

Mobile money: a gateway to achieving financial inclusion in Ghana

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Abstract: *While emerging studies on mobile financial inclusion have focused on the factors driving the adoption of mobile money, little evidence exists on how the service is facilitating the use of formal financial services. Using the World Bank Findex data, we estimate the effect of mobile money adoption on the use of formal accounts, savings, and credit in Ghana. The results of the recursive bivariate probit analysis showed a significant symbiotic relationship between mobile money adoption and the probability of operating a formal account. Mobile money adoption has a positive effect on savings and access to credit but does not affect the avenues to savings and obtaining credit respectively. Mobile money users save in their wallet and obtain microcredit through the mobile money platform but not through formal channels. These findings reinforce the hypothesis that mobile money is the surest financial tool for achieving universal financial inclusion in developing countries.*

Keywords: mobile money, financial inclusion, account, savings, credit

Introduction

EVIDENCE SHOWS THE POTENTIAL OF financial inclusion to enhance the socioeconomic wellbeing of the poor and vulnerable segments of the population in developing countries, who are mostly excluded from the formal financial system (Ozili, 2018). Financial inclusion has been identified as a catalyst to achieving many of the Sustainable Development Goals (SDGs) (CGAP, 2016). Financial inclusion is key to reducing poverty (SDG 1), ending hunger and achieving food security (SDG 2), and improving health quality by enhancing households' ability to respond to health emergencies (SDG 3) (Alderman et al., 2018). Even improving access to quality education (SDG 4), advancing gender equality and empowerment (SDG 5), and enhancing entrepreneurial activity and enterprise growth (SDG 8) all rest on financial inclusion (Bruhn and Love, 2014; Demirgüç-Kunt et al., 2015). Financial inclusion is also positively correlated with the achievement of SDGs 8, 9, 10, and 16 (Beck et al., 2007; UNSGSA et al., 2018).

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Financial inclusion is a multifaceted concept with many conceptual definitions which converge around making formal financial services such as savings, payments, credit, transfers, and insurance available, affordable, and accessible to the financially excluded segments of the population (Sahay et al., 2015). The focus is usually on the poor, women, rural residents, and those with little or no formal education and low financial literacy, the majority of whom are financially excluded (Demirgüç-Kunt et al., 2013; Dube and Gumbo, 2017). Limited financial inclusion severely impacts financial stability, financial security, and economic mobility, thus, effectively impeding the achievement of poverty reduction and shared prosperity. Access to formal financial and payment services, including savings, credit, insurance and social welfare transfers, facilitates improved income distribution and inclusive growth (Riley and Kulathunga, 2017). The definition of financial inclusion was previously limited to the use of accounts and financial services provided by financial institutions licensed by the central bank (Singh and Roy, 2015), but more recently, the definition has been broadened to include mobile money (MoMo). This is because MoMo providers are licensed by central banks to provide users with some basic financial services that were previously being provided only by the traditional 'bricks-and-mortar' financial institutions such as banks (Riley and Kulathunga, 2017). Formal financial services, in the context of this paper, refer to the range of financial services provided by the traditional financial institutions (bricks-and-mortar-based) other than MoMo.

Ghana, like many countries in the sub-region, has made several attempts at achieving financial inclusion over the last couple of decades through the deployment of innovative tools and strategies as first entry points. Popular among them are prepaid debit cards, and interoperable and multifunctional automated teller machines (ATMs). However, the success rate has been painfully slow until the entry of MoMo services (Riley and Kulathunga, 2017). Since 2009, when MTN commenced mobile money operation in Ghana, the rate of adoption has leapfrogged the provision and adoption of formal banking services (Aron, 2018), making it an effective financial instrument for achieving financial inclusion (Kodom et al., 2020). Between 2012 and March 2020, the number of registered MoMo accounts increased from approximately 3.8 million to 34.3 million while active MoMo users increased from 345,434 to 14.8 million. Within the same period, the volume of transactions increased from 18 million to 205 million while the value of transaction increased from GH¢ 594.12 m (US\$ 311.2m) to GH¢ 33.8 bn (US\$ 5.7m). Thus, the number of MoMo users has substantially outpaced the number using e-zwich smartcards (around 1 million in March 2020), credit cards (702,000), cheques (around 563,000), or debit cards (89,000) (Bank of Ghana, 2019, 2020).

Mobile money started in Ghana as a service for making and receiving transfers, mainly peer-to-peer transfers and buying of airtime. Through partnership with other service providers, other services such as payment of utility bills, satellite TV bills, air tickets, salaries of workers, and even taxi fares, among many others, have been added to the MoMo service. Microcredit, savings, and micro-insurance

services, which are key indicators of financial inclusion, are currently available through the service (Bank of Ghana, 2017). With the increasing adoption of MoMo services in Ghana, it is expected that MoMo will drive financial inclusion by not only providing users with a service to make transfers, but graduating them to use other forms of formal financial services such as savings, obtaining credit, and buying insurance through more traditional financial institutions. Little evidence currently exists on the impact of MoMo on the use of such formal financial services, which is the focus of this study.

