Examining consumer adoption and perception of Mobile Money in Ghana

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Abstract: This paper investigates the consumer perception of a new electronic financial service in Ghana, namely mobile money (MM). We analyse the relationships among five MM-related constructs, which are perceived ease of use (PEOU), perceived usefulness (PU), perceived mobile money security (PMMS), attitude (ATT), and intention to use (IU). Importantly, the impact of age, family income, and gender on the relationships among the five MM constructs has been studied using a multi-group analysis approach. We find that PEOU, PU, and PMMS are significant determinants of ATT in the MM market in Ghana when age, family income, gender are not considered. However, the relationships among the five constructs exhibit significant variations when age, family income, and gender are considered. We also find an evidence that the effects of age, family income, and gender on consumers' perception of, ATT towards, and intention of using MM are significant in Ghana. The results of this study provide more insights into the research on MM, thus helping the development of marketing strategies for the service.

Keywords: consumer; mobile; money; perception; structural equations; technology.

1 Introduction

Mobile Money (MM), an innovative way of paying and transferring money through mobile phones, has experienced rapid growth in recent years, especially in developing countries such as Kenya (Jack and Suri, 2011). This novel way of electronically moving money is proving to be very attractive to consumers who otherwise could not have gained access to financial services in the formal banking sector and often felt financially marginalised due to the lack of a bank account or other reasons. Financial exclusion - the lack of access to the formal financial sector by some economic agents (McKillop and Wilson, 2007), remains a hindrance to upward mobility, making it difficult to improve the standard of living of those living on less than a dollar a day (Mitton, 2008). There is ample evidence to show that the inaccessibility of credit and savings accounts poses a significant challenge to the financially marginalized in conducting business to alleviate poverty through wealth generation (Mitton, 2008).

Even though MM has achieved big successes in Kenya, in Ghana, MM adoption rate is relatively low although mobile phone usage has peaked well over 90% in the last decade. The Ghanaian telecom industry is made up of six competitors (Expresso, Tigo, MTN, Vodafone, Airtel, and GLO-Mobile). However, only MTN, Airtel, Tigo and more recently Vodafone provide monetary services. MTN, with the largest market share, shows that of its 28,615,446 subscriber base in Ghana, only 6% are active users of an MM. Tigo cash customers have a relatively lower percentage than MTN followed by users of Airtel Money.

MTN launched MTN MM in partnership with nine banks (CAL Bank, ECO Bank, Fidelity Bank, Merchant Bank, GT Bank, Intercontinental Bank, UBA, Zenith Bank, and Stanbic Bank) to allow Ghanaians to perform a range of basic financial transactions using their handsets. It is claimed that the MM platform allows non-MTN customers to transfer or receive money by using the services of authorised MTN MM merchants. Furthermore, subscribers can enjoy the benefits of this service without the need to open or have a bank account.

Prior to the release of MTN MM, Afric Xpress released the txtNpay with the goal of turning every mobile phone into an electronic wallet. Using an SMS-based application, txtNpay could be operated on every network. With this service, one could send money to anyone having a cell phone, buy prepaid airtime, pay bills, check bank balances, and buy goods and services. Consumers could also transfer money to their electronic wallets or to merchants.

Ghana is certainly not the first African country to have MM introduced to its mobile phone consumer base. Safaricom, which introduced the M-PESA money transfer service to Kenya in 2007, boasts of a customer base of "9.5 million people transferring the equivalent of 11% of Kenya's GDP each year." MTN has launched MM in Uganda, Cote D'Ivoire, Benin, and Cameroun. Zain, one of the MTN's competitors, has launched Zap (its version of MM) in Kenya, Tanzania, Uganda, Niger, Sierra Leone, and now Ghana and estimates a patronage exceeding 10 million people (www.zain.com). Mobile phone patronage estimates in Ghana range from 11.5 million to 14 million according to the 2008 CIA World Factbook (Comninos et al., 2008). This suggests a huge potential customer base for MM to thrive. Notwithstanding MM penetration and adoption in Ghana are quite low compared to its counterparts in East Africa.

Granted that a replication of the Kenyan MM business model might not necessarily augur well for the Ghanaian market due to the distinctiveness of the two markets, it is imperative for researchers, practitioners, and policymakers to understand the Ghanaian consumer's perception of, attitude (ATT) towards, and intention of using this new financial service. The goal of the current study therefore is to investigate the consumer perception of an MM in Ghana by considering the interrelationships among five MM-related constructs, which are perceived ease of use (PEOU), perceived usefulness (PU), perceived mobile money security (PMMS), ATT, and intention to use (IU). Moreover, the role of demographic factors such as age, gender, and family income in the relationships among these five constructs is explored.

Our paper makes an important contribution to the studies on the adoption of MM by assessing the role of a new construct PMMS in the technology acceptance model (TAM) framework given that fraud and network security are of great concern in Sub-Saharan Africa. Furthermore, the dearth of research on MM adoption in Ghana and Sub-Saharan Africa in general cannot be overstated. The current study will therefore provide the research community, MM operators, and regulators with insights into the consumer perception and ATT towards the service as well as the barriers to adoption in the region. It is hoped that by revealing some of the consumer concerns and barriers to the adoption of MM in Ghana, better marketing strategies and regulations could be implemented to facilitate a scaling up of the service in Ghana.

The rest of the paper is organised as follows. The next section reviews the existing literature on MM. Section 3 states the hypothesised relationships and the hypotheses of the effects of age, gender, and family income of an MM consumer on these relationships. Section 4 presents the methodology used in the paper and also discusses the multi-group analysis used in assessing the moderating effects of the demographic variables. Section 5 describes the survey data we randomly collected in Ghana and reports the statistical summary of the data set. In Section 6, the model assessment and specification pertinent to the structural equation modelling (SEM) is presented. In Section 7, we report and analyse the results obtained from SEM and the multi-group analysis. Section 8 presents conclusions of the study and states some implications for researchers and practitioners. Finally, Section 9 outlines some limitations of the study and sets the direction for future research.

