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Is Mobile Money Changing Rural Africa? Evidence from a Field Experiment

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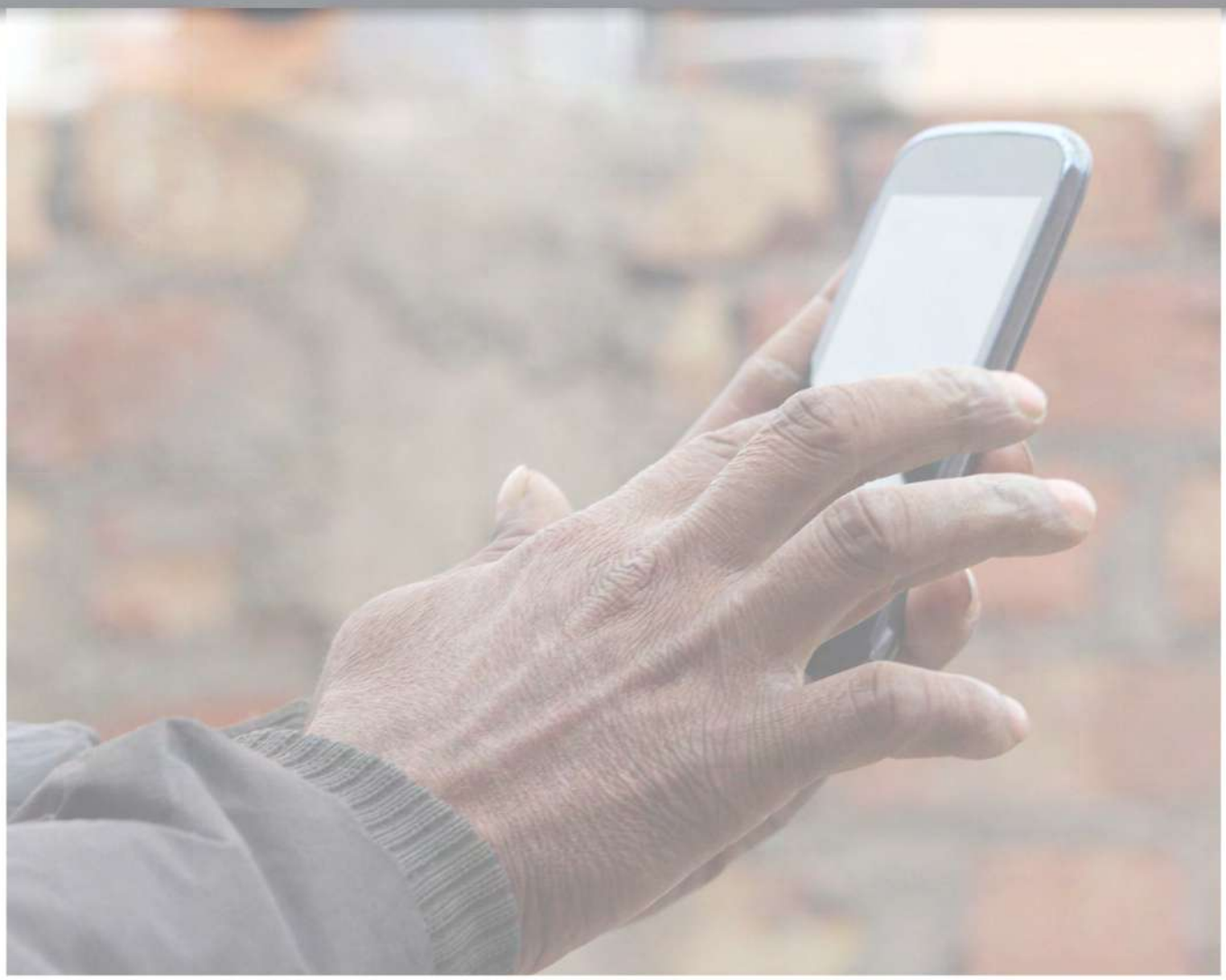

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ABSTRACT

Is Mobile Money Changing Rural Africa? Evidence from a Field Experiment*

Rural areas in Sub-Saharan Africa are typically underserved by financial services. Mobile money brings a substantial reduction in the transaction costs of remittances. We follow the introduction of mobile money for the first time in rural villages of Mozambique using a randomized field experiment. We find that mobile money increased migration out of these villages, where we observe lower agricultural activity and investment. At the same time, remittances received and welfare of rural households increased, particularly when facing geo-referenced village-level floods and household-level idiosyncratic shocks. Our work suggests that mobile money can accelerate urbanization and structural change in Sub-Saharan Africa.