The contribution of this paper to the financial inclusion literature is demonstrated in the working hypothesis: that MoMo serves as a gateway to the use of formal financial services. The impact on savings behaviour and access to credit represents additional contributions. Analysing the impact of MoMo on financial inclusion contributes to the ongoing debate on the effectiveness of investment in digital financial services as an instrument for achieving greater financial inclusion, which is critical to poverty reduction and sustained economic progress in developing countries.

The next section of the paper contains a review of literature on MoMo and the use of financial services. The third section describes the data source and the estimation model. The rest of the paper presents and discusses the results, and draws conclusions based on the findings.

Literature review

The livelihood of the unbanked is usually confronted by two challenges: high volatility in income earnings and exposure to severe shocks. Access to financial services is a solution to these challenges (Saliu, 2015). Recent studies on the impact of MoMo have revealed the potential of the MoMo services to extend formal financial services to the previously unbanked population (Must and Ludewig, 2010). This section presents a review of the impact of MoMo adoption on the use of formal accounts, savings, and access to credit. Although insurance is also a formal financial service, the data used for this analysis did not collect data on insurance. This review therefore excludes the impact of MoMo on insurance uptake.

Use of accounts

Analyses from the Finscope data show that income and education are key determinants of the use of formal accounts. Thus, highly educated people within the top income quintiles are more likely to use formal banking services as compared to those who are less educated and are within the bottom income quintile (Honohan and King, 2012). Lower educational attainment, cost structure of conventional banking, and the weak institutional infrastructure are among the barriers to the use of formal accounts (Aron, 2018). However, MoMo is designed to overcome such barriers through ease of use, low transaction costs, and convenience. The success story of Kenya's M-Pesa has become a model for many African countries including

Ghana, where a greater proportion of the people do not have access to banking services. The use of MoMo technology in Kenya (M-Pesa) increased the level of financial inclusion among the adult population to about 75 per cent (Riley and Kulathunga, 2017). The question is whether experience using MoMo would help overcome barriers to the use of other formal financial services.

There are few empirical studies on the effect of MoMo adoption on the use of formal accounts. So far, the only known study which has attempted to examine the effect of MoMo in graduating people to using formal accounts is Mbithi and Weil (2014). They found that in Kenya, the adoption of MoMo (M-Pesa) increases the probability of users to be banked. Based on these considerations, we hypothesize that:

H1: MoMo serves as a gateway to the use of formal accounts.

Effect of mobile money on savings

Low financial inclusion has made the majority of the population in many developing countries adopt informal means of savings and managing their finances. Evidence available shows that most poor households save through grains and seeds, keeping money in tins or cans, under mattresses or in holes in the ground. Some also save through associations such as Rotating Savings and Credit Associations (RoSCAs) and Accumulating Savings and Credit Associations (ASCAs) (Zimmerman and Banerjee, 2009). The existing financial system is shrouded in complexity, with no tailored service that gives the poor people the flexibility to save at their own convenience. MoMo service meets the needs of the poor by providing them with a service which is compatible with their way of living, thereby enhancing their ability to save (Ouma et al., 2017).

Some empirical studies have found that the adoption of MoMo induces saving among both the previously excluded segment of the population and the rich households (Jack and Suri, 2014; Mbithi and Weil, 2014; Batista and Vicente 2016). Jack and Suri (2014) found that M-Pesa users are able to use the savings made through their MoMo accounts to absorb relatively large income shocks without any significant reduction in their household consumption. These shocks, among others, include unexpected illness, loss of jobs, death of livestock, and harvest failure. On the other hand, the study found that the consumption of non-M-Pesa households falls by as much as 7 per cent on average any time such households experience shocks.

Many poor people save in their MoMo wallet because they do not operate a bank account (Demombynes and Thegeya, 2012). MoMo account holders (M-Pesa) were more likely to have savings compared to non-MoMo account holders. Convenience and safety drive users' savings motives, relative to interest on savings (Jack and Suri, 2011). Mbithi and Weil (2014) note that the adoption of M-Pesa reduces the likelihood of people using informal savings mechanisms. Similarly, Lombe (2013) found that in Nairobi, informal savings groups move their savings into their M-Pesa accounts, mainly because funds in M-Pesa accounts are time- and cost-effective to access at their own convenience. Jack and Suri (2011) found that 90 per cent of

early adopters of M-Pesa use the service as a tool for savings mainly because of its security, privacy, ease of use, and lower transactional cost. In a recent study across four sub-Saharan African countries (Kenya, Uganda, Malawi, and Zambia), Ouma et al. (2017) found that MoMo is a financial service that promotes the likelihood of households saving, as well as increasing the amount saved. They attributed the increasing volume of savings to the fact that MoMo users can deposit any amount of money they get as many times as they want into their wallet, and there is also convenience in making transactions. The second hypothesis is that:

H2: MoMo has a positive effect on savings.

