

**DISSERTATION**

**THE ROLE OF MOBILE MONEY IN FACILITATING RURAL ACCESS TO  
FINANCIAL SERVICES AND THE RESULTANT EFFECT ON HOUSEHOLD  
WELFARE: EVIDENCE FROM UGANDA**

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**2015**



National Graduate Institute for Policy Studies

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By

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## **Abstract**

# **THE ROLE OF MOBILE MONEY IN FACILITATING RURAL ACCESS TO FINANCIAL SERVICES AND THE RESULTANT EFFECT ON HOUSEHOLD WELFARE: EVIDENCE FROM UGANDA**

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September, 2015

Access to financial services is crucial for development as it enhances capital funds mobilization and consumption smoothing, subsequently reducing poverty and vulnerability. However, majority of the population in developing countries have no access to basic financial services, especially in rural areas which are often underserved or unserved by formal financial institutions. Mobile money – a financial product that allows users to make financial transactions over the mobile phone – has been partially bridging this gap in many emerging states especially in Sub-Saharan Africa over the past decade. In Uganda, mobile money was introduced in 2009 and currently, over 18 million people have subscribed to the service. However, despite the general consensus among scholars and policy makers about the enormous potential of this financial product to boost financial access and usage in rural areas, empirical evidence is hardly available. Moreover, there is scanty empirical evidence on whether mobile phone-based access to financial services translates into improved welfare for its users. Using household data from 94 villages, this dissertation investigates

the role played by mobile money in stimulating the saving, credit and remittance behavior of rural households and whether this translates into welfare improvements for the user households. The study finds that mobile money use increases the likelihood of saving, borrowing and receiving remittances, which is made possible by the reduction in transport and transaction costs associated with the services. The study further finds that the amount of savings, credit and remittances increases with mobile money adoption, which translates into an increase in household consumption per adult equivalent. These results imply that, through enhancing access to financial services, mobile money improves the financial behavior of rural households and in turn increases their welfare. Designing pro-poor financial products may thus be an effective strategy to foster financial inclusion and reduce both poverty and vulnerability.

## **Dedication**

To my mother, Nnabulya Hadijah Ggombe; my wife, Akampumuza Precious, my son, Mutebi Abdul-Rahman, my daughter, Namutebi Lashrah and my brother and sisters.

## Summary

It is generally believed that financial sector development has a positive association with economic development and that access to financial services helps people to better manage funds, raise capital for productive investment and smooth their consumption. However, a large proportion of the population in developing countries is excluded from the formal financial services and this curtails their capacity to undertake productive ventures to uplift their livelihoods. Various reasons explain the majority exclusion, including long distance to the financial institutions which imposes high costs in terms of transport fees and travel time, high service cost and the cumbersome documentation required to open bank accounts. These constraints often disproportionately restrict the rural poor from using financial services especially given the relative urban concentration of formal financial institutions in developing countries. Those excluded from the formal financial system often resort to informal and risky alternatives like burying money underground as a form of saving, borrowing from individual money lenders at extremely high interest rates and physically travelling long distances to hand-deliver remittance funds.

The recently introduced mobile money service which allows users to make basic financial transactions over the mobile phone has been steadily bridging this gap, notably in Africa. The rapid rate of dissemination of mobile money is supported by four major considerations. First, with over 60 percent of Africans owning at least one mobile phone, the mobile money service is more accessible by the rural poor and the establishment cost is relatively lower than that of formal financial institutions which would need to incur high fixed costs to establish branches in rural locations with uncertain demand for bank services.

Secondly, general lack of access to formal financial platforms presented mobile money as a viable alternative. For the majority of the rural poor with limited or no access to the formal financial services providers, mobile money is by far the most viable financial product available to them. This partly explains its relatively higher dissemination speed in Africa than in other regions like Asia. Third and closely linked to the previous consideration is that the widely distributed mobile money agents (cash-in and cash-out centers) across rural communities makes mobile money services attractive to the rural populace as it reduces the associated travel time and transport costs of using financial services. Lastly, for some specific financial services, the service fees charged by mobile money are considerably lower than that of commercial banks and MFIs, although this largely depends upon the amount transacted.

This dissertation investigates whether mobile money improves the financial behavior of rural households in Uganda by bringing services closer to them and the resultant welfare effect of access to financial services. Data used in this analysis is drawn from two surveys conducted in Uganda; Research on Poverty, Environment and Agricultural Technology (RePEAT) conducted in 2012 and the Mobile Money Survey conducted between June and July 2014 (hereafter, MM2014). These surveys focus basically on rural households who often tend to be financially excluded and thus they offer a good sample for this analysis. The study first investigates whether the presence of a mobile money user in the household has an effect on the likelihood of saving and borrowing money and receiving remittances from family members and friends. The study then analyzes the difference in the respective amount of money saved, borrowed and received in

remittance between mobile money user-households and non-users, conditional on using these services at all within one year before the survey. Finally, the study analyzes the welfare improvement measured by a change in household consumption expenditure per adult equivalent, brought about by the adoption of mobile money.

In both RePEAT and MM2014, comprehensive household-level and community-level information was collected. Household-level information drawn from RePEAT includes household consumption expenditure from which welfare indicators are constructed, household demographics, land and household asset holdings, usage of mobile money services, health, education and crop production. The community survey captured information on the condition of roads in each village and the physical distance from the village center to main markets and district headquarters where most services (including banking services) are often concentrated. MM2014 elicited information on household usage of financial service providers – commercial banks, mobile money, microfinance institutions (MFIs) and Savings and Credit Association (SACCO) – as well physical access to financial service services measured by the distance from the village center to each of the four financial service providers. This distance measure is used to analyze how proximity to the service center influences the household's decision to use the services offered by the respective financial institutions, to investigate the general consensus in the literature that long distance hinders financial service adoption. The survey also collected information on the amount of money saved, borrowed and received in remittances by household members in one year before the survey, which constitute key outcome variables in the analysis.

The study seeks to test two main hypotheses; (1) mobile money increases proximity to financial service centers and reduces the travel time and transport costs associated with financial service usage which, in turn, induces households to adopt these services and increases the amount of the respective services transacted by the members of user households and (2) through facilitating savings, borrowing and remittance transactions, mobile money provides a platform for households raise funds to augment their consumption expenditures, which improves their welfare. I therefore expect to find a significant difference in the likelihood of a household saving, borrowing and receiving remittances and in the transaction amount of each service between mobile money user-households and non-users. I also expect to find a positive and significant association between mobile money adoption and household consumption expenditure per adult equivalent, which, supposedly, results from the enhanced access to financial services. To the best of my knowledge, no study has analyzed the effect of mobile money on rural financial behavior, particularly the facilitation of savings and credit. Moreover, no study has empirically analyzed the welfare impact of mobile money in the specific context of rural areas with limited or no coverage by formal financial institutions.

The study finds that having at least one member in the household who uses mobile money services is associated with a higher likelihood of saving, borrowing and receiving remittances and an increase in the amount of money saved, borrowed and received in remittances from family members and friends. Another finding of the study is that the distance to the mobile money agent has a significantly negative association with both the household's likelihood and frequency of using mobile money services. Contrary to

the general expectation, there is no systematic association between the distance to the bank, MFI and SACCO and the likelihood and use frequency of these institutions. A possible explanation as to why distance to the bank does not significantly enter the household's decision to use bank services in this context is that this decision may depend more on the household's asset wealth or income which makes it affordable for household members to travel and access bank services as far as hundreds of kilometers in the district town. In fact, the study finds a strong positive correlation between the value of household assets and both bank account adoption and the frequency of using bank services.

A further finding of the study is that households who use mobile money services experience a notable improvement in their welfare, as indicated by an increase in their real consumption per adult equivalent relative to that of their non-user counterparts. Results reveal that the main mechanism of this welfare effect is the facilitation of remittances; user households have a higher likelihood and annual frequency of receiving remittances and the amount of remittances received is significantly higher than that of non-users. This therefore implies that mobile money provides a cheap, fast and convenient channel through which rural households receive financial support from members of their social networks living and/or working outside the village, which in turn complements their consumption budgets. In support of this conjecture, data reveals that over 30 percent of the remittance money received by the sample households is used to supplement household consumption expenditure.

The findings of this study unravel the potential role that mobile money plays in bridging the financial access gap that is characteristic of most rural areas in Uganda particularly and in many developing countries generally. The findings therefore have an implication that designing cheap, easily accessible and convenient financial products could partially relax the financial access constraint of rural households and improve their financial behavior. The results further imply that scaling up mobile phone-based access to financial services should be emphasized and incorporated into poverty alleviation strategies. Indeed, the welfare improvement found in this study as a result of mobile money adoption indicates that rural households could be redeemed from acute poverty and vulnerability by enhancing their access to affordable financial services, which, in turn, could boost their ability to invest in productive assets and smooth consumption.

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## **CHAPTER 1**

### **Introduction**

Scholars widely concede that a well-functioning and developed financial sector is integral to economic development through its role in mobilizing funds for productive investment, aiding in the better management of funds and risk management (World Bank, 2012; Levine, 1997). For the financial sector to enhance the financial inclusion needed for economic transformation, financial services need to be both accessible and affordable especially to the most vulnerable groups (Dupas and Robinson, 2013; Odhiambo, 2009). Enabling access to a cheap savings platform and relaxing the credit access constraints that characterize many poor people in developing countries could potentially make massive contribution to poverty alleviation by boosting productive investments and asset acquisition (Dupas and Robinso, 2013; Bernajee et al., 2009; Jalilian and Kirkpatrick, 2005). Empirical evidence also suggests that access to a cheap credit and remittance channel promotes both formal and informal risk sharing mechanisms and consumption smoothing, ultimately reducing socio-economic vulnerability (Mbiti and Weil, 2011; Jack and Suri, 2014; Kaboski and Twonsend, 2011). However, access to these basic financial services is still a mystery for majority of the world's poor whose ability to undertake livelihood-augmenting strategies and safeguard against their idiosyncratic vulnerabilities is curtailed, especially in developing countries (Beck et al., 2004; Demirgüç-Kunt and Klapper, 2012).

In many developing countries, financial exclusion accrues from either supply-side considerations which limit physical access to financial institutions or demand-side

factors that discourage some people from using the available financial services, or a combination of both considerations. The major supply-side factor is the distance to the financial institutions which is directly linked to the tendency of formal financial institutions like commercial banks and microfinance institutions to concentrate in urban areas with limited or no rural coverage (Pendrosa and Do, 2011). Trekking long distances to access financial services in urban locations is associated with high transport, time and inconvenience costs which deter potential rural-based users from adopting these services. The high transaction costs associated with most of the formal financial services is one of the key demand-side limitations to financial service adoption which is exacerbated by low incomes of potential users (Dupas and Robinson, 2013). Other demand-side factors often cited in the literature include socio-economic, historic, religious and cultural considerations like gender, ethnicity, cultural beliefs and religion (Johnson and Nino-Zarazua, 2011; Sarma and Pais, 2011).

Evidence shows that the lack of access to basic financial services increases the vulnerability of poor households to idiosyncratic and covariate shocks to their incomes sources (Dupas and Robinson, 2009, 2011; Dupas et al., 2014). With formal insurance markets gravely underdeveloped in many developing countries (Townsend, 1994), credit-constrained households are exposed to income and consumption declines associated with weather shocks like droughts and floods (Ringler et al., 2011; Ito and Kurosaki, 2009; Jack and Suri, 2014; Kurosaki, 2006; Dercon et al., 2005). Moreover, the absence of a cheap and convenient remittance platform exacerbates the inability of households to engage in informal risk-sharing mechanisms through remittance exchange with their networks of

family members and friends in distant locations (Jack and Suri, 2014; Munyegera and Matsumoto, 2014).

Mobile money – a financial product that allows users to access financial services over the mobile phone – has been gradually changing the financial access situation for many people formerly excluded from the formal financial sector especially in Sub-Saharan Africa (Hughes and Lonie, (2007). Unlike formal financial institutions which require costly establishment of bank branches, mobile money services are offered via the mobile phone, which makes it easier to infiltrate the rural populace in Africa given that over 60 of the continent’s population has access to a mobile phone (World Bank, 2013). The penetration speed is made even faster by the wide spread of mobile money agents in many rural areas, making cash-in and cash-out transactions faster and more convenient. Thus, by increasing proximity to financial service centers and the resultant reduction in transport, time and transaction costs, mobile money is anticipated to further enhance financial deepening by boosting financial service uptake among the rural poor with implications for poverty and vulnerability reduction (Aker, 2011; Mbiti and Weil, 2011). Indeed, mobile money has been reported to facilitate domestic remittances, effectively buffering consumption expenditure against illness and weather shocks (Jack and Suri, 2014). In the agricultural sector, remittance funds exchanged via Safaricom’s M-PESA in Kenya have been documented to partially relax credit constraints faced by smallholder farmers, allowing them to increase agricultural commercialization and farm incomes (Kikulwe et al., 2014).

Existing studies on mobile money have documented its impact on remittances and the resultant welfare improvement and risk-sharing enhancement. Although the primary function of mobile money is to facilitate peer-to-peer remittances, its secondary functions as store of value and a channel for credit exchange and electronic payment for goods and services are rapidly evolving. This trend therefore provides a base for the general consensus in the literature that mobile money can drastically induce savings and credit access (Mbiti and Weil, 2011; Morawczynski, 2009). However, this potential is barely empirically investigated. Moreover, investigating the claim that mobile money has the potential to bank the unbanked and improve their welfare requires special focus on the formerly excluded groups, for example the rural poor, which has not been given particular attention in the literature.

This dissertation pursues two main objectives in an attempt to fill the gap in the literature; the first objective is to analyze the role played by mobile money in boosting physical access to and usage of financial services among rural households. This attempt is inspired by the general claim in the literature that mobile money has the potential to bail out vulnerable groups from financial exclusion, especially the poor and rural population (Mbiti and Weil, 2011). The dissertation therefore gives specific emphasis on (i) analyzing the effect of mobile money adoption on the likelihood that a household saves, borrows and receives remittances as well as the amount of the financial services transacted and (ii) exploring the association between distance to financial service providers and the usage of these financial institutions. The second objective is to analyze the welfare effect associated with access to mobile money services. As literature has suggested poverty alleviation and

consumption smoothing effects of financial access (Odhiambo, 2009; Beck et al., 2004), I seek to investigate whether mobile money adoption translates into changes in household consumption expenditure per adult equivalent.

I find that mobile money, through reducing distance to service centers, boosts the adoption of financial services – savings, remittances and credit – and significantly increases the amount of the respective services transacted by the rural households using this financial innovation. The study also finds that households that adopt mobile money experience positive and significant welfare improvements as indicated by the increase in their household per adult equivalent consumption. These findings carry vital policy implications: First, they hinge on the need to design pro-poor financial products as one way of leveraging the financial access constraint that characterizes many vulnerable, poor and rural households. Secondly, access to an affordable financial product indeed has a great potential to reduce poverty and improve welfare. This dissertation therefore recommends that enabling access to financial services by low-income people should be incorporated into national poverty alleviation strategies in particular and development plans in general.

The rest of the dissertation is organized as follows. Chapter 2 reviews existing literature on financial access and its development impact and identifies the concerns that have not been given adequate attention in the literature, which this dissertation seeks to address. Using the third and fourth rounds of the ReAPEAT survey (2009 and 2012), Chapter 3 analyzes the welfare effect of mobile money adoption, measured by household consumption per adult equivalent. By categorizing household consumption expenditure into

food expenditure, non-food basics (including education, health and household semi-durables) and social contributions, the chapter also illustrates the differential response of these consumption components to mobile money access. In order to understand the mechanism through which mobile money could affect household welfare, the chapter further analyzes the association of mobile money adoption with three measures of remittances – the likelihood of a household receiving remittances, the number of times a household receives remittances annually and the corresponding total value of remittances received one year before each survey period. Chapter 4 then uses household-level and community-level data from the fourth round of RePEAT conducted in 2012 and the Mobile Money Survey conducted in 2014 (MM2014) to analyze the effect of mobile money adoption on the household’s likelihood of making financial transactions – savings, credit and remittances in the context of rural Uganda. The chapter also analyzes the effect of this financial platform on the amount of money saved, borrowed and received in remittances. Chapter 5 summarizes the findings from the empirical investigations conducted in Chapters 3 and 4 and draws policy recommendations based on these results.

