

Financial Inclusion in Kenya: The Role of Mobile Financial Services

by

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A thesis submitted to the University of Göttingen
to obtain the degree of
Dr. rer. pol.



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October 2022

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Acknowledgments

I am not sure whether doing a Ph.D. can be a straight-lined journey, but I do know that the Corona pandemic has caused mine to be particularly sinuous.

I, therefore, want to thank my supervisor Prof Dr. Oliver Mußhoff. Thank you for the persistent and reliable guidance, for encouraging me during uncertain times to pursue my own ideas, and for sharing your excellent knowledge to transform these ideas into academic work. Furthermore, I would like to thank my two co-supervisors, Prof. Dr. Meike Wollni and Prof. Dr. Martin Qaim for their support in the dissertation process.

I feel particularly grateful for having been able to work closely with Dr. Martin Parlasca. Martin, you are a great researcher, I find your work ethic inspiring and your academic knowledge is impressive. Working closely with you over the past years has surely shaped how I conduct research today and how I will in the future. I am excited to know that this dissertation does not close the chapter of our collaboration and I am very much looking forward to continuing our ongoing research.

I also want to deeply thank Dr. Selina Bruns. Thank you for being a constant reference point regarding research, teaching, and more personal questions. I further want to thank Albert Nsengumuremyi for taking time during his master's studies to accompany and support me in the field in Kenya. Last but not least, thank you also to all my other colleagues for the many discussions we shared, and for your support in academic and ever so often practical questions.

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List of Acronyms

CBK	Central Bank of Kenya
FSD Kenya	Financial Sector Deepening Kenya
MFS	Mobile Financial Services
MNO	Mobile Network Operator
SACCO	Savings and Credit Cooperative
SDG	Sustainable Development Goals
UN	United Nations

Glossary

Blinder-Oaxaca Decomposition:	statistical method that explains the difference in means between two groups.
Chama:	cooperative society that is used to pool savings and give credit to group members.
Digital credit:	form of credit that can be accessed through mobile devices and is commonly defined as automated, remote, and instant.
Dynamic incentive:	method to encourage repayment by rewarding timely repayment with access to larger credit amounts in the future.
Formal conventional credit:	credit provided by conventional, regulated banks, which does not fulfill the characteristics of digital credit.
Formal digital credit:	digital credit where at least one of the lending parties is a regulated bank.
Propensity Score Matching:	quasi-experimental method that constructs an artificial control group by matching each treated unit with a non-treated unit of similar characteristics.
Semi-formal conventional credit:	encompasses credit from Micro Financial Institutions and Savings and Credit Cooperative Organizations, as well as Chamas insofar they are officially registered.
Semi-formal digital credit:	digital credit where none of the lending parties are regulated banks, often also referred to as digital loan apps.
Modern supply chain:	farmers who sell through cooperatives or to companies.
Traditional supply chain:	farmers who sell their product directly to customers and local traders.

1 General Introduction

Financial inclusion is considered to be a crucial factor in the achievement of the United Nations (UN) Sustainable Development Goals (SDGs) (Demirgüç-Kunt & Singer, 2017). The concept of financial inclusion most commonly refers to the accessibility, availability, and/or usage of at least one of four formal financial services, i.e. payments services, savings accounts, credit, and insurance (Demirgüç-Kunt et al., 2022; Kim et al., 2018; Leyshon & Thrift, 1995). The access and usage of these financial services can considerably enhance the welfare of people by increasing their ability to make productive investments and their ability to smooth consumption (Aron, 2018; Demirgüç-Kunt et al., 2022; Demirgüç-Kunt & Singer, 2017). However, financial exclusion remains a common phenomenon in low- and middle-income countries (LMICs), with more than 1.4 billion people who are considered financially excluded¹; a phenomenon that is most prevalent among marginalized groups, foremost women, poor, and rural people (Demirgüç-Kunt et al., 2022; Demirgüç-Kunt & Klapper, 2013).

A variety of obstacles that explain financial exclusion have been identified², of which two are particularly salient and illustrate well why marginalized people are often financially excluded. First, prohibitively high transaction costs for people caused by long travel distances to the nearest financial institution (Aron, 2018; Ozili, 2021). This exemplifies one reason for the persistent rural-urban gap in financial inclusion, as travel times tend to be considerably longer in rural areas. Furthermore, even though such travel times are very similar for men and women, they pose a larger obstacle for women who are often responsible for childcare and cannot leave their houses for a long time, partially explaining the gender gap in financial inclusion (Baydas et al., 1994; Fletschner & Kenney, 2014). Second, information asymmetries between financial institutions and consumers, that are caused by a lack of financial histories. Such information asymmetries, in combination with a lack of collateral, constitute a major reason why formal conventional banks are not willing or able to grant credit to applicants (Jaffee & Stiglitz, 1990; Steijvers & Voordeckers, 2009). Microfinance Institutions (MFIs) have been able to reduce these two constraints by adjusting their business model, i.e. being physically present in rural areas and introducing group lending schemes, which partially decrease information asymmetries (Shankar, 2007; van Tassel, 1999). However, whether MFIs have transformative effects on consumers' welfare remains contested (Banerjee, Duflo et al., 2015; Banerjee, Karlan, & Zinman, 2015) and expensive capital from informal lenders continues to coexist next to MFIs (Donovan, 2012). The latter observation strongly indicates an unmet demand for cheaper capital.

¹ Measured as account ownership at a formal, i.e. regulated, financial institution.

² Other often cited obstacles are a lack of money, lack of trust, and low financial literacy (Demirgüç-Kunt et al., 2022; Ozili, 2021).