Effect of mobile money on access to credit

Credit delivery is cardinal in the poverty reduction agenda of developing countries, as it provides both households and firms with the capital they need to make the investments that can improve their living and working conditions (Amponsah, 2017). Unfortunately, formal financial institutions are found by empirical studies from many sub-Saharan African countries to be reluctant to extend credit facilities to poor households, as well as to people operating micro and small businesses, mainly because they are perceived to be risky borrowers with greater uncertainty for repayment. Because they borrow in small amounts, the cost of transaction is also considered high for the formal financial institutions (Beck and Demirgüç-Kunt, 2006). Hence, most people are forced to borrow from informal sources at high interest rates (Steel and Andah, 2003).

In Ghana, evidence from the Living Standard Surveys (third to fifth rounds) shows that over 75 per cent of households access credit from informal sources, mainly from friends and family as well as from money lenders. The researches have also shown that loans from these informal sources hinder instead of improving the socioeconomic wellbeing of the poor because of the high interest rate informal creditors demand (Steel and Andah, 2003). Fortunately, following the passage of the Borrowers and Lenders Act, 2008 (Act 773) and the Non-Bank Financial Institutions Act, 2008 (Act 774), the fifth round of the Living Standard Survey found that, between 2012 and 2013, as much as 51 per cent of loans were accessed from formal and semi-formal financial institutions (Amponsah, 2017). Outreach by formalized microfinance institutions such as savings and loan companies have contributed to the reduction of informal borrowing (Amponsah, 2017).

Though empirical literature on the impact of MoMo on credit access is scanty, available evidence from Kenya shows that between 2012, when M-Shwari was launched as an entirely new MoMo savings and loan product, and 2016, the number of active customers who had deposited and accessed credit numbered 3.9 million with total deposits of KSh 8.1 bn or US\$ 77.6 million (Aron, 2018). This product was born out of a partnership between the Commercial Bank of Africa and Safaricom (Aron, 2018). The service enables users to move money between their M-Pesa account and M-Shwari bank savings account at no charge. Interest on loans was between 2 per cent and 5 per cent per month, depending on the amount borrowed and time frame. Interest rates on fixed deposits were high

relative to what is available in commercial banks. M-Pesa users with six months' active service usage could apply for an M-Shwari loan without paying any fee or doing any paperwork. The transaction history becomes a credit score upon which loans are granted. Customers can progressively access larger loans when initial loans have been successfully repaid (Aron, 2018). In Ghana also, some financial institutions have partnered with MoMo service providers to provide short-term loans to users, such as Fido Micro Credit (FIDO). However, there is no known empirical study on the extent to which these services are being patronized by customers. This leads to the third hypothesis:

H2: MoMo has a positive effect on credit from formal sources.

Methodology and data

Measuring financial inclusion

There are four classical indicators for measuring financial inclusion: access, quality, usage, and impact (Hannig and Jansen, 2010; Serrao et al., 2012). Access measures the proportion of the population using a financial product and/or service such as a bank account or MoMo account (Serrao et al., 2012). Quality measures the extent to which the use of the financial products and services meets the needs and expectations of the users. Usage measures the 'regularity, frequency and duration of use of a financial service and/or product over time' (Serrao et al., 2012: 7). Impact measures the changes that a user of a financial product and service experiences over a period of time, which can be attributed to the adoption (access), quality, and use of a financial product and service (Hannig and Jansen, 2010; Serrao et al., 2012). Due to data limitations, access has been the common indicator for measuring financial inclusion (Chattopadhyay, 2011). Ownership of a mobile money account has been added to the access indicator of measuring financial inclusion (Demirgüç-Kunt et al., 2018). This paper used the access indicator as a measure of financial inclusion. Having a registered account with a financial institution as well as ownership of a registered MoMo account were therefore used as a measure of financial inclusion.

Data

This study used the World Bank Findex datasets: 2014 and 2017. Since 2011, the World Bank has been conducting a financial inclusion survey (the Global Findex Survey) across many countries, including Ghana. It randomly selects 1,000 people from each country as a representative sample. The target population is adults aged 15 years and above. So far, there exist three rounds of the Findex survey: 2011, 2014, and 2017. In 2011, the proportion of Ghanaians using MoMo was insignificant because it was just two years old in the Ghana market. The 2011 dataset, therefore, was not useful in running any inferential analysis on MoMo adoption and use. Thus, the estimations were done using the 2014 and 2017 datasets, although some descriptive statistics were drawn from the 2011 dataset to assess Ghana's financial inclusion performance over time.

