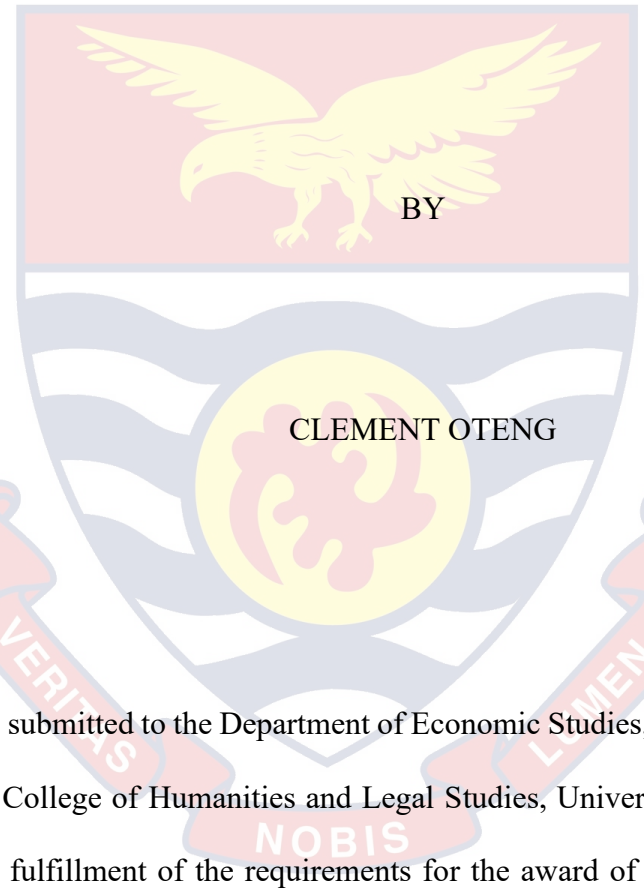
UNIVERSITY OF CAPE COAST

MOBILE MONEY, INCOME AND WELFARE OF SMALLHOLDER FARMERS IN SELECTED DISTRICTS IN GHANA



BY

CLEMENT OTENG

Thesis submitted to the Department of Economic Studies, School of Economics of the College of Humanities and Legal Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Economics.

AUGUST 2019

DECLARATION

Candidates Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature …… Date ……

Name: Clement Oteng

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature……..… Date ……

Name: Dr. James Atta Peprah

Co-Supervisor's Signature……Date ……

Name: Dr. Benedict Afful Jr.

ABSTRACT

Mobile money offers promising ways of making financial services available to rural smallholder farmers but little is known in the Ghanaian context. The study adopts a quasi-experimental design to analyse the impact of mobile money on income and welfare of 460 smallholder farmers from Abura-Asebu-Kwamankese, Adansi South, and Shama districts in Ghana. The study utilises the propensity matching scores (PSM) and the inverse probability weighting (IPW) estimation techniques to analyse the impact of mobile money adoption among these smallholder farmers. The study finds that accessibility of mobile money significantly drives mobile money adoption. Also, the study finds that, mobile money adoption has significant positive impact on both income and welfare among smallholder farmers in the study areas. Based on the results, the study recommends that mobile money network operators should encourage people to become agents in the rural farming communities of Ghana. Again, education on mobile money should form integral part of the extension services provided to smallholder farmers.

KEY WORDS

Adoption

Ghana

Income

Mobile money

Smallholder farmers

Welfare

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisors, Dr. James Atta Peprah and Dr. Benedict Afful Jr. both of the School of Economics, University of Cape Coast, for their unreserved guidance that saw to the completion of this work.

I would also like to thank DRIC for financing this and for generous support to make this work better and providing an enabling environment that led to the successful completion of this study. Thanks to Prof. Samuel Kobina Annim (Former Director, DRIC, UCC).

I am also very appreciative to AERC for the support and funding of JFE 2018 and to all the lecturers of the School of Economics.

I would also like to thank my mother, Mercy Kyeremaah, uncles, Mr. George Oteng, Hon. Yaw Ntow Ababio, DSP (rtd) Patrick Kofi Asante, and my siblings for their support towards my education.

Last and very importantly, I am appreciative to all Economics students, and friends especially Ellen Anima Boadi, James Amoah Edusei, Isaac Kwame Amoah-Ahinful, Agyiri Sally Agnes, and my programme mates for their support during the writing of this thesis and my whole study period.

DEDICATION

To my uncles: Mr. George Oteng, Hon. Yaw Ntow Ababio, and DSP (rtd) Patrick Kofi Asante

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMYS

AAK	Abura-Asebu-Kwamankese
AME	Average Marginal Effect
ATET	Average Treatment Effect of the Treated
AVCF	Agricultural Value Chain Financing
BoG	Bank of Ghana
CGAP	Consultative Group to Assist the Poor
DRIC	Directorate of Research, Innovative and Consultancy
FAO	Food and Agriculture Organization
FBOs	Farmer Based Organizations
GSMA	Global System for Mobile Communications
GLSS	Ghana Living Standard Survey
GoG	Government of Ghana
GSS	Ghana Statistical Service
IDT	Diffusion of Innovation
ISSER	Institute of Statistical, Social and Economic Research
IPW	Inverse Probability Weighting
IRB	Institutional Review Board
IV	Instrumental Variables
KBM	Kernel Based Matching
MMM	Mahalanobis Metric Matching
MFIs	Micro Finance Institutions
MEA	Marginal Effect at Average
MER	Marginal Effect at Representative Value
MNOs	Mobile Network Operators

MoFA	Ministry of Food and Agriculture
MoMo	Mobile Money
NCA	National Communication Authority
NNM	Nearest Neighbour Matching
PEOU	Perceived Ease of Use
POM	Potential-Outcome Means
PPP	Public Private Partnership
PSM	Propensity Score Matching
RM	Radius Matching
SDGs	Sustainable Development Goals
SME	Small-Medium Enterprise
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
WB	World Bank
WCF	World Cocoa Foundation

CHAPTER ONE

INTRODUCTION

This chapter gives the background to the study, statement of the problem, objectives of the study, and research hypotheses. It further covers the significance of the study and how the chapters are organized.

Background to the Study

Ghana is making tremendous progress in ensuring financial inclusion for all its citizens. In recent years, financial inclusion has almost doubled from 29 percent to 58 percent (Demirguc-Kunt, Klapper, Singer, Ansar, & Hess, 2018; Ghana Statistical Services, GSS, 2018). In spite of this growth, disparities in financial inclusion also continue to exist among subpopulations in Ghana. About 50 percent of person living in urban areas have access to a bank account as compared to 28 percent in rural areas (Consultative Group to Assist the Poor [CGAP], 2015).

The rural areas tend to have low penetration rate due to high risk as compared to the urban areas. Among the rural dwellers, smallholder farmers are most disadvantaged. This is because smallholder farmers have low levels of education that discourage them to patronize banking services and also, their inability to save due to low levels of income (Okello, Ofwona-Adera, Mbatia, & Okello, 2010). Other reasons include location of financial institutions, lack of collateral to qualify them for loans, and other covariate and idiosyncratic risk (Okello et al., 2010; Poulton, Kydd & Dorward, 2006).

Consequently, smallholder farmers tend to produce small volumes of output that exclude them from participating in better-paying markets that require large volumes of output (Barrett, 2008). The inability of smallholder farmers to access financial services is one of the major impediments to commercialization of smallholder agriculture in Ghana (Asante, Osei-Asare, & Kuwornu, 2016). Lack of capital limits smallholder farmer's ability to purchase productivity-enhancing inputs (seeds, fertilizers, and pesticide) (Nyoro, 2002). Indeed, smallholder farmers' inability to invest in productivity enhancing inputs due to lack of agricultural finance is the reason such farmers remain untraded and are trapped in low equilibrium poverty trap (Barrett, 2008). There is therefore the need to help smallholder farmers increase output to increase income and improve welfare.

The need to improve smallholder agriculture production has historically led to innovative ways to make access to financial services and agricultural financing to farmers to address the constraints farmers face. Among these models are interventions providing agricultural finance to farmers in groups and attempting to use the Grameen Lending Model (finance to farmers in groups) (Zeller & Sharma, 2000) and the establishment of credit and microfinance platforms based on collateralized lending (Zeller & Sharma, 2000). Other models link farmers to formal agricultural finance markets through flexible lending systems that allow recovery of loan from sales (interlinked credit scheme) (Gine, 2009). These models have limited successes due to high transaction costs of delivering the services to small and widely scattered farmers, high covariate risks, missing markets for managing weather and market risks, and the lack of suitable collateral (Okello et al, 2010). There is, therefore,

the need to use more advanced technology that makes financial services more readily available to these farmers.

The advancement in technology and telecommunications has the potential to make financial transactions more accessible and affordable for the unbanked and the under-served rural people who engage in farming activities. With digital platforms such as mobile phones, smallholder farmers have the opportunity to use financial services without having to visit a bank branch (Kirui, Okello, & Nyikal, 2010). Mobile ecosystem payments and agent networks offer payment solutions with regards to payment of inputs and household expenses, access to credit and payment of loans to rural agricultural household.

In this regard, mobile money (MoMo) is seen as a mechanism designed for poverty reduction and social empowerment to provide financial access and credit to the poor rural farming communities. There are various ways through which MoMo impacts well-being. These include profit level, income, expenditure on food, healthcare and education, or asset. Others are, housing, job creation, and food security (Furuholt & Matotay, 2011; Martin & Abbott, 2011). Hence, MoMo supports informal sectors that often have low returns and low market demand (Feder, Lau, Lin, & Luo, 1990) as well as smallholder farmers who are left out of the formal financial system.

Due to these, MoMo is gradually becoming a major means of payment for the unbanked and the underserved populaces in Ghana (Boateng, 2011). For policy purposes and in the face of high MoMo adoption rate of 70 percent (National Communication Authority, 2016) an assessment of how MoMo

adoption enhances income and welfare of smallholder farmers will justify its upscale and extension.

Statement of the Problem

Many rural farmers in Ghana face many challenges, including limited access to financial services. As a result of this, economic hardship such as low produce (most of them are subsistence farmers), high level of rural-urban migration, poverty, low standard of living, among others, have become part of them. Without access to financial services, these rural farmers easily fall prey to the pressures of their families and neighbours, and to their own temptations. Importantly, saving seems crucial to break the cycle of low investment and low agricultural productivity. Providing enabling environment for savings may be part of the solution to this developmental challenge of which MoMo plays a key role.

MoMo services render a smooth pathway for money transfers to the unbanked yet MoMo services are still poorly operated including the products. There is, therefore, the need to empirically answer some questions to guide policy on the welfare impact of MoMo services (Aker & Mbiti, 2010). Some studies focus on the impact of mobile phones in general on household welfare (Jensen, 2010; Aker, 2011). However, so much is still desired with regards to the Sustainable Development Goals (SDGs) focus areas of significant importance, for instance, zero poverty at all its forms that are directly impacted by MoMo services.

To this effect, studies such as Kikulwe, Fischer, and Qaim (2014), Sekabira and Qaim (2016), and Cobla and Osei-Assibey (2018) analyse the

impact of MoMo on income and welfare but there is endogeneity associated with the adoption of MoMo of which these studies fail to address.

To address the issue of endogeneity of MoMo, studies such as Jack and Suri (2014) Aker, Boumnijel, McClelland, and Tierney (2011), Suri, Jack, and Stoker (2012), and Kirui, Okello, and Nyikal (2012a, 2012b) utilise single econometric models such as propensity score matching and instrumental variable estimation techniques. The disadvantage of using a single model is that the estimates are not robust enough because each model has its own limitations which cannot be individually corrected. For example, selection of instruments associated with instrumental variable estimations. Also, all these studies are discerning but concentrate on the impact of MoMo services in general without specificity on rural smallholder farmers. Again, there is little literature on the impact of MoMo adoption on smallholder farmers in Ghana.

To fill this gap, unlike most previous studies, this study uses the most recent (2018) survey data and two different econometric approaches— (1) propensity score matching (PSM) and (2) inverse probability weighting (IPW) models in its impact analyses of the adoption of MoMo on rural smallholder farmers in the Abura-Asebu-Kwamankese (AAK), Adansi South, and Sharma districts in Ghana.

The Purpose of the Study

This study seeks to analyse the impact of MoMo adoption as a financial inclusion on income and welfare of smallholder farmers in selected districts in Ghana.

Research Objectives

The general objective of this research is to analyse the impact of MoMo adoption on smallholder farmers in selected districts in Ghana. Specifically, the study seeks to:

- analyze the influence of accessibility of MoMo on the adoption of MoMo;
- assess the impact of MoMo adoption on income of smallholder famers and
- evaluate the impact of the adoption of MoMo on smallholder farmers' welfare.

Hypotheses

- **H_A**: MoMo accessibility has significant influence on the adoption of MoMo among smallholder farmers
- **H_A**: MoMo adoption significantly increases income of smallholder farmers
- **H_A:** MoMo adoption has significant positive impact on the welfare of smallholder farmers.

Significance of the Study

The findings of this study will provide appropriate ways of designing suitable MoMo products for the rural smallholder farmers as most of them have mobile phone and access to telecommunication services is available in almost every part of Ghana.

Secondly, the study will offer recommendations to the telecommunication industry and MoMo operators to broaden their services to rural smallholder

farmers such as knowledge of how to borrow from MoMo wallet which will improve the welfare of the rural farmers in Ghana.

Delimitation

This study focuses on MoMo adoption among rural smallholder farmers in AAK, Adansi South, and Sharma districts in Ghana. It also focuses on MoMo adoption and its impact on income and welfare of these farmers.

Organisation of the study

The study is organised into six chapters. Chapter Two outlines smallholder farming and access to financial services. Chapter Three presents a review of the relevant literature, discussing the various theoretical frameworks, and review of empirical literature. The fourth chapter reveals the research design, study area, population, sampling procedure, data collection instruments and procedures, and data processing and analyses. Chapter Five presents the major findings of the study discussing the key results of the study in relation to the literature. Chapter Six outlines the major conclusions of the study and recommendations for further research.

CHAPTER TWO

ACCESS TO FINANCE AND MOBILE MONEY AMONG SMALLHOLDER FARMERS IN GHANA

Introduction

This chapter introduces smallholder farming in Ghana. It brings to light details on the sector's access to finance in Ghana and how mobile money impacts on agriculture.

Smallholder Farming Practices in Ghana

A smallholder farmer in any part of Ghana is one who farms on less than five hectares (Ekboir, Boa, & Dankyi, 2002). Chamberlin (2008) also defines smallholder farming as limited land availability and "resource-poor" farmers (those with limited capital including animals, fragmented holdings, limited access to capital and finance). In another description, smallholders are small-scale farmers, pastoralists, forest keepers, fishers who manage areas varying from less than one hectare to ten hectares and are family-focused, such as using family labour for production and using part of the produce for family consumption (Food and Agricultural Organization [FAO], 2015). According to ActionAid (2015), smallholdings are small farms (up to 10 hectares) normally supporting a single family. These farms depend on a system of family labour and use some of their produce for their own living needs. Smallholder farms provide the basis for economies in the world's poorest communities and rural areas. The poorest people in the world mainly engage in small-scale farming (ActionAid Annual Report, 2015).

Asuming-Brempong et al. (2004), argue that different resource and risk conditions better define smallholders than simple measures of landholdings. A

small-scale farmer cannot therefore be defined according to a single statistical attribute such as the area of land cultivated. They emphasize that in Ghana, defining smallholder farming, therefore, should be based on the method of maintaining soil fertility and the level of technology. Asuming-Brempong et al., determine such characteristics of farming systems as land use patterns, capital inputs, yields, intensity of cultivation and the permanence and impermanence of rights in cultivated to define smallholder farmers.

Smallholder farmers in general own small-based plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour. Some of the main characteristics of the production systems of smallholder farmers are: simple, outdated technologies; low returns; high seasonal labour fluctuations; and women playing a vital role in production (Peprah, Afoakwah, & Koomson, 2016). Smallholder farmers differ in individual characteristics, farm size, resource distribution between food and cash crops, livestock and off-farm activities, their use of external inputs and hired labour, the proportion of food crops sold and household expenditure patterns (Peprah et al.).

It is on the bases of these that this study focuses on farmers with maximum farm holding size less than five hectares, predominantly to guarantee subsistence and also exist on the mercy of the weather.

Access to Financial Services by Smallholder Farmers in Ghana

The World Bank (WB) global financial development report (2014) defines financial inclusion as the number of individuals and firms that use financial services. The report does not define lack of use as lack of access. Some people may have access to certain financial services but may not use it because

of cost, legal barriers, market failures, religious reasons or cultural phenomenon (WB, 2014). It is generally believed that when the poor are financially included, they can gradually accumulate savings, undertake productive investment and smoothen consumption (Dupas & Robinson, 2013; Prina, 2015). A well-functioning financial sector thus ought to achieve the triple goal of enhancing physical access to financial services, ownership, and ensuring that these services are affordable by the average citizen. However, available evidence reveals that many people in developing countries have no access to basic financial services (Demirgüç-Kunt & Klapper, 2012, 2013).

Despite the significant contribution of agriculture to the Ghanaian economy, the sector does not receive adequate financial support. Percentage credit to agriculture continues to decline compared to the volume of credit to the non-agricultural sectors of the economy (Ghana Statistical Service [GSS], 2003). Again, according to Ministry of Food and Agriculture (MoFA) (2011), allocation of credit to agriculture from the formal financial institutions has been on the decline since 1998; it fell from levels close to 20 percent that prevailed prior to the financial sector reforms of the late 1980s and since 2000, allocation to agriculture has been below 10 percent, falling to just above six percent in 2006 (MoFA, 2011). Agriculture in Ghana is perceived to be risky both by commercial banks and Microfinance Institutions (MFIs) (GSS, 2003). They are very reluctant to invest in the sector. It is, therefore, not surprising that most financial institutions in Ghana do not have tailor-made products and services that will help improve agriculture. Few farmers in Ghana have access to formal banking facilities. This could be worst for smallholder farmers in rural areas.

Kwakye (2012) asserts that out of 26 banks interviewed in Ghana, all of them, were not willing to finance agriculture, and 67 percent attributed their reluctance to high default risk. According to Bank of Ghana's sectoral credit distribution of outstanding credit in 2013, the agricultural sector had a mere four percent credit as compared to the services and industry sectors which had 65 percent and 31 percent respectively. This clearly shows that the sector does not receive adequate attention from financial institutions in Ghana. The lack of access to basic financial services – savings, remittances, credit and insurance – is a major factor aggravating poverty and vulnerability in many developing countries (Prina, 2015).

Innovative Approach to Agricultural Financing

Since most Ghanaian banks and MFIs do not finance agriculture due to default risk from bad weather, diseases, pest infestation, crop failure as well as inability of farmer to provide collateral, there should be another approach to finance agriculture. Though it is required and important to secure every loan disbursed, financial institutions can develop more innovative means of financing smallholder farmers considering their inability to provide collateral. One of such innovations is Agricultural Value Chain Finance (AVCF). AVCF is the flow of funds to and among the various links within the agricultural value chain in terms of financial services and products and support services that flow to and/or through a value chain to address and alleviate constraints, and fulfil the needs of those involved in that chain, be it a need for finance, a need to secure sales, procure products, reduce risk and/or improve efficiency within the chain and thereby enhance the growth of the chain (Fries, 2007). Value Chain

Finance is a comprehensive approach which looks beyond the direct borrower to their linkages in order to best structure financing according to those needs.

There are many other models that could be implemented from this innovation to minimize default risk. For example, a bank can ask smallholder farmers and Farmer Based Organisations (FBOs) to link to an agro inputs supplier and a buyer, such that the bank pays the inputs supplier after supplying inputs to the farmers based on their needs and request. The farmers may also be given some amount of money to cater for labour cost. The cost of inputs supplied and the money disbursed to cater for labour cost are put together as the total loan given to the farmers for which they are made to sign a group guarantee to make their liability joint and several. The buyer also buys the produce from the farmers and pays them directly into their account at the bank so that loan repayments are deducted accordingly. This will minimise default and diversion of funds to achieve the purpose of the loan. This model could be used for agro inputs credit or cash credit or both and even agricultural small-medium enterprises financing.

Warehouse receipt system can be another AVCF model target. This model requires a Public Private Partnership (PPP) approach for successful implementation, though the private sector alone could implement it equally well. The model requires a properly built warehouse with all the necessary equipment such as weighing scales, pallets, tarpaulins, refrigerators and others. Here an input supplier is identified to supply inputs to the farmer groups for which the bank pays for the cost after evidence of supply has been delivered to the bank. The input cost then becomes a loan to the farmer groups and a group

guarantee is signed accordingly. A potential buyer is also identified to purchase farmers' produce. The farmer groups and FBOs are assisted to bring their produce to the warehouse for storage. At the warehouse, the produce is then packaged to meet recommended standards and treated to avoid spoilage and quality deterioration. Cold refrigeration is provided for the produce at the warehouse where necessary, especially for vegetables and fruits. The farmers are then given receipts to legally certify the ownership of the produce that is stored in the warehouse. Accounts are opened for the farmers into which the buyer pays the produce bought from the warehouse so that repayments are deducted directly as may be agreed. Irrespective of the AVCF model being used, it is important to determine the farmers' capacity and willingness to repay through proper and effective appraisal to avoid a situation where farmers may be over or underfinanced, and also to minimise default.

All these interventions have not achieved its purposes due to high covariate default risks, low levels of awareness, lack of collaterals, unwillingness of the financial institutions to render these services to widely dispersed rural farmers. Hence, MoMo has been viewed as a solution to financial exclusion.

Impact of Financial Inclusion among Smallholder Farmers

Empirical evidences suggest that financial sector development leads to economic development (Munyegera, 2015) through mobilization of investment funds and strategies for smoothing consumption. WB (2013) identifies financial inclusion as an operative instrument that can aid decrease poverty and income inequality.

There are also other studies, empirical and experimental, that access to affordable financial services translates into tremendous welfare improvements and boots productive investments (Dupas & Robinson, 2013; Prina, 2015). However, many people in developing economies have limited access to basic financial services (Demirgüç-Kunt & Klapper, 2012). Most intriguing is the fact that majority of smallholder farmer are located in rural areas which, in many developing countries, are often underserved or unserved by formal financial institutions. There is thus a growing concern, that the idiosyncratic lack of access to livelihood-augmenting financial services could limit the ability of many smallholder farmers to escape chronical poverty and vulnerability (Munyegera, 2015).

Many supply and demand hinderances make it impossible for the poor and disadvantaged categories of people who are often willing to adopt financial products to do so. The plausible reason being concentration of MFIs and formal banking institutions in urban areas, often imposing long travel times and expensive transport costs (Brune, Giné, Goldberg, & Yang, 2011; Pedrosa & Do, 2011). The high fees of transaction associated with some bank products are also detrimental to the poor to adopt formal banking facilities (Banerjee, Banerjee, & Duflo, 2011; Dupas & Robinson, 2013). Other studies also suggest lack of trust in formal financial institutions and other socio-cultural and religious considerations as hindering the adoption of formal banking accounts (Johnson & Nino-Zarazua, 2011; Sarma & Pais, 2011) especially in Ghana where there has been recent collapse of MFIs and other commercial banks. It is therefore imperative to increase proximity to service centers, reduce service fees, increase trust in formal financial institutions and design pro-poor financial

products to increase the uptake of financial services especially among the poor (Karlan, Ratan, & Zinman, 2014), which hugely involves MoMo.