Mobile Financial Services (MFS) have been attributed with the potential to leapfrog over deficient conventional banking structures by decreasing the two aforementioned obstacles and, therefore, raise hopes to considerably increase financial inclusion, particularly among marginalized people (Aron, 2018). MFS can be divided into mobile money and mobile banking. Mobile money is defined as a payment service that allows mobile phone users to make deposits³, transfers, and withdraw money without the need for a bank account (Suri, 2017). Mobile banking is a more novel innovation, which is built on the rails of mobile money but allows phone users to save money at an interest rate, access credit, and more recently even access to insurance schemes (Aron, 2018; Suri, 2017).

One of the major advantages of MFS over conventional banking structures is the exploitation of nearly ubiquitous mobile phone ownership among people in LMICs. This allows MFS users to considerably decrease the transaction costs of sending and receiving money (Ahmad et al., 2020; Aron, 2018; Nan et al., 2021; Suri, 2017). MFS have congruently been a success story with more than one billion accounts in LMICs so far (Andersson-Manjang & Naghavi, 2021). Furthermore, mobile bank providers can decrease information asymmetries by leveraging non-traditional data, such as widely available mobile money usage data and nearly universally available mobile phone usage data. This enables mobile bank users to access credit (named digital credit) without the need to have financial histories with conventional financial institutions or access to collateral (Björkegren & Grissen, 2018). Consequently, digital credit raises hopes that especially marginalized groups, such as women and rural living people, who are the most constrained from a lack of financial histories, a lack of collateral, and long traveling times, could access this form of credit. On the other hand, especially marginalized people are less likely to generate mobile phone and mobile money usage data, a necessary condition for non-traditional data scoring (Björkegren & Grissen, 2018; Brailovskaya et al., 2021). Empirical research about the extent to which mobile banking products increase financial inclusion for marginalized groups remains thin.

Increasing financial inclusion for marginalized people through MFS appears particularly desirable considering the strong evidence that MFS increase the welfare of users: mobile money increases consumption smoothing abilities (Aker et al., 2016; Jack & Suri, 2014; Riley, 2018), as well as overall consumption (Murendo & Wollni, 2016; Sekabira & Qaim, 2017), and decreases poverty (Suri & Jack, 2016). Studies that investigate mobile banking also find positive but rather modest welfare-increasing effects, such as increases in overall savings levels (Batista & Vicente, 2020; Mel et al., 2022) and increases in digital credit access, which increases consumption smoothing but does not statistically significantly increase productive

³ While mobile money allows to deposit money, to my knowledge there is no example in which this accrues an interest rate.

investments (Suri et al., 2021). Suri et al. (2021) explain the latter finding with typical characteristics of digital credit, including rather small average credit sizes, which might render this product (in its current form) inutile to increase business-related productive assets. Overall, little research exists that specifically investigates the usefulness of MFS to increase financial inclusion for business-related activities.

Next to the largely positive effects of MFS, some scholars have also raised concerns about risks that could be associated with the fast, often unregulated growth of MFS usage, especially because it is presumed that mainly people with little financial experience use these services. The sudden access to financial services could therefore not only have positive effects but also increase over-borrowing, over-indebtedness, and consequent long-term financial exclusions from credit markets (Brailovskaya et al., 2021; Demirgüç-Kunt et al., 2022; Robinson et al., 2022). To my knowledge, it has not been empirically researched whether these concerns are justified or not.

The introduction highlights that MFS bear a great potential to financially include millions of people but that our understanding remains limited with regards to three important questions. First, do MFS truly increase access to all four formal financial services for marginalized people or do they increase existing inequalities? Second, how useful are MFS to increase financial inclusion for business-related purposes? Third, what are risks for consumers that coincide with the rapid growth of MFS? Answering these questions is of high importance in order to be able to formulate adequate private and public interventions to leverage the potential of MFS further and decrease adverse effects. While fully answering the three questions is beyond the scope of this cumulative dissertation, I present three essays that aim to decrease the knowledge gap for all three questions respectively.

The first essay (chapter 2) “Promises and pitfalls of digital credit: Empirical evidence from Kenya”, investigates whether digital credit increases overall borrowing and therewith coinciding risks for consumers to default and consequences of default. The second essay (chapter 3) “Digital credit and the gender gap in financial inclusion: Empirical Evidence from Kenya”, investigates whether formal digital credit affects the gender gap in financial inclusion and subsequently what might hinder formal digital credit to constitute a pathway towards gender equality in financial inclusion. The third essay (chapter 4) “Use of mobile financial services among farmers in Africa: Insights from Kenya”, investigates whether MFS constitute a relevant form of financial inclusion for farm-related activities and, subsequently, what might hinder the usage of MFS for such activities. The following section provides detailed information about the study area Kenya and the data underlying the here presented essays. Section 1.2 motivates the research objectives of three essays and highlights the methods used to achieve these objectives.

1.1 Study Area

All essays in this cumulative dissertation use data from Kenya. Kenya is a paradigm for MFS: the first mobile money service was introduced in 2007 and usage rates have risen to over 80 percent of the adult population in 2020. Mobile banking products were launched in 2012 in Kenya and reported usage rates were above 34 percent of the adult population in 2020 (Central Bank of Kenya et al., 2021). Such high usage rates render Kenya a particularly suitable study region. Other studies in this field, especially those concerned with mobile banking services, typically draw their samples from mobile money users (Brailovskaya et al., 2021; Suri et al., 2021). In contrast, the essays presented here aim to show results applicable for the entire population, which presupposes sufficiently high user rates.

