LUND UNIVERSITY
School of Economics and Management

Master's Programme in Innovation & Global Sustainable Development

# Finance and Mobile Money for Rural Development

## The case of Smallholder Farmers in Haiti

by

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*Abstract:* Globally, 500 million smallholder farmers require finance to secure a more productive, efficient, sustainable, and inclusive food system. Thus far, traditional financial services have been unsuccessful in reaching these farmers. Yet, mobile money services are proposed as a potential tool for enabling smallholder farmers access to financial services. Nonetheless, this proposed impact of mobile money on smallholder farmer finance has, insofar, not been studied in the literature. Accordingly, the primary aim of this study is to contribute to the understanding of whether mobile money enables smallholder farmer finance in Haiti. Moreover, this study aims to identify the advantages and challenges of mobile money for enabling inclusive smallholder farmer finance. As a methodological approach, this study conducts a binary logistic regression which employs a Penalised Maximum Likelihood Estimation using data from the 2018 FinScope Haiti Consumer Survey. The results do not support the expectations of mobile money enabling smallholder farmer finance. Particularly, (remaining) barriers of formal financial access, financial knowledge, income, and attitudes towards financial services are found to challenge mobile money. These results suggest that mobile money alone is unlikely to enable smallholder farmer finance. Instead, it suggests that a wider approach targeting the found challenges is needed for inclusive smallholder farmer finance.

*Keywords:* mobile money, smallholder farmers, rural finance, smallholder farmer finance, Haiti

EKHS35
Master's Thesis (15 credits ECTS)
May 2020
Supervisor: Finn Hedefalk
Examiner: Josef Taalbi
Word Count: 16,575

# Acknowledgements

First and foremost, I would like to thank my supervisor, Finn Hedefalk, for his guidance through each stage of the process. His constructive feedback helped me to shape and steer this thesis. In addition, I would like to thank my family, friends, and fellow master students for their infinite support.

# Table of Contents

# List of Tables

# List of Figures

# 1. Introduction

Worldwide, more than 500 million smallholder farmers exist, securing the livelihood of over two billion people (Lowder, Skoet & Raney, 2016; Mensink & Vranken, 2017). Smallholder farmers are defined by the FAO (2012) as farmers who own small plots of land, cultivate subsistence crops and one or two cash crops while depending almost completely on family labour. These smallholder farmers have a key role in feeding the world, supplying up to 80 percent of the total food stock in non-industrialised countries (ed. FAO, 2014a; Mensink & Vranken, 2017). Currently, smallholder farmers face an increasing number of challenges. For instance, securing a stable supply of food as over twelve percent of the worldwide population suffers from chronic hunger and over one billion are undernourished (Sadler, Millan Arredondo, Swann, Vasileiou, Baedeker, Parizat, Germer & Mikulcak, 2016). Notably, half of the world's undernourished people are smallholder farmers (ed. Hazell, Paulton, Wiggins & Dorward, 2007). With the global population projected to grow to nearly 10 billion by 2050 (United Nations, 2015), it is estimated that the world will need to produce, at minimum, 50 percent more food (Sadler et al., 2016). This indicates that the challenges of worldwide food security will increase. Simultaneously, production is having difficulties to keep up with global demand as crop yields are declining due to increasing constraints on natural resources (Sadler et al., 2016; Trendov, Varas & Zeng, 2019). To demonstrate, health levels of oceans are declining, and quality levels of soil, water, and biodiversity are running alarmingly low (Sadler et al., 2016).

Additionally, smallholder farmers are facing increasing pressure from climate change (Mensink & Vranken, 2017). As debated by Sadler et al. (2016), agriculture is exceptionally exposed to climate change. Crops, livestock and fisheries are sensitive to temperature changes (Sadler et al., 2016). Besides, climate change impacts water availability and the occurrence of extreme weather events (Sadler et al., 2016). Consequently, putting yields at risk, jeopardising productivity, and exposing farmers to serious hazards (Sadler et al., 2016). These negative effects on agricultural yields subsequently affect the income, food security, and livelihoods of smallholder farmers (Sadler et al., 2016). Nonetheless, the practice of agriculture also considerably contributes to climate change (Sadler et al., 2016). To illustrate, smallholder

farmers are estimated to produce five percent of total global greenhouse gas emissions (Vermeulen & Wollenberg, 2017).

Altogether, these challenges are unified in Sustainable Development Goal number 2: *Zero Hunger*. This goal requires "more productive, efficient, sustainable, inclusive, transparent and resilient food systems" (FAO, 2017; Trendov, Varas & Zeng, 2019, p. 1). To achieve this, a transformation of the current agri-food system is essential.

To deal with these challenges and to transform the agri-food system, financial support is essential. Particularly smallholder farmers need financial support as they lack adaptation capacity, have insufficient safety nets, and are greatly threatened by livelihood and food-security risks (Sadler et al., 2016). In order for these smallholder farmers to secure a long-term and sustainable food supply and income, access to finance is crucial (FAO, 2014; Mensink & Vranken, 2017). Total demand for smallholder financing is estimated at around 450 billion U.S. dollars (Mensink & Vranken, 2017). In spite of, the Initiative for Smallholder Finance estimates that the current supply of finance covers solely 10-20 billion U.S. dollars (The Rural and Agricultural Finance Learning Lab, 2020).

This disparity in demand and supply of finance is a substantial problem in developing countries (Sadler et al., 2016). Financiers perceive smallholder farmers to offer low profitability and high operational risks (Sadler et al., 2016). As a result, financiers limit their exposure, increase interest rates, strengthen credit criteria, impose burdensome lending terms, and frequently move away from lending to smallholder farmers completely (Sadler et al., 2016). Subsequently, leading to insufficient and inadequate access to finance for smallholder farmers. As a consequence, the majority of smallholder farmers are financially excluded and rely greatly on cash (APEC, 2017). This is troublesome as cash is costly to collect and send, slow to transport, and subject to thievery and misappropriation (APEC, 2017).

Yet, mobile signals and cell phone ownership are spreading globally, reaching the Global South and impoverished, financially excluded individuals (Avle, Quartey & Hutchful, 2020; GSMA, 2018). Accordingly, it is emphasised that mobile financial services have the potential to enable financial access to smallholder farmers (APEC, 2017). Specifically, the mobile service *mobile money* is argued to have the ability to send money cheaper, safer, and faster (Donovan, 2012; McKay & Pickens, 2010; Morawczynski, 2009a). Hence, it is estimated that mobile money has

the potential to reduce the transaction costs of financial services (Donovan, 2012). Consequently, allowing marginalised individuals to access essential financial services (McIntosh & Mansini, 2018). Altogether, considerable excitement has been generated by the discovery that mobile money creates new opportunities for integrating smallholder farmers in the financial system (Trendov, Varas & Zeng, 2019).

With regards to literature, studies examining the impact of mobile money on specifically smallholder farmers are limited (Baumüller, 2018). Insofar, studies have found mobile money to generally have a positive impact on agricultural development (Yao & Shanoyan, 2018). To demonstrate, literature finds mobile money to lower transaction costs (e.g. Awunyo-Vitor, 2016; Boadi, Boateng, Hinson & Opoku, 2007; Vong, Fang & Insu, 2012) and improve cash flow and liquidity (e.g. Jack & Suri, 2011; Kikulwe, Fischer & Qaim, 2013, 2014; Munyegera & Matsumoto, 2018) for smallholder farmers. Moreover, literature finds mobile money to improve risk management (e.g. Abiona & Koppensteiner, 2020; Batista & Vicente, 2018; Jack & Suri, 2014) and increase investment (e.g. Kirui, Okello, Nyikal & Njiraini, 2013; Sekabira & Qaim, 2017). Based on a systemic literature review, scholars Kim, Zoo, Lee & Kang (2018) argue that research concerning the impact of mobile money on development remains at an early stage. Particularly, literature concerning the impact of mobile money tends to "propose possible or potential impacts, rather than empirically demonstrating or discussing the actual benefits or development impact" (Kim et al., 2018, p. 10).

## 1.1 Aims and Objectives

Thus far, research examining the impact of mobile money has been limited (Kim et al., 2018). The handful of studies that do examine the impact of mobile money have been theoretical, conceptualising possible and potential (positive) impacts rather than examining actual benefits (Kim et al., 2018). Particularly, the impact of mobile money on the livelihood of smallholder farmers has been neglected. According to a systemic literature review by Baumüller (2018), no study has examined the impact of mobile money on credit and insurance for smallholder farmers. Accordingly, it remains to be answered whether smallholder farmers experience livelihood improvements from mobile money. This is especially essential since mobile money has been proposed as the promising new channel for smallholder finance and development by many organisations, including the World Bank, the United States Agency for International

Development, the Consultative Group to Assist the Poor, and the Global Partnership for Financial Inclusion (Martin, Harihareswara, Diebold, Kodali & Averch, 2016; Miller, 2015; Sadler et al., 2016).

Therefore, this thesis aims to contribute to the understanding of whether mobile money enables smallholder farmer finance. Particularly, whether mobile money provides Haitian smallholder farmers access to finance. Haiti was chosen as the study area because only 32.6 percent of the population owns a bank account, while almost 70 percent of the population has access to a mobile phone (World Bank, 2020a). Moreover, Haiti was named as the fastest growing mobile money market worldwide by Simon in 2012 and experienced a mobile money customer base growth of 860 percent between 2015 and 2017 (GSMA, 2017). Besides, almost half of the Haitians are reported to work in the agriculture sector, which is greatly vulnerable as Haiti is reported to be one of the countries to be most prone to natural disasters (Eckstein, Hutfils & Winges, 2018; World Food Programme, 2019). Hence, Haiti offers the interesting combination of many individuals who are financially excluded, who have access to a mobile phone, who have adopted mobile money, and who are likely in need of financial support as they work in the agriculture sector and are at high risk of natural disasters.

In order to examine the relationship between mobile money and Haitian smallholder farmer access to finance, this study applies a binary logistic regression, using FinScope survey data from the FinMark Trust. This binary logistic regression employs a Penalised Maximum Likelihood Estimation to account for few events in the data. The dependent variable concerns smallholder farmer finance, which in this specific case concerns whether Haitian farmers report access to insurance and credit. The dependent variables of insurance and credit are binary, where a value of one indicates access and zero no access. The main independent variable of interest concerns mobile money, which measures whether a farmer uses the service. Additionally, this study seeks to understand the examined relationship between mobile money and insurance and credit. Hence, it sets out to identify the advantages and challenges of mobile money for inclusive smallholder farmer finance.

### 1.2.1 Research Questions

In order to achieve the aforementioned aim, this thesis seeks to answer the question:

*What are the short-term implications of mobile money for inclusive smallholder farmer finance in Haiti?*

To answer this main research question, it is important to examine the relationship between mobile money and smallholder farmer finance. The main tools of smallholder farmer finance have been identified to be insurance and credit (Murendo & Wollni, 2016). Therefore, the first sub-research question is as follows:

*What is the relationship between mobile money and the likelihood to be insured and have accessed credit for Haitian farmers?*

Hereafter, it is important to understand the observed relationship and to examine whether it is inclusive. Hence, it is vital to analyse advantages and challenges for mobile money with regards to inclusive smallholder farmer finance. Accordingly, the second sub-research question concerns:

*What are the advantages and challenges for mobile money with regards to inclusive smallholder farmer finance in Haiti?*

## 1.2 Outline of the Thesis

The overall structure of this thesis takes the form of six main chapters. The first section, chapter two, commences by laying out the theoretical dimensions of the research and introduces the obstacles to inclusive rural finance and its repercussions on smallholder farmer livelihood. Thereafter, it introduces the theoretical framework which explains the theorised potential for mobile money to enable inclusive smallholder farmer finance. Subsequently, chapter three presents the literature review which includes a comprehensive history on smallholder farmer finance, followed by a review of studies examining the impact of mobile money on smallholder farmers. Chapter four presents background information on Haiti with regards to food security, financial inclusion, and mobile money. The fifth chapter describes the material and methods used for this study. This chapter starts by introducing the data used, followed by the analyses applied, and the descriptive results found. Thereafter, chapter six presents the empirical analysis which includes the empirical results and discussion. Finally, chapter seven presents the conclusions of this study.

# 2. Theoretical Framework

Global demand for smallholder farmer finance is estimated to be around 450 billion U.S. dollars (Mensink & Vranken, 2017). Yet, current supply only covers around four percent of this demand (The Rural and Agricultural Finance Learning Lab, 2020). This is unsettling as investing in agriculture is found effective for reducing poverty, inequality and hunger (Christen & Anderson, 2013; Christiaensen, Demery & Kuhl, 2011; FAO, 2012b; World Bank, 2007). To examine the implications of mobile money for smallholder farmer finance, this theoretical framework commences by introducing the current obstacles to inclusive rural finance and its repercussions for smallholder farmers. Thereafter, the theorised potential for mobile money to enable inclusive smallholder finance is presented.

## 2.1 Obstacles to Inclusive Rural Finance

For decades, there have been numerous obstacles challenging access to sufficient and adequate finance for smallholder farmers (Sadler et al., 2016). Formal financial services tend to fail serving most of the smallholder farmers in the Global South (Besley, 1994). Both the supply and demand side face several constraints to inclusive finance. Concerning the supply side, financial service providers face constraints with regards to smallholder farmer characteristics, high transaction costs due to physical distance, resource constraints due to agricultural cycles, and high covariate risks (e.g. Gencer, 2011; IFAD, 2016a; Stephens & Warmington, 2017). To illustrate, smallholder farmers often lack the necessary credit history and suitable means of collateral required by financial service providers (Stephens & Warmington, 2017).

Regarding high transaction costs, smallholder farmers live widely dispersed in rural areas, creating a physical distance between smallholder farmers and financial service providers (Campion, 2017; Poulton, Kydd & Dorward, 2006). Consequently, delivering financial services over this physical distance comes with high transaction costs (Kirui, Okello & Nyikal, 2012a; Poulton, Kydd & Dorward, 2006). For instance, the high cost of establishing branches in widely dispersed areas while facing low profitability levels, making operations financially

unsustainable (APEC, 2017; IFAD, 2016a). As for insurance, similar prohibitive infrastructure costs are experienced by financial service providers (Gencer, 2011). Sending out an auditor for assessing the farmland upon insurance and after an insurance claim is too costly given the small crops smallholder farmers grow (Gencer, 2011). Besides, remote areas are subject to security risks during the transport and storage of cash (APEC, 2017; Sander, 2003).

Moreover, conventional financial services seem unfit for smallholder farmers as they generally require regular repayments (APEC, 2017; Stephens & Warmington, 2017). Smallholder farmers, however, face difficulty adhering to these regular repayments as they experience uneven cash flows (Stephens & Warmington, 2017). To illustrate, farmers require money at the start of the planting season for obtaining farming inputs such as seeds and fertilizer (Stephens & Warmington, 2017). Throughout this season, revenue streams are irregular, only by harvest season will smallholder farmers experience serious revenue streams to repay financial service providers (Stephens & Warmington, 2017). As a consequence, financial service providers experience resource constraints complying to these irregular smallholder farmer income flows (APEC, 2017; Stephens & Warmington, 2017).

In addition, financial service providers experience high covariate risks serving smallholder farmers (Kirui, Okello & Nyikal, 2012a; Sadler et al., 2016). Covariate risks concern risks where neighbouring households experience similar shocks (Barrett, 2011). In the case of smallholder farmer finance, this could, for instance, concern the high risk that harvests of many households simultaneously fail due to droughts or floods, leading to widespread defaults on loans and unpaid bills (Miller, 2015). Subsequently, pressuring the financial service provider (Campion, 2017).

Altogether, these constraints result in financial service providers limiting their exposure, increasing interest rates, tightening lending criteria, and often completely shifting away from providing financial services to smallholder farmers (Sadler et al., 2016). As a result, financial service providers lack the appropriate products and services to meet the financial needs of smallholder farmers (Campion, 2017).

Notwithstanding, the smallholder farmers demand side also faces numerous obstacles to accessing financial services. Namely, insufficient income, documentation, education, trust, and gender discrimination (e.g. Clamara, Ximena & Tuesta, 2014; Turvey, 2017). With regards to income, many smallholder farmers live in poverty, surviving on less than two dollars a day (Rapsomanikis, 2015; World Bank, 2016). Accordingly, they lack the financial resources to pay for back account fees, transaction costs, and maintaining a minimum account balance (Clamara, Ximena & Tuesta, 2014; Demirguc-Kunt & Klapper, 2012; Turvey, 2017).

Concerning documentation, many individuals in the Global South lack the documentation required for accessing financial services (GSMA, 2016). For instance, many do not possess an official birth certificate or official address (Asian Development Bank, 2016; Tuoane-Nkhasi, 2019; UNICEF, 1998). Moreover, the land they farm is often allocated by tradition and culture rather than formal land tenure (IFC, 2013). As a result, the vast majority of smallholder farmers do not have legal rights over their farming land, making it difficult to utilise as collateral for financing (IFC, 2013).

Besides, inadequate education is a critical obstacle for accessing financial services (Ngugi, Pelowski & Ogembo, 2010). Majority of smallholder farmers only have a few years of schooling (Rapsomanikis, 2015). As a result, illiteracy levels are often high and financial knowledge and awareness of financial services and products are often low (FAO, 2020). Lacking financial knowledge and unfamiliarity with financial services may subsequently lead to low levels of trust in financial service providers (Atkinson & Messy, 2013). Notably, trust in financial service providers is an essential driver for engaging in financial services (Babcock, 2015; Karlan, Osei, Osei-Akoto & Udry, 2012).

Finally, gender is found to impact access to financial services (Johnson, 2004; Muravyev, Talavera & Schäfer, 2009). Globally, there are laws and regulations restraining women access to financial services (Morrisson & Jutting, 2005; World Bank, 2020b). Moreover, women are often relegated to unpaid farm work, household chores and excluded from decision-making whereas men undergo education and obtain resources and land (World Bank, 2018a). These social structures are the result of obsolete gender norms where farms are handed over from father to son, not father to daughter (World Bank, 2018a). Besides, women often report lower

levels of income, education, and formal employment, resulting in obstacles to financial access as aforementioned (Jayachandran, 2015).

Overall, it is evident that both financial service providers and smallholder farmers face constraints in providing and accessing inclusive finance. The main obstacles that create these constraints include high transaction costs, irregular farmer income, covariate risks, official documentation, education, and gender. The gap in smallholder finance demand and supply demonstrates that, thus far, these obstacles to inclusive finance have not been overcome. Therefore, this study examines whether mobile money has the potential to play an enabling role in achieving inclusive rural finance.

## 2.2 Repercussions

As a consequence of the aforementioned obstacles, the majority of smallholder farmers experience substantial repercussions arising from the insufficient and inadequate access to finance. Since the income of smallholder farmers is concentrated in a particular season, there is a substantial need to engage in financial services in order to escape a "hand-to-mouth existence" (Mas, 2009, p. 57). The main repercussions concern the inadequate financial support for the large time lag between input investment and profit, unexpected shocks, commercialisation, and the dependency on cash (McIntosh & Mansini, 2018; Ng'weno, Oldja, Hassan & Kapoor, 2018).

With regards to unexpected shocks, smallholder farmers are at risk of yield losses due to floods, droughts, pests, diseases, fires, and livestock illnesses affecting their harvest (Gencer, 2011; Miller, 2015). Deprived of access to financial services, smallholder farmers need to persist with little to no income to feed their households and have no resources to invest in farming input that could potentially improve future crop yields (Gencer, 2011). Access to insurance or credit would enable smallholder farmers to mitigate the risk of unexpected shocks and avoid drastic shortfalls in food consumption (APEC, 2017; Zeller & Sharma, 2000). Moreover, insurance will enable smallholder farmers to adopt more risky, profitable income-generating activities and increase their access to credit (Dalberg Global Development Advisors, 2016; Miller, 2015; Zeller & Sharma, 2000).

Concerning commercialisation, smallholder farmers experience a lack of working capital and low liquidity due to insufficient access to finance, consequently impeding their prospect of commercialisation (APEC, 2017; Kirui, Okello & Nyikal, 2012a). In particular, it restricts smallholder farmers to invest in productivity-enhancing inputs like seeds, fertilizer, and pesticide (IFAD, 2016b; Kirui, Okello & Nyikal, 2012a). Accordingly, smallholder farmers are only able to cultivate small volumes (Kirui, Okello & Nyikal, 2012a). This eliminates them from engaging in large volume markets that are better paid (Kirui, Okello & Nyikal, 2012a). As a consequence, smallholder farmers often remain autarkic and trapped in the *low equilibrium poverty trap* (Kirui, Okello & Nyikal, 2012a).

Moreover, as smallholder farmers are excluded from formal financial services, they greatly rely on cash (Mas, 2009). This dependency is generally disadvantaging smallholder farmers as cash has several drawbacks (APEC, 2017). Firstly, the use of cash is costly (APEC, 2017). To make a payment or transfer money, smallholder farmers either need to travel themselves or book a carrier, resulting in large transaction costs (APEC, 2017). Secondly, cash is insecure as it is susceptible to robberies and thefts during the journey (APEC, 2017; Kirui, Okello & Nyikal, 2012b). Hence, smallholder farmers may never receive their payments. Thirdly, cash is slow (APEC, 2017). It may take weeks to execute a cash payment since it only moves as fast as the human transporting it (APEC, 2017). Subsequently, leaving the smallholder farmer waiting for weeks to receive their payment (Murendo & Wollni, 2016). Finally, cash is not transparent (APEC, 2017). Cash does not always allow for a record of transaction, potentially permitting misappropriation (APEC, 2017). Evidently, cash is connected with high costs of accessing capital (Murendo & Wollni, 2016). Therefore, reducing smallholder farmer disposable income and investment in agriculture (Murendo & Wollni, 2016).

Altogether, the absence of affordable, convenient, and safe financial services constraints smallholder farmers in managing agricultural cycles, unexpected shocks, and commercialisation. As a consequence, they depend on their limited savings to invest in farm inputs, resulting in lower productivity and enduring income inequality (Martin et al., 2016). This indicates that the need for finance is not a demand for merely increasing business, instead, it concerns the need for securing a (basic) livelihood.