## CHAPTER 2

### Background and Literature Review

#### 2.1 Introduction

Access to financial services has been documented to have a remarkable impact on economic development (Arestis and Demetriades, 1997; Jung, 1986; Patrick, 1966; Levine, 1997; King and Levine, 1993). It is generally believed that the poor have the potential to gradually accumulate savings, undertake productive investment ventures and engage in consumption smoothing strategies to improve their welfare given access to affordable financial services (Prina, 2015; Dupas and Robinson, 2013). Existing literature has thus highlighted the lack of access to basic financial services – savings, remittances, credit and insurance as a major factor aggravating poverty and vulnerability in many developing countries (Prina, 2015; Jalilian and Kirkpatrick, 2005; Beck *et al.*, 2004; Demirguc-Kunt *et al.*, 2008; Odhiambo, 2009).

This chapter highlights the existing literature linking financial access and economic development in general and poverty and vulnerability reduction in particular. The major factors behind financial exclusion in developing countries are also presented briefly in the chapter. The chapter then gives an overview of the current financial access situation in Uganda, purposely to illustrate the access gap by social groups and geographical divides. The evolution of mobile money services in the country is also discussed in the chapter to shed light on the prospects of this financial platform to relax financial access constraints especially among the people formerly excluded from the formal financial sector. Lastly, the

chapter reviews existing literature on the dissemination of mobile money, its potential role in bridging the financial access gap and the resultant development impact especially in Sub-Saharan Africa.

## **2.2 Background**

### **2.2.1 The evolution of mobile money services in Uganda**

In March 2009, Mobile Telephone Network (MTN) – the leading Mobile Network Operator in the country – established *MTN Mobile Money*, the first mobile money platform in the country, inspired by the massive success of Safaricom’s M-PESA in Kenya which was launched in March 2007. Airtel Uganda – formerly Zain – embraced the product by rolling out *Airtel Money* in June the same year. This new financial innovation proved to be an efficient way for telecom companies to increase their market shares by widening the range of services available to their clients. This attracted Uganda Telecom to introduce *M-Sente* in March 2010, followed by *Warid Pesa* from Warid Telecom in December 2011 and *Orange Money* from Orange Telecom in the first half of 2012 (Uganda Communications Commission-UCC 2012). Currently (2015), there are three major MNOs offering mobile money services after the 2013 takeover of Warid Telecom by Airtel.

Since mobile money was established in Uganda, the number of subscribers has been steadily increasing. By June 2014, over 17 million Ugandans had adopted mobile money services, representing approximately half of the population and a three-fold expansion from 3 million users in 2011. In the same period, the number of mobile money transactions increased from 180 million to 242 million and the corresponding total value exchanged

through the platform increased from \$1.5 billion to \$4.5 billion (Bank of Uganda, 2012). This rapid expansion partly owes to the high rates of both the roll-out of mobile phone network and adoption of mobile phones. Based on the sample in this analysis, the proportion of households owning a mobile phone increased from 73 percent to 90 percent between 2012 and 2014 while all Local Council 1s (hereafter called LC1s) were covered by mobile phone network in both rounds.<sup>1</sup> One in four households reported possessing more than one mobile phone in the Mobile Money survey of 2014. A quick comparison between mobile money and traditional financial institutions reveals intriguing observations, highlighting on the relative ease of physical access to mobile money service centers. *MTN Mobile Money* alone has over 30,000 agents as compared with 900 commercial bank branches with 786 Automated Teller Machines (ATMs).<sup>2</sup>

Mobile money allows users to deposit money as e-float on a SIM card-based account, called an *m-wallet*, which can be converted into cash at the customer's discretion at any mobile money agent location all over the country. In the initial stages of its establishment, the range of services offered via mobile money was largely limited to person-to-person transfer. However, with the growing interest from various stake-holders, coupled with competition among the mobile network operators (MNOs), service providers have gradually innovated to widen their range of services. Currently, most MNOs offer more complex functions like payment of utility bills, school fees, airtime purchase and electronic payment for goods and services. One of the most interesting advances is an

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<sup>1</sup> LC1 is the smallest administrative unit in Uganda.

<sup>2</sup> Mobile money agents serve as outlet centers or cash points where users can exchange their e-float for cash and vice versa.

arrangement that allows for the payment of government taxes and Kenya Airways tickets using mobile money.

Recent developments in the mobile banking arena have made it possible for users to access bank account information using their mobile phones and move funds between the bank account and *m-wallet* without physically visiting their bank branches, thanks to the recent partnerships between MNOs and banking institutions.<sup>3</sup> This implies that mobile money not only has transformational benefits for formerly excluded individuals but also improves service experience, convenience and quality for the existing users of bank services. With the rapid urbanization in Uganda over the past years, the number of people migrating to urban centers has been steadily increasing, most often in pursuit of lucrative opportunities in urban centers. Those who migrate to cities often extend financial support to their family members and friends in villages in the form of remittances and informal loans. Before the advent of mobile money in the country, the efficiency of such informal risk-sharing arrangements heavily relied on the quality of transport infrastructure as most of these transactions have traditionally been made through informal channels like physical movement of cash by the receiver, sender, and agents like bus and taxi drivers. Besides, such channels are often risky and involve high transaction costs in terms of transport fares and travel time incurred in sending and receiving money among family members and friends especially across geographically distant and remote locations. This background motivates one of the major postulations of this study that mobile money lowers the transaction, time and transport costs associated with the usage of financial services,

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<sup>3</sup>Major partnerships exist between *MTN Mobile Money* and Stanbic Bank, *M-Sente* and Standard Chartered Bank and *WaridPesa* and DFCU Bank.

catalyzing their adoption even by rural households. Similarly, the financial product has made it easier for family members, friends, private money lenders and members of informal social groups to exchange informal credit while others find it convenient and cost-effective to save money in the *m-wallets* in instances where commercial banks are inaccessible.

## **2.3 Literature Review**

### **2.3.1 Financial inclusion, poverty and vulnerability reduction and economic development**

There is a general consensus in the literature that financial sector development augments economic development (Arestis and Demestriades, 1997; Jung, 1986). Commonly cited pathways include the mobilization of investment funds and facilitation of consumption smoothing strategies (Patrick, 1966; Levine, 1997; Dupas and Robinson, 2013; Jack and Suri, 2014). Macro-level evidence points out the inducement of innovations as a major pathway through which the financial system stimulates aggregate economic growth (King and Levine, 1993). Various micro-level studies have therefore demonstrated that access to basic financial services like savings, remittances, insurance and credit carries vital implications for poverty and vulnerability reduction especially in developing countries (Jalilian and Kirkpatrick, 2005; Beck *et al.*, 2004; Demirguc-Kunt *et al.*, 2008; Odhiambo, 2009).

There is a growing body of empirical and experimental evidence that access to affordable bank accounts translates into tremendous welfare improvements and boots productive investments (Prina, 2015; Dupas and Robinson, 2008, 2013). A well-functioning financial

sector thus ought to achieve the double goal of enhancing physical access to financial services and ensuring that these services are affordable by the average citizen. However, available evidence reveals that the vast majority of the people in developing countries have no access to basic financial services (Demirgüç-Kunt and Klapper, 2012). Most intriguing is the fact that majority of the poor are located in rural areas which, in many developing countries, are often underserved or unserved by formal financial institutions. There is thus a growing concern, backed by empirical evidence, that the idiosyncratic lack of access to livelihood-augmenting financial services could limit the ability of many poor people to escape chronic poverty and vulnerability (Dupas and Robinson, 2008).

Recent empirical and experimental evidence reveals that the poor and disadvantaged categories of people are often willing to adopt financial products but are often restricted by supply and demand obstacles. The low uptake of bank accounts among the rural poor for instance is partly attributed to the relative urban concentration of commercial banks and microfinance institutions, often imposing long travel times and expensive transport costs onto potential rural users in their attempt to access financial service points (Brune et al., 2014; Pedrosa and Do, 2011). The high transaction and maintenance fees associated with some bank products are also cited as detrimental to the poor people's adoption of bank accounts (Banerjee and Duflo, 2011; Dupas et al., forthcoming, 2013, 2008). Other studies have highlighted the lack of trust in financial institutions (Dupas et al., forthcoming) and other socio-cultural and religious considerations as hindering the adoption of bank accounts in some communities (Sarma and Pais, 2011; Johnson and Nino-Zarazua, 2011). It is therefore imperative to increase proximity to service centers, reduce service fees, increase

trust in formal financial institutions and design pro-poor financial products to increase the uptake of financial services especially among the poor (Karlan, 2014).

### **2.3.2 Mobile Money, financial access and welfare**

Financial sector innovations have been gradually taking place in an attempt to close the financial access gap in many countries by directly capitalizing on and understanding the challenges that often exclude some categories of people from the formal financial system (World Bank, 2012). Mobile money is a recent financial innovation that allows users to make savings, transfer funds and transact electronically in goods and services over the mobile phone. Its adoption is rapidly expanding especially in East Africa partly due to the high rates of mobile phone network penetration and mobile phone adoption (Porteous, 2006; World Bank, 2012), lack of affordable alternatives especially among rural communities (Mas and Radcliffe, 2010b; World Economic Forum report, 2011) and lower service fees relative to conventional bank accounts (Jack and Suri, 2014).

The mobile money platform is believed to improve financial access among the poor and transform livelihoods because of the relatively lower service charges and reduced physical distance between households and service points (Aker et al., 2011). It is by no surprise therefore that the product has been tremendously boosting remittance flows especially between urban and rural locations (Mbiti and Weil, 2011) which often supplement consumption expenditures (Munyegera and Matsumoto, 2014). Jack and Suri (2014) illustrate that Kenyan households use *M-PESA* to solicit remittances from their networks of family members and friends at lower transactional costs and that these funds

significantly safeguard recipient households against consumption declines when hit by weather and illness shocks. There is also anecdotal evidence that the mobile money platform provides a convenient platform for incremental saving, which can change the financial behavior of households by reducing wasteful expenditure and shifting away from risky informal saving platforms like burying money in the ground and keeping cash at home (Morawczynski and Pickens 2009).

Other pathways through which mobile money-based remittances contribute to welfare improvements among rural households is the relaxation of credit constraints faced by smallholder farmers, enabling them to commercialize their farming activities and increase farm incomes (Kikulwe et al., 2014). This is quite vital especially given that small scale farmers often lack the required collateral to obtain credit from commercial banks and microfinance institutions such that remittances are an invaluable alternative source of funding for the purchase of agricultural inputs. The rapid expansion of mobile money services is therefore expected to transform economies as it is readily adopted in a wide range of sectors including finance, health, agriculture, education and business (World Bank, 2013).

## **2.4 Conclusion**

This dissertation attempts to contribute to and fill some gaps in two strands of literature presented in this chapter; first, on financial inclusion and welfare – and ultimately development – and second, the development impact of mobile money. Anecdotal, empirical and experimental studies have demonstrated that the poor are able and willing to adopt

financial services but often have no affordable and convenient options. This dissertation therefore seeks to investigate whether access to cheap and convenient services over the mobile phone influences the financial behavior of rural households by inducing them to save, borrow and receive more remittances. This is quite important because most of the existing literature on financial access have focused on traditional or formal financial institutions, particularly access to bank accounts while the role of mobile money remains under-investigated. Besides, the few studies that have investigated the financial access potential of mobile money have focused solely on remittance, which is the most popular service offered across this platform. This dissertation therefore attempts to fill the literature gap by investigating the crucial role of this financial innovation in shaping financial behavior by extending the analysis beyond person-to-person remittances to the less conventional services like savings and credit which have not been investigated.

Secondly, the dissertation addresses the question of whether financial access for the poor translates into significant welfare improvements. Although it is widely documented that access to no-frill bank accounts is often associated with great welfare improvements and poverty and vulnerability reduction, empirical evidence on the welfare-enhancing effect of mobile money is still scant. This dissertation thus seeks to examine the effect of mobile money on aggregate and disaggregated components of household consumption per adult equivalent in pursuit of empirical evidence on whether there are welfare gains that accrue to the users of this financial product especially among the rural poor. The dissertation also seeks to investigate the pathways through which this financial access influences welfare, focusing specifically on remittances between rural households and their networks of family

members and friends living and/or working outside their villages. Lastly, the results obtained in this dissertation are used to draw policy recommendations regarding the need to design pro-poor financial products as an effective strategy boost financial access and alleviate poverty and vulnerability.

## **CHAPTER 3**

### **Mobile Money, Remittances and Rural Household Welfare: Panel Evidence from Uganda**

#### **3.1 Introduction**

Financial inclusion plays an integral role in reducing rural poverty as it facilitates saving and borrowing as well as empowering the poor to smooth consumption and insure themselves against a number of vulnerabilities in their lives (World Bank, 2012).<sup>4</sup> However, a large fraction of the population in developing countries lacks access to the basic financial services (Asli and Klapper, 2012). Lack of access to basic financial services restricts the ability of the rural poor to make savings and investments and engage in both formal and informal insurance mechanisms aimed at smoothing consumption and curbing poverty (Dupas and Robinson, 2008).

The prevailing low rate of financial inclusion has attracted the attention of scholars to investigate its driving factors (Asli and Klapper, 2012; Kumar, 2006; Collins et al., 2009;

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<sup>4</sup> Financial inclusion or financial access will be used interchangeably to refer to a situation where an individual has access to the services of a formal financial institution like a commercial bank, Micro-finance institutions and insurance companies. Financial exclusion is used in this paper to refer to the involuntary lack of access to formal financial services.

Johnson and Nino-Zarazua, 2011). Among the commonly cited limiting factors is the relative concentration of formal financial institutions in urban centers with limited penetration among rural communities. This urban concentration poses high monetary and opportunity costs involved in accessing and using financial services, especially by the rural poor in remote locations. In their analysis of financial access and exclusion in Kenya and Uganda, Johnson and Nino-Zarazua (2011) re-defined financial inclusion to include semi-formal and informal financial services like Rotating Saving and Credit Associations (ROSCA) and Savings and Credit Cooperative Organizations (SACCO). They found that exclusion is associated with agro-ecological and socio-cultural characteristics of the region, rather than the mere urban-rural status.

Mobile banking, a recent innovation in the financial sector, is expected to bridge the financial service access gap, thus allowing for socio-economic improvements especially among the financially excluded rural communities in many developing countries. Mobile banking allows users to make, deposits and transfers of funds as well as purchase of some limited range of goods and services using their mobile phone. This provides a relatively cheap and convenient means through which family members and friends exchange financial assistance in the form of remittances especially in remote areas with limited or no access to formal financial institutions like banks. Empirical studies have illustrated the developmental role of mobile banking. One such popular channel of this impact is the change in the pattern of remittances (Mbiti and Weil, 2011). The benefit of mobile money extends beyond the individual and household levels to businesses and organizations. Aker et al. (2011) demonstrated that the welfare program that distributed financial assistance for

people to cope with the adverse effects of a severe drought in 2008 was implemented cheaply through mobile money, relative to conventional transfer mechanisms. This, they argue, owes to the relative inexpensiveness and convenience of mobile banking.

Jack and Suri (2011) provided evidence that access to mobile money services facilitates risk sharing by significantly reducing the transaction costs of remittances among family member and friends in Kenya. They found that households which subscribe to M-Pesa - Kenya's most popular mobile money service - were able to cushion themselves against consumption volatilities when struck by income shocks, by receiving remittances from a wide pool of members in their social networks.

Despite the relative importance of mobile banking in the lives of the rural poor, less is known about its impact on their welfare. Specifically, there is scanty empirical evidence on how financial access affects the lives of the rural poor in developing countries. To the best of my knowledge, there is no empirical study that analyses the socio-economic impact of mobile banking in the Ugandan context, most of the recent works are based on the Kenyan experience (Mbiti and Weil, 2011; Jack and Suri, 2011). Besides, the analysis samples of these studies are inclusive of the urban mobile money users with less focus on the rural communities which tend to be more financially excluded. Moreover, recent studies on mobile money in Uganda are centered on analyzing adoption and use patterns (Johnson and Nino-Zarazua, 2011; Ndiwalana, 2010) while other studies rely anecdotal evidence. Following the rapid adoption of mobile money services in Uganda, there is need to assess whether there is any direct welfare improvement that accrues to its users.