2 Literature review

There exists an extensive array of literature studying consumers' adoption of e-commerce, such as Internet banking, online services, and information management - Aldas-Manzano et al. (2011), Arnold and van Ewijk (2011), Cheng, Lam and Yeung (2006), Clemons (2009), Dai et al. (2012), Gauzente, Ranchhod and Gurau (2008), Malhotra and Singh (2010), Mouakket (2009), Xue, Hitt and Chen (2011), Yousafzai, Foxall and Pallister (2010), Zhao et al. (2010), Goldsmith and McGregor (2000), Dolan et al. (2004), Kolsaker, Lee-Kelley and Choy (2004), Ige (2004), McKinney (2004), Cameron and Galloway (2005), Ha (2006), Mavri and Ioannou (2006), Fransi and Viadiu (2007), Seock and Bailey (2008), Lichy (2011), and Ha (2012). The findings in these studies provide important insights into consumers' behaviour towards e-commerce.

A number of researchers including Maurer (2012), Bara (2013), Mulwa and Ndati (2013), Kizza (2013), and Fang, Russell and Singh (2014) have investigated the role of MM in social and financial inclusion. However, only a few publications including Duncombe and Boateng (2009) and Tobbin and Kuwornu (2011) have explored MM services in Ghana. Duncombe and Boateng (2009) reviewed some concepts, methods, and issues underlying the use of mobile phones in providing financial services while Tobbin and Kuwornu (2011) empirically examined the predictability of consumers' IU MM based on six different attributes such as PEOU, PU, perceived trust, 'trialability', perceived risk, and transactional cost. The paper by Tobbin and Kuwornu (2011) concludes that the PEOU and PU are significant determining factors of consumers' IU the MM service in Ghana. However, their study does not identify the possible differentiations in the relational characteristics due to demographic factors such as a consumer's age, gender, and family income. Existing literature has documented the significant impact of these demographic factors on consumers' behaviour in other types of e-commerce; for example, Cheng, Lam and Yeung (2006), Peng et al. (2011), Gefen and Straub (1997), Laukkanen and Pasanen (2008), Porter and Donthu (2006), Suoranta and Mattila (2004), and Morris and Venkatesh (2000). Thus far, we find no evidence of any existing literature exploring the impact of demographic characteristics on the adoption of MM in Ghana. The current study therefore seeks to fill this gap by studying the impact of age, gender, and family income on the consumers' perception and IU MM in Ghana.

Davis (1989) proposes a methodology to predict consumers' perception and acceptance of information technology by introducing two constructs, namely PU and PEOU. This is the widely used TAM in the literature. Since this seminal development, several extended TAM models have been proposed to include more consumer behaviour-related constructs; Cheng, Lam and Yeung (2006), Venkatesh (2000), Venkatesh and Bala (2008), Venkatesh and Davis (2000), and Venkatesh et al. (2003). These studies show that an extended TAM can capture the relationships among the constructs that are related to the consumers' perception of a new technology-based service.

3 Research constructs and hypotheses

Since MM is a new technology-based financial service developed to attract consumers who do not possess a bank account or cannot get access to online banking services, we anticipate that its ease of use would be important to consumers and therefore include the

PEOU as a variable in our study. However, its ease of use alone would not suffice for full adoption. We therefore argue that consumer-purchase decisions are also dependent on the usefulness of the service. As such, the PU is also included as a construct in this study. Davis (1989), in his study of consumers' acceptance of new technology, found PEOU to be a significant influential factor of PU. It is thus our hypothesis that, in the context of MM, this causal relationship could also exist. A review of existing literature (Cheng, Lam and Yeung, 2006; Davis, 1989; and Shih, 2004) shows that the PEOU of a service could determine consumer ATT towards the service. It is therefore important to test whether this evidence still exists in the choice for MM. In addition to these commonly used four constructs - PEOU, PU, ATT, and IU, a new construct named PMMS is included in an extended TAM model to ascertain the role the perceived security of the MM platform plays in the adoption of the service.

To investigate the interrelationships among the five constructs, we treat these constructs as latent constructs and then employ a SEM technique to test the hypothesised relationships among them. The following are the first set of hypotheses:

H1a: PEOU is a predictor of PU in the MM service in Ghana.

H1b: PEOU is a predictor of ATT towards the MM service in Ghana.

Studies have revealed that when consumers perceive a service to be useful, their ATT towards the service is more positive (Davis, 1989; Porter and Donthu, 2006). Furthermore, consumers would be more inclined to use it (Mathieson, 1991). It is therefore our quest to investigate this evidence in MM in Ghana using the following hypotheses:

H2a: PU is a determinant of ATT towards the MM service in Ghana.

H2b: PU is a predictor of IU in the MM service in Ghana.

As it is with other types of e-businesses, security in MM transactions is always a concern for consumers. Motivated by the findings of Cheng, Lam and Yeung (2006) in their study of Internet banking in Hong Kong, we include the PMMS construct in our study of consumers' acceptance of MM in Ghana. We therefore hypothesise below that PMMS could influence a consumer's ATT towards MM and his or her intention of using this new service:

H3a: PMMS is a predictor of ATT in the MM service in Ghana.

H3b: PMMS is a predictor of IU in the MM service in Ghana.

According to the findings by Bagozzi, Baumgartner and Yi (1989), Davis (1989), Feldman and Lynch (1988), and Vijayasarathy (2004), consumers' ATT towards a service plays a pivotal role in determining whether they intend to use the service. For a new service like MM, revealing the relationship between ATT and IU may help marketers develop more effective strategies to attract new customers. Therefore, we explore in our study the following hypothesis:

H4: ATT towards MM service is a significant predictor of IU in Ghana.

From a marketing perspective, MM is developed to serve a wide array of consumers with different demographic backgrounds. Assessing the impact of age, family income, and gender on the relational characteristics among the five constructs could yield insightful results for developing and scaling up the adoption of the service. We therefore test the following hypotheses:

H5: The age of a consumer has a significant impact on the relationships among the five constructs in the MM market in Ghana.

H6: The family income of a consumer has a significant impact on the relationships among the five constructs in the MM market in Ghana.