## 2.3 Mobile Money

Theoretically, mobile money offers a promising alternative infrastructure for delivering inclusive finance (Aker, Boumnijel, McClellan & Tierney, 2011; APEC, 2017). As explained by Suri & Jack (2016), mobile money concerns "...a service that allows monetary value to be stored on a mobile phone and sent to other users via text messages" (p. 1288). Mobile payments include payments from person to person, business to person, and government to person (Raithatha, 2020). Providing financial services via these digital means of mobile money is projected to enable financial access to smallholder farmers (APEC, 2017). In particular, as stated by the UNCDF, "agricultural mobile finance... can promote increased investment in value chains by providing a cheaper, more efficient, traceable and transparent payment method for high-volume, low-value transactions" (Ogwal & Mugabi, 2015, p. 3). The theoretical impact of mobile money is visualised in figure 2.1.

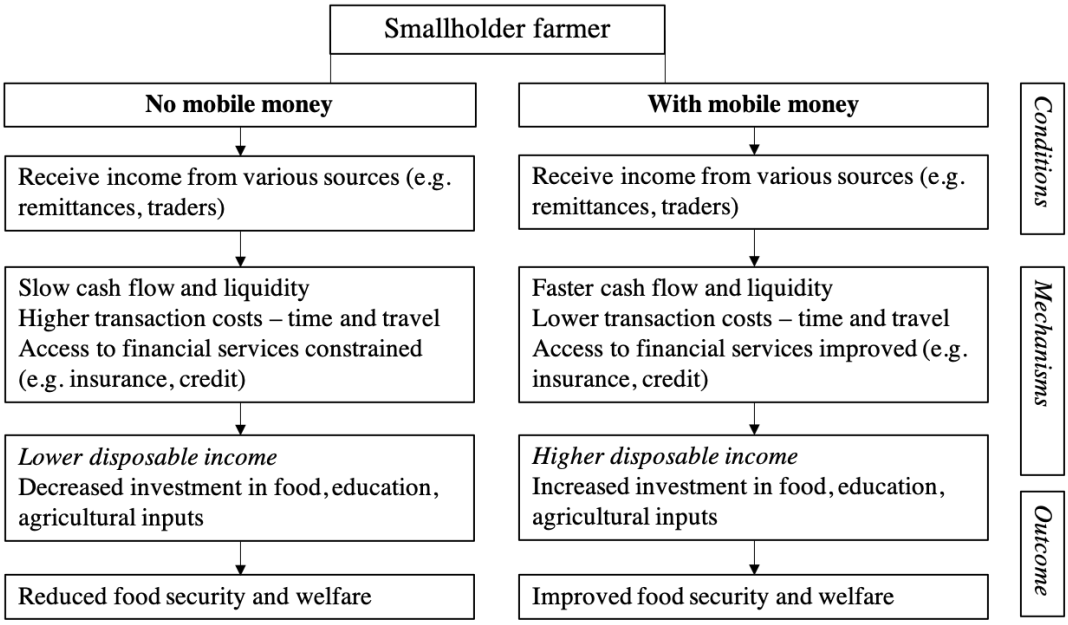


*Figure 2.1, Theoretical Framework (Adapted from Murendo & Wollni, 2016)*

As can be seen in figure 2.1, smallholder farmers receive income from various sources. In case these income streams are received through mobile money, smallholder farmers experience faster cash flow and liquidity, lower transaction costs, and improved access to financial services. To illustrate, mobile money is expected to facilitate easier and more efficient trade (Jack & Suri, 2011). Particularly, using mobile money makes it easier and faster to pay and receive payments for goods and services (Jack & Suri, 2011). As a result, farmers no longer

have to wait weeks for their payment, making payments through mobile money more efficient (GSMA, 2017).

Moreover, mobile money provides an opportunity for financial service providers to reach smallholder farmers in remote areas (APEC, 2017). As aforementioned, upholding a traditional branch network in rural areas is financially unsustainable (APEC, 2017). Mobile money, however, enables accounts to be accessed digitally, making it possible to deposit or transfer money remotely (APEC, 2017). This allows financial service providers to reach smallholder farmers in remote areas at a lower cost (APEC, 2017). Similarly, smallholder farmers experience advantages from accessing mobile financial services and paying bills digitally (GSMA, 2017). Smallholder farmers no longer have to travel to an often-distant (banking) facility with a handful of cash (Jack & Suri, 2011). Hence, using mobile money is more convenient as it incurs less time and travel costs (GSMA, 2017; Jack & Suri, 2011; Kirui, Okello & Nyikal, 2012a).

Additionally, the costs associated with the usage of mobile money are relatively low compared to traditional financial services (Aker et al., 2011; Kirui et al., 2013; Murendo & Wollni, 2016). Generally, mobile money does not incur ledger fees nor requires a minimum balance (Kirui, Okello & Nyikal, 2012a). Instead, mobile money has a low withdrawal fee which is estimated to be affordable for smallholder farmers (Kirui, Okello & Nyikal, 2012a).

Besides, mobile money is more reliable than the informal methods that smallholder farmers rely on traditionally (Murendo & Wollni, 2016). It mitigates handling risks like theft and fraud and provides smallholder farmers with traceable and transparent transactions (GSMA, 2017).

With regard to improved access to financial services, smallholder farmer credit specifically, mobile money enables new models of lending (APEC, 2017). Both the disbursement and repayment of funds can be executed digitally (APEC, 2017). Moreover, the adoption of mobile money offers the possibility for smallholder farmers to create an alternative credit score based on their transactional records (GSMA, 2017; IFAD, 2016a). This alternative credit score can potentially provide access to agricultural credit services (GSMA, 2017; IFAD, 2016a).

Concerning insurance, there is no longer a need for auditors to visit smallholder farmers as index insurance and weather stations can measure rainfall, sunlight, and soil conditions remotely (Baumüller, 2015; Gencer, 2011). With this data, insurance providers can determine whether crop yields will result in a positive or negative harvest (Gencer, 2011). Through mobile money, smallholder farmers pay their insurance premiums and insurance providers pay out their claims (APEC, 2017; Gencer, 2011). Hence, the costs of the insurance process are substantially reduced and insurance providers are able to extend their reach to a wider set of smallholder farmers (APEC, 2017; Gencer, 2011).

As a result of receiving payments through mobile money, smallholder farmers experience faster cash flow and liquidity, lower transaction costs, and improved access to financial services (Murendo & Wollni, 2016). The lower transaction costs of mobile money and improved access to financial services are projected to translate into a higher disposable income and improved risk management (Aker et al., 2011). Therefore, it is expected that investment in agricultural production will increase. This, in turn, is projected to improve food security and welfare of smallholder farmers (Murendo & Wollni, 2016).

### 2.3.1 Obstacles to Mobile Money Adoption

Notwithstanding, for the aforesaid theorised impact to occur, mobile money needs to be adopted by smallholder farmers. Mobile money opens up exciting new opportunities, however, also introduces unfamiliar options to smallholder farmers to organise and control their financial lives (McIntosh & Mansini, 2018). This requires smallholder farmers to be willing to engage in considerable learning costs (McIntosh & Mansini, 2018). Accordingly, there are a number of obstacles hindering smallholder farmers to adopt mobile money services.

As for these obstacles, literature finds several determinants that influence the uptake of mobile money. For instance, access or ownership of a phone is naturally a critical determinant for the uptake of mobile money (Baumüller, 2015). Moreover, the greater the distance to a bank and the closer the distance to a mobile money agent, the more likely a smallholder farmer will adopt the service (Baumüller, 2015; Kirui, Okello & Nyikal, 2012a). Additionally, the quality of the mobile money agents is of great influence as good customer service skills can greatly support smallholder farmers in the adoption process (IFAD, 2016a).

Moreover, higher education levels are found to increase the likelihood of adoption (Baumüller, 2015; Kirui, Okello & Nyikal, 2012a; Masocha & Dzomonda, 2018). However, Hinson (2011) argues that mobile money services are relatively easy to handle, hence enabling the usage among less-educated smallholder farmers (Kim et al., 2018). Besides, trust is found to be a critical determinant for the adoption of mobile finance in rural areas (Babcock, 2015). Since smallholder farmers have long been excluded from the formal economy, there is a tendency to be distrustful of financial services (Babcock, 2015; Cole, Sampson & Zia, 2011; Karlan et al., 2012). Besides, a larger household size, (financial) literacy, awareness of mobile money, age, training, membership of a farmer organisation, endowment of assets, network coverage, and income are found to impact the uptake of mobile money (Babcock, 2015; Baumüller, 2015; ed. FAO, 2014b; GSMA, 2017; Karlan et al., 2012; Kim et al., 2018; Kirui, Okello & Nyikal, 2012a).

The presented theoretical framework is applied to the statistical analyses of this thesis. In particular, studying whether mobile money is associated with improved insurance and credit usage as proposed by Murendo & Wollni (2016). Moreover, the statistical analysis controls for as many aforementioned obstacles as the data set allows for. For instance, education, gender, age, and agricultural training among others.

# 3. Literature Review

This literature review begins by presenting a comprehensive history of smallholder farmer finance. Thereafter, literature studying the impact of mobile money on smallholder farmers is presented. This section is structured according to the theoretical framework presented in chapter 2.3. Namely, commencing with the impact of mobile money on cash flow and liquidity, followed by transaction costs, financial access, income, investment, risk management, and food security. Finally, a summary of the literature review identifying research gaps is presented.

## 3.1 History of Smallholder Farmer Finance

Historically, smallholder farmer finance has been neglected in most developing countries (Roetter, 2008). Only by the 1960s did smallholder farmer finance emerge as an important tool in the agriculture development field (RFILC, 2006). In particular, during the 1960s the *Green Revolution,* also named *Third Agricultural Revolution,* illustrated that improved seeds, fertiliser, and other agriculture input considerably increased farming yields (Hazell, 2009; RFILC, 2006). This resulted in increased engagement and resources from development organisations like the World Bank, promoting rural development banks to provide credit to smallholder farmers (RFILC, 2006). Providing credit was perceived as essential for, among others, agriculture development, reducing poverty, and food security (Nagarajan & Meyer, 2005). During the 1960s and 1970s, credit was generally provided by state-owned agricultural development banks (IFAD, 2016b; RFILC, 2006). The aim was to increase rural lending by lowering the costs and risks through measurements like loan waivers and subsidized interest rates (Nagarajan & Meyer, 2005). Moreover, credit was often combined with new agriculture input like seeds and fertilisers (RFILC, 2006).

Nonetheless, the strategy of providing low-cost credit to smallholder farmers began to demonstrate unsettling developments (RFILC, 2006). Firstly, it was found that the strategy failed to reach the rural poor, instead, credit was given to larger agriculture organisations (Nagarajan & Meyer, 2005; RFILC, 2006; Zeller & Sharma, 2000). In fact, credit was often

provided based on political cronyism (RFILC, 2006). Moreover, many credit providers failed to meet their operating expenses through loan interest earnings, making the strategy financially unsustainable over the long term (Nagarajan & Meyer, 2005; RFILC, 2006). Besides, loan defaults were rising in many rural credit programs as credit had been tied to the purchase of unsuitable technologies that did not increase production levels (RFILC, 2006). Altogether, the approach resulted in failed rural credit programs in the 1960s and 1970s (RFILC, 2006).

Subsequently, a new rural finance paradigm arose in the mid-1980s (Nagarajan & Meyer, 2005). During this time, non-governmental organisations (NGOs) started to emerge and play an increasing role in rural finance (RFILC, 2006). These NGOs improved the field of rural finance by having stronger linkages and involvement with local communities (RFILC, 2006). They provided new models of rural finance including providing credit to a group of farmers instead of an individual farmer, often referred to as the Grameen lending model (Kirui et al., 2013; Kirui, Okello & Nyikal, 2012a; Zeller & Sharma, 2000). Moreover, NGOs started to increasingly provide microfinance in developing countries (McIntosh & Mansini, 2018). Microfinance concerns small, short-term loans with frequent repayment commencing nearly directly after pay-out of the loan (McIntosh & Mansini, 2018; Nagarajan & Meyer, 2005). This repayment schedule is ideal for retail businesses, however, less suitable for agriculture (McIntosh & Mansini, 2018). Particularly, smallholder farmers require long-cycle agricultural investment since agricultural cycles do not allow for immediate loan repayment (McIntosh & Mansini, 2018). Besides, microfinance institutions face high transaction costs reaching the widely dispersed smallholder farmers (Kirui et al., 2013).

Overall, it is evident that providing credit to smallholder farmers has had limited success. Moreover, past strategies have, in general, solely focused on providing credit, neglecting other financial services like insurance (Zeller & Sharma, 2000). As demonstrated in chapter 2.3, mobile money is expected to improve the, thus far, limited success for inclusive smallholder farmer finance.

## 3.2 Impact Mobile Money on Smallholder Farmers

As presented in chapter 2.3, the theorised impact of mobile money projects the mobile service to fasten smallholder farmer cash flow and liquidity, lower transaction costs, and improve access to financial services. Consequently, resulting in a higher disposable income, increased investment, better risk management and improved food security and welfare. In accordance with this theoretical framework, this section commences by presenting empirical studies on mobile money and cashflow and liquidity. Thereafter, this section presents studies examining the impact of mobile money on transaction costs, access to financial services, investment, risk management, and food security. As there are few studies examining the impact of mobile money on smallholder farmers, this literature review was extended by including studies on rural households.

### 3.2.1 Mobile Money and Cashflow and Liquidity

Mobile money is theorised to increase the cashflow and liquidity of smallholder farmers. There are a number of studies that examine this by studying the remittances received and sent. To demonstrate, the work by scholars Kikulwe, Fischer & Qaim (2013, 2014) examines the impact of mobile money on remittances among smallholder banana farmer households in Kenya. The study uses panel survey data and finds mobile money to increase remittances received by 66 percent. A study by Munyegera & Matsumoto (2016) analyses the impact of mobile money on remittances in rural Uganda. Using panel data, the study finds mobile money users to be 20 percentage points more likely to receive remittances, and the value of remittances to be 36 percent higher. Besides, mobile money users were found to receive remittances more frequently. In later work, Munyegera & Matsumoto (2018) find mobile money users to be ten percent more likely to have received remittances in the past twelve months compared to non-users in Uganda. Moreover, the number of remittances was found to be twice as high for users compared to non-users. Likewise, Jack & Suri (2011) find mobile money users in Kenya to send and receive remittances more frequently than non-users. Altogether, the observed increases in remittances seem to suggest an improved cash flow and liquidity among mobile money using smallholder farmers and rural households.

### 3.2.2 Mobile Money and Transaction Costs

Mobile money is projected to lower transaction costs as payments are done digitally. A number of studies have examined this and found supporting signs of declining transaction costs. For instance, a study by Jack & Suri (2011) in Kenya found mobile money users to perceive the service as faster, cheaper, more reliable, and safer compared to money-transfer predecessors. A similar study was conducted by Vong, Fang & Insu (2012) which examined the impact of mobile money on micro-entrepreneurs in six rural provinces in Cambodia. The scholars found mobile money to smoothen the process of trade by reducing operational costs, improving security and safety, increasing market opportunities, and higher profit margins. Likewise, a qualitative study by Boadi et al. (2007) found mobile money to ease the transaction process among rural fisherman and farmers in Ghana. Finally, Awunyo-Vitor (2016) examined the determinants of demand for mobile money among maize farmers in Ghana. The study found that mobile money services were adopted since farmers indicated them to be convenient, fast, reliable, and secured.

Moreover, work by Aker et al. (2011, 2016) studies the impact of delivering social protection payments through mobile money in Niger. As the country was coping with a devastating drought, social protection programmes provided monthly cash transfers to households in affected villages (Aker et al., 2011, 2016). Using panel data, the study found the delivery of social support through mobile money to reduce the distribution costs for the social protection agency while simultaneously reducing the transaction costs for the recipient. Comparatively, cash recipients had to travel on average 4.04 kilometres to obtain their support whereas mobile money recipients had to travel 0.9 kilometres on average to cash-out their support at the closest agent. The scholars argue that this difference concerns the opportunity costs of feeding a family consisting of five members for one day.

Nonetheless, scholars found mobile money to also give rise to new transaction costs. For instance, maize farmers in Ghana were found to be challenged by the limited number of mobile money agents, high commission fees and poor customer service (Awunyo-Vitor, 2016). This increase in new transaction costs may hamper the adoption of mobile money. To illustrate, a study by Boateng (2011) found no uptake of mobile money services among female micro traders in Ghana. Nonetheless, other studies found mobile money to be adopted by households

with a wide range of economic and demographic characteristics (Jack & Suri, 2011; Kikulwe, Fischer & Qaim, 2014; Sekabira & Qaim, 2017).

Besides, the literature presented has mainly examined the *perceived* decline in lower transaction costs. Except for Aker et al. (2011, 2016), no quantitative analyses on the theorised decline in transaction costs have been conducted.

### 3.2.3 Mobile Money and Access to Financial Services

As stated by Baumüller (2018), no study has yet examined the relationship between mobile money and access to credit and insurance for smallholder farmers. It, therefore, remains to be proven whether mobile money has the theorised impact on financial access. However, work by Munyegera & Matsumoto (2018) studies the impact of mobile money on the financial behaviour of rural households in Uganda. By using panel household survey data from 2012 and 2014, the study finds mobile money to significantly increase the likelihood to receive credit. Both informal and formal means of credit were examined. The former concerns borrowing among family, friends, and individual money lenders. Contrarily, formal borrowing concerns borrowing at commercial banks or microfinance institutions through the means of mobile money accounts. The study found both informal and formal credit to be higher among mobile money users. Nonetheless, a stronger positive relationship was found for informal credit. Accordingly, it may be questioned whether mobile money enables the theorised increase in access to formal financial services for smallholder farmers.

### 3.2.4 Mobile Money and Income

As for income, it is projected that the lower transaction costs of mobile money will result in a higher disposable income for smallholder farmers. Few studies have examined the relationship between mobile money and income. Supporting results of the estimated impact of mobile money are found by Sekabira & Qaim (2017). Using panel data, the scholars estimate mobile money to increase household income of smallholder coffee farmers in Uganda by nineteen percent. Likewise, a study by Kirui et al. (2013) examines the impact of mobile money on smallholder farmers in Kenya and finds income from farming activities of mobile money users to be KSh. 17,700/$224 higher than their counterparts. Similar results are found by Kikulwe, Fischer & Qaim (2013, 2014) for smallholder banana farmers in Central and Eastern Kenya.

Specifically, the study finds mobile money users to experience a 40 percent increase in income compared to non-users. One critical pathway for this increase in income is argued to be the 66 percent increase in remittances received by mobile money users (Kikulwe, Fischer & Qaim, 2013, 2014).

### 3.2.5 Mobile Money and Investment

As theorised, mobile money is projected to increase investment of smallholder farmers. So far, a number of studies have examined the relationship between mobile money and investment. For instance, the work of Kirui et al. (2013) found mobile money annual agriculture household input to be KSh. 3,300/$43 higher among Kenyan mobile money users. Moreover, Aker et al. (2011, 2016) found households receiving social protection through mobile money to buy a more diverse set of goods, grow more types of crops, and deplete fewer assets. Moreover, the diet diversity of mobile money households was found to be 9-16 percent higher (Aker et al., 2011, 2016). Finally, the study found children in mobile money households to eat one-third of a meal more per day (Aker et al., 2011, 2016). Hence, indicating an increase in the amount and diversity of investments. The scholars suggest that the positive impact of mobile money may be attributed to the reduced transaction costs, accompanied with enhanced privacy of receiving cash, leading to changes in intra-household bargaining power for women (Aker et al., 2011, 2016).

Additionally, a study by Batista & Vicente (2019) examines the impact of mobile money savings on smallholder farmers in rural Mozambique. In a randomised field experiment, mobile money saving accounts were introduced to smallholder farmers. The study found mobile money to increase savings which, in turn, was found to promote agricultural investment in fertiliser, which reported an increase of 30 percentage points. This study illustrates how improved access to financial services through mobile money can result in higher agriculture investments.

Besides, the decrease in transaction costs and the increase in remittances is suggested to reduce the risk and liquidity constraints of smallholder farmers, allowing them to invest and participate in distant markets. For instance, Yao & Shanoyan (2018) find smallholder farmers in Cote d'Ivoire and Tanzania who use mobile money for receiving buyer payments to be eight percentage points more likely to sell their products at city and regional markets. Similarly,

Sekabira & Qaim (2017) find smallholder farmers using mobile money to sell a larger proportion of their coffee beans on high-value markets, instead of selling directly after harvest to local traders. Moreover, the scholars Kikulwe, Fischer & Qaim (2013, 2014) find commercialisation output of mobile money using smallholder farmers in Kenya to increase by nineteen percent compared to non-users. Likewise, a study by Kirui et al. (2013) found mobile money users to have a 37 percent higher level of commercialisation compared to non-users in Kenya. These findings seem to indicate that the hampered commercialisation efforts of smallholder farmers, explained in chapter 2.2, may be overcome by the adoption of mobile money.

### 3.2.6 Mobile Money and Risk Management

Through mobile money, smallholder farmers are expected to be better able to manage risks. Literature has examined this relationship between mobile money and risk management by analysing the impact of negative shocks. Scholars Abiona & Koppensteiner (2020) study this relationship by using panel data from Tanzania. The results presented show that mobile money enables consumption smoothing for the poorest households affected by negative rainfall shocks, averting them from descending into transient poverty. Furthermore, mobile money was found to help reduce school absenteeism and to increase the number of hours worked on homework during and after rainfall shocks. In particular, the impact of mobile money on education was found strong for girls. Likewise, it found that mobile money protects girls from devoting extra time fetching water or gathering wood as a reaction of shocks. Altogether, the scholars, therefore, argue that mobile money more than neutralises the negative impact of rainfall shocks. Batista & Vicente (2018) find a similar impact of mobile money on shocks in rural Mozambique. Using a randomized controlled trial, the scholars find mobile money to improve consumption smoothing. Specifically, households using mobile money were found less vulnerable to negative weather and self-reported shocks. Likewise, a study by Jack & Suri (2014) in Kenya found shocks to reduce per capita consumption for non-user households by seven percent whereas the per capita consumption for mobile money households was found unaffected. A study by Riley (2018) reports similar findings of mobile money enabled remittances mitigating the negative impact of rainfall shocks in Tanzania.