Many financial inclusion models are mainly based on credit-led and savings-led approaches, the M-pesa experience suggests that there may be a third approach—focusing on building the payment 'rails' on which a broader set of financial services can ride (Donovan, 2012; Mas & Radcliffe, 2010).

Mobile Money as Financial Access among Smallholder Farmers

MoMo is electronically transacting financial services such as savings and transfer of funds over the mobile phone. The rapid adoption of this new financial innovations in Africa is partly due to the high rates of mobile phone network penetration and mobile phone adoption (WB, 2012), inadequate affordable alternatives especially in rural communities (World Economic Forum, 2012) and lower service charges of MoMo relative to formal bank accounts (Jack & Suri, 2014). Other reasons such as reduced travel cost, time cost, and reduced physical distance between households and service points (Aker et al., 2011). It is by no surprise that the product has been tremendously boosting remittance flows in and between urban and rural locations (Mbiti & Weil, 2011) which often supplement consumption expenditures (Munyegera & Matsumoto, 2014)

According to Jack and Suri (2014), Kenyan households use M-pesa to solicit remittances from their relatives and friends at lower transactional costs and that these funds significantly serve as safeguards against consumption declines when hit by weather and illness shocks. There is also evidence that the MoMo platform provides a convenient medium to increase savings, which influences the financial behavior of households by reducing wasteful

expenditure and turning away from risky informal saving ways such as burying money in the ground, under pillows, and keeping cash at home (Morawczynski & Pickens, 2009).

Other pathways through which remittances sent through MoMo contribute to improvement in welfare among rural households is the removal of credit constraints faced by smallholder farmers which enable them to commercialize their farming activities and increase farm incomes (Kikulwe et al., 2014). This is quite vital given the fact that smallholder farmers often lack the required collateral to obtain credit from commercial banks and MFIs. These remittances can be used to purchase agricultural inputs. The rapid expansion of MoMo services is therefore expected to transform economies as it is readily adopted in a wide range of sectors including finance, health, agriculture, education and business (WB, 2013).

Impact of Mobile Money Adoption

Kumbhar (2011) broadly categorizes MoMo as qualitative as well as quantitative and impact indicators (change in income, change in savings, change in living standards, the level of indebtedness, and the level of banking habits). Additionally, other studies reveal positive impact on savings, information exchange, increased income and remittances, and reduced costs (Demombynes & Thegeya, 2012; Dermish et al., 2011; Jack & Suri, 2011; Mbiti & Weil, 2011; Morawczynski, 2011) details as follows.

Reduction in Costs

Boadi, Boateng, Hinson, and Opoku (2007), define costs as operational efficiency which a customer or firm may accrue as a result of adoption of a new technology. Transaction costs are the costs related to using the system including

costs associated with sending and receiving money (Boateng, 2011). Mas and Radcliffe (2010), note that mobile banking turns fixed costs into variable costs but enough to allow the agent to promote the service alongside other products. Bhavnani, Chiu, Janakiram, Silarszky, and Bhatia (2008) establish the effects of using MoMo in the improvement in information flow between transacting parties allowing efficiency among the trading without travelling. Using MoMo for financial transaction cuts the costs of time and travel from rural areas to urban areas to send and receive money. The reduced costs serve as surplus to improve welfare and increase consumer surplus (Sife, Kiondo, & Lyimo-Macha, 2010).

Access to Insurance

Smallholder farmer can use MoMo to buy insurance against risks, for example, drought, fire, crop failure, and others. Many rural Kenya farmers have access to micro-insurance through MoMo provided by Safaricom, UAP Insurance, and the Syngenta Foundation for sustainable agriculture. They provide crop insurance to these rural farmers (Must & Ludewig, 2010). The farmers pay an insurance premium of five percent of the price of a bag of seeds they buy to insure their crops. These farmers make the payment through M-pesa (Must & Ludewig, 2010)

Improved Savings

MoMo provides saving account which makes people without a formal bank account to save in safer and more efficient mechanism. Little amount can be saved on MoMo wallet without difficulties. It actually improves efficiency and regularity of savings (Nandhi, 2012). MoMo banking ability has a transformational benefit offering new ways to access services and support

livelihood (Alleman & Rappoport, 2010; Boateng, 2011; Radcliffe & Voorhies, 2012). Morawczynski (2011) notes that rural MoMo users increase income which also leads to higher savings. Demombynes and Thegeya (2012) demonstrate the possibility of MoMo increasing savings. Jack and Suri (2011) assert that MoMo users save to store funds safe from dangers of theft and inaccessibility to other family members. They further postulate that savings have the potential of adding social value to those constrained by cost of opening a formal bank account and large distance between their household and the closest formal savings establishment. The saved amount can be used to invest in the farm to increase production of smallholder farmers.

Improved Remittance

Relatives and friends of MoMo adopters can easily send remittances to their families with little cost. Holding other factors constant, this will result in improved economic wellbeing as the poor will get a source of income (Alleman & Rappoport, 2010; Hinson, 2011). Demombynes and Thegeya (2012) note that the use of MoMo increases money in circulation which boosts local consumption for the rural people. These improved remittances smoothen consumption of the poor. They further emphasise that the flow of remittances to rural areas increase economic activity by enabling "just-in-time" transfers that make capital available whenever it is needed.

All these benefits associated with the adoption of MoMo make it an imperative to solve financial exclusion among rural unbanked and underserved smallholder farmers.

CHAPTER THREE

LITERATURE REVIEW

Introduction

This chapter starts with the mobile money ecosystem. Theoretical, conceptual, and empirical information from papers on topics related to the research problem are highlighted in this chapter. It scrutinizes what various authors and academic scholars have studied and written about mobile money adoption. The goal is to gain an understanding of the history, evolution and direction which will provide justification in revealing the knowledge gap for which this study is intended.

Mobile Money Ecosystem

Moore (1993) defines business ecosyetem as an economic community which comprises of the suppliers, customers, partners, competitors and other stakeholders' interaction of organizations and individuals' components of the world of business. The scope of the business ecosystem emphasizes the interconnections of the various players which depend on each other for survival (Iansiti & Levien, 2004; Peltoniemi, 2005).

Iansiti and Levien (2004) and Moore (1993) stress that it is impossible for a firm to be self-reliance and that the good performance of a firm depends on good performance of the whole business community. They develop metrics for the dimension of the strength of ecosystems and propose robustness, productivity, and creation of roles as key elements. Moreover, they develop innovation and operation strategies that a firm can adopt the environment of MoMo ecosystem. Figure 1 shows the key stakeholders in the MoMo ecosystem

adopted from Tobin (2011) model. There are many players in the MoMo ecosystem – Mobile Network Operators (MNOs), banks, agents, merchants,

Figure 1: Mobile Money Ecosystem
Source: Tobbin (2011)

competitors and regulators (Jenkins, 2008; Tobbin, 2011). Other stakeholder including MFIs, international financial institutes and donors such as WB, and other civil societies also play roles in the ecosystem.

Historical Background of Mobile Money in Ghana

MoMo is an electronic cash backed by equivalent amount of the Bank of Ghana notes and coins stored using the Subscriber Identification Module in a mobile phone as an identifier. MoMo Operators (MMOs) issue MoMo and keep the electronic account on the SIM in the mobile phone for the users of MoMo (Bank of Ghana, 2017). Global System for Mobile Communications (GSMA) (2013), defines MoMo as a transformational service that uses information communication technology and non-bank retail channels to extend

the delivery of financial services to clients who cannot easily be reached profitably with conventional financial services. The person-to-person money transfer both for domestic and international remittances, phone top-up (paying of credit units), mobile payment for retail transactions (payment of bills) and mobile banking are key services MoMo renders (Hughes & Lonie, 2007; Ivatury & Mas, 2008).

Ghana has the penetration of mobile phone in an excess of 11.5 percent in 2015 (National Communication Authority [NCA], 2016) in the Sub-Africa Region. Ghana's mobile phone network covers approximately 85 percent of the country's geography and more than 65 percent of rural residents have access to mobile phone (WB, 2013). The Findex data by the WB indicates Ghana as one of the 13 markets with mobile financial services penetration greater than 10 per cent in 2014. The report also states that, 13 per cent of adult Ghanaians have access to a mobile account, as compared to its region's average of 11.5 per cent. The increase in MoMo usage shows the key role technology plays to advance the central bank's cash-lite economy agenda, and also ensures that the push for more financial inclusion is brought into the hands of millions of Ghanaians. There are currently four major mobile telecommunication companies operating in Ghana, namely MTN, Tigo/Airtel, Glo, and Vodafone, but only MTN, Tigo/Airtel, and Vodafone operate MoMo. MTN and Tigo/Airtel hold about 72 percent shares of the total market for mobile telecom (Cobla & Osei-Assibey, 2018).

It is comparatively easy for phone subscribers in Ghana to hold MoMo accounts. For this reason, it has been effective in relation to the e-zwich introduced by the Bank of Ghana for branchless banking. Any SIM card user

can just register MoMo. The customer can then make cash deposits at any of the offices of the operator's MoMo agents or partner banks. These cash deposits create electronic money credit in the customer's account. Adopters of MoMo can easily transfer cash and airtime credit to the accounts of other MoMo adopters on the same network. Non-adopters can make cash transfers to MoMo account holders at a very affordable charge. MoMo withdrawals are mostly done at network's MoMo merchants and partner banks. There is little effort to register for and preserve a MoMo account and also people enjoy diversity of services which make it an alternative to formal banking services (Cobla & Osei-Assibey, 2018).

MTN Mobile Money

The largest market share in Ghana telecommunication industry is MTN representing 46.43 per cent and also pioneered MoMo services in Ghana in 2009. MTN currently has more than 50 per cent of active agents on the market. MTN in 2013 had about 238,000 (based on a 90-day metric) MoMo subscribers base according to Cobla and Osie-Assibey (2018). MTN's voice subscriptions for the year 2018 was 19,424,295 representing a percentage increase of 3.34 per cent from 19,237,402 in 2017. MTN's market share for August, 2018 was 48.50 per cent (NCA, 2018). MTN has network coverage in almost every place in Ghana as well as MoMo agents. It is, therefore, not surprising that MTN performs much better in MoMo services than other network operators in Ghana.

Airtel/Tigo Money

Airtel and Tigo recently merged to form Airtel/Tigo when the liquidity of both Tigo cash and Airtel money agent network were weak. Tigo's voice subscriptions in August 2018 increased from 5,478,743 to 5,661,572 in

September 2018 representing a percentage increase of 3.34 percent. Their market share for September 2018 was 14.14 percent as compared to 13.72 percent in August 2018. Airtel's voice subscriptions decreased from 5,363,962 in August 2018 to 4,982.176 as at the end of September 2018, a percentage decrease of 7.12 per cent. Their total market share for September, 2018 was 12.44 per cent (NCA, 2018). Airtel was the second mobile telecommunication company to launch MoMo in the second quarter of 2010 before Tigo launched its in second quarter of 2011 in Ghana. Airtel had an agent base of 1,575 as at the end of 2013 in the market. Airtel was the fourth force in Ghanaian mobile telecom market while TigoCash was the third to penetrate the MoMo services. Tigo Cash had an active agent base of 949 for the year 2013. The company, however, went through several phases to arrive at this number of agents. Tigo in 2013 had a market share of 13.85 percent and an active subscriber base of 285,000 (based on a 60-day metric) representing 7.8 percent penetration of its subscriber base.

Vodafone Cash

According to NCA (2018), Vodafone's mobile voice subscriptions increased from 9,084,551 in August 2018 to 9,198,944 by the end of September 2018. This represents a percentage increase of 1.26 percent. Vodafone's market share for September 2018 was 22.97 percent. Vodafone cash started operations in 2015 five years after MTN has launched its MoMo services. It is, therefore, not surprising that it lags behind the others network operators in terms of MoMo services in Ghana.

Mobile Money Transfers in Ghana

Evidenced from Figure 2 and Table 1, MoMo in Ghana has enjoyed a boost with the passage of the Electronic-money Issuers and Agents Guidelines in July, 2015 to replace the Branchless Banking Guidelines, 2008. Active MoMo customers increased from 2,526,588 in 2014 to 4,868,569 in 2015 indicating 92.69 percent compared with 154.75 percent growth in 2014. People with active MoMo accounts as of September, 2017 was 11,248,758 (21.45% in growth). In September, 2018, there were more than 30 million people with active MoMo account representing 19.06 percent growth. Active MoMo agents was estimated at 107,415 by the end of December, 2016. There are 190,265 MoMo active agents as of September, 2018 representing 35.62 percent in growth, substantially more points of service than the combined number of bank branches (887) and ATM (1,435). Cumulative value of mobile phone-based

Table 1: Mobile Money Transaction in Ghana

Indicators	2015	2016	2017	Jan-Sep 2018	2018 %Growth
Active Agents[a]	56,270	107,415	151,745	190,265	35.62
Total volume of transactions	266,246,537	550,218,427	981,564,563	1,027,794,484	49.90
Total value of transaction (GH¢million)	35,444.38	78,508.90	155,844.84	159,921.84	46.54

[a] *The number of accounts which transacted at least once in the 30 days prior to reporting*

Source: BoG (2018)

money transfers have reached over GH₵52.3 billion (68.68% of growth), in first quarter of 2018. The cumulative active registered agents of the four MMOs in 2015 was 56,270 representing a growth of 171.55 percent over 2014 position of 20,772. Total value of MoMo transactions of GH¢35.44 billion in 2015 showed a 192.35 percent growth over the 2014 position of GH¢12.12 billion compared with a growth of 357.08 percent. The BoG in 2016 reported that MoMo volume of transactions registered a growth rate of 737.4 per cent from 2012 to 2016. In September, 2018, the volume of transaction was GH¢1,027,794,484 representing 49.90 per cent of growth.

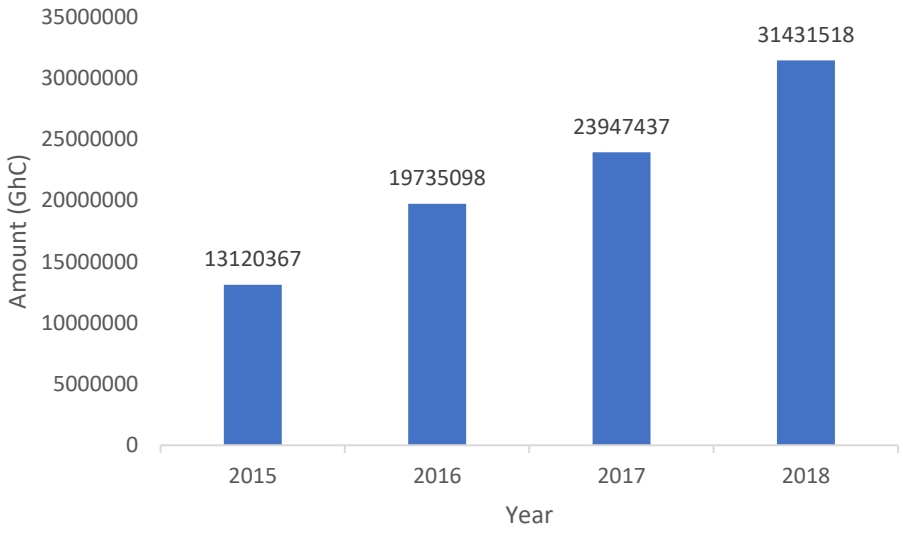


Figure 2: Mobile Money Accounts

Source: BoG (2018)

These growths became possible after the Government of Ghana (GoG) and the BoG in 2008, officially established bank-like financial institutions maximum connectivity and outreach by prohibiting exclusive partnerships and encouraging banks, MNOs, and other agents to form partnerships and entertain each other's customers including drastic procedures for financial institutions and other interested parties who desired to undertake mobile banking in Ghana

(BoG, 2008). Thus, the introduction of m-banking has incited extraordinary transfers of money among people in Ghana. These figures will increase significantly if MoMo recognition increases and bring abundant benefits to stakeholders and users.

Mobile Money Transfers in Ghana among Farmers

According to WB (2014), 90 percent of cocoa farmers have heard of MoMo and five percent of adult receive payment for agricultural products via MoMo. World Cocoa Foundation (WCF) (2015), reports that less than 50 percent of farmers in Ghana conduct MoMo transaction. Also, 67 percent of farmers are receptive to MoMo payments and 67 percent are willing to use MoMo to purchase farm inputs (WCF, 2018). WCF (2015) reveals that, there is 80 percent MoMo awareness among cocoa farmers. Fifty-two percent of the farmers have a MoMo wallet, and 46 percent of farmers have experience using MoMo services. These are strong foundations to influence digital payments among smallholder farmers in Ghana.

Theoretical Reviews

Theories related to the study are presented under this section. It begins with the Technology Acceptance Model and further to Diffusion of Innovation Model and ends with the Unified theory of Acceptance and Use of Technology.

The Theory of Technology Acceptance Model

Technology Acceptance Model (TAM) is widely used to predict the acceptance of a new technology. It theorises that perceived usefulness and perceived ease of use, have great importance to technology acceptance and usage behaviours. Mobile payment procedures are fundamentally information technology measures and channels whereby users make various payment

transactions. Studies show that the acceptance to use the mobile payments differs from context to context where users are able to use a mobile payment procedure. Furthermore, the mobile payment procedures are functional services adopted for serviceable reasons (Khodawandi, Pousttchi, & Turowski, 2003). TAM is a theoretical model that explains how users come to accept and use a technology (Davis, 1989). The model suggests that when users have opportunity to use a new technology, a number of factors play role in its adoption including perceived usefulness and perceived ease of use (Figure 3).

Perceived Ease of Use (PEOU)

Perceived ease of use (PEOU) is the degree to which one has confidence that using a particular system would be effortless (Davis, 1989). Liu and Li (2010), say that, to use a particular form of technology, minimal effort (physical and mental) should be applied. Empirical studies recognise evidence of the significant effect of PEOU on user behavioural intentions (Guriting & Oly Ndubisi, 2006; Ramayah, Siron, Dahlan, & Mohamad, 2002).

Studies such as Khalifa and Shen (2008) and Tsu Wei, Marthandan, Yee-Loong Chong, Ooi, and Arumugam (2009) confirm that perceived ease of use has a positive influence to adopt mobile commerce. Narteh, Mahmoud, and Amoh (2017) indicate that, in the MoMo services, perceived ease of use include how easy is the registration procedure, ease of use of the payment method, easy access to customer services, minimal steps required to make a payment, availability of MoMo transfer agents and how accessible the service is on mobile phones with the basic features and software.

Perceived Usefulness

Hong, Thong, Moon, and Tam (2008) indicate that perceived usefulness is a crucial factor widely used to explain consumer behaviour in a recent M-commerce adoption model work. Perceived usefulness refers to the extent to which individuals believe that using the new technology will enhance their task performance (Davis, 1989). From Figure 3, perceived usefulness shows that the use of a given technology might be useful for someone to achieve a particular result in this digital world (Vijayasarathy, 2004). According to López-Nicolás, Molina-Castillo, and Bouwman (2008), technology should be able to assist the consumer to carry out a job easier, quicker and in better quality. Perceived usefulness in the context of this study, is adopted from the perspective of Cobla and Osei-Assibey (2018), who define it as how technology increases performances and productivity of a task.

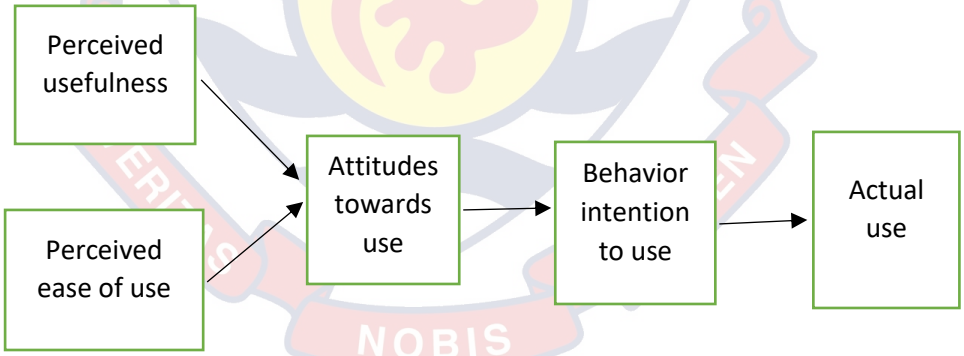


Figure 3. The Technology Acceptance Model
Source: Davies (1989)

According to Tobbin and Kuwornu (2011) intention to use MoMo services will increase if the belief in its usefulness also increases. Other studies (Padashetty & Krishna-Kishore, 2013; Zhou, 2011) have validated perceived usefulness as an essential factor in the acceptance of technology.

Diffusion of Innovation (IDT)

Literature stresses that IDT is commonly used and complements the TAM (Koenig-Lewis, Palmer, & Moll, 2010; Venkatesh, Morris, Davis, & Davis, 2003). Tobbin (2011) presents a framework that emphasizes the concepts of perceived trust, transactional cost and perceived risk in addition to the main constructs of the TAM and the IDT theory to explain the acceptance and use of MoMo transfer services among Ghanaian consumers. IDT helps to understand customer's behavior in the adoption or non-adoption of an innovation (MacVaugh & Schavione, 2010). The theory defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003).The theory highlights five perceived characteristics that influence the adoption and non-adoption of an innovation which are: relative advantage, perceived compatibility, simplicity or complexity of use, trialability and observability (Rogers, 2003; Koenig-Lewis et al., 2010) as the key characteristics that enable an innovation to be taken up by a population. Some of the main constructs of the theory are;

Relative advantage

Rogers (2003) defines relative advantage as the degree to which an innovation is perceived as better than the idea it supersedes. It refers to whether the innovation is perceived to be superior to the product or service from which it evolves (Laukkanen & Kiviniemi, 2010). Liu and Li (2010) argue that relative advantage is a very robust predictor of the intention to adopt and use a particular innovation and corresponds to the perceived usefulness component of the TAM put forward by Davies (1989).

MoMo offers a relative advantage to customers by providing cheaper financial services than existing banking system. McKay and Pickens (2010) reveals in a survey that price of using MoMo is 19 percent cheaper on average than using the conventional banking system. On the other hand, MoMo financial services are accessible from users' mobile phone, and do not require to access a banking infrastructure (ATMs or bank branches), often poorly distributed in countries suffering of financial exclusion, to realize transactions, deposits, or withdraws. The development of mobile financial services in emerging and developing countries, where populations are largely equipped with a mobile phone, could provide a relative advantage for inhabitants, in terms of access to financial services, compared to the traditional banking system. By now, individuals can access to MoMo services wherever the mobile network is available.

Complexity

Rogers (2003) describes complexity as the degree to which an innovation is perceived as relatively difficult to understand and use. Complexity is similar to the perceived ease of use component of TAM and is a significant predictor of the intention to use and adopt an innovation as the more complex an innovation is the slower its rate of adoption will be (Liu & Li, 2010). Perceived complexity can negatively affect MoMo transaction and adoption.

Compatibility

Rogers (2003) defines compatibility as the degree to which an innovation is perceived to be consistent with existing values, past experiences and the need of potential users. Lee and Lee (2010) argue that people tend to

more easily adopt technologies that are compatible with the current technologies that they have or had before. Innovations that match with the lifestyle of users usually have a faster adoption rate (Koenig-Lewis et al., 2010). In the context of MoMo, compatibility refers to the extent to which MoMo is consistent with consumers' lifestyle and current needs.