H7: The gender of a consumer has a significant impact on the relationships among the five constructs in the MM market in Ghana.

4 Methodology

4.1 Data collection

Our study on the consumers' perception of, ATT towards, and intention of using MM service in Ghana is based upon a data set collected through a survey. The survey was administered randomly in Accra, the capital city of Ghana. Apart from being the capital, it is the most populated and culturally diverse city in Ghana. It is also the hub for most of the economic activities in the country and the primary location for MM operators. Its proximity to ports and major government centres has given it a reputation of attracting people across the country for business; therefore, lending itself well for the collection of a data set that is representative of the whole country - and thus, yielding more robust results for our study on the consumer perception of mobile money in Ghana. Finally, we also observed that apart from Accra and Kumasi, MM service is yet to be available in most of the cities and towns across Ghana.

The questionnaire in the survey was divided into three primary sections. The first set of questions focussed on the MM usage habit, the second sought demographic information about survey participants, and the third section presented 19 variables, each of which was assigned a 5-point Likert-type scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. These 19 variables were treated as the measurement variables in the SEM framework in this study. The demographic variables that are the categorical variables in the second part of the survey were used to study whether there are any significant impacts on the relationships among the five constructs that characterise MM consumers' behaviour in choosing or purchasing this new service.

Of the 350 participants sampled, 274 responded and completed the survey, resulting in a 78.3% response rate. This response rate is reasonably high for our study of Ghanaian consumers' perception of, ATT towards, and intention of using the MM services. Approximately 95.62% of our respondents had heard or used MM in one way or the other.

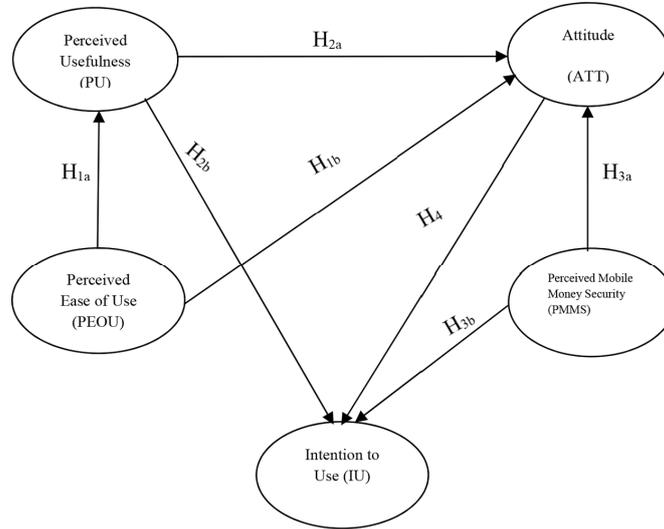### 4.2   *Testing the hypothesised relationships among the five constructs*

We employ a SEM technique to test the hypotheses specified in Section 3. SEM consists of measurement equations and structural equations. A measurement equation captures the potential linear relationship between a latent construct and a certain number of observed measurement variables; a structural equation is a linear regression model that captures a causal dependency of one latent construct on at least one other construct. To illustrate the SEM, suppose three measurement variables (endogenous variables) y_1, y_2, and y_3 are linearly dependent on one latent construct ζ_1, and three other measurement variables y_4, y_5, and y_6 are linearly dependent on another latent construct ζ_2. Further, ζ_2 is dependent on ζ_1, then the SEM that captures these relationships can be specified as:

$$y_1 = \lambda_1\zeta_1 + \varepsilon_1$$
$$y_2 = \lambda_2\zeta_1 + \varepsilon_2$$
$$y_3 = \lambda_3\zeta_1 + \varepsilon_3$$
$$y_4 = \lambda_4\zeta_2 + \varepsilon_4 \tag{3.1}$$
$$y_5 = \lambda_5\zeta_2 + \varepsilon_5$$
$$y_6 = \lambda_6\zeta_2 + \varepsilon_6$$

$$\text{and} \quad \zeta_2 = \gamma_1\zeta_1 + \eta_1 \tag{3.2}$$

where (3.1) presents the six measurement equations, (3.2) is the structural equation. $\varepsilon_1,\dots,\varepsilon_6$, and η_1 are the error terms. The parameters to be estimated in this example are $\lambda_1,\dots,\lambda_6$, $\varepsilon_1,\dots\varepsilon_6$, γ_1, and η_1. For a SEM to be identified in order to obtain a single and unique solution for each of the parameters, the total number of the free parameters cannot exceed the number of data points, $p(p + 1)/2$, where p is the total number of the measurement variables in a SEM. In this example, the causal relationship between the constructs ζ_1 and ζ_2 is tested based on the sign and statistical significance of the parameter γ_1.

We use the five unobserved constructs PEOU, PU, PMMS, ATT, and IU in our SEM. Figure 1 presents the specified paths in the SEM. The end of an arrow in a path connects a predictor construct, and the arrow-head points to a response construct. Testing a hypothesised relationship between two constructs is essentially testing the statistical significance of the path coefficient in the respective structural equation. For example, H1a will not be rejected if the hypothesis of the path coefficient $\gamma = 0$ is rejected at a 5% significance level in the linear structural equation: PU = γ PEOU + ε, where PU is the response construct, PEOU acts as the predictor construct, and ε is the error term with 0 mean and a constant standard deviation.