This paper seeks to fill the literature gap by investigating the impact of mobile money access on the welfare of rural households in Uganda. This study is unique in a way that it targets particularly households in rural locations which often tend to have less access to formal banking services coupled with relatively high poverty rates. I use a two-year panel of 907 households from 94 Local Council 1s in Uganda<sup>5</sup>, collected in 2009 and 2012. In less than four years since its inception in March 2009, the number of active mobile money subscribers has expanded to over nine million users.<sup>6</sup> Between December 2011 and December 2012, the number of mobile money users increased from 2.9 million users to 9 million users. This is expected to facilitate inter-household transfer of funds especially and thereby increase household welfare. The number of LC1s with at least one mobile money booth increased from 26 to 90 out of 94 LC1s in the sample between the two survey rounds. At the same time, household adoption of mobile money services expanded from less than one percent to 38 percent.

From my preferred specification, results indicate that using mobile money is associated with a seven percent increase in household per capita consumption. This is made possible through the facilitation of remittances among family members and friends. In particular, I find that households with at least one mobile money subscriber are 20 percentage points more likely to receive remittances from their members in towns and that the total annual value of remittances received is 33 percent higher compared with their non-user counterparts.

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<sup>5</sup> An LC1 is the second smallest unit of administration in Uganda.

<sup>6</sup> Bank of Uganda estimate as of December 2012.

The rest of the paper is organized as follows. In section II, I provide background information about mobile money in Uganda. Section III discusses the data and summary statistics, followed by empirical strategy in section IV. Empirical results are discussed in section V while section VI concludes.

### **3.2 Background on mobile money in Uganda.**

In March 2009, Mobile Telephone Network (MTN) -Uganda established *MTN Mobile Money*, the first of its kind in the country, following the massive success of Safaricom's M-PESA in Kenya. Airtel Uganda, formerly known as Zain, joined the service when it rolled out its *Airtel Money* in June the same year. This new financial innovation proved to be an efficient way for telecom companies to increase their market shares by widening the range of services available to their clients. This attracted Uganda Telecom's *M-Sente* in March 2010, followed by *Warid Pesa* from Warid Telecom in December 2011 and *Orange Money* from Orange Telecom in the first half of 2012 (Uganda Communications Commission-UCC 2012).

Since mobile money was established in Uganda, the number of subscribers has been steadily increasing. By the end of 2012, Uganda had over 9 million mobile money users all over the country. This represents a three-fold expansion from 3 million users in 2011. The number of mobile money transactions increased from 180 million to 242 million between 2011 and 2012 while the total value exchanged through the platform increased from \$1.5 billion to \$4.5 billion in the same period (BoU, 2012). MTN Mobile Money alone has over 15,000 agents as compared with 455 commercial bank branches with 660 Automated Teller

Machines (ATMs). This rapid expansion partly owes to the high rates of both the roll-out of mobile phone network and adoption of mobile phones. In the analysis sample, the proportion of households owning a mobile phone increased from 52 percent to 73 percent between the two survey rounds while all LC1s were covered by mobile phone network in both surveys.

Mobile money allows users to deposit money as e-float on a SIM card-based account, called an *m-wallet*, which can be converted into cash at any mobile money agent location all over the country. In the initial stages of its establishment, the range of services offered was largely limited to person-to-person transfer but with the growing interest from stakeholders, coupled with competition among the mobile network operators (MNOs), this platform has expanded the range of services to include more complex uses like payment of utility bills, school fees, airtime purchase and direct purchase of goods and services.

Recent developments in the mobile banking arena have made it possible for users to access their bank accounts using their mobile phones without having to physically visit their bank branches, thanks to the partnership between MNOs and banks.<sup>7</sup> This is expected to raise financial inclusion especially at the lower end of the social spectrum while reducing the cost of access and use of basic financial services. With the rapid urbanization in Uganda over the past years, the number of people migrating to towns has been steadily increasing. Those who migrate to cities often render financial support to their rural households in the form of remittances. The efficiency of this remittance system heavily relies on the quality

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<sup>7</sup> Major partnerships exist between *MTN Mobile Money* and Stanbic Bank, *M-Sente* and Standard Chartered Bank and *WaridPesa* and DFCU Bank.

of physical infrastructure as most of these transactions involve physical transfer of cash by the receiver, sender, and agents like bus and taxi drivers among others informal channels. Besides, the massive geographical dispersion between senders and receivers implies high transaction costs in terms of transport fares and travel time involved in sending and receiving money among household members especially across geographically distant and remote locations.

### **3.3 Data and Summary Statistics**

I use data from household and community surveys collected in Uganda in 2009 and 2012 as a part of the Research on Poverty, Environment and Agricultural Technology (RePEAT) project. This is part of the four survey rounds administered jointly by Makerere University, the Foundation for Studies on International Development (FASID) and the National Graduate Institute for Policy Studies (GRIPS) in 2003, 2005, 2009 and 2012. In the baseline survey of 2003, 94 LC1s were sampled and 10 households were randomly selected from each of the LC1s, making a total of 940 households. The follow-up surveys of 2005, 2009 and 2012 successfully captured 856, 816 and 866 of the original households, respectively. The high attrition rate in the third round was partially offset by the inclusion of neighboring households to replace those that could not be traced

The major household-level information that was captured in the surveys included demography, income and consumption expenditure, wealth indicators, use of telecommunication and financial services like mobile phones and mobile banking and farming practices. Community characteristics like distance and travel time to the market

and district towns, availability of mobile phone network and quality of roads were captured in the community-level surveys.

Analysis in this paper is based on a balanced panel of 838 households generated from the third and fourth rounds in 2009 and 2012. I stratify the sample by mobile money adoption status before and after the introduction of mobile money and report the summary statistics in Table 3.1.<sup>8</sup> In 2009, less than One percent of the households reported having used mobile money services and this proportion rose to 38 percent by 2012. Among the households that adopted mobile money, 54 percent reported having at least one mobile phone in 2009 compared to 50 percent reported among non-adopters. By 2012, the proportion of households with at least one mobile phone had increased to 93 percent and 61 percent among adopters and non-adopters, respectively. Although bank account information was not captured in 2009, I do not expect a substantial change between the two rounds. It is not surprising that only 38 percent and 12 percent of adopters and non-adopters reported owning a bank account in 2012, respectively because this sample households are predominantly from rural-based. This throws light on the relative exclusion of majority of rural households and individuals from the formal financial sector services.

At baseline, there was no notable difference between mobile money adopters and non-adopters in the flow of remittances, with an average proportion of 50 percent receiving remittances among both groups. By 2012, however, 78 percent of adopters received

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<sup>8</sup> Although Mobile Money was introduced in the country in 2009, less than one percent of the sample households had adopted the service by the time of the 2009 survey. It is therefore reasonable to refer to 2009 as a year before mobile money and the household characteristics reported for 2009 represent the baseline characteristics of the households.

remittances at least once a year compared to 65 percent among non-adopters. Similarly, the number of remittances received was averagely 2.4 for both groups in 2009 while adopters received 5.5 remittances in 2012 compared to 3.0 remittances received by non-adopters. The total value of remittances received was statistically similar among users and non-users in 2009 while adopters received a significantly larger value of remittances in 2012. There was no notable change in the average land size among users and non-users between the two survey rounds, with adopters (non-adopters) owning 7.2 acres (5.7 acres) in 2009 and 6.9 acres (5.6 acres) in 2012. On average, a household head was 53 years old for both mobile money adopters and non-adopters in both survey rounds while heads of adopting households had two more years of education compared to their non-adopting counterparts. On average, household were similar in terms of major household characteristics in 2009 with the exception of education of the household head, land and asset holdings. I later show how I deal with potential household heterogeneity in the empirical strategy section.

### **3.4 Empirical Strategy**

In this section, I estimate three major equations; (i) the determinants of mobile money adoption at the household level, (ii) the effect of mobile money adoption on household per capita consumption and (iii) the impact of mobile money use on measures of household remittances; probability of receiving remittances, frequency and total value of remittances received.

### 3.4.1 Determinants of mobile money adoption.

The decision to adopt mobile money services depends on observed characteristics of the household and village in the form

$$Mmoney_{ijdt} = 1\{\beta X_{it} + \eta_{dt} + \varepsilon_{ijdt} > 0\}, \quad (1)$$

where  $Mmoney_{ijdt}$  is a dummy variable which takes 1 if household  $i$  living in village  $j$  in district  $d$  uses mobile money services at time period  $t$  and 0 otherwise;  $\eta_{dt}$  is expected to capture the district-year specific unobservable characteristics which would affect mobile money usage;  $X_{it}$  is a vector of household characteristics including household size, log of value of assets and land endowments, age, gender and education level of the household head and a dummy for household mobile phone possession. The Probit regression is employed for the estimation. Moreover, I also try another specification in which household-level fixed effects are introduced in order to rule out the effect of unobservable time-invariant household and village characteristics. A linear probability model is used for this estimation instead of Probit estimation. As I will show in the results section, the change of estimation method does not qualitatively change the main results.

### 3.4.2 Mobile money and household per capita consumption

I first examine the effect of mobile money adoption on household welfare using a simple difference-in-differences strategy that compares the monthly per capita consumption of mobile money users against that of non-users.

$$c_{ijdt} = \alpha_i + \mu Mmoney_{ijdt} + \psi X_{it} + \eta_{dt} + v_{ijdt}, \quad (2)$$

where  $c_{ijdt}$  is the log of monthly real per capita consumption of household  $i$  in village  $j$  in district  $d$  in period  $t$  and  $\alpha_i$  is a household fixed effect. I measure household per capita consumption in real terms by dividing nominal consumption by household size and deflating each consumption category using standard price indices provided by the Uganda Bureau of Statistics. In constructing household real per capita food consumption, I use adult equivalence units rather than head count to adjust for consumption differences by gender and age of household members. The coefficient of  $Mmoney$ ,  $\mu$  represents the parameter of interest or the welfare impact of mobile money use, which is expected to be positive. I use household per capita consumption as a proxy for household welfare. As an alternative, I could use total household income as it is also directly linked to the ability of a household to improve the wellbeing of its members. However, this measure is more vulnerable to short-term economic effects compared to the consumption measure (Gilligan and Hoddinott, 2009).

### 3.4.3 Mechanisms: Mobile Money and Remittances

To assess whether remittance patterns differ across users and non-users of mobile money, I estimate the following equation, which is a slight modification of equation (2).

$$r_{ijdt} = \kappa_i + \pi Mmoney_{ijdt} + \phi X_{it} + \sigma_{jt} + \epsilon_{ijdt}, \quad (3)$$

where  $r$  is a measure of remittances received by household  $i$  in year  $t$ . This measure takes three variants; the probability that a household receives a remittance, the number of remittances received in the past 12 months of the respective survey round and the total value received within the same period. As one of the household-level independent variable,

$X_{it}$ , I include a dummy variable taking one if the household reported having at least one member who moved out to search for a job outside the home village, hereafter used interchangeably as job-seeking behavior and having a migrant worker. In equation (3) I include a full set of controls as in (2) above.

#### **3.4.4 Falsification Test**

In order to confirm that the observed difference in consumption and remittances between users and non-users of mobile money is genuinely due to this financial platform, I replicate the estimation strategy as described above, using RePEAT data for the period prior to mobile money. I thus estimate equations (3) and (4) using 2003 and 2005 data. This constitutes the first and second rounds of the RePEAT series, as described in the Data section of this paper. Using this data, I examine whether there existed differences in consumption and remittance patterns between households that later adopted mobile money against non-adopters. Since mobile money was not available in this period, I use a placebo binary treatment variable equal to one for households that adopted mobile money in/after 2009. I also examine whether having a migrant worker in a household had an influence over remittance patterns. This strategy enables us to assess whether the differences in outcome variables (consumption and remittance measures) between users and non-users are indeed a result of mobile money adoption status. I expect no significant difference between households that later adopted mobile money services and those that did not. If this is true, then the emergence of a significant relationship between mobile money and the outcome variables could be attributed to mobile money.

### **3.4.5 Instrumental Variable and Tobit Regressions**

So far, I have assumed that mobile money adoption by the household is conditionally mean-independent, given the other control variables included in the regressions. This implies that the estimated coefficients are only valid if mobile money adoption is not correlated with the error term conditional on the other controls. Although I am able to rule out the effect of unobserved time-invariant household heterogeneity using fixed effects estimation, the decision to adopt mobile money services may be highly correlated with time-variant un-observables that also affect household consumption expenditure. Also, being a remittance recipient in the past might induce the household to adopt mobile money as a cheaper and convenient platform to receive remittances from their members in towns. This endogeneity resulting from simultaneous effects might confound the OLS and fixed effects estimates. To address the issue, I resort to instrumental variable estimation of consumption using log of the distance to the nearest mobile money agent as an instrument for mobile money adoption at the household level.

The underlying assumption in this framework is that the distance to the nearest mobile money agent is not correlated with household and village characteristics that could affect household consumption. For example, agents might select into communities with larger population densities because of the size of the potential market. This however does not seem to be a threat because mobile money agents were previously existing local businessmen selling airtime cards, who took up the mobile money business as a diversification of their range of services. Besides, the procedure for licensing an agent is not restrictive and the all applications are reviewed by the mobile network operator against

prescribed requirements without due consideration to the geographical and socio-economic characteristics of the agent's location. Besides, I do not find any significant correlation between these characteristics and mobile money agent placement (results available upon request).

I employ a Tobit model in combination with a control function method to deal with two critical challenges associated with the remittance variables. The first challenge concerns the corner solution nature of the remittance measures, owing to the fact that the number and total value of remittances received are only available for households which received positive remittances. This implies that these variables have a skewed distribution given the many zeroes for non-recipients. The control function approach deals with the second challenge - potential endogeneity resulting from the correlation between remittance variables and time-variant unobserved household characteristics (Vella, 1993). In both variants of the Tobit models, I include time averages of household characteristics to rule out the effect of time-invariant household characteristics that could confound the results (Mason, 2013). Like in the standard IV method described above, I include the log of distance to the nearest mobile money agent in estimating the number and total value of remittances received.

#### **3.4.6 Reduced form analysis**

The effectiveness of mobile money services heavily relies on the availability and ease of access to mobile money agents as these facilitate cash-in and cash-out transactions. In this section, I examine whether access to a mobile money agent influences household welfare,

supposedly through mobile money-based remittances. In the spirit of Jack and Suri (2011), I use the log of distance to the nearest mobile money booth as a measure of access to mobile money services and use the specification below to assess this relation.<sup>9</sup>

$$c_{ijt} = \gamma + \alpha_i + \pi \ln Dist_{jt} + \psi X_{it} + \sigma_{jt} + \varepsilon_{ijdt}, \quad (4)$$

where  $\ln Dist_{jt}$  is the log of distance in kilometers from village  $j$  to the nearest mobile money booth. I expect  $\pi$  to have a negative sign because the further the mobile money agent, the harder it may be for a household to access mobile banking services and this might translate into reduced ability of a household to receive financial assistance in form of remittances from its members. This would, in turn, reduce the power of a household to smooth consumption as described in earlier sections.

### 3.5 Results

#### 3.5.1 Determinants of household mobile money adoption.

Table 3.2 presents the determinants of household mobile money adoption. The Probit results in Column 1 reveal that households with mobile phones are nine percentage points more likely to use mobile money services. This is not surprising because mobile money services are offered through a cell phone handset. Education of the household head has a positive and significant impact on the decision to adopt mobile money services; an additional year of education of the household head leads to one percentage point increase in the probability of adopting mobile banking. This could partly capture the literacy effect of educated household heads who could be more able to operate mobile handsets.

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<sup>9</sup> Distance to the nearest mobile money location is captured at the community level.

Alternatively, it could be true that educated household heads are more able to send their children to school who, upon graduation, find jobs in towns and extend financial assistance in form of remittances through mobile money platforms. This claim is partly supported by the significantly positive impact of the job-seeking dummy on mobile money use by the household.

These results remain qualitatively unchanged with the fixed effects estimation in Column 2. The significantly negative coefficient on the distance to the nearest mobile money agent implies that households choose to subscribe to mobile money services if the distance from the nearest booth is relatively shorter. This further supports the notion that the relative urban concentration of banks is partially responsible for the slow adoption of formal financial services. It should be noted that mobile money booths and agents are instrumental in facilitating mobile money transactions in a way that they act as cash-in and cash-out agents.

