IMPACT OF MOBILE FINANCIAL SERVICES ON HOUSEHOLD'S WELFARE AND INEQUALITY: EVIDENCE FROM KENYA

By

ANTHONY GATHOGO GATHONI

DISSERTATION

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

IN PUBLIC POLICY

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SHUN WANG

MOBILE FINANCIAL SERVICES, HOUSEHOLD WELFARE, SAVINGS AND CREDIT MARKET: EVIDENCE FROM KENYA

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ABSTRACT

IMPACT OF MOBILE FINANCIAL SERVICES ON HOUSEHOLD'S WELFARE AND INEQUALITY: EVIDENCE FROM KENYA

By

ANTHONY GATHOGO GATHONI

In the recent past, substantial development in the empirical techniques and re-searches on financial inclusion alongside the availability of micro-level data allows for pragmatic inquiry on the impact of digitally driven mobile finance at the household level. This dissertation consists of five inter-related chapters on the impact of financial inclusion through mobile banking on household welfare and inequality in Sub-Saharan Africa. I exploit micro-level data to provide empirical evidence detailing the effect of mobile banking on household saving behavior, credit uptakes, household consumption patterns, income and wealth inequalities. Thus, the five chapters are organized as follows:-

Chapter 1, provides a brief introduction to the study by focusing on the effect of mobile financial services as a form of financial inclusion for sustainable development. The Chapter also aims to highlight the motivation and road-map of this dissertation, in particular, the impact of bank-integrated mobile financial services on household welfare and inequalities; while teasing out the possible contribution to the growing body of literature on the driving force behind its success in a developing country context.

Chapter 2, This chapter provides a road-map of financial inclusion focusing on mobile finance revolution in the past decade in developing countries. Focus-

ing on Kenya's financial market developments, while it discusses and addresses institutional issues focused on ensuring the financial system's stability and efficiency, in the wake of hybrid integration of mobile financial services with the banking system.

Chapter 3, empirically examines using bivariate and instrumental variable approach the impact of integrated mobile banking on rural-urban household's demand for loans and savings behavior using a micro-level data. The study also explores different channels through which integrated mobile banking affects household's decision to participate in the credit market and their saving practices. I find a positive and significant impact of integrated mobile banking on loans and savings. The results also indicate that access to financial services through integrated mobile banking channel enhances the likelihood of agricultural dependent household to participate in the credit market and to increase their savings for future plans. The findings also reveal that individual demand for loans and savings using integrated mobile banking increases with formal financial institutions and decline with informal financial institutions. In addition, the findings suggest that there exists complementarity between access to integrated mobile banking and demand for loans and savings for investments purposes, with no significant effect on loans or savings for consumption purposes.

Chapter 4, investigates whether integrated mobile banking influences household spending behavior on consumption for physical and human capital investment, and family transfers using instrumental variable estimation technique. The findings obtained are supportive of integrated mobile banking having a positive and significant causal impact on household demand for productive activities beyond total consumption. In particular, I observe that access to integrated mobile banking enables individuals to allocate a significant share of total household consumption on social transfers, and individual's spending on microbusinesses and education, while, I find no significant impact on health expenditures.

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Chapter 5, examines the effect of integrated mobile banking on income and wealth distribution across different quantiles by exploiting instrumental variable of quantile treatment effect approach. The impact of integrated mobile banking on income seems to be higher at the top 20th quantile level, suggesting financial inclusion through integrated mobile banking significantly affect the top half households compared to bottom poor. Similarly, access to integrated mobile banking services widens wealth disparities between the bottom 10th and 90th quantiles, suggesting it disproportionately benefits richer than the poor in terms of wealth accumulation.

Keywords: Financial Inclusion, Integrated Mobile Banking, Household's Welfare, Instrumental Variable.

DEDICATION

This dissertation is dedicated to my wife, Ms. Irene Wambui Ndungu, and our lovely children, Mr. Kien Kimani Gathogo, and Miss Eliana Grace Gathoni Gathogo, for their indispensable emotional, spiritual, and material support during the entire period I dedicated to my doctoral program and the time they spent without my presence.

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LIST OF ABBREVIATIONS

AML/CFT   Anti-Money Laundering/ Countering Financing of Terrorism

ATMS   Automated Teller Machines

BMGF   Bill & Melinda Gates Foundation

BMM   Basic Mobile Money

CAK   Communication Authotrity of Kenya

CBA   Commercial Bank of Africa

CBK   Central Bank of Kenya

CRBs   Credit Reference Bureaus

DFID   Department for International Development

ERAP   Economic Recovery Action Plan

FSAP   Financial Sector Assessment Programme

FSDK   Financial Sector Deepening Kenya

GoK   Government of Kenya

GPFI   Global Partnership for Financial Inclusion

GSMA   Groupe Spéciale Mobile Association

IV   Instrumental Variables

KCB   Kenya Commercial Bank

KDI   Korea Development Institute

KDIC   Kenya Deposit Insurance Company

KNBS   Kenya National Bureau of Statistics

KSh   Kenya Shillings

KYC   Know-Your-Customer

LPM   Linear Probability Methods

IMB   Integrated Mobile Banking

MENA   Middle East and North Africa

MFBs   Microfinance Banks

MFIs   Microfinance Institutions

MFS   Mobile financial services

M-Kopa Mobile-Credit

MNOs   Mobile Networks Operators

M-pesa Mobile-Money

M-Shwari Mobile-Calm

MSMEs Micro, Small, and Medium Enterprises

MRPs   Money Remittance Providers

MVNO   Mobile Virtual Network Operator

NASSEP National Sample Survey and Evaluation Program

NPS   National Payments Systems

OLS   Ordinary Least Squares

PSUs   Primary Sampling Units

SACCOS Savings and Credit Co-operative Society

TSLS   Two Stage Least Squares

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Financial inclusion is a multifaceted approach that entails access to and usage of formal financial services such as remittances, transfers, payment of goods and services, savings, credit, and insurance for sustainable development (Allen, Demirguc-Kunt, Klapper, & Peria, 2012; Beck, Senbet, & Simbanegavi, 2014; Demirgüç-Kunt & Klapper, 2012). However, a grey picture is painted globally with close to 2.0 billion of the world's adult population being excluded from formal financial services (Allen et al., 2012; Gugerty, 2007; Jalilian & Kirkpatrick, 2005; Johnson & Nino-Zarazua, 2011). The Findex Report suggest that close to 69 percent of adults population across the globe in 2017 opened a new account with a formal financial institution, representing 10 percent increase from 2011 (Demirguc-Kunt, Klapper, Singer, Ansar, & Hess, 2018).

The need for convenient means of accessing financial services beyond traditional formal financial institutions such as commercial banks, microfinance institutions (MFIs), and savings and credit co-operative society (SACCOS), has revolutionized banking patterns particularly in reaching the pro-poor population in developing countries (Beck, Demirgüç-Kunt, & Levine, 2007; Diagne, Zeller, Sharma, et al., 2000; Johnson & Nino-Zarazua, 2011; Klapper & Singer, 2014; Mbiti & Weil, 2015; Steiner, Giesbert, & Bendig, 2009; Vaughan, 2007).

A key contributor to the financial development in recent times is highly attributed to mobile finance explosion (Demirguc-Kunt et al., 2018; GSMA, 2018;

Pénicaud & Katakam, 2013; Vaughan, 2007; Wessels & Drennan, 2010). The tremendous impact of mobile driven finance in the developing world has elucidated the need for other market players to enhance an all-inclusive financial sector. In the past 10 years of mobile finance revolution, close to 690 million mobile accounts were registered globally representing 25 percent increase in 2017 compared to previous years, while more than 90 countries utilized this services to bridge the gap to previously excluded population in accessing formal financial services (GSMA, 2018).

Mobile finance has overtime and space expanded financial inclusion, particularly in Sub-Saharan Africa, resulting in dramatic behavioral change among the formerly excluded individuals from formal financial services (Aker & Mbiti, 2010; Francis, Blumenstock, & Robinson, 2017; Frydrych & Aschim, 2014; Orotin, Quisenbery, & Sun, 2014; Ozili, 2018).[1] Indeed, an inclusive financial service through increased access to mobile financing has contributed immensely as a welfare enhancement for formerly underserved individuals in the society (Batista & Vicente, 2013; Demirguc-Kunt et al., 2018; Gruber & Koutroumpis, 2011; Reeves & Sabharwal, 2013; Wamuyu, 2014).

Leveraging the prospects of mobile financial innovations necessitated by thriving market conditions offers an opportunity for reduction in formal financial services exclusion for the unbanked population (GSMA, 2018; Reeves & Sabharwal, 2013).[2] For instance, in developing countries, mobile finance platforms are perceived as enablers for formal financial services through remote transactions (Aker & Mbiti, 2010; Gabor & Brooks, 2017; GSMA, 2018; Kendall, Maurer, Machoka, & Veniard, 2011). They also provide access to formal financial services such as credit facilities, transfers, interest-bearing savings, and insur-

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[1]Mobile finance entails provision of financial services using mobile phone based applications that facilitates savings, provision of loans, and enables users to transfer funds across networks. However, there are other financial services that are offered in the market digitally without necessarily using mobile phone applications such as ATMs, credit cards and debit cards etc.

[2]The GPFI (2016) defines mobile financial inclusion as accessibility and utilization of mobile financial services to expand financial services to previously underserved and excluded population.

2

ance, while they provide historical data aimed at scoring individual's settlement capabilities (Gabor & Brooks, 2017; Lauer & Lyman, 2015).

Conversely, financial markets are characterized by market failures that constrain a significant share of the world's pro-poor populace accessibility and utilization of formal financial services, resulting to majority seeking alternative forms of financial services such as informal mechanisms (Bofondi & Gobbi, 2006; Jack, Ray, & Suri, 2013; Jalilian & Kirkpatrick, 2005; Zeller & Sharma, 2002b).

1.2 Motivation and Literature review

In the recent past, expansion of new financial development solutions and substantial improvement in the empirical techniques and researches on financial inclusion alongside the availability of micro-level data, allows for pragmatic inquiry on the impact of mobile driven financial services at the micro-level.

Despite, rapid development of basic mobile money platform in the provision of formal financial services, its integration with bank led mobile money systems remains largely unexplored. This study, therefore, endeavors to fill this knowledge gap by exploring various channels through which bank-led mobile money services (henceforth integrated mobile banking) influences household's financial practices and welfare decisions. The study also sheds more light on welfare effect of integrated mobile banking on households with limited financial services, particularly agricultural dependent individuals.

Integrated mobile banking [3] is defined as the provision of unsecured banking services through linking mobile phone applications with individual's bank accounts (Asongu & Odhiambo, 2017; Blechman, 2016; Cook & McKay, 2015; Demombynes & Thegeya, 2012). Bank-integrated mobile financial services enables users to earn or pay small interest on their savings and facilitates credit uptake. Equally, it is presumed to increase participation in the formal finan-

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[3]This study uses integrated mobile banking and mobile banking interchangeably

cial institution as individual users reduce usage of informal financial mechanism such as friends or relatives (Cruz, Barretto Filgueiras Neto, Munoz-Gallego, & Laukkanen, 2010; Demombynes & Thegeya, 2012; Lwanga & Adong, 2016).

However, the existing past researches have extensively documented the importance of basic mobile money platform as a tool for cash in-cash out transfers using a mobile phone in the form of text messages (J. Blumenstock, Callen, & Ghani, 2015; Francis et al., 2017; Mas & Klein, 2012; Mbiti & Weil, 2015; Merritt, 2011). As an accelerator for economic growth through inclusive financial development, basic mobile money provides access to financial services such as payment for goods and services, remittances, and facilitates virtual savings through the use of mobile phone devices (Kendall et al., 2011; Onsongo & Schot, 2017; Wamuyu, 2014).

Access to mobile money can motivate users to make long-lasting consumption and investment decisions (Dupas & Robinson, 2013; Park & Mercado, 2015; Suri & Jack, 2016); and improve risk sharing through remittances across social networks (Jack & Suri, 2014; Riley et al., 2016).[4]

Therefore, these studies focuses on the impact of bank-integrated mobile financial services rather than financial services provided through use or access to basic mobile money.[5] This study, therefore, shows that integrating mobile financial services with the banking systems can increasingly promote inclusive financial development.

In Chapter 3, I presume that access to integrated mobile banking financial services can impact positively credit markets and facilitate individual's savings. In particular, I provide a micro-perspective on its causal impact on the credit market and saving behavior by exploiting instrumental variable estimation technique. The study is further motivated by examining various pathways through which mobile banking can affect credit markets and can influence individual's

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[4]Also, it enables users to transfer funds across networks using mobile-based applications and can only facilitate savings using virtual mobile account.

[5]see Cook and McKay (2015) and Demombynes and Thegeya (2012) for further details on differences between basic mobile money and mobile banking in expanding financial inclusion.

saving behavior.

First, I conduct heterogeneous effect of integrated mobile banking on savings and loans, by estimating a sub-sample of agricultural dependent households. This is in understanding that a majority of Kenyan's adult population lives in rural areas, where the main source of livelihood is farming (Batista & Vicente, 2013; Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008; Dupas & Robinson, 2013; Frydrych & Aschim, 2014; Lwanga & Adong, 2016; Zeller & Sharma, 2002a). Second, I explore the heterogeneous effect of mobile banking on whether the savings or loans are taken for investments or consumption and whether they originate from formal or informal institutions (Barslund & Tarp, 2008; Gugerty, 2007; Klapper & Singer, 2014; Steiner et al., 2009).

The rationale for examining other integrated mobile banking channels is hinged on the fact that by examining the homogeneity of loans or savings will not reveal the individual's financial behavior or even savings practices. Also, it is important to examine whether integrated mobile banking is a compliment or a substitute for other forms of financial services. Therefore, I examine the magnitude at which the findings are driven by these competing factors.

A growing continuum of studies have described mobile financial services (MFS) as branchless electronic bank that have overtime and space reduced gap in the provision and facilitation of formal financial services such as savings, credit and insurance through the use of mobile phone devices (Demombynes & Thegeya, 2012; Kikulwe, Fischer, & Qaim, 2014; Kshetri & Acharya, 2012; Ky, Rugemintwari, & Sauviat, 2017; Wamuyu, 2014)

Lwanga and Adong (2016), using a micro-level data to assess the effect of registered mobile money users on savings behavior in Uganda, conclude that individuals living in urban areas have a higher chances of increasing their savings compared to those in rural areas due to well-developed infrastructure such as mobile phone network coverage and high incomes thus have a wide access to formal financial services. Similar evidence points to a majority of households in

the context of developing countries to have increased demand for mobile financial services, particularly, use of basic mobile money to save (Mas, 2017; Mbiti & Weil, 2015; Morawczynski, 2009). For example, empirical work by Jack et al. (2013) using panel data spanning for two periods establishes that more than three quarter of Kenyan adults' population used mobile money as saving instrument. In similar findings, Morawczynski (2009), theoretically opines that basic mobile money has facilitated savings close to a third of individual's users in formal financial institutions and a fifth outside this institutions, suggesting increased usage of this form of financial instrument enhances formal financial services uptakes.

Steiner et al. (2009), investigating determinant for household demand for financial services in rural Ghana find low income households are more likely to increase demand for informal financial services compared to their counterparts high income households. There empirical results also suggest that demand for credit and savings products is highly influenced by other factors such as trust in service providers, shocks, associated risks, and other socioeconomic factors.

Work by Klonner and Nolen (2008) finds a robust positive effect of mobile phone usage on labor market outcomes with significant improvement in household income. Using a randomized field experiment in rural Kenya, Dupas and Robinson (2013) shows that increasing access to basic formal financial services free from savings constraints motivates more women to save in such arrangements compared to men. Morawczynski (2009) theoretically examines financial diaries of mobile money users and concludes that increased use of mobile financial services can increase poor households' willingness to save as well as motivate them to participate in credit markets.

Mdoe and Kinyanjui (2018) uses Kenya micro-level data to examine whether mobile banking can scale-up credit access for micro, small, and medium enterprises (MSMEs). They conclude that mobile banking expands growth of MSMEs through enhancing access to mobile loans.

Empirical work by Mbiti and Weil (2015) investigates the economic impact of mobile money usage using micro-level data from Kenya. Their findings suggest that users of mobile money are more inclined to take advantage of formal financial services compared to non-users.[6] They also shows that increased usage of mobile money leads to a reduction of the use of informal financial services by 15 percentage points and social networks by 30 percentage points.

Burgess and Pande (2005) considers the role of increasing formal financial services through instituting financial reforms in rural India and as a form of poverty eradication tool. Their findings suggest that extensive deployment of rural bank networks facilitates credit uptake, increases savings mobilizations, and enhances household wealth accumulation. Jack and Suri (2014) find similar results using longitudinal data for two periods in Kenya and conclude that users of the mobile money wallet are more likely to build up savings by integrating this services with their bank accounts.

Degryse and Ongena (2005) and Bofondi and Gobbi (2006) find distance between the lenders and firms plays an important role in enhancing or reducing lending conditions. They argue that the closer the distance between the lender and borrowers the less likely borrowers will default on their loans. Giné, Goldberg, and Yang (2012) conduct a randomized field experiment in Malawi where they biometrically investigate borrower's credit history using digital fingerprints before the lender approves loans. They conclude that the exercise yielded positive results through improvement of loan repayment rates and also scaled-up credit uptake.

Despite, the success of mobile finance, the relationship between integrated mobile banking, and credit market and saving behavior is unclear apriori. Similarly, to date, none of the currently existing literature has investigated the effect of integrated mobile banking on the credit market and individual's saving behavior.

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[6]Increased use of mobile money can affect negatively prices of other forms of money transfers such as Western Union and Money Gram Mbiti and Weil (2015).

Thus, the study endeavors to fill this knowledge gap in the literature on the effect of integrated mobile banking on household savings behavior and credit uptake on two main fronts: First, to the best of my knowledge, it could be the first study to empirically explore the impact of integrated mobile banking on rural-urban household's demand for loans and savings behavior using a micro-level data. Conversely, the identification strategy establishes a causal relationship between integrated mobile banking on loans and savings. Second, the study contributes to the growing literature on inclusive financial development through mobile financial services by exploring different channels through which integrated mobile banking affects a household's decision to participate in the credit market and in facilitating their saving behavior.

Therefore, the study seeks to empirically answer the following research questions: Does integrated mobile banking impact on household's saving and borrowing behavior in a developing country? What is its impact on agricultural dependent households? What is its impact on formal and informal institutions? For instance, does it reduce household participation in the informal financial institution? What are the reasons for saving and taking loans using digital credit?

In the empirical strategy, I first explore the effect of integrated mobile banking on loans and savings using linear probability estimation technique (LPM). The OLS findings are robust and positively significant even after controlling for other covariates such as gender of the household head, age, income, education levels, locations, wealth, employment status, distance to the infrastructure development. The findings suggest that increased access and use of integrated mobile banking enhances credit uptake and increases the household propensity to save. However, the main concern with the findings is the possible endogeneity of access to integrated mobile banking as a form of formal financial services. Thus, results provided through the OLS approach cannot infer a causal link and could bias a true effect of integrated mobile banking on credit uptake and savings practices.

Therefore, after accounting for the integrated mobile banking endogeneity issues using instrumental variable approach, the results are not only consistent with OLS findings but are robust and significant. The results also indicate that access to financial services through integrated mobile banking enhances the likelihood of agricultural dependent household to participate in the credit market and to increase savings for future plans. The findings also reveal that individual demand for loans and savings using integrated mobile banking increases with formal institutions and decline with informal institutions. I observe that access to integrated mobile banking has a positive and significant relationship with savings and loans for investment purposes, with no impact on consumption purposes.

Chapter 4, focuses on estimating the causal impact of the sudden proliferation of mobile financial services using micro-level data. In particular, I assess how integrated mobile banking is contributing to household spending on productive activities as well as in alleviating social distress by spending on other family members. I argue that accessibility and availability of integrated mobile banking potentially improve household welfare and in the long-run, act as poverty eradication mechanism at the household level. The spread of integrated mobile banking in developing countries has been beneficial across the board and provides a smooth flow of financial services for the majority who are at the bottom of the pyramid (Johnson & Nino-Zarazua, 2011; Ky et al., 2017; Mas & Klein, 2012; Morawczynski, Pickens, et al., 2009; Munyegera & Matsumoto, 2018). Integrated mobile banking can lead to a shift in household spending behavior through fostering investment in physical and human capital (Alafeef, Singh, & Ahmad, 2012; Apiors & Suzuki, 2018; Kikulwe et al., 2014; Mbiti & Weil, 2015).

In estimating the effect of migratory networks on microenterprises in Mexico, Woodruff and Zenteno (2007) found that intra-household remittance flows motivate households to invest more in microbusinesses. Apiors and Suzuki

(2018) examines the impact of mobile money on expenditure patterns in rural Ghana and conclude that mobile money significantly increased spending on microbusiness, education and on consumption. Aker (2008), explored the quasi-experimental nature of mobile phone penetration in Niger to investigate the effect of the adoption of cellphones on market performance. His findings show a remarkable reduction in price dispersion across grain markets after the adoption of the mobile phone in rural Niger. Munyegera and Matsumoto (2016), using a two-year panel data of 846 households to evaluate the effect of mobile money on household welfare in rural Uganda, suggest that users of mobile innovations have an incentive to increase remittances to improve their household welfare. Using a randomized control trial to estimate the impact of mobile money on employee wages in Afghanistan, J. Blumenstock, Callen, Ghani, and Koepke (2015), found the program to have yielded more benefits to the employers after shifting transaction costs to the service providers, but no significant effect on workers.

Work by Munyegera and Matsumoto (2016) and Jack and Suri (2014) account for the endogeneity of mobile money using an exogenous variation of proximity to mobile money outlet. Their results suggest that the adoption of mobile money provides more incentive for users to shift to other productive activities. Using both self-reported shocks and rainfall shock to explore the effect mobile money on consumption smoothing, Riley et al. (2016) found that the usage of mobile money raises spending on consumption during periods of aggregate shocks. Earlier work by Jack and Suri (2014) found similar results at the household level using self-reported shocks. Using a field experiment in rural Mozambique Batista and Vicente (2013) opine that increased usage of mobile financial services increases household financial literacy and trust.

