Social and cultural impact of mobile payments are under studied
Mobile Payment Adoption	Bigne et al. (2007)	Mobile Commerce	Survey	Age, attitude, previous experience and relations with the mobile phone have a relationship with adoption decision
	Chen (2006)	Mobile Commerce	Survey	Aims to identify the factors for mobile payment adoption using TAM and innovation diffusion theory
	Slade et al. (2015)	P2P Mobile Payment	Survey	Adopted and extended UTAUT with constructs such as risk and trust to understand mobile payment adoption
	Jain (2014)	P2P Mobile Payment	Case Study	Provided a trend analysis of the mobile payment trend in emerging markets
	Kshetri and Acharya (2012)	P2P Mobile Payment	Case Study	Highlights the factors that are driving mobile payment growth in emerging markets
	Mbiti and Weil (2011)	P2P Mobile Payment	Case Study & Survey	Mobile P2P payment in emerging markets decreases prices of competing services and promotes banking and money transfers
	Morawczynski (2009)	Peer-to-Peer Mobile Payment	Case Study	Mobile P2P payment in such emerging markets can drive the growth of wealth for users and help to maintain social networks with others
	Morawczynski and Pickens (2009)	Peer-to-Peer Mobile Payment	Case Study	Users make small but frequent transfers

to 92 percent of Kenyans which signals the huge success of the mobile P2P payment in these emerging markets (Heggestuen, 2014). Furthermore, these studies also explore the economic and social impact of such mobile P2P payment and find that that mobile P2P payment adoption leads to the increase of money transfer activities (Mbiti and Weil, 2011; Morawczynski and Pickens, 2009; Morawczynski, 2009). <Table 1> summarizes the previous studies on mobile payment along with the key findings of the studies discussed in this section.

Complementing these studies, our study attempts to identify some of the key factors that influence the adoption of mobile P2P payment by investigating the relationship between mobile P2P payment usage, traditional banking app usage, and SNS app usage. In addition, we also explore the effects of the banks to see if there is a relationship between the banking apps that users use and their adoption of mobile P2P payment apps. Our study contributes to the literature in the following two ways. First, in contrast to most prior studies that rely on survey data, we use data derived from actual app usage behavior of each user. Second, we explore the social aspects of the mobile P2P payment services by investigating the relationship between mobile P2P payment app usage and SNS app usage. Mobile P2P payment apps are generally used to transfer money between "friends" rather than "strangers" (Mobeewave, 2016; Molinda, 2017). Hence, mobile P2P payment does have social aspects although the effect of these SNS usage on the adoption of mobile P2P payment apps has not been examined in-depth in prior studies. We also observe that most of the research on mobile payments lack to differentiate the systematic differences between the different types of mobile payment systems and define mobile payment services loosely. The result of this is that much the extent literature focused on person-to-merchant type mobile payment services rather than P2P mobile payment services.

Ⅲ. Research Model Development

We explore the relationship between mobile P2P payment and traditional mobile banking usage to identify some of the key factors that affect the adoption of mobile P2P payment. We also examine the effects of the banking system on mobile P2P payment adoption through the characteristics of the banks. In addition, we assess the social aspect of mobile P2P payment through the relationship between mobile SNS usage and mobile P2P payment.