JEL Classification:
O12, O15, O16, O33, G20, R23

Keywords:
mobile money, migration, remittances, investment, agriculture, structural change, technology adoption, insurance, Mozambique, Africa

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1. Introduction

In recent years, the use of mobile phones dramatically changed the African landscape.[1] This technological revolution led to a new wave of financial inclusion through the introduction of mobile money.[2] These services allow financial transactions to be conducted using the simplest cell phones far away from urban areas where most bank agencies are located. In particular, mobile money represents a clear reduction in the transaction costs of remitting, namely when one considers the typical alternatives in place: sending money in person or via bus drivers, which is slow, expensive, and risky.[3] In this context, mobile money has the potential to significantly impact the lives of rural Africans.

This paper contributes to our knowledge of how mobile money is changing rural Africa. The reduction in the transaction costs of money transfers induced by mobile money is likely to change the behavior of rural households in many ways. The main direct implication is that these cheaper transfers improve the ability to share risks for rural households (Jack and Suri, 2014). Additionally, rural households may see migration as less costly if migrants can keep sharing risks with their origin households and support them in times of need. This may be particularly attractive as a risk-sharing strategy to allow migrants to insure against aggregate shocks at origin. Mobile money can then be a driver of migration out of rural areas. At a macro level, these population movements out of subsistence agriculture can induce increased productivity and urbanization. In this way, it is possible that mobile money opens the door to structural change and economic development.

We test for these economic impacts of mobile money by conducting, to the best of our knowledge, the first randomized field experiment evaluating the effects of placing mobile money agents for the first time in rural locations that previously had no formal financial services available at all. Our study entailed following

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[1] The unique subscriber base of mobile phones nearly doubled between 2007 and 2012, making Sub-Saharan Africa the fastest growing region globally for the adoption of mobile communication. By the end of 2016, there were 420 million unique mobile subscribers (and 731 million active SIM connections) in Sub-Saharan Africa, surpassing the number of unique mobile phone subscribers in the United States – and access rates to mobile phone services in Sub-Saharan Africa are even higher since entire households often share a single phone. For additional details, see GSMA Intelligence. *Sub-Saharan Africa Mobile Economy 2017* (available at www.gsma.com).

[2] However, access to financial services in Sub-Saharan Africa is still limited. According to Demirgüç-Kunt et al. (2022), only about 40 percent of adults in sub-Saharan Africa had a bank account in 2021, while less than half of these individuals had formal savings accounts.

[3] There are substantial costs and risks when sending or receiving money transfers in Sub-Sharan Africa: the average cost of sending remittances to Sub-Saharan African countries was higher than to all other regions in the world, and the top ten most expensive remittance corridors in the world were all within Africa, according to the World Bank. Remittance Prices Worldwide 2018 Report.

a sample of households in 102 villages in rural Southern Mozambique over three years. In this period, we had access to administrative data on mobile money transactions and conducted three rounds of household surveying. These surveys allowed measuring migration and remittances, savings and investment, as well as subjective welfare and idiosyncratic shocks. We also employ a geo-referenced measure of floods, which constitutes an important aggregate shock in our setting.

We find that the availability of mobile money generated out-migration flows in the areas where the service was introduced. Specifically, the probability of a treated household having a migrant increased by 14.5pp two years after mobile money agents became operational. This happened as mobile money improved risk-sharing possibilities: migrant remittances received by rural households more than doubled in value due to mobile money availability and even more so when these households were hit by negative shocks, both large floods and household-specific shocks. In the rural African context of our experiment, where most of the population is still dedicated to subsistence agriculture, we also observe that the availability of mobile money led to a decline in agricultural activity and investment. This pattern of disinvestment together with the increased out-migration of rural areas suggests that mobile money can act as a driver of structural change.