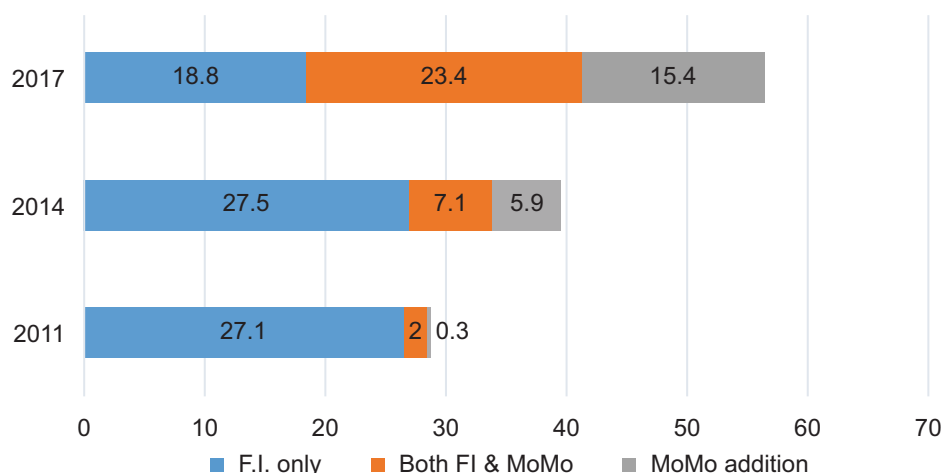


Figure 1 Ghana's Financial Inclusion Performance 2011–2017 (%)

Notes: 'F.I. Only' are the proportion of people who hold an account with only a financial institution. 'Both FI & MoMo' are those who have an account with a financial institution and still have a registered MoMo account. 'MoMo Addition' are those who operate only a MoMo account.

Descriptive analysis

Using ownership of an account as a measure of financial inclusion (Serrao et al., 2012), the results show that between 2011 and 2014, even though there was an 11.1 percentage point increase in the proportion of Ghanaians (aged 15 and above) that had accounts, the majority of Ghanaians (59.5 per cent) were still financially excluded. However, as at 2017, the majority of Ghanaians (57.7 per cent) were financially included. This performance in 2017 can be attributed largely to the increasing adoption of MoMo over the period. Between 2011 and 2017, the proportion of Ghanaians who adopted MoMo in addition to the account they operate at a financial institution increased by 21.4 percentage points (Figure 1). This means that MoMo has been providing an additional financial service to an increasing number of Ghanaians who were already financially included. Within the same period, the results further show that those who had no account at a financial institution and use only MoMo increased from 0.3 per cent in 2011 (two years into its inception) to as high as 15.4 per cent in 2017. This means that between 2011 and 2017, MoMo directly increased the extent of Ghana's financial inclusion by 15.1 percentage points, and indirectly facilitated increased utilization of financial institutions in addition to MoMo.

The results presented in Table 1 compare the demographic characteristics of those who are financially included (own accounts or have MoMo) with those who are financially excluded. The gender analysis shows that men were more likely than women to be financially included in 2014, although the difference was not statistically significant. By 2017, even though the majority of both men and women were financially included, the proportion of men (61.8 per cent) was significantly higher than that of women (53.7 per cent), by 8.1 percentage points. Indeed, studies

Table 1 Demographic characteristics of those who are financially included and excluded

Variables	2014		2017		χ^2 between period
	Included	Excluded	Included	Excluded	
Gender (%)					
Male	41.7	58.3	61.8	38.2	55.22***
Female	39.4	60.6	53.7	46.3	25.39***
χ^2 within period	2.17		10.89**		
Educational attainment (%)					
Primary or less	28.9	75.1	49.4	50.6	47.31***
Secondary	50.5	49.5	65.4	34.6	47.20***
Tertiary	89.6	10.5	97.7	2.3	1.56
χ^2 within period	101.92***		69.67***		
Income terciles (%)					
Bottom 40%	30	70	48.3	51.7	28.25***
Middle 20%	44.8	55.2	61.8	38.2	11.77***
Top 40%	49	51	65	35	45.32***
χ^2 within period	26.62***		31.04***		
Age (Mean)	33	32	32	31	
Percentage	42	62	58	38	
Obs.	421	623	579	377	

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

have shown that globally, the proportion of women who are financially included is 65 per cent against 72 per cent of their male counterparts (Demirgüç-Kunt et al., 2018). The gender gap is even worse among the poor, with a financial inclusion gap of 28 per cent between women and men (Demirgüç-Kunt et al., 2013). Comparatively few women in developing countries 'are able to register phone-based financial accounts in their names' (Arnold and Gammage, 2019: 967) because many of them do not own mobile phones (GSMA, 2015).

The results further show a significant association between level of education and financial inclusion. In both years, increasing levels of education significantly increase the chance of becoming financially included. For instance, in 2014, the proportion of Ghanaians who were financially included increased from 28.9 per cent among those with primary education to 50.5 per cent among those with secondary and further education, to 89.6 per cent among those with tertiary education. Similarly, in 2017, the proportion of those who were financially included increased from 49.4 per cent among those with primary education to 65.4 per cent among those with secondary education, to as high as 97.7 per cent among those with tertiary education. The results further show that the proportion of Ghanaians across all three educational levels who were financially included in 2017 was higher than those who were financially included in 2014. Education as a significant predictor of the use of financial services may be attributable in part to

its association with higher income, financial literacy, and other capabilities (Ajayi and Ross, 2020).