3.1. Mobile Banking Usage and Mobile P2P Payment Adoption

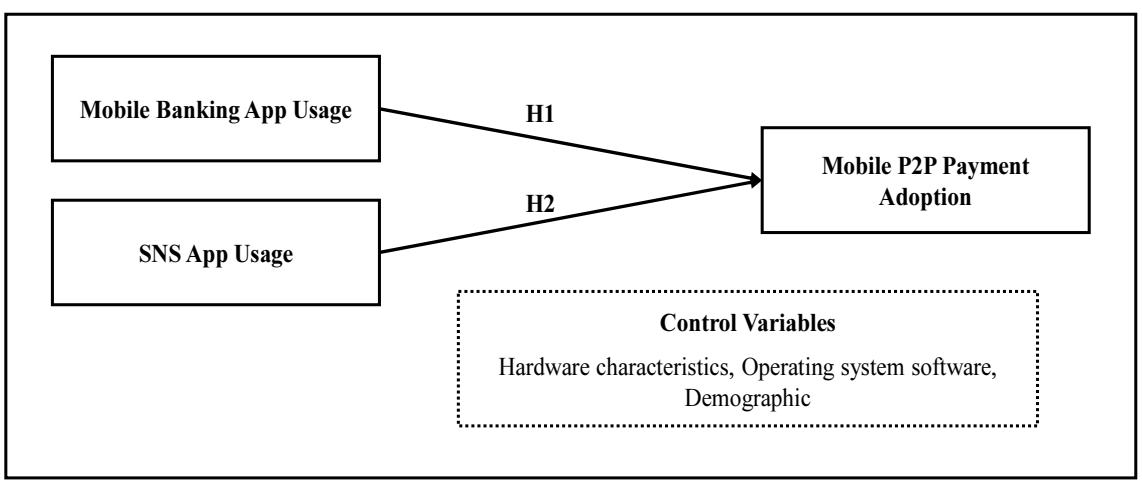
As the functionalities in mobile P2P payment or money transfer apps exist in traditional mobile banking apps, we empirically examine if there is a relationship between how much one uses a banking app and his or her choice to adopt the use of mobile P2P payment apps. Traditionally, although mobile banking apps allow the transfer of money to peers, the apps require users to go through a more tedious process in order for the money transfer to be facilitated and may have limitations and restrictions for money transfers to peers with accounts at other financial institutions (Koren, 2017; Russell, 2017). This tedious and cumbersome process in order to access the functions within the banking apps could mean that users may opt to use mobile P2P payments apps to facilitate simple transactions where the process is much simplified. In a research by Bank of America, convenience is the key reason to the adoption of digital P2P payments. Furthermore, mobile P2P pay-

ment apps are normally used for casual and low-value transactions such as paying a friend after a meal or making recurring payments (Green, 2017). Therefore, users may choose to use a mobile P2P payment app for these types of transactions than to use a traditional banking app. However, as it still seems to be unclear whether the less tedious process of money transfer for mobile P2P payment apps do encourage consumers to adopt for these types of apps instead of the traditional banking apps as well as whether the usage behavior of traditional banking apps has an influence on the adoption of mobile P2P payment apps, hence we model the usage characteristics of banking apps in our research model. Accordingly, we have the following hypothesis:

H1: There is a relationship between the usage behavior of banking app and one's choice to adopt the use of mobile P2P payment apps.

3.2. Mobile SNS Usage and Mobile P2P Payment Adoption

The business model of many of the mobile P2P payment apps available on the market was built on the assumption that users would use the app to send money to friends and family rather than strangers (Molinda, 2017). Users of SNS apps mainly use the platform to connect, communicate, and keep in touch with friends and family. Research on social media usage behavior revealed that the more time spent on interacting with others on SNS platforms and apps, the more likely that that person is more sociable. Furthermore, users who are more extroverted tend to use SNS apps more frequently and for longer durations (Correa et al., 2010; Seidman, 2013). Furthermore, one study used network externalities and motivation theory to study why people use SNS and found that apart from enjoyment, the number of peers one had has a significant influence on their usage behavior on SNS (Lin and Lu, 2011). Hence, we posit that the more peers a person has as well as the more time one spends with these people (i.e., high levels of sociability), the more likely he or she would adopt mobile P2P payment apps to send money to friends or family, which lead to the following hypothesis:



<Figure 1> Research Model

H2: There is a relationship between mobile SNS usage and mobile P2P payment adoption.

3.3. Theoretical Model

<Figure 1> illustrates our research model for mobile P2P payment adoption. In our model, there are two main constructs which we explore to identify if a relationship exists with the adoption of mobile P2P payment. As mentioned in the section above, the features of traditional mobile banking apps and mobile P2P payment apps overlap and one's usage behavior of traditional banking apps may have a relationship with his or her choice to adopt mobile P2P payment apps. Therefore, we empirically test if there is a relationship between the usage behavior of banking app and one's choice to adopt the use of mobile P2P payment apps (H1). Furthermore, we also empirically test if there is a relationship between mobile SNS usage and mobile P2P payment adoption (H2) as we posit that the more peers one has and the more time one spends with these people, the higher their level their sociability. Therefore, that person is more likely face instances that requires him to send money to friends and family, and thus, the likelihood that he or she would adopt mobile P2P payment apps is higher. Apart from the two main constructs, we also explore the effects of mobile hardware characteristics, the operating system software, and demographics on mobile P2P payment users and have included them as control variables in our research model. <Figure 1> illustrates our research model for mobile P2P payment adoption.