Consistent with these effects, the availability of mobile money and the associated migrant transfers improved the subjective welfare and the consumption expenditure of rural households, whose vulnerability to shocks diminished. Specifically, we find a reduction in the episodes of hunger experienced by families in treated locations, as well as improved access to medicines and school supplies, particularly two years after mobile money became available. We find important effects on consumption expenditure when households are faced with aggregate or idiosyncratic shocks.

The rapid expansion of mobile money in Kenya did not allow for its impact to be experimentally evaluated. Over time, however, a body of knowledge has been built about the economic impact of mobile money. The literature was initially focused on the Kenyan success story of M-PESA, which was the first mobile money platform, launched in 2007. The earlier studies by Jack and Suri (2011) and Mbiti and Weil (2013) pointed to internal remittances as the main driver of success for M-PESA. More recent contributions showed how increased migrant remittances due to mobile money contributed to consumption smoothing. Jack and Suri (2014) followed a panel of households to show that the consumption of households with access to M-PESA is not hurt by idiosyncratic shocks, namely due to increased mobile transfers. This evidence is confirmed by Riley (2018), who examines the responses of rural households to weather shocks. Blumenstock et al. (2016) also find evidence supportive of risk sharing in the airtime transfers around an earthquake in

Rwanda. Our work confirms the insurance findings regarding different types of shocks in this literature but conducts an experimental evaluation, while also documenting a novel impact on migration.

A more recent branch of literature describes the potential of mobile money as a tool to fight poverty. Suri and Jack (2016) document positive effects of mobile money on poverty-reduction in Kenya, along with impacts on the occupational choices of women. Their poverty-reduction result is in line with Aker et al. (2016), who study a cash transfer program implemented using mobile money in Niger after a natural disaster, and with Lee et al. (2020), who investigate the experimental impact of incentivizing mobile money usage in Bangladesh among both rural households and their migrant family members in urban areas. Our paper also documents how the availability of mobile money improved the welfare of rural households, and their occupational change.[4]

Finally, this paper is related to the literature on the impact of migrant remittances in developing countries. As made clear in the literature review by Yang (2011), there is limited causal evidence on the development impact of remittances. Yang (2008) employed exchange rate shocks in the Philippines induced by the 1997 Asian financial crisis: he finds that increased migrant resources generated by exchange rate appreciation are used primarily for investment in origin households, rather than for consumption.[5] Yang and Choi (2007) show evidence that migrant remittances serve as insurance in face of negative weather shocks in the Philippines. We add to this literature by studying exogenous variation in migrant remittances.

2. Experimental design

2.1 Randomized intervention

Mobile money services were introduced in 51 rural locations of the provinces of Maputo Province, Gaza, and Inhambane, in southern Mozambique. We partnered with Carteira Móvel (held by telecom Mcel), the only provider of mobile money services in the country at the time, which were marketed as mKesh. Because

[4] Recent literature focused on the impacts of mobile money on savings and investment. Suri and Jack (2016) document positive effects of mobile money on savings in Kenya. A body of experimental studies followed (Bastian et al., 2018; Blumenstock et al., 2018; Jack and Habyarimana, 2018; Aggrawal et al., 2020; Breza et al., 2020; Batista and Vicente, 2020a; De Mel et al., 2020; Batista et al., 2022). Overall, these studies have showed how mobile money can be used as a tool to promote savings and investment. Still, the documented impacts on business performance are not as clear.

[5] This investment takes the form of educational expenditures and entrepreneurial activities. Other recent studies focusing on African countries found similar effects of migration: on education in Cape Verde (Batista et al., 2012) and on entrepreneurship in Mozambique (Batista et al., 2017).

mobile money was not previously available in any of the rural locations included in our sample, the intervention included three different stages: first, the recruitment and training of mKesh agents; second, the holding of a community theater and of a community meeting describing and demonstrating mKesh services; third, the individual dissemination of mKesh to a randomly selected group of villagers.

In the first stage, one mobile money agent per treatment location was recruited. This took place between March-May 2012. The recruited agents were typically local grocery sellers. Three main criteria were sought when proposing local vendors to become mKesh agents. First, they were required to hold a formal license to operate as vendors. Second, they were required to have a bank account. Third, they were assessed as having a sufficiently high level of liquidity in their business.

