Savings for resilience: Investigating saving channels among Malian smallholder farmers

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Abstract

Despite worldwide initiatives to alleviate poverty, 35% of Sub-Saharan Africa's population continues to live below the poverty line. In light of this, many regard the promotion of saving as a cost-efficient and low-risk strategy for household resilience and pro-poor development. We assess saving determinants for 374 Malian farmers by employing a two-step selection model. As a first step, we assess determinants of whether or not a farmer saves by applying a probit model. In the second step, we estimate an Ordinary Least Squares regression to investigate a farmer's savings amount. In both steps, we disaggregate the outcome variable on whether respondents save through mobile money, via a bank account, or a secret place. We find considerable heterogeneity in saving determinants and identify a particularly strong role of supply-side factors such as infrastructure quality. Furthermore, the results suggest that saving with a secret place is persistently popular, in particular among younger respondents and those who do not have access to a smartphone in their household. This indicates a potential to transfer these hidden savings to formal accounts for interest earnings and potentially safer storage. The findings have implications for improving financial practices and resilience among smallholder farmers in SSA, suggesting the transformative potential of secure and accessible saving mechanisms.

Keywords: Household Saving, Mali, Microfinance, Mobile Money, Resilience
JEL Code: D14, G51, I30, O55, Q14

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1 Introduction

Despite global efforts to alleviate poverty, 35% of the Sub-Saharan African (SSA) population still lives on less than $2.15 per day (Hasell, 2022). One avenue to tackle persistent poverty is microfinance, whereby marginalized households get the chance to invest, protect themselves against shocks and smooth consumption through loans, insurance or savings accounts (Banerjee & Duflo, 2007; Elabed & Carter, 2015). In recent years, saving and household financial resource management have been identified by researchers and policy decision-makers as promising instruments for pro-poor development (Banerjee & Duflo, 2011; Karlan et al., 2014). In comparison to credit or insurance, for saving, funding requirements through external capital are negligible (Karlan et al., 2014; Steinert et al., 2018) and there is no risk of over-indebtedness and being blacklisted (Johnen et al., 2021).

While saving can, on a psychosocial level, increase agency and feelings of self-worth instead of dependency (Ssewamala et al., 2016), it can also enable an individual to engage in profitable agricultural investment opportunities, such as fertilizer or small machinery, and thus mitigate the impacts of adverse household shocks (Aggarwal et al., 2023; Karlan et al., 2014; Steinert et al., 2018). The latter is particularly important in the context of rural households that are often dependent on agriculture. Due to the volatile nature of incomes generated through farming and the dependence on the weather, rural households are particularly vulnerable to food insecurity (Rosenzweig, 2001). When hardships arise, these households might have no other choice but to sell property or take up loans under unfavorable conditions.

In contrast to more informal saving mechanisms, formal and semi-formal saving solutions in the form of bank or mobile money (MM) accounts are usually held by an individual and are password-protected, thus creating a higher level of privacy and safety. Evidence further suggests that more formalized saving channels allow for better cash accumulation when compared to foregoing their use (Dupas & Robinson, 2013a; Prina, 2015). Yet, they often come with a cost, directly in the form of account opening and running fees, and indirectly as opportunity and travel costs since Automated Teller Machines (ATMs) and MM agents might not always be close to the individual. Compared to traditional banks, mobile financial services are at an advantage as their technology is accessible through the oftentimes widespread agent network (Geiger et al., 2019). Furthermore, it is a relatively cheap and easy way of storing cash on the phone.

In the past decade, a growing body of literature has contributed to the recognition of saving promotion as a sound policy measure. Studies in Kenya (Dupas & Robinson, 2013a,b), Mali (Beaman et al., 2014), Mozambique (Christian et al., 2022), and Uganda (Karlan & Linden, 2014) demonstrate the beneficial effects of the provision of safe and accessible saving channels. De Nicola (2015) examines the impact of separate weather insurance, saving, and credit on individual welfare in West Africa. According to the simulation results, saving leads to substantial gains, which are higher than those achievable with unsubsidized weather insurance.

Farmers' saving determinants have been previously investigated by for example Baidoo et al. (2018) in Ghana and Kibet et al. (2009) in Kenya. However, Asfaw et al. (2023), and Wulandari et al. (2017) are probably closest to our approach. Asfaw et al. (2023) use a two-step or double hurdle model to assess the determinants for Ethiopian agro-pastoralists for (1) the decision or probability of saving, and (2) the accumulated amount. Yet, previous studies did not differentiate

between different saving tools that are available to farmers and thus are limited in what they can elicit about different effects across saving channels. Contrary to Asfaw et al. (2023), we study the saving behavior of arable farmers. Most of our respondents cultivate cash crops (cereals or maize) and are therefore expected to have some proceeds from sales that they want to save. In contrast to subsistence farmers, they also might require lump sums for seasonal investments into inputs like fertilizer or improved seeds. Our approach is also somewhat related to Wulandari et al. (2017) who investigate credit sources of Indonesian farmers. Yet, while they look at lenders with differing degrees of formality from banks over farmer associations to agricultural input kiosks and traders, we investigate different channels for financial resource management.

Until now, the question remains as to which factors influence (i) the probability to save and (ii) the amount saved. Thus, in this paper, we set out to investigate this issue and, as also pointed out by Asfaw et al. (2023), fill a literature gap by further disaggregating the saving channels: We analyse the factors influencing the saving probability and the associated amount concerning saving via (a) MM, (b) bank or (c) a secret place[1]. Understanding the determinants of farmers' saving decisions when using various channels is crucial to adequately advise MM providers and banks on ways in which to increase the attractiveness of formal and semi-formal accounts to farmers and policymakers. Therefore, this study investigates the determinants of farmers' saving probabilities and the saving amount for different mechanisms. We add to the body of evidence on saving determinants by investigating influencing factors on saving via MM, bank account, or informally with a secret hiding place.

To answer our research questions, and contribute to the knowledge on saving determinants, we analyze a primary data set from Malian smallholder farmers using a two-step selection model by applying a probit model and subsequently an Ordinary Least Squares (OLS) regression. Mali is an ideal setting for our research, since 80% of its population work in agriculture (International Trade Administration (ITA), 2021), a sector characterized by high risk of income volatility and adverse shocks. Another reason for selecting Mali for our research is its thriving market for mobile financial services and the ubiquity of mobile phones needed for MM. According to the International Telecommunication Union (ITU), in 2015, 85% of the population had access to 2G and 10% had access to 3G connectivity. In the past years, mobile network technologies expanded quickly over the region and as of 2022, 70% of the population had 3G connectivity and 100% at least 2G (ITU, 2022). According to Eozenou et al. (2013), 45% of the Malian population lives below the national poverty line. Therefore, we anticipate that the results of this paper will directly enhance financial practices and foster greater accessibility to services. Finally, with our findings, we strive to contribute to improved resilience of smallholder farmers in SSA, especially in the face of climate change and adverse financial shocks.