The results further show a statistically significant association between income and financial inclusion: ownership of accounts (financial inclusion) significantly increases with increasing levels of income (p -value < 0.001). In 2014, the proportion of those who were financially included increased from 30 per cent among those in the bottom 40 per cent income tercile to 44.8 per cent among those in the middle 20 per cent income tercile, and a little further to 49 per cent among those in the top 40 per cent income tercile. In 2017, the proportion of those who were financially included increased from 48 per cent among those in the bottom 40 per cent income tercile to 61.8 per cent among those in the middle 20 per cent income tercile, and further to 65 per cent among those in the top 40 per cent income tercile. Studies have shown that, globally, those within the higher income category and the highly educated are more likely to be financially included (Allen et al., 2012); besides having more income from which to save, those who are highly educated are better able to complete documents needed to open an account.

Empirical analysis

The hypothesis is that the adoption of MoMo serves as a gateway for users to access other forms of formal financial services such as formal accounts, savings, and credit. A probit model is specified in which the probability of use of formal financial services (other than MoMo) is defined as a function of individual characteristics and MoMo use. The decision by an individual with a MoMo account to access other formal financial services is unobserved. As such, a latent variable probit model is estimated such that the ownership of a MoMo account and access to other formal financial services (y_i^*) depend on the current ownership of a mobile money account (M_i). The effect of ownership of a MoMo account on the use of formal financial services is estimated by the equation (1):

$$y_i^* = \beta'X_i + \delta M_i + \varepsilon_i \quad (1)$$

Where (y_i^*) is use of other formal financial services, X_i is the personal characteristics, M_i is the ownership of a MoMo account, and ε_i is the random error term. Ownership of a MoMo account is included as a dummy variable in the probit equation. The use of other formal financial services is given by the relationship:

$$y_i^* = 1 \quad \text{if } y_i > 0$$

$$y_i^* = 0 \quad \text{if } y_i \leq 0$$

The probability that an individual will access other formal financial services given the covariates of personal characteristics and ownership of a MoMo account is obtained as:

$$\Pr(y_i^* | X_i; M_i) = \Pr(y_i > 0) = \Pr(\beta'X_i + \delta M_i + \varepsilon_i) = \Phi(\beta'X_i + \delta M_i) \quad (2)$$

where Φ is the cumulative density function of the standard normal distribution.

However, there exists the potential of endogeneity between use of MoMo and the decision to access other forms of formal financial services through MoMo. For example, endogeneity may arise when omitted variables (such as technology adaptability and location) are correlated with both decisions – a case of unobserved heterogeneity; or reverse causality between the decisions. In the presence of endogeneity, probit estimation of the effect of ownership of a MoMo account on the use of formal financial services will be inefficient and inconsistent. In addition, since the study estimates the effect of a binary treatment (ownership of a MoMo account) on a binary outcome (access to other formal financial services), the appropriate estimation strategy must account for these distribution characteristics.

This study adopts a recursive bivariate probit model to estimate the effect of MoMo ownership on the use of formal financial services. The recursive bivariate model is a two-equation binary outcome model with correlated error disturbances. The ownership of a MoMo account M_i and access to formal financial services y_i are described by the latent variable models:

$$M_i = \mu'X_i + v_i \quad (3)$$

$$y_i^* = \beta'X_i + \delta X_i + \varepsilon_i \quad (4)$$

Where M_i is defined as the unobservable probability of an individual to own a MoMo account and y_i is the unobserved net utility that an individual derives from accessing other financial services. The events are observed if the expected net utility or probability are positive. M_i^* and y_i^* are related to the binary dependent variables M_i and y_i by the following rule:

$$M_i = 1 \quad \text{if } M_i^* \geq 0 \text{ and } 0 \text{ otherwise}$$

$$y_i = 1 \quad \text{if } y_i^* \geq 0 \text{ and } 0 \text{ otherwise}$$

X_i is a vector of the exogenous observed characteristics affecting ownership of a MoMo account and access to formal financial services. Unlike other instrumental variable techniques, the recursive bivariate probit model is identified even if X_i includes the same varying exogenous regressors (Wilde, 2000). The error terms (v_i and ε_i) are assumed to be distributed bivariate normal with a mean of zero and a constant variance, and $\text{corr}(v_i, \varepsilon_i) = \rho$. The error terms capture all the other factors that affect ownership of MoMo and access to formal financial services in Ghana. The estimates of the probit model are consistent when $\rho = 0$ or are statistically insignificant.

Effect of MoMo on operating accounts at a financial institution

The first basic measure of financial inclusion is the ownership of accounts. The results presented in Table 2 show that, in both 2014 and 2017, controlling for the demographic characteristics of the individual, having a MoMo account significantly increases the chance of opening an account at a financial institution. This shows that MoMo serves as a gateway for people to open an account with a financial institution, and this will enable them to access formal financial services.