Jack & Suri (2014) argue that the mechanism underlying this improved risk management is the observed increase in remittances received by mobile money households. During shocks, households with access to mobile money are more likely to receive remittances, receive remittances more frequently, and receive larger amounts of total remittances. Hence, increasing their cash flow in times of need. This observed increase in informal protection networks may question whether mobile money improves access to formal financial services for mitigating risks.

### 3.2.7 Mobile Money and Food Security

Finally, mobile money is expected to improve the food security of smallholder farmers. Scholars Murendo & Wollni (2016) studied this estimated impact on food security in rural Uganda. Using household survey data, their study found the usage of mobile money to positively contribute to household food security. Specifically, usage, frequency of usage, and volumes of money transferred through mobile money were found to be associated with increases in food expenditures. Usage of mobile money was found to be associated with an increase in food expenditure of nine percentage points. In terms of frequency, it was found that one unit increase in frequency was associated with a food expenditure increase of 1.9 percentage points (Murendo & Wollni, 2016).

## 3.3 Literature Summary

As mobile money concerns a rather new service, only limited research has been conducted on the effects (Aron, 2018). Especially, there is a relatively small body of literature that is concerned with the impact of mobile money on smallholder farmers. As a result, there remain several aspects of mobile money for smallholder farmers about which relatively little is known. Additionally, the majority of the studies have been conducted on the African continent. Hence, the lack of studies and lack of spatial focus makes it hard to verify whether the observed findings are universally applicable. It may, therefore, be debated that the generalisability of the published research on this issue is problematic.

Moreover, literature on mobile money for smallholder farmers has, thus far, not been overarching. Notably, literature studying the demand side of smallholder farmers is completely absent. In order for financial services to reach smallholder farmers, it is important to identify the needs and preferences of the target market. In addition, no literature examines the impact of mobile money on smallholder farmer access to insurance and credit (Baumüller, 2018). This is unsettling as mobile money has been proposed as the promising new channel for smallholder finance by many development organisations (Martin et al., 2016; Miller, 2015; Sadler et al., 2016).

Besides, literature suggests that the observed increase in cash flow through remittances enables better risk management and increases in income, rather than improved access to formal financial services. As found by Morawczynski (2009) in Kenya, "major benefits of mobile financial services are derived from informal money transfers that occur between kith and kin rather than new relationships that are cultivated with formal financial institutions" (p. 521). Accordingly, it may be questioned whether mobile money is utilised as an enabler of informal financial services, rather than formal financial services with traditional service providers. However, as there is no literature on the impact of mobile money on smallholder farmer insurance and credit, this relationship is yet to be examined.

Concerning the methods applied, the majority of the literature studies apply a quantitative approach using survey data. Both longitudinal and cross-sectional studies are conducted by scholars. Qualitative studies, on the other hand, are few and mixed-method studies are even rarer. Moreover, geographical data and the consequent mapping of geographical data is absent from studies.

Altogether, it is evident that research on the impact of mobile money on smallholder farmers is in the early stages. Overall, there seems to be some evidence that mobile money improves cash flow and liquidity, lowers transaction costs, and increases investment and risk management. Similarly, it appears that mobile money may have the potential to be a suitable tool for overcoming the obstacles to inclusive rural finance and its accompanying repercussions presented in chapter 2. However, even though the reviewed literature proposes mobile money to improve access to financial services, the actual impact of mobile money on smallholder farmer finance is yet to be empirically tested. Therefore, this study aims at examining the short-term implications of mobile money for inclusive smallholder farmer finance.

Specifically, it aims at doing this by examining mobile money, insurance, and credit among smallholder farmers in Haiti, applying a quantitative cross-sectional study. Additionally, the data used includes geographical indicators which present this thesis with the unique opportunity to map observations in order to detect any specialties. By examining mobile money, insurance, and credit among smallholder farmers in Haiti and mapping observations, this thesis contributes to closing the above-mentioned literature gaps.

# 4. Study Background: Haiti

According to the World Bank, Haiti is the poorest country in the Western Hemisphere (2019). In 2018, it had a Gross Domestic Product (GDP) per capita of 870 dollars and was ranked 168 out of 189 countries in the Human Development Index (United Nations Development Programme, 2019; World Bank, 2019). Numerous individuals in Haiti do not have access to electricity, water, sanitation, and healthcare (World Food Programme, 2019). Moreover, twenty percent of the children in Haiti do not attend primary school and literacy levels regarding the population above ten years of age concern 61 percent (World Food Programme, 2019). Clearly, Haiti is facing numerous development challenges. However, this section will focus on the challenges of food security and financial inclusion in Haiti in order to ultimately better understand the findings of this thesis.

## 4.1 Food Security

Haiti reports one of the highest degrees of food insecurity in the world (World Food Programme, 2019). Over one-third of Haitians are in urgent need of food assistance, equalling nearly 3.7 million individuals (World Food Programme, 2019). Notably, over one million of these individuals are in conditions categorised as an *emergency* (World Food Programme, 2019). In 2018, half of the Haitians were undernourished, reaching the *alarming* threshold on the Global Hunger Index (2019). The severity of the degree of food insecurity in Haiti is particularly reflected in the nutritional status among children (World Food Programme, 2019). To illustrate, 22 percent of children are chronically malnourished, ten percent are underweight, and 66 percent of individuals under the age of five suffer from anaemia, in Haiti (World Food Programme, 2019).

One of the factors driving food insecurity in Haiti concerns the poor performance of the agriculture sector (World Food Programme, 2019). Farming families subsist on roughly two acres of land and scarcely harvest enough crops to feed themselves (World Bank, 2013). These circumstances have been aggravated by successions of natural disasters, consisting of severe

storms, floods, landslides, droughts, the 2010 earthquake, and hurricane Matthew (World Food Programme, 2019). Over 96 percent of Haitians are exposed to these natural disasters (World Bank, 2019). On the 2019 climate risk index, Haiti is ranked fourth as most affected by extreme weather events globally (Eckstein et al., 2018).

As there is a lack of financial support for farmers, it is nearly impossible for farmers to take measures to prevent or minimise the risks and consequences of natural disasters (World Bank, 2013). For instance, with the right investments in watershed protection and irrigation systems, floods and droughts could be mitigated and even prevented (World Bank, 2013).

Moreover, another important factor driving food insecurity in Haiti concerns the high levels of extreme poverty (World Food Programme, 2019). Among the population in Haiti, chronic poverty is common (World Food Programme, 2019). Out of the total 10.9 million individuals living in Haiti, over 6 million live below the 2.42 dollar poverty line, where 2.5 million individuals fall below the extreme poverty line of 1.23 dollars per day (World Bank, 2019).

## 4.2 Financial Inclusion

Sarma (2008 cited in Park & Mercado, 2015) defines financial inclusion as a "process that ensures the ease of access, availability and usage of the formal financial system for all members of an economy" (p. 1). With regards to Haiti, Stahl & Coetzee (2018) report Haiti to have low levels of financial inclusion. Using the data from the Global Findex, the scholars show that 33 percent of the population above the age of fifteen own an account at a traditional financial institution. This shows a low level of traditional financial inclusion, also relative to neighbouring countries (Stahl & Coetzee, 2018). As visualised in figure 4.1 and table 4.1, neighbouring countries to Haiti present higher rates of individuals owning an account.

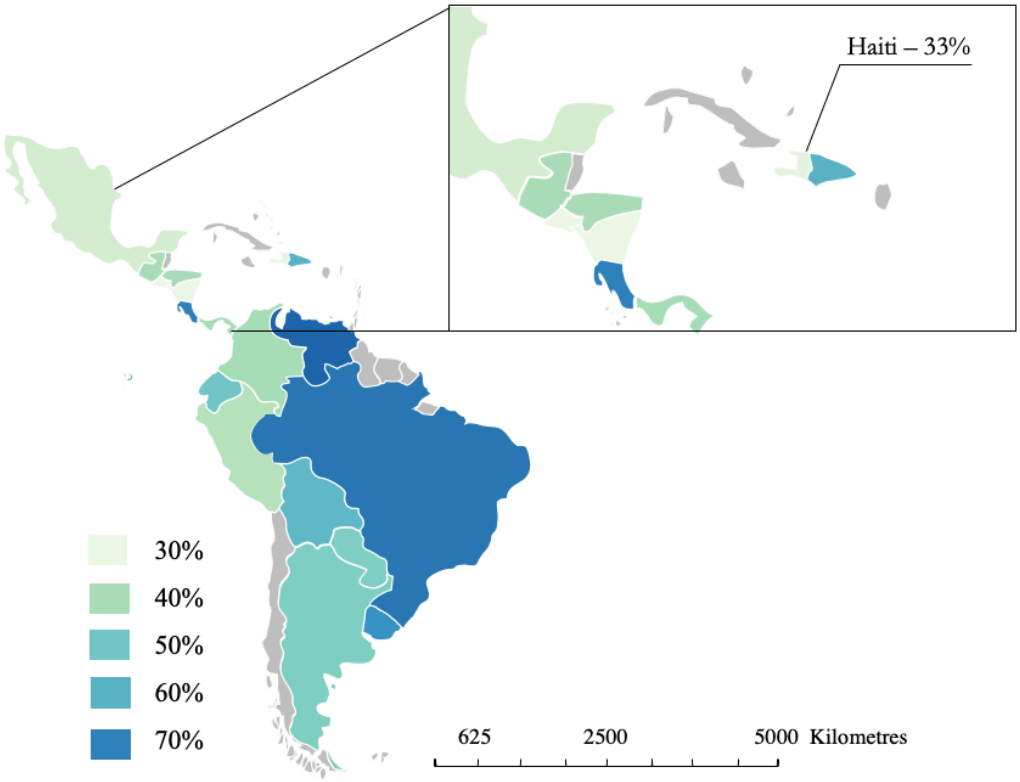


*Figure 4.1, Percentage of Adults age 15+ with an Account (Data from Global Findex Survey, 2017)*

*Table 4.1, Percentage of Adults Age 15+ with an Account (Data from Global Findex Survey, 2017)*

| Country | Percentage |
|---|---|
| Brazil | 70% |
| Venezuela | 73% |
| Costa Rica | 68% |
| Uruguay | 64% |
| Dominican Republic | 56% |
| Bolivia | 54% |
| Ecuador | 51% |
| Argentina | 49% |
| Paraguay | 49% |
| Colombia | 46% |
| Panama | 46% |
| Honduras | 45% |
| Guatemala | 44% |
| Peru | 43% |
| Mexico | 37% |
| Haiti | 33% |
| Nicaragua | 31% |

Besides, Stahl & Coetzee (2018) argue that access to financial services is low in Haiti. This is supported by the Financial Access Survey from the International Monetary Fund (IMF) which reports, among others, 2.11 Automated Teller Machines (ATM) and 2.69 commercial bank branches per 100,000 adults in Haiti (IMF, 2019).

Contrarily, nearly 60 percent of the adult population holds mobile cellular subscriptions (World Bank, 2018b). Hence, there exist nearly twice as many mobile phone users compared to banked individuals in Haiti (Simon, 2012). Accordingly, Simon (2012) emphasises that the mobile phone is an important instrument to explore for expanding financial services, specifically in Haiti.

### 4.2.1 Mobile Money in Haiti

By the end of 2010, two mobile money services were launched in Haiti (Evans & Pirchio, 2014; Simon, 2012; Stahl & Coetzee, 2018). In November 2010, the mobile network operator Digicel launched the service TchoTcho, and in December 2010, the mobile network operator Voila launched the service T-Cash (Evans & Pirchio, 2014). After two years, Digicel acquired Voila and merged the mobile money services into one (Stahl & Coetzee, 2018). Nonetheless, the usage of the mobile money service remained low for the next few years, reporting 30,000-40,000 active users on a 30-day activity basis (Stahl & Coetzee, 2018). Indicating the difficulty of implementing mobile money.

As a result, it was decided to rebrand the mobile money service (Stahl & Coetzee, 2018). After extensive market research, Digicel launched the new mobile money service MonCash in 2015 (Stahl & Coetzee, 2018). MonCash services consist of person to person payments, merchant payments, and bill payments (Stahl & Coetzee, 2018). Within the first two years of the relaunch, MonCash obtained 805,000 active customers on a 90-day activity basis and 540,000 active customers on a 30-day basis (Stahl & Coetzee, 2018). Moreover, agent activity rates rose from 28 percent to 93 percent and the value of mobile money transactions increased by 950 percent (GSMA, 2017). Evidently, MonCash enabled a substantial improvement in adoption and usage rates.

This increase in adoption and usage is partially due to the education efforts of MonCash (Stahl & Coetzee, 2018). In 2015, MonCash started with one on one customer education, employing 500 local educational sales representatives (Stahl & Coetzee, 2018). This effort was further executed by having group *clinics,* interacting with complete communities (Stahl & Coetzee, 2018). By educating individuals in groups, not only were they informed about the services, but also able to participate in hands-on exercises in transactions between clinic attendees (Stahl & Coetzee, 2018). Qualitative research shows that these group clinics resulted in support networks within communities, enabling wide-spread adoption of MonCash (Stahl & Coetzee, 2018).

Besides education, MonCash improved liquidity and access to agents (Stahl & Coetzee, 2018). In the TchoTcho era, mobile agents would regularly have insufficient cash to pay-out users (Stahl & Coetzee, 2018). Hence, when relaunching, MonCash combined different services to improve liquidity levels for agents (Stahl & Coetzee, 2018). With regards to access, the number of agents was increased from 600 to 2000 (Stahl & Coetzee, 2018).

Overall, the mobile money market in Haiti has been referred to as "the fastest growing mobile money market in the world" (Simon, 2012, p. 24). Moreover, it has been classified as a promising market for digital financial services (Martin et al., 2016). Altogether, indicating a strong potential for mobile money enabling financial services in Haiti.

# 5. Material and Methods

In this chapter, the data, methods, and descriptive statistics are presented. Since this study aims at analysing the relationship between mobile money and the insurance and credit behaviour of Haitian farmers, a quantitative research design was employed (Creswell, 2014). For this analysis, a cross-sectional study was conducted due to data availability. First, this chapter presents the data and variables used. Thereafter, the chapter introduces the descriptive and statistical analyses employed. Finally, the limitations of the material and methods employed, and descriptive results are presented.

## 5.1 Data

To study the implications of mobile money for inclusive smallholder farmer finance, this study uses data from the 2018 FinScope Haiti Consumer Survey from the FinMark Trust. The FinMark Trust is an independent non-profit organisation whose aim is to support financial inclusion and regional financial integration (FinMark Trust, 2020). Partners of the FinMark Trust include the Gates Foundation, UK Aid, and the United Nations Capital Development Fund (FinMark Trust, 2020). The FinScope Haiti Consumer Survey was conducted during the period May – October 2018 by Group Croissance (FinMark Trust, 2019). Group Croissance is a consulting firm that has been working on financial inclusion in Haiti for 22 years, collaborating with the national Central Bank of Haiti and the Haitian Ministry of Finance and Economy (Group Croissance S.A., 2018). Notably, different country FinScope Surveys have been used by empirical studies before (e.g. Abel, Mutandwa & Roux, 2018; Honohan & King, 2012; Mhella, 2019; Mori, 2019; Njanike, 2019).

With regards to sampling, a national representative individual-based sample was defined based on the adult population aged fifteen years and older at regional and urban/rural level (FinMark Trust, 2019). The adult population aged fifteen years and older was estimated to be 7.67 million (FinMark Trust, 2019). Using a multi-stage sampling methodology, 4269 individuals were interviewed face-to-face (FinMark Trust, 2019). The applied multi-stage sampling

methodology involved the selection of enumeration areas that were based on recent census or population estimates using probability proportional to size (FinMark Trust, 2019). Hereafter, households were sampled and specific household adult interviewees were selected by using a Kish Grid (FinMark Trust, 2019). The final data set consists of individual-level data concerning demographic information, financial service usage, and attitudes towards financial products and services (Bankable Frontier Associates, 2010).

### 5.1.1 Data Sample and Variables used

Before running the statistical analyses, the data sample was determined, and data was tested for irregularities and outliers. As this study concerns farmers, all observations that did not report farming activities were dropped from the dataset. As a result, the total observations decreased from 4269 to 1588 and solely included individuals in households that are involved in farming or livestock. Thereafter, the remaining farming sample was analysed for inactive farmers. For instance, whether individuals received any pension incomes or whether individuals reported *Agriculture is a hobby.* These observations were excluded from the data set as these are not representable for smallholder farmers who seek insurance or credit for their farming practices. In total, 15 observations were dropped.

Subsequently, the data was checked for outliers. The variable age was found to be unequally distributed and skewed to the right. To exclude inactive farmers and to address the unequal distribution, it was decided to drop older age observations from the dataset. Notably, farmers in developing countries do often not retire in accordance with governmental regulations. In Haiti, the official retirement age is set at 55 years of age (Social Security Administration, 2020). Nonetheless, a study on family farmer characteristics in Haiti found the oldest farm owner to be 72 years of age (Dolly, Ennis & Renwick, 2017). In order to account for any possible irregularities in oldest age of farming, all observations above 75 years of age were excluded from the dataset. In terms of young age, it was decided to include all observations reporting 15-18 years of age as these observations showed access to formal insurance and credit.

Likewise, the data was checked for missing data entries. For the variables *size of farming land* and *proportion of production for sale,* missing variables were observed. When examining these missing data entries, it was found that dropping these observations would impact the mean and standard deviation of the other variables. Besides, there is the possibility that the poorest

individuals in the sample may belong to this group that reports missing data. It is important to account for these individuals in the analyses in order to avoid creating a potential risk of bias in the results. Hence, it was decided to not exclude these observations but instead recode them into a new category; *missing data.* Ultimately, the final dataset included 1511 observations.

Moreover, variables were altered according to the needs of this study. To illustrate, dummy variables were created, and the variable *age squared* was created in order to allow for a non-linear relationship. Furthermore, the variable *size of farming land* was originally measured in different measurement units. In order to compare the size of the farming land of different observations, a new variable was created which converted all observations to square meters.

With respect to the specific variables included in this study, the outcome variables, *formal insurance* and *formal credit,* concern whether an individual has formally accessed insurance or credit. These dependent variables are expected to demonstrate a relationship with the independent variable and control variables in the model. In accordance with the presented theory in chapter 2.3, the independent variable *mobile money* is expected to increase the likelihood to have accessed credit and/or insurance. Besides mobile money, theory identifies other important factors impacting insurance and credit usage. Hence, a number of control variables were included. For *sex*, literature indicates females to face additional financial barriers, therefore it is expected that females are less likely to have accessed insurance and/or credit. Regarding *age*, it is expected that the likelihood to have insurance or credit increases during the first phase of life, however, declines during the second phase. Concerning *partnership*, it is expected that individuals in a partnership (free union/marriage) are more likely to have insurance and/or credit. Moreover, *area* was included as a control variable since individuals in rural areas are expected to be less likely to have insurance and/or credit. Additionally, the variables *education, awareness of mobile money, membership of farming organisation/cooperative*, and *agricultural training* were controlled for since these measure the educational and financial knowledge levels of farmers. According to the theory presented in chapter 2.1, education and knowledge positively impact the usage of insurance and credit. Finally, the variables *mobile phone* and *financial access status* were controlled for as these indicate the financial status of the farmer. Theory expects these variables to positively impact the usage of insurance and credit. Altogether, an overview of the variables and their description is presented in table 5.1.

*Table 5.1 Description of Variables*

| Variable Name | Description | Type |
|---|---|---|
| Insurance_formalD | Dummy variable: value 1 if individual has formal insurance; value 0 if individual has no formal insurance | Dichotomous |
| Credit_formalD | Dummy variable: value 1 if individual has formal credit; value 0 if individual has no formal credit | Dichotomous |
| MMd | Dummy variable: value 1 if individual is a mobile money user; value 0 if individual is not a mobile money user | Dichotomous |
| Sex | Dummy variable: value 1 if individual is female; value 0 if individual is male | Dichotomous |
| Age | Age | Continuous |
| Age_Squared | Age variable squared | Continuous |
| PartnershipD | Dummy variable: value 1 if individual is married/free union; value 0 if individual is single/widowed/divorced | Dichotomous |
| AreaD | Dummy variable: value 1 if individual lives in rural area; value 0 if individual lives in urban area | Dichotomous |
| Education | Educational levels; no formal education, primary education, secondary education, and tertiary education | Ordinal |
| Awareness_MM_D | Dummy variable: value 1 if individual is aware of mobile money services; value 0 if individual is not aware of mobile money services | Dichotomous |
| Farming_OrganisationD | Dummy variable: value 1 if individual is involved or belongs to a farmer organisation or cooperative; value 0 if individual is not involved or does not belong to farmer organisation or cooperative | Dichotomous |
| Agri_TrainingD | Dummy variable: value 1 if individual has received technical assistance or training on agriculture techniques; value 0 if individual has not received technical assistance or training on agriculture techniques | Dichotomous |
| Mobile_PhoneD | Dummy variable: value 1 if individual or someone in the household owns a mobile phone; value 0 if no one owns a mobile phone | Dichotomous |
| Financial_Access | Financial access status; banked, other formal, informal, excluded | Ordinal |

## 5.2 Descriptive Analyses

This study employs a number of descriptive analyses. Firstly, descriptive statistics of the variables in the data set are obtained and analysed. Secondly, the data allowed for descriptive mapping of the variables of mobile money, formal insurance, and formal credit. Hence, these were geographically mapped at Haitian commune level to explore the spatial patterns. Commune level was specifically chosen in order to show the data at the smallest scale. Nonetheless, mapping at Haitian regional level can be found in Appendix A. Before mapping the variables, all communes reported in Haitian Creole were translated into English. Moreover, all communes were checked for farmer observations to ensure no overestimation of the absence of mobile money, formal insurance, or formal credit. To illustrate, in the case of zero mobile money observations, it can be determined whether this is due to missing farmer observations or actual absence of mobile money adoption. In total, it was found that farmer observations were absent from twenty communes. A list of the communes reporting no farmer observations can be found in Appendix B. Finally, the attitudes of farmers towards financial services are descriptively analysed.