It should further be noted that in Kenya a variety of mobile banking providers have emerged, which can be divided into formal and semi-formal providers. Formal mobile banking providers are typically characterized as partnerships between formal banks and a Mobile Network Operator (MNO). We define formal mobile banking providers as those where at least one party is a regulated bank; credit from these providers is consequently termed formal digital credit. In contrast, semi-formal mobile banking providers are those where none of the providers is a regulated bank; credit from these providers is consequently termed semi-formal digital credit.

Such fragmentation of different types of financial providers is a typical phenomenon in LMICs and can also be observed in the conventional financial markets in Kenya. The fragmentation can be understood as a historical process in which formal institutions were unable to financially include all people (Donovan, 2012). The remaining gaps were then filled by semi-formal and informal providers. The terminologies formal and semi-formal are somewhat fuzzy and should not be understood literally. In this dissertation we define banks and the government as providers of formal conventional financial services. We further define MFIs, Savings and Credit Cooperatives (SACCOs) and registered Chamas as semi-formal conventional providers. Unregistered Chamas, financial services from friends, family, shylocks, and other institutions which are not subsumed under formal and semi-formal institutions are considered as informal.

The essays that form this cumulative dissertation use data from four Financial Access household surveys (FinAccess surveys) from 2009, 2012, 2015, and 2018. The FinAccess household surveys are repeated cross-sectional surveys, which are conducted by the Kenya National Bureau of Statistics, Financial Sector Deepening Trust Kenya (FSD Kenya), and the Central Bank of Kenya (CBK)⁴. All surveys use a two-stage stratified cluster sampling design to collect data. In the first stage, clusters are selected based on the National Sample Surveys

⁴ The data of FinAccess survey 2009, 2012, and 2015 are available in "Harvard Dataverse" with the digital object identifiers <https://doi.org/10.7910/DVN/VWLG4>, <https://doi.org/10.7910/DVN/JSPE9W> and <https://doi.org/10.7910/DVN/QUTLO2>. The data of the FinAccess survey 2018 are available on the website of the Central Bank of Kenya, <https://www.centralbank.go.ke/finaccess/>.

and Evaluation Program; substitute households are not allowed. In the second stage, households are chosen randomly in each cluster and then, from each chosen household, an individual aged 16 or above is randomly selected. This procedure is chosen to ensure that the sample is nationally representative of individuals aged 16 and above. The number of respondents varies by survey round with 6598 in 2009, 6449 in 2012, 8865 in 2015, and 8669 in 2018. The surveys are administered through face-to-face interviews in English and translations in several local languages.

All household surveys contain a large set of questions about socio-economic and socio-demographic variables as well as information about the usage of several financial services. However, the focus of each survey round can change. For instance, only the 2018 FinAccess survey entails information about default and “blacklisting”, therefore, it is used in essay 1 to achieve the second objective. Similarly, only the 2018 FinAccess survey entails information about agricultural finance in particular, therefore, is the sole basis for essay 3. The following section describes the motivation of the essays and methods used in more detail.

1.2 Research objectives

Essay 1 (chapter 2) investigates the potential of digital credit to increase overall borrowing as well as risks for consumers that coincide with the fast growth of this form of borrowing. Digital credit can reduce two major constraints of conventional lenders, i.e. transaction costs and information asymmetries and, thereby, open up borrowing opportunities for millions of otherwise constrained people (Björkegren & Grissen, 2018; Costa et al., 2015; Suri et al., 2021). Indeed, grey literature congruently reports millions of digital borrowers in Kenya alone (Gubbins & Totolo, 2018). In an empirical study Suri et al. (2021) infer that increases in digital credit usage do not cause crowding out of other forms of credit, only increase overall credit access. Brailovskaya et al. (2021), in contrast, find modest crowding out in the informal credit market due to digital credit. Both studies only consider rather short time periods (less than two years and nine months, respectively). It is conceivable that crowding out or complementary effects are not detectable in such short periods of time. For instance, previous scholars indicate that the usage of digital credit could generate a credit history, which could be then used for traditional credit scoring from conventional banks and, therefore, increase formal conventional borrowing, where credit sizes tend to be considerably larger (Benami & Carter, 2021; Blechman, 2016). However, such effects are unlikely to be observable in the short-run. In contrast, digital credit could also lead to crowding out from the formal conventional credit market in the long-run, as digital credit uses dynamic incentives. Dynamic incentives of digital credit can be a pathway to substantially larger digital credit sizes, decreasing the gap in credit sizes between digital and conventional credit and, therefore, potentially lead to a substitution between formal credit and digital credit in the long-run.

The first objective of essay 1, therefore, is to investigate whether digital credit increases overall borrower shares in digital and other credit markets or whether crowding out takes place in the long-run. To achieve this objective, we use information from the 2012, 2015, and 2018 FinAccess surveys conducted in Kenya, and compute descriptive statistics of the borrower shares in each of the fragmented credit markets, i.e. formal conventional (such as credit from banks), semi-formal conventional (such as credit from MFIs), and digital credit⁵, to then compare respective changes over time. Informal credit markets are not considered due to the fact that questions regarding informal borrowing are inconsistent between survey rounds and do not allow comparisons over time.