Figure 1 Hypothesised relationships among the five constructs

4.3 Testing the impact of demographic factors on the hypothesised relationships

The literature is replete with the impact of demographic factors on consumer ATTs towards online banking and retail; for example, Cheng, Lam and Yeung (2006), Gang et al. (2011), Gefen and Straub (1997), Laukkanen and Pasanen (2008), Porter and Donthu (2006), Suoranta and Mattila (2004), and Morris and Venkatesh (2000). However, since MM is a new e-commerce service, we believe that it is necessary to examine the impacts of demographic factors on the relationships between the predictor and the response constructs that are related to MM. Following Baron and Kenny (1986), we treat each demographic factor as a categorical moderating variable (moderator). The impact of a moderator on the relationships between predictor and response constructs is referred to as moderating effect. We employ a multi-group analysis proposed by Jöreskog (1971) to test the significance of the moderating effects in this study. The moderators in this study are age, family income, and gender, respectively. In a multi-group scheme, the survey data set is split into different groups relative to each moderator. The statistical significance of the difference of the magnitude of the path coefficients for a given path in the different groups is then tested. For example, when age is treated as the moderator, we aim to test whether the relationships among the five constructs are the same or not in different age groups. In this study, we consider two age groups and thus the data set is split into two age groups. The structural equations in the path of PEOU $\rightarrow$ PU in the two age groups can be expressed as: $\mathrm{PU}^{(1)} = \gamma_1 \mathrm{PEOU} + \varepsilon^{(1)}$ and $\mathrm{PU}^{(2)} = \gamma_2 \mathrm{PEOU} + \varepsilon^{(2)}$, respectively. A hypothesis of γ1 = γ2 (equality hypothesis) is imposed in the structural equation model and then tested. It is shown that the test statistic follows a Chi-square distribution with one degrees of freedom (Bollen 1989; Browne and Cudeck 1993).

In general, the equality hypotheses of multiple pairs of path coefficients are simultaneously imposed on all the structural equations in a SEM's estimation and testing procedures among different groups[1]. The test statistic for testing the equality of path coefficients in multiple paths among different groups also follows a Chi-square distribution. A small *p*-value from a simultaneous test suggests a rejection of the equality of the path coefficients among different groups. This implies that the respective moderator imposes a significant impact on the relationships among the constructs included in a SEM.

5   Survey data summary statistics

The survey participants possessed quite a diverse background in gender, age, and family income when we collected the data in Ghana. Table 1 presents the statistical summary of the data.

Table 1   Statistical summary of the survey data

Demographic information	Number of respondents	Percentage
Gender		
Male	169	61.68
Female	105	38.32
Age		
<18	15	5.47
19–30	161	58.76
31–45	75	27.37
46–60	22	8.03
>60	1	0.36
Monthly income (in Ghanaian Cedis)		
<100	51	18.61
101–500	107	39.05
501–1,000	55	20.07
1,001–1,500	20	7.30
1,501–2,000	4	1.46
2,001–2,500	3	1.09
2,501–3,000	1	0.36
>3,000	7	2.55
Missing	26	9.49

Overall, 63.14% of the survey participants had a college degree. As shown in Table 1, 61.38% of them were male, 58.76% were between 19 and 30 years old, 59% of them had monthly family incomes ranging from 101 to 1,000 Ghana Cedis (approximately, US$61610), and about two-thirds of the respondents were professionals.

Table 2 reports the mean, median, and standard deviation of the 19 measurement variables. Following Downey and King's (1998) treatment of missing data in Likert ratings, we employed a simple mean imputation to replace the missing values in our data.

Table 2 Measurement variable descriptive statistics

Measurement variables	Mean	Median	Standard deviation
Perceived ease of use (PEOU)			
V1 - Using Mobile Money service is easy for me	3.2390	3	1.1581
V2 - I find my interaction with Mobile Money services clear and understandable	3.1487	3	1.1591
V3 - It is easy for me to become skilful in the use of the Mobile Money services	3.3663	4	1.2967
V4 - Overall, I find the use of Mobile Money services easy	3.4015	4	1.2011
Perceived usefulness (PU)			
V5 - Using Mobile Money would enable me to accomplish my tasks more quickly	3.6556	4	1.0436
V6 - Using Mobile Money would make it easier for me to carry out my tasks	3.6898	4	1.0247
V7 - I would find the Mobile Money useful	3.7296	4	1.0441
V8 - Overall, I would find using Mobile Money to be advantageous	3.6974	4	1.0022
Perceived mobile banking security (PMMS)			
V9 - I would feel secure sending sensitive information through Mobile Money	2.9781	3	1.1671
V10 - Mobile Money is a secure means through which to send sensitive information	3.1168	3	1.1771
V11 - I would feel totally safe providing sensitive information about myself through Mobile Money	2.9779	3	1.2016
V12 - Overall, Mobile Money is a safe means to transmit sensitive information	3.2299	3	1.6691
Attitude (ATT)			
V13 - Using Mobile Money is a good idea	3.5584	4	1.1021
V14 - I would feel that using Mobile Money is pleasant	3.5294	4	1.0197
V15 - In my opinion, it would be desirable to use Mobile Money	3.3750	4	1.1393
V16 - In my view, using Mobile Money is a wise idea	3.4689	4	1.2127
Intention to use (INTU)			
V17 - I would use Mobile Money for my banking needs	3.2930	4	1.1157
V18 - Using Mobile Money for my financial transactions is something I would do	3.1808	3	1.1517
V19 - I can see myself using Mobile Money in handling my financial transactions	3.3993	4	1.2058

6   Assessment and specification of structural equation model

6.1   *Validity and reliability test*

To investigate whether the 19 measurement variables in Appendix I are reliable and internally valid to be included in this study, we first conducted an exploratory factor analysis (EFA) and then performed a confirmatory factor analysis (CFA). The purpose of applying an EFA procedure to the 19 measurement variables is to check for its validity in connecting the observed variables to the latent constructs. A sample size of 274 in this study lends itself well for conducting an EFA according to Comfrey and Lee (1992). Following Kaiser (1960), factors with eigenvalue >1 were extracted from the EFA. Five factors were identified based on the explained variances in the EFA. A scree test (Catell, 1966) was also performed to further confirm the validity of the five factors identified. The factor loadings were generated by using the varimax rotating extraction procedure. Table 3 reports the factor loadings and the Cronbach's alphas[2] for the five factors. It is shown that all the factor loadings for the five factors (constructs) are greater than 0.55, implying that all the 19 measurement variables for the five constructs are valid to be included in this study. The values of Cronbach's alpha for all the five factors are much greater than 0.70, exhibiting a strong internal consistency.