Each treatment location was visited for the on-site recruitment of agents. Training of the agents followed in a second visit. At this point in time, agent materials were handed out. The materials included an official shop sign to identify as an mKesh agent, other mKesh advertising posters, and an mKesh agent mobile phone to be used for all mKesh transactions. A briefing describing the remaining dissemination activities in rural areas was held at this point.

The second stage of the intervention included a community theater and a community meeting to disseminate mobile money services at the community level. These events were advertised with the support of local authorities and were held one after the other, close to the agent's shop. The script of the community theater was the same for all treatment locations. It included mentions of mKesh safety, transfers using mKesh, savings using mKesh, and the mobile money self-registration process. The context was a village scene, with a household head and his family/neighbors.[6] The community meeting, which had the presence of local authorities, gave a structured overview of the service, and allowed interaction with the community.

The third stage of the dissemination activities was implemented in the period June-August 2012. It was conducted at the individual level, as mKesh campaigners approached a representative group of targeted individuals. In this context, campaigners distributed a leaflet, which had a full description of the mobile money operations, while also providing instructions. The leaflet is displayed in Figure A1 in the Appendix.

[6] This script is available from the authors upon request.

Campaigners described the leaflet and asked targeted individuals whether they wanted to self-register to use the mKesh services. If they did, the campaigners helped individuals follow the self-registration instructions. Campaigners then offered 76 MZN (about 3 USD) of free trial money to be cashed-in to the mKesh account of each individual. For this purpose, targeted individuals had to accompany the campaigners to the agent's shop in their village. The cash-in instructions were then followed with the purpose of cashing-in the 76 MZN to the individual's mKesh account. After the cash-in was made, campaigners helped individuals to check the balance in their mKesh accounts. Subsequently, each targeted individual was asked to buy something in the agent's shop for the value of 20 MZN. This transaction implied a 1 MZN fee. Finally, targeted individuals were explained how a transfer could be done to another mobile phone and how they could cash-out the remaining 50 MZN from their account - the transfer would cost a 5 MZN fee, which would add up to the 76 MZN total cashed-in. Targeted individuals were also briefed about the pricing structure of the mKesh services.[7]

2.2 Sampling and randomization

We work with a sample of 102 rural areas in Southern Mozambique where mobile money services had never been made available before. These Enumeration Areas (EAs) were sampled randomly from the 2008 Mozambican census for the provinces of Maputo-Province, Gaza, and Inhambane.[8] For each EA to be included in our sampling framework two additional criteria had to be met. First, the EA had to be covered by Mcel signal – this was first checked by drawing 5-km radii from the geographical coordinates of each Mcel antenna, and then confirmed at the actual location of each EA. Second, there needed to be at least one commercial bank branch in the district of each EA to ensure that agents could easily access their account.[9]

The households that took part in this study were selected at the EA level. We sought household heads or spouses while following a n-th house random walk departing from the center of the EA along all walking directions. An additional condition had to be observed by households to be included in our sample: the household head or spouse had to own a Mcel phone number. This was not an important constraint as Mcel was the only cell phone provider in these rural areas at the time of the baseline survey, and only 3% of the households approached did not own a cell phone number. Our initial sample included 1819 households.

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[7] Figure A2 in the Appendix includes all the specific menus described by campaigners.
[8] Note that in Maputo-Province, only its northern districts bordering Gaza province were considered, as they included all rural locations not in proximity to the Maputo capital city.
[9] Mcel made available the geographical data on its antennae, and the Central Bank of Mozambique made available the data on the location of all bank branches.

The treatment was block-randomized using pairs of EAs from the full set of 102 EAs. The blocks were selected by matching on geographic proximity. The 51 treatment EAs were then drawn randomly within each block. Figure A2 shows the location of the 102 EAs in our study, split between treatment and control. The individual-level treatment, as well as invitations for community-level dissemination events, were submitted to an average of 16 individuals per EA selected randomly from those included in our study.