We are motivated by previous research, suggesting that, if implemented carefully, responsible financial resource management and saving can prove transformative for poor households (Karlan et al., 2014). Upon access to secure and reliable saving channels, these households could enter a virtuous cycle of saving, productivity-enhancing investment, and financial resilience (Dupas &

[1]In the questionnaire, the option secret place was framed as 'saved with a secret hiding place'. Saving via MM, bank or secret place were the most commonly used channels. Other saving mechanisms we included in the survey were saving with a saving club (e.g. Tontine) or saving with a trusted person. The respondents could also indicate 'other'. Yet, these mechanisms did not have an $N < 30$, so we did not include them in the comparison.

Robinson, 2013a; Steinert et al., 2018).

Our contribution to the body of evidence is threefold: First, we show initial insights into the heterogeneous effects of relevant determinants on farmers' saving probability for different mechanisms. Second, we observe that better bank infrastructure (measured in walking distance to the next bank branch) seems to improve the likelihood of higher savings. Third, and in line with Aggarwal et al. (2023), we found that the secret place was still of relevance when making saving decisions. Despite the apparent ubiquity of MM, people nonetheless choose to keep a large portion of their savings at home, i.e. in a secret place. Those who are most likely to save via a secret place are younger and have a lower probability of having a smartphone in their household. Here, we identify a considerable potential for formalizing these savings and allowing savers to boost their saving success through increased safety, commitment-increasing behavioral mechanisms, as well as through interest earnings. As a methodological contribution, we apply an instrumental variable (IV) to reduce endogeneity concerns and emphasize the robustness and internal validity of our two-staged approach. Particularly, we identify the self-reported distance to an MM agent as a suitable IV for mobile money saving.

With our results we address practitioners and policy decision makers. We clearly identify a positive effect of MM on savings accumulation and advise mobile network operators and banks to further strengthen their collaboration in the field of mobile solutions and to reach out to more marginalized areas. The paper proceeds as follows: Section 2 introduces the data and Section 3 details the methodology. In Section 4, we present our results and discuss them. Section 5 summarizes and focuses on concluding remarks.

2 Data

In the first part (Section 2.1), we introduce how we collected the data. Next, we present the descriptive statistics in Section 2.2.

2.1 Description of the data collection

All participants of this study are clients of the Malian bank Banque Nationale de Développement Agricole (BNDA). The BNDA is a major commercial bank operating across all sectors in Mali and Western Africa. The smallholder farmers participating in our study reside in Koulikoro (50%), Sikasso (46%), and Bamako (4%) (compare Figure 1).

The data collection took place from December 2022 to February 2023. The ethics committee of our institution [will be filled after acceptance] approved our data collection. Verbal informed consent was obtained, and confidentiality of the information was secured by excluding respondents' identifiers, such as names, from the data collection format. In November 2022, we conducted a one-week training session in Bamako, focusing on thoroughly preparing enumerators to minimize potential interviewer biases. Enumerators were compensated for both their participation in data collection and the intensive in-person training week. Our local partners assisted in sourcing enumerators, all of whom had prior experience in data collection. They further recommended placing significant emphasis on training enumerators not only in French, but also in Bambara. This additional language training was deemed crucial, considering that many respondents, particularly

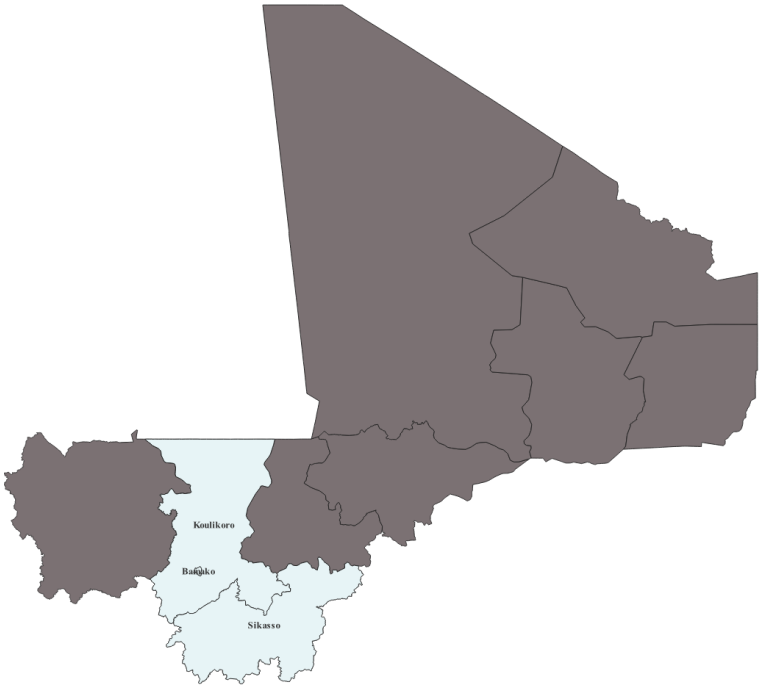

Figure 1: *Map of Mali, the provinces where the data collection took place are highlighted. Source: Own illustration.*

those in rural areas, might prefer Bambara over French. To target lower-income individuals, we only interviewed clients of the microfinance arm of BNDA. We then randomly selected individuals from a list provided by BNDA staff. All survey participants were interviewed face-to-face at their home by our enumerators. After a completed interview, the respondents received non-monetary compensation. In the end, most interviews were conducted in Bambara. We aimed for a sample size of 400; subsequently interviewing 405 smallholder farmers, and after data cleaning to remove incomplete questionnaires, 374 observations remain and constitute our final sample size. The code book can be found in Table A.1 in the Appendix.