3.4. Data

The data in this study was collected through Nielsen Korean Click – a global market research company which collects diverse panel measurements such as Internet usage and attitude data on platforms such as PC and mobile. The panel study ran for a duration of 39 weeks from November 2015 to July 2016. The panel comprises of a large-scale sample of more than 14,000 smartphone users. The panel was methodically selected by using stratified random sampling using an appropriate proportion allocation strategy using demographic information, such as age and gender, in order to more accurately represent the population of smartphone users. To track and measure the participants' smartphone usage behavior, a tracking application was installed on the participants' smartphones. Specifically, the tracking application was able to identify the mobile apps that were used, as well as the usage duration, and the total number of times each app was launched. From the collected data, we were able to track the usage behavior of users who used apps in the finance category. Furthermore, the richness of the data allowed us to explore app usage in other categories such as SNS providing us with the opportunity to build app usage behavior in the SNS app category into our theoretical model and explore if there is a relationship between SNS app usage on the adoption of mobile P2P payment apps in the finance category. Apps such as Facebook, Twitter, and Instagram can be found under the SNS app category. The data for the total financial assets of the banks was also collected from the South Korean Financial Supervisory Service portal. The subject of our study is *Toss*, a mobile P2P payment app, which was first launched in South Korea in February 2015. Toss is the top mobile P2P payment app in South Korea and ranked at the sixth app in the finance category in terms of monthly active users (MAUs) and has a total transaction volume of about US$15 million in the third quarter of 2016 (Kookmin Bank, 2018). Toss is very similar to Venmo

except that users do not pay a fee. The summary statistics along with the definition of the variables used in our research model can be found in the appendix section.

For our analysis, we selected panel members who used exactly one mobile banking app from the 10 banks in South Korea as we explore whether the inherent differences between the banks, such as the size of the banks (i.e., total assets), to see if these characteristics have any relationship with one's adoption of mobile P2P payment. The basis of selection for the banks to be used in our study was based on the banking apps that were ranked within the top 50 apps, based on popularity, in the finance category. Overall, about 5 percent of mobile banking app users used the Toss app at least once during the time period of our study.

3.5 Empirical Model

We formally state our research model as follows:

$$\begin{aligned} &TossAdoption \\ &= \beta_0 + \beta_1 Banksession + \beta_2 MajorBank + \\ &\quad \beta_3 SocialSession + \beta_4 SocialApps + \\ &\quad \beta_5 ScreenSize + \beta_6 ScreenResolution + \\ &\quad \beta_7 SDK + \beta_8 Gender + \beta_9 AgeGroup + \\ &\quad \beta_{10} MaritalStatus + \epsilon_1 \end{aligned} \quad (1)$$

$$\begin{aligned} &TossAdoption \\ &= \beta_0 + \beta_1 BankSession + \beta_2 Bank_i + \\ &\quad \beta_3 SocialSession + \beta_4 SocialApps + \\ &\quad \beta_5 ScreenSize + \beta_6 ScreenResolution + \\ &\quad \beta_7 SDK + \beta_8 Gender + \beta_9 AgeGroup + \\ &\quad \beta_{10} MaritalStatus + \epsilon_2 \end{aligned} \quad (2)$$

The dependent variable, *TossAdoption*, is a binary variable that represents whether each individual adopts Toss app. It is 1 if the panel member is a user of the app; and, 0 otherwise. In both equations, we examine whether the relationship between mobile banking app usage behavior and mobile P2P payment adoption exists using *BankSession*. *BankSession* is a variable that represents the average total duration each time the mobile banking app was utilized after being launched by a user. Similarly, to examine the relationship between SNS app usage behavior and mobile P2P payment adoption, *SocialSession* and *SocialSession* are used. *SocialSession* and *SocialSession* represent, respectively, the average total duration each time a SNS apps is used after being launched and the total number of SNS apps used by a user.[1)] To control for the effects of bank apps each individual uses, we include *MajorBank* in equation (1), and $Bank_i$, $i \in \{1, 2, \ldots, 9\}$ in equation (2). *MajorBank* is a control variable and it is 1 if the type of bank that that individual uses falls under one of the four major banks; and 0 otherwise. Total assets is frequently used to classify large/major banks by most regulatory authorities and academics and in line with this we differentiate between major banks and minor banks by separating the banks according to their total assets, banks with a total asset of 200 trillion Korean won are classified as major banks while banks with a total asset of less than 200 trillion Korean won are classified as non-major banks (Schildbach, 2017). $Bank_i$ are the 9 control variables which represent the each of the bank in our sample that each