### **3.5.2 Mobile money and household per capita consumption**

Table 3.3 reports the basic OLS and fixed effects estimates of household per capita consumption. OLS results in Column include district-by-time dummies among the covariates. The results suggest a 13 percent increase in household per capita consumption given the adoption of mobile money services. To address the possibility of bias in the OLS results that could potentially result from unobserved and time-invariant household heterogeneity, I estimate a fixed effects model with and without district-by-time effects in columns 2 and 3, respectively. Across all specifications, the estimates remain qualitatively

similar, suggesting a significantly higher level of per capita consumption for mobile money users. The district-by-time effects in Column 3 capture district-level trends that might be correlated with both mobile money adoption and per capita consumption.

I further disaggregate consumption expenditure into three categories – expenditure on food items, non-food household basics and social contributions.<sup>10</sup> Table 3.4 gives a report of these three measures using both OLS and fixed effects estimations. Column 1 shows that mobile money adoption has a positive impact on per capita food expenditure, although the relationship disappears after controlling for unobserved time-invariant household characteristics in Column 2. The average impact for basic expenditure ranges between 15% and 20% for OLS and fixed effects models, respectively (Columns 3 and 4). Columns 5 and 6 reveal that a household that uses mobile money services spends between 47 and 56 percent more on social contributions compared to non-user households. These results should, however, be interpreted carefully, as they are likely to be capturing reverse causality effects.<sup>11</sup> Nonetheless, they suggest that social contributions and basic expenditures respond more strongly to mobile money adoption as compared to food expenditure. This result is not rather surprising, owing to the rural nature of households in the sample which implies that a large fraction of consumed food comes from own farms. Chetty and Looney (2006) argue that when consumption is close to subsistence level, any

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<sup>10</sup> Expenditure on household basics includes expenditure on school, medical, transport, clothing, cooking and lighting materials. Social contributions cover expenses on ROSCAs, mutual support organizations – both funeral and non-funeral, churches and mosques, other local organizations and credit repayments.

<sup>11</sup> Household that make numerous social contributions may be convinced by members of their social networks to join mobile money services for easier transmission of contributions.

shocks to income might not necessarily translate into reduced household consumption because its level is already too low such that it cannot be reduced any further.

### **3.5.3 Mechanisms**

#### **3.5.3.1 Mobile money and household remittances.**

As presumed in earlier sections, the impact of mobile money on household welfare is achieved through the facilitation of remittances. I explore into this claim by examining whether households that have access to mobile money services have differential access to remittances and present these results in Table 3.5. Being a mobile money user is associated with a significantly higher probability of receiving remittances and the remittances received are larger in number and total value compared with non-users. In estimating the probability of a household receiving remittance, I estimate equation (4) as a Probit model, since the dependent variable is binary and estimate the frequency and value of remittances by OLS and household fixed effects models. The results in Column 1 show that mobile money adoption increases the probability of receiving remittances by seven percentage points. These results remain qualitatively unchanged when using OLS regression in Column 2. In columns 3 through 6, I present the results from the other two measures of remittances – number of remittances and total value received in the past 12 months. From Columns 3 and 4, mobile money users receive approximately one more remittance at a given time, compared to non-users. The OLS estimates of total value of remittances in Column 5 reveal that adopting mobile money services increases the total value of remittance received by 36%. This translates into approximately 116,706 Uganda Shillings (USD 61), as evaluated

at the mean value of non-users. The fixed effects estimation of remittance value in Column 6 yields similar results even after controlling for unobserved time-invariant heterogeneity between users and non-users. In all specifications, I include controls for household characteristics (mobile phone possession, household size, asset value, land size, as well as age, education and gender of household head). The inclusion of district-by-time effects in the regressions captures local macro trends that may have differential influence on household access to remittances.

### **3.5.3.2 The influence of migration (job-seeking behavior)**

I now account for the source of remittances and examine the possibility that households that have members working outside the village are the ones receiving remittances and that the coefficient of mobile money impact could be capturing these migration dynamics. I thus estimate similar regressions and further control for a dummy for the presence of a migrant worker. These results are reported in Table 3.6. Column 1 reveals that, conditional on mobile money status and other covariates, households that send their members to find town jobs are 11 percentage points more likely to receive remittances. Columns 2 and 3 report results for the number and total value of remittances received, respectively. Having a member working outside the village increases the number and total value of remittances by 1.4 times and 42%, respectively. I believe that the introduction of mobile money reduced the monetary and opportunity costs that hitherto hindered these workers from transferring money to villages. Nonetheless, the mobile money coefficient remains positive and statistically distinguishable from zero. My presumption is that, even when members were working in towns prior to the introduction of mobile money, the idiosyncratic lack of a

cheap and convenient money transfer mechanism rendered it hard for the members to remit financial assistance back to their rural households.

### **3.5.4 Results from Reduced Form Analysis**

Table 3.7 reports the results from the reduced form analysis using log of distance to the nearest mobile money booth as a measure of access to mobile money services at the community level. The dependent variable in column 1 is the log of monthly household per capita consumption. As earlier predicted, being located away from the mobile money booth is associated with a significant reduction in household per capita consumption. The probability, number and total value of remittances received, as measures of remittances, are reported in columns 2, 3 and 4, respectively. Results are consistent with those reported in previous estimations; the distance to the mobile money agents reduces the flow of remittances to rural households. Households located one kilometer away from the mobile money booth have two percentage point lower probability of receiving remittances (Column 2). Similarly, the frequency and total value of remittances received reduces significantly with an increase in the distance to the mobile money agent. Note that the treatment variable in this case is a community-level variable and the inclusion of district and time dummies implies that my estimate is a conservative estimate of the true effect of mobile money access as these controls absorb much of the variations in mobile money access. Most importantly, controlling for district and time effects rules out the potentially confounding effect of local access to services which tend to be concentrated in district towns.

### **3.5.5 Instrumental Variable, Tobit and Weighted Regression (Propensity Score Matching) Results**

Results reported so far rely on the assumption that mobile money is not correlated with the error term conditional on the other controls included in the regressions. However, where this assumption does not hold, both OLS and fixed effects estimates may be biased. As earlier noted, mobile money is potentially endogenous given reverse causality concerns – households may adopt mobile money when they expect to receive remittances. In this section, I account for this endogeneity using standard fixed effects IV method for consumption and Tobit models with a control function approach for remittances. Apart from capturing potential endogeneity, the latter technique takes into account the corner solution problem resulting from the censored nature of the remittance variables, that is, households that never received remittances have no observations for the number and total value of remittances. In the control function version of the Tobit model, I include residuals from the first stage estimation of the determinants of mobile money in the main model. In both methods, I use log of distance to the nearest mobile money agent as an excluded instrument for the potentially endogenous mobile money variable.

Table 3.8 presents the results from fixed effects instrumental variable (FE-IV) estimation for household consumption and Tobit results for the measures of household remittances. Columns 1 and 2 show the second-stage results for per capita consumption and the first stage results for mobile money adoption, respectively. Column 1 reveals a positive and significant effect of mobile money adoption on per capita consumption. As observed from the first-stage results in Column 2, distance to the nearest mobile money agent is a

strong determinant of mobile money adoption which implies its power to identify a causal link between mobile money adoption and consumption. This is confirmed by a substantially large first-stage F-statistic. The Cragg-Donald F-statistic for the weak instrument test is also larger than the critical value for the Stock-Yogo 10 percent maximal IV size which rules out the possibility of weak instrument problem. In other words, the instrument is strong enough to reduce endogeneity bias to a maximum of 10 percent in the FE-IV results relative to the standard FE results. Columns 3 through 6 report the Tobit estimates of the number and total value of remittances received. In columns 3 and 5, I combine Tobit with control function methods to control for corner solution and endogeneity problems. In line with Wooldridge (2003) and Mason 2013, the significance of the residual in Columns 3 and 5 not only implies potential endogeneity of the treatment variable but also deals with the problem. Since the inclusion of residuals from the mobile money regression into the main regression controls for potential endogeneity of the mobile money dummy, I interpret results from Columns 4 and 6 which are endogeneity-free. Columns 4 and 6 show that mobile money adoption increases the total value of remittances received by 70 percent and remittance frequency by close to one, respectively.

Although I present IV results to support the main findings with regards to the effect of mobile money on household consumption, the IV coefficients are extremely large relative to OLS and FE estimates, possibly due to the possibility that the dummy endogenous mobile money variable becomes less defined in linear FE-IV estimation. To further confirm the causal link between mobile money and household consumption, I estimate propensity score matching to compare comparable outcomes of mobile money

user households and non-user counterparts. As shown in the summary statistics tables, these differ substantially along key variables which could as well influence consumption and this difference can be eliminated by matching to create comparable groups of households from user and non-user households of mobile money. In line with Imbens and Wooldridge (2008), I also run weighted regressions to further control for observed household heterogeneity that could confound the results even after matching. Results reported in Table 3.9 are closer to the OLS and FE estimates, confirming a positive and significant mobile money impact on all measures of consumption. This is the preferred specification as it offers double robustness by comparing comparable households and further controlling for any additional household heterogeneity after matching.

### **3.5.6 Alternative Explanations**

Local economic conditions at the village level could account for changes in mobile money penetration and household per capita consumption. For example, mobile money agents could locate in trading centers where economic activities are concentrated, while at the same time business and employment opportunities near trading centers and towns could provide alternative income sources that potentially increase consumption. Instrumenting mobile money possession with distance to the nearest mobile money booth would potentially capture the spurious positive relationship between mobile money and consumption. I take two measures to address this concern. First, in all regressions, I control for the distance between the village center and the nearest district town where major economic activities are concentrated to capture the local economic potential of the corresponding villages. Secondly, since I use fixed effect IV (FE-IV) method with time

and village dummies rather than the conventional IV framework, I smooth out unobserved fixed attributes of the household as well as local time and village effects that could potentially confound my results results.

It is possible to imagine that the mobile money adopters and non-adopters were systematically different and that this difference could be responsible for the observed differences in consumption and remittance patterns which could have existed even in the absence of mobile money. In addition to the matching procedure presented earlier, I also run regressions for consumption and remittances on placebo mobile money dummy which takes a value of one if a household used mobile money after 2009 and zero otherwise. In this estimation, I use a sub-sample of 2003 and 2005 to compare the consumption and remittance patterns between households that adopted mobile money after its introduction in 2009. I also add dummies for mobile phone possession and the presence of a migrant worker in the household to examine their importance before the introduction of mobile money and present the results in Table 3.10. The insignificant coefficient on the placebo mobile money variable indicates that the outcome variables were not significantly different between mobile money user households and non-users prior to 2009 – the inception year of mobile money in Uganda. Since the positive and significant association appeared after 2009, I attribute the change particularly to mobile money adoption. The table further reveals no significant relationship between mobile phone possession and the presence of a migrant worker on one hand and consumption (Column 1) and remittances on the other (Columns 2 through 5). At best, the remittance impact of mobile phone possession is positive and statistically indistinguishable from zero. This partially rules out the possibility that the

observed consumption and remittance changes resulted majorly from mobile phone possession.

### **3.6 Conclusion**

Lack of access to financial services is a typical challenge to rural livelihood in many developing countries. Apart from the direct hindrance on the ability to borrow and save, the associated high costs of remitting funds to financially inaccessible areas impose a limit on the effectiveness of informal sharing mechanisms among friends and relatives. Mobile money - a new financial service that allows direct transaction via a mobile phone –serves to bridge this gap given its relatively lower cost and convenience. In Uganda, mobile money adoption has expanded tremendously over the past three years since its inception in 2009. In this paper, I examine the welfare impact associated with this service by estimating its impact on monthly household per capita consumption. Specifically, I provide evidence that households using this financial innovation experience a significant increase in per capita consumption. The result is robust to sensitivity checks, mainly the change in empirical specification.

Disaggregating consumption into food, basic and social expenditures, I find stronger impacts of mobile money for the social expenditure measure, partially suggesting investment in informal social and insurance networks and saving mechanisms. There are a number of potential pathways through which this result might be realized as cited in the literature including the facilitation of savings (Jack and Suri, 2011) and self-insurance through remittances. I provide evidence that the estimated impact is achieved through the

facilitation of remittances; households with access to mobile money services are more likely to receive remittances, receive remittances more frequently and receive higher value of remittances relative to non-users. Although I do not explicitly demonstrate due to data limitations, I am convinced, based on anecdotal evidence that the average cost of remitting funds across households reduced greatly with the event of mobile money technology. I further venture into the role of family dynamics by comparing remittance patterns across households with and without members working outside the village. I provide a falsification test that the relationship between this migration measure and remittances did not exist prior to mobile money, suggesting that its emergence after 2009 partially reflects reduction in transaction costs that made it possible for workers to remit funds to their rural households.

The results presented in this paper suggest significant welfare benefits of access to financial services which might go afield in reducing rural poverty through reduction in vulnerability by the rural poor. Dercon (2006) suggests stronger welfare benefits of informal insurance mechanisms if random reductions in consumption affect poverty dynamics through persistent income reduction in incomes. One concern however is that, although I plausibly assume reduction in remittance cost as the major pathway of the welfare and remittance impact of mobile money, I do not test this premise within the limitation of the data. This and the analysis of risk-sharing behavior will form the foundation for further research.

## CHAPTER 4

### **Banking on the Cellphone: Mobile Money and the Financial Behavior of Rural Households in Uganda**

#### **4.1. Introduction**

Financial sector development is a crucial element of the development process as it improves the mobilization of savings, allocation of capital funds, monitoring of the use of funds and aiding in risk management (Levine, 1997). Access to financial services like saving, money transfer, insurance and credit has enormous potential to shape people's livelihoods through poverty and vulnerability reduction (Jalilian and Kirkpatrick, 2005; Beck *et al.*, 2004; Demirguc-Kunt *et al.*, 2008; Odhiambo, 2009). However, majority of the world's poor have no access to these basic financial services (Demirgüç-Kunt and Klapper, 2012). The lack of access to affordable financial services limits their ability to smooth consumption and undertake productive investments. The rural poor in developing countries have the least access to such services and ultimately, their capacity to escape chronic poverty is greatly curtailed (Dupas and Robinson, 2008).

Mobile money has been dramatically changing the situation since its recent inception in some developing countries. Mobile money is a financial product that allows users to make basic financial transactions via a mobile phone. This financial innovation has come to the limelight in the financial access literature over the recent years because of its potential to foster financial access especially among the financially excluded rural poor in

developing countries (Jack and Suri, 2011; Hughes and Lonie, 2007) Indeed, mobile money has expanded rapidly over the past decade especially in the developing world where the penetration rate of formal financial services is low. The dramatic expansion of mobile phone network coverage, combined with the rapid adoption of mobile phone devices in the past decade explains much of the success registered by Mobile Money in low-income countries (USAID, 2010). The period between 2000 and 2011 has been dubbed the mobile revolution decade, with mobile phone subscriptions increasing from 10 percent to 80 percent (IC4D, 2012).<sup>12</sup> Approximately 79 percent of the population in developing countries had access to a mobile phone by the end of 2011 while over 50 percent of Africans owned a mobile phone in 2009, compared to 20 percent with a formal bank account (McKinsey, 2009).

There has been a growing body of literature that identifies the factors behind the high incidence of financial exclusion, including socio-cultural factors (Sarma and Pais, 2011; Johnson and Nino-Zarazua, 2011), long distance to the financial institution (Pedrosa and Do, 2011) and high cost of account maintenance (Dupas and Robinson, 2013).<sup>13</sup> In low-income countries, formal financial institutions like commercial banks and deposit-taking micro-finance institutions are concentrated in urban centers. This implies that access to formal financial services by the rural populace is complicated by the long and costly treks made to access service points in urban locations. Besides, the high cost of operating a bank account imposes a challenge to the adoption of formal financial services especially

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<sup>12</sup> Information and Communication for Development

<sup>13</sup> Financially excluded constitutes individuals who cannot either access or afford to use the services offered

among the low-income people. An experimental study by Dupas and Robinson (2013) reveals that access to non-interest-bearing savings accounts increased savings and investments among market vendors in Kenya. The study emphasizes the importance of service cost as a critical factor in the uptake of financial services among low-income communities.