The second objective of chapter 2 is to understand the probability of digital credit defaulting and consequences thereof. Suri et al. (2021) claim that digital credit would have a low risk of putting people in debt and bankruptcy, while other scholars raise concerns about often times opaque loan terms of digital lenders which could lead to default and over-indebtedness (Brailovskaya et al., 2021; Demirgüç-Kunt et al., 2022; Robinson et al., 2022). Reports in grey literature and public media support these concerns, stating that by 2017 in Kenya alone an estimated 2.7 million digital borrowers were reported to one of the credit reference bureaus (CRBs) for defaulting (Gubbins & Totolo, 2018). Such reports often constitute a red flag for all lenders that could result in a long-term exclusion from semi-formal and formal credit markets; the procedure of submitting such reports has congruently been termed “blacklisting”. However, whether and to which extent the “blacklisting” phenomenon takes place has not been empirically researched yet. These questions underscore the importance of the second aim of this essay, i.e. to understand both, probabilities of digital credit defaulting and the risk of consequent “blacklisting”. To achieve this aim, we compute descriptive statistics about default and “blacklisting” probabilities of digital credit and both forms of conventional credit, using the 2018 FinAccess survey⁶ as the basis for this analysis. We then compare the differences in defaulting and “blacklisting” in combination with an analysis of differences in user characteristics in the three credit markets, in order to make inferences about potential drivers of defaulting and “blacklisting”.

Essay 2 (chapter 3) investigates whether formal digital credit decreases the gender gap in financial inclusion and explores reasons why that might not be the case. We define financial inclusion here as formal credit usage, including both: formal conventional and/or formal digital credit. Digital credit is defined as formal when at least one lending party is a regulated bank. Digital app lenders, here semi-formal digital credit, are not regulated and therefore not

⁵ In essay 1 we do not disentangle formal and semi-formal digital credit.

⁶ Only the 2018 FinAccess survey entails relevant questions regarding blacklisting and defaulting, which are necessary for this part of the analysis.

considered formal, a necessary condition in all commonly used definitions of financial inclusion.

There are mainly two reasons why the gender gap could be considerably smaller in the formal digital compared to the formal conventional credit market. First, formal digital credit other than formal conventional credit typically does not require collateral, which could be particularly beneficial for women who often have lesser control over resources accepted as collateral (Fletschner & Kenney, 2014). Secondly, previous studies explain the gender gap in conventional credit access with long travel times to banks, which are relatively more constraining for women, as this group tends to be responsible for domestic household labor and childcare (Baydas et al., 1994; Fletschner & Kenney, 2014). As digital credit is remotely accessible, this constraint becomes largely obsolete.

In contrast to these promising characteristics of digital credit, previous scholars indicate that the algorithm-computed credit scores, which underly the decision of digital credit access, might assign women systematically lower credit scores (Brailovskaya et al., 2021). Credit access theory, in addition, suggests that if regulations (such as interest rate caps) in the formal digital credit market truncate the available set of contract terms, people with lower credit scores could be more likely to be excluded from credit markets (Benami & Carter, 2021; Jaffee & Stiglitz, 1990). Early reports indeed indicate that digital credit usage seems to be biased towards men (Gubbins & Totolo, 2018). However, these reports fail to make a distinction between formal and semi-formal digital credit services and, therefore, cannot answer whether digital credit reduces the gender gap in financial inclusion. Furthermore, these reports leave little insights about the reasons that could explain gender differences in digital credit borrowing. Moreover, these reports only show early borrower shares and, therefore, do not consider that initial gender differences could change over time.

These unanswered questions constitute important gaps in the literature as an increase in digital credit access can be either a threat or an opportunity to women's position in society. In order to formulate policies for more gender equality, it is relevant to understand the influence of digital credit in the gender gap in financial inclusion and the reasons thereof. Hence, our two central research questions are the following: does formal digital credit decrease the gender gap in financial inclusion over time? And, what explains gender differences in formal digital credit usage?

To answer the first research question, we analyze the changes in the gender gap in formal credit markets using the 2009, 2012, 2015, and 2018 FinAccess surveys. More precisely, we distinguish by gender the relative contribution over time of formal digital and formal conventional credit to financial inclusion (i.e. total formal credit usage). To answer the second

research question, we conduct logistic regressions based on the 2018 FinAccess survey⁷. This information enables us to understand whether socio-economic gender differences explain the gender gap in formal digital credit usage. We compare the results to the association between socio-economic characteristics and credit usage in the unregulated semi-formal digital credit market. This comparison yields some further insight whether differences in market specific characteristics, such as regulation, are associated with the relationship between socio-economic variables and digital credit usage. In other words, if regulation truncates the available set of contract terms in the formal digital credit market and, thereby, disproportionately excludes women due to their lower average credit scores, we would expect the gender gap in the less regulated semi-formal market to be smaller.

Essay 3 (chapter 4) investigates usage rates of MFS for farm-related purposes and explores potential obstacles of MFS to be used for such purposes. As foreshadowed by the previous sections, typically rural living farmers are also expected to benefit from MFS as it has the potential to reduce two of their major obstacles with conventional banks and financial service providers in rural areas, i.e. transaction costs and information asymmetries (Benami & Carter, 2021; Demirgüç-Kunt et al., 2022). Several studies show that a considerable share of farmers in developing economies use MFS and that this innovation is indeed associated with increases in welfare (Batista & Vicente, 2020; Kikulwe et al., 2013; Munyegera & Matsumoto, 2016; Sekabira & Qaim, 2017). However, most of these studies investigate the role of payment services without differentiating whether the services are used for farm-related purposes. Hence, our understanding of the role of other MFS, such as digital credit, especially in the context of farm-related activities remains thin. This further implies that our knowledge about potential obstacles of MFS to be used for farm-related activities also remains scarce. Theory and previous studies suggest that MFS have the potential to increase productive investments of farmers (Kirui et al., 2013; Sekabira & Qaim, 2017), however, only an understanding of what hinders MFS usage for farm-related purposes can lead to adequate responses by the private and public sectors.