1) *BankSession* is derived from *BankDuration* and *BankCount* and *SocialSession* is derived from *SocialDuration* and *SocialCount*. We have also explored an alternative model that includes *BankDuration* and *BankCount* (instead of *BankSession*) and *SocialDuration* and *SocialCount* (instead of *SocialSession*). The estimation results of this alternative model are qualitatively consistent with what we reported in Section 4. The estimation results of the alternative model are reported in the appendix section.

individual uses. Lastly, we control for the hardware differences between the panel members based on their mobile phone screen size (*ScreenSize*), screen resolution (*ScreenResolution*), and Android operating system software version (*SDK*). Based on a report published by Kookmin Bank about Toss, in South Korea, males and females in their teens Toss had the highest monthly active users among all finance applications (Kookmin Bank, 2018). For females in their twenties Toss had the top active monthly users while Toss had the second highest monthly active users among men in their twenties. Toss was not the top few apps with the highest monthly active users for the other age groups. Hence, to control for these demographic differences amongst mobile phone users, we include the control variables, gender (*Gender*), age (*Age*), and marital status (*MaritalStatus*), in our research model. The correlation matrix for all the variables used in our research model can be found in the appendix section.

Ⅳ. Model Estimation and Results

We estimate our models (i.e., Model 1 given in equation (1) and Model 2 given in equation (2)) using the Firth's method, a penalized likelihood approach to logistic regression, because our model prediction outcomes are binary and the proportions of 1's for our dependent variable, Toss adoption, is less than 5 percent (Firth, 1993). In addition, we avoid problems resulting from the biased standard errors of the logit coefficients and also problems resulting from the underestimation of the proba-

<Table 2> Estimation Results

	Model 1		Model 2	
	Est.	Std. Err.	Est.	Std. Err.
Banking app usage				
BankSession	-0.0051**	0.0021	-0.0053**	0.0021
SNS app usage				
SocialSession	0.0014*	0.0008	0.0014*	0.0007
SocialApp	0.1863***	0.0355	0.1888***	0.0354
Control Variables				
ScreenSize	-0.2693	0.2794	-0.3062	0.2804
ScreenResolution	-7.42E-08	1.05E-07	-4.58E-08	1.07E-07
SDK	0.0666*	0.0363	0.0698*	0.0367
AgeGroup	-0.1358**	0.0671	-0.1427**	0.0687
Gender	0.0653	0.2000	0.0554	0.2010
MaritalStatus	-0.8603***	0.3231	-0.8486***	0.3300
Constant	-1.9098	1.5703	-0.0703	1.6708
Bank Effects				
MajorBank	-0.7649***	0.2008		
Bank			YES[1)]	
χ^2	125.89***		133.51***	

Note: N = 2.833; Standard errors are in parentheses; *$p \leq 0.1$, **$p \leq 0.05$, ***$p \leq 0.01$;
[1)] All dummy variables that we include for each bank are statistically significant.

bilities of the occurrences, or the number of 1's (King and Zeng, 2001). Hence, in line with other studies, we believe that it is a suitable method to reduce the bias in maximum likelihood estimation and adopt the Firth's method for all our estimates (Allison, 2012; Heinze and Schemper, 2002). We also used skewed logistic regression and negative binomial regression to estimate our models and estimation results from these alternative estimation techniques are qualitatively identical to the one reported in <Table 2>. The estimation results from these alternative estimation techniques are available from the authors upon request.

<Table 2> reports the estimation results. Across both models, there are some significant results which are consistent throughout. Firstly, the effect of *BankSession* is negative and significant in both models, indicating that users who are using mobile banking apps for a shorter session time (i.e., shorter duration each time they launch the app) are more likely to adopt mobile P2P payment apps. Furthermore, there are significant bank effects across all our estimation results. Users who use banking apps from major banks are less likely to adopt and use Toss while users who use banking apps from non-major banks are more likely to adopt and utilize Toss for mobile P2P payment. This finding also suggests that there are inherent characteristics within the banks themselves which influence their customers' adoption of mobile P2P payment apps.