Costs

The cost of a payment transaction has a direct effect on consumer adoption if the cost is passed on to customers. Price consciousness has the strongest characteristic that differentiates the high and low intention groups' intention to adopt a technology. As shoppers in electronic channels are attentive to price the transaction costs of mobile payments should be low enough to make the total cost of the purchase competitive with physical world prices. MoMo has relatively lower cost in transactions compared to other financial institutions.

Payment system security and trust in payment systems providers

In a mobile environment, lack of consumer perceived security and trust in vendors and payment systems is one of the main barriers to electronic and mobile commerce transactions (Siau, Sheng, & Nah, 2003). The key requirements for secure financial transactions in electronic environment include confidentiality, data integrity, authentication, and non-repudiation. Other security factors important for consumer adoption are anonymity and privacy, which relate to use policies of customers' personal information and purchase records (Jayawardhena & Foley, 1998).

Observability

Rogers (2003) argues that observability is the degree to which the results of an innovation are visible and tangible to others. Liu and Li (2010) assert that the more it is easy to describe and observe an innovation the more positive impact it will have on people which will eventually encourage its usage. Cruz, Barretto Filgueiras Neto, Munoz-Gallego, and Laukkanen (2010) affirm that probability of adopting an innovation increases when the benefits and usage of innovation can be easily observed.

Network externalities and creation of critical mass

Payment systems exhibit network externalities as the value of a payment system to a single user increases when more users begin to use it (Van Hove, 2001). Consumer decision to adopt a payment system is therefore significantly affected by the number of other consumers and merchants using it. Failure in creating critical mass has contributed to discontinuance of several previous payment systems, including several smart card systems. As mobile payments represent a new system introduced to the market, reaching a wide enough initial adopter base of consumers and merchants is a critical success factor for MoMo as well.

Trialability

Trialability is defined as the degree to which an innovation can be tried on a limited basis (Rogers 2003). As per Rogers, there is a faster adoption of new ideas when these can be tried before their full implementation whilst adoption tend be slower where prior trial is not possible (Puscel, Mazzon, &

Hernandez, 2010). For financial services, however, customers are unable to try them before adoption.

Unified Theory of Acceptance and Use of Technology (UTAUT)

A broad, powerful and robust theory that consolidates TAM, IDT and other models is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, developed by Venkatesh et al. (2003). Zhou (2011) asserts that it is robust than other theories of technological adoption. The UTAUT aims to explain user intentions to use an Information Systems and subsequent usage behavior. The theory holds that four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behavior (Venkatesh et al., 2003). Koenig-Lewis et al. (2010) in their study have five dimensions including perceived usefulness, compatibility, cost of use, ease of use, and perceived trust. Sun, Goh, Fam, and Xue (2012) also identify five dimensions, perceived usefulness, perceived credibility, perceived financial cost, perceived expressiveness and subjective norm.

Empirical review of literature

This section considered similar studies undertaken by other researchers on the research problem. The relevance of this is to gather a pool of knowledge on the topic under study to create ample opportunity for analysing the data.

Characteristics that drive the Adoption of Mobile Money

Dias and McKee (2010) find that people who do not have bank account subscribe to MoMo in Kenya and South Africa for banking-related transactions such as bill payment, payroll deposits, international remittances, loan receipts

and payments, airtime purchases, groceries, bus tickets and a whole range of other financial services. Etim (2014) co-operates the work of Dias and McKee (2010) findings that mobile phone owners have actually exceeded the number of people who own bank accounts in Sub-Sahara Africa region approving the success of the transformative models as a tool to help include the unbanked in the formal financial industry. These are impressive empirical studies, however, both papers do not explain factors that drive one to adopt MoMo.

In an empirical study of the factors affecting the adoption of mobile banking by the poor in South Africa, Ismail and Masinge (2011), find perceived usefulness, perceived ease of use and affordability as the key determinants of consumer adoption of mobile banking. However, perceived risk does not significantly influence the adoption of mobile banking. In a separate empirical study by Ayo, Ukpere, Oni, Omote, and Akinsiku (2012), 67 percent of the sample population gives a rating of five (excellent) and four (good) that they feel comfortable using the M-pesa services. Further, 87 percent of the sample reports that the system is easy to learn and use. Donovan (2012) explains that the adoption of M-pesa in Kenya is due to the interplay of reason, force, and chance. Reason is explained as the intrinsic meaning that a user derives from the characteristics of the technology and extrinsic meaning that comes from the attractiveness of being a member of a network. Force, on the other hand, can be direct or indirect pressure on a user to adopt the technology. Donovan explains that the effect of intrinsic meaning is powerful at early adoption stage while the network effect (extrinsic) is most effective at later stages of adoption. Laforet and Li (2005) conduct a study on the determinants of the adoption and usage of mobile banking and internet banking in China. Their results show a higher

adoption rate among men than women. They also find that perceived risk, the skills needed to use m-banking, and culture constitute obstacles to adopting m-banking in China. By focusing on gender in their study on Singapore, Riquelme and Rios (2010) reveal that ease-of-use and social norms are factors that influence adoption more for women than for men. All these studies are insightful though they concentrate on how easy and simple to use MoMo without considering the effects of adverts and awareness. Adverts and awareness can easily convince someone to adopt a new technology such as MoMo.

Mbiti and Weil (2011) identify age, level of education, standard of living, and where people live as determinants of m-banking adoption. Bankole, Bankole, and Brown (2011) demonstrate that culture is the most important factor influencing the adoption behaviour of mobile banking users in Nigeria. Amin and Ramayah (2010) also show that, using a multiple regression model, that attitude and social influence have a significant impact on the adoption of M-banking in Malaysia. Afawubo, Agbaglah, Couchoro, and Gbandi (2017) model the adoption of MoMo as a five-step process and identify the likelihood of its adoption based on an Ordered Logit model applied on data from a survey conducted on a sample of 5,197 individuals. They find that social groups, including religious groups and student associations, are powerful vehicles for the adoption of MoMo in Togo. According to Aker and Wilson (2013), deciding to use MoMo services often depends on the usage by the members of one's social network (which is particularly an issue for MoMo transfers). These studies show that social and cultural factors can influence adoption of MoMo.

Distance to roads does not play a significant role, which according to the authors, highlights the potential of MoMo for remote areas (Kikulwe et al., 2014; Sekabira & Qaim, 2016). Kirui, Okello, Nyikal, and Njiraini (2013) and Kikulwe et al. (2014) find that wealthier male farmers are more likely to use m-payments, while Sekabira and Qaim (2016) do not find evidence in this regard. Though all these studies are impressive and insightful, all these studies are silent on the adoption of MoMo services among smallholder farmers. This is vital because smallholder farmers may have different needs such as applying insecticide and fertilizer on their farms to increase production.

Osei-Assibey (2015) using survey data from market traders and susu collectors in Ghana, finds perceived risk, education level, relative advantage and the age of the collector to be vital factors to influence the adoption of MoMo. Regarding susu users, he finds factors such as trialability, observability or awareness, compatibility or education attainment to drive adoption of MoMo. The study again finds the influence of the physical presence of the susu collector to be statistically significant to influence one's behavioural intention to adopt MoMo. This, he finds to be the basic reason inspiring susu users to respect their savings obligation. Narteh et al. (2017) using Structural Equation Modelling Techniques find that perceived ease of use, perceived usefulness, perceived trust and perceived cost of use have a strong influence on MoMo adoption. They use a sample of 300 MoMo users in Ghana to determine the effect of social influence on mobile MoMo. The study finds social influence has a significant effect on the adoption of MoMo.

All these studies give thoughtful and impressive findings regarding the adoption of MoMo. However, these studies focus on the adoption of m-banking

without considering farmers in rural areas. Essentially, these studies do not seek to specifically study factors driving the adoption of MoMo among rural smallholder farmers. Furthermore, these studies examine the context of Asia, Eastern Europe, and parts of Africa, yet no study, to our knowledge, has been conducted on smallholder farmers in Ghana. This study is to empirically study the factors determining the adoption of MoMo among rural smallholder farmers in selected districts in Ghana, particularly, the access to MoMo agents.

Impact of Mobile Money Adoption on Output of Farmers

Kirui et al. (2013) find that m-payment increases the levels of commercialisations by 37 percent compared with nonusers, input use by $42 and income from farming activities by $224 using natural experiment to study M-pesa use in Kenya. They investigate whether adoption of the service enables farmers to access more funds for buying agricultural inputs, selling a larger proportion of their output, and whether this, in turn, increases farm income. Kikulwe et al. (2014) conclude that m-payment use is associated with increases in spending on inputs (except mineral fertiliser), commercialisation (19%) and profits (35%). Similarly, Sekabira and Qaim (2016) find that m-payment users are more likely to sell coffee to buyers in higher value markets rather than local traders, enabling them obtain seven percent higher prices for their coffee. However, Kikulwe et al. (2014) also find that the main income gained because of m-payment use comes from increased remittances by focusing on a sample of smallholder farmers in Kenya who receive cash transfers for agricultural purposes. It is one of the studies that investigates how MoMo use impacts on agricultural production. Their work is on the notion that MoMo increases remittances received and can increase use of farm inputs and technology which

in turn, leads to a rise in sales of outputs and increase profits. This will contribute to creation of more employment. In a whole, these mechanisms are assumed to increase household income. Sekabira and Qaim (2016) emphasize that it is off-farm income sources, including running small-scale businesses in trade, transportation and handicrafts, and not merely remittance, that M-pesa users are able to increase profits. Kikulwe et al. (2014) and Sekabira and Qaim (2016) also highlight the utility of m-payment services for savings.

All these studies are discerning but concentrate on the impact of adoption of MoMo on farmers in general without specificity on rural smallholder farmers. Also, there is endogeneity associated with the adoption of MoMo of which these studies fail to address. This study fills the gap by analysing the impact of the adoption of MoMo on rural smallholder farmers using the propensity matching scores and the inverse probability weighting.

Impact of Mobile Money Adoption on Consumption

Jack and Suri (2014) use household panel data to analyse the impact of M-pesa on risk sharing in Kenya. According to the authors, while shocks reduce consumption by seven percent for nonusers, the consumption of user households is unaffected mainly due to increased remittances from diversified senders associated with reduced transaction costs. A similar ill shock response by poor households owing to MoMo usage is found by Suri et al. (2012).

Cobla and Osei-Assibey (2018) investigate how the use of the MoMo technology affects spending behaviour of students by applying the Ordinary Least Squares regression technique using 506 students from the University of Ghana. Their findings suggest that active use of MoMo services significantly increases students spending behaviour. The reason is that MoMo technology

provides easy access to money and increases spending behaviour of students. These studies though insightful, do not consider the endogeneity issues of MoMo adoption. Also, rural smallholder farmers are neglected.

Aker et al. (2011) use an experimental design to study the impact of Zap in a conditional cash transfer program in Niger. Their study finds that Zap reduces the cost of funder's distribution and recipient's collection, provides more privacy, and potentially changes intrahousehold decision making, which lead to the observed consequence changes in consumption choices. Batista and Vicente (2013) look at the introduction of mKesh in Mozambique. The primary intervention was training a group of people to use the technology. They use experimental survey design to look at secondary outcome effects of mKesh on consumption and investment. They find that MoMo increases the marginal willingness to remit money. The study also observes a propensity for MoMo to substitute traditional alternatives for both savings and remittances.

In Uganda, a panel data analysis of households by Munyegera and Matsumoto (2016) shows that households with access to MoMo record an increase per capita expenditure on consumption (measured by food consumption). They credit it to MoMo user households receiving more recurrent and higher amounts of remittances than non-user households. Aker and Wilson (2013), using a randomized control trial experiment with a government cash transfer program, find that using MoMo reduces costs for both the organization that made the transfers and the recipients. The recipients used the costs saved to increase expenditures on food.

Our challenge here is to specifically analyse the impact of adoption of MoMo on rural smallholder farmers welfare instead on general conclusion.

Rural smallholder farmers have idiosyncratic needs and as such the need for the specificity. The majority of the interventions studied are not designed specifically for smallholder farmers (for example, business loan with repayment beginning immediately), but a small fraction is designed precisely to meet the needs of farmers (in-kind loans repayable at harvest, weather insurance, products bundled with extension services, mobile payment products for trade). We find no compelling evidence that specialised products or services have greater impact for rural smallholder farmers than general products and services. Also, none of the studies assesses the impact of MoMo on rural smallholder farmers in Ghana. Hence the need for such studies in Ghana.

Conceptual Framework

The adoption of MoMo services can influence the welfare of smallholder farmers in diverse ways. A simple framework of potential pathways is shown in Figure 4. A first pathway deemed relevant in recent empirical work is higher remittances received from relatives and friends (Jack & Suri, 2011, 2014; Munyegera & Matsumoto, 2016; Suri, Jack, & Stoker, 2012). This being that MoMo lowers transaction costs of transferring money even to remote rural locations. Remittances from family members working in urban areas and abroad for purposes of family support are regular and often small. The costs of transfers also vary depending on the amounts sent, the instruments used and also the destination with the charges ranging from less than one per cent to 35 per cent of the amount transferred (WB, 2016; Owens, 2007). For small amounts, the charge of amount sent can exceed 35 per cent owing to the high minimum fees charged for every transfer though it can be lower than one per cent of the value

of large amount sent (Owens, 2007). This frequently puts clients with small remittances out of financial inclusion.

As a source of income, remittances would contribute to improved household welfare directly. In addition, the higher readiness of cash can enable investments in farm and off-farm economic activities. Remittances are often a more dependable source of income than self-employed activities for the rural poor, thus also providing some kind of insurance (Jack, Ray, & Suri, 2013). Adoption of MoMo can also affect both farm and off-farm economic activities. Smallholder farmers can use MoMo account for savings, to withdraw cash later to buy inputs such as fertilizers, insecticides, cutlass, and other services.

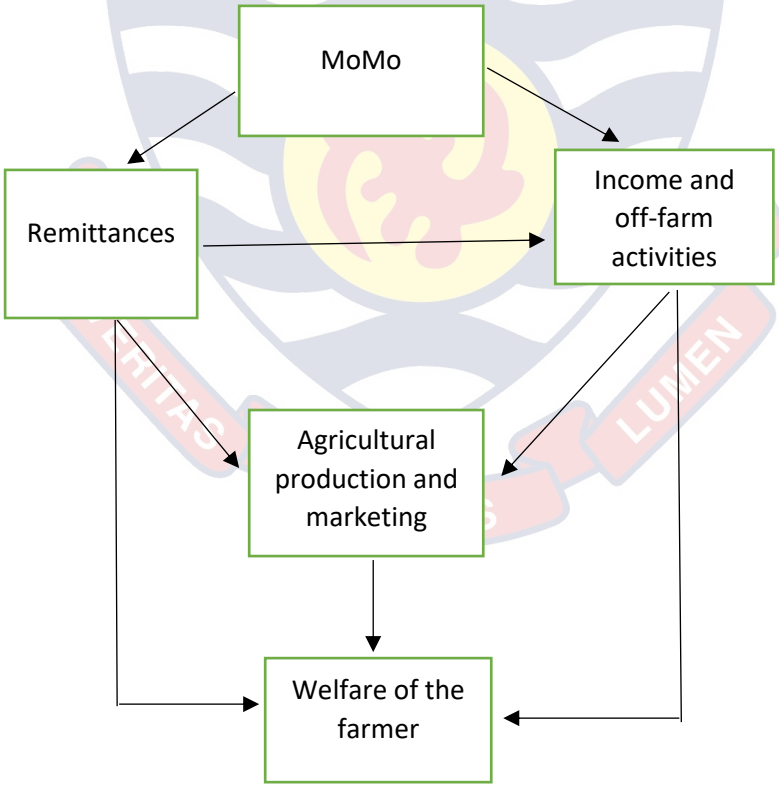


Figure 4: Impact pathways of mobile money on household welfare

Source: Kikulwe et al. (2014)

Kikulwe et al. (2014) show that farmers with MoMo use more fertilizers, pesticides, and hired labor than those without MoMo. These farmers also market a larger proportion of their output, especially when the ordering of goods and services, the delivery, and the payment do not occur in one place and at one point in time. Such conditions are particularly relevant in high-value agricultural markets that often involve contractual ties between buyers and sellers (Rao & Qaim, 2011; Reardon, Timmer, & Minten, 2012).

Smallholder farmers often sell their produce to local traders immediately after harvest, without any further storage or processing, because they need the cash to pay for urgent consumption needs or outstanding bills (Fafchamps & Hill, 2005). Sometimes, farmers who are in serious issues even sell their crop before harvest. According to Chiputwa, Spielman, and Qaim (2015), coffee growers in Uganda, sometimes decide to sell their coffee to middlemen when it is still at the flowering stage in the field. Many other farmers sell the red coffee cherries right after harvest or after some drying, even though more money can usually be earned when selling as shelled green beans. They hypothesise that the use of MoMo allows farmers to sell a larger proportion of their coffee as shelled green beans. They also stress that MoMo helps farmers to fetch higher prices for their coffee. This is not only related to higher levels of processing. Even at the same processing level, farmers with MoMo may find it easier to transact with buyers in different locations, thus being able to benefit from the best price offers.

Beyond employees who receive salaries, many households have their own small non-farm businesses, for instance in food processing, handicrafts, or transport, trade, and repair services. Such off-farm activities can also benefit

from MoMo transactions. Off-farm income sources contribute directly to household welfare (Kikulwe et al., 2014). Also, off-farm earnings are sometimes used for investments in farming, especially in situations where rural financial markets fail (Oseni & Winters, 2009). For instance, inputs may be purchased but paid at a later date without the farmer going to the input shop again. Again, hired farm laborers can be paid more easily and flexibly, without having to keep large amounts of cash. Savings and remittances received may also help to ease liquidity constraints and risk (Mas, 2009; Shambare, 2011). According to Suri et al. (2012), remittances sent or received through MoMo technology tend to reduce the impact of negative economic shocks, thus providing a form of insurance. Mbiti and Weil (2011) find that MoMo services cut the tendency to use informal savings and insurance mechanisms. Such informal savings and insurance mechanisms affect investment behavior and diminish economic efficiency in some situations (Di Falco & Bulte, 2013; Jakiela & Ozier, 2012). Hence, access to MoMo services is likely to increase farmers' willingness and ability to invest in agricultural inputs, which may increase productivity, profits, and thus household income.

Furthermore, access to MoMo may facilitate incorporation of farmers into high-value supply chains. For example, a study by Rao and Qaim (2011) shows that sales to supermarkets are frequently connected with payments that are delayed by several days. In such situations, a cheap and reliable system of money transfer could reduce market entry barriers for smallholder farmers. Also, given that MoMo use is associated with higher economic activity, labor demand is likely to increase, which improves farmers' off-farm employment

opportunities (Kikulwe et al., 2014**)**. It should be noted that several mechanisms work to interpret the observed household welfare effects.

In this present study, we analyze the impact of MoMo adoption on smallholder farmers' income (income value of output) and welfare (consumption expenditure). The mobile infrastructure is more inclusive than the financial system. The main value proposition of mobile financial services is the ability to send money more easily, cheaply, and securely (Jenkins, 2008). The provision of mobile financial services as an intervention is expected to (1) enable rural smallholder farmers access salient financial instruments and pool funds; (2) reduce transaction costs of conducting financial acts such as remitting, borrowing, receiving, and saving among rural smallholder farmers; and (3) enable rural smallholder farmers to have more freedom to participate in the financial landscape and markets.

Chapter Summary

In sum, from the empirical studies coupled with theoretical and conceptual perspectives discussed, it is clear that MoMo independently is an effective channel for improving rural smallholder farmers' output and welfare. Notwithstanding the relevance of MoMo in reducing household poverty levels, the impact of MoMo adoption on rural smallholder farmers remains largely unknown. Also, studies on the impact of MoMo on farmers do not consider the issue of endogeneity associated with MoMo adoption. To fill these gaps, the current study distinct itself by examining the impact of MoMo on rural smallholder farmers using the propensity matching scores and inverse probability weighting approaches.

CHAPTER FOUR

RESEARCH METHODS

Introduction

This chapter presents the research design, the data source and nature, the study areas, data collection instruments, data analyses and procedures, the empirical model used for testing the study hypotheses, description of the variables used for the study and finally the post estimation tests of the study.

Study Design

The study adopted the quasi-experimental design with the use of control and experimental or treatment groups. Data is collected from two groups: those who adopt MoMo and those who do not. One of the ways of measuring the impacts of MoMo is to assume two groups: users and non-users with common characteristics (Kikulwe et at., 2014). The analysis uses the quantitative approach which is in conformity with the positivist philosophy. The choice for this research design therefore becomes necessary not only due to the quantitative nature of the study, but also it is found to be suitable for analysing a phenomenon, situation, or issues by considering a cross section of the population at one point in time (Litvin, Goldsmith, & Pan, 2008).

Study Areas

The focus of the study is on rural smallholder farmers in Abura-Asebu-Kwamankese (AAK), Adansi South, and Sharma Districts in Ghana. These parts of Ghana produce most of the staple foods. Most of their income is from the sale of cocoa, maize, and cereals. They mostly produce twice a year--major and minor seasons. These places have low infrastructure in many respects. The

typical problems centre on the difficulty of getting access to formal financial institutions and services. As a result, if individual wants to make deposit or withdraw, he/she will have to travel for a long round trip, with associated high transport and time costs. For these reasons, people decide not to save money at banks and prefer to save with friends, in their roof, and under their bed, without interest. Sometimes, resulting in fights among friends and relatives. But the good news is that there are many MoMo agents available throughout the day and some can stay up to 10pm to render services. People can go to homes of these agents to deposit or withdraw money from their MoMo wallets.

Population of the Study Areas

The population under study is smallholder farmers with farm size less than five hectares of land within AAK, Adansi South, and Sharma Districts in Ghana. Sharma District has 8,555 people living in the rural areas. The proportion of agricultural activities by households in the rural areas of the district constitutes 4,277 (76.4%). Crop farming constitutes 4,053 (94.8%). Adansi South District has 20,745 people living in the rural areas. The number of people in agriculture activities is 18,400 (88.7%). Crop farming constitutes 18,187 (98.8%). However, majority have farm size greater than five hectares. AAK District has 18,790 people living in the rural areas. The proportion of agricultural activities by households in the rural areas of the district constitutes 14,088 (75%). Crop farming constitutes 13,527 (96%) (GSS, 2010).

Sampling Procedure

For this study, stratified sampling used employed to select three regions in southern Ghana, namely Ashanti, Central, and Western. This is mainly due to high adoption of MoMo and these regions highly engage in

farming more than the Greater Accra Region, though the adoption rate in Greater Accra is the highest. Purposive sampling and Proportional random Sampling techniques were used to identify the three districts from the three regions. The small sample size of 500 from all districts was used because of the homogeneous nature of farming in southern Ghana. Five communities were purposively selected because of the high concentration of smallholder farmers and lack of access to formal financial institutions. The communities are Bedukrom, Anto, Apagya, Asemanya, Assorku Atobiase, Bedukrom, Daboase, Dompim Nkwanta, Essumankrom, Fumso, Homokuraase, Kobina Andoh Krom, New Ebu, Odem, Ohiamadwen, Old Ebu, Pra Ewusi, Siana, and Tsetsi. The names and contact numbers of the farmers were taken from the Extension Officers and FBOs Executives. The sample size of the communities varies due to number of smallholder farmers, availability of the farmers, and completion of the questionnaire.