Contrary to the past empirical work, this study examines differential effects on usage or access to mobile banking on expenditure patterns.[7] The contribu-

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[7] Integrated mobile banking product is measured as follows: The survey had asked the respondents whether they are: 1. are currently active; 2. used in the past but no longer use 3.

tion of the study is manifested in threefold. First, I comparatively investigate the causal relationship between the mobile banking and household spending on physical and human capital investments and on family transfers. Secondly, the empirical strategy employed in this study accounts for the possible endogeneity between mobile banking and household spending patterns. Thirdly, the study provides an empirical evidence showing the importance of mobile finance as a welfare-enhancing tool for sustainable development in developing countries. This study, therefore, seeks to ask whether mobile banking has a causal effect on physical and human capital investment through increased investments in off-farm activities and on spending on social transfers.[8]

Previous empirical works examining the causal link between integrated mobile banking and expenditure patterns often encounter endogeneity biases of mobile banking due to measurement error, reverse causality and omitted variable bias. For instance, users of integrated mobile banking may self-select on whether to smoothen consumption, to caution against unexpected shocks, or to use it for productive activities such as human capital investments. Other confounding factors affecting both integrated mobile banking and household's expenditure pattern may result in difficulties in measuring the true causal impact. To overcome these challenges, a growing continuum of studies have used instrumental variable estimation technique to account for the endogeneity of mobile financial services (Jack & Suri, 2014; Munyegera & Matsumoto, 2016).

The study takes into consideration the endogeneity of integrated mobile banking and uses mobile money agent's networks variation. As a robustness check, I test for the impact of mobile banking by using the number of mobile network services available at the household as additional instruments. I further, examine the heterogeneous effect of the impact of integrated mobile banking on agricultural dependent households.

Never used. For mobile banking use, equals one for those who said are actively using it, zero otherwise, whereas for access equals one if 1 and 2, zero otherwise.

[8]Spending on other immediate family members (i.e. intra-family transfers).

The findings reveal that integrated mobile banking depicts a strong evidence on household expenditure patterns, thus influences the behavioral change of individual users or those who have access. Thus, they are supportive of integrated mobile banking having a positive and significant causal impact on household demand for productive activities beyond total consumption. In particular, I observe that integrated mobile banking has a positive and significant impact on family transfer, individual's investment on microbusinesses, and education compared to non-users, while I find no empirical evidence on health expenditure.

Chapter 5, explores how integrated mobile banking at the micro-level has contributed to the reduction of income and wealth inequalities and as a tool for poverty reduction. The objective is to identify the channels through which integrated mobile banking influences household's decisions on income and wealth. Specifically, I explore the association between integrated mobile banking, household incomes measured as consumption expenditure, and household assets composition of financial outcomes. In particular, extending financial services to the rural poor can bear important effects on economic development and poverty reduction (Adongo & Deen-Swarray, 2006; Bhavnani et al., 2008; J. Blumenstock, Cadamuro, & On, 2015; Burgess & Pande, 2005; Levine, Loayza, & Beck, 2000).

It is understood that a financial system free of financial barriers and comprised of a wide range of financial services can influence behavioral change among the majority in the bottom of the pyramid (J. E. Blumenstock, 2015; Burgess & Pande, 2005; Neaime & Gaysset, 2018; Park & Mercado, 2015; Rojas-Suarez & Gonzales, 2010). For example, income inequality, weak legal framework, and bad governance could potentially affect access to financial services in developing countries (Law, Tan, & Azman-Saini, 2014; Rojas-Suarez & Gonzales, 2010). Similarly, unequal access to financial services and the political landscape can influence income distribution (Claessens & Perotti, 2007).

Kuznets (1955) in his paper "Economic Growth and Income Inequality"

finds income inequalities distribution to have narrowed in developed countries due to increased economic growth and availability of reliable data. Moreover, he finds that income inequality increases in the early stages of economic development and decreases as a country experiences an increased level of economic development.

Mallick and Rafi (2010) using rural Bangladesh micro-level data examines food security between male-headed and female-headed household. Their results suggest that in the absence of social and cultural norms there exist no significant differences in food security, while female-headed households are more empowered to participate in the labor market.

The empirical analysis on income and wealth inequalities suggests that an inclusive financial system free of financial market failures and associated transaction costs can play a pivotal role in addressing income inequalities (J. Blumenstock, Cadamuro, & On, 2015; Claessens & Perotti, 2007; Dabla-Norris, Ji, Townsend, & Unsal, 2015; Mallick & Rafi, 2010; Nanziri et al., 2016). Using a panel of 8 countries in the Middle East and North Africa (MENA) over the period 2003-2016, Neaime and Gaysset (2018), examines the effect of financial inclusion on income inequality and poverty. They find financial development has no significant impact on poverty, but it reduces income inequalities and increases financial stability. Samer et al. (2015) show that increased access to financial services provide an incentive for women to participate in income-generating activities. In contrast, Nanziri et al. (2016) fails to establish a welfare effect on users of financial products across gender. However, her results suggest that women are the majority user of informal financial services, while men are better users of formal financial services.

Studying the effect of the expansion of bank branches in rural India, Burgess and Pande (2005) conclude that increased access to financial services potentially benefits the rural poor, thereby uplifting their welfare. Similar work by Pal and Pal (2014) explains the financial landscape in India and found the unequal dis-

tribution of access to financial services between the poor and the rich.

Beck et al. (2007) opine that financial development reduces income disparities for the poorest quantile individual by 40 percent and 60 percent on aggregate. They also suggest that financial development enhances poor household's economic welfare. Asongu and Odhiambo (2017) uses a cross-country analysis of 93 developing countries to investigate the effect of mobile money on inequality and poverty. Their findings suggest that increased usage of mobile money can have a positive effect on growth, and act as a tool for reducing poverty and income disparities.

However, with the growing literature on the impacts of mobile financial developments at macro and micro-level, little evidence exist in explaining its usage on poverty eradication and in reducing income and wealth disparities. Thus, using micro-data and empirical estimation technique, this study provides the causal link of the effect of integrated mobile banking on household incomes and wealth disparities.

The main research question considers the interrelated literature that has extensively reported on the welfare enhancing the effect of integrated mobile banking, particularly, in poverty eradication through inclusive financial development. Therefore, the chapter seeks to ask if increased usage of mobile banking reduces income and wealth inequalities. Understanding the impact of mobile financial products' use on poverty, and income inequality provide a guide to policymakers to formulate and implement far-reaching reforms aimed at strengthening financial services at the micro-level and beyond. Therefore, this study extends the literature on digitally driven financial services in reducing wealth and income disparities and as a tool for poverty reduction.

Overall, the results suggests that the effect of integrated mobile banking on income seems to be higher at the top 20th quantile level, suggesting financial inclusion through mobile banking significantly affect the top half households compared to bottom poor.Similarly, access to formal financial services through

integrated mobile banking widens wealth disparities between the bottom 10th and 90th quantiles, suggesting its access disproportionately benefits richer than the poor in terms of wealth accumulation.

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CHAPTER 2

FINANCIAL DEVELOPMENT IN KENYA

2.1 Introduction

Kenya is a country in the East African region with a population of close to 50
million people whose main livelihood is agriculture, particularly for the rural
population. Before 2000, the banking industry in Kenya was very shallow and
fragile due to low lending levels, high-interest rate spreads, high levels of non-
performing loans and several bank failures. Also, increased closure of bank
branches, particularly in rural areas due to increased costs risked exacerbating
the financial inclusion challenges.

In 2003 the Government of Kenya rolled out the Economic Recovery Action
Plan (ERAP) as the principle blueprint that aimed at reversing the past periods
of sluggish economic growth. This national strategic plan sought to accelerate
and sustain economic growth and provide policy direction on how to alleviate
poverty through wealth and job creation. This strategic plan underscores the
importance of strengthening the financial sector built around a Financial Sec-
tor Assessment Programme (FSAP). The FSAP was to provide policy direction
aimed at enhancing investors' confidence, protect consumers, and create com-
petitive market conditions for other financial service providers (GoK, 2003).

The ERAP was followed by the launch of a long-term master plan dubbed
"Kenya's Vision 2030" in 2008, which was to be implemented in five-year medium-
term phases. This blueprint provided a road-map of inclusive financial services
by institutionalizing major financial reforms, particularly the legal and regula-

tory framework for a vibrant and robust financial sector. This led to the birth of key financial institutions such as the Credit Reference Bureau that is tailored toward achieving universal financial inclusion.

Kenya banking sector is highly segmented in terms of foreign-owned banks, state-owned banks, large privately owned banks and small private owned banks. The financial institutions in Kenya essentially consist of forty-three (43) licensed commercial banks and one Mortgage Finance Institution, thirteen (13) Micro-finance Banks (MFBs), Three (3) Credit Reference Bureaus (CRBs), nineteen (19) Money Remittance Providers (MRPs), eight (8) non-operating bank holding companies, seventy three (73) foreign exchange (forex) bureaus, and nine (9) foreign banks offices representative (BSD, 2017).

Kenya like any other developing country has its financial market predominated by informal financial institutions leading to the majority of the populace remaining excluded from formal financial services (Gugerty, 2007; Johnson & Nino-Zarazua, 2011; Ndung'u, 2017). Conversely, faced by infrastructural, awareness and outreach challenges of the traditional banking systems, commercial banks have increasingly sought to build on the synergies of access to the population by mobile network operators, to tap into the largely unbanked populace.

The number of Kenyans with access to formal financial services has risen from 26.7 percent in 2006 to 75.3 percent in 2016. This remarkable growth can be attributed to being driven by the spread of mobile financial services. Since the rural areas have the most marginalized population, access to formal financial services rose from 23.8 percent to 69 percent over the same period (FSDK, 2016; Muthiora, 2015).

2.2 Evolution of Kenya's mobile finance

In Kenya, what began as a simple value addition platform for mobile money transactions has spiraled into a revolution of the banking scene; offering an opportunity to innovatively reach and integrate the unbanked population into the formal banking systems. Equally, this has been made possible by ease of mobile phones penetration, which has resulted into increased adoption of mobile financial services thus expanding access to formal financial services.

The government has also tapped into the mobile technology solutions to complement other forms of public service delivery, with over 250 government services being done through mobile finance channels. For instance, the government is currently using mobile payment systems to enhance coverage of various social safety net programmes such as payments of National Health Insurance Funds. Also, the government through partnership with the private sector developed a mobile money interface known as "M-Kopa", through which the rural population without electricity were able to acquire assets in the form of solar-powered electrification and television in their homes. The effect of mobile revolution in Kenya can also be seen in areas such as health, and education.

In 2007, non-bank financial services providers began offering digital mobile money payment services in Kenya. Mobile financial services (MFS) in Kenya began in 2007 with the launch of M-Pesa by Safaricom Limited, one of the leading mobile network operators (CBK & FSDK, 2009; Ndung'u, 2017). M-Pesa experienced a viral growth with wide acceptance across the country, however, at the time of its advent, there was no regulatory framework in place or envisaged to regulate such operations in the financial system (Ndung'u, 2017).

This lack of regulation posed a challenge to the CBK. However, when Safaricom approached the CBK with its proposal to roll-out the mobile payment technology in Kenya in 2006, the CBK had a difficult choice to make; the bank had always wanted innovative ways of expanding financial access to the poor

and underserved sections of the population and Safaricom proposal might finally make that desire a reality. On the other hand, the bank had to contend with then existing banking regulation's lack of scope to regulate the proposed new mobile payments services appropriately. The CBK had to balance its lofty desires for a deepened financial market to its obligation to be a responsible regulator opted not to stifle the favorable latency of mobile payment system in the broader economy and adopted what is now known as the "test and learn" regulatory approach (Ndung'u, 2017).

2.2.1 Basic Mobile Money

Bolstered by deepening penetration of mobile phone usage, the largest mobile network service provider Safaricom supported by the Department for International Development (DFID) launched mobile-phone based financial services system dubbed "M-Pesa" (Swahili for Mobile-Money) in early 2007. M-Pesa registered over 1.1 million Kenyans within eight months of its inception in March 2007 and over US$87 million had been transferred over the system (Safaricom, 2009). By September 2009, these numbers had grown to over 8.5 million registered customers using the service to transact over US$3.7 billion (equivalent to 10 percent of Kenya's GDP) through the mobile payment system (Safaricom, 2009).

For example, Figure 2.1 shows that the amount transacted through mobile supported payments increased from Kenya Shillings (KSh) 166 billion in 2008 to KSh 3,638.5 billion in 2017, while, Figure A.1 shows high mobile money penetration in terms of mobile money account ownership in the Kenyan market compared with other developing countries.

The M-Pesa product allows users to hold electronic cash or e-float on their phones. Users can load e-float to their phones through depositing cash at an agent, they can send the e-float to other people or businesses, use it to purchase products such as airtime, goods, and services as well as paying bills. They can
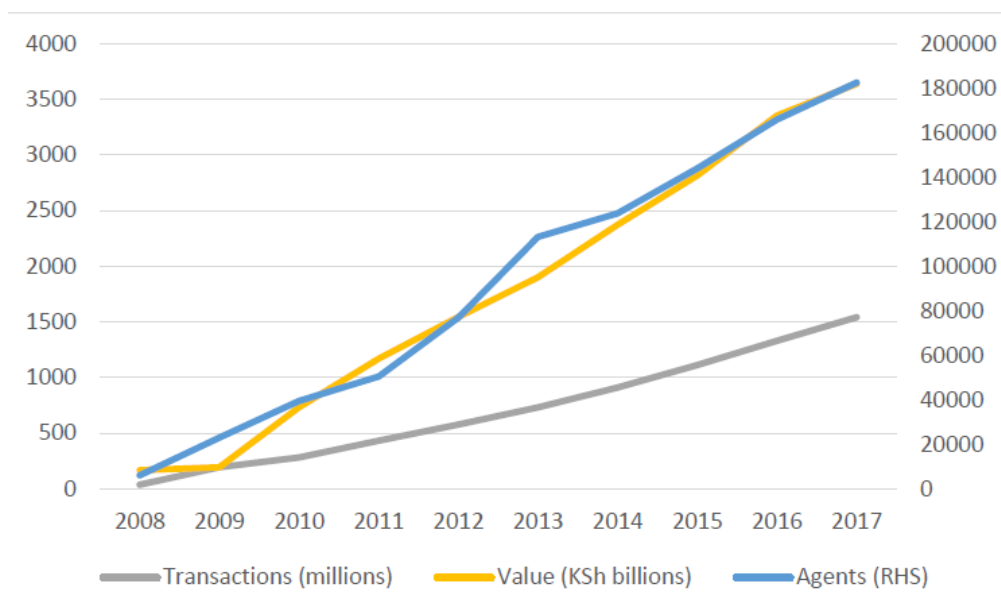
Figure 2.1: Evolution of mobile finance in Kenya.

also exchange the e-float for cash at an agent location. The growth and penetration of mobile phones in Kenya and Africa at large have been very rapid, with mobile money payments penetration at over 97.8 percent (CAK, 2018).

M-Pesa payment system dubbed "The Paybill and Till" was designed for businesses enabling customers to pay for goods and services as well as pay bills. These products offer customers and businesses additional convenience and generally lower transaction costs. The Till number product is most suited for businesses with walk-in customers, it is essentially a payments collection service. In this product, customers can pay for merchandises using a number displayed on the merchant premises instead of transferring funds to the merchant's phone number. The Paybill number product is mostly for a person to business payments mostly where there is an official relationship between the payer and the recipient. This product allows the payer to include an "account number" which is essentially an identifier for the service payment being offered by the merchant or business such as paying electricity bills. This product is not subject to the maximum account balance of KSh 70,000 imposed on individual wallets, however

more stringent Know-Your-Customer (KYC) procedures are carried out prior to issuance of a Till number.

Indeed, the M-Pesa services have now grown to provide cross-border money remittances. For a country like Kenya where a sizeable proportion of inward remittances come from relatives living abroad, M-Pesa has simplified the transfer mechanism since recipients can now receive these inward remittances directly to their mobile phones. This results in increased convenience and relatively cheaper transaction costs compared to other remittance methods.

2.2.2 Integrated Mobile Banking

To further facilitate growth and financial inclusion, it was necessary for basic mobile money to integrate with the banking sector. In line with this, the CBK issued regulations that allowed mobile money financial services to connect with individual savings accounts at commercial banks. The assumption was to provide an alternative financial product model that would be an enabler for already banked clientele to transact remotely, while also transforming the financial access model by integrating formal banking services into mobile financial services (MFS). However, this was met by heavy resistance from the banking sector as they feared it will lead to customers exiting the micro deposit and savings accounts they held in the banks. The CBK was able to successfully convince the banks to buy into the integration with basic mobile money.

Following the rapid adoption of basic mobile money in Kenyan, in 2012 a strategic collaboration was facilitated by the Financial Sector Deepening (FSD) between the Commercial Bank of Africa (CBA) and Safaricom to expand financial services offered to subscribers of the M-Pesa by linking users accounts in the commercial banks with a mobile banking channel titled "M-Shwari".[9] The M-Shwari is pretty much a mobile bank, that allows Kenyans in most cases,

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[9]KCB-Mpesa was rolled out a year later by Kenya largest bank by size Kenya Commercial Bank in collaboration with Safaricom with very insignificant difference with M-shwari platform (see http://fsdkenya.org/blog/m-shwari-vs-kcb-m-pesa-convergence-or-divergence for more details between the two mobile banking platforms (see Africa, 2016 for further insight).

the unbanked and the underserved gain access to formerly rigid formal bank-
ing services (Cook & McKay, 2015; A. FSD, 2016). Services offered by the
M-Shwari are the virtual opening of accounts, and interest-earning savings and
loans platforms. By December 2017, five years after launch, M-Shwari has over
21 Million customers. The average loan per customer is KSh 3,300 ($33), while
customer savings stood at over KSh 12.6 billion.

Figure 2.2 shows the amount of credit provided by commercial banks through
mobile banking channel, which rose from KSh 1,901.6 million in 2013 to KSh
3,638.5 million by 2017. Figure A.2 shows the number and value of mobile
banking accounts by loan tenor, which indicate that approximately 80 percent of
mobile banking credit from commercial banks ranges from one month or less in
tenor. This suggest that borrowers may be compelled to use this mobile bank-
ing channel for consumption rather than in engaging in long-term productive
investments.
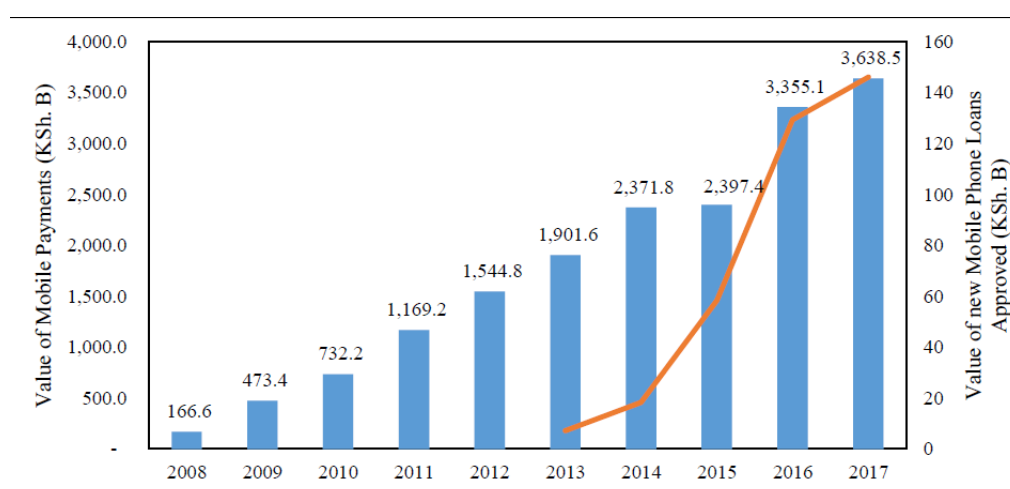
Source: CBK/FSDK.

Figure 2.2: Value and approval of mobile banking loans.

2.2.2.1 Pricing of integrated mobile banking

The integration of basic mobile money with banking system provided the com-
mercial banks and mobile service providers a treasure of transactional data for
individual mobile money users. Additionally, credit-worthiness and eligibility
were determined by evaluating the two mobile financial services transactions

history, and if an individual was a registered mobile or bank account holder, while there are no account opening or maintenance charges. Therefore, using this customer's transaction data, these institutions evaluated and profiled customer behaviors in order to generate credit scores. These acted as a substitute for having collateral, which were a hurdle for many would be borrowers.

The Kenya mobile banking facility is fully regulated by the Kenya Deposit Insurance Company (KDIC) alongside conventional banking system (Cook & McKay, 2015; A. FSD, 2016; Rosengard, 2016). For instance, M-Shwari mobile banking product uses the one term "off facilitation fee" instead of interest on their loan products, while the 7.5 percent facilitation fee is charged a one-off at the start of the loan period. Customers who are unable to pay back the loan within the 30 days can choose to rollover the loan at an additional 7.5 percent, however, this can only be done once and hence the effective loan term is 60 days. [10]

Although not fully launched, "Fuliza-continue" is a product provided by Safaricom in conjunction with the Commercial Bank of Africa. The product is essentially an overdraft facility that enables a user to complete a transaction such as payment of bills and transfer of funds when they do not have sufficient funds in their M-Pesa wallet. The product is essentially powered by big data whereby the bank analyses customer's transaction data and assigns them an overdraft limit which the customer can use to complete allowable transactions. At the time of this paper, the product was still in the initial stages after launch.

2.2.3 Mobile Money Agents' Network

The rapid spread of mobile finance has been made possible by extensive penetration of mobile money agency network, whose locations points had also grown in similar proportions to over 18,000 location points by 2010, from 450 in 2007 (CBK & FSDK, 2009; Safaricom, 2009; Vaughan, 2007). By 2017, mobile agents' networks distribution had increased to 182,472 from 68,141 in 2015 and

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[10]See CBA conditions for M-shwari eligibility https://cbagroup.com/wp-content/uploads/2014/05/M-SHWARI_TERMS_AND_CONDITIONS.pdf.