The lack of access to a formal financial institution in rural communities imposes a high cost of transferring money especially over long distances and this is often exacerbated by poor road conditions. Physical transfer of money is a common channel of remittances among the financially excluded rural communities despite the relatively high risk of theft and the high transport and time cost involved in this exchange mechanism. The low cost of mobile banking relative to conventional banking implies an increase in the flow of remittances among family members and friends (Mbiti and Weil, 2011) which greatly improves the welfare of recipient households (Munyegera and Matsumoto, 2014). The general lack of access to formal financial institutions partly accounts for the rapid adoption of mobile money services as an invaluable alternative for the financially excluded rural poor (World Economic Forum report, 2011).

Empirical research on informal insurance and risk sharing indicates that the availability of a cheap remittance channel increases the incidence of risk sharing and reduces vulnerability to income and consumption shocks. Using panel data from Kenya, Jack and Suri (2014) illustrated that households that used M-PESA - Kenya's most famous mobile money platform – were able to receive remittances to offset the effect of illness and

weather shocks which caused a notable reduction in consumption expenditure among non-user households. Although most studies on mobile banking concentrate on peer-to-peer transfer services, which is the most common service offered across the mobile money platform given its infancy, the product supports business to person, business-to-business and government-to-person services at a relatively lower cost than conventional transfer platforms like commercial banks. A study by Aker et al. (2011) in Niger demonstrated that the use of mobile banking reduced the cost to the government and recipients of a welfare program that distributed financial assistance to the people affected by the critical drought of 2008.

Despite the increasing importance of mobile banking, there is little empirical evidence on the potential of this financial innovation with regards to services beyond money transfer. Mobile money now offers a broader range of services including an integrated access to formal bank services through partnerships between Mobile Network Operators (MNOs) and registered commercial banks and deposit-taking microfinance institutions (MFIs). Other services like the electronic payment of school fees, salaries and utility bills (in principle, water and electricity) are expected to reduce the frequencies of cash transactions and increase financial efficiency (USAID, 2012). Safaricom's M-PESA in Kenya now offers an integrated financial package with extended services like microsavings, credit and agricultural insurance through customized platforms like *M-KESHO* and *Kilimo Safi*. It is documented that access to an affordable savings platform can change the financial behavior of households by reducing wasteful expenditure and saving with informal platforms (Morawczynski and Pickens 2009).

Although considerable effort has been devoted to studying the developmental impact of mobile money in the areas of remittances, risk sharing and consumption smoothing, empirical evidence on its potential to boost savings, credit, insurance and mobile payments remains largely missing. In the context of Uganda, mobile money studies focus on the determinants of adoption (Johnson and Nino-Zarazua, 2011) while others rely on small and less-representative samples (Ndiwalana, 2010). The objective of this study is to fill literature gap by analyzing the effect of mobile money on the saving, credit and remittance behavior of rural households in Uganda. The study is expected to contribute to the existing literature by assessing the potential of mobile money to enhance financial inclusion, extending the analysis beyond peer-to-peer remittances to savings and credit.

The rest of the paper is organized as follows; Section 2 provides background information on mobile money in Uganda and Section 3 describes the survey data and their summary statistics. I describe the empirical strategy in Section 4 and provide the results in section 5 while Section 6 concludes the analysis.

#### **4.2. Development of mobile money service in Uganda.**

In March 2009, Mobile Telephone Network (MTN) – the leading Mobile Network Operator in the country – established *MTN Mobile Money*, the first mobile money platform in the country, inspired by the massive success of Safaricom’s M-PESA in Kenya. Airtel Uganda, formerly known as Zain, joined the service when it rolled out its *Airtel Money* in June the same year. This new financial innovation proved to be an efficient way for telecom companies to increase their market shares by widening the range of services available to

their clients. This attracted Uganda Telecom to introduce *M-Sente* in March 2010, followed by *Warid Pesa* from Warid Telecom in December 2011 and *Orange Money* from Orange Telecom in the first half of 2012 (Uganda Communications Commission-UCC 2012).

Since mobile money was established in Uganda, the number of subscribers has been steadily increasing. By mid-2014, over 17.6 million Ugandans had adopted mobile money services, representing over a five-fold expansion from 3 million users in 2011. In the same period, the number of mobile money transactions increased from 180 million to 242 million and the corresponding total value exchanged through the platform increased from \$1.5 billion to \$4.5 billion in the same period (BoU, 2012). MTN Mobile Money alone has over 15,000 agents as compared with 455 commercial bank branches with 660 Automated Teller Machines (ATMs).<sup>14</sup> This rapid expansion partly owes to the high rates of both the roll-out of mobile phone network and adoption of mobile phones. In my sample, the proportion of households owning a mobile phone increased from 73 percent to 90 percent between 2012 and 2014 while all Local Council 1s (hereafter called LC1s) were covered by mobile phone network in both rounds.<sup>15</sup> One in four households reported possessing more than one mobile phone in the Mobile Money survey of 2014 (hereafter referred to as MM2014).

Mobile money allows users to deposit money as e-float on a SIM card-based account, called an *m-wallet*, which can be converted into cash at any mobile money agent location all over the country. In the initial stages of its establishment, the range of services offered was largely limited to person-to-person transfer. However, with the growing

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<sup>14</sup> Mobile money agents serve as outlet centers or cash points where users can exchange their e-float for cash and vice versa.

<sup>15</sup> LC1 is the smallest administrative unit in Uganda.

interest from stake-holders, coupled with competition among the mobile network operators (MNOs), service providers have gradually innovated to widen the range of services. Currently, most MNOs offer more complex functions like payment of utility bills, school fees, airtime purchase, direct purchase of goods and services and, to some extent, payment of government taxes. Recent developments in the mobile banking arena have made it possible for users to access their bank accounts using their mobile phones without having to physically visit their bank branches, thanks to the partnership between MNOs and banks.<sup>16</sup> This is expected to raise financial inclusion especially at the lower end of the socio-economic spectrum while reducing the cost of access to and use of basic financial services.

With the rapid urbanization in Uganda over the past years, the number of people migrating to urban centers has been steadily increasing, most often in pursuit of jobs. Those who migrate to cities often extend financial support to their family members and friends in villages in the form of remittances and informal loans. The efficiency of this remittance system used to heavily rely on the quality of transport infrastructure as most of these transactions were traditionally made through informal channels like physical movement of cash by the receiver, sender, and agents like bus and taxi drivers. Besides, the massive geographical dispersion between senders and receivers implies high transaction costs in terms of transport fares and travel time involved in sending and receiving money among family members and friends especially across geographically distant and remote locations. This background motivates my postulation that mobile money lowers the time, transport and other transaction costs associated with the usage of financial services, catalyzing their

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<sup>16</sup>Major partnerships exist between *MTN Mobile Money* and Stanbic Bank, *M-Sente* and Standard Chartered Bank and *WaridPesa* and DFCU Bank.

adoption even by rural households. Similarly, the financial product has made it easier for friends and relatives to exchange informal credit while others find it convenient and cost-effective to save money over the m-wallet in instances where commercial banks are inaccessible.

### **4.3. Data and Summary Statistics**

This paper uses a combination of two data sources - the Research on Poverty, Environment and Agricultural Technology (RePEAT) and MM2014. The RePEAT is a panel household survey conducted jointly by the National Graduate Institute for Policy Studies (GRIPS), the Foundation for Advanced Studies on International Development (FASID) and Makerere University in four rounds between 2003 and 2012.

The survey collected detailed information on household consumption, incomes, agricultural production from 940 rural households in 94 LC1s. I followed up 916 households that were interviewed in the last round of RePEAT in 2012 and conducted a MM2014 among these households between June and July 2014. I successfully interviewed 820 out of the 916 households and asked questions about the usage of mobile money, banks, Savings and Credit Associations (SACCOs) and Micro-finance Institutions (MFIs) as well as financial services including savings, remittances and credit (both formal and informal). Analysis is based on 820 households that were interviewed in 2014, constructing financial access and usage variables from the MM2014 while information on household

characteristics is obtained from RePEAT4.<sup>17</sup> The choice of rural households as the analysis sample is intended to portray the contribution of mobile money among the rural poor who are often excluded from the formal financial system.

I stratify the sample by mobile money adoption status and provide summary statistics for financial access and usage in Table 4.1 and household and village characteristics in Table 4.2. Between RePEAT4 and MM2014, the proportion of households with at least one mobile money user increased almost two-fold from 38 percent to 70 percent and barely one percent of the sample households had a mobile money user in the third round of RePEAT in 2009. This reflects a rapid penetration rate within just six years since mobile money was introduced in Uganda in 2009. The rapid adoption of mobile money services is partly attributed to the high adoption rate of mobile phones and the lack of rural coverage by formal financial institutions.<sup>18</sup> Over 80 percent of the households in MM2014 had at least one mobile phone with one in four households possessing more than one handset. The significantly higher rate of mobile phone possession among mobile money users is not surprising given the nature of the mobile money platform which uses the mobile phone as infrastructure for the services offered. In contrast, only 41 and 13 percent of mobile money adapters and non-adapters have at least one bank account, respectively. Table 4.1 further shows that households that adopt mobile money services have more educated heads with an average difference of two years of schooling.

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<sup>17</sup> I was unable to construct a panel because financial access and usage variables are not available in RePEAT surveys except mobile money adoption and remittances transactions.

<sup>18</sup> These include commercial banks and deposit-taking MFIs.

Peer-to-peer remittance is the most commonly adopted function of the mobile money platform. The proportion of mobile money users who report having received remittances at least once in the 12 months before the MM2014 interview date is thus ten percent higher compared to non-users. Similarly, the amount of remittances received is twice as high at UGX 702,000 (USD 270) and UGX 325,000 (USD 125) for users and non-users, respectively. The user households are also more likely to save and borrow money and the amount saved and borrowed is significantly higher. I postulate that mobile money provides a convenient channel not only for remittances but also for short-term savings mainly for school fees to be drawn at the onset of a new school term or for purchasing agricultural inputs when the planting season starts.<sup>19</sup> Mobile money users are generally wealthier than non-users in terms of both asset and land endowments.

User-households tend to be headed by relatively younger members and have a lower proportion of female heads. Regarding physical access to financial service providers, mobile money user households are located one kilometer closer to the mobile money agent relative to non-user households while there are no significant differences in distance to banks because this analysis sample is predominantly rural and majority of banks are located in the district town which is, on average, tens of kilometers away from the village center. Although there are systematic differences in the household and LC1 level characteristics between the mobile money users and non-users, the simple comparison of their outcome variables on savings, credit use, and remittance receipt would not identify the causal effect

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<sup>19</sup> Based on data and Focus Group Discussions, the two main purposes of receiving remittances, saving and borrowing money in the sample are to raise school fees and make farm investments which include hiring labor and buying inputs.

of adoption of the mobile money. Thus, I discuss about the identification strategy in the following section to quantify the association between mobile money adoption and the pattern of financial transactions.

#### 4.4. Empirical Strategy

##### 4.4.1. Adoption of Financial Services

A household's decision to use a particular financial service depends on household and community characteristics in the form

$$Service_{ijd}^h = 1\{\beta_M^h Mmoney_{ijd} + \beta_1^h X_{ijd} + \beta_2^h V_{jd} + \eta_d^h + \varepsilon_{ijd}^h > 0\}, \quad (1)$$

Where  $Service_{ijd}^h$  is a dummy variable taking one if household  $i$  living in village  $j$  of district  $d$  has at least one member who uses the  $h$ -th financial service, and  $h$  comprises of savings, credit and remittances.  $Mmoney_{ijd}$  is a dummy variable taking one if the household has at least one member who uses mobile money services. The parameter  $\eta_d$  captures district fixed effects.  $X_{ijd}$  is a vector of household characteristics which include household size, log of asset value and land endowments, age, gender and education level of the household head.  $V_{jd}$  is a vector of observed village characteristics that could potentially influence service provider adoption. These include distance in kilometers from the village center to the nearest district town and distances to the nearest respective service provider location.

#### 4.4.2 Amount of Financial Services.

In order to understand the extent to which mobile money influences financial service usage, I estimate the amount of money saved, borrowed and received in remittances by the household within 12 months prior to the survey. The amount of financial services transacted is observed only if the household used the service while the outcome remains unobserved for non-user households such that OLS estimation may suffer from negative attenuation bias. I therefore adopt a Tobit approach which allows us to consistently estimate the total value of financial services by considering the outcome variable for non-users as censored at zero as the lower limit.

$$\ln Amount_{ijd}^h = \text{Max}\{0, \gamma_M^h Mmoney_{ijd} + \gamma_1^h X_{ijd} + \gamma_2^h V_{jd} + \mu_d^h + u_{ijd}^h\}, \quad (2)$$

Where  $\ln Amount_{ijd}^h$  is the log-transformed amount of money saved, borrowed or received as remittances in the 12 months preceding MM2014 and  $u_{ijd}$  is an error term normally distributed with mean zero and variance  $\sigma^2$ .

Because systematic differences in observed characteristics between mobile money users and non-users could be driving the differences in the patterns of savings, credit and remittances, I also conduct propensity score matching to identify the true effect of mobile money adoption based on comparable user and non-user households. In order to force a common support between users and non-users and improve covariate distributions, we trim the sample to include matched households for which the estimated propensity score lies between 0.1 and 0.9. Crump et al. (2008a) draw on empirical examples and numerical

calculations to illustrate that this cut-off point often yields good results. In addition to the conventional matching techniques, I run weighted regressions with a full set of covariates with weights assigned by the estimated propensity score. Controlling for covariates gives double robustness by further smoothing out potential heterogeneity between treated and untreated observations (Wooldridge and Imbens, 2008).

In addition to the full set of household characteristics presented earlier, I also include the log of distance in kilometers to each of the nearest financial service provider – mobile money agent, bank, SACCO and MFI as additional controls.

#### **4.4.3 Mechanisms: Convenience of Using Financial Service Providers.**

I postulate that the relatively lower service charges and the convenience associated with closer proximity to financial service providers in terms of reduced travel time and transport costs is the major mechanism through which mobile money boosts savings, credit and remittances. The relative urban concentration of formal financial service providers (banks and MFIs) implies that physical access to financial institutions remains one of the major challenges for rural households to adopt these financial services. If long distance to service points is a major barrier for rural households to adopt financial services, bringing these services closer could leverage the households' likelihood and frequency of the respective service providers.<sup>20</sup> To test the plausibility of this premise, I estimate a system of seemingly unrelated regressions for the likelihood and frequency of using each of the four service

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<sup>20</sup> About 20 and 24 percent of the sample households which have never used banks and MFIs, respectively site long distance to service provider as the principal barrier.

providers, taking into account the possibility that the household's decisions to adopt them are interdependent.

## **4.5. Results**

### **4.5.1. Adoption of Financial Services**

I first estimate the decision of the household to save money, receive remittances and credit. In odd-numbered columns of Table 4.3, the access to mobile money services is measured as a dummy variable taking one if any household member uses mobile money while the distance from the household's village to the nearest mobile money agent is used an alternative access measure in even-numbered columns. The dependent variables take one if any member of the household made any form of saving or received any credit (both formal and informal) or remittance within 12 months prior to the interview date. Having a mobile money user in the household increases the probability of saving, borrowing and receiving remittance by 25, 22 and 82 percentage points, respectively. Assets play a significant role in stimulating remittance receipt but do not systematically explain saving and credit patterns. Distance to the nearest mobile money agent seems to matter strictly for remittances with no significant effect on the likelihoods of saving and borrowing money.

### **4.5.2. Amount of Financial Services.**

Estimating the likelihood of adopting financial services using binary outcome variables does not disclose the extent to which the mobile money service stimulates financial transactions and conceals any possible heterogeneity across households in terms of service amounts transacted. I thus estimate the amount of savings made and credit and remittances

received 12 months before the survey and present the results in Table 4.4. Odd-numbered columns report ordinary Tobit results while even-numbered columns include residuals from the probit regression of mobile money adoption to control for potential endogeneity of mobile money variable. Across both specifications, the presence of a mobile money user in the household has a positive and significant effect on the annual amount of money a household saves, borrows or receives in remittances. As discussed in previous sections, I presuppose that rural households use mobile money to make temporary savings especially for school fees and financing agricultural investments like input purchase, labor hiring and land preparation. For similar purposes, households could use mobile money as a channel through which they solicit informal soft loans and remittances from family members and friends especially those working outside the village. Household size does not significantly affect credit and remittance amounts but reduces the amount of money saved, which could be partly attributed to the huge expenditures needs associated with large families that strain the saving ability of these households.