In choosing appropriate sample for the study, the study centres on rural smallholder farmers who have farm size less than five hectares. One hundred and sixty farmers were selected from each district. The sampled population was first based on simple random sampling due to availability and accessibility. Within each district, we selected specific locations with a high density of particular crop farmers. In these locations, we randomly selected farmers based on lists provided by cooperatives' leaders. In all, 460 farmers were used for this study due to incomplete responses with 96 per cent response rate. One hundred and fifty-six were from AAK, 171 from Sharma, and 133 from Adansi South.

Data Collection Instruments

In order to assess the impact of MoMo adoption on smallholder farmers, this study adopted the quasi-experimental and cross-sectional survey designs to collect data on smallholder farmers in AAK, Adansi South, and Sharma districts in Ghana. Quantitative questionnaire, for face-to-face interviews, was developed based on GSS approach in collaboration with Directorate of Research, Innovation and Consultancy (DRIC), University of Cape Coast (UCC). The survey questionnaire consisted of seven sections. Section A was identification of the farmer. Section B aimed to measure the demographic characteristics of the farmer. Section C was limited to gathering information on the location characteristics of the farmer. Section D was based on crop farming activities. Section E was mainly on adoption and usage of mobile phone and MoMo. Section F was aimed at obtaining information on the farmer's consumption and welfare. The final section solicited information on the farmer's ownership of assets and durable consumer goods (Appendix D).

Data Validation

Data was checked for internal and external validity. For internal validity, the data was cleaned and well managed to ensure that the statistics generated were efficient and reliable using excel and Stata version 14. External validity was checked by comparing selected statistics with other national statistics such as the Ghana Living Standard Survey (GLSS) and Bank of Ghana in Table 2. In terms of MoMo adoption rate and household size, our data is very valid. The variation in these statistics is less than 10 percent which is acceptable in statistical terms. The variation in the monetary values may be due to changes

Table 2: External Validity

Variables	BoG/GSS-6	Field Survey	Variation
MM adoption rate	0.70	0.64	0.06 (8.6%)
Household size (national)	4.753	5.10	0.347 (7.3%)
Western	4.143	5.199	1.056 (25.5%)
Ashanti	4.181	5.205	1.024 (24.5%)
Central	4.155	4.865	0.71 (17.1%)
Income from sale	2047.274	2700.363	652.73(31.9%)
Consumption Expenditure	130.015	452.125	322.11

Source: Author's construct

in the level of prices. Thus, our data is consistent with national data.

As a way of increasing the reliability, information was collected from each District Agriculture Directorate about the sector prior to the research. The information provided by the farmers in the questionnaire was used for the analyses, recommendations and conclusions. After the instruments were approved by DRIC, they were pre-tested at Jukwa (a town in Central Region). The research instrument and other protocols were submitted to the Institutional Review Board (IRB) of UCC for ethical clearance. The consent of respondents was sought for by asking them for their names and telephone numbers on the first page of the questionnaire. This was to make sure that respondents freely opt to be part of the survey. Though the questionnaire captured all the variables of interest, it was too voluminous (a 17-page document).

Data Collection Procedures

In this work, data was collected in one period (September - November, 2018) focusing on key financial highlights of MoMo, household characteristics, and income from output among smallholder farmers. Extension officers and executives of various farmers' associations were contacted to help get the farmers. This was done through visits, telephone calls, and other media. We

used simple random sampling to select respondents with different age (18-85) years, having different educational levels (no level of education to tertiary level of education), and multiple crop farming activities (cash crops, cereals, vegetable, and tubers).

Field assistants and supervisors were recruited based on their levels of education, proficiency in English and Akan languages, availability for the entire training and fieldwork period, familiarity with study areas and experience in data collection. Six master's students were trained as field enumerators to conduct the interviews. The field staff were taken through a day training before the start of the survey. Issues considered during the training were: content, translations, data collection skills and ethical issues. In terms of content, field staff were introduced to the project's overall orientation with the aim of helping them to appreciate the tenets of the study and the expected outcomes of the data collection exercise. A refresher training became necessary due to some experiences in the first village survey that needed not to be repeated in the subsequent ones.

The enumerators, led by their supervisor, entered the communities and administered the questionnaires. All protocol and ethical standards were duly observed. The data collection exercise was closely monitored by the DRIC, the principal and co-supervisors. Data was collected predominantly on the day the farmers had more free time for interviews. Interviews times varied from 30 to 45 minutes. However, some of the farmers refused to be interviewed.

Data Processing and Analysis

Two Master of Philosophy students were recruited for this assignment which lasted for 14 days. The team was responsible for data entry and cleaning.

SPSS 22 was used for the data coding and entry. Data analyses were descriptive and quantitative. Stata version 14 was used for the analyses. The analyses were done by the researcher.

The study focused on individual level of analysis. Key variables of comparison between control and the experimental groups include: educational level, gender, and districts. The descriptive statistics of relevant variables of interest were generated and compared across the two groups (adopters and non-adopters of MoMo). The results are presented in the form of graphs and tables showing the distribution of the various frequencies between the two groups. Two levels of quantitative analyses were conducted: testing the mean difference of key variables between the two groups and estimating the impact of the adoption of MoMo. First, in order to analyse the significant differences in key parameters, the parametric t-test of differences were used to compare the means of variables of interest. The t-test of differences assesses whether the means of two groups are statistically different from each other. This analysis is appropriate whenever there is the need to compare the means of two groups in quasi-experimental. Second, series of regressions were run to estimate the impact of MoMo adoption on income value of output and consumption expenditure of smallholder farmers.

Analytical Framework

First the probit model is used to estimate the probability of adopting MoMo. The decision to adopt MoMo cannot be observed but depends on observed characteristics of the household such as household size, age, gender and education level. MoMo is a latent variable that captures the decision to

adopt MoMo by a farmer. Our variable of interest, MoMo, is then observed only if the latent variable is positive.

One way to measure the impact of MoMo adoption is to assume two groups: adopters and non-adopter (Kikulwe et al., 2014) with common characteristics. As in many impact evaluation studies based on non-experimental observations, we cannot observe the outcome variable for adopters, in the case that they did not adopt and for non-adopters if they had adopted. The adoption of MoMo is not randomly distributed to the two groups of rural farmers, but rather rural smallholder farmers self-select themselves to adopt, therefore adopters and non-adopters may be systemically different. In this case, the unobservable characteristics that drive smallholder farmers to adopt MoMo decision are likely to correlate with unobservable characteristics that influence income and welfare. Ignoring the endogeneity of MoMo would result in biased estimated parameters.

The study adopts econometric model which accounts for the correlation in the unobserved characteristics in the MoMo adoption decision and the impact of adoption of MoMo on farmer's income and welfare.

Econometric model specification and estimations

The type of econometric estimation techniques used in this study are the probit, propensity score matching, and inverse probability weighting estimation techniques. The probit model mainly captures estimation of accessibility of MoMo on the MoMo adoption, which was a binary dependent variable. The choice of propensity score matching and inverse probability weighting technique is informed by the endogeneity of the independent variable (MoMo).

The dependent variables income (income value of output) and welfare (consumption expenditure) are both continuous in nature.

Model specification for mobile money adoption

Since the dependent variable on the determinants (MoMo = 1, 0 if otherwise) is discrete and binary rather than continuous, linear estimation techniques (e.g. Ordinary Least Squares or Linear Probability Model) yields biased results. Linear estimation techniques may yield negative variance of the error term and the probabilities may lie outside the reasonable range of between zero and one. Therefore, the Maximum Likelihood Estimation (MLE) techniques (e.g. Probit and Logit) which are binary response models are appropriate to quantify the factors influencing the rural households'[1] choice to participate in off-farm activities (Cameron & Trivedi, 2009). Probit and logit models yield quantitatively similar results where $\hat{\beta}_{logit} = 1.6\hat{\beta}_{probit}$ when the data are centered on the mean (Amemiya, 1981). However, the current study employed the probit model.

The adoption of MoMo is a choice rather than imposition and thus the choice model fits this study. Consider a model with a binary outcome, $MoMo_i$, denoting whether a farmer adopts MoMo (1) or not (0):

$$MoMo_i = \gamma\omega_i + \mu_i \ with\ MoMo_i = \begin{cases} 1\ if\ MoMoi > 0 \\ 0\ otherwise \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

$$P_r(MoMoi = 1|\omega) = Pr\ (MoMo_i * >\ 0) = \Pr\ (\omega i'\beta + \mu_i > 0|\omega) \ldots\ldots\ldots 2$$

$$= \Pr\ (\omega i'\beta + \mu_i > 0|\omega) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

$$= \Pr(\mu_i > -\omega i'\beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

[1] *Households are number of people depending on the smallholder farmer*

Where $\mu_i \sim i.i.d\ N(0,\sigma^2)$ ……..5

$$P_r(MoMo_i = 1|\omega) = 1 - \phi\left(-\frac{\omega'\gamma}{\sigma}\right), \sigma = 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..6$$

$$P_r(MoMo_i = 1|\omega) = \phi\left(\frac{\omega'\gamma}{\sigma}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

Where ϕ represents the standard normal distribution. ωi is a matrix that represents determinants of MoMo, ω_i is a vector of farm, household, and location characteristics that may influence the decision to adopt MoMo, γ *is* the vector of parameters to be estimated and μ_i is the error term. Therefore, without loss of generality of equation (1), equation (8) expands the scope of consideration for what contributes MoMo adoption among smallholders.

$$\begin{aligned} MoMo_i = {} & \gamma_2 nu\_agents_i + \gamma_3 dis\_agent_i + \gamma_4 male_i + \gamma_5 mstatus_i \\ & + \gamma_6 edul_i + \gamma_7 ferapp_i + \gamma_8 insapp_i + dist_i + \gamma_{10} advert_i \\ & + \gamma_{11} settl_i + \gamma_{11} reli_i + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8 \end{aligned}$$

There are three ways of calculating the marginal effects, which are: (i) Marginal Effects at Averages (MEA), that is at the average point of each individual variable or the (ii) Average Marginal Effects (AME) that is averaging all the slopes for individuals and (iii) Marginal Effect at Representative Value (MER), that is computing at specific values. This is a special case of MEA. In this study, we will interpret AME because averaging the dummy variables in MEA will not be meaningful. The AME are calculated as:

$$AME = \frac{1}{n}\sum_{i=1}^{n}\frac{\partial E(L_i|\omega)}{\partial \omega_i} = \frac{1}{n}\sum_{i=1}^{n}[\lambda(\beta'\omega_i) * \beta_i] \ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

Where n is the number of smallholder farmers.

Model of the impact evaluation of mobile money adoption

Estimation of the impact of MoMo adoption on smallholder farmers' income and welfare outcome variables based on non-experimental observations is not trivial. What we cannot observe is the outcome variable for adopters, in the case that they did not adopt. That is, we do not observe the outcome variables of households that adopt, had they not adopted.

In experimental studies, this problem is addressed by randomly assigning adoption to treatment and control status, which assures that the outcome variables observed on the control smallholder farmers without adoption are statistically representative of what would have occurred without adoption. However, adoption is not randomly distributed to the two groups of smallholder farmers (adopters and non-adopters), but rather to the smallholder farmer him/herself deciding to adopt given the information he/she has, therefore, the two group may be systematically different (Amare, Asfaw, & Shiferaw, 2012).

Propensity score matching

The treatment evaluation model has become a popular approach to estimating the average impact of an intervention (Caliendo & Kopeinig, 2008). This model is very useful in experimental studies as it allows the researcher to make use of the existing data sources (cross-sectional data), so that it is easy and quicker to implement than to look for the data on before and after an intervention which might not be available. More so, the treatment evaluation model does not consider the functional form linking the outcome (income and welfare, in this case) to MoMo adoption. This model also allows for the control of the likely self-selection on observable characteristics that may lead the

smallholder farmer to diversify into income and welfare (Caliendo & Kopeinig, 2008). In addition, using the associated propensity score matching (PSM) technique will reduce the bias attributable to both the observable and unobservable characteristics.

To determine the impact of adoption of MoMo on smallholder farmers' income and welfare, the treatment evaluation model and the propensity score matching techniques are used. Income value of output and consumption expenditure are the dependent variables in the treatment evaluation model. The first step in the treatment evaluation model is to estimate the propensity score for each smallholder farmer that adopt MoMo (participants) and that do not (non-participants) based on the observable/pre-treatment characteristics (Z_i). According to Rosenbaum and Rubin (1983), the predicted propensity scores may be calculated using the logit model. These are in turn used to quantify the Average Treatment Effect on the Treated (ATET) in the treatment evaluation model to deal with the self-selectivity bias in deciding whether to adopt MoMo or not. The model specification for the propensity scores is given by:

$$Prob(z) = Prob[L = 1|Z = z] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 10$$

Where $L = 1$ is the observable treatment (adoption of MoMo) and 0 otherwise; Z is a vector of pre-participation characteristics comprised of demographic, infrastructural and farm level characteristics. The predicted propensity scores in equation (14) are used for matching the participants against their counterfactual group of smallholder farmers that do not adopt MoMo.

After the estimation of the propensity scores, the treatment evaluation model then compares the mean outcomes (income and welfare) of participants

with that of the counterfactual group. The ATET is the parameter of interest to evaluate the impact of the adoption of MoMo on the smallholder farmers' income and welfare. The purpose of the predicted propensity scores is to search for the comparable counterfactual smallholder farmers among all non-participating smallholder farmers to form the control group, and then compare the mean outcome of the participants against that of the non-participants. The underlying idea of the PSM is that the control and treatment units with the same propensity score have the same probability of diversifying into income and welfare, under randomized experiments (Tran, Nguyen, Vu, & Nguyen, 2015). Equation (14) shows the treatment evaluation model.

$$Y_i = \delta' C_i + \alpha L_i + v_i \quad \text{.....11}$$

Where C_i denote the set of variables containing Z_i and all other variables that could explain Y_i (income and welfare) and v_i is an error term.

The parameter of interest here is:

$$\hat{\alpha} = ATET = E(Y_1 - Y_0|Z) \quad \text{.....12}$$

$$= E(Y_1|Z) - E(Y_0|Z) \quad \text{.....13}$$

$$\hat{\alpha} = E(Y_1|Z, L = 1) - E(Y_0|Z, L = 0) \quad \text{.....14}$$

Which is the difference between the expected outcome of the participants (Y_1) given a vector of explanatory variables (Z) and that the smallholder farmer has participated in adoption of MoMo ($L = 1$) and the expected outcome of the counterfactual group (Y_0) given a vector of explanatory variables (Z) and that the smallholder farmer do not diversify into adoption of MoMo ($L = 0$).

There are different matching algorithms which literature suggests to match the treated and the control groups. The four techniques are: Nearest Neighbor Matching (NNM), Radius Matching (RM), Kernel Based Matching (KBM) and Mahalanobis Metric Matching (MMM) techniques. The NNM consists of matching each participant with the non-participant that has the closest propensity score. The advantage of the NNM is that it allows for the replacement of the matches, which increases the average quality of matching. However, this matching algorithm reduces the number of distinct non-participant observations used to calculate the mean for the counterfactual group which increases the variance of the estimators (Kirui et al., 2013). In RM approach, an individual from the control group is chosen as a matching partner for a participant that lies within the specified radius in terms of propensity score. Usually a smaller radius results in better quality matching (Kirui et al., 2013). The KBM involves matching each participant with a weighted average of all controls. The weights used are inversely proportional to the distance between the propensity scores of participants and controls. MMM technique randomly orders subjects and then calculates the distance between the first treated subject and all controls. The minimum distance between the treated subject and the controls is used as a match and the procedure is repeated for all the covariates. According to Kirui et al., (2013), this technique is usually appropriate for panel data hence not applicable to this study. All these matching algorithms compute the difference between the matched treatment and control which is then averaged to obtain the ATET. The ATET measures of the impact of an intervention on the treated.

The credibility of the results of the propensity score matching technique crucially depends on two key assumptions; namely the balancing assumption and the absence of hidden bias. Since we do not condition on all covariates but on the propensity score, we have to check if the matching procedure balances the distribution of the key variables for both the control and treatment group. The underlying assumption for checking the matching quality is to compare the situation before and after matching and check if there are differences after conditioning on the propensity score. After matching there should be no systematic differences in the distribution of covariates between both groups.

Inverse Probability Weighting

Inverse probability weighting (IPW) estimates the effect of parameters using means of the observed outcomes weighted by the inverse probability of treatment. IPW estimators use estimated probability weights to correct for the missing-data problem arising from the fact that each subject is observed in only one of the potential outcomes. IPW offers several choices for the functional form of the model used to predict treatment. There is no outcome model. The IPW estimators use quasi-maximum likelihood to estimate the parameters of the conditional probability model. One advantage of IPW is that, it does not require the selection of a bandwidth parameter. The vector of estimating functions is the concatenation of the estimating functions for the effect parameters with the estimating functions for the conditional probability parameters (Cattaneo, Drukker, & Holland, 2013). The sample estimating functions used by the IPW estimators are

$$S_{ipw,i}(x_{i,}\widehat{\theta})' = S_{ipw,e,i}(x_{i,}\hat{y},\hat{\theta})', S_{tm,i}(z_{i,}1,\hat{\theta})' \quad \ldots\ldots 15$$

$\hat{e}_{i,n}^{IPW} = n^{-1} \sum_{i=1}^{n} S_i 1_{Ai=i} / \hat{p}_n(A_i = i|Z_i)$.....16

Where S_i is a binary indicator equal to unity if observation i is used in the observation, and zero otherwise, and Ai is observed whenever $S_i = 1$. The estimating functions $S_{ipw,e,i}(x_{i,}\hat{y}, \hat{\theta})'$ vary over the effect parameter. All the IPW estimators use normalized inverse-probability weights. The functional form for the normalized inverse probability weights varies over the effect parameters potential-outcome means (POM), ATE, and ATET. PSM assigns greater weight to comparison group subjects with estimated probabilities that more closely resemble those of the participants. IPW, on the other hand, assigns greater weight to comparison-group members with higher estimated probabilities of participation. IPW approach is also more appealing intuitively (Handouyahia, Haddad, & Eaton, 2013).

The weighting is used to deflate the weight for those individuals who are oversampled. The weighted analysis can be thought of as creating a study with no differential selection. IPW reweights the data in exactly the way that is done for survey data to compensate for variations in response rates. In this case, it reweights the comparison group data to account for the effect that untreated units with low propensity scores are over-represented in the comparison group and under-represented in the treatment group. There is some controversy in the literature about the finite-sample performance of IPW, where some authors express concern over bad behavior with very low (near to zero) and very high (near to one) estimated propensity scores, even when the estimator is implemented to force the probabilities to sum to one in the sample (Handouyahia et al., 2013).

The IPW algorithm also produces biased standard errors because it does not take into account the variation that arises because the propensity model is estimated. Therefore, we again use bootstrapping to produce unbiased standard errors and confidence intervals. Another assumption also underlying this method is that selection into the program is based only on observable characteristics. One can argue that this assumption is satisfied if the unobserved characteristics plausibly are correlated with the observed variables (Handouyahia et al., 2013).

Justification of variables

Mobile money adoption

The treatment variable in all models is MoMo adoption, which is defined as a dummy that takes a value of one if a smallholder farmer adopts MoMo services and zero otherwise. If a product is open, the individual could use it for the first time in order to make a first test, the irregular use does not need to have an account. Nevertheless, a recurrent use needs opening an account. So, at the first use, individual will decide to adopt if the benefits are significant for future use, corresponding to the 'Possession' step in Fall, Ky, and Birba (2014). This step in the adoption process is reached only if the first use is satisfactory. As adopting MoMo means its frequent use, its impact on income and welfare among smallholder farmers who do not have access to conventional financial institutions justifies this study.

Income value of output in Ghana Cedis

Most of the farmer innovations are related to increase in output, hence, are anticipated to affect productivity and subsequently income. However, farmer innovation may result in resource reallocation, which could have indirect

effect on his income (Tambo & Wünscher, 2017). To capture these potential indirect effects, we analyze the impact of MoMo innovation on farmers' value of output in Ghana cedis.

Welfare* (*Total smallholder farmer consumption expenditure measure)

Smallholder farmer consumption expenditure, gleaned from field data, is the sum of the value of goods and services purchased by the smallholder farmers, consumed from home production, or received as gifts or payment in kind. While household income can be used as a measure of household well-being, consumption expenditure is often preferred because it is less prone to seasonal fluctuations and measurement errors, hence, more reliable (Tambo & Wunscher, 2017). The components of consumption expenditure used to construct this aggregate fall into two main groups: food items and non-food items. The specific items in each group in aggregating the consumption components are presented as follows:

Food consumption comprises food consumed inside the household from a variety of sources (food purchases) and food consumed outside the household (restaurants etc.).

Non-food items refer to education (tuition fees, textbooks, etc.), health (medical care and health expenses) and a wide range of other non-food expenses (such as domestic fuel and power, tobacco products, clothing and footwear, transport, recreation, utilities, personal care, miscellaneous goods and services) adopted from (GSS, 2014).

Statistical systems in developing countries in particular use expenditure statistics for the analysis of poverty, inequality and social exclusion (International Labour Organisation [ILO], 2003). Given the majority of self-

employment and non-monetized economic activities in these economies including Ghana, income statistics can have only limited uses (ILO, 2003). Besides, consumption expenditure is relatively more stable over time, as households tend to smooth out their consumption, and so is a better measure of poverty. It is also easier to understand conceptually as well as less sensitive and so probably more accurately measured.

Deaton and Zaidi (2002) argue that consumption better reflects long-term income as it is not closely tied to short-term fluctuations in income and is smoother and less variable than income. Additionally, consumption is more stable especially in agricultural societies as it is smoothed over the seasons, therefore better reflecting the real living standard. Finally, income is likely to be a more sensitive issue for respondents than consumption and there is some evidence that well-off households are less likely to partake in the surveys; this results in an underestimation of income inequality among households (Korinek, Mistiaen, & Ravallion, 2006).

Education

The years of schooling play a role in the adoption of MoMo and welfare of smallholder farmers. Previous studies identify literacy as important in the use of mobile phones for information access due to difficulty of navigating through the phone menus, often written in English (Okello, Al-Hassan, & Okello, 2010). The expected sign is positive for the educated and negative for the less and uneducated. An increase in the education level of individual implies more knowledge about MoMo and more value attached to it thus higher chances of adopting it (Table 3).

Age

The expected sign is positive or negative. Age has an impact on the probability of adoption of MoMo and with an age threshold beyond which consumption and wealth can increase or decrease. Age is identified as a key determinant of MoMo adoption. Older smallholder farmers are less likely to adopt MoMo. For they may find it difficult to adopt MoMo and also to navigate through the menu.

Sex

The expected sign is positive or negative. In addition, men are more likely to adopt a new innovation than women. This could be the existence of severe disadvantages towards women, such as low incomes, inadequate or even insufficient savings and guarantees due to very limited access to property, low literacy, that require an adaptation of financial products (Sekabira & Qaim, 2016).

Number of agents

Increasing the number of agents in a particular location can influence high adoption of MoMo among smallholder farmers. This can be due to accessibility of MoMo. The expected sign is positive on the adoption of MoMo.