49,417 in 2013 (K. FSD, 2015). Figure A.3, shows the geographical distribution of mobile money agents network based on FinAccess 2015/16 household geospatial locations information. To contrast this, at the same time, Kenya had only 491 bank branches, 500 Postbank branches, and 352 ATMs (K. FSD, 2015; Mas & Ng'weno, 2010).

2.2.4 The Legal and Regulatory Framework

Through the CBK Act of 2003, the CBK is the designated competent authority to oversee and supervise the stability of the financial system and in extension the national payment infrastructure of the country. The Central bank of Kenya has remained averse to its regulatory role, focusing on ensuring the financial system's stability and efficiency, in the wake of the hybrid integration of mobile money services with mobile banking services. The CBK supervisory authorities have been adapting the existing legal and regulatory frameworks in line with market and technological developments in order to allow the financial infrastructure to grow and develop. The CBK Act authorizes the bank to oversee and supervise the national payments infrastructure as the principal existing framework that facilitated the launch of mobile money services.

The Banking Acts of Kenya also gives the CBK the legal mandate to oversee the supervision of the banking industry (CBK, 2015). At the onset of mobile money roll-out, the Banking Act presented a challenge concerning how to capture the scope of the new product Safaricom was proposing (Muthiora, 2015; Ndung'u, 2017). The Banking Act defines a "banking business" as 'accepting from members of the public of money on deposit repayable on demand or at the expiry of a fixed period or after notice; the accepting from members of the public money on current account and payment on and acceptance of cheques; and the employing of money held on deposit or on current account, or any part of the money, by lending, investing or in any other manner for the account and at the risk of the person so employing the money' (CBK, 2015). Section 16 of the

Act further restricts any institution from taking deposit except (unless) such an institution has a valid license.

At this point, the mobile network operator was not offering to provide banking services but a mere mobile payment services using its vast distribution capabilities. The regulatory gap in the legislation led the CBK to seek legal opinion, which notes the difference between the banking functions pictured under the Banking Act and the mobile money model being proposed by Safaricom. Guided the legal opinion the mobile money services and its mobile money agents network were deterred from accepting cash deposits on current account or using the funds collected to invest or lend to make a profit.

Furthermore, the CBK sought assurances from Safaricom to ensure that M-Pesa was secure enough and mandated them to adopt an Anti-Money Laundering/Countering Financing of Terrorism (AML/CFT) risk management mechanism. Upon the satisfaction of this safeguards, the CBK issued a "Letter of no objection" to Safaricom to commence the offering of M-Pesa to the public in 2007. In addition to this, the 2006 Communications Law recognized electronic units of money providing the legal framework for Safaricom to store the monetary value in SIM cards. At this point, the national payments and settlement bill had not been passed into Law.

However, the CBK developed a Trust Account invoking the Trust Law. This was necessary since the customer funds, which are essentially public funds were to be held in a special bank account (the trust account) at Commercial Bank of Africa. This Trust account was under the custody of trustees, separate entities from Safaricom and Commercial Bank of Africa. This framework allowed the operationalization of M-Pesa. All transactions performed by M-Pesa users in their sim cards would be simultaneously reflected in the trust account. Conversely, all transactions including agent transactions settlement are done through the trust account in order to mitigate settlement risk. The CBK saw this adequate since the M-Pesa system, albeit having high volumes, the transaction values were

low. In order to mitigate liquidity risk, the CBK directed Safaricom to impose stringent vetting criteria for partner counterparties.

This culminated to the development of the National Payments System draft guidelines by the regulator to supervise the market. The National Payments Act of 2011 vetoed through an Act of Parliament followed since the onset of digitally driven mobile finance in 2007. The Act required the mobile service providers to obtain a "Mobile Virtual Network Operator (MVNO)" license as opposed to the initial letters of no-objection issued by the CBK to offer low-cost mobile banking services. These frameworks provided an enabling legal and regulatory environment that guides market environment, protect the consumer, address systemic risks that may occasionally arise, and governance (Ndung'u, 2017).

In 2014 a legal notice giving effect to the NPS Act was issued by the government of Kenya. The regulation provided legitimacy and regulatory certainty that could promote further innovation and investment in the industry. For instance, the growth of the unsecured digital mobile banking facility escalated following the enactment of the National Payments Act of 2011, which spurred investor confidence to introduce diverse financial products including banking and credit facilities; leading to a revolutionary foray into the large unbanked section of the Kenyan population. It also did a lot to ensure that adequate and prudent governance structures were put in place by the mobile network operators.

The NPS regulation encompasses all stakeholders on the supply-side of the mobile money market. It provided for the non-exclusive money distribution; interoperability across mobile service networks; consumer protection provisions; and an equally strong framework to prevent money laundering and to counter the financing of terrorism.

2.3 Conclusion

As a result of an accommodating and a forward-looking regulatory environment, particularly the supportive role the CBK has played in nurturing the industry from its infancy; the mobile payment industry in Kenya should expect to see continued growth and an increasing role in Kenya's effort to achieve a deepened financial inclusion and improve its economy's competitiveness. This friendly business environment will further incentivize the industry to become more efficient and bring about more innovation. The competitiveness enabling provisions built into the NPS regulations of 2014 will encourage new entrant into the industry. The continuous development of the digital mobile payment platforms could also simplify the methods in which remittances sent into the country by the diaspora thus, increasing the inward flow of remittance into the country.

Finally, mobile finance changed payments in Kenya in a big way, society has changed as a result of the introduction of the platform, and new industries have emerged as well. With continuous collaboration between MVNOs and regulators, further depth in the development of the market could be experienced. Regulators in being dynamic, and keeping up with the speed of change in the industry must be strict yet moderate enforcing regulations in order not to stifle creativity in the fledgling industry.

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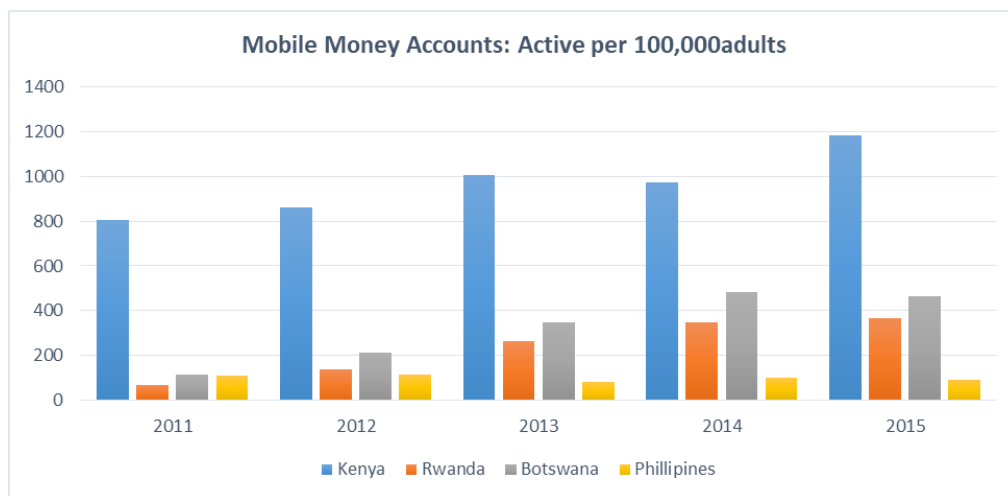
Source: Global Findex 2011- 2015

Figure A.1: Mobile money accounts ownership by Developing Countries.
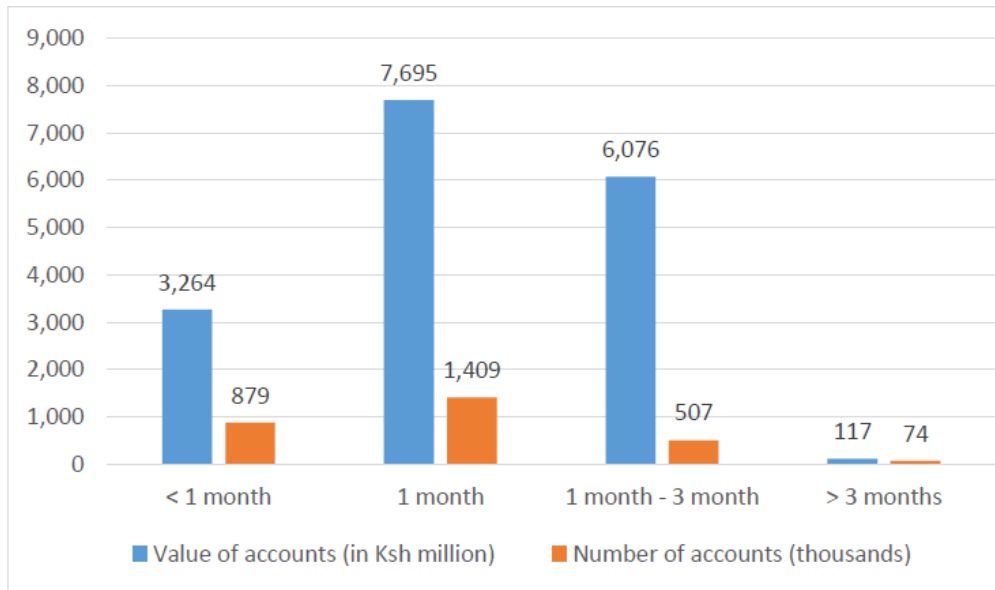
Source: Central Bank of Kenya

Figure A.2: Number and value of mobile banking accounts by loan tenor.
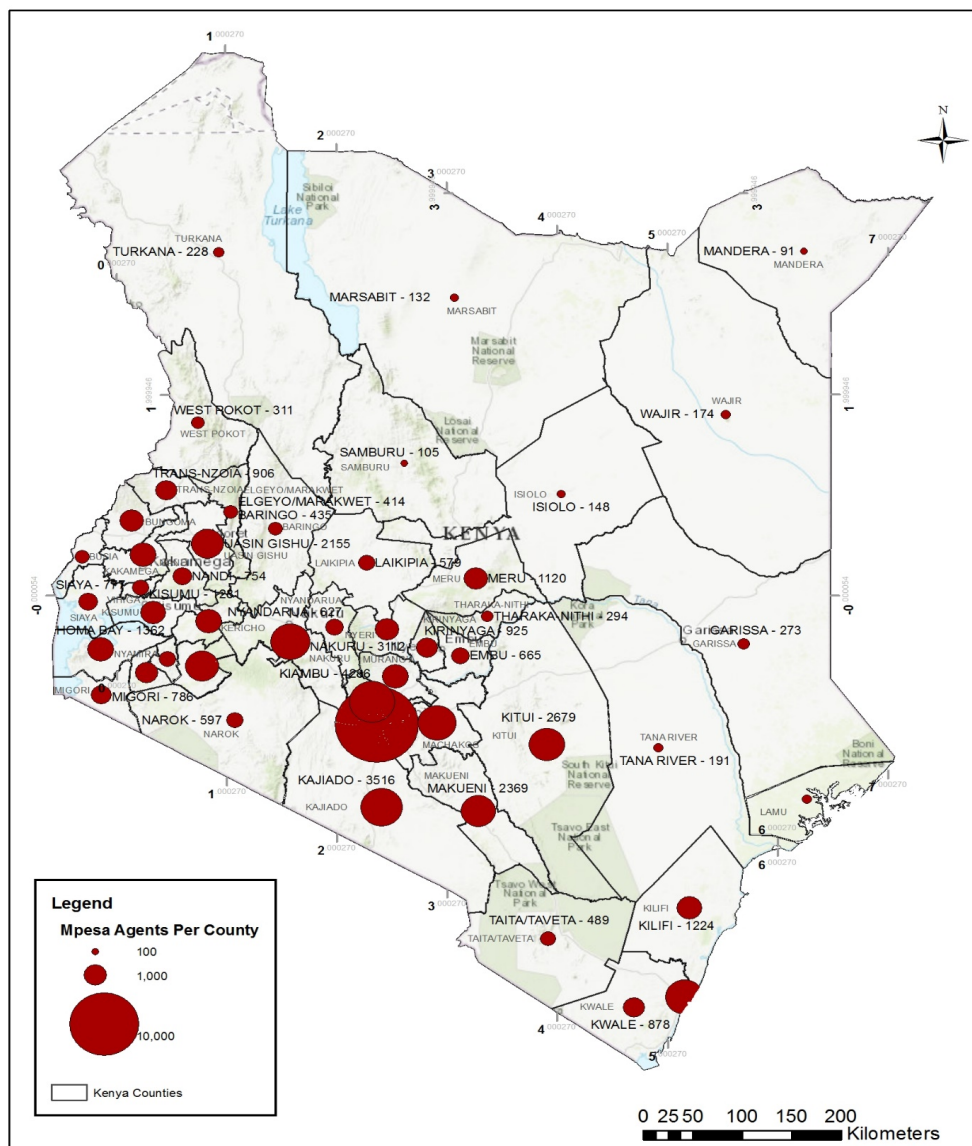
Source: Author's own calculation- FinAccess Household Survey 2015

Figure A.3: Mobile money agent network concentration by region

CHAPTER 3

INTEGRATED MOBILE BANKING, SAVINGS, AND CREDIT MARKET

3.1   Introduction

The main purpose of financial development for economic growth is to influence the investors to hold their savings in more productive ventures relative to unproductive ventures and provision of incentives to frontier savings and credit markets (Patrick, 1966). Increased financial intermediation could impact positively financial sector development and overall economic development (Aggarwal, Demirgüç-Kunt, & Peria, 2011; Levine, Loayza, & Beck, 2000; Onsongo & Schot, 2017; Porteous, 2006). For example, the majority of unbanked poor individuals have an incentive to make investment decisions aimed at improving their welfare during times of unpredictable events (Alafeef, Singh, & Ahmad, 2012; Jack, Ray, & Suri, 2013; Rojas-Suarez & Gonzales, 2010).

A growing pool of empirical works in developing countries have intensely focused on the key drivers that determine household's demand for mobile financial services such as savings and credit, with the former gaining prominence across the academic fronts and in policy-making processes. Some of these literature alludes to the fact that access or participation to formal financial services reduces households financial constraints and are capable of absorbing associated risks (Diagne, Zeller, Sharma, et al., 2000; Jack & Suri, 2014; Onsongo & Schot, 2017). Their exists mixed evidence of the effect of mobile innovations on household locations with some suggesting reduction of participation in in-

formal savings or credit after exposure to this mode of financial inclusion (see, (Cruz, Barretto Filgueiras Neto, Munoz-Gallego, & Laukkanen, 2010; Lwanga & Adong, 2016; Mbiti & Weil, 2015), while Steiner, Giesbert, and Bendig (2009) find opposite effect.

Therefore, expanding financial services beyond "brick and mortar" can play a vital role in overcoming challenges of financial market failures (Burgess & Pande, 2005; Camner & Sjoblom, 2009; Jalilian & Kirkpatrick, 2005; Porteous, 2006). The Global Findex report on financial inclusion estimate approximately 43 percent of the developing world to have mobilized savings (Demirguc-Kunt, Klapper, Singer, Ansar, & Hess, 2018). The remarkable upswing in mobile financial services in developing countries is vastly driven by mobile phone affordability and access (Kshetri & Acharya, 2012).

For instance, integrated mobile banking [11] enables users to reliably perform real-time transactions such as save for future use and apply for credit through the use of their mobile phone (Demirguc-Kunt et al., 2018; Diagne et al., 2000; Johnson & Nino-Zarazua, 2011). Conversely, provision of mobile banking financial services has significantly increased financial inclusion through relaxing borrowing constraints (Blechman, 2016; Lwanga & Adong, 2016; Zeller & Sharma, 2002). In addition, it also enables users to manage risks and reduces transaction costs associated with saving or taking loans through the use of informal sources and social networks, while it increases efficiency and convenience of financial services delivery (Hughes & Lonie, 2007; Mbiti & Weil, 2015; Munyegera & Matsumoto, 2018).

Despite a growing interest on the effect of mobile money on savings, little empirical evidence hardly examine the impact of integrated mobile banking on credit market and savings. In this chapter, I presume that access to mobile banking financial services can impact positively credit markets and facilitate individual's savings. In particular, I provide a micro-perspective on the causal

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[11]This study uses integrated mobile banking and mobile banking interchangeably

impact of mobile banking on the credit market and saving behavior by exploiting instrumental variable estimation technique. The study is further motivated by examining various pathways through which integrated mobile banking can affect credit markets and can influence individual's saving behavior.

First, I conduct heterogeneous effect of integrated mobile banking on savings and loans, by estimating a sub-sample of agricultural dependent households. This is in understanding that a majority of Kenyan's adult population lives in rural areas, where the main source of livelihood is farming. Second, I explore the heterogeneous effect of integrated mobile banking on whether the savings or loans are taken for investments or consumption and whether they originate from formal or informal institutions.

The rationale for examining other integrated mobile banking channels is hinged on the fact that by examining the homogeneity of loans or savings will not reveal the individual's financial behavior or even savings practices. Also, it is important to examine whether integrated mobile banking is a compliment or a substitute for other forms of financial services. Therefore, I examine the magnitude at which the findings are driven by this competing factors.

The other sections of the study are organized as follows. Section 3.2 discusses the data sources, variables description and descriptive summary statistics. The identification strategy is presented in Section 3.3, while empirical results and heterogeneous effects are discussed in Section 3.4. The study concludes in Section 3.5.

3.2 Data Sources

3.2.1 Survey

The empirical analysis for this study draws its data from a cross-sectional household survey FinAccess 2015/2016 administered by Financial Sector Deepening (FSD) Kenya in partnership with Central Bank of Kenya and Kenya National

Bureau of Statistics (KNBS). The survey is the fourth nationally representative financial access survey that was conducted in August to October 2015 and designed to periodically assess access and demand for financial services overtime (CBK, 2016).[12]

The survey is collected across thirteen sub-regions and clustered in terms of urban and rural areas. A multi-stage stratification technique was applied to a sample of 8,665 household randomly selected adults aged 16 years old and above from 165 primary sampling units (PSUs).[13] The survey collected information on household and individual demographic characteristics, household access to and usage of financial services product, household expenditure and incomes and their sources, household's occupations status, mobile financial services, credit uptake, and household savings behavior.

I complement FinAccess 2015/16 survey using FinAccess 2016 geospatial mapping collected between March to August of 2015 by Brand Fusion and financed by Bill & Melinda Gates Foundation and a consortium of three other institutions (BMGF, 2016).[14] This survey provides close to 92,000 geographical locations of financial access points and mapped 27,684 markets locations and other agricultural outlets across the country (see appendix Figure B.1. I use this data to construct the distance between households and the closest mobile money agent.[15]

3.2.2 Descriptive Summary Statistics

Table 3.1 reports descriptive summary statistics for all variables included in the empirical models between integrated mobile banking users and non-users, while

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[12]The current and other waves are publicly available from www.fsdkenya.org.

[13]The FinAccess 2015/16 sampling frame was constructed using KNBS NASSEP. Further, I adjust all empirical results using the sample weights provided both at the individual and household level proportion to the total adult population. FinAccess 2015/16 includes geospatial information upon request from FSD Kenya.

[14]Further details can be found at http://fsdkenya.org/dataset/finaccess-geospatial-2015/.

[15]The survey also covers a wide range of other financial service operators such as bank networks, microfinance institutions, Savings and Credit Cooperative Organizations (Saccos), money transfers systems and agricultural markets locations.

Table B.3 provide full variables descriptions and there units of measurements. It is evident that on average 31 percent of the 1,749 households reported having used integrated mobile banking to borrow compared to non-users, with a standard deviation of 0.46, while a majority are mainly savers averaging 96 percent. It is also evident that there is a significant variation in loans and savings as depicted by their high standard deviations. Also, there are substantial differences between users of integrated mobile banking to save or take loans from formal financial institutions.

The data shows that on average roughly 43 percent of households saved in formal financial institutions compared to 22 percent of borrowers, while their standard deviations show significant heterogeneity in enhancing financial inclusion through access to integrated mobile banking. Similarly, there is no significant difference between those who save or borrow from informal financial institutions with non-users. However, a high proportion of the households uses informal mechanisms to borrow loans accounting for 25 percent, while on average 72 percent have a saving product in the informal financial institutions.

The data also contain individual's financial behaviors regarding their main motivations for participating in the credit markets as well as putting aside some savings. I categorized savings and loans into investments and consumption components. Investment purposes includes all individual savings and loans whose intended purposes is for engaging in productive activities such as starting new businesses, education of self or household member, spending on emergency or health, and farming; whereas consumption comprises of food, utilities or other related households assets. Table B.2 provides descriptive statistics of reasons for taking loans and savings. The data shows that their exists no significant differences between loan for consumption and investments for users of integrated mobile banking compared to non-users. However, a higher proportion for users of integrated mobile banking saved for investments purposes averaging approximately 85 percent with 49 percent of them saving for consumption reasons.

Majority of households have more than one mobile network services suggesting high penetration of mobile financial services, while most of them live within 1 km radius from a mobile agent outlet. It is also evident that the majority of households resides within a 30 min walk to other infrastructural developments comprised of health centres and or banks. On average, household comprises approximately 4 members, while school going children below the age of 15 years old are on average at least 2 per household.

It is also evident that integrated mobile banking users have younger male heads and are less likely to be married compared to non-users. In terms of the education levels, majority of the integrated mobile banking users have attained secondary or more education compared to non-users who are more likely to have completed primary education, while the remaining percentage were those who reported having no formal education. Financial literacy plays a vital role in the usage of financial products with users of integrated mobile banking reporting to have high knowledge of interest rates, collateral, and inflation rate. A significant proportion of households exposed to integrated mobile banking are more likely to participate in off-income activities compared to non-users who prefers engaging in farming.