I then estimate reduced form Tobit models using the distance to the nearest mobile money agent as an exogenous measure of mobile money access. I also control for the distances to the nearest bank, SACCO and MFI as this could influence financial service transactions besides mobile money access. Results in Table 4.5 reveal that the distance from the village center to the nearest mobile money agent is associated with significant reduction in the household's likelihood and amount of saving, credit and remittances. Asset wealth plays an integral role in facilitating household credit access, possibly because asset-rich households could use their asset base as collateral to obtain larger amounts of credit

relative to their asset-poor counterparts. Households headed by more educated members make significantly more savings and receive more remittances and credit. This could be a reflection of either their relative financial literacy or the presence of salary-earning members who may use their salaries as collateral to obtain formal credit from banks and MFIs.

As presented earlier, summary statistics in Tables 4.1 and 4.2 reveal that households that use mobile money are systematically different from non-users along observable characteristics which could confound my results. To address this concern, I adopt a propensity score matching technique to reduce observable household heterogeneity by comparing financial service amounts between mobile money users and comparable non-users. I further force a common support by considering only observations whose estimated propensity scores are bounded within 0.1 and 0.9, a range that is considered to deliver reliable estimates (Crump et al. (2008a). Finally, I run regressions weighted by the propensity score, controlling for a full set of household and village characteristics to further remove any remaining observable household heterogeneity after the matching exercise (Wooldridge and Imbens, 2008). This approach is highly robust and thus constitutes my preferred strategy.

Results reported in Table 4.6 are consistent with previous estimates; mobile money adoption significantly increases the amount of saving, credit and remittance transactions made by the households. Most of the other controls have insignificant coefficients, reflecting the fact that observable heterogeneity was successfully removed by the matching

method. Finally, Table 4.7 reports results from covariate balance tests before and after matching. P-values for the equality of means of most covariates smaller than 0.05 before matching but larger than 0.1 after matching, indicating that covariates were unbalanced before matching but became balanced after matching. Rejecting the hypothesis of joint equality of means after matching shows that covariates for mobile money users and non-users are drawn from comparable distributions (Caliendo & Kopeinig, 2008). Additionally, a mean absolute bias of 3.4% is far smaller than the 5% recommended to yield reliable estimates (Rosenbaum and Rubin, 1985).

I then disaggregate the amount of credit received by the household into formal and informal categories to investigate the two possible pathways through which mobile money access could influence the credit behavior of the household. As noted before, the first possible channel could be the facilitation of informal borrowing arrangements among family members, friends, individual money lenders and members of local savings and credit associations made possible by the availability of a convenient remittance channel. The second channel is rather less straightforward; the recent interlinkage between mobile network operators and banking institutions – commercial banks and MFIs – allowed for the interconnectivity of mobile money accounts and bank accounts. This innovation allows users to freely move funds between the two types of accounts and could have made it swifter for banking institutions to market their loan products to mobile money users through short messaging service (SMS) and disseminate loan proceeds to borrowers without requiring them to physically travel to bank branches. It is also possible that the interlinkage could have increased service satisfaction among customers using interlinked

bank and mobile money accounts, increasing their demand for loan products. Results in Columns 2 and 3 of Table 4.8 confirm that both pathways are at play; both informal and formal credit increases with mobile money possession. However, as noted earlier, the informal channel is stronger, indicating the ease associated with mobile money in exchanging informal microcredit among members of informal social networks and private money lenders.

#### **4.5.3. Mechanisms: Usage Financial Service Providers.**

Table 4.9 presents marginal effects Probit estimates and results from a system of seemingly unrelated regressions that take into account potentially interdependence in household's decisions to adopt the four financial service providers – mobile money, bank, SACCO and MFI. For each of the four financial service providers, the dependent variables in Columns 1 to 4 are binary indicators taking one if the household used the respective service provider within a year preceding the survey while the frequency of using the service providers is presented in Columns 5 to 8. Columns 1 and 4 respectively reveal that the probability of using mobile money services reduces by eight percentage points and 24 percent when the distance from the village center to the nearest mobile money agent doubles. Distances to the nearest bank, SACCO and MFI do not significantly enter into the household decision to adopt these institutions. One possible explanation in the case of bank adoption is that no matter how close the household may be to the bank premises, sign-up documentation as well as actual and/or perceived cost of account opening and maintenance may impose additional restrictions to the up-take of bank accounts. The significantly positive coefficient on log of asset value rather stresses the relative importance of household wealth, implying

that asset-wealthy households can afford to use bank services despite the long distances they have to travel to access these services. The education level of the household head is positively associated with a higher likelihood and frequency of using mobile money and banks, which may reflect the literacy role in shaping financial behavior.

#### **4.5.4. Robustness checks.**

##### **4.5.4.1. Endogeneity of mobile money adoption.**

In all previous results, mobile money adoption was treated as exogenous to the household. However, this is unlikely because households who normally save or borrow money and receive remittances may adopt mobile money services to ease the flow of these services. In this case, causation runs in the reverse direction and this implies potential endogeneity of mobile money adoption due to simultaneous effects. The default approach in this case would be to run instrumental variable regressions in a 2SLS framework using distance to the mobile money agent as an instrument for mobile money adoption. I instead add a control function approach to the Tobit models to establish a causal link between mobile money adoption and financial service amounts while taking into account the corner solution problem in the outcome variables.<sup>21</sup> In the first step, I run probit models for mobile money adoption on all exogenous variables including log of distance to the nearest mobile money agent (results not shown) and obtain predicted residuals which I add as an extra covariate in the (second-step) outcome regressions. The results reported in the odd-numbered columns of Table 4.3 show that the mobile money coefficient remains strongly

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<sup>21</sup> From this point throughout the analysis that follows, I refer to this approach as Tobit-CF.

significant. The positive coefficient on the predicted residuals in savings and credit regressions indicates that the endogeneity of mobile money imposed an upward bias on the standard Tobit estimates of these variables. The inclusion of auxiliary residuals in the standard Tobit models not only checks for endogeneity but also alleviates its confounding power (Wooldridge, 2003; Mason, 2013).

#### **4.5.4.2. Alternative Explanations.**

I presume that the distance to the mobile money agent is independent of household and village characteristics because mobile money agents were, in most cases, already established shop keepers in the villages selling household merchandise and airtime cards, who later took on mobile money as an additional service on their service menus when this financial platform was introduced in the country in 2009. This differs from the case where non-resident mobile money entrepreneurs self-select into the villages they perceive to be profitable. Nonetheless, I appreciate the possibility that already established shop keepers could decide whether or not to extend their range of services to cover mobile money, basing on the local economic potential of villages, which could be a reflection of potential demand from the residents. A profit-oriented mobile money agent would consider the local economic potential of the village and locate in the village town, which is often closer to the district headquarters (district town). However, I control for distance from the village center to the nearest district town in all my regressions and the estimates remain qualitatively and quantitatively similar to those without this control (unreported).

The second concern relates to the possibility that banks, SACCOs and MFIs could have mobilized savings and credit during or prior to the study period. If this was the case, my estimates would be capturing the spurious correlation between mobile money adoption and the up-take of financial services. However, for 90 percent of the sample villages, the nearest banks and MFIs are available in the district town and controlling for this distance provides a remedy to this problem. It is important to note, however, that SACCOs are available in most villages and the distance to the district town does not necessarily affect their power to infiltrate and mobilize financial service up-take among rural households. I therefore control for the distance to the nearest SACCO, a dummy variable for household membership to SACCOs and binary indicators for whether a SACCO is present in the village in Tables 3, 4 and 5 and the results remain highly robust<sup>22</sup>.

#### **4.5.4.3. Attrition**

The final check for the robustness of the main results is a test for the possibility of attrition bias. As discussed in earlier sections, I was able to follow 820 out of the 916 households that were sampled in the fourth round of RePEAT in 2012. This represents a 10.5 percent attrition rate which could bias the results if the households that could not be interviewed in 2014 systematically differ from those that were successfully interviewed. I therefore regress the attrition indicator on key household and village characteristics and show OLS and Probit results respectively in Columns 1 and 2 of Table 4.10. The results reveal no

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<sup>22</sup> I control for these variables separately due to collinearity. However, I report only results with distance to SACCO and district town to save space. Moreover, results were qualitatively similar across all specifications.

systematic differences between households that were interviewed in 2014 and those that were missed, suggesting that attrition bias does not confound the main results.

#### **4.6. Conclusion**

As lack of access to financial services remains a key challenge to many people in developing countries, the advent of mobile phone-based financial platforms has been changing the financial livelihoods of the rural poor. Mobile money – a financial innovation that allows the user to deposit, exchange and withdraw money using their mobile phone – is a cheap and convenient option for majority of the financially excluded rural populace.

I explore the role of this financial product in shaping the financial behavior of rural households in Uganda using a randomly selected sample of 820 households. I provide empirical evidence that mobile money leverages the financial access constraint of rural households and stimulates their uptake of financial services. Accounting for possible selection bias, endogeneity of mobile money adoption at the household level and the influence of local economic conditions at the village level, I provide robust evidence that the amounts of remittances, credit and savings made by mobile money users is significantly higher than that of non-users. The results found in this analysis results feed into existing literature in two ways; first, by profiling the potential of mobile money to drive remittance flow and second, by illustrating that reducing service cost and distance to service points improves the saving behavior of rural households. This paper uniquely contributes to the literature by extending the analysis of the potential of mobile money beyond the traditional peer-to-peer remittances to credit and saving services.

I illustrate that the main mechanism of this observed effect is the reduction of distance to service points, as mobile money agents are located in almost all the sub-counties in the study areas. I therefore postulate that access to mobile money services reduces the burden in terms of transport and time cost associated with remittance and informal credit exchange among family members and friends and boosts temporary savings to facilitate school fees and farm investments. The cross-sectional nature of my data, however, does not allow us to rule out the potential effect of unobserved household fixed attributes that could influence the observed financial behavior and I leave this issue for future research. In the case of remittances, this concern was alleviated using household fixed effects models in Munyegera and Matsumoto (2014). Nonetheless, the results suggest a critical policy implication that enhancing access to convenient and affordable financial services has a great potential to boost financial access among the rural poor who are often excluded from the formal financial system. This enhanced access could improve their financial behavior and augment their capacity to smooth consumption, safeguard against vulnerabilities in their lives and make productive investments, eventually redeeming themselves from poverty.

## **CHAPTER 5**

### **Conclusions and Policy Implications**

Existing studies have revealed that a large proportion of the population in developing countries has no access to basic financial services yet this is a crucial tool for poverty and vulnerability reduction and, consequently, economic development. It is however intriguing that many people in developing countries, particularly the poor, are often excluded from the formal financial sector by the lack of an affordable service provider despite their general willingness to use financial services. It is therefore believed that enhancing access to affordable financial services could deliver considerable welfare improvements especially among the poor and rural communities in developing countries. Mobile money is one the most popular financial innovations that emerged out of the direct need to close the financial access gap among rural and poor communities, allowing its users to make financial transactions via the mobile phone. However, empirical analysis on the potential financial access role of this financial product is largely lacking and this forms the principle objective of this dissertation. To the best of my knowledge, this dissertation is the first to make an empirical inquiry into the role played by mobile money in shaping rural financial behavior with comprehensive emphasis on savings, credit and remittances.

This dissertation first analyzes the determinants of adoption of mobile money to better understand the key factors that induce rural households to take up the services

offered by this product. The dissertation then explores whether the adoption of mobile money services is associated with systematic increases in saving, credit and remittance transactions among these households who barely have access to the services offered by formal financial institutions. Analysis of the potential welfare benefits that are often claimed to accrue to the users of mobile money are also explored in this dissertation. This is quite important because most of the rural households are not served by formal financial institutions like banks and microfinance institutions and thus enabling access to savings, remittances and credit using the widely possessed mobile phones could offer a partial remedy to their financial access constraints.

Several findings are presented in the dissertation; first, that the adoption of mobile money services is expanding rapidly. In 2009 when mobile money was introduced in Uganda, only less than one percent of the sample households used in this dissertation had adopted the service. This is expected because the rural nature of the sample households implies relatively slower infiltration rates of new technologies. However, the adoption rates shot up to 38 percent and 70 percent in the subsequent surveys in 2012 and 2014, respectively. Physical proximity to service centers is one of the critical factors behind this rapid expansion; shorter distances to the mobile money agent are associated with significant increases in the likelihood that household members adopt mobile money services. This finding is consistent with earlier studies that found that the adoption of financial services is heavily hampered by long distance to financial institutions and the associated high transport costs and long travel time incurred by potential rural users. The finding is also supported by the fact that, in the analysis sample, the distance to the nearest mobile money agent is

significantly shorter than the case for commercial banks and microfinance institutions. This implies that mobile money has been successful in bringing services closer to the rural poor and in reducing the transport and time cost associated with financial service use.

Another finding of this dissertation is that households with access to mobile money services are more likely to save and borrow funds and receive remittances from family members and friends. Conditional on using each of these respective services, the dissertation further finds that households using mobile money make significantly more savings, borrow larger amounts of funds – from both formal and informal sources – and receive larger volumes of remittances from family members and friends living and/or working outside their villages. This finding therefore corroborates findings from earlier studies that the poor are willing and able to make financial transactions but often lack an affordable platform, particularly for saving and borrowing.

Regarding the welfare-enhancing potential of mobile money access, this dissertation finds significant increases in household consumption per adult equivalent. Analysis of disaggregated components of consumption expenditure reveals significant increases in food consumption, expenditure on household basics – education, health and semi-durable household items like clothes and footwear – and contributions towards local savings schemes and socio-cultural and religious functions including funerals, weddings, parties and religious ceremonies. This is also in line with previous empirical and experimental evidence that access to cheap and convenient financial services often translates into welfare benefits capable of alleviating poverty and vulnerability. An inquiry into the mechanism of

this welfare impact points to the crucial risk-pooling role of household members through remittance exchange; households that use mobile money services are more likely to receive remittances, receive remittances more frequently and the volume received is significantly higher than that received by non-user households. Again, this observation corroborates findings from earlier studies that mobile money reduces the transaction cost of risk-sharing and boosts the flow of remittances among members of informal social networks, generating supplementary funds which receiver households use to safeguard the multitude of income shocks encountered in their lives.

Various policy implications can be drawn from the findings of this dissertation. First, the finding that the rural households are willing and able to use financial services when they have an affordable platform implies a great need to design and streamline such financial products that cater for their financial needs. The emergence of mobile money and the willingness of the rural poor to take up this innovation are indicative of the need by governments and stakeholders to design supportive policies to scale up this financial product to many more financially excluded people. This will go a long way increasing access to productive opportunities by disadvantaged groups of people and promoting inclusive growth. With specific reference to savings, promoting this financial platform could stimulate and strengthen a savings culture and increase saving rates at the individual, household and aggregate economy levels, ultimately transforming the economy through the mobilization of funds for productive investments. Additionally, promoting a convenient and cheap channel for the exchange of remittances and credit would partly relax the

idiosyncratic credit constraints that hinder effective investment in productive ventures especially among the rural poor.

Secondly, the welfare impact of mobile money documented in this dissertation implies that streamlining the operational framework of this financial product could be an effective strategy to alleviate poverty and vulnerability. Direct pathways through which this could be realized include boosting per capita consumption through the facilitation of risk-sharing and consumption smoothing arrangements among members of informal social networks, particularly family members and friends. Indirect pathways rely on the ability of the user households to transform financial access into development outcomes, especially through incremental saving and engagement in productive investments in both physical and human capital. However, investment in productive physical capital requires an adequate level financial literacy and investment skills and could be quite challenging for the rural poor who hardly possess these skills. It is therefore recommended to consider training programs in financial literacy and entrepreneurship skills specifically targeting the rural poor in order to fully leverage the investment potential associated with the mobile money platform in complement with promoting access to its range of services.

Lastly, this dissertation recommends that more efforts to developing and popularizing recent innovations in the mobile money ecosystem. The most promising among such innovative services is the electronic payment for goods and services, including school fees, government taxes, utility bills and selected airline tickets. The government, mobile network operators and stakeholders ought to devise creative strategies to scale up

these services to enhance payments efficiency and reduce the volume of cash-based financial transactions. In support of this cause therefore, more private sector players and government agencies need to embrace this innovation as part of their payment options as it has been documented that electronic payments are relatively cost-effective and efficient compared to cash-based payment channels (USAID, 2012). Bank of Uganda would thus tap into this opportunity in order to fulfill its target of significantly reducing the size of the cash economy.