Table 2 Effect of MoMo on operating accounts at a financial institution

Variables	MoMo account		Financial institution account	
	2014	2017	2014	2017
Female	0.021 (0.027)	0.007 (0.028)	-0.019 (0.021)	-0.051 (0.062)
Age	0.013*** (0.004)	0.006 (0.004)	-0.004 (0.005)	0.000 (0.008)
Age ²	-0.000** (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
Educational attainment (ref: primary or less)				
Secondary education	0.146*** (0.032)	0.041 (0.036)	-0.005 (0.030)	0.021 (0.076)
Tertiary education	0.400*** (0.083)	0.305*** (0.117)	-0.103* (0.054)	-0.044 (0.197)
Income quintiles (ref: bottom 40%)				
Middle 20%	0.060 (0.038)	-0.007 (0.037)	0.018 (0.030)	0.055 (0.067)
Top 40%	0.065** (0.031)	0.047 (0.033)	0.017 (0.026)	-0.005 (0.052)
MoMo account	0.551*** (0.042)	0.460*** (0.030)		
Financial institution account			0.380*** (0.039)	0.436** (0.172)
Obs.	992	957	992	957
Prob > χ^2	0.000	0.00	0.000	0.000

Notes: Estimated marginal effects are presented and robust standard errors are in parentheses.

Standard errors are robust to heteroscedasticity.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

This finding supports the work of Mbithi and Weil (2014) who found that, in Kenya, the adoption of MoMo (M-Pesa) increases the probability of users to be banked. However, the effect size somewhat reduces over time. Thus, between 2014 and 2017, controlling for the demographic characteristics of an individual, the probability of a MoMo user operating an account at a financial institution reduced from 55 per cent to 46 per cent.

For a robustness check, a recursive bivariate probit analysis was further conducted to examine the reverse effect of ownership of an account at a financial institution on the adoption of MoMo. The results show that, controlling for the demographic characteristics, having an account at a financial institution has a positive effect on the chances of opening a MoMo account in both years. The results show that in 2014, there was a 38 per cent chance for people who already have an account at a financial institution to adopt MoMo, and this probability increased to 44 per cent in 2017. This means that there is a symbiotic

relationship between having an account at a financial institution and having a MoMo account: MoMo influences people to open an account at a financial institution, and people who have an account at a financial institution tend to open a MoMo account as an additional service.

This increasing adoption of MoMo among those who are already included may be explained from the integration of MoMo into bank accounts, where bank account holders can make payments from their accounts to MoMo users directly and also transfer money from their bank account into their MoMo wallet, and vice versa. This convenience in financial transactions may have contributed to the increasing adoption of MoMo among people already using bank accounts.

Effect of mobile money adoption on savings

The second indicator of financial inclusion is savings. The hypothesis is that MoMo serves as a gateway for people to save, and that they may go on to save at a financial institution as well as in their MoMo wallet. The results show that although in 2014 there was a positive association between having a MoMo account and saving, this relationship was not statistically significant. In 2017, having a MoMo account was a significant determinant for saving (Table 3). In 2017, having a MoMo account significantly increased the chance of saving by 48 per cent. Scholars such as Batista and Vicente (2016), Jack and Suri (2014), Honohan and King (2012), and Shem et al. (2012) have all found that the adoption of MoMo induces savings behaviour among those who previously had no savings because they had no accounts. Jack and Suri (2014) explain that having savings enables MoMo users who were previously excluded to absorb relatively large income shocks without any significant reduction in their household consumption.

In terms of the forms of savings, the results show that in 2014, controlling for the demographic characteristics of the individual, those with a MoMo account were 44 per cent more likely to save at a financial institution than non-users. However, in 2017, this effect diminished and was not statistically significant. Based on the demographic characteristics of those who saved in their MoMo wallet, it can be concluded that in 2014, the MoMo account holders who saved at a financial institution were more likely to be those who already had an account at a financial institution (i.e. those who were already financially included). The results further show that, in both years, controlling for the demographic characteristics of the individual, having a MoMo account did not have any significant effect on the likelihood of an individual to save using informal sources.