Table 3.1: Descriptive statistics

Variables	Mobile Banking				Mean Difference
	Non-Users		Users		
	Mean	SD	Mean	SD	
Saving	0.544	0.498	0.960	0.196	-0.416***
Loan	0.006	0.079	0.312	0.464	-0.306***
Formal Loan	0.065	0.247	0.222	0.416	-0.157***
Informal Loan	0.227	0.419	0.249	0.433	-0.022
Formal Saving	0.172	0.378	0.425	0.494	-0.253***
Informal Saving	0.585	0.493	0.716	0.451	-0.132***
Consumption(loan)	0.189	0.391	0.315	0.465	-0.126***
Investment (Loan)	0.145	0.352	0.368	0.482	-0.223***
Consumption (Saving)	0.397	0.489	0.492	0.500	-0.094***
Investment (Saving)	0.519	0.500	0.852	0.355	-0.334***
Mobile money agent outlet (Kms)	5.599	12.532	1.777	5.738	3.822***
#Network Available	0.704	0.520	1.128	0.383	-0.424***
Age	39.836	17.172	33.062	10.987	6.774***
Age Squared	18.817	16.741	12.137	8.987	6.680***
Male Head	0.721	0.449	0.792	0.406	-0.072***
Married	0.639	0.480	0.620	0.486	0.019
Family Size	4.476	2.480	3.770	2.313	0.706***
#Children	2.367	2.059	1.643	1.713	0.724***
Primary School	0.220	0.414	0.188	0.390	0.032**
Secondary School	0.125	0.331	0.316	0.465	-0.191***
Financial Literacy	0.639	0.480	0.820	0.384	-0.181***
Total Income (KSh)	141.88	2102.51	263.15	430.459	-121.27***
Farming	0.473	0.499	0.328	0.470	0.144***
Employed	0.589	0.492	0.852	0.355	-0.263***
Bank distance(<30min)	0.531	0.499	0.768	0.422	-0.236***
Bank distance(1hr)	0.252	0.434	0.174	0.379	0.078***
Bank distance(>2hrs)	0.216	0.412	0.058	0.235	0.158***
Health Centre(<30min)	0.711	0.454	0.871	0.335	-0.161***
Health Centre(1hr)	0.209	0.406	0.111	0.315	0.097***
Health Centre(>2hrs)	0.081	0.273	0.017	0.130	0.064***
Observations	6385		1749		8134

3.3   Identification Strategy

3.3.1   Model Specification

In order to test the first hypothesis I use a linear probability model to examine the effect of mobile banking (henceforth, IMB) on two household decision outcomes, that is, demand for loans and demand for savings using the following specification model:

$$Y_{ij} = \beta_0 + \beta_1 IMB_{ij} + \phi X_{ij} + \tau_j + \epsilon_{ij} \tag{3.1}$$

Where Y_{ij} is the outcome variables of interest (that is, it equals to one for those who responded to have taken loans or set aside some money in the form of savings in the last 12 months and zero otherwise) for household i at county level j; IMB_{ij} is the treatment variable assuming a value of one if the household member has access or uses integrated mobile banking (IMB), 0 otherwise; X_{ij} is a vector of covariates influencing the outcome variables and comprises of gender, age, marital status, financial literacy, number of children aged 15 years and below, completed education levels, incomes, occupation status, and proximity to infrastructural developments. The variable τ_j denotes the districts level dummy that accounts for unobservable time-invariant characteristics such as geographical variations across districts. Lastly, the normally distributed mean zero disturbance error term is denoted by ϵ_{ij} and clustered at the county level to allow for unobserved heterogeneity at the regional level. The parameter of interest is given by β_1 and measures the effect of IMB on outcomes of interest.

However, a major concern in estimating a linear probability model is that the predicted probabilities may go outside the 0-1 range (Wooldridge, 2018, pp. 249). However, based on the estimated models in Table B.2, approximately 95 percent of the predicted probabilities are within the expected range. Nevertheless, following similar work by Demombynes and Thegeya (2012) and Lwanga

and Adong (2016) I estimate the following probit model:

$$PROB(y_{ij} = 1) = \Phi(\beta_0 + \beta_1 IMB_{ij} + \phi X_{ij} + \tau_j + \epsilon_{ij}) \qquad (3.2)$$

Where ϕ is the standard normal cumulative distribution of probit distribution, while X_{ij} includes all controls used in equation 3.1. The coefficient of interest is given by β_1 and assess the average marginal effect of IMB on the probability of loans and saving. I also explore the heterogenous effects of IMB on motives for loan and savings, whether they originate from formal or informal financial institutions and agricultural dependent households (see Table B.2 for more details).

3.3.2 Instrumental Variable

A major concern with the findings derived from estimating univariate models is the endogeneity of IMB. That is, the estimates of equation 3.1 and 3.2 do not account for the endogeneity of IMB, thus results may not infer a causal relationship between IMB and outcomes of interest.

The endogeneity issue may arise due to reverse causality, that is, some household may be compelled to borrow due to unavoidable economic shocks or those who are saving using IMB channel have a positive stream of incomes or were early adopters of mobile banking, thus the estimates may be biased upward or downward. Also, the omitted variable bias emanating from missing information as a result of unobserved households characteristics may bias the estimated results, while the model could also suffer from measurement errors that could bias the estimations due to non-random selection into adopting IMB.

In order to address these potential endogeneity issues arising from the access to IMB and following Jack et al. (2013), I explore the causal link of IMB on loans and savings by estimating equation 3.1 using a two-stage least square method as discussed in Angrist and Pischke (2008) by using proximity (i.e. distance) to

the nearest mobile money outlets as an instrument. I further conduct robustness check on impact of IMB on savings and loans using distance to mobile money outlets and the number of mobile networks available at the household level as instruments for IMB.

The proximity between mobile money outlets and households is an exogenous measure of the level of individual exposure to mobile financial services. However, the choice of instrument should only be correlated with outcomes of interest through its effect on IMB, that is, it should satisfy the exclusion restriction. Nonetheless, the instrument may fail to meet this condition due to other potential confounding factors such as population density, [16] the level of financial markets developments or other unobserved individual or regional characteristics that might influence propensity to save or credit uptake.

Despite this potential sources of biases, the micro-level data used for this study reveal that the location of mobile money outlets are not strategically located across all regions and by the cluster type in Kenya. In other words, there is no systematic link between observed individual characteristics and their proximity to the mobile money outlets.

Therefore, in order to rule out any potential sources of biases, I control for the proximity of households to other infrastructural development such as distance in terms of the time it takes an individual to walk to the nearest bank or health centers. The argument is that households, especially in rural areas lack access to financial services due to unavoidable geographical characteristics and other confounding factors, thus I assume additional controls will to some extent overcome any potential unobservable characteristics associated with the instrument (Munyegera & Matsumoto, 2018).

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[16]For instance, mobile money agent outlets may be located in densely populated locations due to availability of ready market

3.4 Empirical Results

3.4.1 Main Findings

Table 3.2 reports the main findings for the respective loan and savings outcomes. As expected OLS estimates in column (1) and (4) shows that users of IMB have a higher propensity to save and are more likely to participate in the credit market, while holding other controls constant. That is, controlling for other covariates, individuals users of IMB are 25.7 percentage point more likely to have some savings compared to non-users and roughly 30.9 percentage point more likely to borrow loans.

The above OLS findings are confirmed in Column (2) and Column (5) of Table 3.2, which report the marginal effect after probit model estimation for overall loans and savings on access to IMB. The marginal effect results for IMB access are robust and positively related to savings and loans at all significant levels. The finding suggests that access to IMB, holding other controls constant increases individuals chances of taking loans by 18.7 percentage point and saving by 36.3 percentage point compared to those who have no access to IMB.

Table 3.2 column (3) and (6) report the 2SLS findings for the causal impact of mobile banking on demand for credit and in facilitating savings. The estimated results are consistent with the previous OLS estimations, however with a larger magnitude an indication of inconsistency associated with the OLS or probit estimations. That is, the OLS and probit models understate the true impact of IMB on household's savings and the likelihood to participate in the credit market. Also, the results remain robust even after controlling for other factors that might influence the demand for loans and savings, while also purging off the endogeneity of IMB. The results are not only robust but are positive and significantly different from zero. The second stage findings shows that IMB increases the probability of taking loans by 40.1 percentage points, and savings by 79.4

percentage points, respectively.

In order to test the validity of the instrument, I controlled for unobserved community-level characteristics by using proximity measured by distance in terms of time spent traveling to the nearest health centers and financial institutions. Therefore, I conclude that even after controlling for the endogeneity of IMB the 2SLS are consistently measured and as indicated by the partial F-statistics which are greater than the ten thresholds (Staiger & Stock, 1994).

Table 3.2: Impact of IMB on loans and savings

	Saving Dummy			Loan Dummy		
	OLS	Probit	2SLS	OLS	Probit	2SLS
Mobile Banking	0.247***	0.363***	0.794**	0.309***	0.186***	0.408***
	(0.02)	(0.02)	(0.26)	(0.01)	(0.01)	(0.08)
Age	0.012***	0.011***	0.014***	0.002	0.006***	0.002*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age Squared	-0.013***	-0.011***	-0.014***	-0.002*	-0.008***	-0.002*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male Head	-0.062**	-0.074***	-0.070**	-0.013	-0.013	-0.015*
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Married	0.073***	0.076***	0.082***	0.006	0.004	0.008
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Family Size	-0.002	0.004	-0.006	0.002	0.005	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
#Children	0.006	-0.011	0.012	-0.001	-0.005	-0.000
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Primary School	0.047**	0.067***	0.061***	-0.013	-0.016*	-0.010
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Secondary School	0.052***	0.073***	-0.009	0.017	0.015*	0.006
	(0.01)	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)
Financial Literacy	0.058***	0.073***	0.032	0.001	0.004	-0.004
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Income(log)	0.059***	0.049***	0.020	0.008**	0.008**	0.001
	(0.00)	(0.01)	(0.02)	(0.00)	(0.00)	(0.01)
Farming	0.018	0.022	0.035	0.000	-0.007	0.003
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Employed	0.048**	0.077***	0.023	0.006	0.014	0.001
	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Partial F-Stats	-	-	29.6	-	-	29.6
R-squared	0.290	-	-	0.277	-	-
Observation	8016	8016	8016	8016	8016	8016

*Note: Reported Probit results are marginal effects and other controls includes distance to infrastructural development, while logarithm of mobile money agent outlet distance (Kilometers) is used as instrument for two stage least (2SLS) estimations. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, and *, ** and *** shows significance level at 5%, 10% and 1%.*

3.4.2 Robustness Check

As a robustness check, I replicate the above findings in Table 3.2 column (3) and (6) by instrumenting IMB using logarithm of distance to mobile money outlet and the number of mobile networks available at the household level. The findings presented in Table B.1 are consistent and similar both in sign and significance, an indication that the findings are robust to an alternative model estimation.

3.4.3 Heterogeneous treatment effects of IMB

In order to understand the impact of IMB on savings and loans, I estimate equation 3.1-3.3 using a sub-sample of agricultural dependent households. This is in understanding that a majority of Kenyan's adult population lives in rural, where the main source of livelihood is farming.

I further motivate the results by exploring the heterogeneous effect of IMB on whether the savings or loans are taken for investments or consumption and whether they originate from formal or informal institutions. The rationale for examining other IMB is hinged on the fact that by examining the homogeneity of loans or savings will not reveal the individual's financial behavior or even savings practices. Also, it is important to investigate whether mobile banking is a compliment or a substitute for other forms of financial services. Therefore, I examine the magnitude at which the findings are driven by these competing factors by estimating equation 3.1 to 3.3 using OLS, Probit and 2SLS estimations.

To complement the results for participation in credit markets and savings, I further examine whether IMB can lead to a shift in the saving culture or appetite for loans based on whether they originate from formal or informal institutions. A conventional view is that increased use of IMB could be a perfect substitute for informal institutions, especially in developing countries where the majority of the population are un-banked, while it act as a complement for formal institutions

such as traditional banks (Cruz et al., 2010; Lwanga & Adong, 2016; Mbiti & Weil, 2015; Porteous, 2006).

3.4.4 Impact on Agricultural Dependent Households

Results from Table 3.3 in column 3 and 6 indicates that access to financial services through IMB has a positive and significant effect on the likelihood of propensity to save and credit uptake for agricultural dependent households. The observations above suggest that IMB has indeed been a driver for financial growth in Kenya, especially for the rural poor who are also mostly pro-poor population.

Table 3.3: Impact of IMB on agricultural dependent

	Savings			Loans		
	OLS	Probit	2SLS	OLS	Probit	2SLS
Mobile Banking	0.235***	0.386***	1.815***	0.326***	0.157***	0.368***
	(0.02)	(0.04)	(0.20)	(0.03)	(0.01)	(0.05)
Age	0.010**	0.012***	0.015***	0.001	0.006*	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age Squared	-0.012**	-0.012***	-0.013**	-0.001	-0.007*	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Male Head	-0.061*	-0.088**	-0.103*	-0.023**	-0.022*	-0.024**
	(0.03)	(0.03)	(0.05)	(0.01)	(0.01)	(0.01)
Married	0.069*	0.085***	0.113*	0.009	0.006	0.010
	(0.03)	(0.03)	(0.06)	(0.01)	(0.01)	(0.01)
Family Size	0.002	0.007	-0.008	0.007	0.006*	0.007
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
#Children	0.004	-0.018	0.019	-0.011*	-0.010*	-0.011*
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Primary School	0.053*	0.104***	0.108**	-0.016	-0.014	-0.014
	(0.02)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)
Secondary School	0.046*	0.110**	-0.195***	0.011	0.010	0.005
	(0.02)	(0.04)	(0.06)	(0.03)	(0.01)	(0.03)
Financial Literacy	0.079**	0.095***	-0.001	-0.002	0.000	-0.004
	(0.03)	(0.02)	(0.04)	(0.01)	(0.01)	(0.01)
Income (log)	0.052***	0.045***	-0.044**	0.007	0.004	0.004
	(0.01)	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Partial F-stats	-	-	57.88	-	-	57.88
J-Hansen P-value	-	-	0.320	-	-	0.12
R-squared	0.312	-	-	0.339	-	-
Observation	3526	3526	3526	3526	3526	3526

Note: Reported Probit results are marginal effects. Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile network available at household level are used as instruments for 2SLS estimations, while other controls include distance to infrastructural development. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, and *, ** and *** shows significance level at 5%, 10% and 1%.

3.4.5   Impact of IMB on loans and savings by origin

Table 3.4 panel A and Table 3.5 panel A report the results for saving or takings loans in formal or informal financial institutions. The findings reveal that individual demand for loans using IMB increases with formal financial institutions and decline for informal financial institutions. However, the findings are statistically significant from zero when household demand loans from formal financial institutions, while I find no significant evidence that IMB is a substitute for informal institutions. However, IMB increases the probability for demand

for loans and propensity to save for both formal and informal institutions. Table 3.4 panel A column (3 and 6) shows that access to IMB increases household's savings in a formal institution by percent 89.2 percentage points, while that for informal institutions increases by 80.1 percentage points.

3.4.6   Impact of IMB on loans and savings by purposes

In Table 3.5 panel B column (1 and 2) the coefficients related with IMB in the case for taking loans for consumption are positive and significant an indication that there is complementary between access to IMB and demand for loans in case of OLS estimations. However, the 2SLS results reported in column (3) are positive and insignificant, suggesting that IMB has no impact on loans for consumption. In contrast, Table 3.5 panel B column (4-6) finding reveals that access to mobile banking increases an individual's appetite for loans targeted towards investments. Table 3.5 Column (6) result suggests that access to IMB increases individual's likelihood to borrow for investments by 41.8 percentage points compared to those who have no access to this channel.

Table 3.4 Panel B reports the estimations for savings for consumption and investments purposes. In column (3) it is clear that IMB has no impact on savings for consumption despite depicting a positive effect. In column (6) I find a positive and significant impact of access to IMB, which increases the probability of saving for investment purposes by 94.6 percentage point.

Table 3.4: Heterogeneous effect of IMB on savings

Panel A: Mobile banking on saving origins

	Formal Financial Institutions			Informal Financial Institutions		
	OLS	Probit	2SLS	OLS	Probit	2SLS
Mobile Banking	0.128***	0.113***	0.892***	0.063***	0.082***	0.801*
	(0.02)	(0.01)	(0.18)	(0.02)	(0.02)	(0.35)
Bank distance(1hr)	-0.015	-0.021	0.006	0.005	0.011	0.043
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Bank distance(>2hrs)	-0.072***	-0.126***	-0.045	-0.037	-0.048	0.003
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Health Centre(1hr)	-0.033**	-0.038*	-0.007	0.019	0.032	0.061*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Health Centre(>2hrs)	0.002	-0.011	0.020	-0.040	-0.074*	-0.056
	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Partial F-stats	-	-	40.39	-	-	40.39
R-squared	0.22	-	-	0.13	-	-
Observation	8016	8016	8016	8016	8016	8016

Panel B: Mobile banking on saving purpose

	Consumption Purpose			Investment Purpose		
	OLS	Probit	2SLS	OLS	Probit	2SLS
Mobile Bank	0.081***	0.080***	0.453	0.171***	0.209***	0.946**
	(0.02)	(0.02)	(0.26)	(0.02)	(0.02)	(0.30)
Bank distance(1hr)	0.029	0.027	0.043*	-0.016	-0.016	0.019
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Bank distance(>2hrs)	0.004	-0.008	0.020	-0.041	-0.058*	-0.008
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)
Health Centre(1hr)	0.023	0.028	0.043	-0.023	-0.018	0.013
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Health Centre(>2hrs)	-0.023	-0.035	-0.021	-0.072**	-0.092***	-0.074*
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Partial F-stats	-	-	40.39	-	-	40.39
R-squared	0.10	-	-	0.23	-	-
Observation	8016	8016	8016	8016	8016	8016

Note: Reported Probit results are marginal effects. Logarithm of mobile money agent outlet distance (Kilometers) is used as instrument, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), financial literacy, family size, children aged below 15 years, incomes, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, and *, ** and *** shows significance level at 5%, 10% and 1%.

Table 3.5: Heterogeneous effect of IMB on loans

Panel A: Mobile banking on loan origins

	Formal Financial Institutions			Informal Financial Institutions		
	OLS	Probit	2SLS	OLS	Probit	2SLS
Mobile Banking	0.105***	0.074***	0.431***	0.024	0.029	-0.132
	(0.02)	(0.01)	(0.12)	(0.02)	(0.02)	(0.20)
Bank distance(1hr)	-0.008	-0.006	0.004	0.001	0.003	-0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Bank distance(>2hrs)	-0.034***	-0.069***	-0.021	0.025	0.021	0.009
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.03)
Health Centre(1hr)	-0.013	-0.017	-0.004	0.007	0.004	-0.002
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Health Centre(>2hrs)	0.019	0.024	0.025	-0.013	-0.009	-0.013
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Partial F-stats	-	-	40.4	-	-	40.4
R-squared	0.150	-	-	0.060	-	-
Observation	8016	8016	8016	8016	8016	8016

Panel B: Mobile banking on loan purposes

	Consumption Purpose			Investment Purpose		
	OLS	Probit	2SLS	OLS	Probit	2SLS
Mobile Banking	0.125***	0.116***	0.072	0.168***	0.137***	0.418*
	(0.01)	(0.01)	(0.23)	(0.01)	(0.01)	(0.19)
Bank distance(1hr)	-0.005	-0.010	-0.012	-0.017	-0.006	0.002
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Bank distance(>2hrs)	0.009	0.004	-0.000	-0.037*	-0.050**	-0.025
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Health Centre(1hr)	0.019	0.023	0.020	-0.002	-0.008	-0.001
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Health Centre(>2hrs)	0.017	0.030	0.026	0.014	-0.001	0.012
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Partial F-stats	-	-	40.4	-	-	40.4
R-squared	0.069	-	-	0.159	-	-
Observation	8016	8016	8016	8016	8016	8016

Note: Reported Probit results are marginal effects. Logarithm of mobile money agent outlet distance (Kilometers) is used as instrument, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), financial literacy, family size, children aged below 15 years, incomes, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, and *, ** and *** shows significance level at 5%, 10% and 1%.

3.5   Conclusion

This study sought to explore the relationship between IMB and the demand for loans and savings. The study further examines other channels through which mobile banking could influence savings and credit market. Following similar empirical evidence from (Demombynes & Thegeya, 2012; Diagne et al., 2000; Ky, Rugemintwari, & Sauviat, 2017; Lwanga & Adong, 2016; Munyegera & Matsumoto, 2018; Steiner et al., 2009).

I find significant evidence that IMB enhances financial inclusion through enhanced access to financial services such as participation in the credit market and in facilitating savings. I also find that IMB enables individuals to make future plans through increased investments in productive activities, while I find no impact on consumption.

The findings suggest that there exists complementarity between access to IMB and demand for loans for investments purposes, with no significant effect on loans for consumption purposes. I find similar results where access to IMB complement household's decisions to save for long-term investments with no evidence on its impact on savings for consumption. Further, the results suggest that increased access to IMB can increase use of other existing formal financial institutions and act as a substitute for informal financial institutions.

These findings provide a better understanding of how IMB can bridge the gap between the users and non-users of such services, while providing a better option through which individuals can gain access to other forms of financial services. Further, the findings suggest that whereas there have been remarkable in road in enhancing service delivery through provision of mobile financial services using basic mobile money there is need to sensitize the un-banked population who are deprived of formal financial services on importance of using integrated mobile banking, which can increase their savings and credit uptake base.