2.2 Descriptive statistics

Table 1 shows the summary statistics describing the socioeconomic characteristics of the sampled farmers. The mean age of the farmers is 47 years and the majority are male (95%). Mali's society is characterized by male household authority figures and patriarchal lineages (Whitehouse, 2022). Thus, the male household head is most likely the authority signing credit contracts. As we interviewed bank clients, we expected a high share of male participants. Most of the sampled farmers have no formal education (59%), while 41% attended at least primary school. Additionally, 33% have some oral French skills and can read and write in French, which we use as a proxy for education. The majority of the farmers describe themselves as ethnic Bambara (59%). We observe that the average household size is 12 and the number of wives per household varies between 0 and 5. The average savings amount per farmer is 846,759 F CFA (approximately 1,264 Euro). 29% of the farmers also have a job outside the agricultural sector and 33% state to have migrated for work-related reasons. 19% report that they can walk to a bank branch, while 58% live within walking distance to a MM agent. The farmers walk, on average, 10 minutes to access a mobile

Table 1: Summary statistic

	Mean	SD	Min	Max
Farmer's characteristics				
Farmer's age, in years	47.29	10.00	24	80
Dummy if farmer is male (0: no, 1: yes)	0.95	-	0	1
Education Dummy (0: no, 1: yes)				
Dummy if farmer has at least some primary formal education	0.41	-	0	1
Dummy if farmer has writing skills in French	0.33	-	0	1
Dummy if farmer has some oral French skills	0.33	-	0	1
Dummy if farmer's ethnicity is Bambara (0: no, 1: yes)	0.59	-	0	1
Farmer's number of wives	1.25	1.14	0	5
Dummy if farmer has a job outside of agricultural sector (0: no, 1: yes)	0.29	-	0	1
Dummy if farmer has migrated for work (0: no, 1: yes)	0.33	-	0	1
Farmer's total savings (in F CFA)	846,759	2,642,643	0	30,000,000
HH characteristics				
Farmer's HH size (continuous variable)	12.21	7.25	1	37
Farmer's region (categorical variable)	2.93	1.03	1	4
Dummy if HH has any phone (0: no, 1: yes)	0.99	-	0	1
Dummy if HH has a smartphone (0: no, 1: yes)	0.64	-	0	1
Distances				
Dummy if it is possible to walk to bank branch (0: no, 1: yes)	0.19	-	0	1
Minutes farmer has to walk to next bank branch	30.4	47.22	0	300
Dummy if it is possible to walk to MM agent (0: no, 1: yes)	0.58	-	0	1
Minutes farmer has to walk to next MM agent	10.02	10.70	0	60
Agricultural characteristics				
Farmers' number of plots (continuous variable)	3.60	2.11	0	13
Farmers' number of crops (continuous variable)	3.388	1.91	0	13
Observations	374			

F CFA refers to the CFA-Franc (issued by the Central Bank of the West African States (BCEAO)) and is tied to the Euro with a fixed exchange rate of 655.96 F CFA = 1 €.
Source: Own illustration.

money agent and 30 minutes to access the next bank. The number of plots varies between 0 and 13, while the number of crops also varies between 0 and 13. The 9 farmers stated to be cultivating zero crops are livestock farmers.

In the study context, both simple phones and smartphones are suitable for MM operations. This makes the use of MM services feasible for wealthier and poorer farmers alike. At the household level, we observe a phone ownership rate of 99%. We report a household smartphone ownership rate of 64%.

All explanatory variables included in our estimation strategy, along with their coding, can be found in Table A.2 in the Appendix.

To assess the representativeness of our results and generalize our findings to the entire Malian context, we compare the summary statistic of our sample with Mali's representative Living Standards Measurement Study (LSMS) data (World Bank, 2017) in Table A.3 in the Appendix. Comparing the mean for various household characteristics of our sample and the LSMS sample, we come to the conclusion that our sample is comparable to several characteristics of Malian farmers in the three respective regions[2].

[2]The mean age of the household head in the LSMS data is 53 years, while the mean age of the farmers in our collected data set is 47 years. The share of farmers with primary education is also similar (20.3% in LSMS and 25.3% in our collected data set). The majority of the farmers describe themselves as Bambara in the LSMS (58.1%) and in

3 Estimation strategy

In the first part of this Section (3.1), we explain our empirical model. Subsequently, we introduce an IV to test the robustness of our results and to account for potential endogeneity concerns (Section 3.2).

3.1 Empirical model - two-part selection model

In order to investigate the factors influencing Malian farmers' saving probability and their amount of savings per saving channel, we apply a two-part selection model. In particular, we employ a probit regression for the probability of observing a positive-versus-zero outcome, following Anastasiou et al. (2022). Conditional on a positive outcome, we apply an OLS regression as suggested by Belotti et al. (2015), and used in previous research by Kumar et al. (2021), Spaenjers & Spira (2015) and Deb & Norton (2018). We do so as our research interest is twofold: First, we are interested in the determinants of farmers' saving with different channels, and second, we aim to investigate the respective saving amount. In addition, a considerable share of our dependent variables (total household savings and savings per channel) are zero values, as shown in Table A.2 in the Appendix. By omitting these households from the analysis, the population sample might not be random, as it does not include potential savers. In general, various approaches have been developed and employed to deal with a considerable number of zero values (e.g. Heckman selection model, tobit or poisson (Verbeek, 2017)).

By comparing the two-part selection model with the Heckman selection model, important differences exist. First, despite their superficial similarity, the two-part model should not be viewed as being nested within the Heckman selection model and equivalent when there is no selection on unobservables. The two-part model does not make any assumption about the correlation between the errors of the binary and continuous equations. Second, from a conceptual standpoint, the zeros in the Heckman selection model denote censored values of the positive outcome, while zeros in the two-part model are true zeros. Finally, Monte Carlo evidence shows that when the data are generated from the generalized tobit model without exclusion restrictions to identify the "zeros" equation, the two-part model generally produces better estimates of the conditional mean and of marginal effects (ME) than the correctly specified generalized tobit model (Belotti et al., 2015).

Our two-part selection model is described subsequently. To model whether or not a farmer is saving with the several saving channels, we use a probit model. The latent variables contain the probability of observing any savings per channel, which is defined by:

$$y_i = \beta_i x_i + \varepsilon_i \tag{1}$$

$$y_i = \begin{cases} 1 & if y_i^* > 0 \\ 0 & otherwise \end{cases} \tag{2}$$

where y_i^* is a latent dummy variable having the value of 1 if the farmer saves with the respective channel, and has the value of 0 when the farmer is not reporting savings ($y_i^* = 0$). β_i represents

our sample (58.9%). The average household size is 12 in our collected data and 11 in the LSMS data.

a parameter vector containing the coefficients of the selection equation, x_i is a vector of the set of explanatory variables, the subscript i indicates a farmer's observation and ε_i describes the error term.