Our results show that *SocialApp* and *SocialSession* are positive and significant from all our models. In line with our expectations, users that are active on multiple SNS platforms and use SNS apps for a longer duration each time are more likely to adopt mobile P2P payment apps. The estimation results from our control variables also show some interesting results. It shows that younger and single users and the ones that use more updated versions of the Android operating systems (OS) are more likely to adopt Toss app. This result is somewhat consistent with the founding in Hwong (2017) and Mbiti and Weil (2011). They show that the demographics of mobile P2P payment apps tend to be younger and the majority of the users of these apps tend to be concentrated below the age of 35.

Ⅴ. Findings and Implications

While mobile P2P payment apps are gaining popularity and greater demand, the factors influencing the adoption of these types of apps remain unclear. In this paper, we have explored the factors influencing the adoption of mobile P2P payment apps and sought to find out whether the app usage behavior of both traditional mobile banking apps and SNS apps have any influence on one's adoption of mobile P2P payment apps by examining two models. Our findings indicate that usage behavior of both the two types of mobile apps (traditional mobile banking apps and SNS apps) are significant and have an impact on one's adoption of mobile P2P payment apps—specifically, the average session duration of banking app, the banking app used, the average session duration of SNS app, the number of SNS apps used, and other factors such as age and the version of Android OS used all have an influence on one's adoption of mobile P2P payment apps.

5.1. Mobile Banking Usage and Mobile P2P Payment Adoption

In line with another study which found that duration and frequency of mobile use are the key predictors of adoption behaviors for mobile commerce

(Bigne et al., 2007), we complement existing studies on mobile payment adoption using actual usage behavioral data and found that the groups of users that use their banking apps for a shorter duration each time they launch the app are more likely to choose to adopt mobile P2P payment apps. This could point that the types of tasks these users frequently carry out has an impact on whether they choose to carry out these tasks using mobile P2P payment apps or traditional mobile banking apps. Typically, for the case of a traditional banking app, users need to go through a more tedious and cumbersome process in order to access the functions within the banking apps meanwhile the process is much simpler and quicker for Toss (Russell, 2017). Thus, intuitively, users who wish to carry out simpler tasks could instead opt to adopt Toss to carry out their money transfers activities instead. This is because of the simplicity of the authentication procedure and convenience that mobile P2P payment apps bring. Users would rather use these types of apps instead of having to go through a more complex procedure for traditional banking apps to carry out tasks that do not require too much time. Together with our results, further research should consider looking into the specific activities that users carry out while using these apps. The potential implication of this is that mobile banking firms should look to design easier to use and simplify processes in order to retain their users and compete with mobile P2P payment app providers. The strength of mobile P2P payment apps seems to lie with their convenience and simplicity, mobile P2P payment app firms should look to come up with new and innovative ideas to further simplify the process of mobile money transfers. Banks are starting to launch new platforms to simplify traditional mobile banking as well as add features commonly found in mobile P2P payment apps. Liiv, a mobile only platform, was launched by Shinhan Bank and incorporates mobile banking services as well as a function to split bills among friends (Wang, 2017).

We also found that the bank control variables were significant in both of our estimation models. Users that use banking apps that were from banks that are larger (i.e., higher total assets) were less likely to adopt the mobile P2P payment app in our study. On the other hand, the users that were using mobile banking apps that were from smaller banks were more likely to adopt mobile P2P payment apps. In mobile banking studies, trust and perceived competence have been identified as key adoption factors for the adoption of mobile banking apps (Gu et al., 2009; Kim et al., 2009; Lin, 2011). For users of traditional banking apps, these users might have a higher switching cost when switching to mobile P2P payment apps based on the level of perceived trust that they have with their banks. In addition, the larger banks could be perceived as more competent, particularly with regards to security, and users of these banking apps could have a more positive attitude towards these traditional banking apps and are more willing to use them even though there exist substitutable products which are more convenient and simple. For stakeholders of both mobile banking firms and mobile P2P firms, the implication of this is clear. Perceived trust and competence can be a strong retaining factor in keeping customers from opting to use mobile P2P payment apps.

5.2. Mobile SNS Usage and Mobile P2P Payment Adoption

Mobile P2P payment apps are touted as money transfer apps that facilitate quick and easy money transfer to peers such as friends and family (Molinda,

2017). Hence, in essence, these types of apps can be seen as apps which help to foster and maintain social relationships. We explore whether if there is a social aspect or component to mobile P2P payment apps by looking at the relationship of mobile P2P payment adoption with the usage behavior of SNS apps. In line with our expectations, we found that the average duration each time an SNS app is used as well as the total number of SNS apps used have a positive relationship with whether a user chooses to adopt mobile P2P payment apps.