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APPENDIX B

Table B.1: Robustness Check: Impact of IMB on loans and savings

Panel A: Second Stages: Savings

		Origins		Purposes	
	Savings	Formal	Informal	Consumption	Investment
Mobile banking	1.549***	0.819***	0.287***	0.115	0.869***
	(0.17)	(0.06)	(0.09)	(0.09)	(0.13)
Bank distance(1hr)	0.013	0.010	0.013	0.031	0.008
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Bank distance(>2hrs)	-0.023	-0.039*	-0.026	0.005	-0.007
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Health Centre(1hr)	0.040	-0.006	0.027	0.024	0.004
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Health Centre(>2hrs)	0.012	0.022	-0.033	-0.022	-0.051*
	(0.03)	(0.02)	(0.03)	(0.04)	(0.02)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	57.13	57.13	57.13	57.13	57.13
J-Hansen P-value	0.03	0.93	0.09	0.97	0.03
Observation	8016	8016	8016	8016	8016

Panel B: Second Stages: Loans

		Origins		Purposes	
	Loans	Formal	Informal	Consumption	Investment
Mobile banking	0.398***	0.451***	0.253***	0.460***	0.539***
	(0.04)	(0.05)	(0.07)	(0.06)	(0.08)
Bank distance(1hr)	-0.001	0.004	0.009	0.007	-0.004
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Bank distance(>2hrs)	0.002	-0.017	0.036	0.025	-0.019
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Health Centre(1hr)	0.007	0.001	0.015	0.032	0.012
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Health Centre(>2hrs)	0.008	0.030	-0.006	0.026	0.025
	(0.01)	(0.02)	(0.03)	(0.02)	(0.03)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	57.13	57.13	57.13	57.13	57.13
J-Hansen P-value	0.89	0.76	0.01	0.02	0.13
Observations	8016	8016	8016	8016	8016

Note: Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile network available at household level are used as instruments. Other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), financial literacy, family size, children aged below 15 years, incomes, and employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.
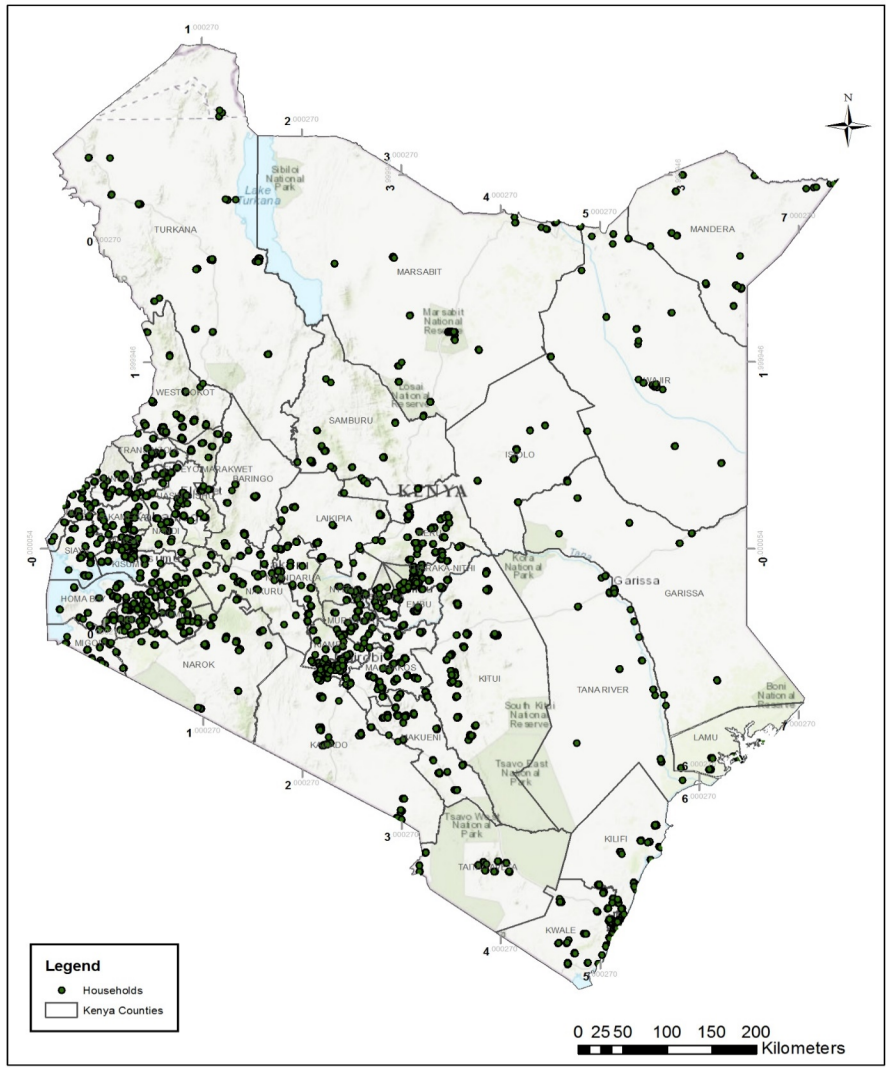
Source: Author's calculation from FinAccess and Geospatial Mapping Surveys 2015.

Figure B.1: Geographical distribution of mobile money agent's outlets.

Table B.2: List of loans and savings by origin and purposes

Panel A: Origin

Formal Financial Institutions	Informal Financial Institutions
- Commercial Banks	- Employer
- Post Banks	- Family members, friends, or Neighbor
- Microfinance Institutions	- Savings group
-Savings and Credit Corporations (SACCOs)	- Rotating Savings and Credit Association (ROSCAS)
	- Shop or convenient stores
	- Informal moneylender/Shylock

Panel B: Purposes

Consumption	Investments
- Clothes, foot wares, transport, or food	- Earning interest on savings
- Household assets (TV, refrigerator)	- Education related expenditure
- Vehicles or motorbikes	- Assets acquisitions or own house improvement
- Pay utilities (airtime, electricity, bills or rent)	- Spend on agricultural machinery or inputs
- For social reasons (wedding, bride price, etc.)	- Health related expenditures including medical emergency
	- Starting a new business or business expansion
	- Buy financial assets (shares,stocks or bonds)
	- Pension related expenditures

Table B.3: Variables definition and units of measurement

Variables	Units	Definitions
Integrated Mobile Banking (IMB)[*]	Equal one if respondent actively uses or has access to IMB account, and zero otherwise	Dummy
Loans or Savings	Equal one if respondent borrowed or saved some amount in the last 12 months, zero otherwise	Dummies
Formal Loans or Savings	Equal one if respondent borrowed or saved from/in the formal/informal financial institutions, zero otherwise	Dummies
Informal Loans or Savings	Equal one if respondent borrowed or saved from/in the informal institutions, zero otherwise	Dummies
Mobile money agent outlets	Distance (in Kilometers) if mobile money agent outlet is the closest financial provider	Continuous
Infrastructural Development	Distance measured in time taken to walk to closest financial provider and health centres	Categorical
Male Head	Equal one if the household head is male, zero otherwise	Dummy
Age	Indicate the age of respondent	Years
Education	Where: none (reference), primary school, secondary school and above	Categorical
Married	Equal one if the respondent is married, zero otherwise	Dummy
Financial Literacy	Equal one if the respondent has knowledge of interest rates, collateral and inflation rate, zero otherwise	Dummy
Family Size	Number of family members living in the household	Discrete
Children	Number of children aged 15 years and below in the household	Discrete
Income	Total household labor incomes from engaging in off-farm or on-farm activities	Continuous
Employed	Equal one if off-farm activities are main sources of income (i.e. formal or informal employment, self-employed), zero otherwise	Dummy
Farming	Equal one if main occupation is farming, zero otherwise	Dummy

[*] I use interchangeably integrated mobile banking and mobile banking

CHAPTER 4

INTEGRATED MOBILE BANKING AND CONSUMPTION DECISIONS

4.1 Introduction

In recent times, mobile finance has seamlessly transformed the financial landscape of most developing countries and emerging markets. These efforts are primarily an initiative of mobile networks operators (MNOs) and are further heightened by regulators' legislative frameworks and increased financial services integration with other financial market players (Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008; Burgess & Pande, 2005; Camner & Sjoblom, 2009; Levine, Loayza, & Beck, 2000; Pénicaud & Katakam, 2013; Plyler, Haas, & Nagarajan, 2010; Rojas-Suarez & Gonzales, 2010; Rosengard, 2016).

The tremendous impact of mobile finance in the developing world has elucidated the need for other market players to enhance an all-inclusive financial sector. That is, increased access to mobile financial services could unlock major investments through increased appetite for the comprehensive choice of financial products (Aker & Mbiti, 2010; Apiors & Suzuki, 2018; Blumenstock, Callen, Ghani, & Koepke, 2015; Cruz, Barretto Filgueiras Neto, Munoz-Gallego, & Laukkanen, 2010). Equally, access to mobile financial services can motivate users to make long-lasting consumption decisions and diversify their incomes to productive activities (Ajayi & Ross, 2017; Cruz et al., 2010; Jack & Suri, 2014; Park & Mercado, 2015; Plyler et al., 2010; Reeves & Sabharwal, 2013; Riley et al., 2016).

Despite, the role of mobile financial services' tremendous impact on household consumption smoothening in Kenya, its effect on diverse categories of household expenditures remains largely unexplored. This study, therefore, endeavors to fill this knowledge gap by assessing how integrated mobile banking[17] is contributing to household spending on productive activities and in alleviating social distress through increased spending on other family members.

I argue that accessibility and availability of mobile banking services improve social welfare and in the long-run act as poverty eradication mechanism at the household level. Conversely, enhanced access and utilization of mobile financial services can lead to a shift in household spending behavior through fostering investment in physical and human capital (Apiors & Suzuki, 2018; Jack & Suri, 2014; Munyegera & Matsumoto, 2016; Riley et al., 2016). That is, provision of mobile financial services beyond conventional banking system and informal settings has revolutionized banking patterns, particularly for small-scale investments (Frydrych & Aschim, 2014; Gabor & Brooks, 2017; GSMA, 2018; Kikulwe, Fischer, & Qaim, 2014).

In developing countries, physical human capital investments are highly flooded by Micro, Small & Medium Enterprises (MSMEs), which are increasingly taking advantage of the mobile finance for service delivery, and as a form of employment. Moreover, a significant number of MSMEs operates either formally or informally. In Sub-Saharan Africa, most firms are predominantly MSMEs (Frederick, 2014; Kikulwe et al., 2014). For instance in Kenya, they accounts for more than 70 percent of the labor force participation and 20 percent of a country's economic growth (Mdoe & Kinyanjui, 2018).

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[17]This study uses integrated mobile banking and mobile banking interchangeably

4.2 Data Sources

4.2.1 Survey

The empirical analysis for this study draws its data from a cross-sectional household survey FinAccess 2015/2016 administered by Financial Sector Deepening (FSD) Kenya in partnership with Central Bank of Kenya and Kenya National Bureau of Statistics (KNBS). The survey is the fourth nationally representative financial access survey that was conducted in August to October 2015 and designed to periodically assess access and demand for financial services overtime (CBK, 2016).[18]

The survey is collected across thirteen sub-regions and clustered in terms of urban and rural areas. A multi-stage stratification technique was applied to a sample of 8,665 household randomly selected adults aged 16 years old and above from 165 primary sampling units (PSUs).[19] FinAccess 2016 data captures information on household demographic characteristics, financial literacy, household expenditure patterns on investment in physical and human, and social transfers among other expenditures, sources of household incomes and incomes, household access to and product usage of financial services, and other household's characteristics that include assets ownership, household risks and vulnerability.

I complement FinAccess 2015/16 survey using FinAccess 2016 geospatial mapping collected between March to August of 2015 by Brand Fusion and financed by Bill & Melinda Gates Foundation and a consortium of three other institutions (BMGF, 2016).[20] This survey provides close to 92,000 geographical locations of financial access points and mapped 27,684 markets locations and other agricultural outlets across the country (see appendix Figure C.1. I use

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[18]The current and other waves are publicly available from www.fsdkenya.org.

[19]The FinAccess 2015/16 sampling frame was constructed using KNBS NASSEP. Further, I adjust all empirical results using the sample weights provided both at the individual and household level proportion to the total adult population. FinAccess 2015/16 includes geospatial information upon request from FSD Kenya.

[20]Further details can be found at http://fsdkenya.org/dataset/finaccess-geospatial-2015/.

this data to construct the distance between the households and the closest mobile money agents as well as other financial services operators such as bank branches or closest market.[21]

4.2.2 Descriptive summary statistics

Table 4.1 presents summary statistics of the outcomes variables and other household's characteristics included in the empirical estimations, while Table C.7 provide full variables descriptions and units of measurement. Consumption is measured as total household consumption of both food and non-food items. On average users of mobile banking spend roughly KSh 8000 ($80) on average per month for consumption purposes. Microbusiness includes all household spending on capital for business start-ups or expansion, and registration; while spending on social transfers includes intra-households' transfers aimed at helping household members without economic attachment. Education includes all spending on school tuition fees, books, uniforms, and transportation, while health expenditures include spending on hospital bills, registrations, and other associated medical bills. With respect to the expenditure pattern, it is evident that most of the household have diversified their spending to both physical and human capital investments. In addition, integrated mobile banking users allocate approximately KSh 1,247 of total household consumption to microbusiness, KSh 1,205 percent to education, while health and family transfers receive a small share of total consumption.

Majority of households have more than one mobile network services suggesting high penetration of mobile financial services, while most of them live within 1 km radius from a mobile agent outlet. It is also evident that the majority of households resides within a 30 min walk to other infrastructural developments comprised of health centres and or banks. On average, household comprises ap-

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[21]The survey also covers a wide range of financial service operators such as bank networks, microfinance institutions, Savings and Credit Cooperative Organizations (Saccos), money transfers systems and agricultural markets locations.

proximately 4 members, while school going children below the age of 15 years old are on average at least 2 per household.

It is also evident that integrated mobile banking users have younger male heads and are less likely to be married compared to non-users. In terms of the education levels, majority of the integrated mobile banking users have attained secondary or more education compared to non-users who are more likely to have completed primary education, while the remaining percentage were those who reported having no formal education. Financial literacy plays a vital role in the usage of financial products with users of mobile banking reporting to have high knowledge of interest rates, collateral, and inflation rate. A significant proportion of households exposed to mobile banking are more likely to participate in off-income activities compared to non-users who prefers engaging in farming.

Table 4.1: Descriptive summary statistics

	Mobile Banking									
	Users					Non-Users				
Variables	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max
Dependent Variables: *Expenditures* ('000)										
Microbusiness (KSh)	1542	12.47	13.66	0	50	6212	5.11	9.09	0	50
Education (KSh)	1575	12.05	17.49	0	75	6145	7.75	13.36	0	75
Health (KSh)	1639	2.1	3.54	0	18	6056	1.79	3.38	0	18
Family Transfer (KSh)	1568	5.76	7.53	0	29	6163	2.63	5.12	0	29
Total Consumption (KSh)	1611	80.7	67.88	0	312	6266	42.04	49.65	0	310
Independent Variables										
Mobile money agent outlet (Kms)	1749	1.51	4.41	0	71	6385	4.6	10.41	0	95
#Mobile Network Available	1749	1.15	0.39	0	2	6385	0.73	0.53	0	2
Age	1749	32.96	11.1	18	90	6385	40.4	17.48	18	100
Age Squared	1749	12.1	9.03	3	81	6385	19.38	17.11	3	100
Male Head	1749	0.83	0.38	0	1	6385	0.76	0.43	0	1
Married	1749	0.62	0.49	0	1	6385	0.64	0.48	0	1
Family Size	1749	3.75	2.32	1	20	6385	4.33	2.45	1	18
#Children	1749	1.62	1.71	0	15	6385	2.2	1.98	0	15
Primary School	1749	0.18	0.39	0	1	6385	0.22	0.42	0	1
Secondary School	1749	0.33	0.47	0	1	6385	0.14	0.35	0	1
Financial Literacy	1749	0.81	0.39	0	1	6385	0.67	0.47	0	1
Total Income (KSh)	1749	276.39	506.93	0	6870	6385	141.5	1702.8	0	151500
Farming	1749	0.34	0.47	0	1	6385	0.49	0.5	0	1
Employed	1749	0.86	0.35	0	1	6385	0.62	0.49	0	1
Bank distance(<30min)	1747	0.76	0.43	0	1	6269	0.53	0.5	0	1
Bank distance(1hr)	1747	0.18	0.39	0	1	6269	0.27	0.45	0	1
Bank distance(>2hrs)	1747	0.06	0.24	0	1	6269	0.2	0.4	0	1
Health Centre(<30min)	1749	0.87	0.34	0	1	6385	0.72	0.45	0	1
Health Centre(1hr)	1749	0.11	0.31	0	1	6385	0.21	0.41	0	1
Health Centre(>2hrs)	1749	0.02	0.15	0	1	6385	0.07	0.26	0	1

4.3   Identification Strategy

This section provides an econometric model for analysis to establish a causal pathway through which mobile banking services influences the household behavioral responses on resource allocation towards physical and human capital investment, and family transfers.[22] The underlying hypotheses test whether integrated mobile banking usage or access has a significant effect on the three components of household expenditures. Therefore, I first examined the effect of mobile banking on household welfare outcomes using the following OLS specification model:

$$E_{ij} = \beta_0 + \beta_1 IMB_{ij} + \phi X_{ij} + \tau_j + \epsilon_{ij} \tag{4.1}$$

Where E_{ij} is welfare outcomes (microbusiness, education, health, family transfer, and total consumption) for household i at county j; IMB_{ij} is a dummy variable assuming a value of one if the respondent has access or uses integrated mobile banking, 0 otherwise; X_{ij} is a vector of covariates influencing the outcome variables and comprises of gender, age, marital status, financial literacy, number of children aged 16 years old, completed education levels, incomes, occupation status (farmer, employed and dependent), and proximity to infrastructural developments. The variable τ_j denotes the districts level dummy that accounts for unobservable time-invariant characteristics such as geographical variations across districts. Lastly, the normally distributed mean zero disturbance error term is denoted by ϵ_{ij} and clustered at the county level to allow for unobserved heterogeneity at the regional level. The parameter of interest is given by β_1 and measures the effect of IMB on welfare outcomes of interest.[23]

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[22]All expenditures are adjusted to account for economic of scale using square root of family size. Also, due to possibility of outliers wielding undue influence, extremes top values are dropped from each expenditure category. This helps in overcoming for possible measurement errors that may attenuate the results upwards.

[23]Regressions include individual inverse probability weights and standard errors are clustered at district level, while accounting for county fixed effect.

However, a primary caveat in estimating equation (4.1) using the OLS estimation model is that the parameter of interest may be inconsistently estimated owing to endogenous integrated mobile banking (Jeffrey, 2018). Additionally, the estimated regression only captures the magnitude of the effect of mobile money banking on welfare outcomes but fail to establish the direction of causality due to several confounding factors (Wooldridge, 2018).

The first source of bias could arise from an omitted variable bias because of missing information due to individual unobserved characteristics that could influence the OLS estimation model. For example, users of mobile banking services could be individuals who have certain innate behaviors in adopting new innovations quickly or are techno-savvy, and thus an unobserved individual's characteristics may influence household consumption decisions. The second source of bias is the reverse causation between integrated mobile banking and outcomes of interest as households with entrepreneurial skills are more inclined to take greater risks in the use of technology for productive activities (Frederick, 2014). Lastly, the model could also suffer from measurement error, such that people with high income flows resulting from investments or due to economic shocks may influence adoption of integrated mobile banking.

4.3.1 Instrumental Variable Estimation

As a robustness check and in order to overcome the potential endogeneity bias of IMB, the study uses an instrumental variable estimation technique to measure the local average treatment effect of IMB on household expenditure patterns of interest. This study uses two instruments to control for endogeneity that may affect the OLS model estimations. Following Jack and Suri (2014) and Frederick (2014), I assess the exogenous variation of the mobile money agent network using distant to the nearest mobile agent outlet and mobile network operators available at the household level as instruments.[24]

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[24]See Card (1993).

Distance to the closest mobile money outlets captures the intensity of IMB accessibility and I assumed it to be negatively correlated with IMB.[25] Mobile network operators' increases the likelihood of mobile banking services use and measured as number of mobile networks available at the household's level. The study conjectures a positive relation between mobile network operators and IMB services. However, the other important concerns relating to the validity of the instruments such that they must be correlated with the IMB and that they are not correlated with the disturbance error term.

The first assumption requires the existence of a correlation between mobile banking and the instruments. For instance, individuals that are far from mobile outlets are highly disadvantaged in accessing mobile services, thus they are more likely not use these services. Conversely, households that have more than one mobile network subscription are more likely to adopt mobile products. The second assumption requires that the choice of instruments must meet the exclusion restriction condition, that is, they should only affect the outcomes of interest through their effect on mobile banking (Card, 1993).

Nonetheless, the instruments may fail to meet this condition due to other confounding factors such as non-randomness in the selection of the locations of the mobile money agents or due to other individual unobserved characteristics. For instance, some household access or use of mobile financial services may be affected by unobservable factors that could influence their choices of engaging in certain type of investments. Also, family transfers are highly common in the poor and extremely vulnerable households, while entrepreneurship skills and highly educated individuals may self-select to use mobile banking based on their historical use of technology in business activities and their financial literacy levels.

The study conjecture that the number of mobile networks available at the household level is not related to unobservable individual characteristics that

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[25]Distance (in kilometres) by matching household with geo-spatial coordinates provided upon request from FSD Kenya.

could affect expenditure outcomes of interest. Furthermore, mobile network operators make the decision to provide mobile money services exogenously beyond household decisions. However, with a growing clientele base, other firms in the service sector have so far joined the mobile money market either directly or indirectly.[26] The mobile network operators' decision to diversify in the mobile money market is mainly driven by regulation standards, customer clientele base, marketing strategies, competition, pricing mechanism, and product (technology) development

Therefore, I ruled out possible endogeneity bias that is attributable to the supplier of this services conditional on increased households' choice of mobile money operators. I assumed that the mobile agents are not systematically located since their main importance is to allow users of the mobile product to cash in or to cash out Mbiti and Weil (2015). Additionally, most mobile money agents are largely retail outlets, which are spread out across communities, thus can be established with any other form of business entities. For that reasons, I also controlled for the proximity of households to other infrastructural development such as distance to the nearest health centers and banks Munyegera and Matsumoto (2016). The rationale of including this additional controls hinges on the fact that banks and health centers are more likely to be found near the urban centers. Thus, I assumed that controlling for distance to infrastructural development will solve any other potential unobservable characteristics related to the instrument.

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[26]Notably, the mobile money network roll-out predominantly affected the telecommunication industries with only one dominant firm offering services.

4.4 Empirical Results

4.4.1 Main Findings

Table 4.2 reports the simple OLS model estimations for the effect of access to IMB on expenditure patterns. Column 1-4 presents the findings for microbusiness, family transfers, education, and health expenditure all measured in levels. Table 4.2 (column 1) shows a robust and significant positive effect of access to IMB access on spending on microbusiness. The findings suggest that access to IMB increases spending on business activities by KSh 303.4 ($18.65), while holding other covariates constant. Other controls such as income and number of informal groups' membership are positively and significantly different from zero. In the appendix Table C.1 (column 1) present similar results by examining the effect of actual users of IMB on household expenditures. I find that users of IMB are more likely to increase spending on business activities by KSh 332 ($3.32) compared to non-users.