2.3 Measurement

The measurement of the impact of the intervention we follow is based on three main sources of data. First, we make use of the administrative records of mobile money transactions carried out by all individuals in our sample since the beginning of the project in July 2012. Carteira Móvel made these records available to us for the subsequent three years (until July 2015). The data include for each individual and for each transaction conducted: the date of the transaction, the type of transaction, the transaction amount, and the fees paid if any. In this period, a total of 15,971 transactions were recorded in the mobile money system for our sample of experimental subjects.[10]

Second, we conducted three household surveys including standard questions on demographics, consumption expenditure, investment and savings, idiosyncratic shocks, as well as a full module on household migration and remittances.[11] These three household survey rounds included a baseline survey, conducted between June and August 2012, a one-year follow-up survey, conducted between July and September 2013, and a two-year endline survey, conducted between July-September 2014.

Third, we employ geo-referenced data to measure the flood shocks that affected Mozambique in the 2012/2013 rainy season.[12] Specifically, we use the Standardized Precipitation Evapotranspiration Index (SPEI) proposed by Vicente-Serrano et al. (2010) corresponding to each of our EAs since 1981. The SPEI extends the traditional precipitation index in that it is based on water balance, i.e., the difference between

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[10] All transactions related to the individual dissemination activities conducted by mKesh campaigners are excluded for the purpose of our analysis.
[11] Survey questions are displayed in Appendix Table A10.
[12] For a description of these floods, see for example the report by the United Nations OCHA Regional Office for Southern Africa (ROSA), available at: http://reliefweb.int/sites/reliefweb.int/files/resources/Southern%20Africa%20Floods%20Situation%20Report%20No.%205%20%28as%20of%2008%20February%202013%29.pdf (last accessed on July 4, 2022).

precipitation and potential evapotranspiration (taking into account temperature, wind speed, vapor pressure, and cloud coverage). This provides a much-improved measure of extreme weather conditions, as evaporation and transpiration can consume a large fraction of rainfall. In our work, we define flood shocks as happening in areas with SPEI values above two standard deviations relative to the average computed for the 1981-2010 period.[13] Note that the January 2013 flood affected 69 percent of all locations in our sample, evenly balanced across treatment and control locations (balance test with a p-value of 67 percent).

2.4 Experimental validity: balance and survey attrition

We now turn to testing the quality of random assignment of locations and households to treatment status. We performed balance tests for a range of baseline variables. Appendix Table A1a shows balance in the characteristics of treatment and control locations. We note that 63 percent of the control locations have electricity supply, and that the quality of cell phone coverage is classified in the baseline survey of these locations as 4.7 in a 1-5 scale. They are located at an average of 62 minutes from a commercial bank. In terms of balance across treatment and control locations, we only find one difference between treatment and control that is statistically significant: electricity supply is more frequent in control locations.

Appendix Tables A1b-e examine demographic traits of the experimental subjects. We note that the average individual in the control group has 39 years of age, is female with a 63-percent probability, and has 5.5 years of education. Forty-six percent of control individuals selected farming as their main occupation. We also observe that 86 percent of the control sample owns a plot of land (*machamba*), and that 27 percent have a bank account. Ninety-nine percent of the respondents report using their cellphone every day or several times every week. We do not find differences between treated and control individuals across a range of variables related to basic demographics, occupation, religion/ethnicity, technology and finance, migration and remittances. We only observe minor differences in terms of property. Overall, the results of the balance checks show that our randomization procedure was effective in building comparable treatment and control groups.

We now turn to concerns related to attrition. Note that there is no attrition when considering outcomes measured through the administrative records on mobile money transactions as we have access to the

[13] Using the longer time spell 1961-2010 for which data are available does not change our results. The earlier years are however likely to be subject to more noise in measurement.

universe of transactions performed by individuals interviewed in our baseline survey regardless of treatment status.[14] Our concerns relate to potential differential attrition across survey rounds. We experienced an overall attrition rate of 30.7% in the first follow-up survey and 27.2% in the endline survey. Attrition is positively correlated with treatment status, but this is not statistically significant. Nevertheless, to alleviate any concerns, we check whether treatment is correlated with baseline survey household characteristics in the two follow-up surveys. The results of this analysis are presented in Appendix Tables A2. There were very few minor imbalances, marginally statistically significant. Overall, we do not find evidence in favor of differential attrition across the survey waves.