Firstly, users of SNS apps that use SNS apps for a longer time are more likely to adopt and use Mobile P2P payment apps. As described in the earlier sections, users that spend more time on SNS apps are more sociable and are more likely to have more friends than others. This, together with the fact that mobile P2P payment apps are intended to be used as a vehicle for money transfer between peers, implies that the usage behavior of mobile P2P apps and mobile SNS apps are intertwined and there is a social aspect that exists in mobile P2P payment apps that is yet to be explored in depth. Even though the use case of mobile P2P payment adoption is clear, to our knowledge, this study is the first to explore the link between mobile P2P payment apps and SNS apps. This relationship will be more significant in the future as an increasing amount of mobile P2P payment apps are starting to integrate social features which are integral in SNS apps such as online chatting tools and public social feeds. Venmo, the leading mobile P2P payment app in the U.S., has built a social feed into the app which shares all the transactions one made to others (D'Onfro, 2015). The benefit of adding a social feed to the app is to attract users to continuously launch and check the app to see what transaction their peers are involved in even when they do not need to make a transaction.

5.3. Age, Marital Status, and mobile OS version, and Mobile P2P Payment Adoption

In line with the studies conducted on mobile P2P payment apps mentioned throughout the paper, the characteristics of the users that are more likely to adopt the mobile P2P payment app in our study were younger and single. More interestingly, we found that users who had a more up-to-date version of Android operating system on their mobile phones were more likely to adopt mobile P2P payment apps. Mobile P2P payment apps may be considered as a more innovative solution as compared to money transfers using traditional mobile banking apps. Hence, in line with studies that study the impact of personality on mobile app adoption, users with an innovator's personality, who are more open to newer technologies and innovations, may be more willing to adopt mobile P2P payment apps and install newer versions of operating systems on their mobile phones (Vishwanath, 2005; Xu et al., 2016). New firms should look to target and attract these groups of users when developing and marketing new mobile P2P payment apps.

Ⅵ. Conclusion

As the market for mobile P2P payment apps grows, the goal of identifying the adoption factors which drive users to adopt such apps becomes more relevant and important. This study contributes to the research on the adoption of mobile P2P payment apps by exploring the relationship between usage behavior of a substitute (traditional mobile banking apps) and SNS apps with the adoption of mobile P2P payment apps.

As discussed in the previous section, this study

has managerial implications for both stakeholders of mobile banking as well as stakeholders of mobile P2P payment. While prior studies on mobile payment mainly relied on data derived from surveys or adopted a case study approach into analyzing mobile payment adoption, in this study, data directly obtained from actual users of smartphones, was used to help us identify some of the key patterns and factors to which why some users adopt mobile P2P payment apps while others do not. Therefore, the key contrast from previous studies is that we were able to observe the actual usage patterns and behaviors of mobile P2P payment apps and other related apps such as SNS and traditional banking apps while previous studies could only survey intention to use rather than actual usage.

However, as in most empirical research, our work has several limitations. Firstly, in our selection of native banking apps that the users used, we only included the 10 banks from the top 50 apps in the finance category for our analysis. To improve our model further, we can consider including more banks in order to control for the bank specific effects. In future research, all the banks in Korea including those outside of the top 50 apps in the finance category should be included. Secondly, bank dummy variables as well as the major bank control variable were used to control for the different types of banks that users use. However, the use of such a variable may not be very useful in controlling for the true differences between the banks. It may be more useful to use key variables that are representative of the banks' characteristics, such as the number of ATMs or branches, in order to have more relevant and interpretable implications. Finally, because our dependent variable is skewed, as there were significantly more non-Toss users than Toss users and our sample for Toss users may be slightly small, our models may also suffer from small-sample bias. To overcome this limitation, for our main results, we used Firth's method to reduce the bias in maximum likelihood estimation. However, the Firth's method is not perfect and has its limitations and critics (Elgmati et al., 2015; Greenland and Mansournia, 2015). In addition, there are other alternative estimation methods which also achieve the same goal such as exact logistic regression and rare events logistic regression described by King and Zeng (2001) which we will consider and utilize to test the robustness of our results in all our future work.