Table 4.2: OLS Estimation- Integrated mobile banking and Expenditure patterns

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Access	3.034***	1.329***	2.808***	0.345**	13.490***
	(0.50)	(0.22)	(0.57)	(0.11)	(1.96)
Financial Literacy	1.512***	0.821***	0.265	-0.022	6.397***
	(0.32)	(0.17)	(0.48)	(0.11)	(1.32)
Income(log)	1.913***	0.752***	0.987***	0.175***	11.393***
	(0.14)	(0.07)	(0.19)	(0.04)	(0.79)
#Informal Groups	1.067***	0.311***	0.593*	0.110	2.343*
	(0.18)	(0.09)	(0.22)	(0.06)	(0.97)
Bank distance(1hr)	-0.408	-0.449*	-0.385	-0.039	-4.550*
	(0.36)	(0.17)	(0.51)	(0.12)	(1.87)
Bank distance(>2hrs)	-0.328	0.046	-1.053	-0.038	-2.598
	(0.52)	(0.22)	(0.62)	(0.15)	(2.61)
Health Centre(1hr)	-0.335	-0.082	-0.273	0.080	-2.169
	(0.37)	(0.21)	(0.62)	(0.14)	(2.31)
Health Centre(>2hrs)	-0.220	-0.241	-0.096	0.245	-2.937
	(0.43)	(0.34)	(0.98)	(0.24)	(2.69)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R-squared	0.262	0.191	0.123	0.104	0.415
Observation	7636	7615	7603	7581	7759

Note: All outcomes are per adult equivalence in levels and top extremes values are dropped, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

Table 4.3 and Table C.2 examines the causal impact of mobile banking on expenditure patterns by exploiting distance to the mobile agent network. In Table 4.3 (column 1) and appendix Table C.2 (column 1) estimation results for microbusiness activities are positive and significant at all levels. I find that individuals who have access to or use IMB are motivated to increase spending on investment in microbusiness by KSh 1,864.7 ($18.65) percent and KSh 2,721, respectively compared to non-user or those who have no access to mobile banking platform.

Most individuals in most of the developing countries spend almost a third of their incomes on other members of the family in the form of family transfers

aimed to alleviate poverty. Therefore, this study examines the impact of IMB on family transfers. I hypothesis that access to or usage of mobile banking has a significant effect on the family social cohesion measured in terms of family transfers. I find significant differences between individuals who have access to and users of IMB. Overall, In Table 4.3 (column 2) and appendix Table C.2 (column 2) reports the causal relationship between access and usage of mobile banking on family transfers. For instance, IMB increases household spending on family transfers by KSh 843.1 compared to non-users, while holding other covariates constant.

I further investigated the impact of IMB on household spending on human capital investments. In Table 4.3 (Column 3) indicates a significant positive effect of access to IMB on investment in education and consistent with Ajayi and Ross (2017) findings. In Table C.2 (column 3) also shows positive and significant evidence of mobile banking on education. Additionally, In Table C.2 (column 3) shows IMB use leads to KSh 1,649.1 increase in education expenditure at 5 percent significant level. These results suggest that increased access to or usage of IMB has a positive effect on return to school. Table 4.3 (column 4) and Table C.2 (column 4) reports findings for the effect of integrated mobile banking on health. The results are not significant despite having a positive relationship with household spending on health.

Table 4.3: IV Estimations: Integrated mobile banking and Expenditure patterns

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Access	18.647**	8.431**	14.747*	1.776	137.122***
	(5.71)	(3.12)	(7.10)	(1.81)	(31.78)
Financial Literacy	0.837	0.521*	-0.196	-0.079	0.970
	(0.43)	(0.23)	(0.56)	(0.14)	(2.66)
Income(log)	0.966**	0.294	0.245	0.081	3.400
	(0.36)	(0.20)	(0.48)	(0.12)	(2.08)
#Informal Groups	0.663*	0.138	0.235	0.074	-1.258
	(0.27)	(0.12)	(0.32)	(0.07)	(1.42)
Bank distance(1hr)	0.005	-0.263	-0.082	0.000	-0.927
	(0.38)	(0.17)	(0.51)	(0.12)	(2.10)
Bank distance(>2hrs)	0.254	0.327	-0.558	0.024	2.913
	(0.57)	(0.24)	(0.71)	(0.17)	(3.29)
Health Centre(1hr)	0.212	0.155	0.170	0.126	1.882
	(0.55)	(0.27)	(0.63)	(0.15)	(2.89)
Health Centre(>2hrs)	0.396	0.012	0.382	0.284	1.023
	(0.53)	(0.45)	(1.01)	(0.25)	(3.13)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	28.34	31.15	34.24	31.67	28.01
Observations	7636	7615	7603	7581	7759

Note: All outcomes are per adult equivalence in levels and top extremes values are dropped. Logarithm of mobile money agent outlet distance (Kilometers) is used as instrument, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

Table 4.4 first stage results show a significant negative effect of distance to the mobile network, suggesting that households who are far from this agent networks are less likely to use mobile banking. It also indicates that the choice of the instrument is validly selected given that F-statistics is greater than the "rule-of-thumb" of 10 (Staiger & Stock, 1994). I control for additional infrastructure development to account for unobserved individual characteristic using time spent walking to the nearest health center or bank and find no significant effect on household expenditure pattern as well as a determinant for integrated mobile banking in the first stage (see Table 4.3). This suggests that these results are

not driven by any other unobserved factors other than through the instruments. I also control for district variation using district fixed effects in all estimations.

Table 4.4: First-Stage: Impact on expenditure patterns

	Panel A: Dependent variable: Mobile Banking Access				
	(1)	(2)	(3)	(4)	(5)
Mobile money agent outlet	-0.041***	-0.040***	-0.041***	-0.041***	-0.040***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(1hr)	-0.018	-0.018	-0.017	-0.018	-0.021
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(>2hrs)	-0.023	-0.025	-0.027	-0.028*	-0.030*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Health Centre(1hr)	-0.028	-0.026	-0.030	-0.025	-0.026
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
Health Centre(>2hrs)	-0.031	-0.027	-0.031	-0.018	-0.023
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observation	7636	7615	7603	7581	7759
	Panel B: Dependent variable: Mobile Banking Use				
	(1)	(2)	(3)	(4)	(5)
Mobile money agent outlet	-0.037***	-0.038***	-0.037***	-0.039***	-0.036***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(1hr)	-0.026	-0.026*	-0.023	-0.023	-0.026*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(>2hrs)	-0.025	-0.029	-0.029*	-0.028	-0.032*
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Health Centre(1hr)	-0.020	-0.015	-0.022	-0.018	-0.017
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Health Centre(>2hrs)	-0.011	-0.003	-0.013	0.004	-0.003
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observation	7636	7615	7603	7581	7759

Note: Logarithm of mobile money agent outlet distance (Kilometers) is used as instrument, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), financial literacy, family size, children aged below 15 years, number of informal group membership, incomes, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

4.5 Robustness Check

I further investigate the impact of mobile banking on household expenditure pattern by instrumenting integrated mobile banking using distance to mobile money

outlet and the number of mobile networks available at the household level. Table 4.5 and Table C.3 results indicate a significant positive effect of IMB use on human capital investment and household total expenditure. Results presented in Table 4.5 (Column 5) shows a robust and significant positive effect of IMB on household consumption an indication that access to mobile banking leads to an increase in household consumption. Munyegera and Matsumoto (2016), Kikulwe et al. (2014), Jack and Suri (2014) find similar impact of basic mobile money on household consumption.

Table 4.5: IV Estimations: Impact on expenditure patterns

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Access	15.379***	7.718***	15.228***	1.529**	112.562***
	(1.90)	(1.03)	(3.22)	(0.59)	(14.61)
Financial Literacy	0.978**	0.551**	-0.215	-0.069	2.048
	(0.35)	(0.19)	(0.52)	(0.11)	(2.15)
Income(log)	1.164***	0.340***	0.215	0.098	4.988***
	(0.17)	(0.09)	(0.21)	(0.06)	(1.01)
#Informal Groups	0.748***	0.156	0.220	0.080	-0.543
	(0.20)	(0.09)	(0.25)	(0.05)	(1.19)
Bank distance(1hr)	-0.081	-0.282	-0.070	-0.007	-1.647
	(0.37)	(0.15)	(0.48)	(0.12)	(1.80)
Bank distance(>2hrs)	0.132	0.299	-0.538	0.013	1.818
	(0.58)	(0.23)	(0.64)	(0.15)	(3.00)
Health Centre(1hr)	0.097	0.131	0.188	0.118	1.077
	(0.47)	(0.25)	(0.64)	(0.15)	(2.49)
Health Centre(>2hrs)	0.267	-0.013	0.401	0.277	0.236
	(0.46)	(0.42)	(1.02)	(0.24)	(2.85)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	56.89	54.32	63.20	66.89	57.49
J-Hansen P-value	0.55	0.79	0.94	0.87	0.32
Observations	7636	7615	7603	7581	7759

Note: All outcomes are per adult equivalence in levels and top extremes values are dropped. Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile network available at household level are used as instruments, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

4.6 Heterogenous Effect

In order to understand the impact of integrated mobile banking on expenditure patterns, I estimate equation 1-3 using a sub-sample of agricultural dependent households. In Table 4.6 and Table C.5 in the appendix I find strong evidence of IMB on family transfers, household consumption and investment in micro-business and education for agricultural dependent households. The findings suggest that the expansion of access to financial services through IMB may lead to increased uptake of long-term investment activities as well as increase overall consumption for agricultural dependent households (Frydrych & Aschim, 2014; Kikulwe et al., 2014; Plyler et al., 2010; Riley et al., 2016).

Table 4.6: IV Estimations: Effect on agricultural dependents

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Access	14.918***	7.908***	15.009***	2.530	129.093***
	(3.34)	(2.03)	(4.19)	(1.37)	(20.46)
Financial Literacy	0.398	0.367	-0.452	-0.256	-0.362
	(0.54)	(0.33)	(0.71)	(0.23)	(2.64)
Income(log)	1.255***	0.385*	0.561	0.068	2.844*
	(0.23)	(0.16)	(0.29)	(0.07)	(1.31)
#Informal Groups	0.578	0.243	0.491	-0.012	-1.392
	(0.34)	(0.20)	(0.45)	(0.11)	(1.86)
Bank distance(1hr)	0.109	-0.084	-0.585	0.029	-2.362
	(0.47)	(0.31)	(0.81)	(0.25)	(2.48)
Bank distance(>2hrs)	0.605	0.008	-2.092*	-0.045	-0.397
	(0.59)	(0.39)	(1.05)	(0.32)	(3.33)
Health Centre(1hr)	-0.142	0.198	-0.535	-0.072	0.697
	(0.56)	(0.33)	(0.76)	(0.19)	(2.59)
Health Centre(>2hrs)	-0.988	0.379	0.669	0.030	-1.464
	(0.76)	(0.48)	(1.51)	(0.28)	(3.66)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	44.36	38.67	42.08	35.91	44.09
J-Hansen P-value	0.41	0.07	0.73	0.67	0.85
Observations	2447	2451	2405	2369	2480

Note: All outcomes are per adult equivalence in levels and top extremes values are dropped. Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile network available at household level are used as instruments, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

4.7 Conclusion

This study uses micro-level data from a developing country to examine whether integrated mobile banking influences household spending behavior, particularly on physical and human capital investment as well as family transfers. I employ instrumental variable estimation technique to overcome potential endogeneity problems associated with usage of integrated mobile banking in examining expenditure pattern. The study exploits the exogenous variation of the mobile money agent network using distant to the closest mobile agent outlet and the number of mobile network operators available at the household level as instruments.

I find a significant impact of integrated mobile banking on various categories of household expenditure pattern. I observe that integrated mobile banking has a positive and significant impact on family transfer, individual's investment on micro-businesses, and education, while I find no empirical evidence on health expenditure.

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APPENDIX C
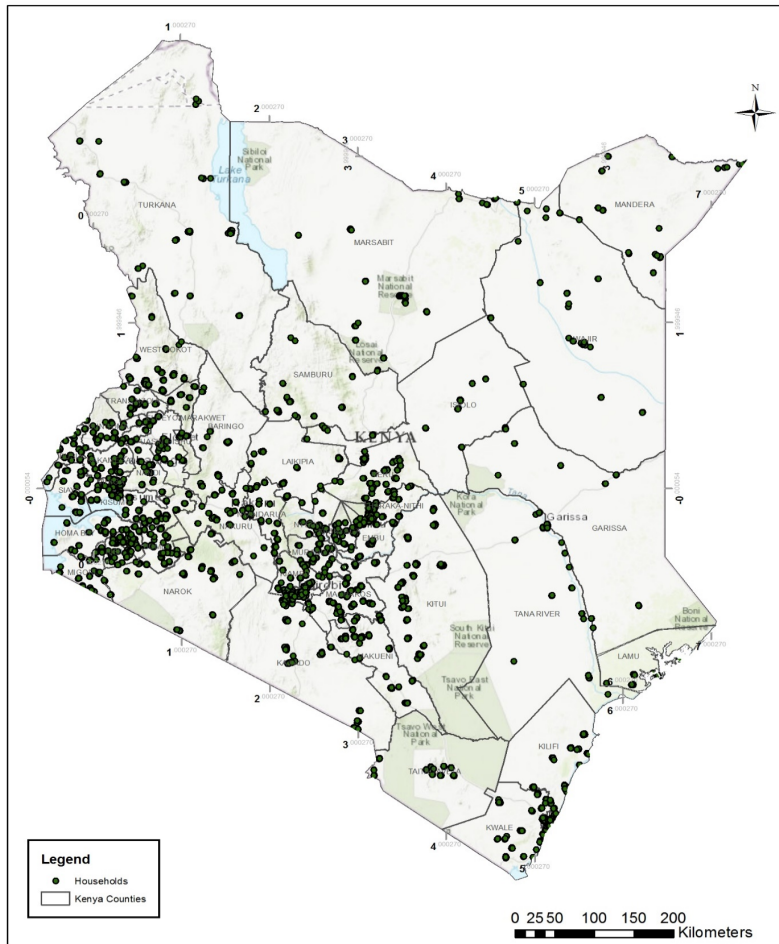
Source: Author's calculation from FinAccess and Geospatial Mapping Surveys 2015.

Figure C.1: Geographical distribution of mobile money agent's outlets.

Table C.1: Effect on expenditure patterns (OLS Estimations)

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Use	3.322***	1.553***	3.448***	0.302**	15.574***
	(0.50)	(0.23)	(0.55)	(0.10)	(2.14)
Financial Literacy	1.523***	0.820***	0.267	-0.019	6.412***
	(0.31)	(0.17)	(0.48)	(0.11)	(1.31)
Income(log)	1.919***	0.749***	0.973***	0.180***	11.375***
	(0.14)	(0.07)	(0.19)	(0.04)	(0.80)
#Informal Groups	1.056***	0.304**	0.571*	0.111	2.263*
	(0.18)	(0.09)	(0.22)	(0.06)	(0.98)
Bank distance(1hr)	-0.376	-0.431*	-0.352	-0.039	-4.421*
	(0.37)	(0.17)	(0.51)	(0.12)	(1.91)
Bank distance(>2hrs)	-0.314	0.060	-1.023	-0.040	-2.504
	(0.52)	(0.22)	(0.62)	(0.15)	(2.62)
Health Centre(1hr)	-0.353	-0.092	-0.280	0.076	-2.244
	(0.36)	(0.21)	(0.61)	(0.14)	(2.31)
Health Centre(>2hrs)	-0.278	-0.272	-0.135	0.236	-3.209
	(0.43)	(0.35)	(0.97)	(0.24)	(2.66)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R-squared	0.263	0.193	0.125	0.104	0.417
Observation	7636	7615	7603	7581	7759

*Note: All outcomes are per adult equivalence in levels and top extremes values are dropped, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.*

Table C.2: Impact on expenditure pattern (IV Estimations)

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Use	20.721***	8.890**	16.491*	1.885	152.280***
	(6.15)	(3.13)	(7.73)	(1.94)	(37.22)
Financial Literacy	0.899*	0.554*	-0.135	-0.071	1.341
	(0.39)	(0.22)	(0.53)	(0.14)	(2.45)
Income(log)	0.989**	0.329	0.258	0.088	3.563
	(0.33)	(0.18)	(0.48)	(0.12)	(2.31)
#Informal Groups	0.588*	0.119	0.171	0.066	-1.888
	(0.26)	(0.11)	(0.33)	(0.07)	(1.47)
Bank distance(1hr)	0.208	-0.181	0.042	0.010	0.183
	(0.46)	(0.19)	(0.58)	(0.12)	(2.74)
Bank distance(>2hrs)	0.352	0.378	-0.470	0.027	3.608
	(0.55)	(0.24)	(0.72)	(0.17)	(3.45)
Health Centre(1hr)	0.110	0.071	0.088	0.114	0.976
	(0.48)	(0.24)	(0.57)	(0.14)	(2.48)
Health Centre(>2hrs)	0.046	-0.193	0.143	0.243	-1.796
	(0.49)	(0.46)	(1.01)	(0.25)	(3.00)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	24.82	28.30	27.67	29.04	24.46
Observations	7636	7615	7603	7581	7759

Note: All outcomes are per adult equivalence in levels and top extremes values are dropped. Logarithm of mobile money agent outlet distance (Kilometers) is used as instrument, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

Table C.3: 2SLS Estimates: Impact on expenditure patterns

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Use	16.666***	8.463***	16.737***	1.676*	123.668***
	(2.01)	(1.14)	(3.49)	(0.65)	(15.55)
Financial Literacy	1.045**	0.570**	-0.143	-0.064	2.402
	(0.33)	(0.19)	(0.50)	(0.11)	(2.08)
Income(log)	1.206***	0.353***	0.245	0.100	5.198***
	(0.15)	(0.08)	(0.23)	(0.05)	(1.09)
#Informal Groups	0.697***	0.129	0.164	0.072	-1.020
	(0.18)	(0.08)	(0.24)	(0.05)	(1.18)
Bank distance(1hr)	0.072	-0.195	0.049	0.004	-0.781
	(0.41)	(0.17)	(0.51)	(0.12)	(2.15)
Bank distance(>2hrs)	0.197	0.359	-0.459	0.018	2.329
	(0.57)	(0.23)	(0.65)	(0.15)	(3.07)
Health Centre(1hr)	0.002	0.061	0.095	0.109	0.302
	(0.42)	(0.23)	(0.60)	(0.14)	(2.27)
Health Centre(>2hrs)	-0.030	-0.198	0.148	0.242	-2.091
	(0.45)	(0.44)	(1.02)	(0.24)	(2.68)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stats	65.54	64.16	70.59	69.59	65.65
J-Hansen P-value	0.48	0.87	0.97	0.90	0.31
Observations	7636	7615	7603	7581	7759

*Note: All outcomes are per adult equivalence in levels and top extremes values are dropped. Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile network available at household level are used as instruments, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.*

Table C.4: First-stage: Determinants of integrated mobile banking

	Panel A: Dependent variable: Mobile Banking Access				
	(1)	(2)	(3)	(4)	(5)
#Network Available	0.132***	0.130***	0.130***	0.134***	0.129***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Mobile money agent outlet	-0.031***	-0.033***	-0.030***	-0.033***	-0.031***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(1hr)	-0.026	-0.025	-0.023	-0.022	-0.026*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(>2hrs)	-0.014	-0.018	-0.018	-0.017	-0.021
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Health Centre(1hr)	-0.019	-0.014	-0.021	-0.017	-0.016
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Health Centre(>2hrs)	-0.006	0.002	-0.009	0.009	0.002
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observation	7636	7615	7603	7581	7759
	Panel B: Dependent variable: Mobile Banking Use				
	(1)	(2)	(3)	(4)	(5)
#Network Available	0.143***	0.144***	0.143***	0.148***	0.141***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)
Mobile money agent outlet	-0.035***	-0.034***	-0.034***	-0.034***	-0.034***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(1hr)	-0.018	-0.017	-0.017	-0.018	-0.020
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(>2hrs)	-0.011	-0.012	-0.014	-0.016	-0.018
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Health Centre(1hr)	-0.027	-0.025	-0.029*	-0.025	-0.025
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Health Centre(>2hrs)	-0.025	-0.022	-0.026	-0.013	-0.019
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observation	7636	7615	7603	7581	7759

Note: Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile networks available at the household level are used as the instruments, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), financial literacy, family size, children aged below 15 years, number of informal group membership, incomes, employed (1= self-employed, employed, 0 otherwise), farming. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

Table C.5: IV Estimations: Impact on agricultural dependents

	Microbusiness	Family Transfer	Education	Health	Consumption
	(1)	(2)	(3)	(4)	(5)
Mobile Banking Access	4.445***	1.264**	3.782**	0.494	19.725***
	(0.96)	(0.46)	(1.13)	(0.32)	(5.03)
Financial Literacy	0.742	0.574	-0.088	-0.193	3.186
	(0.49)	(0.30)	(0.75)	(0.23)	(1.74)
Income(log)	1.665***	0.655***	1.023***	0.150**	7.478***
	(0.20)	(0.12)	(0.26)	(0.06)	(0.87)
#Informal Groups	0.822**	0.395*	0.803	0.042	1.231
	(0.29)	(0.17)	(0.42)	(0.11)	(1.14)
Bank distance(1hr)	-0.007	-0.153	-0.724	0.008	-3.861*
	(0.49)	(0.32)	(0.74)	(0.26)	(1.83)
Bank distance(>2hrs)	0.066	-0.282	-2.597*	-0.147	-5.792
	(0.55)	(0.40)	(1.05)	(0.33)	(3.10)
Health Centre(1hr)	-0.410	0.073	-0.801	-0.110	-0.856
	(0.54)	(0.29)	(0.79)	(0.20)	(2.61)
Health Centre(>2hrs)	-0.945	0.385	0.662	0.066	0.361
	(0.76)	(0.38)	(1.70)	(0.29)	(5.82)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
R-squared	0.299	0.207	0.174	0.168	0.380
Observation	2447	2451	2405	2369	2480

Note: All outcomes are per adult equivalence in levels and top extremes values are dropped, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), family size, children aged below 15 years. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

Table C.6: First Stage-Integrated mobile banking on determinants

	Dependent variable: Mobile Banking Access				
	(1)	(2)	(3)	(4)	(5)
#Network Available	0.120***	0.125***	0.123***	0.125***	0.123***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Mobile money agent outlet	-0.035*	-0.032*	-0.038**	-0.039**	-0.036**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank distance(1hr)	-0.001	-0.001	-0.003	0.000	-0.004
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Bank distance(>2hrs)	-0.026	-0.019	-0.019	-0.024	-0.024
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Health Centre(1hr)	-0.018	-0.011	-0.017	-0.011	-0.007
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Health Centre(>2hrs)	0.012	0.011	0.009	0.026	0.026
	(0.03)	(0.03)	(0.03)	(0.05)	(0.04)
District FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observation	2447	2451	2405	2369	2480

Note: Logarithm of mobile money agent outlet distance (Kilometers) and number of mobile networks available at the household level are used as the instruments, while other controls include age, age squared, marital status, male household head, education levels (none (reference), primary school completed, secondary school and above), financial literacy, family size, children aged below 15 years, number of informal group membership, incomes. All regressions are adjusted for sampling weights; and reported in parentheses are robust standard errors clustered at county levels, with *, **, and *** shows significance level at 1%, 10% and 5%.