Farm size

Farm size is a continuous variable measured in hectares. Smallholder farmers with higher land holding sizes are more likely to adopt MoMo to receive payment from higher quantity compared to smaller farm size.

Ownership of phone

This is a dummy variable representing the ownership of mobile phone. A value of one is assigned if the individual owns a phone and zero if one does

not. First and foremost, the individual must have a mobile phone because in Ghana, MoMo services are linked to telephone numbers.

Number of formal banking institutions

This can influence the output, consumption, and wealth among smallholder farmers. With the quest to be financially included, farmers will adopt MoMo if there is no availability of formal and informal banking institutions.

Districts of smallholder farmer

The district that smallholder farmer lives can affect his output and welfare. If the district and regional urban capitals are far from the rural areas of the farmers, it may not induce higher production because of no readiness of market. Hence, district is very important in farming.

Marital status

Smallholder farmers who are married are more likely to adopt MoMo for transactional purposes to send money to spouses. Also, married smallholder farmers can increase output and wealth than those who are not married due to increased labour and joint contribution on both parts.

Access to health center

The expected sign is positive for communities with health center on output and negative for communities without access to health center. Smallholder farmers in communities with access to health centres can get treatment when the need arises with little effort and travel and time costs.

Type of settlement

The type of settlement of the smallholder farmers can easily affect his/her adoption of MoMo as well as output, consumption expenditure, and wealth. People living in dense areas are poorer compared to people living in planned areas.

Religion

Religious faith of the smallholder farmer has been investigated and found with empirical evidence to affect MoMo adoption (see for instance Afawubo et al., 2017). It can also influence consumption and wealth because of certain beliefs relating to consumption and farming on a certain day.

Advert

The expected sign is positive for those aware and negative for the unaware to adopt MoMo. Higher levels of information concerning MoMo adoption do increase an individual's entire knowledge about MoMo and thus increasing smallholder farmer's chances of adopting it.

Table 3: Definition and Measurement of Variables

Variable	Type	Definition and measurement	Expected sign
Consume	Continuous	Total household consumption expenditure	
Income	Continuous	Total amount of income from sale of output (GhȻ)	
own_ph	Dummy	Ownership of phone	+
MoMo	Dummy	Whether farmer adopts mobile money or not	+
Fsize	Continuous	Farm size in hectares	+
Ferapp	Dummy	Whether farmer apply fertilizer or not	+
Insapp	Dummy	Whether farmer apply insecticide or not	+
num_fin	Continuous	Number of financial institutions	+
Advert	Dummy	Whether farmer has heard mobile money advert or not	+
Age	Continuous	Age of the farmer in years	-
Hhsize	Continuous	Household size (number of people depending on the farmer)	+
acc_rd	Dummy	Whether road is accessible or not	+
Male	Dummy	Sex of the farmer (whether male or female)	+/-

Table 3	*continued*		
Dist	Categorical	District of residence	+/-
Settl	Categorical	Type of settlement of the farmer	+/-
Health	Dummy	If farmers have access to health centre	+
Edul	Categorical	Level of education of the Farmer	+
Mstatus	Categorical	Marital status of the farmer	+
dis_agent	Continuous	Distance to Mobile Money agent (metres)	-
Reli	Categorical	Religious affiliation of the farmer	+/-

Note*:* MoMo, income, and consumption are dependent variables. All other variables are independent variables.

Source: Author's Construct.

Post Diagnostic Test

For the estimates to be efficient and consistent, ε must be normally distributed. To test for this, goodness-of-fit test and linktest for the probit model specification are performed. In addition, multicollinearity and correlation matrix are also performed (Appendices A-C).

Chapter Summary

This chapter explained in detail the methodology used to analyse the data required for this study. The research design was first described where the positivist approach to research was adopted. This was followed by the data type and source. Probit model, propensity matching and inverse probability estimation techniques were specified and a post estimation test of model specification and pre-test of the PSM and the IPW tests were stated to help in choosing the appropriate estimation techniques. Also, a detailed description of the variables made.

CHAPTER FIVE

RESULTS AND DISCUSSION

Introduction

This chapter presents an in-depth analyses and discussion of the results of the study. This chapter provides the descriptive statistics of continuous and discrete variables. The next section presents the empirical estimations (probit, PSM, and IPW estimations). Which are in relation to the objectives and hypotheses of the study presented in the form of tables, figures, and regression analyses.

Summary Statistics of the Respondents

From Table 4, consumption expenditure has a mean of Gh₵452.125. This means that, on the average, a smallholder farmer spent Gh₵452.125 a week prior to the survey and it has a standard deviation of Gh₵361.924 which signifies that expenditure deviates from the average by Gh₵361.924. Household size (hhsize) which is measured as the number of individuals depending on the

Table 4: Summary statistics of continuous variables

Variables	Obs	Mean	Std. Dev.	Minimum	Maximum
number_financial	460	2.12	2.314	0	6
consumption	460	452.15	361.924	11.4	2224.5
Hhsize	460	5.104	2.162	1	10
distance_agent	460	24.241	56.379	0	500
Age	460	46.13	15.086	18	85
number_agents	460	2.422	4.210	0	50
Farmsize	460	1.938	1.287	0.004	4.464
income	460	2700.363	7681.863	20	85000

Note**:** Obs represents observation and Std. Dev. represents Standard Deviation.
Source: Field Survey (2018)

farmer records a mean score of 5.104 and has a 2.162 dispersion from the mean. The highest household size is 10 and the lowest, one. The mean score of distance to agents (distance_agent), measured in meters, is 24.241. This implies that for a farmer to access MoMo agent, he has to travel 24.241m. There is however a 56.379 variation in this variable from the mean with a highest of 500m and the lowest, 0m.

Number of financial institutions (number_financial) also has a mean score of 2.12, implying that on the average a community has about 2.12 formal financial institutions. With a standard deviation of 2.314, indicating a 2.314 variation from the mean, a maximum of six and a minimum of zero. Age, measured as number of years of the farmer has a mean score of 46.13. It has a standard deviation of 15.085, a maximum score of 85 and a minimum of 18. The mean farm size (*farmsize*) measured in hectares, is 1.938 with the highest farmland size of 4.464 hectares and the lowest of 0.004 hectares. It also records a 1.287 deviation from the mean. Income value of output measured in Ghana Cedis, measured as income from sale of total output from the farm also documents an average score of Gh₵2700.363 and also a standard deviation of Gh₵7681.863. A Gh₵20 income is recorded as the lowest and Gh₵85,000 is recorded as the highest. The number of MoMo agents (number_agents) in a community records approximately 2.422 on the average. The greatest number of MoMo agents is 50 and the least is zero. It records a standard deviation of 4.21.

Descriptive Statistics of Categorical Variables

Table 5 shows that the proportion of smallholder farmers that adopt MoMo (63.91%) is significantly higher than the proportion that do not adopt

(36.09%). The proportion of females who are smallholder farmers (50.87%) in all the districts is higher than the proportion of males who are smallholder

Table 5: Summary statistics of categorical variables

Variable	Categories	Frequency	Percentage
MoMo	*Yes*	294	63.91
	No	166	36.09
Sex	*Females*	234	50.87
	Males	226	49.13
Marital status	*Divorced*	36	7.83
	Single	41	8.91
	Married	326	70.87
	Widowed	57	12.39
Settlement	*Planned*	30	6.52
	Scattered	246	53.48
	Dense	184	40.00
District	*Sharma*	171	37.17
	AAK	156	33.91
	A.South	133	28.91
Levels of education	*No education*	169	36.74
	Primary	56	12.17
	JHS	161	35.00
	SHS&Higher	74	16.09
Religion	*Catholic*	19	3.70
	Other	321	4.13
	Christian	90	69.78
	Moslem	17	19.57
	Traditionalist	13	2.83
	No religion		
Advert	*Heard*	363	78.91
	Notheard	97	21.09
Own phone	*Yes*	382	83.04
	No	78	16.96

Source: Field Survey (2018)

farmers (49.13%). This means that females dominate smallholder farming. This may be due to low income levels of women especially in rural areas of Ghana. More so, the proportion of the participants who own cellphones (83.04%) is

much higher than those who do not (16.96%). In addition, the proportion of the smallholder farmers who are married (70.87%) is relatively high in the other marital status. Sharma district has the higher percentage of smallholder farmers (37.17%). There are a lot of rural communities in the Sharma districts compared to all the other districts. Adansi South district has the smallest number of smallholder farmers (28.91%). Most of the people there engage in large farm and off-farm activities such as trade. From this study, majority of smallholder farmers are moslems (69.78%) and the minor religious belief is those smallholder farmers who do not belong to any religion (2.83%). This is typical of Ghanaian rural communities. Many Ghanaians are affiliated with a specific belief.

The proportion of smallholder farmers who have no level of education relatively higher (36.74%). This is because in many rural areas in Ghana, there are no schools and students will have to travel long distance to acquire education. Surprisingly, smallholder farmers with the primary level of education is the lowest (12.17%).

Distribution of Sex of Respondents

Table 6 shows the differences in percentages of sex across groups. The percentage of female with no education is about three times higher (74.56%) than male without education (25.44%). The percentage of female in basic school category (67.86%) which is almost twice higher compared with males (32.14%) with basic education. The percentage of females declines as the level of education changes to a higher level (from 74.56% to 18.33% for SHS & Higher). However, the percentage of males increases from no level of education

(25.44%) to 81.67 percent for SHS & Higher. This is typical in Ghana where the enrolment at the basic schools has higher females but at the higher levels the percentage of males increases (GSS, 2014). The percentage of male farmers

Table 6: Distribution of sex across respondents

Variables	Female (%)	Male (%)	Significance
No Education	74.56	25.44	***
Primary	67.86	32.14	***
JHS	41.74	58.26	***
SHS & Higher	18.33	81.67	***
Insecticide App			
No	51.64	48.36	*
Yes	48.8	51.2	*
Fertilizer App			
No	54.98	45.02	***
Yes	43.79	56.21	***
AAK	44.44	55.56	***
Sharma	59.62	40.38	***
Adansi South	48.87	51.13	
House Ownership			
No	51.64	46.98	**
Yes	49.84	50.16	

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

Source: Field Survey (2018)

who apply fertilizer (56.21%) is higher than the percentage of females who apply fertilizer (43.79%). This is also consistent with farmers who do not apply

insecticide and those who do. There are 59.62 percent of females and 40.38 percent males in AAK. Sharma and Adansi South have fewer percentages of males higher than females. Females who own a house is 49.84 percent as against those who do not own a house. Males who own a house (50.16%) is higher than females who own a house. This is because, the head of the household is most of the time a male.

Distribution of levels of education across districts

From Table 7, AAK has higher percentage (39.09%) of farmers who have no education and Adansi South has the lowest (26.63%). At the primary level, AAK still has highest level of percentage of farmer (41.07%) though it is not significant compared with Sharma. From JHS level to highest level of education, AAK has the lowest percentage of farmers (from 39.09% to 30%).

Table 7: Education levels across districts of respondents

Variables	Sharma (%)	AAK (%)	A.South (%)	Total (%)
No education	34.32	39.09	26.63	100
Primary	41.01	41.07	17.86	100
JHS	37.39	26.96	35.65	100
SHS & Higher	39.17	30	30.83	100

Source: Field Survey (2018)

Sharma has highest percentage of farmers in SHS and Higher (from 34.32% to 39.17%). Though it deceases to 37.39 percent at the JHS level, it is relatively highest. There is high level of farming in the Western region for the southern part of Ghana.

Distribution of mobile money adoption across levels of education

From Figure 5, those who adopt MoMo (51.48%) are greater than those who do not (48.52%) for farmers who have no level of education. This is partly due to the flexibility, affordability, and easiness of MoMo adoption. MoMo adoption does not require formal level of education. This is also true for farmers who have primary level of education and all the other levels of education. The adoption of MoMo increases from 51.48 per cent for no education level to 78.33 per cent at the SHS & Higher level of education. Also, those who do not adopt MoMo decrease from 48.52 per cent for no level of education to 21.67 per cent

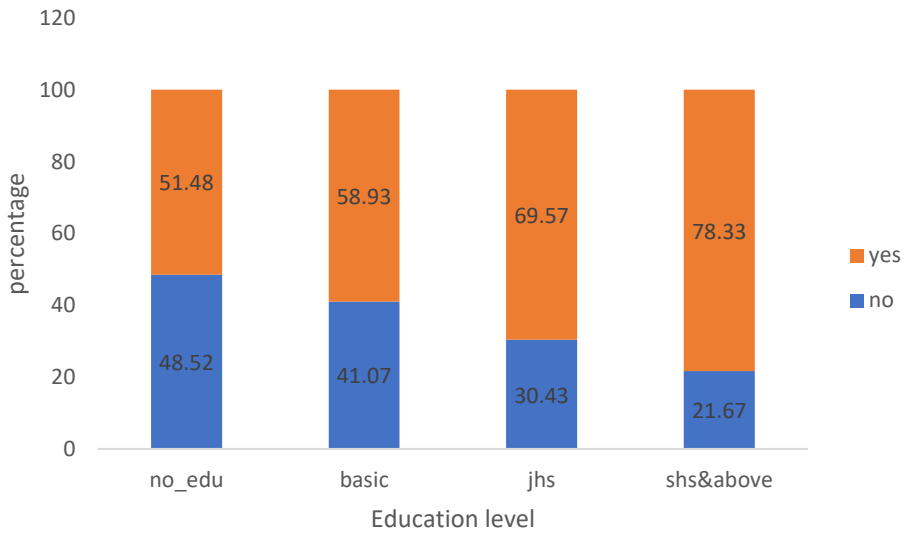


Figure 5: Mobile money adoption across levels of education of respondents
Source: Field Survey (2018)

at SHS & Higher level of education. This means that the MoMo adoption increases with the level of education. This implies that as the level of education increases, farmers understand the need for financial inclusion and how MoMo influences financial inclusion in the rural areas.

Distribution of mobile money adoption across districts by sex

From Figure 6, female farmers who adopt MoMo and those who do not in Sharma district are the same (50%). Also, male farmers who adopt MoMo (27.37%) are far lower than those who do not (72.63%) in Sharma district. In AAK, female who do not adopt MoMo (62.37%) are lower than males who do not (69.84%). Females who adopt MoMo in Adansi South (47.69%) are higher than males who adopt (25%). This clearly indicates that MoMo is not bias toward females like the other formal financial institutions.

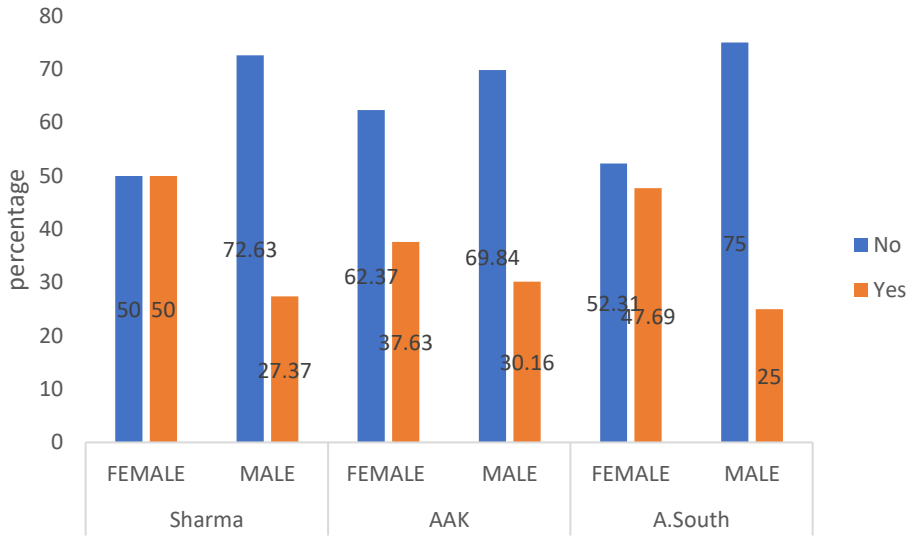


Figure 6: Mobile money adoption across districts by sex

Source: Field Survey (2018)

Distribution of mobile money adoption across respondents

Table 8 evidences that farmers who adopt MoMo have higher consumption expenditures (GH¢ 499.96) compared with non-adopters of MoMo (GH¢ 367.4) and it is significant at one percent. Farmers who adopt MoMo have an average output of 6.76 bags compared with farmers without

MoMo (3.79). The test of significance of the difference in the mean is 10 percent. There is no significance difference between the age of farmers with MoMo account and those without. Farmers who have MoMo account and apply fertilizer is almost 60 percent higher than farmers who apply fertilizer but have no MoMo account. This difference is significance at one percent. The result is not far different from farmers who use insecticide. Advert is highly significant

Table 8: Distribution of mobile money adoption across respondents

Variables	No	Yes	Significance
Farm size (acres)	4.42	4.3	
Age (years)	46.98	45.65	
Output	3.79	6.76	*
Female	44.44	55.56	***
Male	27.43	72.57	***
Distancetoagent	4.68	3.15	
Consumption (GH₵)	367.40	499.96	***
Sharma	37.43	62.99	***
AAK	34.62	65.38	***
Adansi South	36.09	63.91	***
Fertilizer App			
No	46.05	53.95	***
Yes	18.93	81.07	***
Insecticide App			
No	37.01	62.99	**
Yes	33.6	66.4	***
Advert			
Not heard	52.58	47.42	**
Heard	31.68	68.32	***
Single	24.39	75.61	***
Married	35.28	64.72	**
Divorced	24.39	58.33	**
Widowed	45.61	54.39	*
No education	48.52	51.48	
Primary	41.07	58.93	**
JHS	30.43	69.57	***
SHS & Higher	21.67	78.33	***

Note: All discrete variables are in percentages, * p<0.1, ** p<0.05, *** p<0.01.

Source: Field Survey (2018)

and increases MoMo adoption. The mean distance to MoMo agent is statistically insignificant as well as district of the farmer. Also, the adoption of MoMo increases with the level of education. It increases from 51.48 percent for no level of education to 78.33 percent for SHS & Higher. The test of significance of the difference in the mean is one percent indicating the influence of education on the adoption of MoMo. AAK has the highest MoMo adoption (65.38%) followed by Adansi South (63.91%) and Sharma (62.99%) and all are significant at one percent. However, the difference between MoMo account holder farm size (4.3 acres) and non-MoMo account farm size (4.42 acres) is not significant.

Econometric Results

The result as shown in Table 9 is based on the factors influencing the adoption of MoMo using the probit estimation technique. The results in Tables 10, 11, 12, and 13 are based on the PSM and IPW estimations. To get a better understanding of the coefficients and their expected signs, correlation and post estimation analyses are performed. Appendix A is the post estimation tests and Appendix B provides the pre-test of the PSM and IPW models. Appendix C provides a correlation matrix on the association between the dependent variables and their various explanatory variables.

The influence of mobile money accessibility on the adoption of mobile money

From Table 9, the average marginal effect of Advert is 0.1153 and is significant at five percent (p-value=0.004). This means that on average, those who hear MoMo advert have 0.1153 higher probability of adopting MoMo compared to those who do not hear. Advert has potential to convince

smallholder farmers about how easy, convenient, safe, and less transaction cost associated with MoMo adoption. This corroborates the work of Chogo and Sedoyeka (2014) that in order for customers to adopt MoMo, they need to be aware that, the product provides services with value to the customer and has

Table 9: Accessibility of mobile money on the adoption of mobile money

Variables	A.M.E.	Std. Err.	p-value
Advert	0.1153***	0.0398	0.004
Own_ph	0.6927***	0.0845	0.000
Reli(base=traditionalist)			
Catholic	-0.0174	0.1476	0.906
Other Christians	0.0740	0.1146	0.519
Moslem	0.1057	0.1183	0.372
No Religion	0.1461	0.1425	0.305
Number of agents	0.0143*	0.0077	0.064
Insectapp	-0.0375	0.0428	0.381
Mstatus(base=divorced)			
Single	0.2154***	0.0809	0.008
Married	0.0685	0.0696	0.325
Widowed	0.1121	0.0818	0.170
Edul(no-education)			
Primary	0.0378	0.0595	0.526
J.H.S	0.0807*	0.0446	0.070
S.H.S&Higher	0.1076*	0.0563	0.056
Male	0.0532	0.0398	0.181
Ferapp	0.1792***	0.0406	0.000
Age	0.0004	0.0014	0.784
Dist(base=A.south)			
AAK	0.1400***	0.0493	0.005
Sharma	0.1005*	0.0550	0.068
Settl(base=planned)			
Scattered	0.0807	0.0793	0.309
Dense	0.0729	0.0827	0.378
Number of obs =	460		
LR chi2 (25) =	243.62		
Prob > chi2 =	0.000		
Pseudo R2 =	0.405		
Log likelihood =	-178.990		

Note: Obs represents observation, * p<0.1, ** p<0.05, *** p<0.01.

Source: Field Survey (2018)

usability qualities. Awareness involves customer's mindfulness of the service, agent location and the benefits the service brings.

On average, increasing the number of MoMo agents by one person increases the probability of MoMo adoption by 0.0143 and it is significant at five percent (p-value=0.064). As the number of MoMo agents increases, it makes MoMo more accessible to these smallholder farmers. This reduces travel and time cost to access MoMo. This finding is consistent with Chogo and Sedoyeka (2014), Kikulwe et al. (2014), and Sekabira and Qaim (2016), who find that it is one of the most common factors used by most of the customers in the service provider choice when there is the challenge as to who is the best service provider. Customers adopt MoMo services in order to save time. This makes sense as the issue of agent availability is the first factor in selecting MoMo service provider. If a person wants to send money to a friend and decides to save time by using MoMo, then he would not wish to waste time looking for the agent hence he will use the agent that is near him. After identifying why customers adopt MoMo and the factors customers use in selecting the service providers, this study identifies that MTN MoMo is mostly used in Ghana. This could be because they have a good and more accessible MoMo agents compared to other providers.

Single smallholder farmers have 0.2154 higher probability to adopt MoMo as compared to divorced smallholder farmers and it is significant at one percent (p-value=0.008). This could be that single smallholder farmers have lower dependency ratio and as such adopt MoMo to save the little amount they earn. We also find that age has no significant impact on the probability of adopting MoMo, consistent with the work of Kikulwe et al. (2014), that age

does not play a significant role in adopting MoMo but in contrast with that of Mbiti and Weil (2011) on Kenya, who identify age as a determinant of MoMo adoption.

Smallholder farmers who have mobile phones have 0.6927 higher probability to adopt MoMo as compared with those without mobile phones. This is because in Ghana, to adopt MoMo, one must have registered sim card.

On average, smallholder farmers who have J.H.S. education have, on average, 0.0807 higher probability of adopting MoMo compared to those who have no level of education and it is significant at 10 percent (p-value=0.070). Likewise, smallholder farmers who have S.H.S. and Higher level of education, have on average, 0.1076 higher probability of MoMo adoption and it is significant at 10 percent (p-value=0.056) compared to those with no level of education. The adoption of MoMo increases from 0.0378 at primary level to 0.1076 at the SHS & Higher level of education as well as the significant level (from 0.526 to 0.056 p-values). This means that the adoption of MoMo increases with the level of education. This is not surprising because educated households are more likely to be financially informed compared to the non-educated. Being educated has higher probability of exposing an individual to knowledge, availability and usage of financial products and services. The level of education enhances financial literacy of an individual thus educated farmers are more likely to be financially included. As financial markets become complex, it is more likely that the educated would be able to make informed financial decisions about usage of financial products and services (Chithra & Selvam, 2013). It is also consistent with the findings of Kirui et al. (2010), Kikulwe et al. (2014), and Sekabira and Qaim (2016). Jack and Suri (2011) and Mibit and

Weill (2011) also find evidence that MoMo users follow this same pattern of technology adoption as the broader portion of the population takes up the technology. The studies on Kenya with M-pesa find that the innovator and early adopter profile of MoMo users is wealthier, banked, more educated and urban. As more of the population adopts the technology the profile of the users becomes less wealthy, less educated, less likely to have access to financial services, more rural and more likely to already own a phone, which mirrors more closely the population of Kenya as a whole.