Following Sekabira & Qaim (2017), Ghosh & Vinod (2017) and Molinier & Quan (2019), we included a set of socio-demographic variables (age, education, ethnicity, gender, mobile phone ownership, number of wives) as explanatory variables in the probit model. Furthermore, we control for the number of farmers' saving accounts, the possibility to walk to a bank branch as well as to a mobile money agent . Finally, farmers' risk perception of having money stolen was investigated. All explanatory variables that were included in our estimation strategy and the vector x_i as well as their codings can be found in Table A.2.

In the probit model, the amount of savings is not included. Therefore, to model the reported saving amount by farmers in general, and with respect to the different channels, we estimate an OLS regression after the sample selection given that savings are reported as a continuous outcome. Accordingly, a farmer's expected saving amount is defined as follows:

$$y_i = \beta_i x_i + \varepsilon_i \tag{3}$$

where y_i denotes the respective dependent variable that indicates the amount of savings of a farmer i per channel; x_i is a column vector of all explanatory variables; β_i depicts a vector of unknown parameters; and the scalar ε_i represents the error term. Similar to the probit model, we investigated the same set of determinants for x_i in the OLS regression as the effect of these determinants might be different for the savings intensity compared to the savings decision.

3.2 Instrumental variable as robustness test

The IV approach is widely used as a means to address endogeneity concerns such as omitted variable bias, especially when associated with non-experimental data such as our sample selection model (Wooldridge, 2010). This issue can lead to biased and inconsistent parameter estimates, compromising the internal validity of the statistical analysis. In our case, factors such as financial literacy and risk aversion may impact overall savings and thus may be omitted variables, which we in our analysis cannot control for. Endogeneity may also arise when there is a simultaneous relationship between the dependent variable and one or more of the independent variables. For instance, savings might influence educational attainment, but educational levels can also affect saving behavior. Inaccuracies or imprecision in measuring variables, such as savings (measured in F CFA) and income, can be a source of endogeneity.

The IV method relies on the availability of a suitable instrument. The instrument must be a variable that is correlated with the variable of interest (overall savings), but demonstrably uncorrelated with with any other determinant of the dependent variable (Angrist & Pischke, 2009). We propose using the self-reported distance in minutes to the nearest bank branch and the distance to the nearest MM agent as IVs to examine its impact on overall savings. The choice of these IVs stems from the plausible assumption that proximity to a bank facility or MM agent can influence individuals' financial behaviors and, consequently, their overall savings.

In economics, distance is a commonly used instrument. For example, Card (1993) investigated college proximity as an exogenous determinant of schooling. The rationale behind this instrument

is that the proximity of colleges should substantially reduce the costs of attending college for school-aged children but should otherwise have no effects on education. Dee (2004) used two instruments, the distance from respondent's high school to the nearest 2-year college and the count of the number of 2-year colleges within respondent's county, to assess the effect of educational attainment on voter participation and support for free speech. Again, the rationale is similar to Card (1993). The instrument generated exogenous variation in individual levels of schooling, which should otherwise be unrelated to adult civic outcomes. Jack & Suri (2014) use the distance to the closest agent and the number of agents within 5 km of the household, along with their interactions with an income shock, as instruments to investigate reduced transaction costs on risk sharing. The expansion of the MM network is utilized as a source of exogenous variation in access to the innovation. Debela et al. (2022) use the inverse distance to the closest large palm oil mill as an instrument to investigate the effects of palm oil contract farming on the diets of palm oil smallholders. In their setting, the instrument should capture the distance to the next contracting company and, therefore, the likelihood of the farmer receiving a contract offer but should otherwise have no effects on diets of palm oil smallholders. Finally, Rink & Barros (2021) use the distance to a former British base in India as an instrument for investigating female empowerment and its effects on household consumption and financial decisions in a matrilineal society. The historical exogenous cultural shock serves as the instrument to investigate the effect of female empowerment on household financial decision-making.

Proximity to banking facilities and mobile money agents could have a considerable effect on an individual's financial behavior and saving opportunities. We expect the distance to these facilities to primarily affect overall savings through accessibility rather than directly influencing the saving amount. Distance or proximity to a financial facility is expected to be independent of unobservable characteristics that may affect overall saving (e.g., risk preferences or intrinsic saving habits). The proposed instruments for overall savings are thus based on two proximity variables: distance to the closest bank branch and distance to the nearest mobile money agent.

An IV must satisfy two requirements. First, the instrument must be correlated with MM savings/bank savings, which is also known as the relevance assumption (Abadie & Cattaneo, 2018). We therefore regress during the first stage the endogenous variable (amount saved with bank account and mobile money) on the instrumental variables (distance to bank branch/distance to MM agent in minutes, and transformed to a logarithm) and other control variables that may affect savings. The following control variables are included in the first stage regression: farmer's age, gender, the number of wives, dummies indicating whether a farm household has a smartphone, belongs to the ethnicity Bambara, and has some French skills, the self-assessed risk of money gets stolen when kept it at home, and the number of saving channels used over the past 12 month. We include the same control variables in the second stage estimations. We estimate the IV with robust standard errors. The estimated coefficient of the distance to the bank branch in this stage reflects its impact on overall savings through its effect on banking accessibility. Second, the respective saving channel must only affect overall savings through the effect of the distance to MM savings and the distance to bank savings. This requirement is also known as the exclusion restriction. Because one cannot test this latter assumption, its validity should be discussed (Abadie & Cattaneo, 2018). If the exclusion restriction holds, a local average treatment effect can be identified, as shown by Angrist

et al. (1996). The rationale is that the expansion of the MM network and bank branches are utilized as a source of exogenous variation in access to savings.

The exclusion restriction might hold because neither the distance to the nearest bank branch, nor to the nearest MM agent should have a direct impact on an individual's financial well-being. The only effect of distance is on an individual's ability to access banking services and/or an MM agent, which in turn affects their saving behavior. Because only a share of the farmers stated that they could walk to the next bank branch, the sample size for this robustness test is reduced. 114 respondents stated that they could walk to a MM agent, while only 38 stated that they could walk to a bank branch. As the small sample size of 38 would reduce the IV's credibility, we only use the distance to the next MM agent as the instrument.

4 Results and Discussion

In the first part of this section (Section 4.1), we present and discuss the results. In the second part of the section (4.2), we present the IV results to test the robustness of our estimations.