Table C.7: Variables definition and units of measurement

Variables	Definitions	Units
Integrated Mobile Banking (IMB)[*]	Equals one if respondent actively uses or has access to IMB, zero otherwise	Dummy
Consumption	Spending on food consumption and non-food consumption	Continuous
Microbusiness	Spending on start-up or expansion capital, stocks and assets acquisition, and formal business registration or operations permit	Continuous
Family Transfer	Spending on non-contributory social benefits such as allowances for household members, and cash benefits	Continuous
Education	Spending on books, tuition fees, school transport and other subsistence	Continuous
Health	Spending on medical emergencies, registrations, and other medical bills	Continuous
Mobile money agent outlets	Distance (in Kilometers) if mobile money agent outlet is the closest financial provider	Continuous
Infrastructural Development	Distance measured in time taken to walk to closest financial provider and health centres	Categorical
Male Head	Equal one if the household head is male, zero otherwise	Dummy
Age	Indicate the age of respondent	Years
Education	Where: none (reference), primary school, secondary school and above	Categorical
Married	Equal one if the respondent is married, zero otherwise	Dummy
Financial Literacy	Equal one if the respondent has knowledge of interest rates, collateral and inflation rate, zero otherwise	Dummy
Family Size	Number of family members living in the household	Discrete
Children	Number of children aged 15 years and below in the household	Discrete
Income	Total household labor incomes from engaging in off-farm or on-farm activities	Continuous
Employed	Equal one if off-farm activities are main sources of income (i.e. formal or informal employment, self-employed), zero otherwise	Dummy
Farming	Equal one if main occupation is farming, zero otherwise	Dummy
Informal group membership	=1 if belongs to merry go rounds, savings or lending, investment clubs, or welfare groups, zero otherwise	Dummy

[*] I use interchangeably integrated mobile banking and mobile banking

CHAPTER 5

INTEGRATED MOBILE BANKING AND HOUSEHOLD

WELFARE INEQUALITY

5.1   Introduction

In the past decade, low-income countries have made substantial progress growing their economies, but this growth has not converted in equal measure in uplifting the welfare of the pro-poor population from the shackles of poverty resulting in widening income inequalities (Adongo & Deen-Swarray, 2006; Allen, Demirguc-Kunt, Klapper, & Peria, 2012; Asongu & Odhiambo, 2017; Tita, Aziakpono, et al., 2017). The Findex database suggests that 74 percent of high-income households across the globe participated in formal financial services, with 61 percent among the low-income households owning a bank account (Demirguc-Kunt, Klapper, Singer, Ansar, & Hess, 2018).

Indeed, increased financial innovations, particularly through integration of mobile financial services with banking systems have steadily spurred financial inclusion in most developing countries and eased access to formal financial services, particularly, to pro-poor populace (Adongo & Deen-Swarray, 2006; Asongu & Odhiambo, 2017; Dabla-Norris, Ji, Townsend, & Unsal, 2015; Law, Tan, & Azman-Saini, 2014; Tita et al., 2017). This disruption of financial services provision impacted by the mobile finance revolution is crucial in addressing the concerns of inclusive development underpinning the Sustainable Development Goals (Jalilian & Kirkpatrick, 2005; Johnson & Nino-Zarazua, 2011; Orotin, Quisenbery, & Sun, 2014; Reeves & Sabharwal, 2013).

In particular, extending financial services to the rural poor can bear impor-

tant effects on economic development and as a poverty reduction tool (Adongo & Deen-Swarray, 2006; Beck, Demirgüç-Kunt, & Levine, 2007; Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008; Burgess & Pande, 2005; Claessens & Perotti, 2007; Demirgüç-Kunt & Klapper, 2012; Sridhar & Sridhar, 2007; Suri & Jack, 2016). Further, expanding access to mobile financial services to spur the financial development agenda and alleviate poverty has become an integral focus across the globe for policymakers and other practitioners (Aggarwal, Demirgüç-Kunt, & Peria, 2011; Alafeef, Singh, & Ahmad, 2012; Blechman, n.d.; Dabla-Norris et al., 2015; Lauer & Lyman, 2015; Sridhar & Sridhar, 2007). Additionally, it has also provided favorable prospects for a solid growth of other financial innovations designed to benefit the poor population (Gruber & Koutroumpis, 2011; Nanziri et al., 2016; Nolen, 2008; Park & Mercado, 2015).

It is understood that a financial system free of financial barriers and comprised of a wide range of financial services can influence behavioral change among the majority in the bottom of the pyramid (Blechman, n.d.; Neaime & Gaysset, 2018; Pal & Pal, 2014; Rosengard, 2016). Therefore, this study explores how mobile banking at the micro-level has contributed to the reduction of income inequalities and wealth acquisition. The objective is to identify the channels through which mobile banking influence the household's decisions on income and wealth acquisition. Specifically, I explore the association between household incomes level and assets composition of financial outcomes. The main research question considers the interrelated literature that has extensively reported on the welfare enhancing, particularly, poverty eradication through financial development.

However, with the growing literature on the impacts of mobile money products at macro and micro-level, little evidence exist in explaining their impacts on assets acquisition and in reducing income disparities. Thus, using micro-data and empirical estimation technique, this study provides detailed, the causal link

of the effect of integrated mobile banking[27] on income and wealth disparities. Additionally, understanding, the impact of financial products' use on poverty, and income inequality provide a guide to policymakers to formulate and implement far-reaching reforms aimed at strengthening the use of and access to financial services at the micro-level and beyond. Therefore, this study extends the literature on access and usage of financial services as a tool to reduce poverty, wealth and income disparities.

5.2 Data Sources

5.2.1 Survey

The empirical analysis for this study draws its data from a cross-sectional household survey FinAccess 2015/2016 administered by Financial Sector Deepening (FSD) Kenya in partnership with Central Bank of Kenya and Kenya National Bureau of Statistics (KNBS). The survey is the fourth nationally representative financial access survey that was conducted in August to October 2015 and designed to periodically assess access and demand for financial services overtime (CBK, 2016). [28]

The survey is collected across thirteen sub-regions and clustered in terms of urban and rural areas. A multi-stage stratification technique was applied to a sample of 8,665 household randomly selected adults aged 16 years old and above from 165 primary sampling units (PSUs).[29] FinAccess 2016 data captures information on household demographic characteristics, household expenditure patterns, sources of household incomes, household access to and product usage of financial services, and other household's characteristics that include assets

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[27]This study uses integrated mobile banking and mobile banking interchangeably

[28]The current and other waves are publicly available from www.fsdkenya.org.

[29]The FinAccess 2015/16 sampling frame was constructed using KNBS NASSEP. Further, I adjust all empirical results using the sample weights provided both at the individual and household level proportion to the total adult population. FinAccess 2015/16 includes geospatial information upon request from FSD Kenya.

ownership, household risks, and vulnerability. I also derived a wealth index of household ownership of durables assets using factor analysis and extract the first-factor loading with the highest variation as the measure of household wealth.

5.2.2   Descriptive Summary Statistics

Table 5.1: Summary statistics (Wealth index indicators)

Variables	Definition	Mean	SD	Factor Loading
House Type	1= permanent; = 0 traditional	0.688	0.463	0.402
House Floor	1=cement, tiled, 0=others	0.308	0.462	0.282
House Wall	1= brick, stone; = 0 mud, wood	0.379	0.485	0.236
Cooking Fuel	1= electricity; = 0 others	0.247	0.431	0.542
Lighting Source	1= electricity; = 0 others	0.466	0.499	0.421
Toilet Type	1= flush toilet; = 0 others	0.219	0.414	0.607
Water Source	1= Piped; = 0 others	0.240	0.427	0.682
Television	1= television; = 0 others	0.308	0.462	0.344
Refrigerator	1= refrigerator; = 0 others	0.055	0.228	0.381
Stove	1= Stove; = 0 others	0.020	0.139	0.560
Iron Box	1= Electric; = 0 others	0.366	0.482	0.636
Kitchen Sink	1=Kitchen Sink; = 0 others	0.063	0.242	0.426
VCD/DVD	1= VCD/DVD; = 0 others	0.227	0.419	0.360
Frying Pan	1= frying pan; = 0 others	0.337	0.473	0.606
Mobile Phone	1= own phone; = 0 others	0.753	0.431	0.798
Car	1=own car, motorcycle; 0 others	0.121	0.326	0.747
Sleeping Rooms	Number of Sleeping rooms	1.576	0.686	0.591

Kaiser-Meyer-Olkin measure of sampling adequacy equals 0.900

Table 5.1 above and Figure D.1 in the appendix shows the mean, standard deviation and factor loadings of various indicators used to measure wealth of an individual. The model of fit for the wealth index is adequately appropriate as indicated by the Kaiser-Meyer-Olkin measure of sampling adequacy, which is greater than 0.6. Use of mobile phone is on average the main item owned by the household. On average majority either have a permanent or semi-permanent house, while households with piped water averaged roughly 24 percent meaning majority get water from open sources.

Also, the majority of the households have more than two bedrooms, which is as typical setting with most of the Kenyan households. About 46.6 percent of

the total sample have electricity as the main source of lighting, this can be explained in part by the concerted efforts by the Government to increase electricity coverage to majority especially in rural areas. The wealth index derived from principal component analysis averaged 37.2 percent with a standard deviation of 0.22.

Table 5.2 presents the summary statistics of the household characteristics. On average users of integrated mobile banking spend roughly KSh 8000 ($8) on average per month for consumption purposes. Majority of households have more than one mobile network services suggesting high penetration of mobile financial services, while most of them live within 1 km radius from a mobile money agent outlet. It is also evident that the majority of households resides within a 30 min walk to a health center or are very close to other financial service providers such as bank.

Since use of integrated mobile banking might be potentially be endogenous I consider using proximity to mobile money agent outlets as an instrument. It is a binary variable assuming a value of one if it take less than 1 km radius to walk to the closest mobile money agent outlet. It is evident from Table 5.2 that majority of individuals resides within a less than 1 km radius to a mobile money agent outlet, while it takes less than 30 minutes to reach other infrastructural developments comprised of health centres and banks. On average, household comprises approximately 4 members, while school going children below the age of 15 years old are on average at least 2 per household.

It is also evident that integrated mobile banking users have younger male heads and are less likely to be married compared to non-users. In terms of the education levels, majority of the integrated mobile banking users have attained secondary or more education compared to non-users who are more likely to have completed primary education, while the remaining percentage were those who reported having no formal education. Financial literacy plays a vital role in the usage of financial products with users of integrated mobile banking reporting to

have high knowledge of interest rates, collateral, and inflation rate. A significant proportion of households exposed to integrated mobile banking are more likely to participate in off-income activities compared to non-users who prefers engaging in farming.

Table 5.2: Descriptive summary statistics

Variables		Mobile Banking								
		Users					Non-Users			
	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max
Dependent Variables: *Expenditures* **('000)**										
Total Consumption (KSh)	1611	80.7	67.88	0	312	6266	42.04	49.65	0	310
Independent Variables										
Mobile money agent outlet (dummy)	1749	0.92	0.26	0	1	6385	0.79	0.41	0	1
Age	1749	32.96	11.1	18	90	6385	40.4	17.48	18	100
Age Squared	1749	12.1	9.03	3	81	6385	19.38	17.11	3	100
Male Head	1749	0.83	0.38	0	1	6385	0.76	0.43	0	1
Married	1749	0.62	0.49	0	1	6385	0.64	0.48	0	1
Family Size	1749	3.75	2.32	1	20	6385	4.33	2.45	1	18
#Children	1749	1.62	1.71	0	15	6385	2.2	1.98	0	15
Primary School	1749	0.18	0.39	0	1	6385	0.22	0.42	0	1
Secondary School	1749	0.33	0.47	0	1	6385	0.14	0.35	0	1
Financial Literacy	1749	0.81	0.39	0	1	6385	0.67	0.47	0	1
Total Income (KSh)	1749	276.39	506.93	0	6870	6385	141.5	1702.8	0	151500
Farming	1749	0.34	0.47	0	1	6385	0.49	0.5	0	1
Employed	1749	0.86	0.35	0	1	6385	0.62	0.49	0	1
Bank distance(<30min)	1747	0.76	0.43	0	1	6269	0.53	0.5	0	1
Bank distance(1hr)	1747	0.18	0.39	0	1	6269	0.27	0.45	0	1
Bank distance(>2hrs)	1747	0.06	0.24	0	1	6269	0.2	0.4	0	1
Health Centre(<30min)	1749	0.87	0.34	0	1	6385	0.72	0.45	0	1
Health Centre(1hr)	1749	0.11	0.31	0	1	6385	0.21	0.41	0	1
Health Centre(>2hrs)	1749	0.02	0.15	0	1	6385	0.07	0.26	0	1

5.3   Identification Strategy

To explore the effects of integrated mobile banking on income and wealth distribution across different quantiles, I exploit the instrumental variable of quantile treatment effect approach documented by Chernozhukov and Hansen (2005), Fröolich and Melly (2010) and in Abadie, Angrist, and Imbens (2002), to account for endogeneity arising from systematic differences due to use of mobile banking financial services. Thus assuming a linear function of the form:

$$Y_i = f(M_i, X_i, \epsilon_i) \qquad (5.1)$$

Where Y_i is the outcome of interest measured by household expenditue per adult equivalence and wealth index, M_i is a dummy variable assuming a value of one if the respondent has access or uses mobile banking, 0 otherwise; X_i is a vector of covariates influencing the outcome variables and comprises of gender, age, marital status, financial literacy, number of children aged below 15 years old, completed education levels, incomes, occupation status (farmer, employed and dependent), and proximity to infrastructural developments, while ϵ_i is the disturbance error term assumed to be normally distributed at mean zero. Furthermore, I derived a linear quantile treatment effect as follows:

$$Y_i^m = X_i\beta^\tau + M_i\delta^\tau + \epsilon_i \quad ; \quad \text{and} \quad Q_{\epsilon i}^\tau = 0 \qquad (5.2)$$

where i=1,...,n and M $\in$(0,1), while β^τ and δ^τ, are the unknown parameters of the model, with δ^τ representing unconditional quantile treatment effects τ. Also, $Q_{\epsilon i}^\tau$ is defined as the τth quantile of an unobserved error term ϵ_i. From equation (5.1) vector M_i is assumed to be potentially endogenous and follows:

$$M_i = \phi(Z, u) \qquad (5.3)$$

Where, Z_i is a vector of excluded instrument correlated with the treatment variable, and not correlated with othe outcome of interest, and u, is a scalar of the error term. The aim is to identify the distributional impact of M_i on potential outcome variable Y_i (continuous variable). Given that both M_i and Z_i are dummies, and such that Y_i^1 and Y_i^0 are the potential outcome for the individual *i*, where superscript, 1=user and 0=non-user of mobile banking, then the quantile treatment effect for τ^{th} quantile corresponding to the distributional effect of mobile banking follows:

$$\Delta^\tau = Q^\tau_{Y_i^1} - Q^\tau_{Y_i^0} \tag{5.4}$$

M_i is endogenous and can only be identified through the instrumental variable, Z_i. Therefore, allowing the M_i to be arbitrarily heterogeneous, then it follows that the impact is identified for the population that complied to changes in the instrument Frölich and Melly (2013). Thus, the quantile treatment effect for the compliers (c) is given as:

$$\Delta^\tau = Q^\tau_{Y_i^1|c} - Q^\tau_{Y_i^0|c} \tag{5.5}$$

Where Δ^τ_c is a partial unconditional effect of mobile banking use, given that the condition applies only to the compliers and excludes other covariates. Therefore, the overall bivariate quantile regression estimator is derived using the optimization problem following Frölich and Melly (2013) is given by:

$$(\alpha_{iv}, \ \Delta^\tau_{iv}) = arg \ \min_{\alpha,\Delta} \ \sum \omega_i \ \rho_\tau(Y_i - \alpha - M_i\Delta) \tag{5.6}$$

Given that,

$$\omega_i = \frac{Z_i - pr(Z = 1|X_i)}{pr(Z = 1|X_i)(1 - pr(Z = 1|X_i))}(2M_i)$$

Where ω_i are nonnegative weights that provide balances between the distribution of the covariates for mobile bank user and non-users.

5.4 Empirical Results

In the spirit of Blaylock and Smallwood (1982) the study motivates the empirical findings using Lorenz curve approach, which examines the proportion of the entire wealth or expenditure that is accounted for by a certain fraction of the total household.
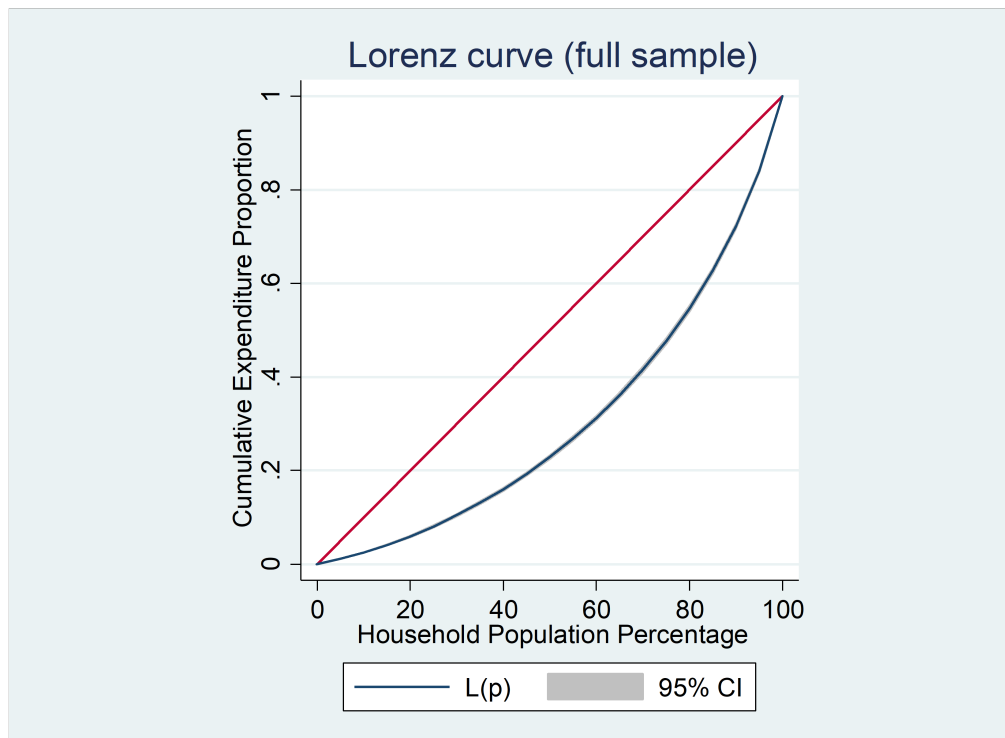

Figure 5.1: Lorenz Curve for total household's expenditure

Figure 5.1 above indicates the Lorenz curve for the entire household's expenditure distribution and it is evident that roughly 40 percent of the total households in the data share less than 20 percent of the cumulative expenditure of the entire population. While, Figure 5.2 below indicates that the expenditure distribution for accessibility of integrated mobile banking is somewhat less unequal compared to that of non-users, which is an indication of the re-distributive effect of income of the households. Incomes equalize slightly above 40 percent where the two curves separate from each other.
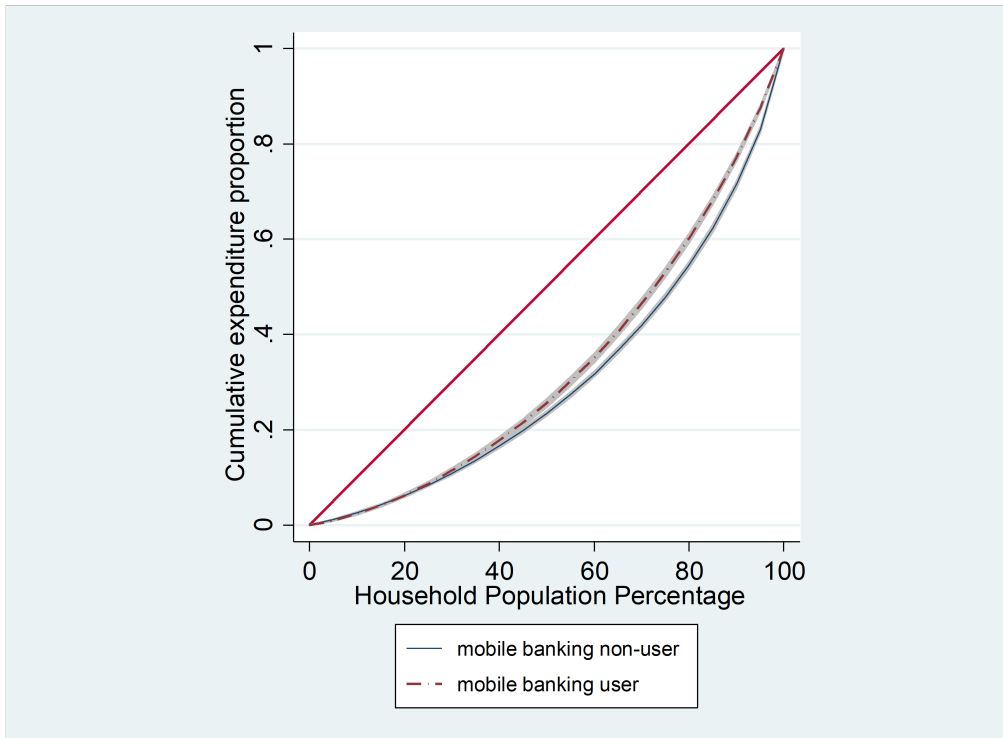
Figure 5.2: Lorenz Curve by mobile banking status