For those who have no account at a financial institution, MoMo provides them with the opportunity to save (Ouma et al., 2017). In both 2014 and 2017, the determinants of the probability of Ghanaians to save in their MoMo wallet were gender, education, and income. Compared to men, women were 3.4 per cent and 9.0 per cent less likely to save in their MoMo wallet in 2014 and 2017, respectively. Compared with those with only primary education, those with secondary education were 6.0 per cent and 8.1 per cent more likely to save in their MoMo wallet in 2014 and 2017, respectively. This probability increases to 13.1 per cent and 20.6 per cent among those with tertiary education in 2014 and 2017

Table 3 Effect of MoMo on the various forms of savings

Variables	2014				2017			
	Save	Formal savings	Informal savings	MoMo wallet	Save	Formal savings	Informal savings	MoMo wallet
Female	-0.035 (0.033)	0.025 (0.021)	-0.029 (0.032)	-0.034* (0.020)	0.011 (0.041)	0.009 (0.039)	-0.008 (0.036)	-0.090*** (0.032)
Age	0.007 (0.007)	0.008** (0.004)	0.005 (0.006)	0.005 (0.005)	0.003 (0.006)	-0.006 (0.004)	0.004 (0.005)	0.007 (0.005)
Age ²	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Educational Attainment (ref: primary/less)								
Secondary	0.117** (0.050)	0.085*** (0.029)	-0.011 (0.085)	0.060*** (0.020)	-0.003 (0.044)	0.016 (0.042)	0.014 (0.038)	0.081** (0.035)
Tertiary	0.370*** (0.082)	0.143** (0.062)	0.133 (0.240)	0.131** (0.060)	-0.055 (0.079)	0.074 (0.141)	-0.032 (0.073)	0.206*** (0.087)
Income Tercile (ref: bottom 40%)								
Middle 20%	0.090* (0.052)	0.025 (0.029)	-0.017 (0.062)	0.071*** (0.027)	0.011 (0.054)	-0.033 (0.040)	0.047 (0.048)	0.128*** (0.048)
Rich 40%	0.123*** (0.037)	0.059** (0.026)	0.069 (0.076)	0.067*** (0.022)	0.025 (0.043)	0.030 (0.037)	-0.002 (0.036)	0.096*** (0.036)
Momo user	-0.306 (1.037)	0.443*** (0.042)	0.080 (0.979)		0.484*** (0.076)	0.310 (0.221)	0.029 (0.134)	
Obs.	992	992	992	992	957	918	891	957
Prob > χ^2	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000

Notes: Estimated marginal effects are presented and robust standard errors are in parentheses. Standard errors are robust to heteroscedasticity.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

respectively. Thus, increasing levels of education increases savings through the MoMo wallet. Similarly, compared to those within the bottom 40 per cent income tercile, those within the middle 20 per cent income tercile were 7.1 per cent and 12.8 per cent more likely to save in their MoMo wallet respectively. Similarly, those within the richest 40 per cent income tercile were 6.7 per cent and 9.6 per cent more likely to save in their MoMo wallet respectively, compared to those within the bottom 40 per cent income tercile.

Since saving is a function of income, it is not surprising that the proportion who are saving increases as people's income level rises. Many studies have shown that MoMo adoption induces both the rich and the poor to save some of their income through their MoMo account due to the convenience it offers to transfer money to others at a relatively lower cost (Honohan and King, 2012; Shem et al., 2012; Jack and Suri, 2014; Mbithi and Weil, 2014; Batista and Vicente, 2016). Higher education also increases people's knowledge, confidence, and ability to use technology-based applications like MoMo (Riddell and Song, 2017; Kodom et al., 2020). Roger's (1995) innovation diffusion model found education as a major predictor of innovation adoption. Earlier studies in Ghana have also found higher education to be a major predictor of MoMo adoption (Dzokoto and Appiah, 2014; Osei-Assibey, 2015).

Effect of MoMo on access to credit

The third and final indicator is access to credit, which is an additional financial service capable of aiding the poor and vulnerable to make the investments needed to lift them out of poverty and absorb economic shocks. Table 4 presents the results of the probability that an individual using MoMo has: 1) accessed credit; 2) accessed credit from a financial institution; or 3) accessed credit from informal sources. A comparative analysis of the results shows that in 2014, controlling for the demographic characteristics of a person, having a MoMo account did not significantly influence the chances that a person had accessed credit. However, in 2017, MoMo account holders were 46.3 per cent more likely to access credit.

In the same vein, in 2014, controlling for the demographic characteristics of a person, having a MoMo account was significantly associated with access to credit from a financial institution. However, in 2017, having a MoMo account did not significantly influence the likelihood of an individual to access credit from either a formal or informal source. The relatively weaker association between MoMo and access to credit compared to savings reflects the fact that there are other barriers to credit. Unlike the formal system, where one can open a bank account and after a period of using the account may be eligible to obtain credit, operating a MoMo account does not make one easily eligible to access credit from financial institutions. Although in the past couple of years there are some credit facilities that users of MoMo can access on the MoMo platform, these are not widespread and the value of credit one can obtain through those services is very low. Unlike Ghana, Kenya has developed its M-Shwari services to the point that they serve as a major source of access to credit for many MoMo users (Aron, 2018).