## 5.3 Statistical Analyses

To test the implications of mobile money for smallholder farmer finance in Haiti, this thesis examines the relationship between mobile money and insurance and credit. According to the theoretical framework, mobile money is expected to lead to an increase in the likelihood for farmers to be insured and have accessed credit. Accordingly, the hypotheses regarding the likelihood to be insured and have accessed credit are the following:

Hypothesis insurance

$H_0$: Adoption of mobile money does not change the likelihood to be insured for farmers in Haiti
$H_1$: Adoption of mobile money increases the likelihood to be insured for farmers in Haiti

Hypothesis credit

$H_0$: Adoption of mobile money does not change the likelihood to have accessed credit for farmers in Haiti
$H_1$: Adoption of mobile money increases the likelihood to have accessed credit for farmers in Haiti

To test the hypothesised relationship between mobile money and insurance and credit, this research follows a correlational design. As for the specific technique, the study employs a binary logistic regression since the dependent variable concerns a binary (dichotomous) variable. This technique was, moreover, chosen as alternative techniques like a linear probability model would potentially estimate probabilities greater than one or less than zero, result in non-normal error term distribution, and produce heteroskedastic residuals (Greene, 2012; Tabachnick & Fidell, 2001; Verbeek, 2012).

Furthermore, the binary logistic regression employs a Penalised Maximum Likelihood Estimation (PMLE). As mentioned previously, the total sample size concerns 1,511 observations. With respect to the specific dependent variables *insurance* and *credit*, few events are reported; 23 and 62 respectively. This relatively large sample size with few events can result in small-sample bias in the models. To reduce the small sample bias, the PMLE is applied as proposed by Firth (1993). Besides, a number of the control variables present patterns of data separation; independent variables perfectly predicting the outcome of the dependent variables (Statistics Solutions, 2018). To account for this, Heinze & Schemper (2002) propose the aforementioned PMLE. Accordingly, in order for this study to account for small-sample bias and data separation, a binary logistic regression using PMLE was employed.

To test the hypotheses using a binary logistic regression and PMLE testing, two analytical models were defined. As a foundation, the analytical model from Kirui, Okello & Nyikal (2012) was taken and adjusted in accordance with the theoretical framework. The set of control variables in the analytical model was based on the obstacles to rural finance presented in the theoretical framework. Ultimately, the final set of control variables was determined by the overall model fit, model significance, and possible multicollinearity. Though literature identified *income*, *farm size*, and *proportion of production sold* to be important predictors for insurance and credit usage, model fit testing showed these variables to be poor predictors for insurance and credit behaviour among Haitian farmers. Subsequently, model fit, and significance were found to decrease when including these variables. Therefore, it was decided to exclude these variables from the analytical model. The specific test results can be found in Appendix D. Regarding multicollinearity, the variance inflation factor showed no indication of multicollinearity among the variables. The variance inflation factor test results are presented in Appendix E.

For insurance, the following analytical model was defined:

$$s_i = \alpha_0 + \beta_1 MM\_useD_i + X_i'\delta + u_i$$

Where $s_i$ concerns whether a farmer *has* or *used to have* insurance, $\beta$ is a vector of regression parameters, $MM\_useD_i$ a dummy variable identifying whether a farmer uses mobile money services or not, and $X_i$ a vector of control variables. $s_i$ is a dichotomous variable that takes the value of 1 if the farmer has insurance and 0 if not. The control variables include the variables *sex, age, age squared, partnership, area, education, awareness of mobile money, membership of farming organisation/cooperative, agriculture training, mobile phone,* and *financial access status*.

As for credit, the following analytical model was defined:

$$c_i = \alpha_0 + \beta_1 MM\_useD_i + X_i'\delta + u_i$$

Where $c_i$ concerns whether a farmer has borrowed money during the last 12 months, $\beta$ is a vector of regression parameters, $MM\_useD_i$ a dummy variable identifying whether a farmer uses mobile money services or not, and $X_i$ a vector of control variables. $c_i$ is a dichotomous variable that takes the value of 1 if the farmer has borrowed money during the last 12 months and 0 if not. As aforementioned, the set of control variables is based on the theoretical framework and model fit testing. It was found that the same group of control variables as the insurance model reported the best model fit results. Hence, these variables were included in the final model for credit.

The analytical models are run in four different models which gradually include all control variables. Model 1 includes mobile money and demographic variables whereas model 2 includes an additional group of variables measuring financial knowledge. The third model includes additional variables measuring the financial status of farmers. Model 4 includes the same variables as model 3, however, only includes the observations that report formal financial access.

## 5.4 Limitations of Material and Methods

Admittedly, the material used, and the methods applied contain certain limitations. Firstly, by using cross-sectional data, all variables were simultaneously measured at a specific point in time. For this reason, no causal relationship can be established (Setia, 2016; Spector, 2019). Furthermore, variables measured in survey responses are time-specific and may, therefore, differ over time. Cross-sectional data does not account for the possible difference in variables over time (Spector, 2019). Hence, it may be that a longitudinal study would yield different and more robust results than the applied cross-sectional study (Masocha & Dzomonda, 2018).

Secondly, the data used in this study concerns structured interviews which may give rise to certain limitations. To illustrate, most of the questions included in the structured interview concerned close-ended questions. As a result, the respondent has a limited number of responses which may not always reflect the exact occurring. Additionally, survey respondents may not always provide truthful and accurate information. To demonstrate, a study by Baumüller (2015) asked farmers questions about costs and incomes repetitively and found answers to differ for similar questions. Hence, it is suggested that relying only on the perception of farmers to evaluate monetary outcomes concerns a limitation as they "...struggle to recollect prices or income" (Baumüller, 2018, p. 150). Hence, the reported answers by farmers may suffer from selective memory, telescoping, attribution, or exaggeration bias (Price & Murnan, 2004).

Furthermore, the FinScope survey does not include any repetitive scale questions. Therefore, it was not possible to form any composite scores in order to conduct reliability checks like the Cronbach's Alpha test (Grootenhuis, 2019). Accordingly, the survey instrument could not be tested for internal consistency and reliability (Creswell, 2014).

Additionally, the FinScope data does not allow for testing all the dimensions that may affect the financial development of smallholder farmers. To illustrate, governance, policies, and management structures may also impact the financial development of smallholder farmers (Asongu, Anyanwu & Tchamyou, 2017). The FinScope survey does not include data to examine the impact of these dimensions.

Finally, the dependent variables in this study, insurance and credit, report rare events. Specifically, 23 observations report insurance and 62 observations report credit, which may lead to small-sample bias as indicated previously. Nonetheless, this is accounted for by employing the Penalised Maximum Likelihood Estimation. Moreover, the observation of rare events may demonstrate the general financial situation for Haitian farmers.

Despite these limitations, FinScope surveys have been used in a number of empirical studies for other countries (Abel, Mutandwa & Roux, 2018; Honohan & King, 2012; Mhella, 2019; Mori, 2019; Njanike, 2019). Therefore, indicating a certain level of data quality (Grootenhuis, 2019).

## 5.5 Descriptive Results

This section presents the descriptive results of this study. It commences by presenting the descriptive statistics of the data. Thereafter, descriptive geographical mapping of the variables mobile money, insurance, and credit are presented. Finally, the attitudes towards financial services are presented descriptively.

### 5.5.1 Descriptive Statistics

Table 5.2 presents the descriptive results of the dependent variables insurance and credit. As can be observed, both variables report rare events. Solely 1.52% and 4.10% report formal insurance and formal credit respectively. Indicating that the larger proportion of Haitian farmers does not have formal insurance and credit. Moreover, as can be seen in figure 5.1, insurance and credit users seem to include different farmers. Solely 0.4% of the farmers report using both insurance and credit.

*Table 5.2, Descriptive Statistics Dependent Variables Insurance and Credit*

| | *N* | *% of total obs.* | *Missing obs.* |
|---|---|---|---|
| **Insurance_formalD** | **1511** | | **0** |
| *Have insurance* | 23 | 1.52 | |
| *Have no insurance* | 1488 | 98.48 | |
| **Credit_formalD** | **1511** | | **0** |
| *Have credit* | 62 | 4.10 | |
| *Have no credit* | 1449 | 95.90 | |

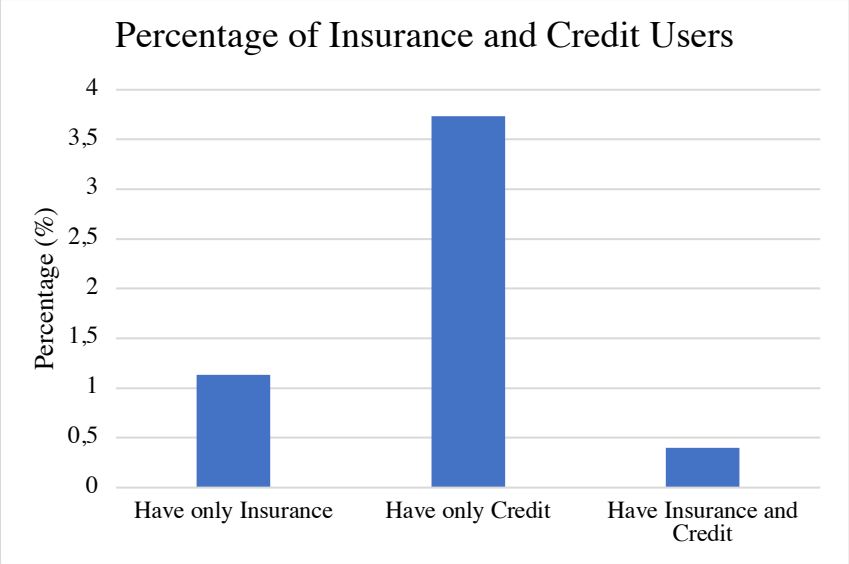


*Figure 5.1, Percentage of Insurance and Credit Users*

Table 5.3 presents the descriptive results for the categorical variables in the model. Regarding mobile money, over fifty percent of Haitian farmers report to be aware of the service, however, just over eleven percent report using mobile money. Regarding education, a large proportion of over thirty-five percent reports to have no formal education and solely around one percent reports tertiary education. Indicating overall relatively low education levels among Haitian farmers. Another notable variable is financial access. Merely around five percent of Haitian farmers report being banked. Contrarily, over seventy percent report being formally excluded from financial services. Referring to chapter 4, the study background identified 33 percent of the adult population in Haiti to have an account at a traditional financial institution. Hence, it appears that this proportion of traditionally banked is considerably lower among farmers. Similarly, around forty-five percent of the farmers report access to a mobile phone, which is roughly fifteen percent lower compared to total population access reported in chapter 4.

Since the overall number of insurance and credit observations are relatively small, the percentages of insurance and credit respondents are naturally relatively low in table 5.3. Nonetheless, it appears that Haitian farmers who live in urban areas, have higher levels of education, are aware of mobile money, and report formal financial access, report higher proportions of insurance. For credit, it appears that Haitian farmers who live in urban areas, have access to a mobile phone, and report formal financial access, report higher proportions having credit. Notably, the financial access categories *informal* and *excluded* report no insurance or credit observations. Solely the categories *banked* and *other formal* report insurance and credit observations.

*Table 5.3, Descriptive Statistics Categorical Variables in Model*

| | *N* | *% of total obs.* | *Missing obs.* | *% reporting insurance* | *% not reporting insurance* | *% reporting credit* | *% not reporting credit* |
|---|---|---|---|---|---|---|---|
| **MMd** | **1511** | | **0** | | | | |
| *Have mobile money* | 179 | 11.85 | | 0.60 | 11.25 | 1.72 | 10.13 |
| *Have no mobile money* | 1332 | 88.15 | | 0.93 | 87.23 | 2.38 | 85.77 |
| **Sex** | **1511** | | **0** | | | | |
| *Female* | 701 | 46.39 | | 0.79 | 45.60 | 1.72 | 44.67 |
| *Male* | 810 | 53.61 | | 0.73 | 52.88 | 2.38 | 51.22 |
| **PartnershipD** | **1511** | | **0** | | | | |
| *Married/free union* | 866 | 57.31 | | 0.86 | 56.45 | 2.51 | 54.80 |
| *Single/widowed/divorced* | 645 | 42.69 | | 0.66 | 42.03 | 1.59 | 41.10 |
| **AreaD** | **1511** | | **0** | | | | |
| *Rural* | 670 | 44.34 | | 0.40 | 43.94 | 1.72 | 42.62 |
| *Urban* | 841 | 55.66 | | 1.13 | 54.53 | 2.38 | 53.28 |
| **Education** | **1511** | | **0** | | | | |
| *No formal education* | 550 | 36.40 | | 0.20 | 36.20 | 0.73 | 35.67 |
| *Primary education* | 554 | 36.66 | | 0.40 | 36.27 | 1.59 | 35.08 |
| *Secondary education* | 391 | 25.88 | | 0.79 | 25.08 | 1.59 | 24.29 |
| *Tertiary education* | 16 | 1.06 | | 0.13 | 0.93 | 0.20 | 0.86 |
| **Awareness_MM_D** | **1511** | | **0** | | | | |
| *Aware of mobile money* | 769 | 50.89 | | 1.26 | 49.64 | 2.91 | 47.98 |
| *Not aware of mobile money* | 742 | 49.11 | | 0.26 | 48.84 | 1.19 | 47.92 |
| **Farming_OrganisationD** | **1511** | | **0** | | | | |
| *Farming organisation* | 44 | 2.91 | | 0.13 | 2.78 | 0.26 | 2.65 |
| *No farming organisation* | 1467 | 97.09 | | 1.39 | 95.70 | 3.84 | 93.25 |
| **Agri_TrainingD** | **1511** | | **0** | | | | |
| *Agricultural training* | 27 | 1.79 | | 0.07 | 1.72 | 0.07 | 1.72 |
| *No agricultural training* | 1484 | 98.21 | | 1.46 | 96.76 | 4.04 | 94.18 |
| **Mobile_PhoneD** | **1511** | | **0** | | | | |
| *Mobile phone* | 675 | 44.67 | | 1.39 | 43.28 | 3.24 | 41,43 |
| *No mobile phone* | 836 | 55.33 | | 0.13 | 55.20 | 0.86 | 54,47 |
| **Financial_Access** | **1511** | | **0** | | | | |
| *Banked* | 80 | 5.29 | | 0.73 | 4.57 | 1.79 | 3.51 |
| *Other Formal* | 318 | 21.05 | | 0.79 | 20.25 | 2.32 | 18.73 |
| *Informal* | 321 | 21.24 | | 0.00 | 21.24 | 0.00 | 21.24 |
| *Excluded* | 792 | 52.42 | | 0.00 | 52.42 | 0.00 | 52.42 |

With regards to the continuous variables in the model, table 5.4 presents the descriptive statistics. The average age of Haitian farmers in the dataset is 42.5 years old. The youngest age observation in the dataset is 15 years of age while the oldest is 75 years of age.

*Table 5.4, Descriptive Statistics Continuous Variables in Model*

| | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| **Age** | 1,511 | 42.55261 | 16.31916 | 15 | 75 |
| **Age_Squared** | 1,511 | 2076.864 | 1450.139 | 225 | 5625 |

Table 5.5 presents the descriptive observations for the variables that are excluded from the analytical model. Generally, smallholder farmers plot less than 10,000 $m^2$ (FAO, 2012a). As is apparent, the majority of farmer observations report their farming land to be less than 10,000 $m^2$. Concerning insurance, it appears that smallholder farmers report lower insurance usage in the smaller farming land categories. Contrarily, this seems to differ for credit as smaller farm sizes report relatively higher proportions of credit usage. Regarding income, the largest share of Haitian farmers report to have no monthly household income, followed by relatively lower-income categories. Markedly, 500 gourdes equals roughly 4.71 euro, indicating that a large proportion of Haitian farmers live underneath the international poverty line (XE, 2020). Nonetheless, it is important to note that the highest monthly household income category, 75,000 gourdes, equals 634 euro (XE, 2020). Hence, even though 75,000 gourdes may be relatively more, it does not equal extreme levels of wealth. This may indicate overall low levels of income among Haitian farmers. Concerning income and insurance usage, it appears that insurance is completely absent from lower-income categories. Similarly, lower-income categories report absent and lower proportions of credit usage.

Finally, with respect to the proportion of production being sold, smallholder farmers consume most of their production and sell merely small proportions. As can be seen in table 5.5, it appears that insurance and credit do reach smaller farmers, however, it seems to reach farmers selling more than half of their production relatively more.

Overall, the Haitian farmers in this study report low uptake levels of financial services. A slight majority reports being aware of mobile money services, whereas merely over eleven percent report to use mobile money services. Besides, the majority reports relatively lower levels of education, income, and size of farming land. Furthermore, the majority reports being excluded from the formal financial system.

*Table 5.5, Descriptive Statistics Variables absent from Model*

| | *N* | *% of total obs.* | *Missing obs.* | *% reporting insurance* | *% not reporting insurance* | *% reporting credit* | *% not reporting credit* |
|---|---|---|---|---|---|---|---|
| **Farm size** | **1511** | | **0** | | | | |
| *1-25 m2* | 151 | 9.99 | | 0.00 | 9.99 | 0.60 | 9.40 |
| *26-100 m2* | 39 | 2.58 | | 0.00 | 2.58 | 0.33 | 2.25 |
| *101-500 m2* | 95 | 6.29 | | 0.07 | 6.22 | 0.07 | 6.22 |
| *501-1000 m2* | 72 | 4.77 | | 0.07 | 4.70 | 0.33 | 4.43 |
| *1001-5000 m2* | 139 | 9.20 | | 0.13 | 9.07 | 0.33 | 8.87 |
| *5001-10,000 m2* | 301 | 19.92 | | 0.20 | 19.72 | 0.60 | 19.32 |
| *10,000-50,000 m2* | 349 | 23.10 | | 0.73 | 22.37 | 1.39 | 21.71 |
| *50,001-100,000 m2* | 38 | 2.51 | | 0.07 | 2.45 | 0.07 | 2.45 |
| *100,001-500,000 m2* | 36 | 2.38 | | 0.00 | 2.38 | 0.00 | 2.38 |
| *500,000-1,000,000 m2* | 2 | 0.13 | | 0.00 | 0.13 | 0.00 | 0.13 |
| *> 1,000,000 m2* | 80 | 5.29 | | 0.13 | 5.16 | 0.26 | 5.03 |
| *Do not know* | 209 | 13.83 | | 0.13 | 13.70 | 0.13 | 13.70 |
| **Monthly household income** | **1511** | | **0** | | | | |
| *No income* | 210 | 13.90 | | 0.00 | 13.90 | 0.33 | 13.57 |
| *< 500 gourdes* | 12 | 0.79 | | 0.00 | 0.79 | 0.13 | 0.66 |
| *500-999 gourdes* | 24 | 1.59 | | 0.00 | 1.59 | 0.00 | 1.59 |
| *1000-1999 gourdes* | 83 | 5.49 | | 0.00 | 5.49 | 0.00 | 5.49 |
| *2000-2999 gourdes* | 128 | 8.47 | | 0.00 | 8.47 | 0.13 | 8.34 |
| *3000-4999 gourdes* | 165 | 10.92 | | 0.07 | 10.85 | 0.00 | 10.92 |
| *5000-7499 gourdes* | 201 | 13.30 | | 0.26 | 13.04 | 0.66 | 12.64 |
| *7500-9999 gourdes* | 109 | 7.21 | | 0.07 | 7.15 | 0.20 | 7.02 |
| *10,000-14,999 gourdes* | 91 | 6.02 | | 0.07 | 5.96 | 0.60 | 5.43 |
| *15,000-19,999 gourdes* | 44 | 2.91 | | 0.20 | 2.71 | 0.13 | 2.78 |
| *20,000-29,999 gourdes* | 41 | 2.71 | | 0.00 | 2.71 | 0.46 | 2.25 |
| *30,000-49,999 gourdes* | 21 | 1.39 | | 0.33 | 1.06 | 0.20 | 1.19 |
| *50,000-74,999 gourdes* | 9 | 0.60 | | 0.07 | 0.53 | 0.07 | 0.53 |
| *> 75,000 gourdes* | 10 | 0.66 | | 0.07 | 0.60 | 0.13 | 0.53 |
| *Do not know* | 363 | 24.02 | | 0.40 | 23.63 | 1.06 | 22.96 |
| **Proportion production sold** | **1511** | | **0** | | | | |
| *Consumption only* | 282 | 18.66 | | 0.26 | 18.40 | 0.73 | 17.94 |
| *Less than half* | 425 | 28.13 | | 0.33 | 27.80 | 0.73 | 27.40 |
| *50-50* | 161 | 10.66 | | 0.20 | 10.46 | 0.79 | 9.86 |
| *More than half* | 506 | 33.49 | | 0.73 | 32.76 | 1.79 | 31.70 |
| *Selling only* | 25 | 1.65 | | 0.00 | 1.65 | 0.00 | 1.65 |
| *Do not know* | 94 | 6.22 | | 0.00 | 6.22 | 0.07 | 6.15 |
| *Missing data* | 18 | 1.19 | | 0.00 | 1.19 | 0.00 | 1.19 |

## 5.5.2 Mapping

Figure 5.2, 5.3, and 5.4 report the percentage of observations per commune reporting mobile money, insurance, and credit respectively. In line with the descriptive statistics in table 5.2 and 5.3, mobile money presents most observations, followed by credit. Even though relatively high percentages can be observed, it is important to acknowledge the general small uptake of insurance and credit described previously. Especially, as some areas have very few observations, the map may present relatively high percentages which should be interpreted with care.

As can be seen in the figures, the uptake of mobile money, insurance, and credit are spread out unequally throughout Haiti. Certain communes report higher percentages of uptake relative to other communes. In particular, some communes report zero observations of mobile money, insurance, or credit. Hence, it does not seem to reach certain communes, indicating that the usage of the services may not be inclusive. Nonetheless, no clear clustering of uptake of mobile money, insurance, or credit can be observed either.