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**Table 3.1: Summary Statistics by Survey Year and Mobile Money Adoption Status**

VARIABLES	2009				2012			
	Non-Adopters		Adopters		Non-Adopters		Adopters	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>ICT Use</i>								
1 if mobile phone owned	0.5099	0.5003	0.5462	0.4985	0.6133	0.4874	0.9320	0.2520
1 if holds bank account	-		-		0.1269	0.3332	0.3815	0.4865
<i>Wealth</i>								
Total value of assets (UGX)	266,466	564,907	411,356	568,729	390,208	555,563	831,826	1,189,717
Land holding size (acre)	5.7931	7.1484	7.1633	10.0797	5.5852	6.1938	6.9291	9.1896
<i>Remittances</i>								
1 if received remittance	0.5036	0.5004	0.5098	0.5006	0.6558	0.4755	0.7892	0.4084
No. of Remittances	2.4116	4.7165	2.3838	4.6326	3.0394	5.0995	5.5496	7.3803
Total remittance (UGX)	566,222	1,002,502	558,571	914,789	621,833	1,116,481	1,088,673	1,595,953
<i>Welfare</i>								
Per capita consumption (UGX)	27,484	28,121	31,488	25,073	43,524	35,182	54,636	41,080
<i>Household Demographics</i>								
Age of household head	53.1414	14.5252	53.3301	14.1900	52.6536	14.6563	52.7336	13.1949
1 if head is female	0.1170	0.3218	0.1481	0.3557	0.1554	0.3627	0.1569	0.3642
Head education	5.1611	3.6416	7.2138	4.1048	4.9328	3.5509	7.2215	3.9826
Household size	6.8675	3.2063	7.1512	3.6603	6.9068	3.4249	7.3549	3.6206
<i>Village Characteristics</i>								
Distance to district town (km)	13.4557	10.9761	11.8712	9.5719	10.3639	8.4176	8.7333	7.5988
Number of households	521		325		521		325	

Notes: Authors' computation based on RePEAT 2009 and 2012. According to the annual Bank of Uganda Report 2012, 1 USD was equivalent to Ush 2028 and 2557 in financial years 2008/2009 and 2011/2012, respectively.

**Table 3.2: Determinants of Household Mobile Money Adoption**

Variable	(1) Probit	(2) FE
1 if mobile phone owned	0.0806*** (0.0142)	0.117*** (0.0273)
1 if HH has migrant worker	0.0349*** (0.0131)	0.0908*** (0.0268)
Log of distance to nearest MM agent in km	-0.0137*** (0.00383)	-0.0442*** (0.0106)
Head years of schooling	0.00543*** (0.00152)	0.0115*** (0.00332)
Age of household head	0.00192 (0.00234)	0.00471 (0.00472)
Age (squared) of household head	-1.50e-05 (2.17e-05)	-4.16e-05 (4.32e-05)
Log of land size in acre	0.00207 (0.00710)	0.00132 (0.0185)
Household size	0.000151 (0.00135)	0.000378 (0.00365)
1 if head is female	0.0289 (0.0185)	-0.0141 (0.0357)
Log value of total assets	0.0195*** (0.00485)	0.0248** (0.0114)
District*Time dummies	Included	Included
Number of observations	1,692	1,692
R-squared		0.448
Number of households		846

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively.

**Table 3.3: Mobile Money and Household Consumption****Dependent Variable: Log(Real Household Per capita Consumption)**

Variable	(1) OLS	(2) FE	(3) FE
1 if mobile money used	0.135***	0.110*	0.0947*
	(0.0394)	(0.0565)	(0.0565)
Constant	9.144***	8.611***	9.359***
	(0.288)	(0.377)	(0.383)
District*Time dummies	Included		Included
Number of observations	1,692	1,692	1,692
R-squared	0.300	0.272	0.379
Number of households		846	846

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age and education level of household head.

**Table 3.4: Mobile Money and Disaggregated Consumption Expenditure**

Variable	Food Expenditure		Non-food Basics		Social Contributions	
	OLS (1)	FE (2)	OLS (3)	FE (4)	OLS (5)	FE (6)
1 if mobile money used	0.0977**	-0.0129	0.154***	0.207**	0.563***	0.474**
	(0.0483)	(0.0683)	(0.0594)	(0.0832)	(0.117)	(0.187)
Constant	10.82***	11.75***	7.255***	8.193***	6.854***	7.213***
	(0.231)	(0.295)	(0.236)	(0.358)	(0.668)	(0.893)
District*Time dummies	Included	Included	Included	Included	Included	Included
Number of observations	1,690	1,690	1,690	1,690	1,690	1,690
R-squared	0.302	0.354	0.303	0.470	0.380	0.373
Number of households		845		845		845

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age and education level of household head. In constructing household real per capita food consumption, I use adult equivalence units rather than head count to adjust for consumption differences by gender and age of household members.

**Table 3.5: Mobile Money and Household Remittances: Dependent Variable: Measures of Remittances**

Dependent Variable:	1 if Remittances Received		No. of Remittances		Total Remittances	
	(1)	(2)	(3)	(4)	(5)	(6)
Variable	Probit	OLS	OLS	FE	OLS	FE
1 if mobile money used	0.0706*	0.0581*	0.843**	0.940*	0.360***	0.381*
Constant	(0.0399)	(0.0324)	(0.421)	(0.525)	(0.133)	(0.220)
District*Time dummies		0.0273	-5.028**	-1.772	5.066***	5.080***
Number of observations	1,682	(0.190)	(2.441)	(3.354)	(0.872)	(1.253)
R-squared		Included	Included	Included	Included	Included
Number of households		1,682	1,682	1,682	1,682	1,682
		0.228	0.188	0.261	0.278	0.286
				841		841

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age and education level of household head.

**Table 3.6: Mobile Money, Job-seeking and Remittances. Dependent Variable: Measures of Remittances**

Variable	(1) 1 if Remittances Received	(2) Number of Remittances	(3) Total Remittances
1 if mobile money used	0.0952**	1.385**	0.428***
	(0.0456)	(0.629)	(0.163)
1 if HH has migrant worker	0.114***	1.384***	0.415***
	(0.0327)	(0.482)	(0.138)
Constant		2.831	9.607***
		(2.315)	(0.605)
District*Time dummies	Included	Included	Included
Number of observations	1,682	1,682	1,682
R-squared		0.265	
Number of households		841	841

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age and education level of household head.

**Table 3.7: Reduced Form Results for Consumption and Measures of Remittance**

VARIABLES	(1) Consumption	(2) 1 if Remittances Received	(3) No. of Remittances	(4) Total Remittances
Log (distance to booth)	-0.0481** (0.0238)	-0.0211* (0.0127)	-0.517*** (0.182)	-0.259** (0.123)
Constant	11.48*** (0.257)	0.622*** (0.141)	1.733 (1.687)	9.642*** (1.104)
District*Time dummies	Included	Included	Included	Included
Number of observations	1,690	1,682	1,682	1,682
R-squared	0.345	0.216		
Number of households	845		841	841

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age and education level of household head.

**Table 3.8: IV and Tobit Results. Dependent Variables: Consumption and Remittances**

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Consumption		Total Remittance		# of Remittances	
	FE-IV 2 <sup>nd</sup>	FE-IV 1st	Tobit	Tobit-CF	Tobit	Tobit-CF
1 if mobile money used	0.390** (0.174)		0.984*** (0.319)	0.707** (0.338)	0.917* (0.543)	0.889* (0.470)
First stage residual				2.913*** (0.937)		1.070 (2.113)
Log distance to MM agent		-0.037** (0.016)	-0.103 (0.0989)	-0.0186 (0.102)	-0.478** (0.222)	-0.367 (0.229)
1 if mobile phone owned	0.0183 (0.0508)	0.016 (0.034)	0.115 (0.219)	-0.181 (0.224)	0.826* (0.494)	0.765 (0.547)
1 if migrant worker present	-0.103** (0.0495)	0.058 (0.034)	0.524*** (0.202)	0.312 (0.210)	0.937** (0.464)	0.737 (0.485)
Head years of schooling	-0.00850 (0.0127)	0.006 (0.008)	0.0800*** (0.0259)	0.0558** (0.0270)	0.284*** (0.0593)	0.273*** (0.0626)
Age of household head	0.0371** (0.0180)	0.013 (0.009)	0.00615 (0.0410)	0.00737 (0.0433)	0.0277 (0.0975)	0.0323 (0.0992)
Log land size in acres	0.299** (0.130)	0.080 (0.088)	0.458*** (0.147)	0.366** (0.150)	0.911*** (0.327)	0.700** (0.328)
Household size	-0.0314*** (0.00938)	0.0035 (0.006)	-0.0403 (0.0294)	-0.0291 (0.0302)	-0.275*** (0.0671)	-0.237*** (0.0651)
1 if head is female	0.0356 (0.126)	-0.064 (0.070)	1.120*** (0.263)	1.103*** (0.275)	3.286*** (0.658)	3.497*** (0.676)
Log value of total assets	0.143*** (0.0318)	0.022 (0.0183)	0.692*** (0.0887)	0.622*** (0.0921)	1.038*** (0.203)	0.985*** (0.215)
Constant			0.745 (1.526)	1.848 (1.588)	-15.48*** (3.787)	-15.01*** (3.955)
R-squared	0.069					
First stage F-stat		17.76				
Cragg-Donald Walk F-stat		18.546				
Stock-Yogo critical value (10%)		16.38				
Observations	1,690	1,690	1,682	1,682	1,682	1,682

Robust standard errors are reported in parentheses. Asterisks \*, \*\* and \*\*\* represent significance the ten, five and ten percent levels, respective. Additional controls include log of distance in kilometers to the nearest district town, and district-by-time dummies.

**Table 3.9: Mobile Money and (Log of) Per Capita Consumption: Weighted Regression Based on Propensity Score Matching**

VARIABLES	(1) Consumption	(2) Food	(3) Basics	(4) Human Capital	(5) Social Contributions
1 if mobile money used	0.0717** (0.0356)	0.312*** (0.0430)	0.164*** (0.0601)	0.120** (0.0521)	0.362*** (0.103)
1 if mobile phone owned	0.198** (0.0896)	0.154 (0.0997)	0.288* (0.148)	0.361* (0.205)	-0.160 (0.252)
Years of schooling of head	0.00675 (0.00463)	-0.0174*** (0.00542)	0.0262*** (0.00760)	0.0295*** (0.0106)	0.0391*** (0.0131)
Head age	0.0109 (0.00849)	-0.0119 (0.0111)	0.0560*** (0.0130)	0.0977*** (0.0172)	0.0537 (0.0330)
headage2	-0.000100 (7.85e-05)	6.40e-05 (0.000101)	-0.000448*** (0.000121)	-0.000807*** (0.000158)	-0.000516* (0.000294)
Log value of land currently held	0.181** (0.0781)	0.153 (0.105)	0.298** (0.127)	0.482*** (0.182)	0.756*** (0.264)
logland2	-0.0297* (0.0180)	-0.0401 (0.0246)	-0.0413 (0.0286)	-0.0843** (0.0405)	-0.120** (0.0608)
Household size	-0.0561*** (0.00560)	-0.0266*** (0.00655)	-0.0962*** (0.00937)	0.0479*** (0.0122)	-0.125*** (0.0144)
1 if head is female	-0.0280 (0.0560)	-0.0575 (0.0665)	0.153* (0.0907)	0.0138 (0.124)	-0.101 (0.158)
Log value of total assets	0.201*** (0.0200)	0.137*** (0.0252)	0.371*** (0.0300)	0.430*** (0.0407)	0.527*** (0.0556)
Constant	7.881*** (0.346)	9.232*** (0.444)	2.988*** (0.503)	3.648*** (0.709)	-0.291 (1.127)
Observations	1,426	1,426	1,426	1,420	1,426
R-squared	0.303	0.197	0.369	0.323	0.302

Robust standard errors are reported in parentheses. Asterisks \*, \*\* and \*\*\* represent significance the ten, five and ten percent levels, respectively. Additional controls include log of distance in kilometers to the nearest district town, and district-by-time dummies. The reduction in number of observations is because these regressions include only households whose propensity score lies within an inclusive range of 0.1 and 0.9. Crump et al. (2008a) illustrate that this cut-off point often yields good results.

**Table 3.10: Mobile Money Adoption (Placebo Treatment), Household Per capita Consumption and Remittances: A Falsification Test using 2003 and 2005 Data**

Variable	(1) Consumption	(2) 1 if Remittances Received	(3) No. of Remittances	(4) Total Remittances
1 if mobile money used	-0.0650 (0.0675)	0.0113 (0.0418)	-0.108 (0.238)	-0.0788 (0.0708)
1 if owns mobile phone	-0.101 (0.106)	-0.250 (0.475)	0.0150 (0.117)	-0.0201 (0.0561)
1 if HH has migrant worker		0.0245 (0.0350)	0.105 (0.243)	-0.0589 (0.0697)
Constant	8.222*** (0.533)		6.967*** (1.870)	-0.0446 (0.431)
District*Time dummies	Included	Included	Included	Included
Number of observations	1,862	1,862	1,862	1,862
R-squared	0.261		0.153	0.431
Number of households	931		931	931

Robust standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively. Additional controls include household size, a dummy for household mobile phone possession, log of asset value, log of land size owned as well as gender, age and education level of household head. The placebo mobile money dummy was constructed in such a way that it takes the value one for a household that used mobile money services in 2009 and/or 2012 and zero otherwise.

**Table 4.1: Access to and Usage of Financial Services by Mobile Money Adoption Status in 2014**

VARIABLES	Non-adopters		Adopters		Difference
	Mean	SD	Mean	SD	Mean
<b><u>Usage of financial services</u></b>					
1 if saved money in past 12 months	0.56	0.50	0.80	0.39	0.24***
1 if borrowed money in past 12 months	0.48	0.50	0.69	0.46	0.21***
Amount saved in past 12 months ('000 UGX)	196	431	664	1,415	468***
Amount borrowed in past 12 months ('000 UGX)	138	305	619	1,248	481***
1 if owns bank account	0.13	0.32	0.41	0.49	0.28***
1 if belongs to SACCO	0.53	0.49	0.65	0.47	0.12***
1 if used an MFI	0.02	0.14	0.10	0.34	0.08***
1 if received remittance	0.62	0.48	0.72	0.44	0.10***
Total value of remittances (1000 UGX)	325	826	702	1,350	377***
<b><u>Access to financial services</u></b>					
1 if bank available in LC1	0.06	0.23	0.12	0.32	0.06**
1 if mobile money agent available in LC1	0.35	0.47	0.48	0.49	0.13***
1 if MFI available in LC1	0.08	0.26	0.10	0.29	0.02
1 if SACCO available in LC1	0.56	0.49	0.61	0.48	0.05
Distance from LC1 to nearest bank	54.84	87.72	53.20	85.88	1.64
Distance from LC1 to nearest MM Agent (km)	4.73	4.10	3.76	3.88	0.97***
Distance from LC1 to nearest MFI (km)	27.31	29.28	23.84	27.52	-3.47
Distance from LC1 to nearest SACCO (km)	5.86	10.76	6.16	11.64	0.30
Observations	244		576		

Note: Authors' Computation based on RePEAT4 and MM2014. The average exchange rate during the survey period was UGX 2,600 per USD 1 (Bank of Uganda, 2014). Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively.

**Table 4.2: Household and Village Characteristics by Mobile Money Adoption Status in 2014**

VARIABLES	Non-adopters		Adopters		Difference
	Mean	SD	Mean	SD	Mean
<b><i>Household characteristics</i></b>					
1 if owns any mobile phone	0.54	0.49	0.89	0.31	0.35***
Total value of assets (1000 UGX)	681	1,344	1,236	2,126	555***
Land size (hectare)	5.02	5.51	6.91	8.75	1.89***
Household size	6.26	3.29	7.33	3.47	1.07***
Age of household head	52.83	15.32	51.64	13.57	-1.19
1 if female head	0.17	0.38	0.14	0.35	0.03
Head years of schooling	4.40	3.49	6.48	3.84	2.08***
<b><i>Village characteristics</i></b>					
Distance (km) from LC1 to nearest district town	11.03	0.56	9.86	0.36	1.16*
Observations	244		576		

Note: Authors' Computation based on RePEAT4 and MM2014. The average exchange rate during the survey period was UGX 2,600 per USD 1 (Bank of Uganda, 2014). Asterisks \*\*\*, \*\* and \* indicate significance of mean difference at one, five and ten percent levels, respectively.