Essay 3, therefore, has two main objectives: first, to understand the role that MFS play in farm-related activities and second, to explore the reasons of what might hinder MFS usage for farm-related activities. In order to achieve these two aims, we use descriptive statistics based on the 2018 FinAccess survey⁸, which includes over 3,000 observations from farming households. In the first step, we analyze general usage rates of MFS for making or receiving payments, savings, and loans and also to what extent farmers use MFS for activities that directly relate

⁷ Only the 2018 FinAccess survey entails an additional question, which elicits whether individuals have used the respective credit forms in the past 12 months. It is important for the logistic regressions to make sure that digital credit usage is rather recent, as socio-economics are not stable over time.

⁸ Only the 2018 FinAccess survey entails necessary information about agricultural finance in particular.

to their agricultural business. In the second step, we explore reasons of potential obstacles for the usage of MFS for agricultural purposes. We specifically explore differences in MFS usage for farm and non-farm related purposes with regard to mobile payments, mobile savings, and digital credit. Due to the fact that usage rates of any agricultural insurance are extremely low, we do not investigate this service. Furthermore, we expect that farmers, depending on their sales channel, might have different needs for MFS. We therefore also investigate usage differences between farmers in modern supply chains (i.e. those who sell through cooperatives or to companies) and those in more traditional supply chains (i.e. those who sell their product directly to customers and local traders).

2 Promises and pitfalls of digital credit: Empirical evidence from Kenya

Authors: Constantin Johnen, Martin Parlasca, Oliver Mußhoff

Published in: PLOS ONE

DOI:10.1371/journal.pone.0255215

Abstract

Digital credit is a recent innovation that raises hopes of improving credit access in developing countries. However, up until now, empirical research on the extent to which digital credit actually reaches people who are otherwise excluded from conventional credit markets and whether increased credit access is sustainable or threatened by high default and blacklisting rates is very scarce. Using representative data from Kenya, this article shows that digital credit increases borrowing opportunities, including for people less likely to otherwise have credit access in the conventional credit markets. However, we find that digital credit borrowing is also responsible for 90 percent of all blacklistings, which is partially driven by higher default rates in the digital credit market but also by a higher probability that digital credit defaults lead to blacklisting of the borrower, compared to defaults in other credit markets.

Key Words: Default; Blacklisting; Digital Credit; Mobile Money; Mobile Banking

3 Digital credit and the gender gap in financial inclusion: Empirical evidence from Kenya

Authors: Constantin Johnen, Oliver Mußhoff

Published in: Journal of International Development

DOI:10.1002/jid.3687

Abstract

Formal digital credit raises hope to decrease the gender gap in financial inclusion. However, up until now, it remains unknown whether these hopes are justified. Using nationally representative household surveys from Kenya, the present study aims to fill this gap. We find strong indication that formal digital credit, contrasting to expectations, has led to an increase in the gender gap in financial inclusion. We further find indication that the pervasive gender gap in the formal digital credit market is largely attributable to gender differences in socio-economic variables in combination with a lack of contract term heterogeneity in that market. The paper suggests that policies to strengthen women's position in society and/or to encourage contract term heterogeneity in the formal digital credit market could decrease the gender gap in financial inclusion

Key Words: Digital Financial Services, Formal Credit, Gender Equality, Regulation

4 Use of mobile financial services among farmers in Africa: Insights from Kenya

Authors: Martin Parlasca, Constantin Johnen, Matin Qaim

Published in: Global Food Security

DOI:10.1016/j.gfs.2021.100590

Abstract

The recent proliferation of mobile phones in rural Africa has also led to increased interest in mobile financial services (MFS), such as mobile money and mobile banking. Such services are often portrayed as promising tools to improve agricultural finance, especially among smallholders who are typically underserved by traditional banks. However, empirical evidence on the actual use of MFS for agricultural activities is thin. Here, we use nationally representative data from Kenya to analyze the use of mobile payments, mobile savings, and mobile credit among the farming population. We find that more than 80% of farmers use mobile money, but only 15% use this innovation for agriculture-related payments. Mobile loans for agricultural investments are used by less than 1% of farmers. Usage rates are somewhat higher among farmers in modern supply chains, even though for them traditional banking services are often also accessible and still much more important. Overall, the use of MFS for agriculture is lower than commonly assumed, indicating that these services do not yet have a transformative impact on smallholder farming. As Kenya is one of the leaders of the MFS boom in Africa, this general finding likely holds for other African countries as well.

Keywords: Mobile Money; Digital Credit; Agricultural Finance; Kenya; Mobile Banking; Small Farms

5 Summary and conclusion

Financial inclusion remains a major aim towards the achievement of the UN SDGs. The emergence of MFS has led to hopes of substantially increasing financial inclusion by enabling people to leapfrog over deficiencies in conventional banking structures. Indeed, the usage of MFS is already very high, with more than one billion accounts worldwide. However, the fast and furious growth of MFS might have also obscured risks and underutilized potentials of MFS. In this cumulative dissertation I present three essays which contribute to our understanding of such risks and the low utilization of MFS in specific domains. The first essay shows that digital credit appears to substantially increase the share of people who borrow money in formal and semi-formal credit markets but also disproportionately increases the risk of default and consequent “blacklisting”. The second essay further shows that digital credit seems to increase the gender gap in financial inclusion and, thereby, increase gender inequalities. The third and last essay strongly indicates that MFS, in their current form, do not seem to be directly suitable to substantially enhance the financial inclusion of farm-related operations. Overall, this dissertation somewhat dampens the enthusiasm about MFS as it reveals substantial obstacles for MFS to financially include all people and risks that coincide with the usage of these novel financial services. In the remainder of this section, I will summarize the three here presented essays and discuss in detail the results and implications for policymakers and researchers.