Table 3   Factor loadings and the five factors' Cronbach's alpha obtained from the exploratory factor analysis

	Factor loading	*Cronbach's alpha*	*Variance explained (%)*
Perceived ease of use (PEOU)		0.8452	20.19
V1 - Using Mobile Money services is easy for me	0.7255		
V2 - I find my interaction with Mobile Money services clear and understandable	0.7798		
V3 - It is easy for me to become skilful in the use of the Mobile Money services	0.6188		
V4 - Overall, I find the use of Mobile Money services easy	0.7909		
Perceived usefulness (PU)		0.8902	21.79
V5 - Using Mobile Money would enable me to accomplish my tasks more quickly	0.7981		
V6 - Using Mobile Money would make it easier for me to carry out my tasks	0.7414		
V7 - I would find the Mobile Money useful	0.7238		
V8 - Overall, I would find using the Mobile Money to be advantageous	0.7630		
Perceived Mobile Money security (PMMS)		0.8631	20.97
V9 - I would feel secure sending sensitive information through Mobile Money	0.7565		
V10 - Mobile Money is a secure means through which to send sensitive information	0.7796		

Table 3 Factor loadings and the five factors' Cronbach's alpha obtained from the exploratory factor analysis (continued)

	Factor loading	*Cronbach's alpha*	*Variance explained (%)*
V11 - I would feel totally safe providing sensitive information about myself through Mobile Money	0.7590		
V12 - Overall, Mobile Money is a safe means to transmit sensitive information	0.8042		
Attitude (ATT)		0.8821	21.70
V13 - Using the Mobile Money is a good idea	0.7588		
V14 - I would feel that using Mobile Money is pleasant	0.5632		
V15 - In my opinion, it would be desirable to use Mobile Money	0.7757		
V16 - In my view, using Mobile Money is a wise idea	0.7993		
Intention to use (IU)		0.9020	15.35
V17 - I would use Mobile Money for my financial needs	0.7437		
V18 - Using Mobile Money for my financial transactions is something I would do	0.6836		
V19 - I can see myself using Mobile Money in handling my financial transactions	0.7393		

To assess the validity of the hypothesised model in SEM, we apply CFA to the five factors and the associated measurement variables that are identified in EFA. Figure 2 outlines the paths of the measurement models in CFA. In this test, all the five constructs' variances are set to 1. Table 4 reports the major statistics obtained from CFA.

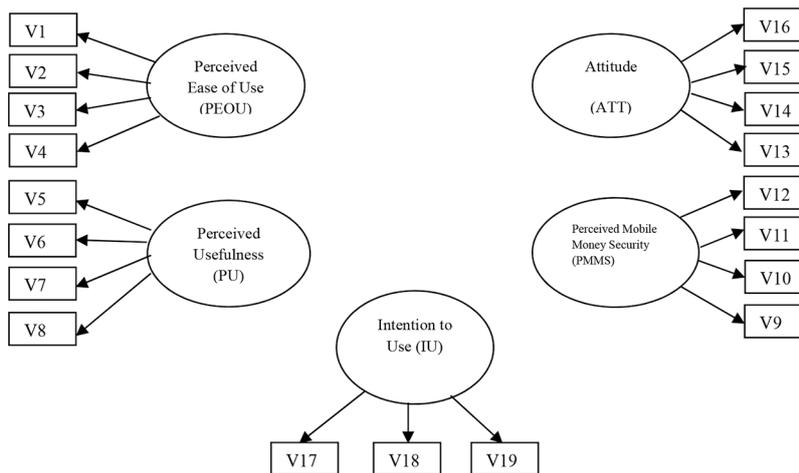**Figure 2** The measurement models in confirmatory factor analysis (CFA)

Table 4   Major statistics from the confirmatory factor analysis

Goodness of fit index (GFI)	0.8710
Adjusted GFI	0.8275
Chi-square	330.8109
Chi-square DF	142
Root mean square residual (RMSR)	0.0588
Standardised RMSR	0.0461
RMSEA estimate	0.0738
RMSEA lower 90% confidence limit	0.0635
RMSEA upper 90% confidence limit	0.0842
Akaike information criterion	426.8109
Schwarz Bayesian criterion	594.8713

Even though the Goodness of Fit Index (GFI) is 0.8710 < 0.9000, other statistics such as Root Mean Square Residual (RMSR) and Root Mean Square Error of Approximation (RMSEA) suggest that the overall model fitting is in an acceptable range. All the factor loadings from CFA are statistically significant at the 5% level. Therefore, all the 19 measurement variables are included in the measurement equations in SEM.

### 6.2   Multivariate normality and outlier test

The measurement variables in a SEM framework are assumed to follow normal distribution and are sensitive to outliers. To test multivariate normality and outliers, we follow Royston (1982, 1983), Rousseeuw and Van Zomeren (1990), and Filzmoser, Reimann, and Garrett (2003). The multivariate outlier test uses Mahalanobis distance to identify outliers (Filzmoser, Reimann, and Garrett, 2003). Applying this procedure to the 19 measurement variables in our data set, the outlier test did not identify any outliers at the 2.5% significance level; the multivariate normality test (Royston, 1982) suggests that the measurement variables follow a multivariate normal distribution at a 10% significance level.

6.3   Specification of the structural equation model

Based on the results from CFA in Section 5.1, we combine Figures 1 and 2 to formulate the path diagram for the structural equation model, which reflects the hypothesised causal relationships described in Section 3. Figure 3 presents a visual representation of the specification of the measurement and structural models in SEM. In Figure 3, it shows that 19 measurement models and three structural models are included in SEM. Therefore, 57 free parameters in the model need to be estimated. According to Section 4.2, for a SEM to be identified, the number of free parameters must be less than or equal to the number of data points, $p(p + 1)/2$, where p is the total number of measurement variables. This study includes 19 measurement variables with $p(p + 1)/2$ being 190, the model is thus

identifiable for the estimation of the free parameters. We use the PROC CALIS procedure in SAS to estimate the parameters in the specified SEM and follow Hair et al. (1998) to conduct the diagnosis of SEM. Specifically, the goodness-of-fit index (GFI; Bentler, 1990), root mean square error approximation (RMSEA; Steiger, 1990), and a χ^2 test (Kline, 1998) are employed in the model diagnosis.