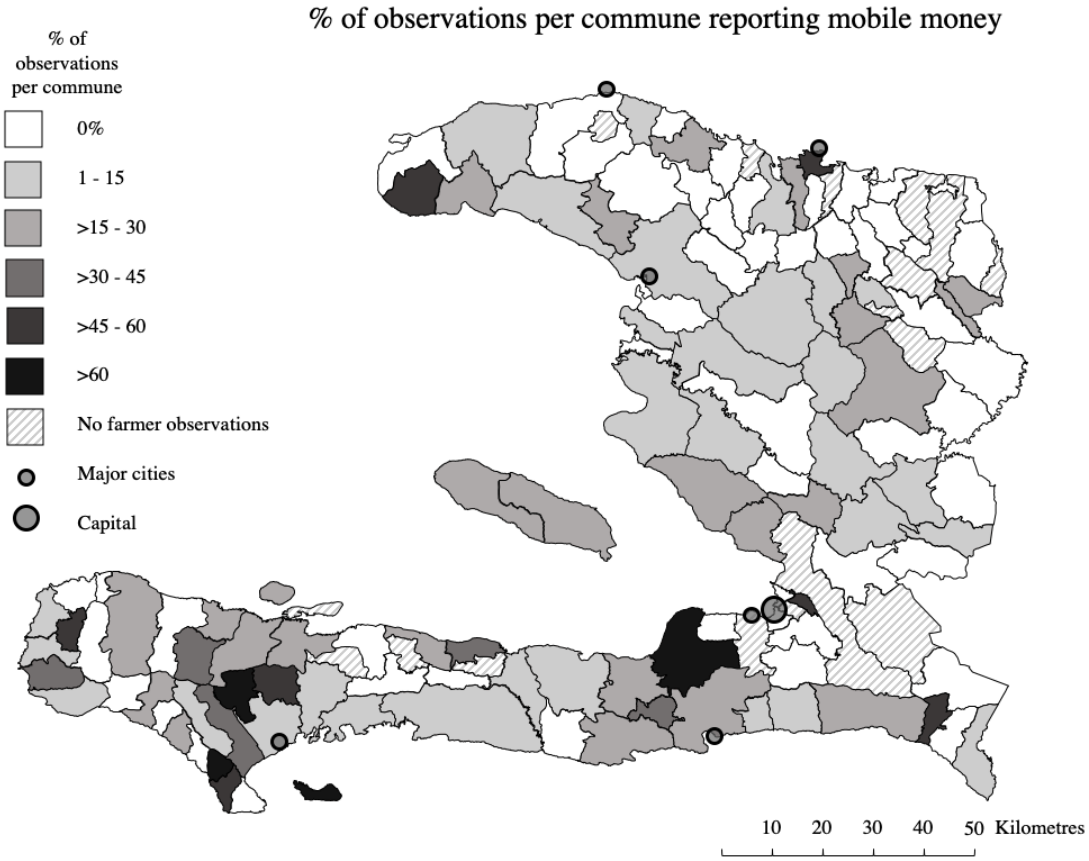


*Figure 5.2, Percentage of Observations per Commune reporting Mobile Money*

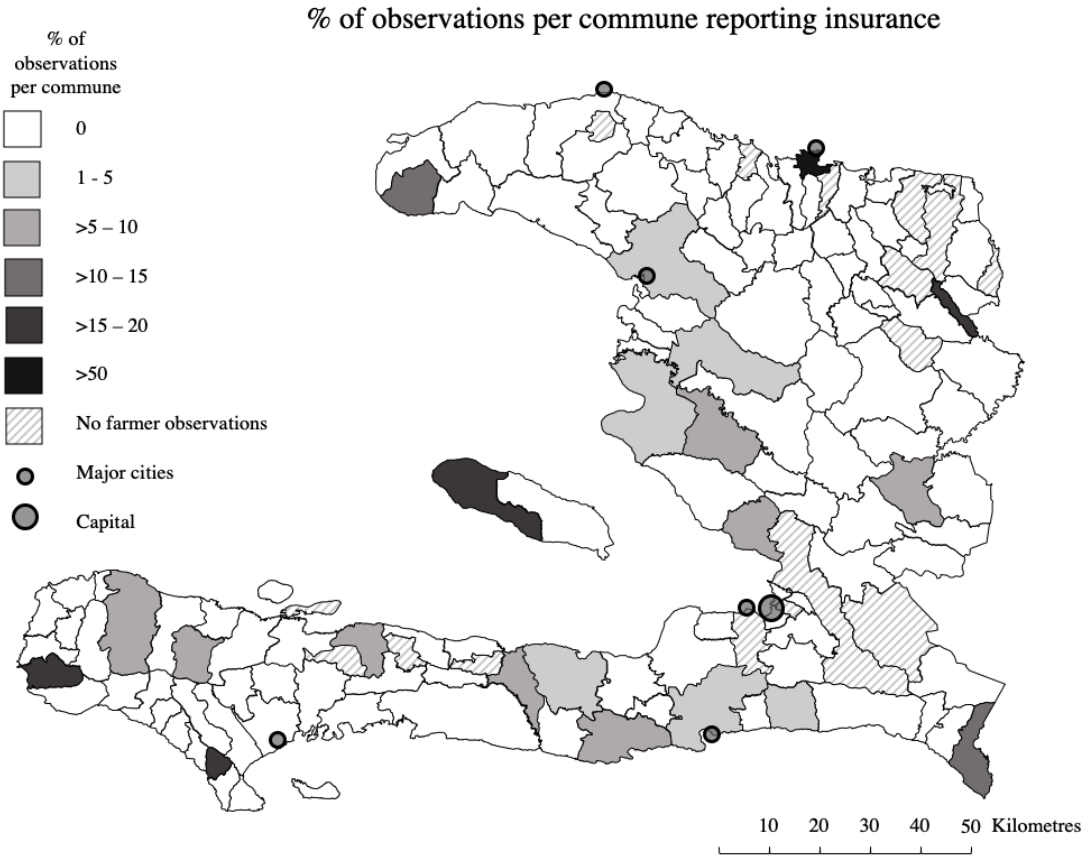


*Figure 5.3, Percentage of observations per Commune reporting Insurance*

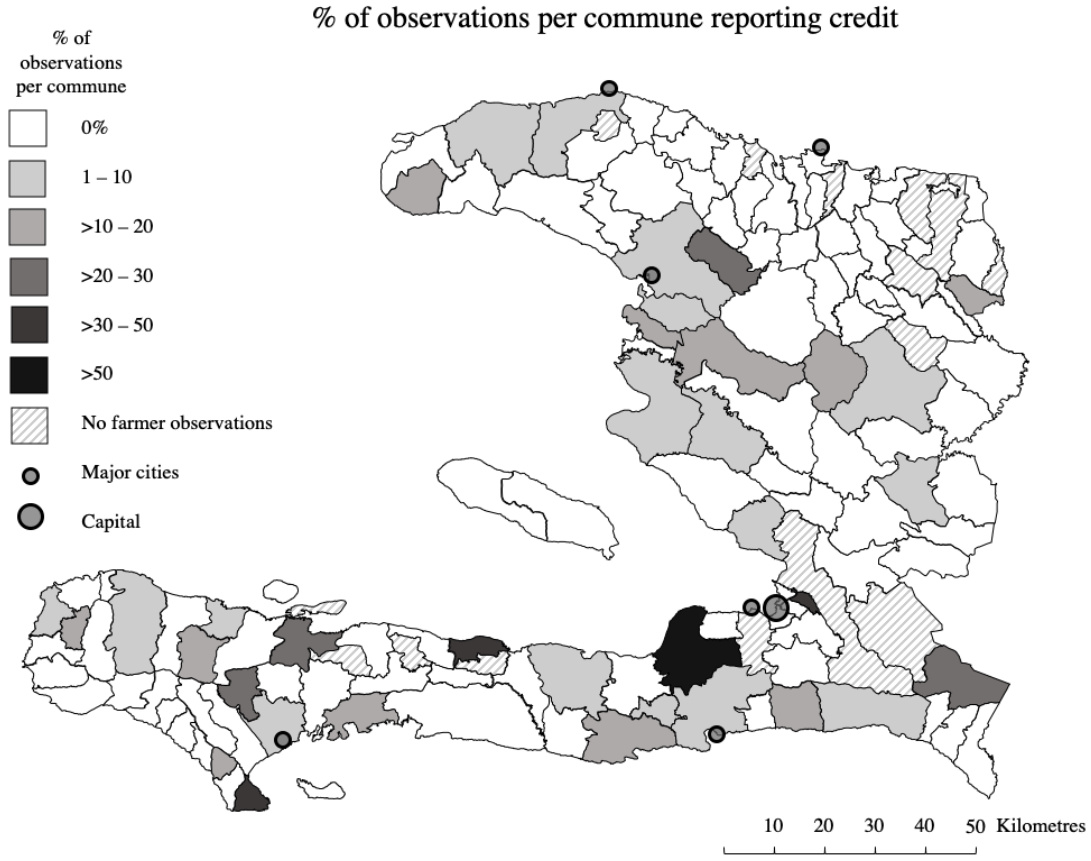


*Figure 5.4, Percentage of Observations per Commune reporting Credit*

### 5.5.3 Attitudes towards Financial Services

In addition to financial service usage and geographical information, the data also includes attitudes towards financial products. Importantly, these reported attitudes contribute to the understanding of the uptake of financial services. This section descriptively presents the most frequent attitudes, commencing with the advantages of mobile money, followed by the challenges for inclusive rural finance.

#### 5.5.3.1 Advantages of Mobile Money

Figure 5.5 presents the most frequently reported advantages of mobile money among users. As can be seen, mobile money is reported to not be expensive, to be most convenient, the only service to be accessible, and to be trusted. These found attitudes towards mobile money are in line with the theorised convenience, affordability, and accessibility of mobile money presented in chapter 2.3.

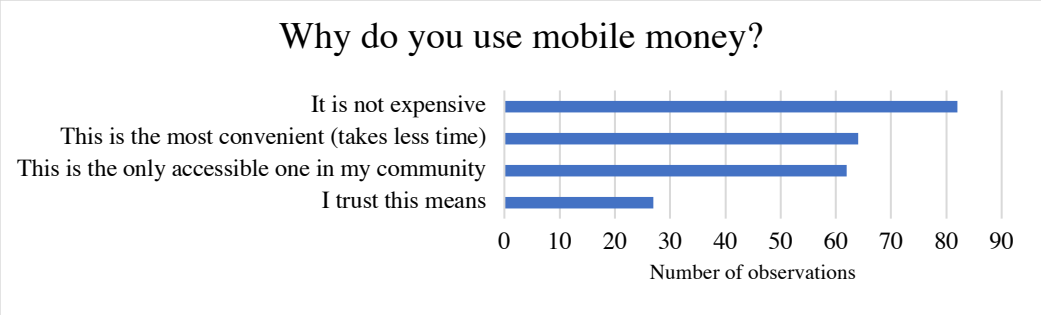


*Figure 5.5, Reasons for using Mobile Money*

#### 5.5.3.2 Challenges for Inclusive Rural Finance

Figure 5.6 to 5.10 present attitudes towards financial services that potentially indicate challenges for inclusive rural finance. Figure 5.6 presents the most frequently reported reasons for not using mobile money. The farmers in the sample reported to not have enough information about the service, to not have money to send or receive, to not have a mobile phone, and that there are no mobile money service providers in their area. These reported reasons are in line with the obstacles to mobile money presented in chapter 2.3.1. In order to adopt mobile money services, financial knowledge, income, access to a mobile phone and an agent network are essential.

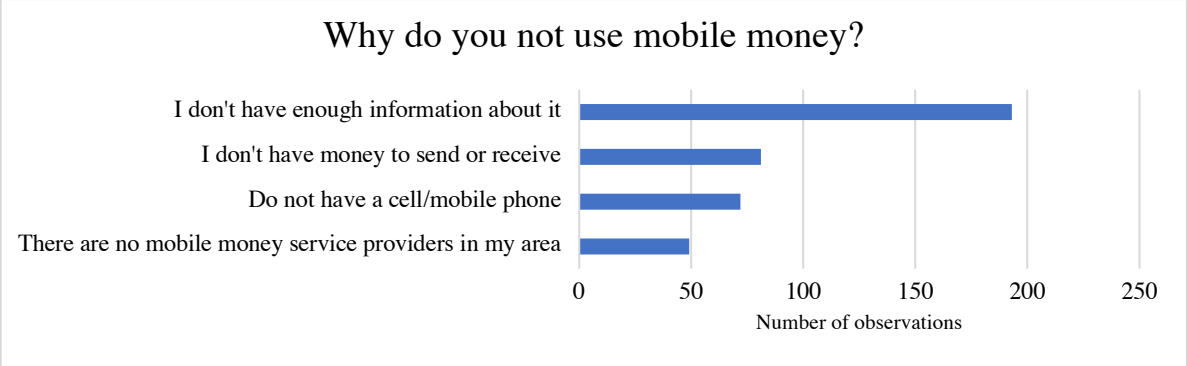


*Figure 5.6, Reasons for not using Mobile Money*

Figure 5.7 and 5.8 present the reasons for not having insurance and loans. The most frequently reported reasons include not having sufficient income, absence of a regular job, lack of (financial) knowledge, and perception barriers. Concerning the latter, the reasons *I do not believe in insurance* and *I do not like having debts* seem to indicate a resistance against adopting financial services.

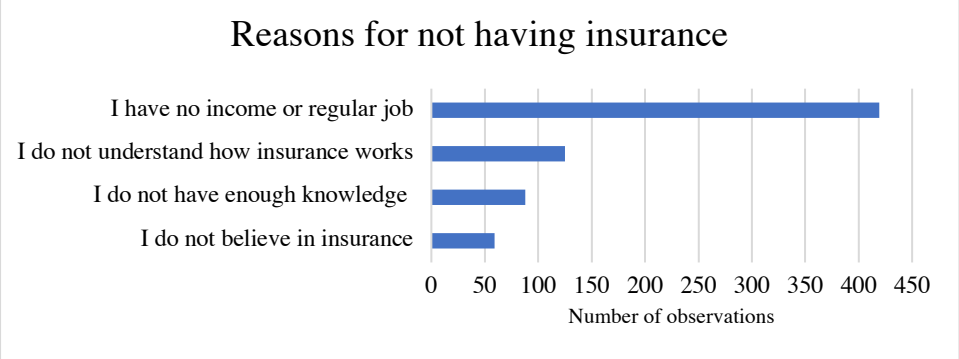


*Figure 5.7, Reasons for not having Insurance*

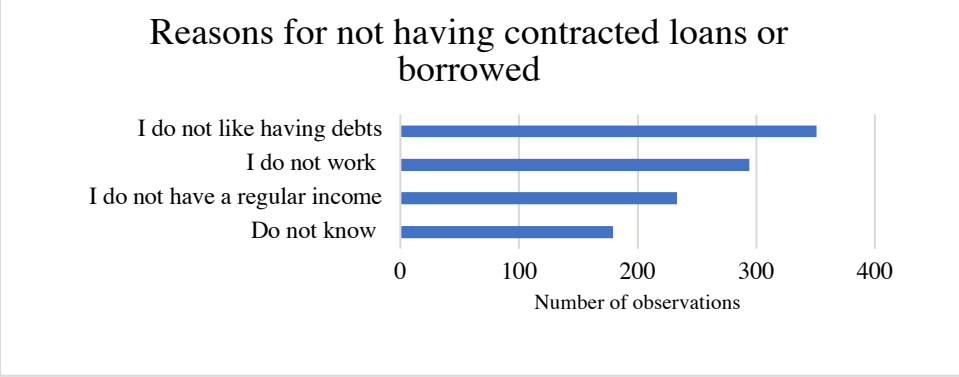


*Figure 5.8, Reasons for not having contracted Loans or Borrowed*

Finally, figure 5.9 and 5.10 present some attitudes challenging inclusive rural finance. Figure 5.9 demonstrates that roughly 900 farmers agree with the statement that there are other ways then insurance to protect yourself against future problems. This may indicate the existence of an informal financial community where family members and fellow villagers rely on one

another for financial support. Likewise, figure 5.10 indicates that over 900 farmers find borrowing money embarrassing. In other words, nearly sixty percent of the farmers in the sample find borrowing money embarrassing. Indicating a substantial attitudinal barrier to inclusive rural finance.

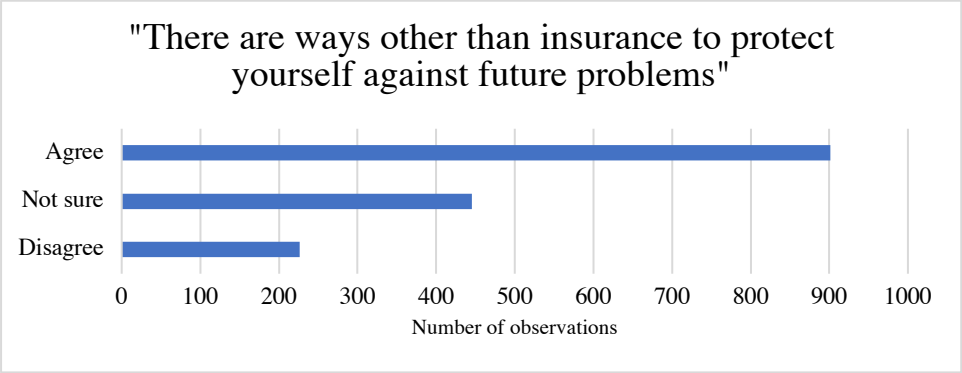


*Figure 5.9, Attitudinal Statement Insurance*

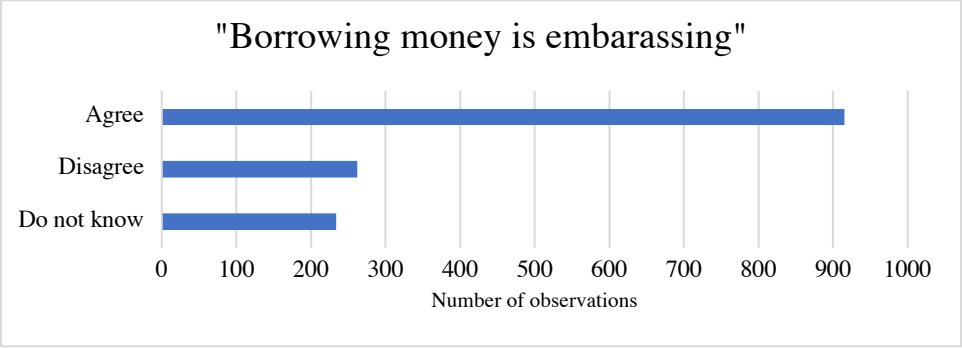


*Figure 5.10, Attitudinal Statement Credit*

Altogether, the descriptive results presented in this section find mobile money users to support the theorised benefits of mobile money in terms of affordability, convenience, and accessibility. Nonetheless, the attitudes presented in the second section present a number of challenges for inclusive rural finance. The main challenges observed concern insufficient knowledge about financial services, insufficient income to participate in financial services, and negative attitudes towards using financial services.

# 6. Empirical Analysis

In this chapter, the empirical analysis is presented. At first, it introduces the results of mobile money and insurance, followed by mobile money and credit. Thereafter, the overall results are discussed in the discussion section.

## 6.1 Results

### 6.1.1 Mobile Money and Insurance

As described in chapter 5.3, a binary logistic regression using a Penalised Maximum Likelihood Estimation was employed to examine the relationship between mobile money and insurance and credit. These regression results are presented in table 6.1 and include the odds ratios, p-values, and model fit and significance scores. The odds ratios represent the constant effect of a predictor X on the likelihood to have insurance. Concerning the overall model fit and model significance, the results present improving scores across model testing.

What stands out in table 6.1 is the change in observed relationships when controlling for additional variables in model 2 and model 3. At first, model 1 finds a positive significant relationship between insurance and mobile money. Nonetheless, when controlling for financial knowledge, the relationship between insurance and mobile money is found to be insignificant. Both *secondary* and *tertiary education* report a significant positive relationship with insurance relative to farmers who report having *no formal education.* Strikingly, when controlling for financial status, the relationship between insurance and mobile money is found to be negative and significant at $p < 0.05$, which indicates that mobile money users are less likely to have insurance. Accordingly, the null hypothesis is rejected.

Additionally, the observed significant positive relationship between education and insurance turns insignificant when controlling for financial status. Access to a mobile phone reports a significant positive relationship with insurance. Farmers with access to a mobile phone report to be almost 4 times more likely to have insurance compared to farmers who do not have access to a mobile phone. Regarding financial access, a significant positive relationship is found, reporting high odds ratios. To illustrate, *banked* farmers are around 123 times more likely to have insurance compared to farmers who are *excluded.* These high odds ratios may be explained by the absence of insurance observations in the categories *informal* and *excluded.* As can be seen in table 6.1, when excluding *informal* and *excluded* from the regression in model 4, the odds ratios for *banked* are substantially lower; banked farmers are around 2.5 times more likely to report insurance compared to *other formal* farmers. The odds ratios and significance levels for the other variables remain nearly the same in model 4. Finally, the relationship between insurance and the demographic variables remain insignificant throughout the four models.

*Table 6.1, Binary Logistic Regression Results from Insurance Model*

| | **Model 1** | | **Model 2 Financial Knowledge** | | **Model 3 Financial Status** | | **Model 4 Excluding *informal & excluded*** | |
|---|---|---|---|---|---|---|---|---|
| | Odds ratio | P > \|z\| | Odds ratio | P > \|z\| | Odds ratio | P > \|z\| | Odds ratio | P > \|z\| |
| **MMd** | 4.798*** | 0.000 | 1.633 | 0.323 | .316 | 0.025 | .315** | 0.025 |
| **Sex** | 1.279 | 0.557 | 1.605 | 0.269 | 1.772 | 0.219 | 1.772 | 0.219 |
| **Age** | .1.091 | 0.297 | 1.125 | 0.171 | 1.061 | 0.505 | 1.061 | 0.503 |
| **Age_Squared** | .999 | 0.351 | .999 | 0.347 | .999 | 0.709 | .999 | 0.706 |
| **PartnershipD** | .754 | 0.525 | .795 | 0.610 | .886 | 0.800 | .887 | 0.803 |
| **AreaD** | .510 | 0.149 | .480 | 0.150 | .583 | 0.283 | .582 | 0.282 |
| **Education** | | | | | | | | |
| *No formal education* | - | - | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | - | - | 2.192 | 0.258 | 1.086 | 0.909 | 1.079 | 0.916 |
| *Secondary education* | - | - | 7.748*** | 0.003 | 1.810 | 0.427 | 1.793 | 0.433 |
| *Tertiary education* | - | - | 21.453*** | 0.004 | 4.288 | 0.186 | 4.234 | 0.190 |
| **Awareness_MM_D** | - | - | 2.520 | 0.107 | 3.434** | 0.041 | 3.445** | 0.041 |
| **Farming_OrganisationD** | - | - | 2.867 | 0.179 | 2.917 | 0.176 | 2.911 | 0.177 |
| **Agri_TrainingD** | - | - | 1.422 | 0.719 | 1.490 | 0.685 | 1.480 | 0.688 |
| **Mobile_PhoneD** | - | - | - | - | 3.888** | 0.047 | 3.880** | 0.048 |
| **Financial_Access** | | | | | | | | |
| *Banked* | - | - | - | - | 123.447*** | 0.001 | 2.470* | 0.057 |
| *Other Formal* | - | - | - | - | 49.718*** | 0.007 | (omitted) | (omitted) |
| *Informal* | - | - | - | - | 1.680 | 0.796 | - | - |
| *Excluded* | - | - | - | - | (omitted) | (omitted) | - | - |
| Number of obs. | 1,511 | | 1,511 | | 1,511 | | 398 | |
| Wald chi2 | 17.80 | | 37.19 | | 36.95 | | 21.27 | |
| Prob>chi2 | 0.0067 | | 0.0002 | | 0.0021 | | 0.0949 | |
| Adjust McFadden | 0.013 | | 0.056 | | 0.249 | | 0.031 | |

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

### 5.1.2 Mobile Money and Credit

Likewise, a binary logistic regression using PMLE was employed for examining the relationship between credit and mobile money. The results are presented in table 6.2 and include the odds ratios, p-values, and model fit and significance scores. Throughout the regressions, the model fit, and model significance report improved scores when adding additional control variables.