On average, smallholder farmers who apply fertilizer, have 0.1792 higher probability of adopting MoMo compared to those who do not and it is significant at one percent (p-value=0.000). This is probably due to the fact that these smallholder farmers do not want to carry huge sums of money on them and as such adopt MoMo. This validates the findings of Kirui et al. (2012) and Balasuriya and de Silva (2011), that the farmers use it to make demand and supply in the rural areas.

Consistent with the finding of Kikulwe et al. (2014), sex does not significantly affect MoMo adoption contrary to the finding of Sebira and Qaim, (2016), that males are significantly less likely to adopt MoMo compared to females. This could be due to the fact that MoMo solves inequality in financial inclusion which is always biased towards males.

Smallholder farmers who reside in AAK have, on average, 0.1400 higher probability of adopting MoMo compared to those who reside in Adansi South and it is significant at five percent (p-value=0.005). This could be attributed to the fact that communities in AAK have lower number of financial institutions than Adansi South. Smallholder farmers who reside in Shama have

0.1005 higher probability of adopting MoMo compared to those in Adansi South. These communities have to travel longer distances to access financial services.

Impact of mobile money adoption among smallholder farmers

The results in Tables 10, 11, 12, and 13 are based on the PSM and IPW estimations to analyse the impact of MoMo adoption on income and welfare of smallholder farmers of the study.

The Balancing Property Condition Check

Rubin (2004) recommends a treatment evaluation model that balances the confounding factors before looking at results for the estimated treatment evaluation model. Thus, we do not interpret the treatment evaluation results before checking if the model has the balanced covariates. This test checks if the distribution of the conditioning variables (pre-treatment characteristics) is not different across the treated and the counterfactual group in the matched samples. More so, this test helps to check if the selection bias (due to observable characteristics) have been eliminated. This satisfies the matching requirements for calculating average treatment effects. The study used the balance box plot to check for the balancing condition. The results of the test are presented in Appendix B.

This shows that the balancing condition is satisfied. This implies that the distribution of the conditioning confounding factors does not differ across the treatment and the control group in the matched samples. This confirms that there are no pre-treatment differences between mobile money adopters and non-

adopters; meaning that the self-selection bias has been eliminated, satisfying the matching requirement for computing treatment effects

Impact of mobile money adoption on income of smallholder farmers

Theoretically, the argument is that with high levels of financial inclusion through MoMo, households have the opportunity of accessing credit, operating savings account, receiving remittances, and patronizing insurance products which enhance agricultural activities. Higher income levels for farmers means higher crop output and with available financial institutions farmers are more likely to use financial services. The presentation in this section is based on the propensity score matching and inverse probability weighting results after correcting for endogeneity.

Using the PSM algorithms, results from all matching approaches indicate that the adoption of MoMo has a positive impact on income of smallholder farmers (Table 10). The Nearest Neighbour Matching, Kernel-based matching, and Radius Matching show that MoMo adoption has a positive impact on income value of output. Precisely, the Radius Matching result shows that the level of income is higher among adopters of MoMo by 36.5 percent compared to non-adopters.

Table 10: Propensity score matching estimation result on the impact of mobile money adoption on income of smallholder farmers

ATET methods (yes vs no)	Coefficient	Std. Err	t-value
Nearest neighbour	0.152	0.230	0.662
Radius	0.365	0.129	2.830
Kernel	0.141	0.151	0.935

Source: Field Survey (2018)

From Table 11, MoMo adoption causes income value of output to increase by an average of 20.1 percent from the average of GH¢6.765 for smallholder farmers who do not adopt MoMo. Hence, adoption of MoMo has

Table 11: Inverse probability weighting estimation result on the impact of mobile money adoption on income of smallholder farmers

	Coefficient	Robust Std. Err	p>|z|	[95% conf.	Interval
MoMo (yes vs no)	.201*	.113	.076	-.021	.423
POmean MoMo (No)	6.765***	.098	.000	6.574	6.957

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

Source: Field Survey (2018)

the potential of reducing poverty. The result reveals that the average treatment effect—the effect we would have observed had the entire population been treated—is 20.1 percent more in income value of output.

The regression analyses results (Tables 10 and 11) reveal that, in general, adoption of MoMo has a significant impact on the income value of output of rural smallholder farmers. This finding is consistent with Kikulwe et al. (2014) and Kirui et al. (2013), which confirm that MoMo services contribute to increased market transactions on the output side. This is also consistent with the finding of Peprah et al. (2016), who find access to credit to increase yield. MoMo provides fast, easy, and convenient means of financial transactions, which people can use for their day-to-day activities. For instance, MoMo is used to send and receive payments (Munyegera & Matsumoto, 2016) and remittances

from family and friends (Suri et al., 2012; Blumenstock, Eagle, & Fafchamps, 2011) and business partners.

Using MoMo for payments means faster transactions, which may include income-generating transactions (Augsburg, De Haas, Harmgart, & Meghir, 2015; Batista & Vicente, 2013; Aker & Wilson, 2013). Facilitating transactions with convenience implies a higher volume of transactions within a unit of time, and hence, a positive impact on microbusinesses may arise, as suggested by Bauchet, Marshall, Starita, Thomas, and Yalouris (2011), and Klapper, El-Zoghbi, and Hess (2016). We observe that our data also aligns with this finding, because apart from daily personal expenses, business-related activities are the next most important purpose for the most recent transactions by adopters. For instance, smallholder farmers that adopt MoMo may also adopt other technologies more rapidly. MoMo adopters may also be more entrepreneurial, which could lead to higher efficiency in production and marketing beyond the impact of MoMo. The implication is that, once MoMo transactions are used for business-related activities, it is likely that these activities may generate income for users, which can be a useful contribution towards achieving the sustainable development goals (SDGs) one—zero poverty in all forms. This shows that MoMo can equally achieve the benefits of financial inclusion.

MoMo adoption reduces costs associated with formal financial institutions including time and transaction costs. MoMo adopters do not need to join long queues at banks. Also, transaction costs such as long-round trips to withdraw or save money reduces with the adoption of MoMo. This saved time could be used to invest in the farm which increases income.

To this end, it can be inferred that adopting MoMo is very beneficial in increasing income of smallholder farmers.

Impact of mobile money adoption on welfare of smallholder farmers

Using the PSM algorithms, results from all matching approaches indicate that the adoption of MoMo has a positive and significant impact on consumption expenditure of smallholder farmers (Table 12). Specifically, the Nearest Neighbour, Radius Matching, and Kernel Matching results show that

Table 12: Propensity score matching estimation result on the impact of mobile money adoption on welfare of smallholder farmers

ATET (yes vs no)	methods	Coefficient	Std. Err|	t-value
Nearest Neighbor		0.312	0.126	2.489
Radius		0.295	0.107	2.765
Kernel		0.266	0.103	2.580

Source: Field Survey (2018)

the level of consumption expenditure is higher among adopters of MoMo by 31.2 percent, 29.5 percent, and 26.6 percent respectively compared to if they had not adopted MoMo.

From Table 13, MoMo adoption causes consumption expenditure to increase by an average of 32.1 percent from the average of GH¢6.577 for smallholder farmers who do not adopt. The table reveals that the average treatment effect—the effect we would have observed had the entire population been treated—is 32.1 percent more in consumption expenditure.

Table 13: Inverse probability weighting estimation result on the impact of mobile money adoption on welfare

	Coefficient	Std. Err	p>|z|	[95% conf.	Interval]
MoMo (yes vs no)	.321***	.078	.000	.168	.474
POmean MoMo (no)	5.577***	.066	.000	5.449	5.706

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

Source: Field Survey (2018)

From Tables 12 and 13, adoption of MoMo influences smallholder farmers' spending behaviour. Smallholder farmers who adopt MoMo spend more than those who do not. This is due to the fact that, the ability to execute instantaneous peer-to-peer transfers, compared to other alternatives such as transporting money in person or using a bus driver, increases one's purchasing power, implying that they have the capacity to consume immediately. MoMo provides fast, easy, and convenient means of financial transactions, which people can use for their day-to-day activities as the need arises. Apparently, the MoMo technology facilitates smallholder farmers access to money thereby inducing high spending among those that use it actively. For instance, MoMo is used to send and receive payments (Munyegera & Matsumoto, 2016) and remittances from family and friends (Suri et al., 2012; Blumenstock et al., 2011). Access to MoMo increases the willingness of individuals to remit cash (Batista & Vicente, 2013; Munyegera & Matsumoto, 2016). The findings by Munyegera and Matsumoto (2014), Cobla and Osei-Assibey (2018), and Sekabira and Qaim, (2016) are confirmed by the findings of this study. These studies find that MoMo usage enable users to absorb large negative income

shocks better without any reduction in household consumption, compared with non-M-pesa users.

Chapter Summary

The probit estimation technique is used to assess the accessibility of MoMo on its adoption among smallholder farmers. The PSM and IPW estimation techniques are used to evaluate the impact of MoMo on income value of output and consumption expenditure of smallholder farmers because of endogeneity issues associated with MoMo adoption. It is found that MoMo adoption positively impact income value of output and consumption expenditure. A test for the goodness-of-fit and specification test for the probit model and pre-tests for the PSM and IPW estimation techniques as well as the correlation matrix were performed. The tests are shown in the Appendices A-C.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This final chapter of the research presents the summary of findings, conclusions and recommendations on the major findings of the study for the impact of mobile money adoption among smallholder farmers in some selected districts in Ghana. The summary presents major findings of the study with conclusions summarizing the overall outcome of the study in light of a brief overview of the problem statement, objectives, research questions, methodology and hypotheses tested. Additionally, recommendations are made for the relevant bodies and suggestions are also made for future research.

Summary of the Study

The general objective of this research was to analyse the impacts of mobile money adoption on smallholder farmers in selected districts in Ghana. Specifically, the study sought to:

- analyze the influence of accessibility of mobile money on its adoption;
- assess the impacts of mobile money adoption on output of smallholder famers
- evaluate the impacts of the adoption of mobile money on smallholder farmers' welfare.

The study was grounded in Davis's (1989) technology acceptance model which emphasizes the perceived ease of use and perceived usefulness of technology, in this study, MoMo. Quota sampling technique was used to select

one districts from the regions understudy. Stratified non-proportional sampling techniques was used to select equal number of communities from each selected district. Purposive sampling technique was finally used to select 500 smallholder farmers from each community. In all, 460 smallholder farmers were used for the study. There was a return rate of 96 per cent. The study generally examined the impact of MoMo adoption on income and welfare among smallholder farmers in AAK, Adansi South, and Shama districts in Ghana. A probit estimation technique is used to determine the accessibility of MoMo on the adoption of MoMo while the PSM and IPW estimation techniques are used to examine the impact of adoption of MoMo on income and welfare of smallholder farmers due to endogeneity issues associated with the adoption of MoMo.

Quantitative and qualitative research design were used to explore the problem. The target population for the study comprises of smallholder farmers in AAK, Adansi South, and Shama Districts in Ghana. The research design was first described where the positivist approach to research was adopted. This was followed by the data type and source. Probit model was employed to analyse the accessibility of MoMo on the adoption of MoMo. PSM and IPW estimation techniques were employed to analyse the impact of MoMo on income and welfare of smallholder farmers and a post estimation test of model specification and pre-test of the PSM and the IPW tests were stated to help in choosing the appropriate estimation techniques.

Summary of the Findings

The study finds that accessibility of MoMo (Table 9) has significant positive impact on the adoption of MoMo among smallholder farmers. Thus, increasing the number of MoMo agents increases the adoption of MoMo. This is because, as the number of agents increases, the agents spread out which makes MoMo more accessible and affordable.

Concerning the second and third objectives, it is found that smallholder farmers that adopt MoMo have significant improvement in their income and welfare levels compared to those that do not (Tables 10, 11, 12, and 13). This is because MoMo provides fast, easy, and convenient alternative approach of financial transactions, which smallholder farmers can use for their day-to-day activities as the need arises. Also, MoMo reduces costs including transaction and time costs. Again, MoMo increases savings and remittances. These saved cost and increased remittances could be invested in productivity and welfare outcomes.

Finally, it is found that the IPW estimation results on income and welfare are higher than the PSM estimations excerpt for RM algorithm, which is the only significant algorithm on income. This implies that, the endogeneity issues of MoMo adoption and selection bias cannot be underestimated.

Conclusions

The study concludes that accessibility of MoMo drives its adoption among smallholder farmers in the study areas. Increasing the number of MoMo agents is therefore necessary.

Also, the study concludes that the adoption of MoMo increases income of smallholder farmers in the study areas. This is mainly due to the fact that

MoMo reduces costs including transaction and times costs. These smallholder farmers use the reduced costs to invest in their farms.

Again, the study concludes that MoMo adoption improves welfare of smallholder farmers in the study areas. MoMo adoption increases consumption expenditure of smallholder farmers due to increased remittances and reduction in transaction costs.

In short, the fast, easy, convenient, and cost-effective features provided by MoMo offers the potential for facilitating the process of meeting existing financial needs, which is a step towards reducing poverty, smoothing income, and achieving sustainability. The bottom line is that MoMo is contributing towards the sustainable development goals.

Recommendations

Having considered the findings and conclusions of this study, the following recommendations are proffered:

MoMo and network providers should make MoMo more accessible especially in the rural areas by increasing the number of MoMo agents for the unbanked populace to also benefit from the services of MoMo as a mean of improving financial inclusion. This can be done by MoMo operators increasing the incentives given to MoMo agents especially in rural areas and also, reducing merchant charges of MoMo agents in the rural areas.

MoMo and network operators should embark on awareness campaigns that build understanding to help adopters see how this new service is both relevant and beneficial to them. This typically requires a process of education carried out by an agent of the operator of the adopters.

At national level, financial authorities should put much emphasizes on electronic money generated by the MoMo technology when making monetary policies as it also influences individual user's consumption spending. Financial authorities must strategize on how to manage economic shocks that could emanate from the use of the MoMo technology.

Extension officers should incorporate the use of MoMo services as part of the services they render to farmers by educating the smallholder farmers about the benefit and cost effectiveness of MoMo. This would encourage smallholder farmers to adopt MoMo.

Given that MoMo influences income and welfare status of smallholder farmers, it is recommended that smallholder farmers who adopt MoMo should be more vigilant and circumspect in how they use MoMo so as to maximize the positive influences (increases in income) and minimize the negative influences (indiscriminate spending).

Limitations of the Study

It is important to note that, MoMo is prone to serious risk issues. Indeed, in a situation of risk, necessarily emerges the need for confidence (Mayer, Davis, & Schoorman, 1995). Thus, trust and confidence are fundamental. However, this study could not consider risks, trust, and confidence in the adoption of MoMo.

Also, the study could not capture all the rural areas of the districts under the study. The study focused on only 460 smallholder farmers in all the three districts.

Again, the quantitative nature of the study made the questionnaire too voluminous (a 17-page document), which made field enumerators spend a lot of time on one respondent resulting in nonresponses in some cases.

Furthermore, the study could not capture the time period of MoMo adoption by these smallholder farmers.

Suggestion for Further Research

This study could be used as the basis for further study to observe the short and long-term impact of mobile money. This study uses only one round of data in a quasi-experimental procedure to estimate the impact of adoption of MoMo. Future studies could consider collecting multiple rounds of data over a period to create panel data.

Also, to perform a similar study in different districts in Ghana, it is important to consider a higher sample size to ensure a stronger statistical power of the impact estimate.

Again, future studies should consider risks and confidence in the adoption of MoMo.

REFERENCES

ActionAid. (2015). *Annual Report 2014*. Johannesburg, South Africa: ActionAid International.

Afawubo, K., Agbaglah, M., Couchoro, M. K., & Gbandi, T. (2017). Socioeconomic determinants of the mobile money adoption process: the case of Togo. *Cahier de Recherche*, *17*, 03.

Aker, J. C. (2011). Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, *42*(6), 631–647.

Aker, J. C., Boumnijel, R., McClelland, A., & Tierney, N. (2011). Zap it to me: The short-term impacts of a mobile cash transfer program. *Center for Global Development Working Paper*, (268).

Aker, J. C., & Wilson, K. (2013). Can Mobile Money be Used to Promote Savings? *Evidence from Northern Ghana (SSRN Scholarly Paper No. ID 2217554). Rochester, NY: Social Science Research Network*.

Alleman, J., & Rappoport, P. (2010). Mobile money: Implications for emerging markets. *Communications and strategies*, (79), 15-28.

Amare, M., Asfaw, S., Shiferaw, B. (2012). Welfare impacts of maize-pigeonpea intensification in Tanzania. *Agricultural Economics 43* (1), 27–43

Amemiya, T. (1981). Qualitative response models: A survey. *Journal of Economic Literature*, *19*(4), 1483-1536.

Amin, H., & Ramayah, T. (2010). SMS banking: Explaining the effects of attitude, social norms and perceived security and privacy. *The*

Electronic Journal of Information Systems in Developing Countries, *41*(1), 1–15.

Asante, S. B., Osei-Asare, Y. B., & Kuwornu, J. K. M. (2016). Smallholder maize farmers' food consumption expenditures in Ghana: The mediating role of commercialization. *AGRIS On-Line Papers in Economics and Informatics*, *8*(665), 13.

Asuming-Brempong, S., Al-Hassan, R., Sarpong, D. B., Kwadzo, G. T. M., Akoena, S. K. K., Sakyi-Dawson, O., & Ashley, S. (2004). Poverty and social impact analysis studies for Ghana: Economic transformation of the Agricultural Sector. *Final Report Submitted to the National Development Planning Commission (NDPC)/Ministry of Food and Agriculture (MoFA), and DFID, Ghana*.

Augsburg, B., De Haas, R., Harmgart, H., & Meghir, C. (2015). The impacts of microcredit: Evidence from Bosnia and Herzegovina. *American Economic Journal: Applied Economics*, *7*(1), 183–203.

Ayo, C. K., Ukpere, W. I., Oni, A., Omote, U., & Akinsiku, D. (2012). A prototype mobile money implementation in Nigeria. *African Journal of Business Management 6*(6), 2195-2201.

Balasuriya, A., & de Silva, H. (2011). Connecting to work: non-agricultural livelihood opportunities for rual wage labour in Sri Lanka. *Praise for This Book*, 71.

Banerjee, A. V., Banerjee, A., & Duflo, E. (2011). Poor economics: A radical rethinking of the way to fight global poverty. *Journal of Information Development*, *2*(4), 253–265.

Bank of Ghana (2017). *Annual Report*. Retrieved from https://www.bog.gov.gh/whars-new/3654-annual-report-2017

Bank of Ghana (2016). *Annual Report*. Retrieved from https://www.bog.gov.gh/whars-new/2645-annual-report-2016

Bank of Ghana (2008). *Annual Report.* Retrieved from https://www.bog.gov.gh/whars-new/1243-annual-report-2008

Bankole, F. O., Bankole, O. O., & Brown, I. (2011). Mobile banking adoption in Nigeria. *The Electronic Journal of Information Systems in Developing Countries*, *47*(1), 1–23.

Barrett, C. B. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy*, *33*(4), 299–317.

Batista, C., & Vicente, P. C. (2013). *Introducing mobile money in rural Mozambique: Initial evidence from a field experiment*. NOVAFRICA Working Paper Series, 1301.

Bauchet, J., Marshall, C., Starita, L., Thomas, J., & Yalouris, A. (2011). Latest Findings from Randomized Evaluations of Microfinance, Vol. 2. In *Access to Finance Forum: CGAP, Financial Access Initiative, Innovations for Poverty Action, Abdul Latif Jameel Poverty Action Lab, Washington, DC: Consultative Group to Assist the Poor (CGAP)/The World Bank*.

Bhavnani, A., Chiu, R. W.-W., Janakiram, S., Silarszky, P., & Bhatia, D. (2008). The role of mobile phones in sustainable rural poverty reduction. *Journal of Global Information and Communications, 4(*2) 46-57.

Blumenstock, J., Eagle, N., & Fafchamps, M. (2011). Risk Sharing Over the Mobile Phone Network: Evidence from Rwanda. *Unpublished Manuscript, University of California-Berkeley*.

Boadi, R. A., Boateng, R., Hinson, R., & Opoku, R. A. (2007). Preliminary insights into m-commerce adoption in Ghana. *Information Development*, *23*(4), 253–265.

Boateng, R. (2011). Mobile phones and micro-trading activities–conceptualizing the link. *Info*, *13*(5), 48–62.

Brune, L., Giné, X., Goldberg, J., & Yang, D. (2011). *Commitments to save: A field experiment in rural Malawi*. The World Bank.

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1), 31-72.

Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics using stata* (Vol. 2). College Station, TX: Stata press.

Cattaneo, M. D., Drukker, D. M., & Holland, A. D. (2013). Estimation of multivalued treatment effects under conditional independence. *The Stata Journal*, *13*(3), 407-450.

Chamberlin, J. (2008). *It's small world after all: Defining smallholder agriculture in Ghana* (Vol. 823). International Food Policy Research Institute.

Chiputwa, B., Spielman, D. J., & Qaim, M. (2015). Food standards, certification, and poverty among coffee farmers in Uganda. *World Development*, *66*, 400–412.

Chithra, N., & Selvam, M. (2013). *Determinants of financial inclusion: An empirical study on the inter-state variations in India*. Retrieved from ssrn.com/abstract=2296096.

Chogo, P. J., & Sedoyeka, E. (2014). Exploring factors affecting mobile money adoption in Tanzania. *International Journal of Computing & ICT Research*, *8*(2).

Cobla, G. M., & Osei-Assibey, E. (2018). Mobile money adoption and spending behaviour: the case of students in Ghana. *International Journal of Social Economics*, *45*(1), 29–42.

Consultative Group to Assist the Poor (2015). *Financial inclusion insights survey in Rwanda and Ghana*. Retrieved from https://www.cgap.org/blog/series/2015-financial-inclusion-insights-survey-rwanda-and-ghana.

Cruz, P., Barretto Filgueiras Neto, L., Munoz-Gallego, P., & Laukkanen, T. (2010). Mobile banking rollout in emerging markets: evidence from Brazil. *International Journal of Bank Marketing*, *28*(5), 342-371

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319–340.

Deaton, A., & Zaidi, S. (2002). *Guidelines for constructing consumption aggregates for welfare analysis* (Vol. 135). World Bank Publications.

Demirgüç-Kunt, A., & Klapper, L. (2012). *Financial inclusion in Africa: an overview*. Washington, DC: The World Bank.

Demirgüç-Kunt, A., & Klapper, L. (2013). Measuring financial inclusion: Explaining variation in use of financial services across and within countries. *Brookings Papers on Economic Activity*, *2013*(1), 279–340.