Figure 3   Path diagram of the structural equation modelling (SEM)
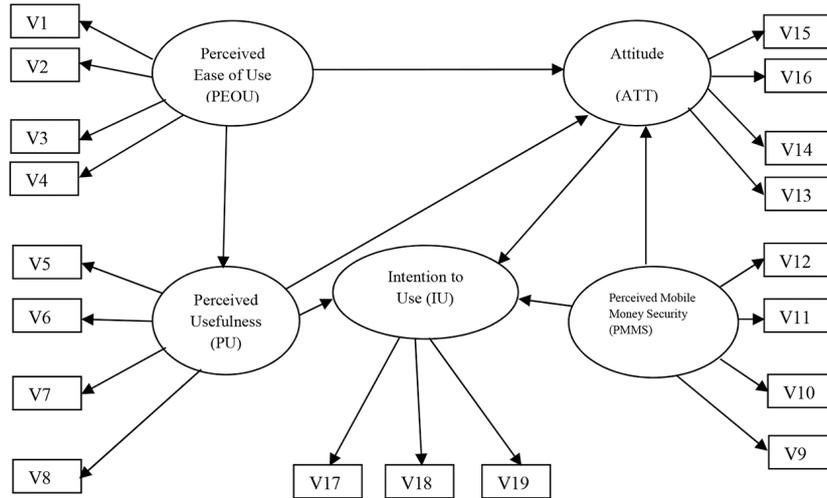
7   Empirical results and analysis

7.1   Testing the hypothesised relationships among the five constructs

To test the hypothesised relationships among the five constructs described in Section 3, we apply the SEM estimation procedure to the whole data set. Since the focus of this study is on the relationships of the constructs, we only report the estimated standardised path coefficients and the respective statistics in the structural equations in SEM. The estimation results for the measurement equations in SEM are available upon request. Table 5 presents the results from the SEM estimation procedures. In the 'path' column of Table 5, each row denotes a path of a structural equation in SEM. In each path, the variable on the left side of the arrow is the predictor construct, and the variable on the right side of the arrow is the response construct. In the estimate of path coefficient column, each row lists the estimated path coefficient in the respective path. The value and sign of a standardised path coefficient in each path indicate the strength and direction of the causal effect imposed by the predictor construct to the response construct. The value of a path coefficient implies the corresponding change in the response construct based on a unit of change in the predictor construct. A positive sign implies that the response construct follows the same direction as that of the predictor construct. On the other hand,

a negative sign of a path coefficient implies an opposite causal direction. A higher absolute value of a path coefficient implies that the strength of the causal effect of the predictor construct on the response construct is significant, all else being equal. Table 5 also reports the respective standard error and the *t*-value for the estimated path coefficient.

Table 5   Estimates from structural equation model

Path	Estimate of path coefficient	Standard error	t-value[a]
PEOU → PU	0.8064	0.0354	22.7500
PEOU → ATT	0.2711	0.1245	2.1777
PU → ATT	0.7027	0.1121	6.2687
PMMS → ATT	0.5159	0.0594	8.6832
PU → IU	0.3842	0.0723	5.3156
PMMS → IU	0.2443	0.0698	3.4973
ATT → IU	0.3337	0.0926	3.6036

Major statistics of the model fitting: goodness of fit index (GFI), 0.8824; RMSEA, 0.0716; RMSEA lower 90% confidence limit, 0.0608; RMSEA upper 90% confidence limit, 0.0825; Chi-square, 299.5249; Chi-square DF, 133; ratio of Chi-square to Chi-square DF, 2.2521; Pr > Chi-square, <0.0001.

[a]*Note*:   An absolute *t*-value that is greater than 1.96 indicates that the path coefficient is statistically significant at 5% significance level.

The results in Table 5 show that all the *t*-values associated with the estimated path coefficients are greater than 1.96. This indicates that the hypothesised relationships among the five constructs presented in Figure 1 are all statistically significant at a 5% significance level. That is, PEOU is a significant predictor of PU. Moreover, PEOU, PU, and PMMS influence ATT. Finally, the results show that ATT, PU, and PMMS are the significant determinants of IU. Therefore, we find the evidence to support the hypotheses H1, H2a, H2b, H3a, H3b, and H4 in this study. Our findings are similar to those obtained by Klopping and McKinney (2004) in their study of online shopping and Cheng, Lam and Yeung (2006) in their study of the adoption of Internet banking in Hong Kong.

7.2   Testing the moderating effect of age on relationships among the five constructs

To explore the moderating effect of an MM consumer's age on the relationships among the five constructs, we split the data set into two age groups (participants below 30 years of age and those who are at least 30 years old) and then tested hypothesis H5 using a multi-group analysis as described in Section 4.3. Table 6 reports the estimates of the path coefficients in the structural equations for the two age groups.

Table 6 Estimates of the path coefficients in the two age groups

Path	Estimate of path coefficient	Standard error	t-value[a]	Estimate of path coefficient	Standard error	t-value[a]
	Age up to 30			Age over 30		
PEOU → PU	0.8044	0.0454	17.7232	0.8278	0.0488	16.9463
PEOU → ATT	0.4608	0.1625	2.8354	0.0606	0.1718	0.3528
PU → ATT	0.8172	0.1535	5.3245	0.5413	0.1580	3.4253
PMMS → ATT	0.5903	0.0655	9.0140	0.5135	0.0790	6.5030
PU → IU	0.4480	0.0871	5.1427	0.4054	0.0968	4.1883
PMMS → IU	0.3522	0.0947	3.7187	0.0081	0.0972	0.0828
ATT → IU	0.1849	0.1220	1.5155	0.5364	0.1293	4.1486

[a]*Note*: An absolute *t*-value that is greater than 1.96 indicates that the relationship is statistically significant at 5% significance level.