As shown in table 6.2, the binary logistic regression results find a positive and significant relationship between credit and mobile money in model 1. Moreover, age and age squared are found significant. Specifically, it finds age to significantly increase the likelihood to have credit, whereas age-squared to significantly decrease the likelihood to have credit. This indicates a nonlinear relationship: as farmers get older, their likelihood to have insurance increases until a certain point, after which it declines. When controlling for financial knowledge in model 2, the relationship between credit and mobile money remains significant. However, a decline in coefficients and odds ratios is evident. Concerning *education, secondary* and *tertiary* education levels are found to have a significant positive relationship with credit.

Finally, when controlling for the financial status of farmers in the third model, the relationship between credit and mobile money is found insignificant. Accordingly, this study fails to reject the null hypothesis. Additionally, when controlling for financial status, all educational variables report insignificant relationships. Solely financial access, age, age squared, and mobile phone access report a significant positive relationship with credit. In particular, high odds ratios are found for financial access where *banked* farmers are found to be roughly 700 times more likely to have credit while *other formal* farmers roughly 200 times compared to *excluded* farmers. These high odds ratios may be attributed to the absence of credit observations in the categories *informal* and *excluded.* As can be seen in table 6.2, when excluding these categories from the regression, the odds ratio for *banked* is considerably lower; *banked* farmers are nearly 3.5 times more likely to report credit compared to *other formal* farmers. The other variables report nearly the same odds ratios and significance levels in model 4. Lastly, the other control variables remained insignificant throughout all four models.

*Table 6.2, Binary Logistic Regression Results from Credit Model*

| | **Model 1** | | **Model 2 Financial Knowledge** | | **Model 3 Financial Status** | | **Model 4 Excluding *informal & excluded*** | |
|---|---|---|---|---|---|---|---|---|
| | Odds ratio | P > \|z\| | Odds ratio | P > \|z\| | Odds ratio | P > \|z\| | Odds ratio | P > \|z\| |
| **MMd** | 6.392*** | 0.000 | 4.779*** | 0.000 | .812 | 0.557 | .812 | 0.557 |
| **Sex** | .791 | 0.384 | .840 | 0.522 | .757 | 0.351 | .757 | 0.352 |
| **Age** | 1.200*** | 0.003 | 1.210*** | 0.002 | 1.124* | 0.065 | 1.123* | 0.065 |
| **Age_Squared** | .998*** | 0.002 | .998*** | 0.002 | .999** | 0.037 | .999** | 0.037 |
| **PartnershipD** | .825 | 0.507 | .876 | 0.651 | .893 | 0.724 | .894 | 0.725 |
| **AreaD** | 1.053 | 0.848 | 1.033 | 0.908 | 1.270 | 0.422 | 1.270 | 0.423 |
| **Education** | | | | | | | | |
| *No formal education* | - | - | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | - | - | 1.761 | 0.139 | .852 | 0.706 | .851 | 0.705 |
| *Secondary education* | - | - | 2.506** | 0.029 | .607 | 0.282 | .607 | 0.281 |
| *Tertiary education* | - | - | 4.590** | 0.047 | .767 | 0.742 | .766 | 0.741 |
| **Awareness_MM_D** | - | - | 1.094 | 0.790 | 1.025 | 0.949 | 1.025 | 0.949 |
| **Farming_OrganisationD** | - | - | 1.456 | 0.514 | 1.415 | 0.561 | 1.413 | 0.563 |
| **Agri_TrainingD** | - | - | .554 | 0.521 | .395 | 0.315 | .395 | 0.314 |
| **Mobile_PhoneD** | - | - | - | - | 1.840* | 0.085 | 1.837* | 0.086 |
| **Financial_Access** | | | | | | | | |
| *Banked* | - | - | - | - | 706.734*** | 0.000 | 3.460*** | 0.000 |
| *Other Formal* | - | - | - | - | 204.019*** | 0.000 | (omitted) | (omitted) |
| *Informal* | - | - | - | - | 2.202 | 0.694 | - | - |
| *Excluded* | - | - | - | - | (omitted) | (omitted) | - | - |
| Number of obs. | 1,511 | | 1,511 | | 1,511 | | 398 | |
| Wald chi2 | 54.52 | | 62.56 | | 58.74 | | 31.11 | |
| Prob>chi2 | 0.0000 | | 0.0000 | | 0.0000 | | 0.0053 | |
| Adjust McFadden | 0.079 | | 0.070 | | 0.354 | | 0.010 | |

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

## 6.2 Discussion

This study assessed the short-term implications of mobile money for inclusive smallholder farmer finance. Specifically, it examined the relationship between mobile money and insurance and credit, and the advantages and challenges of mobile money for inclusive smallholder finance. This section will commence by discussing the relationship between mobile money and insurance and credit. Thereafter, the advantages and challenges are discussed, followed by the limitations and implications of this study.

As presented in the theoretical framework in chapter 2.3, mobile money is theorised to enable previously excluded smallholder farmers access to financial services such as insurance and credit. Nonetheless, in reviewing the literature, no studies were found to examine this relationship. Accordingly, the first sub research question in this study sought to determine the relationship between mobile money and insurance and credit. Contrary to expectations, the binary regression did not find a positive significant relationship between mobile money and insurance and credit. Instead, the relationship between mobile money and insurance was found to be significant and negative. Contrarily, the relationship between mobile money and credit was found insignificant. Hence, the findings of the current study fail to support the theorised impact of mobile money on insurance and credit. A possible explanation for this may be the (remaining) observed challenges to inclusive rural finance, discussed hereafter.

The second sub-research question sought out to understand the observed relationship between mobile money and insurance and credit. Thus, examining the advantages and challenges for mobile money with regards to inclusive smallholder farmer finance. Regarding the former, mobile money users were found to perceive mobile money as not expensive, convenient, accessible, and trustworthy. These perceived advantages reported by users seem to be in line with the benefits of mobile money found in previous studies (e.g. Awunyo-Vitor, 2016; Murendo & Wollni, 2016). Nonetheless, these perceived benefits should not be overemphasised. When comparing awareness levels of mobile money with the actual usage of mobile money, a gap seems to be evident. Namely, over fifty percent of the farmers report being aware of mobile money services whereas merely around eleven percent report using them. Moreover, these findings are subject to the selection effect; mobile money users are naturally more likely to report positive results.

Even though users report these advantages, mobile money was found to not have a positive significant relationship with insurance and credit. This may be explained by a number of observed challenges for mobile money with regards to inclusive smallholder farmer finance. When examining the insurance and credit observations, it is apparent that only a very small proportion of farmers report using these services. Merely 1.52% of the farmers report having insurance and 4.10% report having credit. This suggests that current finance is not equally distributed and does not reach the majority of Haitian farmers. Considering the descriptive statistics of farm size and proportion of production that is being sold, insurance and credit do seem to reach farmers that can be categorised as a smallholder farmer.

Nonetheless, descriptive data on financial access indicates that insurance and credit do not reach smallholder farmers that are excluded from the financial system. Solely formally included farmers report insurance and credit. This suggests that mobile money does not seem to enable access to financial services for farmers that are excluded from formal financial services. Therefore, not improving the financial status of excluded smallholder farmers. Moreover, when including the financial access variables in model 3, other control variables report weakened relationships with insurance and credit relative to their reported relationships in model 1 and 2. This suggests that financial access is an overriding factor. Besides, being banked and formally included report high and significant odds ratios where banked farmers are up to hundreds of times more likely to receive financial services. These findings suggest that formal financial access remains to be a great challenge for inclusive smallholder farmer finance.

Furthermore, findings suggest financial knowledge to be a challenge for inclusive rural finance. Firstly, the binary regression results report significant positive relationships between certain educational levels and insurance and credit. Particularly for insurance, where *secondary* and *tertiary* education report relatively high significant odds ratios. Similarly, a significant positive relationship between mobile money awareness and insurance is observed. In this instance, it can be argued that awareness may embody the greater financial knowledge of farmers. Hence, the results potentially demonstrate the importance of financial knowledge for insurance adoption. Secondly, the distribution of the education variable presented in the descriptive statistics finds higher educational levels to generally report higher levels of insurance and credit. Moreover, farmers indicated that they did not adopt insurance because they do not

understand the service, they do not have enough knowledge, and they do not have enough information. Similarly, many reported to not know why they did not use credit, suggesting a lack of financial knowledge about financial services and products. Altogether, it may, therefore, be assumed that more financial knowledge is required in order for farmers to uptake financial services, especially for insurance. Likewise, the results suggest that mobile money has, thus far, not been able to overcome the financial knowledge barrier to inclusive smallholder farmer. The importance of education for accessing financial services is in line with the work of Ngugi, Pelowski & Ogembo (2010).

Moreover, the results of this study indicate (regular) income to be a barrier to inclusive smallholder farmer finance. Although income is absent from the empirical model, descriptive statistics show no uptake of insurance in lower-income levels. With respect to credit, some lower-income categories do report uptake, however, higher income levels report a relatively higher frequency of credit uptake. Additionally, when analysing the reasons for not adopting financial services, many farmers reported to not have money to send or receive and to not have an income or regular job. Therefore, potentially indicating that there exists an income barrier to inclusive financial services. Considering the specific case of Haiti, many individuals live in extreme poverty. Accordingly, mobile money services may be as perfect as can be, but in case a farmer has no income nor funds, it will be difficult to use any form of financial service. Therefore, the results suggest that income remains to be a challenge for inclusive smallholder farmer finance.

In addition, the results indicate attitudes towards financial services to form a challenge for inclusive smallholder farmer finance. The reported attitudes towards insurance and credit shed some light on the uptake of these financial services. In particular, many farmers reported to not like having debts and to not believe in insurance. Indicating rather unfavourable attitudes towards insurance and credit. Moreover, many agreed to the statement that there are other ways than insurance to protect oneself. This suggests the existence of an informal financial security network for financial protection. As described in chapter 3.1, farmers have had to depend on informal financial structures for years now. Hence, it may be reasonable to believe that farmers have created other ways than insurance to protect themselves. The familiarity with these informal financial protection mechanisms may result in a reluctance of farmers to adopt formal insurance. Besides, many farmers reported borrowing money to be embarrassing. This suggests a strong attitudinal barrier to inclusive rural financial services. It may be debated that mobile

money is unlikely to overcome this in the short-term. However, mobile money may simultaneously be the solution to this since borrowing through the means of mobile money can be executed more discreetly. Hence, mobile money may enable the potential to borrow more secretly without being embarrassed in the future. Nonetheless, in order for this to happen, farmers will first need to adopt mobile money.

With regards to the geographical mapping, it is evident that that adoption of mobile money, insurance, and credit is not equally spread throughout Haiti. However, no clear clustering or spatial focus of adoption is apparent either.

Concerning the variables sex, partnership, area, membership of a farming organisation, and agricultural training, the binary regressions found insignificant relationships. These insignificant relationships were unexpected and suggest that the other control variables that do report significant relationships are overriding factors.

Altogether, it is evident that a number of advantages and challenges exist for mobile money to enable inclusive rural finance. In terms of advantages, the findings suggest mobile money to be perceived as affordable, accessible, convenient, and trustworthy, which is consistent with the literature. Nevertheless, a gap between awareness of mobile money and usage is observed, suggesting challenges for adopting mobile money.

Regarding the challenges, the findings indicate a number of (remaining) factors challenging inclusive smallholder farmer finance. Firstly, the results indicate that formal financial access remains to be a barrier to inclusive rural finance. Thus far, this study finds no uptake of financial services among farmers who are informally served or completely excluded from financial services. Secondly, this study finds financial knowledge to be an important factor for the uptake of insurance and credit. Particularly, many farmers reported to not have sufficient knowledge about insurance and credit. Thirdly, findings suggest income to be a challenge for inclusive smallholder finance. Observations of insurance and credit are few in the lower income levels and many farmers reported to not have sufficient income to adopt the services. Finally, attitudes of farmers towards financial services are found to be unfavourable. Specifically, a large proportion of farmers find borrowing money embarrassing and do not believe in insurance. Hence, indicating that the attitudes of farmers towards financial services challenge

inclusive rural finance. To summarise, the results of this study suggest formal financial access, financial knowledge, income, and attitudes to challenge inclusive smallholder finance.

As for the main research question, the short-term implications of mobile money for inclusive smallholder farmer finance can be inferred from the presented findings. Contrary to what theory projects, the results suggest the prospect of inclusive smallholder finance by means of mobile money to be doubtful in the short-term. In particular, the overall few observations of insurance and credit imply that there may exist large structural barriers to inclusive rural finance. Thus far, the results suggest mobile money to be unable to overcome the challenges of formal financial access, financial knowledge, income, and attitudes. Yet, mobile money is perceived by users as more affordable, convenient, and accessible. Hence, mobile money may still be a useful service infrastructure for enabling inclusive smallholder finance in the future. Nonetheless, mobile money will likely need to be accompanied by supporting measurements in order to overcome the challenges to inclusive rural finance. For instance, financial training to overcome the challenge of financial knowledge. Alternatively, collaborations between mobile money services, insurance and credit providers, and agricultural organisations in the value chain may provide opportunities. An example could be obtaining insurance or credit when purchasing certified seeds or fertilizer.

### 6.2.1 Limitations

The findings of this study must be interpreted with caution and a number of limitations should be borne in mind. Firstly, the findings are context-specific to the case of Haiti. Therefore, mobile money may report other results with respect to enabling inclusive smallholder finance in other socio-economic circumstances. Moreover, due to data availability, this thesis employed a cross-sectional study. As a result, this study cannot determine a causal effect nor study the long-term effects of mobile money. Accordingly, future studies following a longitudinal research design could potentially account for this. Moreover, the data from this study was collected in 2018. Notably, mobile money concerns a fast-growing market (GSMA, 2020). Hence, the current situation of mobile money may have changed since data was collected. Besides, the quantitative nature of this study provides a merely limited understanding of the financial situation of Haitian farmers. Future research in the form of qualitative interviews with both farmers and financial service providers could provide a more in-depth and comprehensive understanding. Finally, as the relationship between mobile money and

insurance and credit has not been studied previously, no benchmark comparison exists. Therefore, further research examining the relationship between mobile money and insurance and credit is required for the findings to be conclusive.

### 6.2.2 Implications

The findings discussed, present some important implications for developing inclusive smallholder farmer finance. The results suggest that mobile money alone is unlikely to enable inclusive smallholder finance in Haiti. Particularly, a combination of findings suggest that formal financial access, financial knowledge, income and attitudes are yet too strong of a challenge for mobile money to overcome. These findings may help to understand that in order to achieve inclusive smallholder finance, a wider approach targeting the observed challenges is essential. Further research, however, will be needed to determine successful approaches. Therefore, in order for smallholder farmers to obtain finance for ensuring productive, efficient, and sustainable food systems, mobile money will need to be accompanied by a number of other approaches targeting the remaining challenges to accessing insurance and credit.

# 7. Conclusion

The aim of the present study was to contribute to the understanding of whether mobile money enables smallholder farmer finance. More specifically, this study set out to understand the short-term implications of mobile money for inclusive smallholder farmer finance in Haiti. Accordingly, the first sub-research question examined the relationship between mobile money and the financial services insurance and credit. Thereafter, the second sub-research question aimed at understanding the observed relationship by analysing the advantages and challenges for mobile money for enabling inclusive smallholder farmer finance.

The employed logistic regression found no significant positive relationship between mobile money and insurance and credit. These observed relationships were unexpected as the theoretical framework proposed mobile money to increase the likelihood of accessing financial services. Nonetheless, the results of the present study suggest that mobile money does not positively affect the likelihood to have insurance or credit among Haitian farmers.

These rather unexpected results may be due to the observed challenges for inclusive smallholder farmer finance. Firstly, formal financial access was found to significantly increase the likelihood to have insurance and credit. In particular, solely farmers with access to formal financial services reported uptake of these financial services. Secondly, financial knowledge was found to play a substantial role in accessing financial services. The logistic regression found positive significant relationships between education and credit and insurance. Moreover, farmers reported having insufficient knowledge and information about financial services. Thirdly, the results indicate that income remains to be a barrier to accessing financial services. Farmers report having insufficient income for adopting financial services. Finally, this study finds farmers to report unfavourable attitudes towards financial services.

Although no positive associations were found between mobile money and having insurance or credit, mobile money adopters indicate a number of advantages of the service. To demonstrate, adopters perceive mobile money to be affordable, accessible, and convenient. Hence, suggesting that mobile money may still benefit smallholder farmers. Even though adopters report these advantages, no significant positive relationship with financial services is observed. This suggests that the force of the aforementioned challenges to inclusive smallholder farmer finance are yet too strong for mobile money to overcome.

These findings have important implications for the understanding of how mobile money can be utilised for enabling inclusive smallholder farmer finance. The findings of this study suggest that mobile money alone is unlikely to enable inclusive finance opportunities for smallholder farmers. Instead, a wider approach targeting the challenges of formal financial access, financial knowledge, income, and attitudes is necessary. This will likely require active efforts and collaborations between different stakeholders. Therefore, in order to achieve inclusive finance for smallholder farmers, different measurements aiming at overcoming the observed challenges are required.

The findings reported here provide new insights on mobile money for smallholder farmer finance and will be of interest to a wide range of stakeholders working on rural development. This project is the first comprehensive study of mobile money for smallholder farmer finance. Hence, this study contributes to our understanding of how mobile money may play a role in facilitating finance for smallholder farmers. In particular, the findings reported in the present study provide an understanding of the challenges for mobile money to enable smallholder farmer finance.

## 7.1 Future Research

Certainly, several questions remain unanswered at present. For instance, future research is required to verify the results of the present study. In particular, replicating this study in diverse research settings in order to confirm whether the results can be generalised or, alternatively, are context-specific to the case of Haiti. Moreover, the identified challenges are an important issue for future research. Specifically, future research should be undertaken to investigate effective approaches for overcoming these challenges. For instance, the impact of providing

financial training, microloans, or combining financial services with certified agriculture input. Furthermore, to better understand the unfavourable attitudes towards financial services, further studies will be needed. Especially, additional studies with more focus on qualitative research are suggested. Also, further studies examining the determinants of insurance and credit adoption can determine whether there are additional challenges to inclusive smallholder finance. Particularly, the overall low number of insurance and credit observations suggest that additional challenges to inclusive smallholder finance may exist. Besides, further research could examine the spatial aspects that impact smallholder farmer finance. For instance, distance to financial services and types of farming land. Finally, this study examines the subject of smallholder farmer finance from the demand side. Future research might explore the subject from the supply side and study financial service providers.

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# Appendix A

This section presents maps for mobile money, insurance, and credit, visualising the total number of observations per region.