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<Appendix>

<Table A1> Summary Statistics of All the Variables

Variable	Definition	Mean	Std. Dev.	Min	Max
TossAdoption	1 if user has used the mobile P2P payment app during the study period, 0 otherwise	0.0421	0.2009	0	1
BankDuration	Total duration in seconds of banking app used	7,891	12,271	3	197,059
BankCnt	Total number of times banking app was launched	69	97	1	1,095
BankSession	Average duration for each banking app use (BankDur/BankCnt)	131	279	3	9,635
SocialDuration	Total duration in seconds of all SNS apps used	227,355	439,587	3	6,421,146
SocialCnt	Total number of times all SNS apps were launched	1,507	2,494	1	26,310
SocialSession	Average duration for each SNS app use (SocialDuration/SocialCnt)	137	110	0	1,958
SocialApps	Total number of different SNS apps used	4.46	2.28	1	18
ScreenSize	Size, in inches, of mobile phone screen	5.35	0.39	3.5	8.4
ScreenResolution	Number of pixels on mobile screen	2,152,903	1,144,796	57,600	4,096,000
SDK	Categorical variable for Android OS version	10.27	3.15	1	16
AgeGroup	Categorical variable for age group	5.56	2.34	0	9
Gender	1 if male, 0 otherwise	0.4780	.5000	0	1
MaritalStatus	1 if married, 0 otherwise	0.6517	0.4765	0	1
MajorBank	1 if Bank has total assets of more than 300 trillion Korean won, 0 otherwise	0.5532	0.4972	0	1

<Table A2> Correlation Among Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.Toss	1														
2.BankDur	-.032	1													
3.BankCnt	.007	.839	1												
4.BankSession	-.039	.1	-.043	1											
5.SocialDuration	.128	.022	.092	-.033	1										
6.SocialCnt	.131	.018	.104	-.037	.823	1									
7.SocialSession	.066	.014	-.014	.02	.304	.056	1								
8.SocialApps	.159	-.022	.045	-.033	.386	.418	.124	1							
9.ScreenSize	-.003	-.036	.019	-.08	.055	.057	-.017	.064	1						
10.ScreenResolution	.013	-.059	.029	-.093	.049	.081	-.04	.084	.366	1					
11.SDK	.033	-.077	-.033	-.057	-.004	.041	-.058	.04	.155	.509	1				
12.AgeGroup	-.18	.14	-.011	.109	-.314	-.28	-.219	-.289	-.088	-.082	-.047	1			
13.Gender	-.003	-.118	-.089	-.003	-.138	-.103	-.088	-.011	.026	.058	.055	.048	1		
14.MaritalStatus	-.167	.125	.017	.057	-.242	-.222	-.198	-.212	-.033	-.051	-.034	.721	-.026	1	
15.MajorBank	-.053	-.108	-.066	-.027	.004	.023	-.023	.044	-.017	.003	-.008	-.04	.059	-.089	1

<Table A3> Estimation Results of an alternative model

	Model 1		Model 2	
	Est.	Std. Err.	Est.	Std. Err.
Banking app usage				
BankDuration	-3.7E-05	2.3E-05	-4.0E-05*	2.3E-05
BankCount	0.0034*	0.0018	0.0034*	0.0019
SNS app usage				
SocialDuration	-5.5E-09	2.5E-07	4.9E-08	2.5E-07
SocialCount	3.6E-05	4.4E-05	2.7E-05	4.5E-05
SocialApp	0.1692***	0.0380	0.1763***	0.0381
Control Variables				
ScreenSize	-0.2144	0.2787	-0.2795	0.2810
ScreenResolution	-1.05E-07	1.07E-07	-6.62E-08	1.09E-07
SDK	0.0765**	0.0362	0.0755**	0.0369
AgeGroup	-0.1608**	0.0655	-0.1725***	0.0673
Gender	0.0679	0.2032	0.0514	0.2057
MaritalStatus	-0.8683***	0.3195	-0.8632***	0.3268
Constant	-2.0745	1.5441	-0.4547	1.6624
Bank Effects				
MajorBank	-0.7345***	0.2009		
Bank			YES[1)]	
χ^2	144.06***		157.48***	

Note: N = 2.833; Standard errors are in parentheses; $^{*}p \leq 0.1$, $^{**}p \leq 0.05$, $^{***}p \leq 0.01$;
[1)] All dummy variables that we include for each bank are statistically significant.

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