Our results show that PEOU does not significantly influence ATT for consumers who are at least 30 years old. This finding is in line with that of Liu et al. (2003). Moreover, PMMS did not impose a significant impact on IU in the same group. This finding is contrary to other findings that are based on data from the developed world, where network security is a grave concern. In fact there is very little evidence in the existing literature reporting this finding, making our results unique among other studies on e-commerce. Anecdotally, we gathered from a number of respondents that while "*network security meets expectation*", fraud was prevalent in the system. In other words, although participants perceived MM network systems to be secured (and trust that monetary transactions would go through), it did not preclude the possibility of a fraudster exploiting the system to conduct fraudulent activities also known as "*sakawa in Ghana.*" To an extent, respondents failed to associate fraud directly with network security in the study - possibly explaining the lack of support for H3b. This, however, reveals another dimension (sociocultural) of how consumers perceive the risk associated with the adoption of a new technology in the developing world. In Ghana, the low income and older consumers tend to be less knowledgeable about cashless transactions and their attendant security issues compared to their counterparts in the developed world. The dynamic nature of '*sakawa*' due to the adaptive strategies of its perpetrators (Bolton and Hand, 2002) makes it very difficult to control - and remains a nuisance. Fraud, therefore is an important factor that should be explicitly included in future studies assessing the perception of an MM risk in developing countries.

The *t*-value of the estimated coefficient in the path of ATT → IU in the consumers' age group under 30 years is 1.5155, indicating that ATT is not a significant predictor of IU. This result implies that, among the younger MM consumers in Ghana, their ATT towards MM may not necessarily be a significant determinant of their IU the service.

In the simultaneous Chi-square equality test in each pair of the path coefficients in the structural equations between the two age groups, the statistic is 12.7950, and the *p*-value is 0.0773 with seven degrees of freedom. This shows that the equality hypothesis in the path coefficients of the structural equations between the two groups can be rejected at a 10% significance level. Therefore, there exists a moderating effect of age on the relationships among the five constructs. The hypothesis H5 is thus supported in this

study. The existence of the moderating effect of age also confirms the results of Porter and Donthu (2006), who argue that consumers' beliefs in a new information technology such as Internet banking are related to age. Furthermore, our finding is in line with that documented by Morris and Venkatesh (2000). The revealed distinctive behavioural differences between the two age groups in the context of MM in Ghana may provide important information to researchers and practitioners from a marketing perspective.

7.3   Testing the moderating effect of family income on relationships among the five constructs

To investigate whether there are variations in consumers' perception, ATT, and IU MM among different family income groups in Ghana, we tested hypothesis H6 as specified in Section 3. The data set was split into low income (consumers who earned less than 500 Ghana Cedis per month) and high family income (those earning at least 500 Ghana Cedis per month) groups. A multi-group analysis was conducted and a simultaneous Chi-square equality test in the path coefficients in each pair of the structural equations was performed. Table 7 reports the results.

Table 7   Estimates of the path coefficients in the two family income groups

Path	Estimates of path coefficient	Standard error	t-value[a]	Estimates of path coefficient	Standard error	t-value[a]
	Low family income			High family income		
PEOU → PU	0.8267	0.0458	18.0676	0.8254	0.0503	16.4261
PEOU → ATT	0.1582	0.1653	0.9569	0.6181	0.2045	3.0226
PU → ATT	0.4266	0.1528	2.7923	1.1839	0.1908	6.2056
PMMS → ATT	0.6728	0.0670	10.0383	0.4224	0.0792	4.6859
PU → IU	0.4832	0.0796	6.0710	0.5539	0.1362	4.0655
PMMS → IU	0.2010	0.1160	1.7321	0.2831	0.0970	2.9181
ATT → IU	0.2512	0.1297	1.9377	0.1713	0.1660	1.0314

[a]*Note*:   An absolute *t*-value that is greater than 1.96 indicates that the relationship is statistically significant at 5% significance level.

Even though a majority of the coefficients are statistically significant at a 5% significance level in both family income groups, there are differences in some path coefficients. In the low family income group, PEOU is not a significant factor for predicting ATT, and PMMS is not a significant determinant of IU. ATT only marginally predicts IU at a 5% significance level. In the high family income group, ATT is not a significant determinant of IU. The simultaneous Chi-square equality test statistic is 14.1344 and the *p*-value of the statistic is 0.0488 with seven degrees of freedom. Based on these results, the equality hypothesis in the path coefficients in the structural equations between the two family income groups can be rejected at a 5% significance level. We therefore conclude that family income imposes a significant moderating effect on the relationships among the five constructs. Gang et al. (2011) find similar evidence in their study of households' adoption of computers. Furthermore, Suoranta and Mattila (2004) report a significant moderating effect of household income on mobile banking adoption.

7.4 Testing the moderating effect of gender on relationships among the five constructs

It is well documented in the literature that males and females hold different views on the adoption of new information technology (Gefen and Straub, 1997; Laukkanen and Pasanen, 2008; Morris and Venkatesh, 2000). To investigate whether there exists a moderating effect of gender on the adoption of MM in Ghana, we classified the survey respondents in this study into male and female groups and then tested H7 as specified in Section 3. A multi-group analysis and a Chi-square equality test were then conducted in the SEM framework. Table 8 presents the results in the two gender groups.

Table 8 Estimates of the path coefficients in the male and female groups

Path	Estimates of path coefficient	Standard error	t-value[a]	Estimates of path coefficient	Standard error	t-value[a]
	Female			Male		
PEOU → PU	0.6802	0.0878	7.7490	0.8692	0.0388	22.3886
PEOU → ATT	0.0183	0.1643	0.1115	0.6379	0.2189	2.9141
PU → ATT	0.3923	0.1525	2.6728	1.0639	0.2040	5.2156
PMMS → ATT	0.5731	0.0974	5.8816	0.5433	0.0807	6.7350
PU → IU	0.0926	0.1193	0.7761	0.7586	0.1022	7.4217
PMMS → IU	0.0331	0.1385	0.2392	0.3084	0.1041	2.9617
ATT → IU	0.7340	0.1519	4.8329	0.0793	0.1458	0.5444

[a]*Note*: An absolute *t*-value that is greater than 1.96 indicates that the relationship is statistically significant at 5% significance level.