Table 4 Effect of MoMo on access to credit

Variables	2014			2017		
	Access credit	Financial institution credit	Credit from informal sources	Access credit	Financial institution credit	Credit from informal sources
Female	-0.032 (0.032)	0.027 (0.020)	-0.028 (0.030)	0.016 (0.040)	-0.000 (0.024)	-0.055 (0.045)
Age	0.021*** (0.006)	0.017*** (0.004)	0.014** (0.007)	0.006 (0.007)	0.004 (0.003)	0.019*** (0.006)
Age ²	-0.000*** (0.000)	-0.000*** (0.000)	-0.000** (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000*** (0.000)
Educational attainment (ref: primary/less)						
Secondary	0.037 (0.043)	0.027 (0.023)	0.041 (0.064)	-0.046 (0.030)	0.008 (0.026)	0.005 (0.061)
Tertiary	0.238*** (0.072)	0.111* (0.064)	0.134 (0.111)	-0.151*** (0.054)	0.031 (0.055)	-0.074 (0.135)
Income terciles (ref: bottom 40%)						
Middle 20%	-0.033 (0.051)	-0.012 (0.026)	0.006 (0.061)	-0.035 (0.040)	0.046 (0.034)	0.092* (0.050)
Top 40%	0.099*** (0.038)	0.027 (0.028)	0.102*** (0.037)	-0.024 (0.030)	0.026 (0.026)	0.017 (0.041)
MoMo user	-0.369* (0.201)	0.236** (0.108)	-0.444* (0.234)	0.463*** (0.073)	0.013 (0.044)	-0.220 (0.295)
Obs.	992	992	992	957	957	957
Prob > χ^2	0.000	0.000	0.000	0.000	0.001	0.000

Notes: Estimated marginal effects are presented and robust standard errors are in parentheses. Standard errors are robust to heteroscedasticity.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Conclusion

This study assessed the extent to which MoMo serves as a gateway to the use of formal financial services. The study found that MoMo has a positive effect on the probability that users operate a formal account, save, and obtain credit. An initial association between use of MoMo and both saving and credit with formal financial institutions was observed in 2014; however, this relationship was not statistically significant in 2017. Nor was there a significant diminution in saving through informal mechanisms, implying that formal and informal finance remain complementary. Between 2014 and 2017, there was a 15.7 percentage point increase in the proportion of MoMo users who saved in only their MoMo account. This includes people who previously saved through informal means but have gained trust in MoMo as a relatively secure place to keep their savings. This is a positive sign for greater financial inclusion, as people

do not just use MoMo as a tool for transfers, but also as a means for mobilizing savings, especially among the previously excluded segment of the population.

The positive effect of MoMo on savings and microcredit can be attributed to the regulatory changes in 2015. The 2015 electronic money issuers guidelines compelled banks (who keep the MoMo savings) to pay a minimum of 7 per cent annual interest on MoMo deposits to the service providers (PricewaterhouseCoopers, 2016), who subsequently share it with their customers (80 per cent to customers). The regulatory changes also permitted credit houses to provide microcredit to users on the platform.

The implication of these findings for financial inclusion is that the unbanked segment of the Ghanaian population using MoMo is more comfortable with conveniently accessing formal financial services from the MoMo platform than directly from a formal institution. This has implications for policy. The regulator and service provider should consider facilitating unbanked MoMo users to convert their MoMo accounts into a bank account, or otherwise enable their transactional history to become a credit score for accessing higher funds.

One key factor that limits the use of MoMo is the charges. On 1 May 2022, Ghana commenced the implementation of the 'Electronic Transaction Levy' or 'E-Levy' of 1.5 per cent on electronic transactions: MoMo payments (above GH¢ 100 or US\$16), bank transfers, merchant payments, and inward remittances. Even though the levy is meant to provide government with a projected GH¢6.96 bn (\$1.1 bn) revenue in 2022, there are concerns about the effect of the levy on financial inclusion. A few days before the implementation of the levy, the country witnessed panic MoMo withdrawals and a couple of days into the implementation, there were concerns about reduced daily MoMo transactions. The e-levy is likely to reduce the volume and value of MoMo transactions, negatively affect the MoMo retail business, and increase the use of cash payments. There is likely to be a trade-off between government's domestic revenue mobilization and financial inclusion. The government seems to have safeguarded the financially excluded by introducing a waiver to exempt all MoMo transfers not exceeding GHS 100 or US\$16 (Oni and Gasparri, 2022). The low financial literacy rate is likely to erode the gains Ghana has made in digital financial inclusion. Intensification of public education on the e-levy by both the government and the service provider is critical to achieve the government's predicted 24 per cent drop in MoMo users within the short term of implementing the levy. Without it, the effect of the levy on the use of MoMo may be severe.

Despite the contribution of the study to emerging literature on mobile financial inclusion, the absence of some potentially important variables in the World Bank Findex data posed a limitation to the study. For instance, while education and income are important predictors of MoMo adoption, other variables such as locality of residence (urban or rural), household size, employment status, and financial literacy are also important variables whose inclusion could enhance the robustness of the analysis. Frequency of using a financial service (or MoMo), value of savings in the MoMo wallet, need for credit facilities, amount of credit obtained, and period of MoMo adoption are potentially important variables whose addition to the Findex dataset could enhance the analysis.

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