Demirguc-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2018). *The Global Findex Database 2017: Measuring financial inclusion and the fintech revolution*. Washington, DC: The World Bank.

Demombynes, G., & Thegeya, A. (2012). *Kenya's mobile revolution and the promise of mobile savings*. Washington, DC: The World Bank.

Dermish, A., Kneiding, C., Leishman, P., & Mas, I. (2011). Branchless and mobile banking solutions for the poor: a survey of the literature. *Innovations: Technology, Governance, Globalization*, *6*(4), 81–98.

Di Falco, S., Veronesi, M., Yesuf, M., (2011). Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. *American Journal of Agricultural Economics 93*, 829–846.

Dias, D., & McKee, K. (2010). *Protecting branchless banking consumers: Policy objectives and regulatory options*. CGAP focus note.

Donovan, K. (2012). Mobile money for financial inclusion. *Information and Communications for Development*, *61*(1), 61–73.

Dupas, P., & Robinson, J. (2013). Savings constraints and microenterprise development: Evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics*, *5*(1), 163–92.

Ekboir, J., Boa, K., & Dankyi, A. A. (2002). Impact of no-till technologies in Ghana, CIMMYT, Mexico.

Etim, A. S. (2014). Mobile banking and mobile money adoption for financial inclusion. *Research in Business and Economics Journal*, *9*, 1.

Fafchamps, M., & Hill, R. V. (2005). Selling at the farmgate or traveling to market. *American Journal of Agricultural Economics*, *87*(3), 717–734.

Fall, F.-S., Ky, Y., & Birba, O. (2014). Analyzing the mobile-banking adoption process among low-income populations: A sequential logit model. *Economics Bulletin*, *35*(4), 2085–2103.

Feder, G., Lau, L. J., Lin, J. Y., & Luo, X. (1990). The relationship between credit and productivity in Chinese agriculture: A microeconomic model of disequilibrium. *American Journal of Agricultural Economics*, *72*(5), 1151–1157.

Food and Agricultural Organisation (2015). The state of food insecurity in the world. *Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition.* FAO, Rome: Italy.

Fries, B. (2007). The value chain framework, rural finance, and lessons for TA providers and donors. *Presentation at the International Conference: Agri Revolution: Financing the Agricultural Value Chain.* Mumbai: India.

Furuholt, B., & Matotay, E. (2011). The developmental contribution from mobile phones across the agricultural value chain in rural Africa. *The Electronic Journal of Information Systems in Developing Countries*, *48*(1), 1–16.

Ghana Statistical Service (2018). *Ghana Living Standards Survey Round 7 (GLSS-7): Poverty Trends in Ghana 2005–2017*. Accra, Ghana: Ghana Statistical Service.

Ghana Statistical Service (2014). *Ghana Living Standards Survey Round 6 (GLSS6): Poverty Report*. Accra, Ghana: Ghana Statistical Service.

Ghana Statistical Service (2003). *Quarterly digest of statistics*. Accra, Ghana: Ghana Statistical Service.

Gine, X. (2009). *A field experiment on dynamic incentives in rural credit markets*. Mimeo. Washington, DC: World Bank.

Global System for Mobile Communications (2013). *Mobile economy Sub-Saharan Africa Report*. Retrieved from https://www.gsma.com/newsroom/resources/gsma-mobile-economy-sub-saharan-africa-report-2013/pdf.

Government of Ghana (2018). *For increased food production, the smallholder farmer deserves attention*. Retrieved from http://www.ghana.gov.gh/index.php/media-center/features/1750-for-increased-food-production-the-smallholder-farmer-deserves-attention.

Guriting, P., & Oly Ndubisi, N. (2006). Borneo online banking: evaluating customer perceptions and behavioural intention. *Management Research News*, *29*(2), 6–15.

Handouyahia, A., Haddad, T., & Eaton, F. (2013). Kernel matching versus inverse probability weighting: a comparative study. In *Proceedings of World Academy of Science, Engineering and Technology* (No. 80, p. 16). World Academy of Science, Engineering and Technology (WASET).

Hinson, R. E. (2011). Banking the poor: The role of mobiles. *Journal of Financial Services Marketing*, *15*(4), 320–333.

Hong, S.-J., Thong, J. Y., Moon, J.-Y., & Tam, K.-Y. (2008). Understanding the behavior of mobile data services consumers. *Information Systems Frontiers*, *10*(4), 431.

Hughes, N., & Lonie, S. (2007). M-PESA: mobile money for the "unbanked" turning cellphones into 24-hour tellers in Kenya. *Innovations: Technology, Governance, Globalization*, *2*(2), 63–81.

Iansiti, M., & Levien, R. (2004). Keystones and dominators: Framing operating and technology strategy in a business ecosystem. *Harvard Business School, Boston*, 24–25.

International Labour Organisation (ILO). (2003). *Household income and expenditure statistics, Report II* (Report II) (pp. 1–95). Geneva: International Labour Organisation. Retrieved from http://www.ilo.org/public/english/bureau/stat/download/17thicls/r2hies.pdf.

Ismail, T., & Masinge, K. (2011). Mobile banking: Innovation for the poor.

Ivatury, G., & Mas, I. (2008). The early experience with branchless banking. *CGAP Focus Note*, (46).

Jack, W., Ray, A., & Suri, T. (2013). Transaction networks: Evidence from mobile money in Kenya. *American Economic Review*, *103*(3), 356–61.

Jack, W., & Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review*, *104*(1), 183–223.

Jack, W., & Suri, T. (2011). *Mobile money: The economics of M-PESA*. National Bureau of Economic Research.

Jakiela, P., & Ozier, O. (2012). *Does Africa Need a Rotten Kin Theorem? Experimental Evidence from Village Economies'. World Bank Policy Research Working Paper.* Washington, DC*: World Bank*.

Jayawardhena, C., & Foley, P. (1998). Overcoming constraints on electronic commerce-Internet payment systems. *Journal of General Management*, *24*(2), 19-35.

Jenkins, B. (2008). Developing mobile money ecosystems. *Washington, DC: International Finance Corporation and Harvard Kennedy School*.

Jensen, R. B. (2010). Optimizing library content for mobile phones. *Library Hi Tech News*, *27*(2), 6-9.

Johnson, S., & Nino-Zarazua, M. (2011). Financial access and exclusion in Kenya and Uganda. *Journal of Development Studies*, *47*(3), 475–496.

Karlan, D., Ratan, A. L., & Zinman, J. (2014). Savings by and for the poor: A research review and agenda. *Review of Income and Wealth*, *60*(1), 36-78.

Khalifa, M., & Shen, K. N. (2008). Drivers for transactional B2C m-commerce adoption: Extended theory of planned behavior. *Journal of Computer Information Systems*, *48*(3), 111–117.

Khodawandi, D., Pousttchi, K. and Turowski, K. (2003). Acceptance of mobile payment procedures in Germany. *Proceedings of the 3rd International Workshop Mobile Commerce* (pp. 375-389). Augsburg, Germany.

Kikulwe, E. M., Fischer, E., & Qaim, M. (2014). Mobile money, smallholder farmers, and household welfare in Kenya. *PloS One*, *9*(10).

Kim, C., Mirusmonov, M., & Lee, I. (2010). An empirical examination of factors influencing the intention to use mobile payment. *Computers in Human Behavior*, *26*(3), 310–322.

Kirui, O. K., Okello, J. J., & Nyikal, R. A. (2012a). Awareness of mobile phone-based money transfer services in agriculture by smallholder farmers in

Kenya. *International Journal of ICT Research and Development in Africa*, *3*(1), 1–13.

Kirui, O. K., Okello, J. J., & Nyikal, R. A. (2012b). Determinants of use and intensity of use of mobile phone-based money transfer services in smallholder agriculture: case of Kenya. *International Journal of ICT Research and Development in Africa*, *3*(1), 14–25.

Kirui, O. K., Okello, J. J., & Nyikal, R. A. (2010). *Awareness and use of m-banking services in agriculture: The case of smallholder farmers in Kenya.* Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference. Cape Town: South Africa, September 19-23, 2010.

Kirui, O. K., Okello, J. J., Nyikal, R. A., & Njiraini, G. W. (2013). Impact of mobile phone-based money transfer services in agriculture: evidence from Kenya. *Quarterly Journal of International Agriculture*, *52*(892), 141.

Klapper, L., El-Zoghbi, M., & Hess, J. (2016). Achieving the Sustainable Development Goals: The role of financial inclusion. *Washington, DC: CGAP*.

Koenig-Lewis, N., Palmer, A., & Moll, A. (2010). Predicting young consumers' take up of mobile banking services. *International Journal of Bank Marketing*, *28*(5), 410-432.

Korinek, A., Mistiaen, J. A., & Ravallion, M. (2006). Survey nonresponse and the distribution of income. *The Journal of Economic Inequality, 4*(1), 33–55.

Kumbhar, V. M. (2011). Alternative Banking Channels and Customers' Satisfaction: An Empirical Study of Public and Private Sector Banks. *International Journal of Business and Management Tomorrow*, *1*(1), 1.

Kwakye, J. K. (2012). *Financial intermediation and cost of credit in Ghana*. No. 36. : Institute of Economics Affair Monograph.

Laforet, S., & Li, X. (2005). Consumers' attitudes towards online and mobile banking in China. *International Journal of Bank Marketing*, *23*(5), 362–380.

Laukkanen, T., & Kiviniemi, V. (2010). The role of information in mobile banking resistance. *International Journal of Bank Marketing*, *28*(5), 372-388.

Lee, H. H., & Lee, S. E. (2010). Internet vs mobile services: Comparisons of gender and ethnicity. *Journal of Research in Interactive Marketing*, *4*(4), 346-375.

Litvin, S. W., Goldsmith, R. E., & Pan, B. (2008). Electronic word-of-mouth in hospitality and tourism management. *Tourism Management*, *29*(3), 458–468.

Liu, Y., & Li, H. (2010). Mobile internet diffusion in China: An empirical study. *Industrial Management & Data Systems*, *110*(3), 309–324.

López-Nicolás, C., Molina-Castillo, F. J., & Bouwman, H. (2008). An assessment of advanced mobile services acceptance: Contributions from TAM and diffusion theory models. *Information and Management*, *45*(6), 359–364.

MacVaugh, J., & Schiavone, F. (2010). Limits to the diffusion of innovation: A literature review and integrative model. *European Journal of Innovation Management*, *13*(2), 197-221.

Martin, B. L., & Abbott, E. (2011). Mobile phones and rural livelihoods: Diffusion, uses, and perceived impacts among farmers in rural Uganda. *Information Technologies & International Development*, *7*(4), 17.

Mas, I. (2009). The economics of branchless banking. *Innovations: Technology, Governance, Globalization*, *4*(2), 57–75.

Mas, I., & Radcliffe, D. (2010). Mobile payments go viral: M-PESA in Kenya. *Capco Institute Journal of Financial Transformation*, *3*(2),169-181.

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review*, *20*(3), 709–734.

Mbiti, I., & Weil, D. (2011). Mobile Banking: The Impact of M-Pesa in Kenya Working Paper 17129, 1050 Massachusetts Avenue. *Cambridge, MA*, *2138*.

McKay, C., & Pickens, M. (2010). *Branchless banking 2010: Who's served? At what price? What's next?* (Vol. 66). CGAP Focus Note.

Ministry of Food and Agriculture (2011). 'Agriculture in Ghana: Facts and Figures (2010)', *Statistics, Research and Information Directorate (SRID), Ministry of Food and Agriculture*, Accra.

Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review*, *71*(3), 75–86.

Morawczynski, O. (2011). Examining the adoption, usage and outcomes of mobile money services: The case of M-PESA in Kenya. *Journal of East African Studies, 3*(3).

Morawczynski, O., & Pickens, M. (2009). Poor people using mobile financial services: Observations on customer usage and impact from M-PESA. *Journal of East African Studies, 3*(1).

Munyegera, G. K. (2015). The role of mobile money in facilitating rural access to financial services and the resultant effect on household welfare: *Evidence from Uganda* (Doctoral dissertation, National Graduate Institute for Policy Studies).

Munyegera, G. K., & Matsumoto, T. (2014). Mobile money, remittances and rural household welfare: Panel evidence from Uganda. *Tokyo, Japan: GRIPS*.

Munyegera, G. K., & Matsumoto, T. (2016). Mobile money, remittances, and household welfare: panel evidence from rural Uganda. *World Development*, *79*, 127–137.

Must, B., & Ludewig, K. (2010). Mobile money: Cell phone banking in developing countries. *Policy Matters Journal*, *7*(2), 27-33.

Nandhi, M. A. (2012). Effects of mobile banking on the savings practices of low income users–The Indian experience. *Institute for Money, Technology and Financial Inclusion, University of California, Irvine*.

Narteh, B., Mahmoud, M. A., & Amoh, S. (2017). Customer behavioural intentions towards mobile money services adoption in Ghana. *The Service Industries Journal*, *37*(8), 426–447.

National Communications Authority. (2018). *First quarter quality of service monitoring results published*. Retrieved from https://nca.org.gh/media-and-news/news/2018-first-quarter-quality-of-service-monitoring-results-published.

National Communication Authority (2016). *Quarterly statistical bulletin on communications in Ghana.* Retrieved from https://nca.org.gh/media-and-news/news/2016-quarter-statistical-bulletin-on-communication-in-ghana-published.

Nyoro, J. K. (2002). Agriculture and rural growth in Kenya. *DFID Kenya Commissioned Study, Tegemeo Institute, Egerton University*.

Okello, J. J., Al-Hassan, R., & Okello, R. M. (2010). A framework for analyzing the role of ICT on agricultural commercialization and household food security. *International Journal of ICT Research and Development in Africa*, *1*(1), 38–50.

Okello, J. J., Ofwona-Adera, E., Mbatia, O. L., & Okello, R. M. (2010). Using ICT to integrate smallholder farmers into agricultural value Chain: The case of DrumNet project in Kenya. *International Journal of ICT Research and Development in Africa*, *1*(1), 23–37.

Osei-Assibey, E. (2015). What drives behavioral intention of mobile money adoption? The case of ancient susu saving operations in Ghana. *International Journal of Social Economics*, *42*(11), 962–979.

Oseni, G., & Winters, P. (2009). Rural nonfarm activities and agricultural crop production in Nigeria. *Agricultural Economics*, *40*(2), 189–201.

Owens, J. (2007). Leapfrogging access to finance with mobile phone technology: Philippine rural banks offering M-banking & M-commerce

services. In *IFC/CGAP Conference, Washington, DC.* Retrieved from http://siteresources.worldbank.org/FSLP/Resources/JohnOwensshortversionupdated.

Padashetty, S., & Krishna Kishore, S. V. (2013). An empirical study on consumer adoption of mobile payments in Bangalore City–A case study. *Researchers World: Journal of Arts*, *Science & Commerce*, *4*(1).

Pedrosa, J., & Do, Q.-T. (2011). Geographic distance and credit market access in Niger. *African Development Review*, *23*(3), 289–299.

Peltoniemi, M. (2005). Business ecosystem: A conceptual model of an organisation population from the perspectives of complexity and evolution. *Research Reports 18.* Tampere, Finland: E-Business Research Centre.

Peprah, J. A., Afoakwah, C., & Koomson, I. (2016). Crop yield volatility among smallholder farmers in Ghana. *United Nations University Institute for Natural Resources in Africa*.

Poulton, C., Kydd, J., & Dorward, A. (2006). Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. *Development Policy Review*, *24*(3), 243–277.

Prina, S. (2015). Banking the poor via savings accounts: Evidence from a field experiment. *Journal of Development Economics*, *115*, 16–31.

Püschel, J., Afonso Mazzon, J., & Mauro C. Hernandez, J. (2010). Mobile banking: proposition of an integrated adoption intention framework. *International Journal of Bank Marketing*, *28*(5), 389-409.

Radcliffe, D., & Voorhies, R. (2012). A digital pathway to financial inclusion, Bill Melinda Gates Foundation. *Copia recuperada el*, *7*.

Ramayah, T., Siron, R., Dahlan, N., & Mohamad, O. (2002). Technology usage among owners/managers of SME's: The role of demographic and motivational variables. In *The proceedings of the 6th Annual Asian-Pacific Forum for Small Business on Small and Medium Enterprises Linkages, Networking and Clustering*.

Rao, E. J., & Qaim, M. (2011). Supermarkets, farm household income, and poverty: insights from Kenya. *World Development*, *39*(5), 784–796.

Reardon, T., Timmer, C. P., & Minten, B. (2012). Supermarket revolution in Asia and emerging development strategies to include small farmers. *Proceedings of the National Academy of Sciences*, *109*(31), 12332–12337.

Riquelme, H. E., & Rios, R. E. (2010). The moderating effect of gender in the adoption of mobile banking. *International Journal of Bank Marketing*, *28*(5), 328–341.

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41-55.

Rubin, D. B. (2004). Teaching statistical inference for causal effects in experiments and observational studies. *Journal of Educational and Behavioral Statistics,* 29, 343–368.

Sarma, M., & Pais, J. (2011). Financial inclusion and development. *Journal of International Development*, *23*(5), 613–628.

Sekabira, H., & Qaim, M. (2016). Mobile money, agricultural marketing, and off-farm income in Uganda. *Agricultural Economics*, *48*(5), 597-611.

Shambare, R. (2011). Cell phone banking adoption in South Africa. *Business and Economic Research*, *1*(1).

Siau, K., Sheng, H., & Nah, F. (2003). Development of a framework for trust in mobile commerce. *Journal of Communications of the Association for Computing Machinery, 46*(4), 91–94.

Sife, A. S., Kiondo, E., & Lyimo-Macha, J. G. (2010). Contribution of mobile phones to rural livelihoods and poverty reduction in Morogoro region, Tanzania. *The Electronic Journal of Information Systems in Developing Countries*, *42*(1), 1–15.

Sun, S., Goh, T., Fam, K. S., Xue, Y., & Xue, Y. (2012). The influence of religion on Islamic mobile phone banking services adoption. *Journal of Islamic Marketing*, *3*(1), 81-98.

Suri, T., Jack, W., & Stoker, T. M. (2012). Documenting the birth of a financial economy. *Proceedings of the National Academy of Sciences*, *109*(26), 10257–10262.

Tambo, J. A., & Wünscher, T. (2017). Farmer-led innovations and rural household welfare: Evidence from Ghana. *Journal of Rural Studies*, *55*, 263–274.

Tobbin, P. (2011). Understanding mobile money ecosystem: Roles, structure and strategies. In *2011 10th International Conference on Mobile Business* (pp. 185–194). IEEE.

Tobbin, P., & Kuwornu, J. K. (2011). Adoption of mobile money transfer technology: structural equation modeling approach. *European Journal of Business and Management*, *3*(7), 59–77.

Tran, T. Q., Nguyen, S. H., Vu, H. V., & Nguyen, V. Q. (2015). A note on poverty among ethnic minorities in the Northwest region of Vietnam. *Post-Communist Economies*, *27*(2), 268-281.

Tsu Wei, T., Marthandan, G., Yee-Loong Chong, A., Ooi, K.-B., & Arumugam, S. (2009). What drives Malaysian m-commerce adoption? An empirical analysis. *Industrial Management & Data Systems*, *109*(3), 370–388.

Van Biljon, J., & Kotzé, P. (2008). Cultural factors in a mobile phone adoption and usage model. *Journal of Universal Computer Science, 14*(16), 2650-2679.

Van Hove, L. (2001). The New York City smart card trial in perspective: A research note. *International Journal of Electronic Commerce*, *5*(2), 119-131.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.

Vijayasarathy, L. R. (2004). Predicting consumer intentions to use on-line shopping: the case for an augmented technology acceptance model. *Information & Management*, *41*(6), 747–762.

World Bank (2016). *World Development Indicators 2016*. Washington, DC: The World Bank.

World Bank (2014). *Global financial development report 2014: Financial inclusion* (Vol. 2). World Bank Publications.

World Bank (2013). E*nd Extreme Poverty 2030: Promote Shared Prosperity. Annual Report.* Washington, DC: The World Bank.

World Bank (2012). *The World Bank Annual Report: Main Report.* Washington, DC: The World Bank.

World Cocoa Foundation (2018). Future of mobile money for cocoa farmers in Côte d'Ivoire and Ghana. Retrieved from https://www.cgap.org/blog/future-mobile-money-cocoa-farmers-cote-divoire-ghana.

World Cocoa Foundation (2015). Mobile money for cocoa farmers in Ghana. Retrieved from https://www.cpg.org/blog/mobile-money-cocoa-farmers-ghana.

World Economic Forum (2012). *Annual Report.* Retrieved from https://www.weforum.org/reports/annual-report-2011-2012

Zeller, M., & Sharma, M., (2000). The Demand for Financial Services by the Rural Poor. In Sharma, M (Ed.). *Microfinance: A pathway from poverty.* (pp. 375-389). International Food Policy Research Institute, Washington, DC.

Zhou, T. (2011). An empirical examination of users' post-adoption behaviour of mobile services. *Behaviour & Information Technology*, *30*(2), 241–250.

APPENDICES

Appendix A: Linktest and Goodness-of-Fit-Test for the Probit Model

MM	Coef.	Std. Err.	p>|z|
_hat	1.020	0.100	0.000
_hatsq	0.078	0.060	0.190
_cons	-0.075	0.111	0.498
Goodness-of-fit			0.193

Appendix B: Pre-Estimation Test for the PSM

Estimation of the propensity score

Mobile money	Coefficient	Std. Err.	p>|z|	[95% conf.	Interval
Farmsize	-.070	.053	0.191	-.175	.035
Fertilizer application	.927	.157	0.000	.620	1.235
Insecticide application	-.231	.165	0.162	-.555	.093
Marital status	.056	.094	0.554	-.129	.241
Education level	.174	.047	0.000	.082	.265
Sex	.220	.141	0.117	-.055	.496
Age	-.000	.005	0.939	-.009	.009
District	.064	.085	0.455	-.103	.231
Accessible road	-.045	.130	0.732	-.300	.211
_cons	-.522	.366	0.154	-1.239	.196
Log likelihood	-266.547				
Lr chi2(9)	68.51				
Prob>chi2	0.000				
Pseudo R2	0.1139				
Number of obs	460				

Note: the common support option has been selected. The region of common support is [.26817411, .95395075]

Description of the estimated propensity score in region of common support

	Percentiles	Smallest		
1%	.2912565	.2681741		
5%	.3412691	.2824995		
10%	.3920299	.2876765	Obs	458
25%	.4983502	.2888799	Sum of Wgt.	458
50%	.6540661		Mean	.6423773
		Largest	Std. Dev.	.1784106
75%	.7774145	.9491531		
90%	.8827533	.9493252	Variance	.0318303
95%	.9180507	.9493987	Skewness	-.1355776
99%	.9475292	.9539507	Kurtosis	2.04378

The final number of blocks is 6. This number of blocks ensures that the mean propensity score is not different for treated and controls in each block. The balancing property is satisfied.