From the *t*-values of the estimated path coefficients in Table 8, it is observed that PEOU and PU are not significant predictors of IU among female MM consumers. Furthermore, ATT is not significantly influenced by PEOU in the female group. And in the male group, ATT is not a significant determinant of IU. The Chi-square equality test statistic is 21.9463, and the *p*-value of this statistic with seven degrees of freedom is 0.0026. This suggests a strong rejection of the equality in the path coefficients in the structural equations of the two gender groups. We therefore conclude that there exists a moderating effect of gender on the relationships among the five constructs. This is in line with the documented findings in Gefen and Straub (1997), Laukkanen and Pasanen (2008), and Morris and Venkatesh (2000).

8 Conclusion and implication

8.1 Conclusion

This study investigates consumers' perception of MM in Ghana by testing the hypothesised relationships among five constructs, namely PEOU, PU, PMMS, ATT, and IU in a SEM framework. Additionally, the moderating effects of age, income, and gender on the relationships among the five constructs are also examined.

We find that excluding demographic factors such as age, gender, and family income, PEOU, PU, and PMMS have significant impact on ATT towards MM service in Ghana. Moreover, PU, PMMS, and ATT cast significant influence on IU. Conversely, we find that the relationships among the five constructs exhibit significant variations due to the moderating effects of age, family income, and gender in the MM service in Ghana. Among the consumers who are at least 30 years old, ATT is not significantly impacted by PEOU, and PMMS does not significantly influence ATT. Regarding the moderating effect of family income, we find that relatively low family income earners do not weigh PEOU as a factor-influencing ATT. Similarly, PMMS was found to be an insignificant predictor of IU.

Finally, we find variations in the relationships among the five constructs moderated by gender. Among the female consumers, the only significant predictor of IU is ATT, and PEOU does not influence ATT. However, we find that in the male group, ATT is not a significant determinant of IU. Fraud is repugnant to consumers in both developed and developing countries nonetheless; the discrepancies in the sociocultural interpretation of perceived risk in the two worlds cannot be overemphasised. It is therefore important to pay attention to the sociocultural norms and interpretations of the risk associated with technology adoption in developing countries.

To summarise, the current study provides new insights into the studies on technology adoption by demonstrating that variations in demographic factors such as age, family income, and gender cannot be ignored when investigating the acceptance of a new financial instrument. Evidence from our data clearly shows that demographic characteristics play a role in consumers' perception of MM service in Ghana.

8.2   Implications for researchers and practitioners

This study has several implications for researchers and practitioners in the MM service in Ghana. To researchers, our findings provide further insights into the studies on consumers' behaviour towards a new technology-enhanced financial service. Additionally, we demonstrate that the impact of a demographic factor is worth taking into consideration since it may influence consumers' decision to use MM. It is our hope that this conclusion will initiate further investigation into the technology adoption in Sub-Saharan Africa where very few studies have been conducted.

An important finding from this study is that a consumer's age, family income, and gender has a significant impact on his or her perception of the MM service in Ghana. To practitioners, this finding highlights the importance of demographics in developing marketing strategies to scale up adoption. For instance, we find that consumers who were older than 30, or females, or respondents from low income families had a favourable ATT towards MM and were more likely to use the service. This could provide valuable information to MM operators in designing marketing strategies to attract consumers within a given category.

9   Limitations and future research directions

A limitation of this study is that the results are primarily based on data collected in Ghana. Our focus on Ghana narrows the discussion on an issue that might not be exclusive to Ghana alone. It is therefore possible that the implications of our findings

would not necessarily be applicable in the context of other countries. We believe that it will be more beneficial if a cross country comparative study is conducted on the issue of MM adoption paying attention to consumers' perception within a given cultural context.

The concern about fraud in MM practices in Ghana is yet another important factor worth considering. The spate of fraudulent activities (*sakawa*) in the informal financial sector in Ghana is alarming. This raises a concern as it would create unnecessary suspicion of any newly introduced financial services by the private sector - especially in the absence of government regulation. Unfortunately, unlike the developed world, where network security is of grave concern, the myriad of fraudulent activities is the main problem in developing countries. Future studies on technology acceptance in developing countries may therefore benefit from adding fraud as a new construct in the extended TAM.

Finally, consumers' views on the adoption of MM could change with improvements in the MM industry due to the potential for the development of complementary digital financial services or products in the market. It is, therefore, the recommendation of this paper that future studies in this area take notice and account for the possible behavioural changes resulting from the advances in this emerging market.

Acknowledgements

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Notes

1   This procedure is implemented in SAS TCALIS.
2   Cronbach's alpha measures internal consistency (reliability) within a group of measurement variables. The higher the Cronbach's alpha, the stronger the internal consistency is within a group of measurement variables.

Appendix I

Measurement variables and their corresponding constructs

Perceived ease of use (PEOU)

V1 - Using the Mobile Money service is easy for me

V2 - I find my interaction with Mobile Money services clear and understandable

V3 - It is easy for me to become skilful in the use of Mobile Money services

V4 - Overall, I find the use of Mobile Money services easy
Perceived usefulness (PU)

V5 - Using Mobile Money would enable me to accomplish my tasks more quickly

V6 - Using Mobile Money would make it easier for me to carry out my tasks
V7 - I would find Mobile Money useful

V8 - Overall, I would find using Mobile Money to be advantageous
Perceived mobile money security (PMMS)

V9 - I would feel secure sending sensitive information through Mobile Money

V10 - Mobile Money is a secure means through which to send sensitive information
V11 - I would feel totally safe I would feel totally safe sending money and
other sensitive information about myself over the mobile phone

V12 - Overall, Mobile Money is a safe

Attitude (ATT)

V13 - Using Mobile Money is a good idea

V14 - I would feel that using Mobile is pleasant

V15 - In my opinion, it would be desirable to use Mobile Money

V16 - In my view, using Mobile Money is a wise idea
Intention to use (IU)

V17 - I would use Mobile Money for transfer
V18 - Using Mobile Money for money transfer is something I would do
V19 - I can see myself using mobile phone for my financial transactions