5.1 Summary and conclusion of chapter 2

Essay 1 (chapter 2) has two objectives: first, to investigate whether digital credit increases overall borrowing and second, to investigate to what extent digital borrowing is associated with defaulting and reporting to CRBs. Even though, there are previous studies that indicate that digital credit increases borrowing opportunities, results about whether digital credit is a substitute or a complement to other forms of credit are conflicting, short-termed, they do not disaggregate semi-formal, formal, and digital markets, and are often only theoretical (Benami & Carter, 2021; Brailovskaya et al., 2021; Robinson et al., 2022; Suri et al., 2021). There is also no empirical study that investigates whether concerns about digital credit defaulting and subsequent reporting to CRBs are justified. Filling these gaps forms a cornerstone for adequate policy measures regarding digital credit.

To achieve the first objective, we compute descriptive statistics based on the 2012, 2015, and 2018 FinAccess surveys from Kenya. We find that since the launch of digital credit in 2012 the share of people borrowing in semi-formal and formal credit markets has sharply increased from 20 percent of the Kenyan adult population to 39 percent in 2018. Within a time-span of six years, digital credit has become the most common source of semi-formal and formal credit, with 21 percent of the population borrowing in this market; it has also become an exclusive source of semi-formal and formal credit for about 13 percent of the adult population. Borrower

shares in the two conventional credit markets are rather stable over time, indicating that digital credit is neither substantially a substitute for conventional credit nor constitutes a pathway towards more sizeable formal conventional loans. These findings strongly indicate that digital credit has substantially increased the share of people who borrow in semi-formal and formal credit markets.

The essay can, however, not observe or estimate counterfactual scenarios, i.e. how would the conventional markets have developed if digital credit had not come into existence. Inferences about potential complementary and substitutive effects and, therefore, total increases in borrower shares are not causal in nature. It could be, for instance, that conventional credit market borrower shares would have risen sharply in the counterfactual scenario; if this scenario were true, digital credit would, in fact, be substitutive for conventional credit. However, the results presented here indicate that the credit markets are largely separated in terms of borrower characteristics, which renders such a counterfactual scenario somewhat less convincing. Nevertheless, investigating potential causal substitutive and complementary effects between digital credit and other forms of credit in more detail is an interesting topic for future research. I further recommend that such studies include credit amount by credit market measures in their analyses in order to gain more precise results; data of that ilk was not accessible for this essay. It is important to note that the first essay does not differentiate between formal and semi-formal digital credit and, therefore, cannot directly assess to which extent and for whom digital credit increases financial inclusion. Such an analysis constitutes another interesting avenue for future research.

To achieve the second objective, we compute descriptive statistics based on the 2018 FinAccess survey. We find that more than 90 percent of reports to CRBs are directly related to defaults in the digital credit market. Such reports can result in insurmountable hurdles to full credit access in the long-term (Gubbins & Totolo, 2018). This finding raises concerns about the fast growth of digital credit. Disentangling the extremely large share of digital credit-related “blacklisting” shows that digital credit borrowers are disproportionately likely to default and disproportionately likely to be reported to CRBs in case of defaults. The present study cannot directly analyze what causes the disproportionately high default rates but indicates that observable characteristics, such as income or education alone, are unlikely to fully explain the differences in default between the fragmented credit markets. For instance, we find that borrowers in the digital credit market display a similar income level and higher education levels compared to borrowers in semi-formal markets, but that the probability to default is about twice as high for digital credit borrowers (14 percent) compared to semi-formal conventional credit borrowers (7 percent). I strongly recommend for future studies to further investigate whether

opaque loan terms, lack of loan enforcement mechanisms, low financial literacy, or other variables can explain this finding.

A plausible explanation for the large share of digital credit defaults that are reported to CRBs (38 percent) compared to, for example, only 2 percent in the semi-formal conventional market, is that digital credit lenders have access to few other contract enforcement mechanisms and, therefore, disproportionately often “blacklist”. The recent measure of the CBK to suspend reports to CRBs by digital lenders (Central Bank of Kenya, 2020) is unlikely to be a sustainable long-term solution, as a major contract enforcement mechanism for digital lenders ceases to exist. The suspension of reporting could, therefore, largely increase overall default and threaten the sustainability of the entire digital credit market. Furthermore, if reporting does not exist, digital credit cannot constitute a pathway to formal conventional credit, as credit histories are not created.

Contrasting to the recent measure of the CBK, we suggest that an enforced all-encompassing reporting, i.e. reporting of positive and negative repayment behavior, for all lenders could be more fruitful. Enforcing (or at least controlling) lenders’ reporting of positive repayment behavior could be rather easily achieved as borrowers could receive automated messages from CRBs about reported repayments and defaults and, thereby, survey lenders’ reporting at a low cost. This could have several advantages. First, defaulting would result in a lower credit score but not necessarily a red flag when borrowers also have timely repayments in their history. Second, digital credit histories would become more reliable and, therefore, decrease information asymmetries also for conventional lenders. This is a pre-requisite for digital credit to constitute a gateway to formal conventional credit. A currently incomplete reporting might explain why we do not find any indication that digital credit increases access to formal conventional credit in this essay. Furthermore, it could incentivize borrowers to repay their digital credit, when they anticipate that positive repayment behavior could be a pathway to more sizeable formal conventional credit. Third, the formal digital credit market in Kenya is characterized by a monopoly and an all-encompassing reporting could increase competition in the market as it decreases information asymmetries for other lenders.