This table shows the inferior bound, the number of treated and the number of controls for each block

	Mobile Money		
Inferior of block of pscore	**No**	**Yes**	**Total**
.2	26	22	48
.4	67	56	123
.6	48	63	111
.7	13	62	75
.8	10	91	101
Total	164	294	458

Note: the common support option has been selected

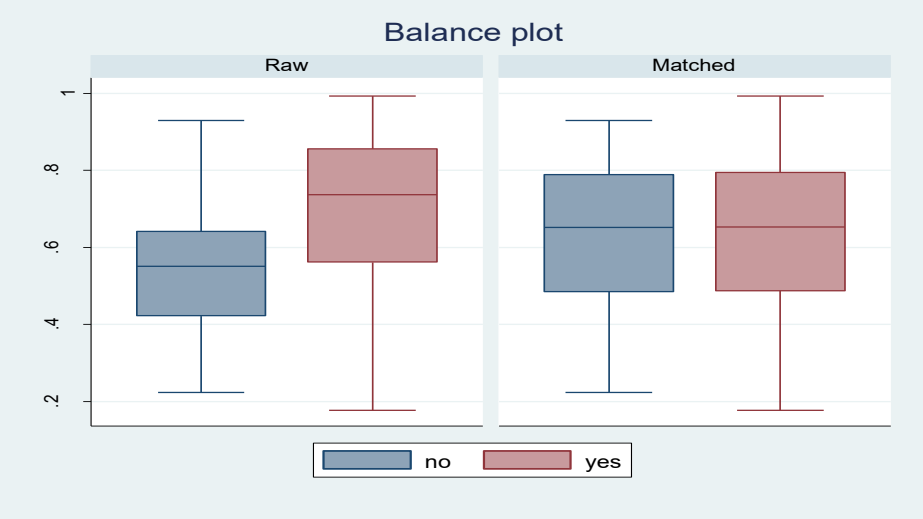
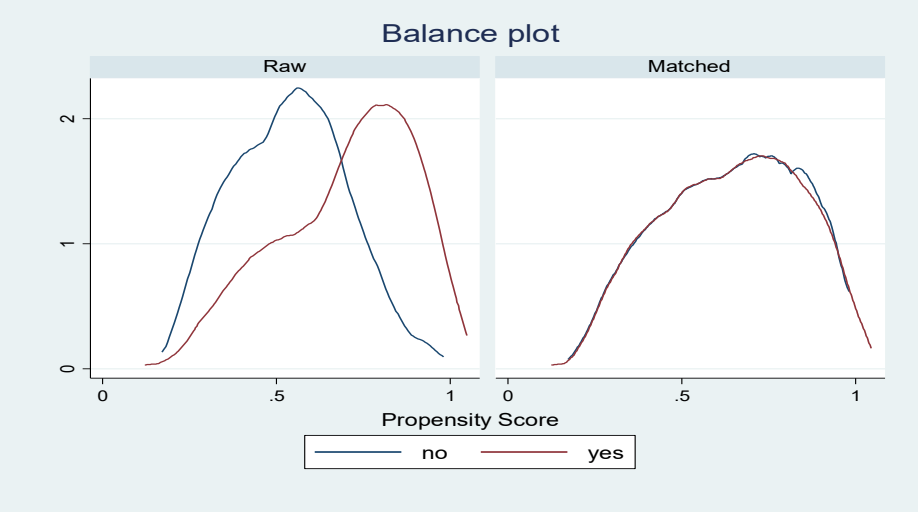


Figure 7: The Balancing Condition Test Using the Balance Box plot



Balance condition check using summary statistics

Variables	Standardized Differences Raw	Matched	Variance Ratio Raw	Matched
Hhsize	0.1040	-0.0846	0.7569	0.5828
Health	0.1304	-0.0890	1.0561	0.9619
Own_house	-0.0356	-0.2119	1.0513	1.2203
Numbr_financial	-0.1574	-0.0547	0.8131	0.9323
Farmsize	-0.0411	-0.1479	0.8944	0.9336
Insapp	0.0661	-0.1084	1.0692	0.9133
Mstatus(base=divorced)				
Single	0.1642	0.1197	1.6618	1.5098
Married	0.0545	-0.0439	0.9494	1.0459
Widowed	-0.1517	-0.0396	0.7122	0.9135
Edul(no-education)				
Primary	-0.0793	0.0620	0.8327	1.1655
J.H.S	0.2224	-0.0360	1.1666	0.9807
S.H.S&Higher	0.3452	0.0248	2.0978	1.0518
Male	0.3751	-0.0826	1.0513	1.0004
Ferapp	0.6062	-0.1295	1.5949	0.9420
Age	-0.0883	-0.1631	1.1237	0.9903
Age2	-0.0644	-0.1551	1.0375	0.9041
Dist(base=A.south)				
AAK	0.0457	0.1692	1.0296	1.1139
Sharma	-0.0445	-0.2378	0.9746	0.8956
Settl(base=planned)				
Scattered	0.1848	0.0609	0.9812	0.9952
Dense	-01649	-0.0750	0.9394	0.9741
	Raw	Matched		
Number of obs	460	920		
Treated obs	294	460		

Appendix C: Correlation Matrix of coefficients of regression model

	MM	Advert	Settl	Income	F_size	Consum	M_status	Age	Edu_l	Sex	Dis
MM	1.000										
Advert	0.178	1.000									
Settl	-0.080	0.099	1.000								
Income	0.088	0.014	-0.003	1.000							
F_size	-0.020	-0.077	0.065	0.194	1.000						
Consum	0.176	0.041	-0.040	-0.140	0.100	1.000					
M_status	-0.039	-0.051	0.018	0.011	0.022	0.160	1.000				
Age	-0.042	-0.051	-0.014	0.002	0.028	-0.179	0.289	1.000			
Edu_l	0.227	0.142	-0.049	0.026	0.085	0.106	-0.168	-0.288	1.000		
Sex	0.177	0.092	-0.119	0.091	0.069	0.142	-0.149	-0.062	0.431	1.000	
Dis	0.013	0.040	0.13	-0.198	0.262	-0.163	0.114	0.138	-0.004	-0.045	1.000

Appendix D: Questionnaire

SECTION A: IDENTIFICATION OF RESPONDENT

Name of respondent:	
Respondent's ID:	
Settlement/Location:	[1]-Urban [2]-Rural
Name of community/town:	
Indicate nearby popular spot or area name where house can be located, GPS coordinates	
Contact number	
Date of interview (dd/mm/yyyy):	[ ][ ] [ ][ ] 2018

Location:

a.Region code:	
Western	01
Central	02
Ashanti	06

b. District code:	
Shama	0106
AAK	0203
Adansi South	0604

c. Community code:	

SECTION B: RESPONDENT CHARACTERISTICS

Code	2 Relationship to HHH	3 Sex	4 Age in completed years	5 Highest level of education completed	6 Years of schooling completed	7 literacy (Can you read or write?)	8 Marital status	9 Religion	10 Main Ethnic Group	11 How many members are in your HH
01										

Key to Section B:

Relationship to HH	Sex	Highest level of education completed	Literacy	Marital Status	Main ethnic group	Religion
0. Household Head 1. Spouse 2. Child 3. Niece/Nephew 4. Brother/Sister 5. Parent 6. In-law 7. Grandparent 8. Grandchild 9. Other relative 10. Other non-relative	1. Female 2. Male	0. None 1. Non-formal 2. Kindergarten 3. Primary 4. JSS/JHS 5. Middle 6. SSS/SHS /Secondary/O and A levels 7. Voc/Tech/ Commercial 8. Teacher Training/ Nursing Training/ HND 9. Bachelor degree 10. Post graduate 11. Other (specify)	1. Cannot read and write 3. Can read only 4.Can write only 4. Can read and write	1. Single/Never Married 2. Consensual union/informal/ living together 3. Married 4. Divorced 5.Separated 6.Widowed	1. Akan 2. Ga-Adangbe 3. Ewe 4. Guan 5. Mole/ Dagbani 6. Grushi 7. Mande 8. Other (Specify) ----------	1. No religion 2. Catholic 3. Protestant 4. Pentecostal/ Charismatic 5. Other Christian 6. Islamic 7. Traditional 8. Other (specify) ----------

		----------				

SECTION C: LOCATION CHARACTERISTICS

1. What type of Settlement is in this district? Scattered ☐ Dense ☐ Planned ☐
Other (Specify) ----------

2. Which network coverage is available in this district? MTN ☐ Vodafone ☐ AirtelTIGO ☐ GLO ☐
Other (specify) ……

3 a. How many Financial Institutions can be found in this community? One ☐ Two ☐ Three ☐ Above Fou ☐
Other (specify) ----------

3 b. Which type is more common? Bank ☐ Credit union ☐ Microfinance ☐ Savings and Loans ☐

4. Does your district have accessible roads to the various farmlands? YES ☐ NO ☐

5.	Which language is commonly spoken in this district? [***Multiple response***]: 1-English ☐ 5-Hausa ☐ 9-Other (specify): ☐ _____ 2-Akan ☐ 6-Ewe ☐ 3-Ga-Dangbe ☐ 7-Nzema ☐ 4-Mole-Dagbani ☐ 8-Guan ☐

SECTION D: CROP FARMING ACTIVITIES

1. What is the size of your farmland? ……

2a. Crop	What size if your land was planted to this crop	2b. What was the quantity of crop produced from the last major farming season?		2c. Income from crop sales during the last major farming season	
		i. Quantity	ii. Unit	i. Quantity if no sales	ii. Income (GH¢)
1.					
2.					
3.					

2a. Crop	3a. Did you apply fertilizer in the cultivation of the crops in the previous season	3b. If **YES**, how many kilograms of fertilizer did you apply on your farm in the previous season?		4a Did you apply insecticides in cultivating your crops in the previous years?	4b. If **YES**, how many litres of insecticides did you apply in the previous years?	
	1 Yes 0 No	i. Quantity	ii. Unit	1 Yes 0 No	i. Quantity	ii. Units
1.						
2.						
3.						

SECTION E: ADOPTION AND USAGE OF MOBILE PHONE AND MOBILE MONEY

1. Do you have mobile phone? YES ( ) ( ) if NO >>>Q2

2a. If **YES,** do you use the mobile Phone? YES (1) NO (0) ***(if NO skip to Question 5)***

2b. What is the brand of your phone? Nokia Samsung iPhone Tecno Other (specify) …….

3.Which kind of network do you use? Multiple responses allowed MTN [1] Vodafone [2] AirtelTIGO [3] GLO [4] Kasapa [5]

4a.Are you registered for the mobile money service on your mobile network? YES (1) NO (0)

4b. If **YES**, Complete the following table

Mobile Money Service	**Code**	**Average Amount**	**Frequency of usage**	Rank the frequencies according to the following: 1. Very Often 2. Often 3. Less Often 4. Rare
Borrowing	01			
Sending Money	02			
Receiving Money	03			
Saving	04	`		
Payment of Bills/loans/items	05			
Purchasing of Inputs	06			
Payment of Insurance	07			

5a. Does any other member of the household own a mobile phone? YES (1) NO (0) if NO >>>Q6

5.b If **YES**, how many members of the household own a mobile phone? ----------

5.c.i What brand of phone is owned by these members? Nokia [1] Samsung [2] iPhone [3] Tecno [4] Other (specify) ……

5.c.ii Which networks do they use? MTN [1] Vodafone [2] AirtelTIGO [3] GLO [4] Kasapa [5]

6a. Does any of the other members in the household use mobile money? YES (1) NO (0)

6b. Have you ever received money through the mobile phone from any person either than yourself? YES (1) NO (0)

6c. Who was this person? …… (relation to person)

6d. Is this person in your household? YES (1) ☐ NO (0) ☐

7.What is the source of money you use to save on your mobile money account?

[1] Income from Farm Harvest [2] Remittances [3] Household Contribution [4].Loan [5]Other *(Specify)* ----------

---

8.Do you receive payment for your farm produce through mobile money? YES ☐ NO ☐

9.How often do you receive payments using through mobile money?

[1.] Very Often [2.] Quite Often [3.] Sometimes [4.] Not at all [5.] Other *(specify)* ----------

10. How many mobile money agents are in your community? [ ]

11. What is the distance (in metres) from your house to the nearest mobile money agent in the community? [ ] metres

12a. Does your household own a TV? Yes [1] No [0]

12a. Does your household own a radio? Yes [1] No [0]

13.Have you ever heard any advert on mobile money on TV/radio? Yes [1] No [0]

14.How many network bars do you usually have on your phone? [ ]

SECTION F: WELFARE
HOUSEHOLD EXPENDITURE (Food Item)

0a ITEM	0b Code	1. Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	2. How many times was …. Bought in the last 7 days?	3. How much was spent on … for the last 7 days altogether? (Total in GH cedis)
CEREALS AND BREAD				
Guinea corn / sorghum	001			
Maize	002			
Millet	003			
Rice (Local)	004			
Rice (Imported)	005			
Other cereals	006			
Bread-sugar bread	007			
Other bread	008			
Biscuits	009			
Flour (wheat)	010			
Maize ground / corn dough	011			
Kenkey / banku (without sauce)	012			
Baby food (cereals, etc)	013			
Other cereal product	014			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
MEAT: LIVE, FRESH, FROZEN, PROCESSED				
Corned Beef	018			
Pork	019			
Beef	020			
Goat Meat	021			

Mutton	022			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
Bushmeat / Wild game	023			
Other meat (dog, cat, etc)	024			
POULTRY				
Chicken	027			
Other domestic poultry	028			
Game birds	029			
FISH: FRESH, DRIED, FRIED				
Fish (fresh and frozen)	034			
Fish (dried)	035			
Fish (smoked)	036			
Fish (fried)	037			
Fish (canned)	038			
Fish (salted)	039			
Other (fish)	040			
MILK AND MILK PRODUCTS				
Milk (fresh)	044			
Milk (powder)	045			
Baby milk	046			
Tinned milk (unsweetened, evaporated)	047			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
Tinned milk (condensed)	048			
MILK AND MILK PRODUCTS *(continued)*				
Other milk products including cheese	049			
EGGS				

Chicken Eggs	053			
Other Eggs	054			
OIL AND FATS				
Coconut oil	058			
Groundnut oil	059			
Palm kernel oil	060			
Palm oil	061			
Shea butter	062			
Margarine / Butter	063			
Other vegetable oils including animal fats	064			
FRUITS, FRESH OR CANNED				
Coconut	068			
Banana	069			
Orange / tangerine	070			
Pineapple	071			
Mango	072			
Avocado pear	073			
Water melon	074			
Canned or processed fruits	075			
Other fruits not canned	076			
VEGETABLES INCLUDING POTATOES AND OTHER TUBER VEGETABLES				
Cocoyam leaves (kontomire)	080			
Garden eggs	081			
Okro	082			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
VEGETABLES INCLUDING POTATOES AND OTHER TUBER VEGETABLES *(continued)*				
Carrots	083			
Pepper (fresh or dried)	084			
Onions (large / small)	085			
Tomatoes (fresh)	086			
Tomatoes puree (canned)	087			

Other vegetables	088			
SUGAR, JAM, HONEY, SYRUPS, CHOCOLATE AND CONFECTIONERY				
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
Sugar (cube, granulated)	092			
Honey	093			
Ice cream, ice lollies, etc	094			
Chocolate	095			
Other confectioneries	096			
FOOD PRODUCTS NOT ELSEWHERE CLASSIFIED - - *Condiments and Spices*				
Black pepper	100			
Salt	101			
Ginger	102			
Dawadawa	103			
Other condiments (Royco, Maggie, etc)	104			
Starchy Staples				
Cassava	107			
Cocoyam	108			
Plantain	109			
Yam	110			
Other starchy staples	111			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
Pulses and Nuts				
Beans	115			
Pulses and Nuts *(continued)*				
Groundnuts (roasted or raw)	116			

Pam nuts	117			
Cola nuts	118			
Other pulses and nuts	119			
Processed Starchy Staples				
Cassava -dough	123			
Gari	124			
Other processed starchy staples	125			
NON-ALCOHOLIC BEVERAGES - - Coffee, Tea and Cocoa				
Coffee	129			
Chocolate drinks (including Milo, Bournvita, etc)	130			
Tea	131			
Other beverages drinks	132			
Minerals waters, soft drinks and juices				
Soft drinks and minerals	136			
Malta and Malt drinks	137			
Fruit juices	138			
Mineral water (incl. bottled water)	139			
Mineral water (incl. sachet water)	140			
ALCOHOLIC BEVERAGES, TOBACCO AND NARCOTICS - -SPIRITS				
Schnapps	143			
Whiskies and Gins	144			
Akpeteshie	145			
Other spirits	146			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
WINE				
Palm wine / Raffia palm wine etc	150			
Pito / Brukutu, etc	151			
Other local wine	152			
Other imported wine	153			

BEER				
Beer (local)	157			
Beer (imported)	158			
Guiness & other stout	159			
TOBACCO				
Cigarette, cigar	163			
Tobacco (processed)	164			
Other tobacco products	165			
HOUSING, WATER, ELECTRICITY, GAS AND OTHER FUELS - - - OTHER SERVICES RELATING TO THE DWELLINGS				
Refuse disposal	169			
Expenditure on public toilets (WC and others)	170			
SOLID FUELS				
Charcoal	174			
Firewood and other solid fuels	175			
ICE				
Ice block (household cooling and refrigeration only)	179			
FURNISHING, HOUSEHOLD EQUIPMENT AND ROUTINE MAINTENANCE - - NON-DURABLE HOUSEHOLD GOODS				
Washing soaps & powder	180			
Bathing / toilet soaps (liquid or solids)	181			
Bleaches	182			
Disinfectants and cleaners	183			
FURNISHING, HOUSEHOLD EQUIPMENT AND ROUTINE MAINTENANCE - - NON-DURABLE HOUSEHOLD GOODS (continued)				
Insecticides coils and sprays	184			
Matches	185			
Toilet papers	186			
NON-DURABLE PRODUCTS, APPLIANCES AND EQUIPMENT				
Candles	187			
Kerosene	188			
Other non-durable goods	189			
HEALTH - - MEDICAL PRODUCTS, APPLIANCES AND EQUIPMENT				
Pain killers (paracetamol, APC, etc)	193			

Antibiotics	194			
Anti malaria medicine	195			
Condoms	196			
Other (specify) ----------				
HEALTH - - MEDICAL PRODUCTS, APPLIANCES AND EQUIPMENT (continued)				
Other medical and pharmaceutical drugs	198			
TRANSPORT - - FUELS AND LUBRICANTS (HOUSEHOLD USE AND PRIVATE CARS)				
Petrol	202			
Diesel	203			
MAINTENACE,REPAIR AND OTHER SERVICES				
Washing / parking spaces services	207			
PASSENGER TRANSPORT BY RAIL				
Cost of travel by rail	211			
PASSENGER TRANSPORT BY ROAD				
Bus fares (STC, Metro Mass Transport, Neoplan, etc)	215			
Trotro, taxi & other transport	216			
ITEM	Code	Was anything spent by the HH on …… for the last 7 days? 0.NO 1.YES	How many times was …. Bought in the last 7 days?	How much was spent on … for the last 7 days altogether? (Total in GH cedis)
PASSENGER TRANSPORT BY SEA AND INLAND WATERWAY				
Cost of travel by ferries and canoes	220			
OTHER PURCHASED TRANSPORT SERVICES				
Porters (kayaye, male porters, etc)	224			
Cost of luggage and items transported unaccompanied	225			
COMMUNICATIONS - - POSTAL AND TELECOMMUNICATION SERVICES				
Postage (within Ghana)	229			
Postage (outside Ghana)	230			
Telephone calls	231			
Internet / e-mail	232			

Other postal services	233			
RECREATION AND CULTURE - - GAMES OF CHANCE				
National lotteries	237			
Other lotteries	238			
BOOKS				
Exercise books & writing pads	242			
Text books, story books, pamphlets / dictionaries, etc	243			
NEWSPAPERS AND PERIODICALS				
Graphic and Times	247			
Private newspapers	248			
Magazines	249			
Other newspapers & periodicals	250			
HOTELS, CAFÉ AND RESTAURANTS - - RESTAURANTS, CAFÉ, TAKE-AWAYS AND THE LIKE				
Cooked rice and sauce	254			
Fufu or Tuo with soup	255			
Banku or kenkey with sauce	256			
Other prepared meals	257			
Fast foods	258			
CANTEENS (WORKERS / UNIVERSITIES AND SCHOOLS CANTEEN)				
Cooked rice and sauce	262			
Fufu or Tuo with soup	263			
Banku or kenkey with sauce	264			
Other meals	265			
MISCELLANEOUS GOODS AND SERVICES - - HAIRDRESSING SALONS AND PERSONAL GROOMING ESTABLISHMENTS				
Services of barbers, beauty shops, etc (Men)	269			
Services of barbers, beauty shops (Women) including manicure and pedicure	270			
Mesh / Wigs (Natural / artificial)	271			
Other personal grooming services	272			
APPLIANCES, ARTICLES AND PRODUCTS FOR PERSONAL CARE				

Goods for personal care (toothpaste, razor blades, combs, scent sprays, cosmetics, etc)	276			
Other articles and products for personal care	277			

4.a Do you have a source of drinkable water in your region / community? 1 – YES ☐ 0- NO ☐

4b.IF **YES** what is the main source of drinking water for your household ? ☐☐

Type of Water Source	**Code**
Pipe-borne inside dwelling	01
Pipe-borne outside dwelling but on compound	02
Pipe-borne from neighboring house	03
Public tap/standpipe	04
Borehole/Pump/Tube Well	05
Protected well	06
Harvested Rain water/spring	07
Protected spring	08
Bottled Water	09
Sachet Water	10
Tanker supply/Vendor Provided	11
Unprotected well	12
Unprotected spring	13
River /Stream	14
Dug out/ pond/Lake/ Dam/ Canal	15
Other (Specify) ----------	16

4c. What is the main source of drinking water for your household in this community during rainy season? ☐☐

Type of Water Source	**Code**
Pipe-borne inside dwelling	01
Pipe-borne outside dwelling but on compound	02
Pipe-borne from neighboring house	03
Public tap / standpipe	04

Borehole/ Pump/Tube Well	05
Protected well	06
Harvested Rain / spring	07
Protected spring	08
Bottled Water	09
Sachet Water	10
Tanker supply / Vendor Provided	11
Unprotected well	12
Unprotected spring	13
River / Stream	14
Dug out / pond / Lake / Dam / Canal	15
Other (Specify) ----------	16

5.a. Do you own a house? YES (1) ☐ NO (0) ☐

5.b. If **YES**, what type of house do you own in this community? [1.] Block building [2.] Wooden Structure [3.]Hut [4.] Other (specify) ------

6. Are you staying with your household? 1- YES ☐ 0 – NO ☐

7. Is there a health facility in the community that you live? 1- YES ☐ 0 – NO ☐

8. If **YES**, which kind of health facility is in the community that you live? 1. Hospital 2. Clinic 3. Chips Compound ☐
Other (specify) ----------

SECTION G: ASSETS AND DURABLE CONSUMER GOODS

1.Within the house household, specify the type of durable asset that the household owns

This section seeks to obtain information on household durable assets, age of the assets and current value of all assets whether in use or not in use

H1	Item	Item code	Does any member of the household own……? 1-Yes, working 2-Yes, not working 3-No			How long ago was …… obtained? LESS THAN ONE YEAR: 00 ITEM			How much could you sell it now in Ghana Cedis? I T E M		
			A	B	C	A	B	C	A	B	C
	Furniture	01									
	Sewing machine	02									
	Stove (Kerosene)	03									
	Stove (Electric)	04									
	Stove (Gas)	05									
	Refrigerator	06									
	Freezer	07									
	Air conditioner	08									
	Fan	09									
	Radio	10									
	Radio cassette	10									