**Table 4.3: Determinants of Financial Service Usage: Marginal Effects from Probit Regression**

VARIABLES	Pr(Savings=1)		Pr(Credit=1)		Pr(Remittance=1)	
	(1)	(2)	(3)	(4)	(5)	(6)
1 if used mobile money	0.249*** (0.0407)		0.220*** (0.0426)		0.815*** (0.0298)	
Log(distance to MM Agent)		-0.0213 (0.0273)		0.0284 (0.0306)		-0.0457* (0.0272)
Education of household head	0.00671 (0.00500)	0.0112** (0.00486)	0.00472 (0.00538)	0.00994* (0.00530)	0.000236 (0.00595)	0.0176*** (0.00508)
Age of household head	0.00523 (0.00763)	0.00631 (0.00748)	0.0118 (0.00882)	0.0106 (0.00904)	-0.0154** (0.00723)	-0.0105 (0.00753)
Household size	-0.00525 (0.00535)	-0.00210 (0.00535)	0.00118 (0.00592)	0.00405 (0.00591)	0.0133** (0.00569)	0.0186*** (0.00585)
1 if female head	0.0149 (0.0464)	0.0248 (0.0450)	-0.0517 (0.0539)	-0.0409 (0.0530)	-0.0577 (0.0472)	-0.0127 (0.0475)
Log(total asset value)	0.0249 (0.0181)	0.0345* (0.0178)	-0.0109 (0.0191)	-0.000317 (0.0187)	0.0494** (0.0194)	0.0655*** (0.0179)
Observations	785	785	785	785	785	785
Pseudo R-Squared	0.124	0.083	0.090	0.066	0.654	0.191

Standard errors clustered at the village level in parentheses. Standard errors clustered at the village level in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively. Included controls not shown in the table include district dummies.

**Table 4.4: Amount (in log) of Remittances, Credit and Savings: Tobit Model with CF and full Controls**

VARIABLES	Log(Savings Amount)		Log(Credit Amount)		Log(Remittance Amount)	
	(1)	(2)	(3)	(4)	(5)	(6)
1 if used mobile money	0.817*** (0.234)	0.820*** (0.251)	0.685*** (0.123)	0.654*** (0.133)	0.840** (0.364)	0.766** (0.387)
First stage residual		1.517** (0.671)		0.650* (0.368)		-0.604 (1.044)
Log(Distance to district town)	-0.0554 (0.154)	-0.0509 (0.154)	-0.0277 (0.0964)	-0.0205 (0.0969)	-0.170 (0.284)	-0.138 (0.284)
1 if migrant worker present	0.0620 (0.235)	0.00338 (0.236)	-0.217 (0.142)	-0.236* (0.142)	0.750** (0.355)	0.775** (0.361)
1 if SACCO available in LC1	0.117 (0.267)	0.127 (0.268)	0.0110 (0.160)	0.0135 (0.161)	0.377 (0.413)	0.421 (0.414)
Head years of schooling	0.0329 (0.0292)	0.00728 (0.0310)	0.0308* (0.0184)	0.0191 (0.0197)	0.0351 (0.0448)	0.0461 (0.0478)
Age of household head	0.0129 (0.0473)	0.0127 (0.0475)	-0.00335 (0.0290)	-0.00220 (0.0291)	-0.0160 (0.0690)	-0.00632 (0.0691)
Log value of land currently held	0.0674 (0.170)	-0.00721 (0.174)	0.0348 (0.106)	-0.00304 (0.107)	0.491* (0.265)	0.527* (0.271)
Household size	-0.0664* (0.0346)	-0.0854** (0.0361)	-0.00351 (0.0188)	-0.0140 (0.0196)	-0.0392 (0.0507)	-0.0321 (0.0519)
1 if female head	-0.311 (0.306)	-0.327 (0.308)	-0.211 (0.163)	-0.222 (0.164)	1.122*** (0.411)	1.101*** (0.412)
Log value of total assets	0.190* (0.112)	0.140 (0.113)	0.114* (0.0633)	0.0937 (0.0652)	0.993*** (0.158)	1.011*** (0.160)
Observations	770	770	770	770	770	770

Standard errors clustered at the village level in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively. Included controls not shown in the table include district dummies and a squared term of age of household head and land holding size.

**Table 4.5: Adoption and Amount of Financial Services: Marginal Effects from Reduced Form Tobit**

VARIABLES	Pr(Saving=1) (1)	Log(Savings Amount) (2)	Pr(Credit=1) (3)	Log(Credit Amount) (4)	Pr(Remit=1) (5)	Log(Remit Amount) (6)
Log(distance to MM Agent)	-0.0547* (0.0319)	-0.371** (0.181)	-0.0278* (0.0253)	-0.143* (0.0863)	-0.0814** (0.0337)	-0.328** (0.141)
Log(distance in km to bank)	0.0387 (0.0217)	0.238 (0.124)	0.0294* (0.0173)	0.0719 (0.0570)	0.0492** (0.0244)	0.233** (0.109)
Log(distance in km to SACCO)	-0.00990 (0.0217)	-0.0544 (0.130)	0.00161 (0.0182)	-0.0398 (0.0635)	0.00789 (0.0236)	-0.0321 (0.0937)
Log(distance in km to MFI)	-0.00398 (0.0216)	-0.0129 (0.123)	-0.0228 (0.0182)	-0.0287 (0.0631)	-0.00170 (0.0235)	0.00445 (0.103)
Head years of schooling	0.00880* (0.00514)	0.0670** (0.0295)	0.00516 (0.00503)	0.0376** (0.0180)	0.0154*** (0.00566)	0.0974*** (0.0231)
Age of household head	0.00268 (0.00805)	0.0150 (0.0498)	0.000982 (0.00848)	-0.0123 (0.0299)	-0.0107 (0.00864)	-0.0384 (0.0366)
Household size	-0.00565 (0.00559)	-0.0427 (0.0359)	0.00390 (0.00560)	0.000409 (0.0195)	0.0146** (0.00603)	0.0592** (0.0253)
1 if female head	-0.0212 (0.0508)	-0.266 (0.311)	-0.0562 (0.0513)	-0.195 (0.167)	-0.0314 (0.0520)	-0.225 (0.210)
Log value of total assets	0.0365* (0.0187)	0.260** (0.112)	0.00211 (0.0175)	0.163*** (0.0622)	0.0469** (0.0192)	0.310*** (0.0821)
Observations	784	784	784	784	784	784

Standard errors clustered at the village level in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively. Other controls include district dummies, log of distance to district town, a squared term of age of household head and land holding size.

**Table 4.6: Amount of Financial Services: Weighted Regression Analysis Based on Propensity Score**

VARIABLES	Log(Savings) (1)	Log(Credit) (2)	Log(Remittance) (3)
1 if used mobile money	0.534*** (0.168)	0.680*** (0.127)	0.639** (0.321)
Education of household head	0.0507 (0.0327)	0.0611** (0.0251)	0.0456 (0.0292)
Age of household head	0.00246 (0.0422)	-0.00531 (0.0353)	-0.0167 (0.0345)
Log(land size)	-0.0131 (0.172)	0.0216 (0.139)	0.170 (0.151)
Household size	-0.0369 (0.0352)	-0.0114 (0.0264)	0.0332 (0.0311)
1 if female head	-0.168 (0.280)	-0.177 (0.206)	0.347 (0.259)
Log(distance to MM Agent)	-0.253 (0.190)	0.165 (0.145)	0.0739 (0.179)
Log(distance in km to bank)	0.170 (0.121)	0.0602 (0.0903)	0.195* (0.111)
Log(distance in km to SACCO)	-0.0727 (0.129)	0.0128 (0.100)	0.117 (0.107)
Log(distance in km to MFI)	0.0160 (0.119)	-0.101 (0.0925)	-0.167 (0.105)
Log(Distance in km to district town)	-0.0933 (0.168)	0.0501 (0.139)	0.259 (0.160)
Log value of total assets	0.235** (0.111)	0.117 (0.0905)	0.0121 (0.0987)
Observations	673	673	673
R-squared	0.200	0.196	0.258

Standard errors clustered at the village level in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively.

**Table 4.7: Balance Check for Comparability of Covariates before and after Propensity Score Matching**

Variables	Mean before			Mean after			%  Bias
	MM=1	MM=0	P-value	MM=1	MM=0	P-value	Reduction
Head ears of schooling	5.79	4.12	0.000	5.94	5.96	0.889	89.6
Head age	51.39	52.52	0.326	51.39	50.22	0.194	63.7
Land size in hectares	5.83	4.51	0.005	5.83	5.48	0.342	78.4
Household size	6.93	6.15	0.002	6.93	6.86	0.731	91.3
1 if female head	0.15	0.19	0.25	0.15	0.13	0.466	50.8
Total assets in '000 UGX	850	550	0.000	850	800	0.400	63.2
Distance in km to MM agent	4.14	4.86	0.030	4.14	4.14	0.989	99.5
Distance in km to bank	54.24	56.47	0.756	54.24	50.16	0.462	83.0
Distance in km to SACCO	6.12	6.05	0.938	6.12	5.49	0.388	74.8
Distance in km to MFI	23.70	27.79	0.074	23.75	23.16	0.444	85.3
Distance in km to district town	10.41	11.34	0.200	10.41	10.40	0.990	99.2
1 if owns mobile phone	0.82	0.51	0.000	0.82	0.81	0.279	96.8
Pseudo R <sup>2</sup>	-	-	0.077	-	-	0.006	-
Mean Bias	-	-	16.9	-	-	3.4	-
P-value (Joint Mean Equality)	-	-	0.000	-	-	0.724	-

Balance check before and after PSM for observations for which  $0.1 < e(X) < 0.9$ . Pseudo R<sup>2</sup> indicates how well covariates explain treatment probability; a small value after matching indicates goodness of the matching technique (Sianesi, 2004). A standardized absolute mean bias less than 5 after matching indicates effective matching (Rosenbaum and Rubin, 1985). A non-significant p-value for the joint mean equality test after matching shows significant similarity between treatment and control groups after matching (Caliendo & Kopeinig, 2008)

**Table 4.8: Determinants of Disaggregated Formal and Informal Credit Amount:  
Tobit-CF**

VARIABLES	(1) Log(Credit)	(2) Log(Informal Credit)	(3) Log(Formal Credit)
1 if used mobile money	0.685*** (0.174)	0.594*** (0.218)	0.237** (0.106)
First stage residual	-0.289 (0.187)	0.0497 (0.158)	0.655 (0.485)
Years using mobile money	0.0385 (0.0436)	-0.0174 (0.0360)	0.0217 (0.0219)
Years using bank	0.0561*** (0.0142)	-0.0365*** (0.0105)	0.0399*** (0.00641)
Years using SACCO	0.000227 (0.000315)	0.000289 (0.000317)	-0.00128 (0.00738)
Years using MFI	0.223*** (0.0457)	0.0299 (0.0495)	0.0806*** (0.0164)
Education of household head	0.0241 (0.0215)	-0.0106 (0.0183)	-0.0230 (0.0317)
Household size	0.00781 (0.0198)	0.00210 (0.0180)	-0.0402 (0.0257)
1 if female head	-0.142 (0.164)	-0.120 (0.143)	-0.0904 (0.108)
Observations	773	773	773

Standard errors clustered at the village level in parentheses. Standard errors clustered at the village level in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively. Other covariates include log of distance to nearest district town, bank, MFI, SACCO and mobile money agent; age and age squared of the household head; log(land size) and log(asset value)

**Table 4.9: Decision to Adopt and Frequency of Using Financial Service Providers: SUR Estimation**

VARIABLES	Adopt service financial providers				Frequency of financial service provider usage			
	M- Money (1)	Bank (2)	SACCO (3)	MFI (4)	M- Money (5)	Bank (6)	SACCO (7)	MFI (8)
Log(distance to MM Agent)	-0.0846*** (0.0299)	-0.0161 (0.0301)	0.0209 (0.0327)	0.0203 (0.0206)	-0.235** (0.116)	-0.0140 (0.0813)	0.0743 (0.119)	0.0208 (0.0483)
Log(distance in km to bank)	0.0487** (0.0192)	0.0154 (0.0193)	-0.00352 (0.0210)	-0.00379 (0.0132)	0.128* (0.0720)	0.0244 (0.0507)	-0.0519 (0.0740)	-0.0362 (0.0301)
Log(distance in km to SACCO)	0.000255 (0.0196)	0.00290 (0.0198)	0.00920 (0.0214)	0.00288 (0.0135)	-0.00591 (0.0756)	-0.0200 (0.0532)	0.0422 (0.0776)	0.00760 (0.0316)
Log(distance in km to MFI)	0.00180 (0.0191)	-0.0197 (0.0192)	-0.0176 (0.0209)	-0.00675 (0.0131)	-0.0576 (0.0718)	-0.0606 (0.0505)	0.00372 (0.0737)	0.00853 (0.0300)
Head years of schooling	0.0184*** (0.00456)	0.0235*** (0.00460)	0.000131 (0.00499)	0.00452 (0.00314)	0.0652*** (0.0173)	0.0455*** (0.0122)	-0.0106 (0.0178)	-0.00113 (0.00723)
Age of household head	2.16e-05 (0.00715)	-0.0121* (0.00721)	0.00762 (0.00782)	-0.00583 (0.00492)	-0.0203 (0.0273)	-0.0275 (0.0192)	0.0199 (0.0281)	-0.0127 (0.0114)
Household size	0.0142*** (0.00502)	-0.00117 (0.00507)	0.00394 (0.00550)	0.00796** (0.00346)	0.0452** (0.0193)	-0.0109 (0.0136)	0.00716 (0.0198)	0.0113 (0.00809)
1 if female head	0.0265 (0.0453)	0.0404 (0.0457)	-0.0199 (0.0496)	-0.0200 (0.0312)	0.0840 (0.174)	0.0934 (0.123)	-0.147 (0.179)	-0.0703 (0.0729)
Log value of total assets	0.0428*** (0.0163)	0.0885*** (0.0164)	-0.0226 (0.0178)	-0.00362 (0.0112)	0.212*** (0.0615)	0.226*** (0.0433)	-0.0790 (0.0631)	0.000367 (0.0257)
Constant	-0.134 (0.286)	-0.526* (0.288)	0.922*** (0.313)	0.202 (0.197)	-0.854 (1.093)	-1.308* (0.769)	2.939*** (1.122)	0.539 (0.457)
Observations	770	770	770	770	770	770	770	770
R-squared	0.182	0.194	0.126	0.110	0.310	0.168	0.134	0.104

Standard errors clustered at the village level in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively. Other controls include district dummies, log of distance to district town, a squared term of age of household head and land holding size.

**Table 4.10: Correlation between Attrition and Household and Village Characteristics**

VARIABLES	(1) OLS	(2) Probit
Log(distance to MM Agent)	-0.00324 (0.0146)	-0.00496 (0.0142)
Log(distance in km to bank)	0.00337 (0.00962)	0.00450 (0.00934)
Log(distance in km to SACCO)	0.0128 (0.0104)	0.0111 (0.00996)
Log(distance in km to MFI)	-0.0144 (0.0101)	-0.0141 (0.00971)
1 if migrant worker present	0.0312 (0.0229)	0.0303 (0.0236)
Head years of schooling	-0.00372 (0.00290)	-0.00376 (0.00291)
Age of household head	-0.00635 (0.00467)	-0.00510 (0.00421)
Age of household head 2	5.58e-05 (4.23e-05)	4.40e-05 (3.79e-05)
Log(land size)	-0.000639 (0.0160)	1.99e-05 (0.0159)
Household size	-0.000992 (0.00319)	-0.00103 (0.00311)
1 if female head	0.0406 (0.0288)	0.0358 (0.0303)
Log value of total assets	-0.0109 (0.0101)	-0.0104 (0.00967)
Constant	0.508*** (0.171)	
Observations	871	871
R-squared	0.025	

Standard errors in parentheses. Asterisks \*\*\*, \*\* and \* indicate significance at one, five and ten percent levels, respectively.