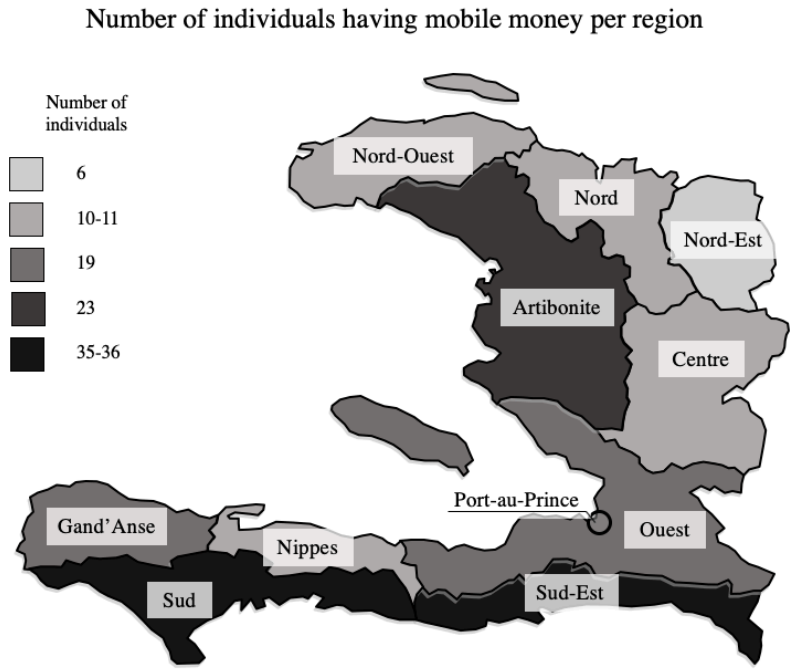


*Figure A.1, Number of Individuals having Mobile Money per Region*

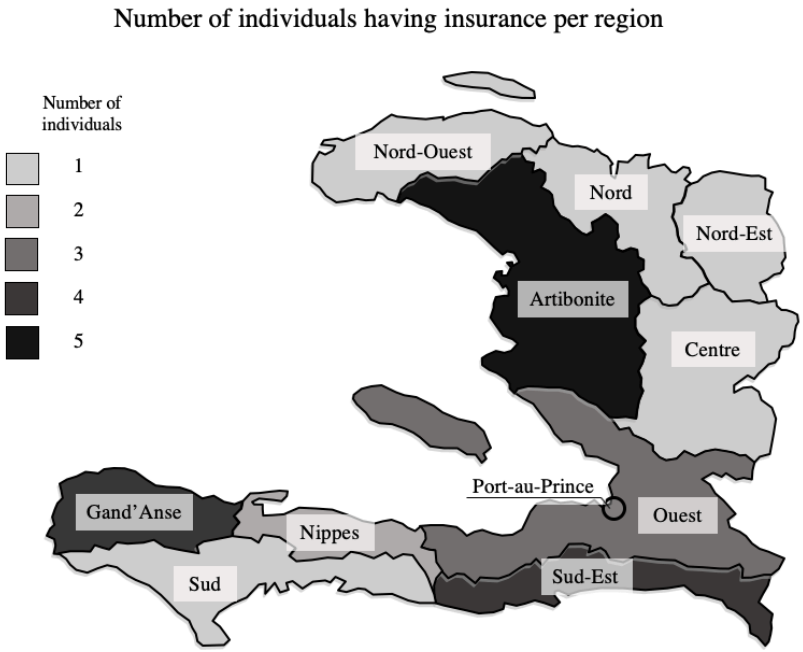


*Figure A.2, Number of Individuals having Insurance per Region*

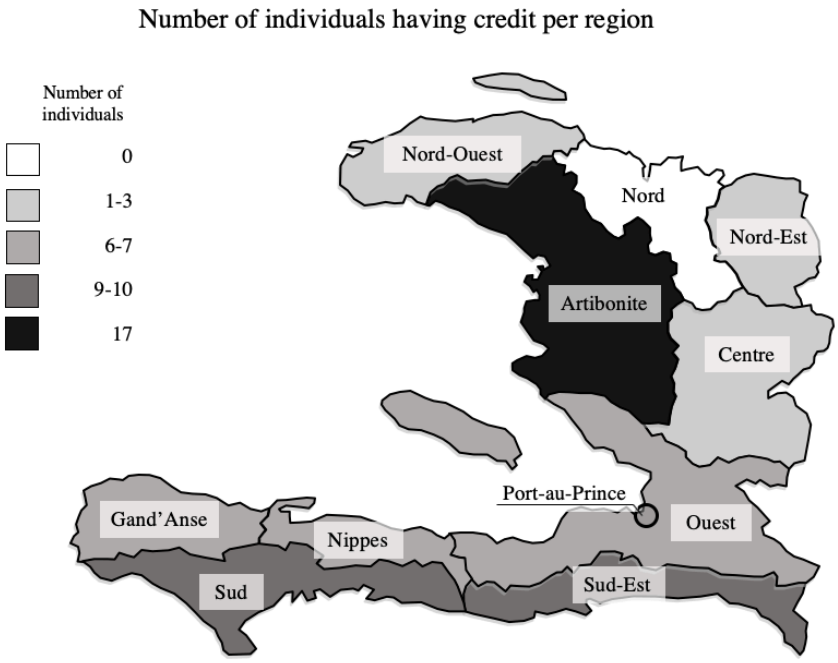


*Figure A.3, Number of Individuals having Credit per Region*

# Appendix B

Overview of communes with no *Farmer* observations.

*Table B.1, Overview of Communes reporting no Farmer Observations*

| **Name of commune** |
|---|
| Arnaud |
| Bas-Limbé |
| Capotille |
| Carrefour |
| Cerca-Carvajal |
| Chansolme |
| Croix-des-Bouquets |
| Delmas |
| Fond des Blancs |
| Fort-Liberté |
| Ganthier |
| Grand-Boucan |
| Kenscoff |
| La Victoire |
| Paillant |
| Plaisance-du-Sud |
| Port-au-Prince |
| Quartier-Morin |
| Terrier-Rouge |
| Vallières |

# Appendix C

Figure C.1 visualises which Haitian communes report *Farmer* observations and which communes do not report *Farmer* observations.

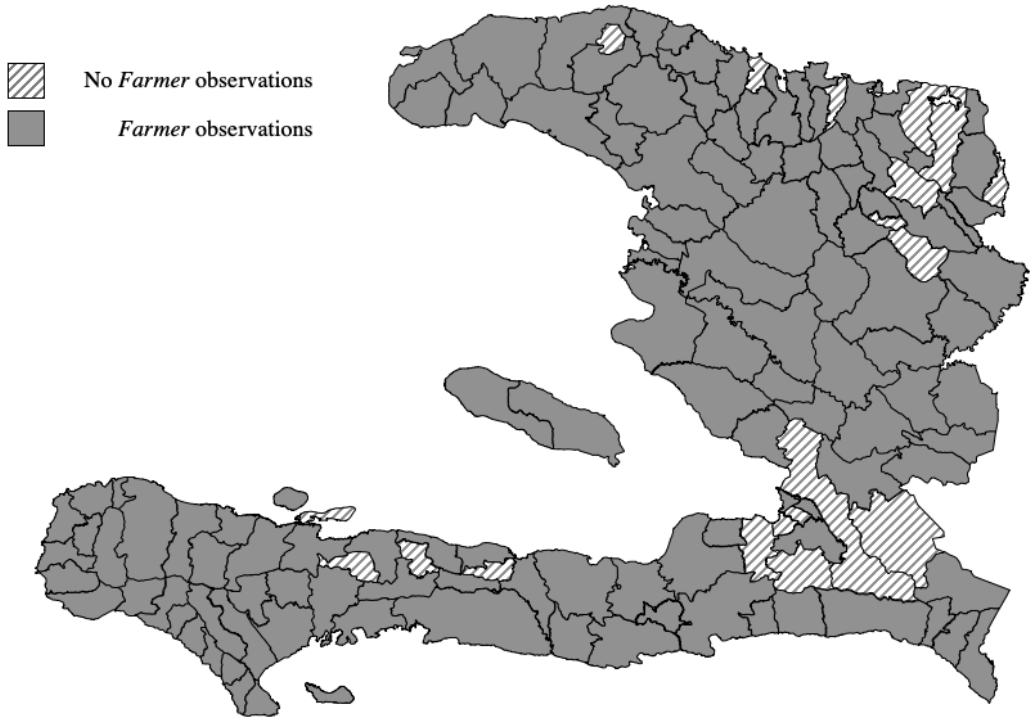


*Figure C.1, Map of (no) Farmer Observations per Commune*

# Appendix D

As can be seen in table D.1, when including the variables income, farm size, or proportion of production sold in the analytical model, the significance levels and (Adj) McFadden scores decrease. Moreover, table D.2 on the next page shows the coefficients and significance levels of the variables when running the regression with all variables. As is apparent, no variable shows coefficients that are significant at $p < 0.01$ or $p < 0.05$.

*Table D.1 Model Fit and Significance Testing Results*

| *Analytical model* | *Model* | *Prob>chi2* | *(Adj) McFadden* |
|---|---|---|---|
| ***Insurance*** | **Model 3** | **0.0049** | **0.245** |
| ***Insurance*** | Model 3 + income | 0.0454 | 0.198 |
| ***Insurance*** | Model 3 + farm size | 0.0912 | 0.175 |
| ***Insurance*** | Model 3 + proportion of production sold | 0.0395 | 0.181 |
| ***Insurance*** | Model 3 + income, farm size, proportion of production sold | 0.4135 | 0.064 |
| ***Credit*** | **Model 3** | **0.0000** | **0.357** |
| ***Credit*** | Model 3 + income | 0.0003 | 0.353 |
| ***Credit*** | Model 3 + farm size | 0.0000 | 0.355 |
| ***Credit*** | Model 3 + proportion of production sold | 0.0000 | 0.342 |
| ***Credit*** | Model 3 + income, farm size, proportion of production sold | 0.0150 | 0.322 |

*Table D.2, Regression Results with additional Variables Income, Farmingland, and Production Sale*

| **Analytical model** | **Insurance** | | **Credit** | |
|---|---|---|---|---|
| | Coef. | P>\|z\| | Coef. | P>\|z\| |
| **Income_H** | | | | |
| *<500 Gourdes* | 1.910352 | 0.456 | 1.751522 | 0.556 |
| *500 - 999 Gourdes* | .7594299 | 0.727 | -.2271932 | 0.897 |
| *1000-1999 Gourdes* | -.4724882 | 0.819 | -2.853113 | 0.079 |
| *2000-2999 Gourdes* | -.0092459 | 0.996 | -2.042605 | 0.079 |
| *3000-4999 Gourdes* | .3839924 | 0.821 | -2.594652 | 0.101 |
| *5000-7499 Gourdes* | 1.065171 | 0.484 | -.2617226 | 0.718 |
| *7500-9999 Gourdes* | .2938439 | 0.864 | -1.53571 | 0.093 |
| *10,000-14,999 Gourdes* | -.0922273 | 0.956 | -.2035088 | 0.786 |
| *15,000-19,999 Gourdes* | 1.334429 | 0.398 | -1.172202 | 0.233 |
| *20,000-29,999 Gourdes* | -1.641195 | 0.461 | .1253835 | 0.878 |
| *30,000-49,999 Gourdes* | 1.904309 | 0.239 | -.384933 | 0.673 |
| *50,000-74,999 Gourdes* | 1.825408 | 0.326 | .1543205 | 0.904 |
| *> 75,000 Gourdes* | .2981576 | 0.872 | -.5608251 | 0.584 |
| *Do not know* | .5476148 | 0.716 | -.1780497 | 0.786 |
| *No income* | (omitted) | | | |
| **Farmingland** | | | | |
| *1-25 m2* | (omitted) | | | |
| *26-100 m2* | 1.033176 | 0.649 | .6029834 | 0.485 |
| *101-500 m2* | 1.690176 | 0.364 | -1.254973 | 0.250 |
| *501-1000 m2* | 2.314667 | 0.189 | .3047547 | 0.690 |
| *1001-5000 m2* | 1.167032 | 0.483 | -.6945515 | 0.348 |
| *5001-10,000 m2* | 1.556017 | 0.325 | -.7946154 | 0.223 |
| *10,001-50,000 m2* | 1.945563 | 0.188 | -.6355964 | 0.275 |
| *50,001-100,000 m2* | .8519392 | 0.660 | -.7290588 | 0.471 |
| *100,001-500,000 m2* | .2772714 | 0.899 | -2.5457 | 0.111 |
| *500,001-1,000,000 m2* | 1.102351 | 0.679 | .4685436 | 0.817 |
| *More than 1,000,000 m2* | 1.812031 | 0.293 | -.4002593 | 0.629 |
| *Do not know* | 1.231156 | 0.478 | -1.521929 | 0.082 |
| **Production_Sale** | | | | |
| *Consumption only* | (omitted) | | | |
| *Less than half* | .0960515 | 0.893 | -.3528337 | 0.501 |
| *50-50* | .3809404 | 0.665 | .9093535 | 0.111 |
| *More than half* | .0043774 | 0.995 | -.0585022 | 0.902 |
| *Selling only* | -.2531505 | 0.888 | -1.944556 | 0.221 |
| *Do not know* | -.3598129 | 0.843 | -.2017286 | 0.851 |
| *Missing data* | .736504 | 0.711 | -.9240112 | 0.762 |

# Appendix E

As argued by Midi, Sarkar & Rana (2010), testing for multicollinearity in a logistic regression model is best done by running a linear regression, testing for the variance inflation factor (VIF). Figure E.1 visualises the VIF results from running a regression using the variables included in the credit and insurance model. At first, the results show high scores for the variables age and age squared, assumedly since they both originate from the same variable. When dropping the variable age squared, the high scores for VIF disappear. Ultimately, the VIF scores range from 1.03 to 1.76, indicating no problems with multicollinearity among the variables (Miles, 2014)

| Variable | VIF | 1/VIF |
|---|---|---|
| MMd | 1.76 | 0.567836 |
| Sex | 1.03 | 0.971123 |
| Age | 39.36 | 0.025403 |
| Age_Squared | 37.31 | 0.026802 |
| PartnershipD | 1.21 | 0.826017 |
| AreaD | 1.05 | 0.954307 |
| Education | | |
| 2 | 1.06 | 0.944828 |
| 3 | 1.07 | 0.932742 |
| 4 | 1.66 | 0.604102 |
| 5 | 1.75 | 0.569827 |
| 6 | 1.64 | 0.608799 |
| 7 | 1.17 | 0.851356 |
| Awareness_MM | 1.23 | 0.814090 |
| Farming_Or~D | 1.11 | 0.903624 |
| Agri_Train~D | 1.05 | 0.950074 |
| Mobile_Pho~D | 1.16 | 0.863086 |
| Financial_~s | | |
| 1 | 1.36 | 0.737099 |
| 2 | 1.70 | 0.588309 |
| 3 | 1.20 | 0.834927 |
| Mean VIF | 5.20 | |

| Variable | VIF | 1/VIF |
|---|---|---|
| MMd | 1.76 | 0.568337 |
| Sex | 1.03 | 0.971335 |
| Age | 1.47 | 0.682352 |
| PartnershipD | 1.08 | 0.924048 |
| AreaD | 1.05 | 0.954451 |
| Education | | |
| 2 | 1.06 | 0.945133 |
| 3 | 1.07 | 0.932843 |
| 4 | 1.66 | 0.604103 |
| 5 | 1.72 | 0.580838 |
| 6 | 1.64 | 0.611301 |
| 7 | 1.17 | 0.851370 |
| Awareness_MM | 1.23 | 0.814359 |
| Farming_Or~D | 1.11 | 0.903730 |
| Agri_Train~D | 1.05 | 0.950083 |
| Mobile_Pho~D | 1.16 | 0.864969 |
| Financial_~s | | |
| 1 | 1.34 | 0.747266 |
| 2 | 1.70 | 0.588522 |
| 3 | 1.20 | 0.835700 |
| Mean VIF | 1.30 | |

*Figure E.1, Multicollinearity testing Results*

# Appendix F

This section presents the exact number of observations per commune presented in separate tables for mobile money, insurance, and credit.

*Table F.1, Mobile Money Observations per Commune*

| Name of commune | Obs. per commune | Mobile money obs. | % of obs. per commune reporting mobile money |
|---|---|---|---|
| Acul-du-Nord | 9 | 1 | 11.1 |
| Anse-à-Pitres | 8 | 1 | 12.5 |
| Anse-à-Veau | 12 | 2 | 16.7 |
| Anse-d'Hainault | 7 | 1 | 14.3 |
| Anse-Rouge | 8 | 1 | 12.5 |
| Aquin | 22 | 1 | 4.5 |
| Arcahaie | 27 | 7 | 25.9 |
| Arniquet | 5 | 3 | 60.0 |
| Bahon | 4 | 1 | 25.0 |
| Baie-de-Henne | 5 | 1 | 20.0 |
| Bainet | 19 | 5 | 26.3 |
| Baradères | 18 | 4 | 22.2 |
| Beaumont | 12 | 4 | 33.3 |
| Belle-Anse | 22 | 5 | 22.7 |
| Bombardopolis | 9 | 5 | 55.6 |
| Borgne | 20 | 4 | 20.0 |
| Boucan-Carré | 20 | 2 | 10.0 |
| Cabaret | 12 | 3 | 25.0 |
| Camp-Perrin | 7 | 5 | 71.4 |
| Cap-Haïtien | 2 | 1 | 50.0 |
| Carice | 5 | 1 | 20.0 |
| Cavaillon | 21 | 1 | 4.8 |
| Cayes- Jacmel | 25 | 3 | 12.0 |
| Chambellan | 6 | 3 | 50.0 |
| Chantal | 12 | 1 | 8.3 |
| Chardonnières | 10 | 3 | 30.0 |
| Corail | 12 | 2 | 16.7 |
| Côteaux | 5 | 1 | 20.0 |
| Dame-Marie | 16 | 1 | 6.3 |
| Desdunes | 9 | 1 | 11.1 |
| Dessalines | 47 | 6 | 12.8 |
| Gonaïves | 34 | 3 | 8.8 |

| | | | |
|---|---|---|---|
| Grand-Goâve | 13 | 2 | 15.4 |
| Grand-Gosier | 7 | 4 | 57.1 |
| Hinche | 19 | 3 | 15.8 |
| Île-à-Vache | 4 | 3 | 75.0 |
| Jacmel | 37 | 10 | 27.0 |
| Jean-Rabel | 32 | 3 | 9.4 |
| Jérémie | 27 | 6 | 22.2 |
| La Gonâve | 6 | 1 | 16.7 |
| La Vallée | 16 | 7 | 43.8 |
| Lascahobas | 16 | 1 | 6.3 |
| Léogâne | 1 | 1 | 100.0 |
| Les Cayes | 22 | 3 | 13.6 |
| Les Irois | 5 | 2 | 40.0 |
| Maïssade | 8 | 1 | 12.5 |
| Maniche | 7 | 4 | 57.1 |
| Marigot | 22 | 3 | 13.6 |
| Miragoâne | 19 | 2 | 10.5 |
| Mirebalais | 22 | 1 | 4.5 |
| Mont-Organisé | 9 | 2 | 22.2 |
| Pestel | 15 | 3 | 20.0 |
| Petit-Goâve | 21 | 1 | 4.8 |
| Petite-Rivière-de-Nippes | 3 | 1 | 33.3 |
| Pignon | 6 | 1 | 16.7 |
| Plaine-du-Nord | 6 | 1 | 16.7 |
| Port-Salut | 4 | 2 | 50.0 |
| Ranquitte | 8 | 1 | 12.5 |
| Saint-Louis-du-Nord | 20 | 3 | 5.0 |
| Saint-Louis-du-Sud | 18 | 2 | 11.1 |
| Saint-Marc | 42 | 1 | 2.4 |
| Saint-Michel-de-l'atalaye | 38 | 4 | 10.5 |
| Saint-Raphaël | 11 | 1 | 9.1 |
| Saut-d'Eau | 13 | 2 | 15.4 |
| Savanette | 18 | 1 | 5.6 |
| Tabarre | 2 | 1 | 50.0 |
| Terre-Neuve | 7 | 2 | 28.6 |
| Tiburon | 7 | 1 | 14.3 |
| Torbeck | 15 | 6 | 40.0 |
| Verrettes | 38 | 5 | 13.2 |

*Table F.2, Insurance Observations per Commune*

| Name of commune | Obs. per commune | Insurance obs. | % of obs. per commune reporting insurance |
|---|---|---|---|
| Anse-à-Pitres | 8 | 1 | 12.5 |
| Arniquet | 5 | 1 | 20.0 |
| Bainet | 19 | 1 | 5.3 |
| Beaumont | 12 | 1 | 8.3 |
| Bombardopolis | 9 | 1 | 11.1 |
| Cabaret | 12 | 1 | 8.3 |
| Cap-Haïtien | 2 | 1 | 50.0 |
| Carice | 5 | 1 | 20.0 |
| Dessalines | 47 | 1 | 2.1 |
| Gonaïves | 34 | 1 | 2.9 |
| Jacmel | 37 | 1 | 2.7 |
| Jérémie | 27 | 2 | 7.4 |
| Lascahobas | 16 | 1 | 6.3 |
| Les Irois | 5 | 1 | 20.0 |
| Marigot | 22 | 1 | 4.5 |
| Miragoâne | 19 | 1 | 5.3 |
| Petit-Goâve | 21 | 1 | 4.8 |
| Petit-Trou-de-Nippes | 16 | 1 | 6.3 |
| Pointe-à- Raquette | 6 | 1 | 16.7 |
| Saint-Marc | 42 | 1 | 2.4 |
| Verrettes | 38 | 2 | 5.3 |

*Table F.3, Credit Observations per Commune*

| Name of commune | Obs. per commune | Credit obs. | % of obs. per commune reporting credit |
|---|---|---|---|
| Arniquet | 5 | 1 | 20.0 |
| Bainet | 19 | 3 | 15.8 |
| Baradères | 18 | 4 | 22.2 |
| Beaumont | 12 | 2 | 16.7 |
| Belle-Anse | 22 | 1 | 4.5 |
| Bombardopolis | 9 | 1 | 11.1 |
| Cabaret | 12 | 1 | 8.3 |
| Camp-Perrin | 7 | 2 | 28.6 |
| Chambellan | 6 | 1 | 16.7 |
| Corail | 12 | 1 | 8.3 |
| Dame-Marie | 16 | 1 | 6.3 |
| Desdunes | 9 | 1 | 11.1 |
| Dessalines | 47 | 9 | 19.1 |
| Ennery | 8 | 2 | 25.0 |
| Fonds-Verettes | 8 | 2 | 25.0 |
| Gonaïves | 34 | 2 | 5.9 |
| Hinche | 19 | 1 | 5.3 |
| Jacmel | 37 | 3 | 8.1 |
| Jean-Rabel | 32 | 1 | 3.1 |
| Jérémie | 27 | 2 | 3.7 |
| L'Estère | 10 | 1 | 10.0 |
| La Vallée | 16 | 1 | 6.3 |
| Lascahobas | 16 | 1 | 6.3 |
| Leogâne | 1 | 1 | 100.0 |
| Les Cayes | 22 | 2 | 9.1 |
| Maïssade | 8 | 1 | 12.5 |
| Marigot | 22 | 3 | 13.6 |
| Mont-Organisé | 9 | 1 | 11.1 |
| Petit-Goâve | 21 | 1 | 4.8 |
| Petite-Rivière-de-Nippes | 3 | 1 | 33.3 |
| Port-de-Paix | 26 | 1 | 3.8 |
| Saint-Louis-du-Sud | 18 | 2 | 11.1 |
| Saint-Marc | 42 | 1 | 2.4 |
| Saint-Jean-du-Sud | 6 | 2 | 33.3 |
| Tabarre | 2 | 1 | 50.0 |
| Verrettes | 38 | 1 | 2.6 |

# Appendix G

This section presents maps for mobile money, insurance, and credit, visualising the total number of observations per commune.