4.1 Results - two-step selection model

To assess whether different saving channels can promote the saving probability and the savings amount of Malian farmers, we employ a two-step model with two equations. With the selection equation (see equation (2)), we estimate the farmers' use of the saving channels MM, bank, or secret place (subsection 4.1.1). Equation (3) allows us to investigate the factors influencing the respondent's savings amount for the different saving accounts (subsection 4.1.2). In the following two subsections, we present and discuss the results.

4.1.1 Farmers' saving probability

According to Table 2, 306 farmers use at least one saving channel (82%). In particular, 190 farmers save via MM (51%), 119 farmers use bank accounts (32%) and 84 farmers (22%) save in a secret place. Table 2 presents the ME of the probit model regarding farmers' probability of saving with the different saving channels. Our results suggest that older farmers have a statistically significant higher probability of saving with a bank account. In contrast, a statistically significant negative association of age on the likelihood of saving at a secret place is identified. According to the ME, the probability of saving at a bank increases by 0.7% per additional year of age, while the probability of saving at a secret place decreases by 0.5% per year. We find a slightly positive, but statistically insignificant association of age with respect to saving with MM.

With respect to gender, male farmers have a higher probability of saving with MM and at a bank, while they have a lower probability of saving at a secret place compared to females. In particular, the probability of saving with mobile money is 15.2% for male farmers. Furthermore, the probability of saving at a bank is statistically significantly higher for male farmers by 18.4% . The latter finding might be intuitive given that the literature provides insights that women might feel particularly pressured to share their income within their family to avoid social consequences (Carranza et al., 2021; Jakiela & Ozier, 2016; Steinert et al., 2018). Considering this, saving at a secret place seems to be attractive from a woman's perspective. However, it is unclear whether

Table 2: Marginal effects of the probit model for farmers' saving probability.

Independent variable	(1) Total savings	(2) MM savings	(3) Bank savings	(4) Secret place savings
Farmer's age, in years	-0.00159	0.0000839	0.00671***	-0.00470**
	(0.00181)	(0.00235)	(0.00169)	(0.00194)
Dummy if farmer is male (0: no, 1: yes)	0.0548	0.152	0.184*	-0.0750
	(0.0885)	(0.116)	(0.102)	(0.0670)
Dummy if farmer has some writing French skills (0: no, 1: yes)	0.0561	0.0840	0.0413	-0.0248
	(0.0424)	(0.0522)	(0.0395)	(0.0416)
Dummy if farmer's ethnicity is Bambara (0: no, 1: yes)	0.0604	0.180***	-0.0245	-0.0260
	(0.0429)	(0.0520)	(0.0413)	(0.0399)
Farmer's number of wives	0.00900	-0.0171	0.00266	0.0151
	(0.0189)	(0.0214)	(0.0163)	(0.0150)
Total number of farmers' savings accounts	0.284***	0.303***	0.316***	0.223***
	(0.0398)	(0.0481)	(0.0253)	(0.0242)
Dummy if it is possible to walk to bank branch (0: no, 1: yes)	0.0960	-0.0953	0.153***	0.0262
	(0.0637)	(0.0655)	(0.0507)	(0.0504)
Dummy if it is possible to walk to MM agent (0: no, 1: yes)	0.0867**	-0.0264	0.0728*	0.0245
	(0.0392)	(0.0520)	(0.0418)	(0.0410)
Dummy if farmer's HH has a smartphone (0: no, 1: yes)	0.00577	0.0625	0.0673	-0.132***
	(0.0380)	(0.0473)	(0.0413)	(0.0390)
Self-assessment risk of getting money stolen when keeping it at home	-0.00607	0.0179	0.0133	-0.0357***
	(0.0128)	(0.0164)	(0.0124)	(0.0136)
Regional fixed effects	Yes	Yes	Yes	Yes
Pseude R^2	0.218	0.169	0.329	0.231
Savings reported	306	190	119	84
Observations	374	374	374	347

The total savings amount as well as the amounts for the different saving channels were transformed to logarithmic outcomes (see column (1) to (4)).
Heteroskedasticity robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$
The description of the variables can be found in Table A.2 in the Appendix.
Source: Own illustration.

women genuinely prefer to save money in a secret place, or if they do so out of necessity due to the lack of accessible and secure alternatives, such as bank transactions. This behavior may be attributed to their engagement in domestic tasks, rendering them less mobile and unable to access traditional banking services. Yet, our findings are not statistically significant at conventional levels and rely on a small fraction of female respondents (N=20).

Further, farmers' education, measured as having writing skills in French, is positively, however not statistically significantly, associated with the saving probability in general and regarding saving with MM and at a bank in particular. In contrast, French writing skills are negatively associated with saving money at a secret place. Education is often considered a key determinant of technology adoption such as MM (Amoah et al., 2020; Johnen et al., 2023). Even though our results indicate the same for Malian farmers, they are not statistically significant at conventional levels.

Belonging to the ethnicity Bambara has ambiguous associations on farmers' saving probability among all channels. On the one hand, farmers identifying themselves as Bambara have a statistically significantly higher probability of saving with MM by 18.0%. On the other hand, they have an 2.5% lower probability of saving money at a bank, and a 2.6% lower probability of saving at a secret place, however without statistically significance.

Farmers' number of wives shows no statistically significant association on neither formal, informal and not institutional saving channel. On the contrary, the number of savings accounts show a statistically significant positive association on all saving channels, indicating that our results are reliable.

Our results show that the possibility of walking to a bank has a statistically significant positive association on the likelihood to save at a bank. In particular, the probability of saving money in a bank account increases by approximately 15.3%. Therefore, in cases where several opportunities exist, saving with a bank seems to be attractive to farmers. The possibility of walking to a MM agent has a statistically significant positive association on the probability of saving in general and at a bank account. More specifically, the probability of saving money increases by 8.7% in general and the probability of bank savings by 7.3%. Surprisingly, a slightly negative, though not statistically significant association was found for saving with MM.

Owning a smartphone has a slightly positive but not statistically significant association with farmers' probability of saving money with MM or at a bank. On the contrary, it has a statistically significant negative association with the probability of saving money at a secret place. More specifically, farmers with access to a smartphone have a 13.2% lower probability of saving money at a secret place. This could indicate, that once savers have the opportunity to deposit their cash formally in a bank account or semi-formally via MM, they prefer this over keeping it in a secret place where it might be stolen or spent more easily.

Lastly, we asked the farmers to rate the risk of getting money stolen on a scale from very low to very high on a 5-point equally spaced Likert scale. We find that perceiving one's own financial situation as risky has a slightly positive, however, not statistically significant positive association on farmers likelihood to save money with MM or at a bank. On the other hand, a lower risk perception affects saving at a secret place in a statistically significant negative way. The ME indicates that a one point higher risk perception decreases the probability of saving at a secret place by 3.6%.