5.2 Summary and conclusion of chapter 3

Essay 2 (chapter 3) has two objectives: first, to understand whether formal digital credit decreases the prevailing gender gap in financial inclusion (here defined as formal credit usage) and second, to analyze which factors explain the gender gap in formal digital credit. Previous literature indicates that digital credit could induce both a decrease or an increase in the gender gap in financial inclusion. However, empirical assessments about which of these mutually exclusive scenarios is true are missing. Consequently, it remains further unknown why digital

credit closes or widens the gender gap, which constitutes the basis for adequate policy measures towards gender equality.

To achieve the first objective, we analyze changes in the gender gap concerning financial inclusion, based on the 2009, 2012, 2015, and 2018 FinAccess surveys from Kenya, and distinguish the relative contribution of formal digital and formal conventional credit. We find that, since the introduction of digital credit in 2012, the gender gap in total formal credit usage has statistically significantly increased from 4 percentage points at baseline to 8 percentage points in 2018. This increase appears to be largely driven by formal digital credit where the gender gap is rather stable over time with a statistically significant difference of about 6 percentage points. In contrast, the gender gap in formal conventional credit is considerably lower and has only marginally, and not statistically significantly, changed from 4 percentage points in 2012 to 5 percentage points in 2018. Therefore, the present study is the first to point towards a largely overlooked risk, i.e. that digital credit seems to increase gender inequalities. As in essay 1, this study cannot observe the counterfactual scenario, i.e. how the gender gap would have developed if digital credit had not come into existence. However, as essay 1 shows that credit markets are to a substantial extent mutually exclusive, it seems unlikely that changes in the formal conventional credit market would have been radically different in the counterfactual scenario. Nevertheless, using experiments or quasi-experiments to investigate the causal effect of formal digital credit on the gender gap in formal credit markets is an interesting path for future studies.

The resulting question from the first finding is what explains the considerable gender gap in formal digital credit usage. To approach this question, we conduct logistic regressions based on the 2018 FinAccess survey. We find strong indications that gender differences in socio-economic variables (foremost in education, income, and mobile phone ownership) largely explain differences in formal digital credit usage. The finding is robust to using other estimation techniques including propensity score matching and a Blinder-Oaxaca decomposition. The finding implies that the long-standing aim of policy makers to decrease gender differences with regard to the aforementioned socio-economic characteristics would likely translate into a decrease in gender differences in formal digital credit usage.

Interestingly, we do not find a gender gap in the semi-formal digital credit market despite gender differences in socio-economic characteristics. We suggest that differences in regulation between the formal and semi-formal digital credit market could partially explain the differences in the gender gap between these markets. Economic theory suggests that regulations, such as the interest rate cap in the formal digital credit market, can truncate the set of available contract terms and thereby disproportionately exclude people with low credit scores, such as women. Comparing semi-formal and formal digital credit markets in Kenya indeed shows a

larger heterogeneity in available contract terms in the semi-formal credit market compared to its formal counterpart. However, this observation does not prove that regulation truly truncates the set of available contract terms in the formal digital credit market. The recent decision of the CBK to retract interest rate caps, i.e. to substantially loosen regulation in all credit markets, hence constitutes an interesting opportunity for researchers. The results from essay 1 and essay 2 imply that in the short-run women might be more likely to be included in the formal digital credit market as a result of the decision by the CBK, but also that this could disproportionately increase default and “blacklisting” for women.

5.3 Summary and conclusion of chapter 4

Essay 3 (in chapter 4) has two objectives: first, to investigate the role that MFS play for farm related financial activities and second, to investigate potential obstacles to the usage of MFS for such purposes. While several previous studies investigate the usage and effects of MFS among farmers, there are remaining gaps in the literature about the usage of more novel mobile banking products, the differentiation of MFS usage between farm-related and non-farm related purposes, and, consequently, analyses about potential obstacles of MFS to be used for farm-related purposes. These constitute important gaps as theory and previous literature suggest that MFS could reduce farmer’s constraints to make productive investments. It is, therefore, crucial to understand which obstacles might hinder farmers to leverage such promising services.

To achieve the first objective, we use descriptive statistics, based on the 2018 FinAccess survey from Kenya, that show that more than 82 percent of the farmers use mobile money, while mobile banking is only used by about 20 percent of the farmers. More importantly we show that the use of MFS for agricultural activities is still very limited. Only 15 percent of the farmers mention that they had used mobile money for making or receiving agriculture-related payments during the last 12 months prior to the survey. Only 1 percent mention that they had used mobile banking savings as a source of agricultural finance, and only 0.6 percent state that they had used a formal digital credit during the last 12 months for agricultural purposes. Mobile insurance is not further investigated, as only 1 percent of farmers use agricultural insurances, a fraction of which might be delivered through mobile technology. These findings imply that MFS are not yet transformative for smallholder farmers’ business-related financial activities and, therefore, can hardly directly influence productive investments.