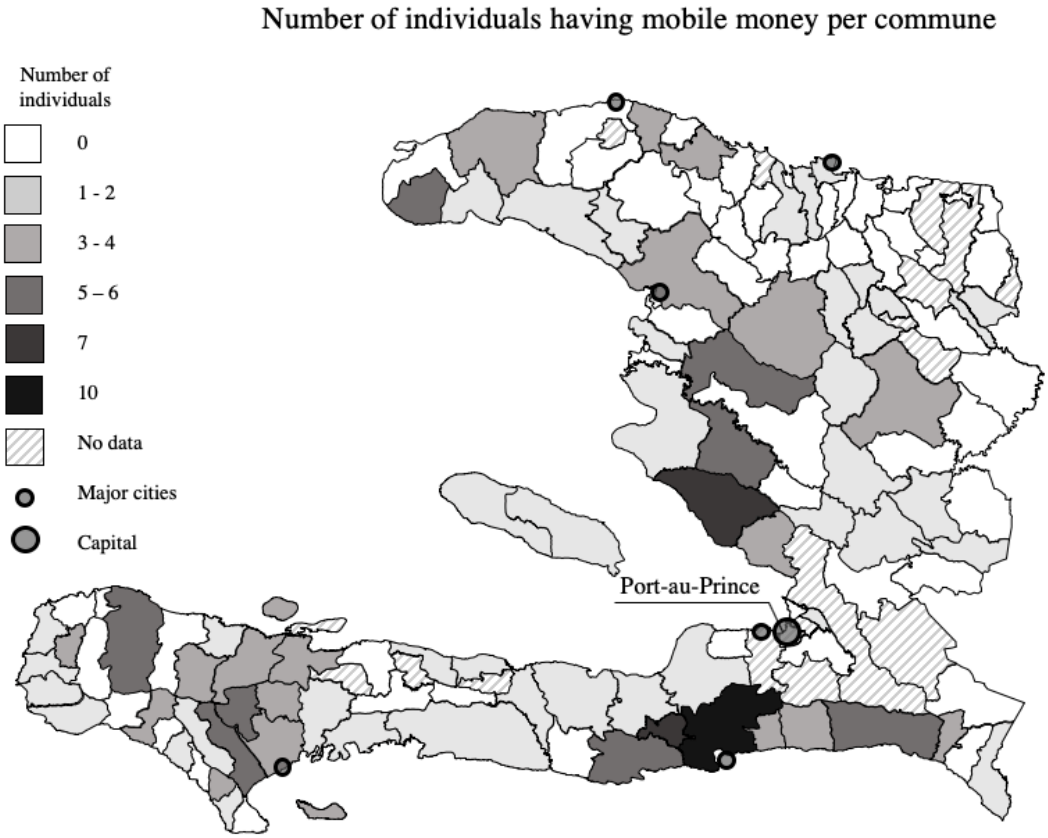


*Figure G.1, Number of Individuals having Mobile Money per Commune*

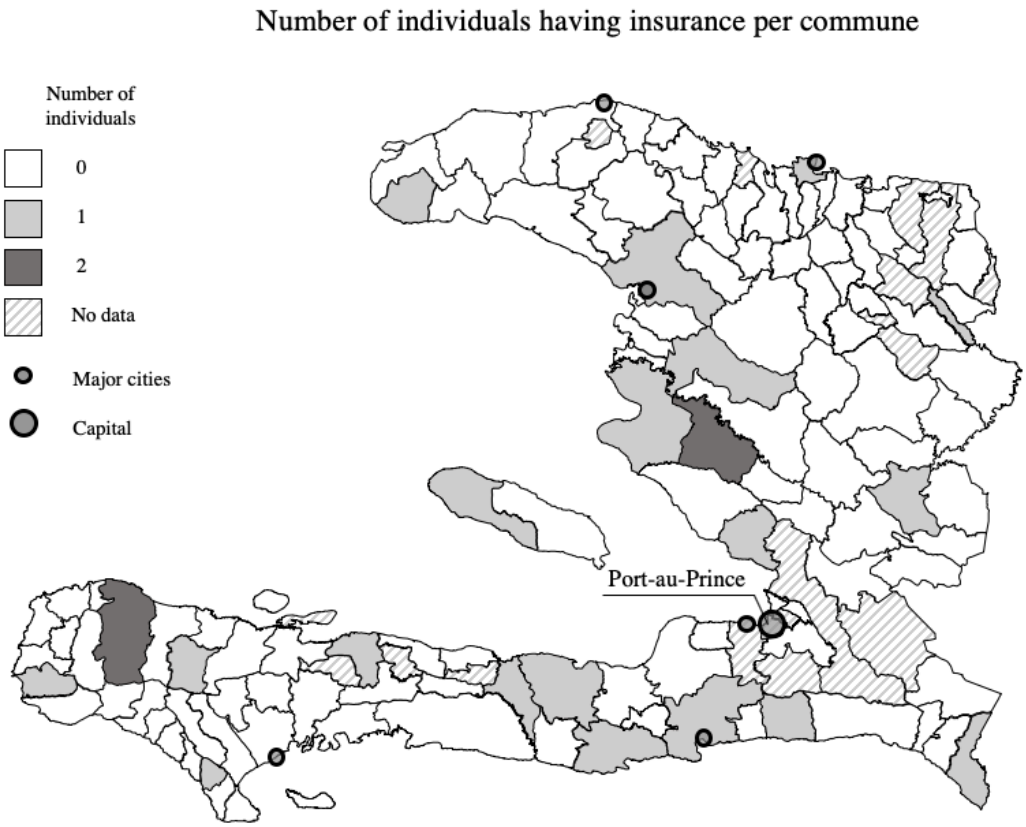


*Figure G.2, Number of Individuals having Insurance per Commune*

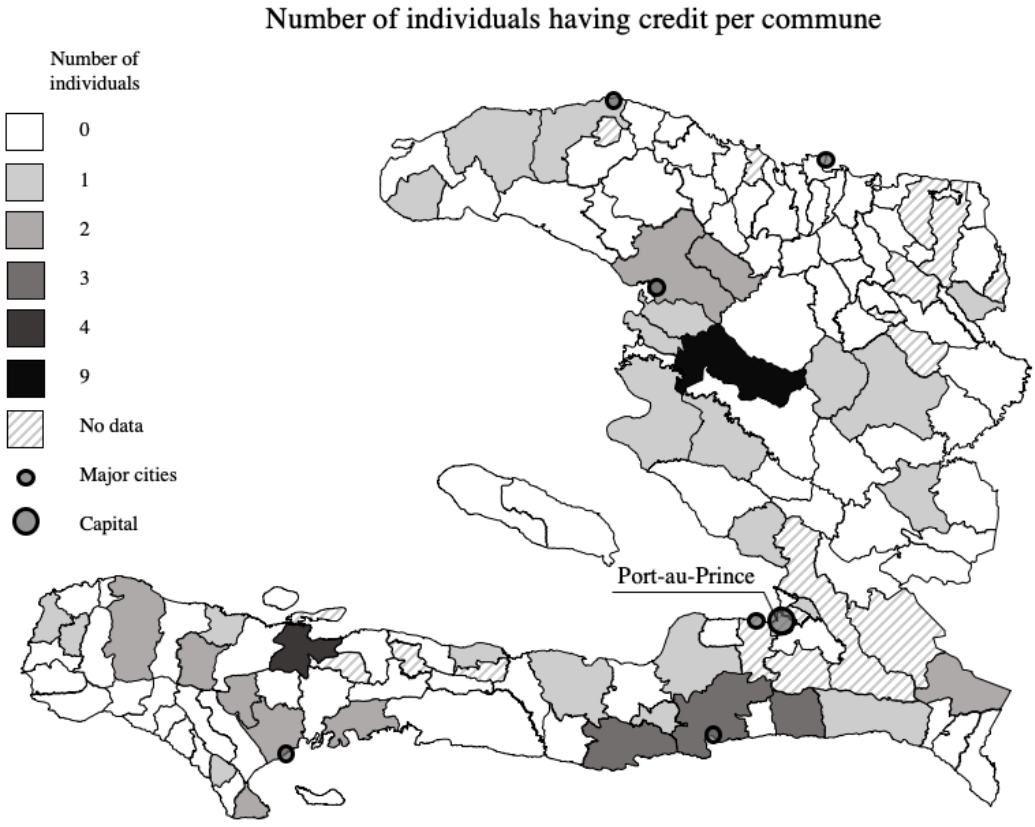


*Figure G.3, Number of Individuals having Credit per Commune*

# Appendix H

This section presents the binary logistic regression results for the insurance models, including the coefficients, odds ratios, p-values, and confidence intervals.

*Table H.1, Binary Logistic Regression Results Insurance Model 1*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | 1.568207*** | 4.798037*** | 0.000 | .728 | 2.408 |
| **Sex** | .2458528 | 1.278711 | 0.557 | -.575 | 1.067 |
| **Age** | .0873317 | 1.091259 | 0.297 | -.077 | .251 |
| **Age_Squared** | -.000855 | .9991454 | 0.351 | -.003 | .001 |
| **PartnershipD** | -.2820602 | .7542283 | 0.525 | -1.151 | .587 |
| **AreaD** | -.6726854 | .5103363 | 0.149 | -1.586 | .241 |
| **Education** | | | | | |
| *No formal education* | - | - | - | - | - |
| *Primary education* | - | - | - | - | - |
| *Secondary education* | - | - | - | - | - |
| *Tertiary education* | - | - | - | - | - |
| **Awareness_MM_D** | - | - | - | - | - |
| **Farming_OrganisationD** | - | - | - | - | - |
| **Agri_TrainingD** | - | - | - | - | - |
| **Mobile_PhoneD** | - | - | - | - | - |
| **Financial_Access** | | | | | |
| *Banked* | - | - | - | - | - |
| *Other Formal* | - | - | - | - | - |
| *Informal* | - | - | - | - | - |
| *Excluded* | - | - | - | - | - |
| Number of obs. | 1,511 | | | | |
| Wald chi2 | 17.80 | | | | |
| Prob>chi2 | 0.0067 | | | | |
| Adjust McFadden | 0.013 | | | | |

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

*Table H.2, Binary Logistic Regression Results Insurance Model 2*

| | Coef. | Odds Ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | .4904939 | 1.633123 | 0.323 | -.483 | 1.464 |
| **Sex** | .4733844 | 1.605418 | 0.269 | -.366 | 1.314 |
| **Age** | .1183756 | 1.125667 | 0.171 | -.051 | .288 |
| **Age_Squared** | -.0008781 | .9991223 | 0.347 | -.003 | .001 |
| **PartnershipD** | -,2296606 | .7948033 | 0.610 | -1.111 | .652 |
| **AreaD** | -.7344814 | .4797542 | 0.150 | -1.733 | .265 |
| **Education** | | | | | |
| *No formal education* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | .7847717 | 2.191906 | 0.258 | -.574 | 2.143 |
| *Secondary education* | 2.047391*** | 7.747663 | 0.003 | .676 | 3.419 |
| *Tertiary education* | 3.065866*** | 21.45303 | 0.004 | 1.004 | 5.128 |
| **Awareness_MM_D** | .9241182 | 2.519645 | 0.107 | -.200 | 2.048 |
| **Farming_OrganisationD** | 1.053189 | 2.866778 | 0.179 | -.483 | 2.589 |
| **Agri_TrainingD** | .3523737 | 1.42244 | 0.719 | -1.564 | 2.269 |
| **Mobile_PhoneD** | - | - | - | - | - |
| **Financial_Access** | | | | | |
| *Banked* | - | - | - | - | - |
| *Other Formal* | - | - | - | - | - |
| *Informal* | - | - | - | - | - |
| *Excluded* | - | - | - | - | - |
| Number of obs. | 1511 | | | | |
| Wald chi2 | 37.19 | | | | |
| Prob>chi2 | 0.0002 | | | | |
| Adjust McFadden | 0.056 | | | | |

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

*Table H.3, Binary Logistic Regression Results Insurance Model 3*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | -1.152359** | .3158908 | 0.025 | -2.160 | -.145 |
| **Sex** | .5719721 | 1.771758 | 0.219 | -.341 | 1.485 |
| **Age** | .0587871 | 1.060549 | 0.505 | -.114 | .232 |
| **Age_Squared** | -.0003576 | .9996424 | 0.709 | -.002 | .002 |
| **PartnershipD** | -.1210914 | .885953 | 0.800 | -1.059 | .817 |
| **AreaD** | -.539854 | .5828334 | 0.283 | -1.526 | .446 |
| **Education** | | | | | |
| *No formal education* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | .082712 | 1.086229 | 0.909 | -1.341 | 1.506 |
| *Secondary education* | .5933313 | 1.810008 | 0.427 | -.870 | 2.056 |
| *Tertiary education* | 1.455709 | 4.287521 | 0.186 | -.704 | 3.615 |
| **Awareness_MM_D** | 1.233679** | 3.433841 | 0.041 | .048 | 2.420 |
| **Farming_OrganisationD** | 1.070548 | 2.916977 | 0.176 | -.478 | 2.620 |
| **Agri_TrainingD** | .3994055 | 1.490938 | 0.685 | -1.532 | 3.332 |
| **Mobile_PhoneD** | 1.35786** | 3.887866 | 0.047 | .015 | 2.700 |
| **Financial_Access** | | | | | |
| *Banked* | 4.815814 | 123.4473 | 0.001 | 1.901 | 7.731 |
| *Other Formal* | 3.906377 | 49.71849 | 0.007 | 1.051 | 6.762 |
| *Informal* | .5185504 | 1.679591 | 0.796 | -3.418 | 4.4555 |
| *Excluded* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| Number of obs. | 1511 | | | | |
| Wald chi2 | 36.95 | | | | |
| Prob>chi2 | 0.0021 | | | | |
| Adjust McFadden | 0.249 | | | | |

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

*Table H.4, Binary Logistic Regression Results Insurance Model 4*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | -1.153192** | .3156277 | 0.025 | -2.158 | -.148 |
| **Sex** | .572178 | 1.772123 | 0.219 | -.340 | 1.485 |
| **Age** | .0589562 | 1.060729 | 0.503 | -.114 | .232 |
| **Age_Squared** | -.0003606 | .9996395 | 0.706 | -.002 | .002 |
| **PartnershipD** | -.119572 | .8873001 | 0.803 | -1.057 | .818 |
| **AreaD** | -.5407212 | .5823281 | 0.282 | -1.527 | .445 |
| **Education** | | | | | |
| *No formal education* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | .0765714 | 1.079579 | 0.916 | -1.347 | 1.500 |
| *Secondary education* | .584123 | 1.793417 | 0.433 | -.878 | 2.046 |
| *Tertiary education* | 1.443035 | 4.233524 | 0.190 | -.713 | 3.599 |
| **Awareness_MM_D** | 1.236952** | 3.445096 | 0.041 | .052 | 2.422 |
| **Farming_OrganisationD** | 1.068767 | 2.911787 | 0.177 | -.482 | 2.619 |
| **Agri_TrainingD** | .3952576 | 1.484767 | 0.688 | -1.534 | 2.325 |
| **Mobile_PhoneD** | 1.355048** | 3.876947 | 0.048 | .013 | 2.697 |
| **Financial_Access** | | | | | |
| *Banked* | .9055094* | 2.473191 | 0.057 | -.028 | 1.840 |
| *Other Formal* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Informal* | - | - | - | - | - |
| *Excluded* | - | - | - | - | - |
| Number of obs. | 398 | | | | |
| Wald chi2 | 21.27 | | | | |
| Prob>chi2 | 0.0949 | | | | |
| Adjust McFadden | 0.031 | | | | |

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

# Appendix I

This section presents the binary logistic regression results for the credit models, including the coefficients, odds ratios, p-values, and confidence intervals.

*Table I.1, Binary Logistic Regression Results Credit Model 1*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | 1.855086*** | 6.392248*** | 0.000 | 1.318 | 2.392 |
| **Sex** | -.2337428 | .7915654 | 0.384 | -.760 | .292 |
| **Age** | .1827054*** | 1.200461*** | 0.003 | .063 | .302 |
| **Age_Squared** | -.002183*** | .9978194*** | 0.002 | -.004 | -.001 |
| **PartnershipD** | -.1919471 | .8253506 | 0.507 | -.759 | .376 |
| **AreaD** | .0516875 | 1.053047 | 0.848 | -.476 | .579 |
| **Education** | | | | | |
| *No formal education* | - | - | - | - | - |
| *Primary education* | - | - | - | - | - |
| *Secondary education* | - | - | - | - | - |
| *Tertiary education* | - | - | - | - | - |
| **Awareness_MM_D** | - | - | - | - | - |
| **Farming_OrganisationD** | - | - | - | - | - |
| **Agri_TrainingD** | - | - | - | - | - |
| **Mobile_PhoneD** | - | - | - | - | - |
| **Financial_Access** | | | | | |
| *Banked* | - | - | - | - | - |
| *Other Formal* | - | - | - | - | - |
| *Informal* | - | - | - | - | - |
| *Excluded* | - | - | - | - | - |
| Number of obs. | 1,511 | 1,511 | 1,511 | | |
| Wald chi2 | 54.52 | 54.52 | 54.52 | | |
| Prob>chi2 | 0.0000 | 0.0000 | 0.0000 | | |
| Adjust McFadden | 0.079 | 0.079 | 0.079 | | |

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

*Table I.2, Binary Logistic Regression Results Credit Model 2*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | 1.56416*** | 4.778657 | 0.000 | .914 | 2.214 |
| **Sex** | -.1742579 | .8400802 | 0.522 | -.707 | .359 |
| **Age** | .1903465*** | 1.209669 | 0.002 | .069 | .311 |
| **Age_Squared** | -.0021426*** | .9978597 | 0.002 | -.004 | -.001 |
| **PartnershipD** | -.1322647 | .8761091 | 0.651 | -.706 | .441 |
| **AreaD** | .0322394 | 1.032765 | 0.908 | -.517 | .581 |
| **Education** | | | | | |
| *No formal education* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | .5658752 | 1.760988 | 0.139 | -.184 | 1.316 |
| *Secondary education* | .9188058** | 2.506296 | 0.029 | .095 | 1.742 |
| *Tertiary education* | 1.523822** | 4.589733 | 0.047 | .018 | 3.029 |
| **Awareness_MM_D** | .0900927 | 1.094276 | 0.790 | -.574 | .754 |
| **Farming_OrganisationD** | .3754674 | 1.455672 | 0.514 | -.753 | 1.503 |
| **Agri_TrainingD** | -.5910031 | .5537715 | 0.521 | -2.397 | 1.215 |
| **Mobile_PhoneD** | - | - | - | - | - |
| **Financial_Access** | | | | | |
| *Banked* | - | - | - | - | - |
| *Other Formal* | - | - | - | - | - |
| *Informal* | - | - | - | - | - |
| *Excluded* | - | - | - | - | - |
| Number of obs. | 1511 | | | | |
| Wald chi2 | 62.56 | | | | |
| Prob>chi2 | 0.0000 | | | | |
| Adjust McFadden | 0.070 | | | | |

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

*Table I.3, Binary Logistic Regression Results Credit Model 3*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | -.208588 | .8117296 | 0.557 | -.905 | .488 |
| **Sex** | -.2781711 | .7571673 | 0.351 | -.863 | .307 |
| **Age** | .1166851* | 1.123765 | 0.065 | -.007 | .241 |
| **Age_Squared** | -.0014923** | .9985088 | 0.037 | -.003 | -.001 |
| **PartnershipD** | -.1128719 | .893265 | 0.724 | -.739 | .513 |
| **AreaD** | .2390094 | 1.26999 | 0.422 | -.345 | .823 |
| **Education** | | | | | |
| *No formal education* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | -.1600779 | .8520774 | 0.706 | -.992 | .672 |
| *Secondary education* | -.4995297 | .606816 | 0.282 | -1.409 | .410 |
| *Tertiary education* | -.2652439 | .7670188 | 0.742 | -1.844 | 1.313 |
| **Awareness_MM_D** | .0242987 | 1.024596 | 0.949 | -.722 | .770 |
| **Farming_OrganisationD** | .3472581 | 1.415182 | 0.561 | -.825 | 1.519 |
| **Agri_TrainingD** | -.9283057 | .3952228 | 0.315 | -2.738 | .881 |
| **Mobile_PhoneD** | .6087184* | 1.838074 | 0.085 | -.084 | 1.302 |
| **Financial_Access** | | | | | |
| *Banked* | 6.560655*** | 706.7344 | 0.000 | 3.712 | 9.409 |
| *Other Formal* | 5.318215*** | 204.0193 | 0.000 | 2.507 | 8.130 |
| *Informal* | .7891487 | 2.201521 | 0.694 | -3.139 | 4.717 |
| *Excluded* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| Number of obs. | 1511 | | | | |
| Wald chi2 | 58.74 | | | | |
| Prob>chi2 | 0.0000 | | | | |
| Adjust McFadden | 0.354 | | | | |

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

*Table I.4, Binary Logistic Regression Results Credit Model 4*

| | Coef. | Odds ratio | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|
| **MMd** | -.2086363 | .8116904 | 0.557 | -.905 | .488 |
| **Sex** | -.2780579 | .757253 | 0.352 | -.863 | .310 |
| **Age** | .1166733* | 1.123752 | 0.065 | -.007 | .241 |
| **Age_Squared** | -.0014921** | .998509 | 0.037 | -.003 | -.001 |
| **PartnershipD** | -.1123867 | .8936986 | 0.725 | -.738 | .513 |
| **AreaD** | .23893 | 1.26989 | 0.423 | -.345 | .823 |
| **Education** | | | | | |
| *No formal education* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Primary education* | -.1606775 | .8515666 | 0.705 | -.993 | .672 |
| *Secondary education* | -.4999923 | .6065354 | 0.281 | -1.410 | .409 |
| *Tertiary education* | -.2659539 | .7664745 | 0.741 | -1.844 | 1.312 |
| **Awareness_MM_D** | .0242306 | 1.024527 | 0.949 | -.723 | .770 |
| **Farming_OrganisationD** | .3456821 | 1.412953 | 0.563 | -.826 | 1.517 |
| **Agri_TrainingD** | -.928765 | .3950413 | 0.314 | -2.738 | .880 |
| **Mobile_PhoneD** | .6079391* | 1.836642 | 0.086 | -.085 | 1.301 |
| **Financial_Access** | | | | | |
| *Banked* | 1.241329*** | 3.460209 | 0.000 | .607 | 1.876 |
| *Other Formal* | (omitted) | (omitted) | (omitted) | (omitted) | (omitted) |
| *Informal* | - | - | - | - | - |
| *Excluded* | - | - | - | - | - |
| Number of obs. | 398 | | | | |
| Wald chi2 | 31.11 | | | | |
| Prob>chi2 | 0.0053 | | | | |
| Adjust McFadden | 0.010 | | | | |

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