4.1.2 Farmers' savings amount

Table 3 shows the results of the OLS regression after the sample selection. All independent variables of the probit model were included in the OLS regression. While the results are mostly similar in terms of sign, magnitude, and statistical significance, some variables show different associations. Therefore, the differences are of major interest in this section. To increase the models' performance and allow the coefficients to be interpreted as direct elasticities, the total savings amount as well as the amounts for the different saving channels were transformed to logarithmic outcomes.

Our results indicate that the farmers' age has a statistically significant positive association with overall savings, and the amount of bank savings. Being one year older increases the bank saving amount by 11.9%. On the contrary, a statistically significant negative association on farmers' savings amount at a secret place was found. In particular, being one year older decreases the secret place savings by 6.9%. The small positive association of age with the farmers' savings amount with MM is not statistically significant at conventional levels.

According to Table 3, men save more in total, with a bank account and MM but less at a secret place, compared to women. Yet, the association is only statistically significant at conventional levels for the savings amount at a bank: Being a male farmer increases the amount of bank savings in a statistically significant way by 310.9%. This may be explained by the disproportionate distribution of capital and the control over household finances. Since women have lower access to productive resources and capital and are in many cases more likely to be approached to share their money with family members (Carranza et al., 2021), they consequently might save smaller amounts compared to their male counterparts (Carranza et al., 2021; Lambrecht et al., 2018).

French literacy is positively but not statistically significantly associated with farmers' total savings as well as with MM savings and bank savings. For saving via a secret place, a slightly negative association was identified, again without statistical significance.

Bambara farmers have statistically significantly higher savings with MM in particular compared to other ethnicities: If a farmer states to be Bambara, their MM savings are, on average, 190.3% higher than those from other ethnic groups. In contrast, their savings at a bank are lower on average compared to other ethnic groups. In addition, Bambara farmers also have lower savings at a secret place. However, given no statistical significance, these associations should be considered with caution and needs further investigation.

The number of wives is slightly positively but not statistically significantly associated with farmers' total savings as well as with secret place savings. For saving via MM and with bank savings, we observe a slightly negative association, however, without statistical significance.

The number of saving accounts has, as expected, a statistically significantly positive association on farmers' total savings as well as on all other saving channels considered in this analysis.

In contrast, when a bank is located within walking distance, bank savings are higher by 261.4%. Additionally, the total amount of savings increases by 89.0%. Both associations are statistically significant at the 1% level. Our results are in line with previous findings that argue that banks prefer establishing branches in regions with better infrastructure and potentially wealthier clients (Geiger et al., 2019; Dupas et al., 2014). For perspective, a bank was only within walking distance for approximately 20% of the surveyed farmers. Therefore, we assume the bank infrastructure to be of high relevance for farmers' saving ambitions and more so via a formal account. The effect for

MM savings is negative and for secret place savings it is positive. Both effects are not statistically significant at conventional levels.

We find a positive but not statistically significant association for the distance to the next MM agent on the total saving amount, bank savings and saving with a secret place. Most notably, the availability of a MM agent nearby has a slightly negative association on MM savings. While this is a surprising outcome at first, we suspect that proximity might also lower the barrier to spontaneous withdrawals. Contrarily, the further away the agent, the harder it is for the saver to liquidate their funds. This might thus function as an indirect tool to increase the saving commitment.

In the previous subsection, we identified smartphone use as a key driver for using or not saving via the respective saving channels. With regard to the savings amount, owning a smartphone leads to statistically significantly lower savings at a secret place. In contrast, a statistically significantly positive association was found for the total saving amount and bank savings. More specifically, smartphone owners have 63.2% higher total savings and 150.3% higher bank savings. Lastly, smartphone owners also have higher savings wit MM. However, this effect is not statistically significant at conventional levels. The analysis highlights the relevance of distinguishing between the saving channels. To ensure that smartphone adopters are not different from non-adopters, we conducted a mean comparison of some socio-demographic characteristics of both groups - adopters and non-adopters. Please find the results in Table A.4 of the Appendix. We observe no statistically significant differences between these two groups.

The higher the subjective perceived risk of money getting stolen when saving it at home, the lower are the reported savings at a secret place. A one-point higher risk perception of having money stolen when keeping it at home statistically significantly increases the saving amount with MM by 41.2%. In contrast, one-point higher risk perception of having money stolen reduces the saving amount at a secret by 40.4%. This association confirms our expectations, as farmers might consider other saving channels as a safer way to deposit money than keeping it in their pocket. This can be claimed given that a slightly positive but not statistically significant association was found for the bank savings amount.

4.2 Results of the instrumental variable robustness test

As introduced in Subsection 3.2, we considered two variables, which are commonly used as instruments and decided to use only one variable as an instrument: the distance to the next MM agent. We used the variable as continuous variable as a potential instrument. We add the following control variables to the first stage regression: farmer's age, gender, and number of wives, dummies indicating whether a farm household has a smartphone, belongs to the ethnicity Bambara, and has some French skills, the self-assessed risk of money gets stolen when kept it at home, and the number of saving channels used over the past 12 month. Table A.5 in the Appendix shows the results of the first and second stage.

We observe a statistically significant association between the instrument 'minutes to the next mobile money agent' and endogenous variable MM savings (as continuous (column (1)). However, this statistically significant correlation does not hold for the amount saved with MM when transformed as a logarithmic value. We note a positive and statistically insignificant association close to zero (column (2)). Nonetheless, since we observe the expected negative association in column

Table 3: Results of the OLS regression regarding the determinants of farmers' savings amount.