In support of this Figure 5.2 above indicates how household consumption is distributed across different quantiles for integrated mobile banking users and non-users. It is evident that the bottom 90 percent are moderately better off if exposed to mobile banking, while the top 10 percent are fairly worse off. The corresponding Gini coefficient shown in Figure D.2 is more than 50 percent for non-user of mobile banking suggesting that exposure to mobile banking improves household's consumption levels.
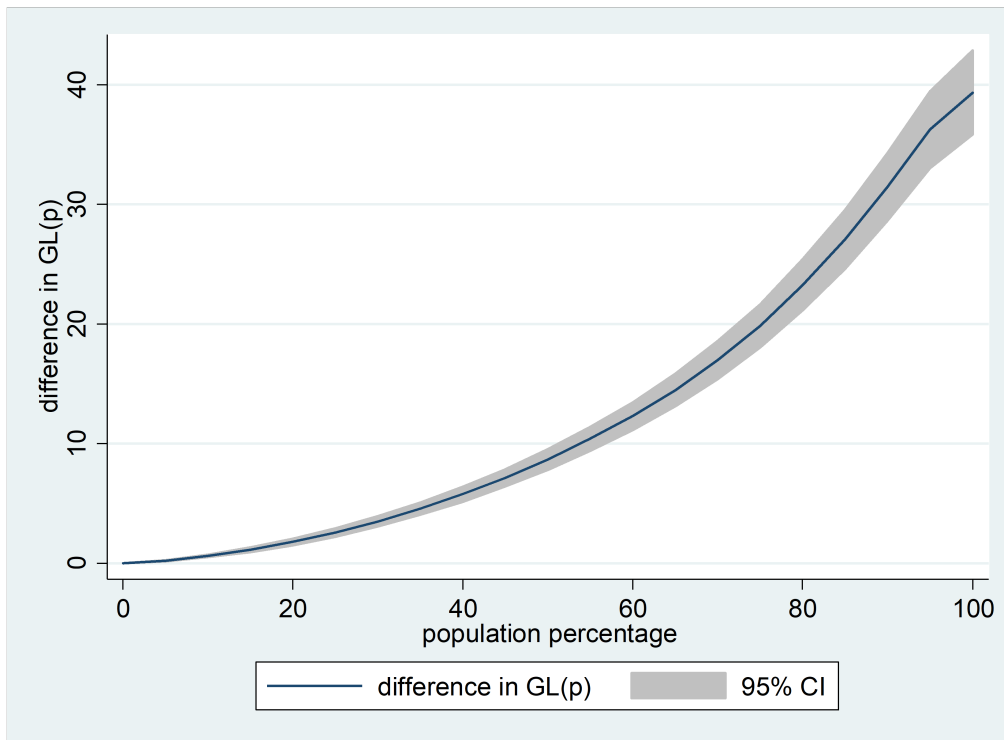
Figure 5.3: Welfare ordering of Lorenz curve

Figure 5.3 above shows cumulative mean expenditure for users and non-users of mobile banking. Figure 5.3 suggest that expenditure distribution of users of mobile banking is less equal compared to non-users of mobile banking. That is, expenditure distribution of users of mobile banking dominates the expenditure distribution of non-user, thus it is more desired from a welfare point of view.

5.4.1 Main Findings

Table 5.3 and Table 5.4 reports the empirical analysis of unconditional instrumental variable treatment effect following (Frölich & Melly, 2013). Table 5.3 below results suggest that access to integrated mobile banking increases household consumption in all expenditure distribution though not uniformly distributed across all income levels. For instance, the coefficient for expenditure at 75th and 90th quantiles are high than that of the 10th and 50th quantiles. The effect of mobile banking on income seems to be higher at the top 20th quantile level, suggesting financial inclusion through integrated mobile banking significantly

affect the top half households compared to bottom poor.

Table 5.3: Effect of integrated mobile banking on income inequality

	Dependent Variable: Household Consumption				
Variables	q10	q25	q50	q75	q90
Mobile Banking	0.742***	0.824***	0.894***	0.950***	1.052***
	(0.11)	(0.08)	(0.07)	(0.07)	(0.14)
Age	0.033**	0.038**	0.043***	0.026**	0.010
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Age Squared	-0.038***	-0.044**	-0.046***	-0.028**	-0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Family Size	-0.239***	-0.212***	-0.180***	-0.146***	-0.076*
	(0.06)	(0.03)	(0.02)	(0.02)	(0.03)
#Informal Groups	0.097**	0.115***	0.080***	0.051*	0.014
	(0.04)	(0.03)	(0.02)	(0.02)	(0.03)
#Children	0.045	0.014	-0.024	-0.035	-0.092
	(0.06)	(0.04)	(0.02)	(0.03)	(0.05)
Male Head	0.009	0.023	0.035	0.071	0.087
	(0.09)	(0.08)	(0.06)	(0.08)	(0.11)
Married	0.109	0.029	0.017	-0.064	-0.046
	(0.09)	(0.06)	(0.06)	(0.07)	(0.08)
Primary School	-0.044	-0.176**	-0.134*	-0.140*	-0.146
	(0.10)	(0.07)	(0.07)	(0.06)	(0.10)
Secondary School	0.025	0.043	0.008	0.005	0.065
	(0.08)	(0.06)	(0.05)	(0.05)	(0.09)
Financial Literacy	0.199	0.061	0.047	0.016	0.048
	(0.12)	(0.08)	(0.06)	(0.06)	(0.10)
Farming	0.331*	0.112	0.008	-0.065	0.034
	(0.16)	(0.12)	(0.08)	(0.11)	(0.16)
Employed	0.541***	0.312**	0.214**	0.182*	0.161
	(0.15)	(0.10)	(0.07)	(0.08)	(0.16)
Controls	No	No	No	No	No
Observations	7759	7759	7759	7759	7759

*Note: Dependent variables: logarithm of total household consumption per adult equivalence, while other controls includes distance to infrastructural development and proximity to the closest mobile money outlets dummy serves as an instrument for mobile banking. Robust standard errors are reported in parentheses. *, ** and *** represent significant at 5%, 10%, and 1%.*

5.4.2   Robustness check

Table 5.4 reports the effect of integrated mobile banking on wealth distribution. The findings suggest that access to integrated mobile banking increases the likelihood of wealth disparities between the 10th and 90th quantiles from 16.2 percent to 39.4 percent. That is the wealthier an individual is the more they accumulate wealth.

Overall, improving financial inclusion through integrated mobile banking could potentially widen individual's income inequalities and wealth disparities between the bottom 10th and 90th quantiles.

Table 5.4: Effect of integrated mobile banking on wealth inequality

Variables	Dependent Variable: Wealth Index				
	q10	q25	q50	q75	q90
Mobile Banking	0.162***	0.213***	0.293***	0.367***	0.394***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)
Age	-0.002*	-0.002*	-0.002	-0.002	-0.003
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age Squared	0.002*	0.002*	0.002	0.002	0.004
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Family Size	0.005	0.008**	0.015***	0.026***	0.041***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
#Informal Groups	0.012*	0.019***	0.017***	0.017*	0.007
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
#Children	-0.010*	-0.016***	-0.024***	-0.034***	-0.045***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Male Head	-0.023*	-0.018	-0.016	-0.014	-0.007
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Married	0.002	-0.000	0.001	0.000	-0.011
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Primary School	0.004	-0.008	-0.023*	-0.032*	-0.042
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Secondary School	0.051***	0.044***	0.040***	0.031	0.033
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Financial Literacy	0.015	0.024**	0.034***	0.026	0.016
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Farming	-0.045***	-0.057***	-0.076***	-0.110***	-0.165***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.04)
Employed	-0.028*	-0.019	-0.026	-0.046*	-0.070*
	(0.01)	(0.01)	(0.02)	(0.02)	(0.04)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	8016	8016	8016	8016	8016

Note: Dependent variable in all estimations: wealth index, while other controls includes distance to infrastructural development and proximity to the closest mobile money outlets dummy serves as an instrument for mobile banking. Robust standard errors are reported in parentheses. *, ** and *** represent significant at 5%, 10%, and 1%.

5.5 Conclusion

This study sought to explore the distributional effect of integrated mobile banking on income inequality and wealth disparities at different quantiles. The findings on the effect of integrated mobile banking on income suggests integrated mobile banking significantly affect the top half quantile households compared to bottom poor. Similarly, access to integrated mobile banking services widens wealth disparities between the bottom 10th and 90th quantiles. These suggest that access to integrated mobile banking services disproportionately benefits individuals at the upper quantile who are richer than those who falls in the lower quantiles and are likely to be poor.

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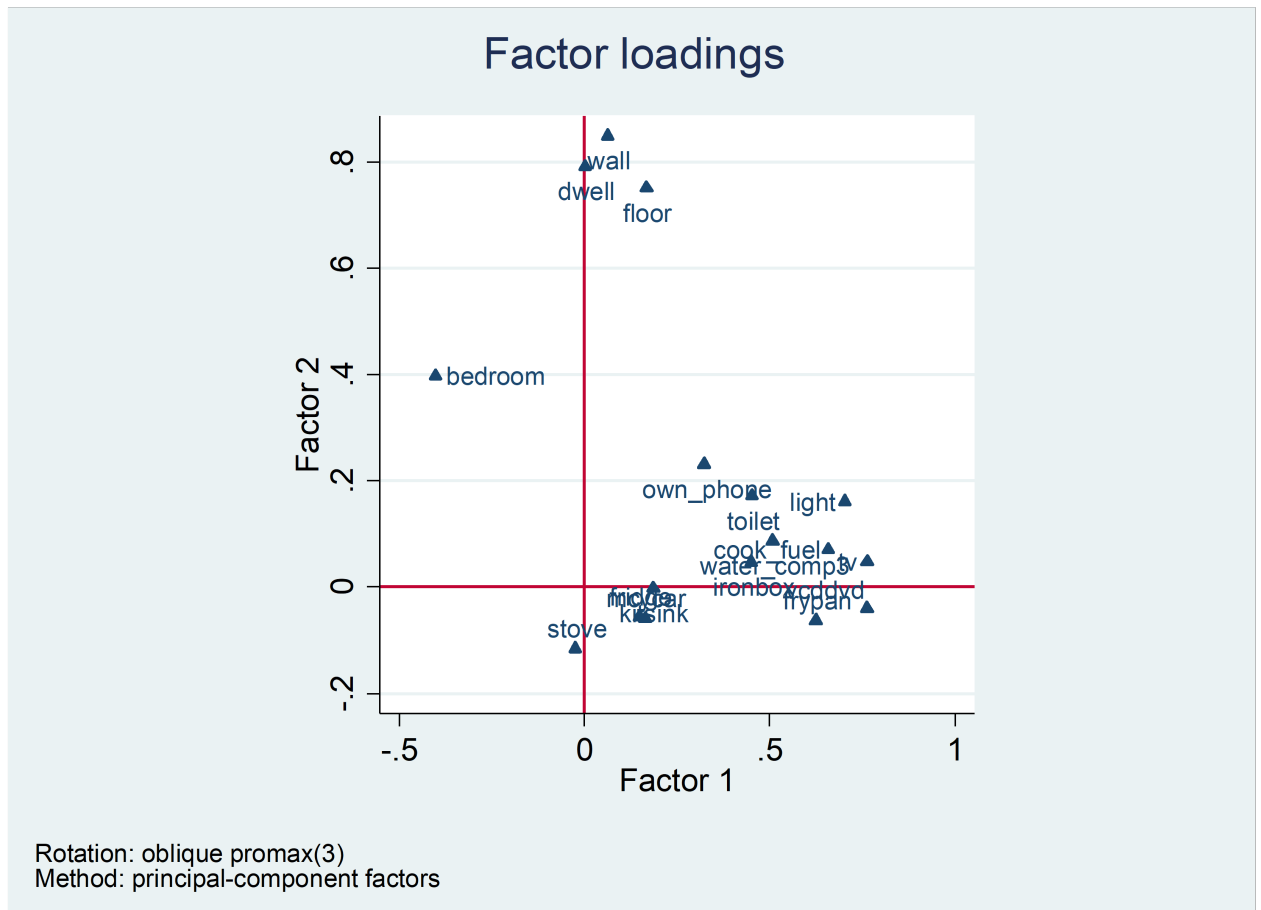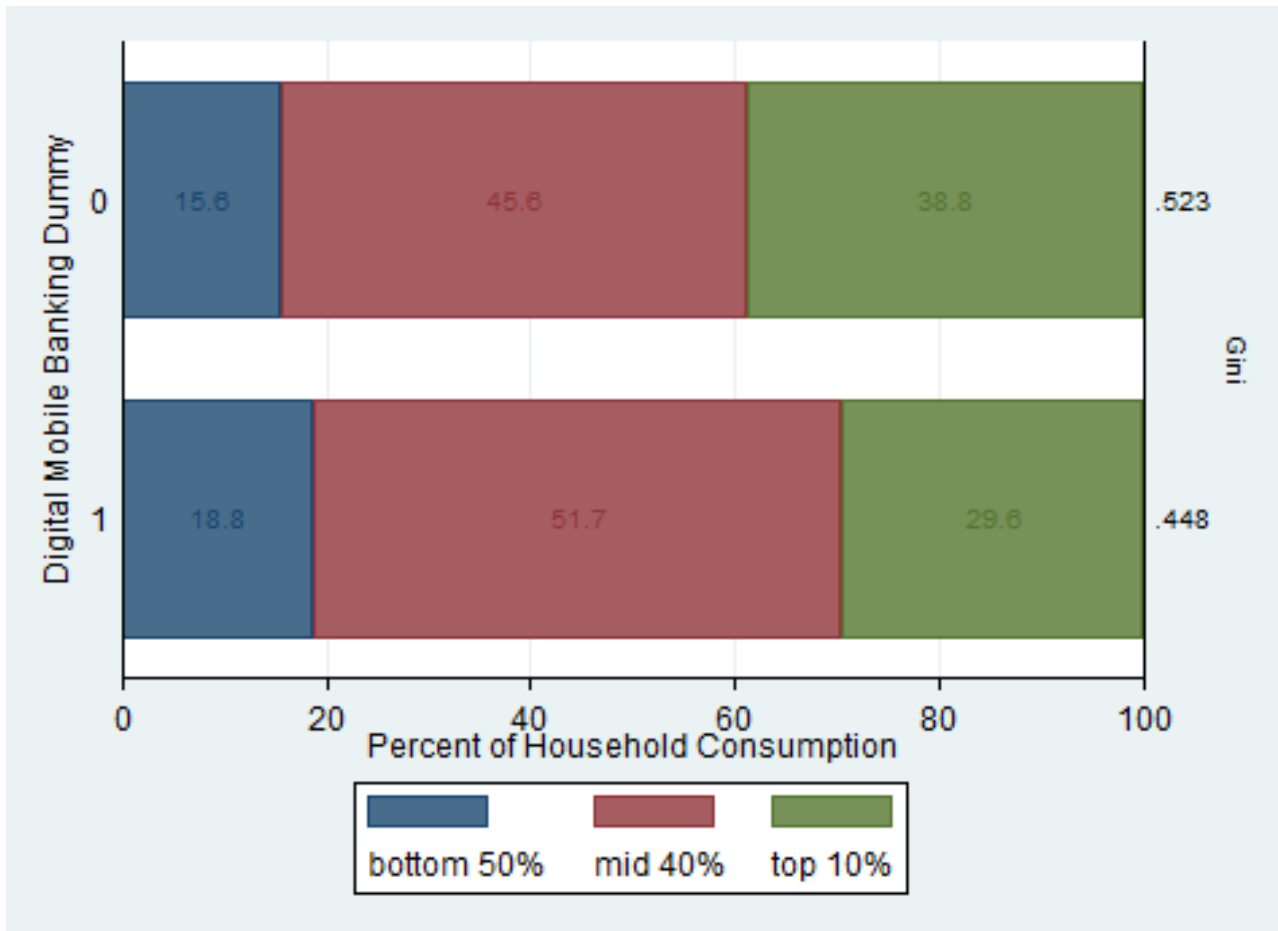
Figure D.1: Wealth Index Factor Loadings

Figure D.2: Percentile share for household's consumption

Table D.1: Variables definition and units of measurement

Variables	Definitions	Units
Integrated Mobile Banking (IMB)[*]	Equals one if respondent actively uses or has access to IMB, zero otherwise	Dummy
Consumption	Spending on food consumption and non-food consumption	Continuous
Wealth Index	First principal component of household assets composition	Continuous
Mobile money agent outlet	Equal one if it take less than 1 km radius to walk to a mobile money outlets	Dummy
Infrastructural Development	Distance measured in time taken to walk to closest financial provider and health centres	Categorical
Male Head	Equal one if the household head is male, zero otherwise	Dummy
Age	Indicate the age of respondent	Years
Education	Where: none (reference), primary school, secondary school and above	Categorical
Married	Equal one if the respondent is married, zero otherwise	Dummy
Financial Literacy	Equal one if the respondent has knowledge of interest rates, collateral and inflation rate, zero otherwise	Dummy
Family Size	Number of family members living in the household	Discrete
Children	Number of children aged 15 years and below in the household	Discrete
Income	Total household labor incomes from engaging in off-farm or on-farm activities	Continuous
Employed	Equal one if off-farm activities are main sources of income (i.e. formal or informal employment, self-employed), zero otherwise	Dummy
Farming	Equal one if main occupation is farming, zero otherwise	Dummy

[*] I use interchangeably integrated mobile banking and mobile banking

CHAPTER 6

CONCLUSION

6.1   Conclusion

Access to financial services primarily in the developing world has recently gained prominence as an effective policy tool for achieving sustainable development. Conversely, increased financial restructuring witnessed in developing countries, particularly mobile money revolution in Kenya, provides an enabling environment for financial product development. Further, the accessibility, diversity, and ease of use of integrated mobile banking services combined with the intrepid offering of diverse financial services have transformed the formal banking system in Kenya. Integrated Mobile banking services have indeed been a driver for financial growth in Kenya, especially for the underbanked and unbanked population. It has also been a catalyst for growth in other formal financial services.

Chapter 3, sought to explore the relationship between integrated mobile mobile banking and the demand for loans and savings. The study further examined other channels through which integrated mobile mobile banking could influence savings and credit uptake. Following similar empirical evidence from Demombynes & Thegeya, 2012; Ky, et. al, (2017); and Munyegera & Matsumoto (2018) I find significant evidence that mobile banking enhances financial inclusion through increasing access to formal financial services such as participating in the credit market and in facilitating savings. I find that integrated mobile mobile banking enables individuals to make future plans through increased investments in productive activities, while consumption seems not a major reason for its adoption. Further, the results suggest that enhanced access to integrated

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mobile banking can lead to increased use of other existing formal financial institutions and could act as a substitute for informal financial institutions (see similar undertakings by Jack & Suri, 2014; Johnson & Nino-Zarazua, 2011; and Mbiti & Weil, 2011).

These findings provide a better understanding of how integrated mobile mobile banking services can bridge the gap between the users and non-users, while providing a better option through which individuals can gain access to other forms of financial services, thereby increase their consumption and investment in productive activities.

Chapter 4, This study uses micro-level data from a developing country to examine whether integrated mobile banking influences household spending behavior, particularly on physical and human capital investment as well as family transfers. The findings suggest that integrated mobile banking services have a significant positive effect on household demand for productive activities beyond total consumption. Overall, financial inclusion through access to and utilization of integrated mobile banking services enables households to divert a higher share of total consumption on micro-enterprises, education, family support, while I find no empirical evidence on health expenditure. The findings are in line with Apiors & Suzuki (2018) who finds positive effect on mobile money payments on expenditures pattern in rural Ghana.

Chapter 5, results contribute to the growing literature on the impact of mobile financial services on household income and wealth inequalities. The effect of integrated mobile banking on income seems to be higher at the top 20th quantile level, suggesting financial inclusion through integrated mobile banking significantly affect the top half households compared to bottom poor and top rich individuals. On contrary, integrated mobile banking widens wealth disparities between the bottom 10th and 90th quantiles, suggesting access to integrated mobile banking services disproportionately benefits richer than the poor.

These findings provide empirical evidence that can inform policy directions

for sustainable development on the role of financial inclusion through increased access to and utilization of integrated mobile banking services on income and wealth inequality. This could be attributed to improved income levels as well as robust financial institution reforms tailored towards benefiting the poor.

6.2 Policy Implications

As a result of an accommodating and a forward-looking regulatory environment, particularly the supportive role the CBK has played in nurturing the financial system from its infancy; the mobile financial services in Kenya should expect to see continued growth and an increasing role in Kenya's effort to achieve a deepened financial inclusion and improve its economy's competitiveness. This friendly business environment will further provide incentive to the industry to become more efficient and bring about more innovation.

Further, the study findings suggest that whereas there have been remarkable achievements in mobile finance in enhancing service delivery there is need to sensitize the excluded population who are deprived of formal financial services on importance of using integrated mobile banking, which could expand their savings and credit uptake base. This can be achieved by developing mobile financial product interfaces that are users friendly, secure and affordable.

It is therefore important to formulate and implement policies tailored towards promoting public-private partnership for inclusive financial development through diversifying financial products. Additionally, to improve the welfare of poor population new strategies such as increased funding in research and development and sensitization of new financial products in the market should be intensified.

Encourage frequent knowledge-sharing channels through which mobile money service providers and regulators can evaluate the deployment of mobile financial services to enhance services delivery as well as protect consumers. With

continuous collaboration between MVNOs and regulators, further depth in the development of the market could be experienced. Regulators in being dynamic, and keeping up with the speed of change in the industry must be strict yet moderate enforcing regulations in order not to stifle creativity in the fledgling industry.