The second overarching objective is to understand why MFS only play a limited role for farm-related purposes. Often-cited reasons for low MFS usage among rural people are poor electricity and mobile network infrastructures. This study does not allow us to directly test the impact of poor infrastructure on MFS usage for farm related purposes. However, it does not seem to be a very convincing explanation to hold for the 82 percent of farmers who use MFS

just not for agricultural purposes. Nevertheless, a substantial share of 18 percent of farmers might be hindered by poor infrastructure to use MFS in general and therefore for farm-related purposes in particular. We strongly recommend for future studies to investigate the role of infrastructure for the usage of MFS among farmers.

We further explore potential explanations for the large gap between farmers who do use MFS in general but not for farm-specific purposes. We first look at mobile money products. A plausible explanation for the large gap of farmers who generally use mobile money but not for farm-related purposes, is that that farmers cannot exploit mobile money's advantages, such as low transaction costs, over alternative payment methods in their typical farming transactions. For instance, farmers in traditional supply chains -who are least likely to use mobile money for farm-related purposes in our analysis- often conduct business face-to-face, where transaction costs are already low. In such situations, farmers might prefer using cash, given that mobile money transfers are associated with small but positive transaction fees and suffer from server system downtimes. Farmers in modern supply chains typically make and receive larger payments, so for them mobile money might have advantages over cash; this could explain why farmers in modern supply chains are more likely to use mobile money for farm-related purposes than farmers in traditional supply chains. However, our data shows that most farmers in modern supply chains already have bank accounts, which might be the preferred choice over mobile payments which often have transaction limits; potentially explaining overall low usage rates of mobile money for farm-related purposes also among farmers in modern supply chains. Therefore, we suggest that decreases in transaction fees on small transactions, higher transaction limits and improvements in server system downtimes could induce farmers to increasingly use mobile payment services for farm-related purposes.

Turning to mobile banking products, we find that the usage of mobile banking savings is extremely low at 1 percent. A potential reason for this finding is that mobile banking products in general appear to be much less trusted than other financial providers, including mobile money providers. Low levels of trust in mobile banking products might also partially explain why digital credit, are not used very often for farming-purposes. However, low trust cannot convincingly explain the 7 percentage point gap to farmers who use digital credit for non-farm related purposes. Reasons for this gap might lay in the typical contract structures of digital credit which are characterized by low credit amounts, high interest rates, and short repayment periods. Especially short repayment periods of typically one month can pose a large-obstacle for farm-related purposes given that the repayment period is shorter than the natural crop cycle of most crops.

We suggest that in order to further leverage the potential of mobile banking products for farm related purposes average credit sizes of digital credit and repayment periods should be

increased. Safaricom (Kenya's largest MFS provider) has recently launched "digifarm", which encompasses the aforementioned suggestions and additionally offers other products such as soil testing and agricultural insurance. It is an interesting opportunity for researchers to study this or similar products. Our findings, albeit hypothetical, also suggest that to invest in growing trust in mobile banking products could be fruitful in increasing their usage for agricultural purposes. It should be noted that none of the provided explanations for low MFS usage for farm-related purposes are causal in nature and it is a very interesting opportunity for future studies to investigate whether increases in transaction limits of mobile payments, elongation of repayment periods of digital credit, improvements in server system downtimes, and increases in trust in mobile banking can also increase MFS usage for farm-related purposes.

5.4 Further avenues for future research

All three here presented essays investigate MFS in the Kenyan context. Kenya is chosen as it represents a paradigm for MFS, which is a pre-requisite for the here presented analyses. Nevertheless, the essays show that for instance socio-economic variables or differences in regulation appear to constitute important explanatory variables for MFS usage and non-usage. Such variables can of course differ sharply between different LMICs. It is important to understand the obstacles of MFS towards financial inclusion and risks that coincide with MFS usage also in the context of other countries, since MFS have become a worldwide phenomenon.

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Declarations

Declaration of contribution

I herewith declare my specific contribution to each of the essays presented in this dissertation.

The first essay *Promises and pitfalls of digital credit: Empirical evidence from Kenya* was composed by Constantin Johnen (CJ), Dr. Martin Parlasca (MP), and Prof. Dr. Oliver Mußhoff (OM). CJ conceptualized the idea, suggested the methodological approach together with MP, conducted data curation and the formal analysis and drafted the original manuscript. MP and OM critically revisited the conceptual ideas and analytical approaches as well as the manuscript, contributing important intellectual content. MP further specifically contributed to the writing of section 2.3.

The second essay *Digital credit and the gender gap in financial inclusion: Empirical evidence from Kenya* was composed by Constantin Johnen (CJ), and Prof. Dr. Oliver Mußhoff (OM). CJ conceptualized the idea, chose the methodological approach, conducted data curation and formal analysis and drafted the original manuscript. OM critically revisited the conceptual ideas and analytical approaches as well as the manuscript, contributing important intellectual content.

The third essay *Use of mobile financial services among farmers in Africa: Insights from Kenya* was composed by Dr. Martin Parlasca (MP), Constantin Johnen (CJ), and Prof. Dr. Martin Qaim (MQ). MP conceptualized the idea, suggested the methodological approach, conducted data curation and the formal analysis and drafted the original manuscript. CJ and MQ critically revisited the conceptual ideas and analytical approaches as well as the manuscript, contributing important intellectual content. CJ further specifically contributed to the literature search.

Author declaration

1. I, hereby, declare that this Ph.D. dissertation has not been presented to any other examining body either in its present or a similar form. Furthermore, I also affirm that I have not applied for a Ph.D. at any other higher school of education.

Sacramento,

Constantin Johnen

2. I, hereby, solemnly declare that this dissertation was undertaken independently and without any unauthorised aid.

Sacramento,

Constantin Johnen