Independent variable	(1) Total savings	(2) MM savings	(3) Bank savings	(4) Secret place savings
Farmer's age, in years	0.0185*	0.0184	0.119***	-0.0685**
	(0.00960)	(0.0293)	(0.0292)	(0.0285)
Dummy if farmer is male (0: no, 1: yes)	0.513	1.747	3.109*	-0.908
	(0.330)	(1.451)	(1.608)	(1.118)
Dummy if farmer has some writing French skills (0: no, 1: yes)	0.0202	0.471	0.507	-0.461
	(0.194)	(0.631)	(0.675)	(0.584)
Dummy if farmer's ethnicity is Bambara (0: no, 1: yes)	-0.289	1.903***	-0.838	-0.666
	(0.203)	(0.683)	(0.747)	(0.623)
Farmer's number of wives	0.0187	-0.453	-0.0488	0.268
	(0.0736)	(0.282)	(0.293)	(0.258)
Total number of farmers' savings accounts	1.095***	2.277***	4.299***	3.071***
	(0.120)	(0.436)	(0.413)	(0.380)
Dummy if it is possible to walk to bank branch (0: no, 1: yes)	0.890***	-1.208	2.614***	0.281
	(0.237)	(0.804)	(0.875)	(0.754)
Dummy if it is possible to walk to MM agent (0: no, 1: yes)	0.127	-1.061	0.754	0.309
	(0.195)	(0.665)	(0.701)	(0.599)
Dummy if farmer's HH has a smartphone (0: no, 1: yes)	0.632***	0.943	1.503**	-1.600**
	(0.196)	(0.621)	(0.711)	(0.622)
Self-assessment risk of getting money stolen when keeping it at home	0.0870	0.412**	0.238	-0.404**
	(0.0615)	(0.201)	(0.221)	(0.175)
Regional fixed effects	Yes	Yes	Yes	Yes
R^2	0.360	0.187	0.353	0.228
Observations	305	190	119	81

The total savings amount as well as the amounts for the different saving channels were transformed to logarithmic outcomes (see column (1) to (4).
Heteroskedasticity robust standard errors in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$
The description of the variables can be found in Table A.2 in the Appendix.
Source: Own illustration.

(1), we conclude that the relevance assumption for this instrument has been met. The expected negative and statistically significant association that we observe indicates that living closer to the next MM agent increases the amount saved with MM savings. The F-Stat is below the rule of thumb value of 10, indicating a weak instrument. However, we employ the distance to the next MM agent as a robust test.

We show the second stage results of the IV regression in Table A.5 in the Appendix for both instruments considered. In column (1) the dependent variable is the overall savings amount as a continuous variable, while it is in column (2) the total savings as logarithmic variable. The distance to the next MM agent branch is the instrument. We add the following control variables to the second stage regression: farmer's age, gender, and number of wives, dummies indicating whether a farm household has a smartphone, belongs to the ethnicity Bambara, and has some French skills, the self-assessed risk of money getting stolen when kept at home, and the number of saving channels used over the past 12 month.

An overidentification test is employed to assess whether the number of instruments used in the model is excessive. The null hypothesis posits that the instruments are correctly specified and not overidentifying. The test statistic equals 0, indicating that there is no evidence to suggest overidentification.

We observe a positively and statistically significant association between the instrument on total savings endogenous variable MM savings (as continuous (column (1)). However, this statistically significant correlation does not hold for the instrument and the amount saved with MM transformed as a logarithmic variable. We note a positive and statistically insignificant association close to zero (column (2)).

The results of the relatively stronger instrument (column (1)) indicate that the closer the distance to the next mobile money agent, the lower the overall savings. This result may seem counterintuitive at first but indicates that the amount saved with mobile money is relatively smaller compared to the amounts saved with a bank account. Given that the amount saved with a bank account is more than 10 times larger (compare Table A.2), this result is not surprising.

5 Conclusion

Many people struggle to save as much as they would like to. While households in industrialized countries can access a multitude of mechanisms that may help them save in private and overcome behavioral barriers to savings accumulation, households in lower-income economies face exacerbated structural barriers to accumulating cash and often have fewer opportunities to overcome these obstacles (Karlan et al., 2014). In recent years, substantial efforts have been made to financially include marginalized inhabitants of low-income economies (Steinert et al., 2018; Karlan et al., 2014; Banerjee & Duflo, 2007).

The promotion of household saving and responsible financial planning is a promising area for pro-poor development and plays an important role in facilitating the transformation towards resilient and sustainable livelihoods. Based on a comprehensive primary data set from rural Mali, this paper investigates drivers of (i) saving probability and (ii) the respective saving amounts. While other authors have assessed general saving determinants in Ghana (Aidoo-Mensah, 2019) or the mechanisms behind saving with mobile linked bank accounts in Sri Lanka (De Mel et al., 2022), we

add novelty by disaggregating the respondents' main avenues of saving, looking separately at the channels (a) MM, (b) bank accounts, and (c) secret place.

We find that despite the spread of formal and semi-formal saving channels in the past years, saving through secret places remains a relevant way to put aside and accumulate cash (Aggarwal et al., 2023). Further, our results suggest heterogeneous effects of relevant determinants on farmers' probability to save via different channels. In particular, and in line with Kiiza & Pederson (2001), we find that supply-side factors such as an adequate bank branch infrastructure is associated to a better accumulation of savings. The IVs emphasize the robustness of our two-staged approach, as we identify the distance to the nearest MM agents as an appropriate instrument: The closer a farmer lives to the nearest MM agent, the larger the MM savings.

Our study suggests that while poor individuals store money in a variety of ways, informal saving channels still seem to be a popular option. On the one hand, for mobile money providers and banks, this provides an opportunity to pull these savings out of the hidden places and generate revenues. Savers, on the other hand, minimize the risk of theft and could start earning interest for their savings. However, up to now it seems that either, these formal mechanisms are not accessible for the poor or not attractive enough. Hence, and based on our findings, we suggest financial institutions should focus on the supply side e.g. by attracting savers through interest rates or advertising the improved security of saving formally to facilitate more savings among smallholder farmers.

In conclusion, our study provides valuable insights into the relationship between saving channels and temptation spending in Mali. These findings have important implications for policymakers and financial institutions who look to strengthen the resilience of the agricultural sector in Mali and reduce poverty. By taking into account the saving channels of farmers, policymakers can design targeted and more effective policies and financial products.

Our paper contributes to a broader debate on the analysis of saving behavior in the lower income economies. As our sample targets mostly male farmers, we encourage further research on a female or gender-balanced sample. Finally, since our results are based on a regionally and, for specific variables, comparable set of farmers who are customers at a commercial bank in Mali, our approach could also be applied to other countries in the Global South. Hereby the research would contribute to a more heterogeneous understanding of farmers' saving and decision-making behavior in the region.

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6 Appendix

Table A.1: Code book of the questionnaire items used for analysis.

Variables	Question the variable is based on	Unit of the variable
Dependent variables		
Total savings	This is the sum of all saving instruments a farmer use.	in F CFA
MM	Which of the following saving instruments have you used within the past 12 months?	0: no, 1: yes
Bank	Which of the following saving instruments have you used within the past 12 months?	0: no, 1: yes
Secret place	Which of the following saving instruments have you used within the past 12 months?	0: no, 1: yes
Amount (MM)	Please indicate how much money you have saved with each of the following saving instruments (if applicable)	in F CFA
Amount (bank)	Please indicate how much money you have saved with each of the following saving instruments (if applicable)	in F CFA
Amount (secret place)	Please indicate how much money you have saved with each of the following saving instruments (if applicable)	in F CFA
Independent variables		
Farmer's age, in years	How old are you?	years
Farmer's gender	What is your gender?	1: male, 2: female
Dummy if it is possible to walk to MM agent	How many minutes do you have to walk to reach the next mobile money agent?	0: no, 1: yes
Dummy if it is possible to walk to bank branch	How many minutes do you have to walk to reach the next bank?	0: no, 1: yes
Dummy if farmers' HH has smartphone/ any phone	Does someone in your household possess any handheld device for telephoning?	1: no phone, 2: calls only, 3: internet access, 4: calls and internet
Risk perception	If you kept the money at home how high would you rate the risk of it getting stolen?	1: very low, 2: low, 3: neutral, 4: high, 5: very high
Dummy if farmer has some writing French skills	Do you have any writing skills in French?	0: no, 1: yes
Dummy if farmer's ethnicity is Bambara	Which ethnic group are you part of?	1: Other, 2: Bambara, 3: Bobo/ Bomu, 4: Bozo/ Tyako, 5: Dogon/ Dôgôsô, 6: Khassonké/ Khassonkakan, 7: Malinké/ Maninkakan, 8: Minianka/ Mamara, 9: Peulh/ Fulfulde, 10: Samogo/ Dungooma, 11: Sarakole/ Sooninke, 13: Sénoufo/ Syenara
Total number of farmers' savings accounts	Sum of all savings accounts the farmer has	Number
Farmer's number of wives	How many wives do you have?	Number

The questionnaire was conducted in French and Bambara. To increase readability and comprehension for the international readership, we translated the items to English.
Source: Own illustration.

Table A.2: Description of the variables considered for the analysis.

Variables	Units	Mean	SD
Dependent variables			
Total savings	0: no, 1: yes	0.82	-
MM	0: no, 1: yes	0.51	-
Bank	0: no, 1: yes	0.32	-
Secret place	0: no, 1: yes	0.22	-
Amount (MM)	in F CFA	149,702	280,287
Amount (bank)	in F CFA	2,083,193	4,183,987
Amount (secret place)	in F CFA	300,851	357,618
Independent variables			
Farmer's age, in years	Years	47.29	9.99
Dummy if farmer is male	0: female, 1: male	0.95	0.23
Dummy if farmer has some writing French skills	0: no, 1: yes	0.33	0.47
Dummy if farmer's ethnicity is Bambara	0: no, 1: yes	0.59	0.49
Farmer's number of wives	Number	1.25	1.14
Total number of farmers' savings accounts	Number	1.37	0.67
Dummy if one of the HH members has a smartphone	0: no, 1: yes	0.64	-
Dummy if it is possible to walk to bank branch	0: no, 1: yes	0.19	-
Dummy if it is possible to walk to MM agent	0: no, 1: yes	0.58	-
Farmers' perceived risk of money getting stolen when saving		2.19	1.52

Source: Own illustration.

Table A.3: Summary statistic LSMS data and own collected data.

		LSMS data		Study sample	
	Unit	Mean	SD	Mean	SD
Farmer's age	Years	32.08[2]	17.58	47.29	9.97
Education					
Dummy if farmer has no formal education	Dummy (0: no, 1: yes)	0.80	-	0.59	-
Dummy if farmer has some primary formal education	Dummy (0: no, 1: yes)	0.20	-	0.25	-
Dummy if farmer has some secondary formal education	Dummy (0: no, 1: yes)	0.08	-	0.15	-
Dummy if farmer went to University	Dummy (0: no, 1: yes)	0.00	-	0.01	-
Dummy if farmer has some oral French skills	Dummy (0: no, 1: yes)	0.26	-	0.33	-
Dummy if farmer has a job outside of agricultural sector	Dummy (0: no, 1: yes)	0.19	-	0.29	-
Dummy if farmer's ethnicity is Bambara	Dummy (0: no, 1: yes)	0.58	-	0.59	-
Farmer's household size	Individuals	10.82	6.89	12.21	7.25
Dummy if farmer owns a smartphone	Dummy (0: no, 1: yes)	0.63	-	0.55	-
Observations		2,645		374	

We are using the 2018/19 LSMS data set (INSTAT, 2022) which we adjusted for the regions (only Bamako, Koulikoro, Sikasso), the sector (only respondents who state being employed in the agricultural sector) and gender (only male, as the majority of our respondents are male) [2]the household heads are on average 53.26 years old.
Source: Own illustration.

Table A.4: Selected characteristics of smartphone adopters and non-adopters.

	(1) Adopters	(2) Non-adopters	(3) t-test
Farmer's age (in years)	48.07	46.82	1.17
Dummy if farmers is male	0.92	0.96	1.67
Dummy if farmer has no formal education (0: no, 1: yes)	0.59	0.59	0.16
Dummy if farmer's ethnicity is Bambara (0: no, 1: yes)	0.58	0.60	0.36
Farmer's HH size (continuous variable)	12.35	11.96	0.46
HH's total savings	1,029,944	540,578	1.74
Observations	234	140	

Source: Own illustration.

Table A.5: First and second stage results for the instrumental variable approach

	First Stage	
	(1) MM savings	(2) MM savings (as log)
Minutes farmer has to walk to next MM agent	-2,595.33**	0.049
	(1,029.721)	(0.036)
F-statistic	2.75	8.22
	Second Stage	
	Total savings	Total savings (as log)
Minutes farmer has to walk to next MM agent	13.917**	-0.605
	(7.239)	(0.902)
Control variables	Yes	Yes
Regional fixed effects	Yes	Yes
Cragg-Donald Wald F-statistic	1.72	2.18
Overidentification test of all instruments	0.00	0.00
Observations	114	114

Notes: As not all farmers can walk to a MM agent, only the sub sample of farmers who can walk to an MM agent is included in the analysis. This reduces the sample size to 114. This estimation includes the following control variables: farmer's age, gender, and number of wives, dummies indicating whether a farm household has a smartphone, belongs to the ethnicity Bambara, and has some French skills, the self-assessed risk of money gets stolen when kept it at home, and the number of saving channels used over the past 12 month. As only 114 farmers can walk to a MM agent, the sample size is reduced accordingly.
Source: Own illustration.