2.5 Adoption of mobile money

To measure usage of mobile money following its introduction in treatment locations, we employ administrative records including all mobile money transactions performed by all individuals in our sample in the three years between July 2012 and June 2015.

In the first year following the introduction of the mobile money service in rural areas, 77 percent of individuals in our sample performed at least one mobile money transaction. This percentage decreased to 53 and 54 percent, respectively, in each of the following two years. Overall, 87 percent of the sampled individuals performed mobile money transactions over the three years for which we have administrative records. The average number of transactions conducted per individual over the first year after the service was introduced was 7, but this decreased to an average of 3 in the subsequent two years. The average value of transactions per treated individual reached close to 1000 MZN (about 40 USD) in the three years after the introduction of mobile money.

Appendix Figures A3 break down mobile money usage per type of transaction performed in each quarter. The value of all transactions performed peaked in the first quarter of 2013, which includes the large floods that took place in most areas of Southern Mozambique. More than two-thirds of these transactions were transfers received by household and cash-outs. This is consistent with mobile money serving as a channel to send transfers in times of need.

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[14] Because households were reinterviewed twice over the course of the three years for which we have administrative mobile money data, we could keep track of individual transactions even if there were changes in individual cell phone numbers.

Note that there is only residual adoption of mobile money in the control locations – only between 0.5 and 1.2 percent of individuals in control locations conducted at least one transaction in each of the three years in our data. No mobile money agents opened for business in any of the control locations in this period.[15]

Overall, the analysis of the administrative transaction data indicates significant levels of usage of mobile money.

3. Empirical strategy

Since the mobile money intervention was randomized and we have pre-treatment measures for most outcomes, we employ an ANCOVA specification including baseline values of the dependent variable as a control variable to identify the Intent-To-Treat (ITT) effect of interest (β):[16]

$$Y_{hl,t} = \alpha + \beta T_l + \gamma Z_s + \theta Y_{hl,-t} + \varepsilon_{hl,t} \qquad (1)$$

In this equation, Y is an outcome of interest, h and l are the identifiers for household h and location l. Note that time is defined either for post-treatment periods (t) or for the baseline period ($-t$). T_l is a dummy variable taking value 1 for treatment locations since the intervention was randomized at the location (EA) level, and 0 otherwise; Z_s is the vector of randomization strata fixed effects, where each location was assigned to a strata s. Errors $\varepsilon_{hl,t}$ are clustered at the unit of randomization level (EA). Whenever baseline information is not available for our outcome of interest, we employ the same specification as above, but without baseline values of the outcome.

We also analyze a specification that interacts treatment with shock binary measures $X_{h|l}$ at the level of the household h or the location l, as follows:

$$Y_{hl,t} = \alpha + \beta T_l * X_{h|l} + \rho T_l + \mu X_{h|l} + \gamma Z_s + \theta Y_{hl,-t} + \varepsilon_{hl,t} \qquad (2)$$

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[15] Tables A3 of the Appendix show an analysis of treatment effects on whether the individuals in our sample used mobile money, on the number of transactions performed, and on the value of each of these transactions. Batista and Vicente (2020b) further describe mobile money usage patterns over time, as well as the characteristics of users.

[16] McKenzie (2012) underlines statistical power gains of using ANCOVA when a baseline is available, and autocorrelations are low.

For simplicity and transparency in the presentation of results we employ OLS in all regressions in this paper. To address the issue of multiple hypotheses testing, we compute p-values adjusted for family-wise error rate (FWER) using the step-down multiple testing procedure proposed by Romano and Wolf (2016). We report FWER-adjusted q-values that adjust for multiple hypothesis testing, based on 1000 simulations.

4. Empirical results

4.1 Migration

Introducing mobile money in rural areas increased both the incidence of migration and the number of migrants in rural households.[17] Table 1 displays our estimation results. We find that the probability of a treated household having a migrant increased by 11.9pp relative to the control group in the first year after mobile money became available, as shown in column (1), Panel A. This increase went up to 14.5pp in the second year as displayed in column (2). The number of migrants in a treated household also increased relative to control households, by about 0.19 in both time periods (columns 3 and 4).

To understand whether this increased migration was prompted by negative shocks, we examine the interaction between the mobile money treatment and negative shocks affecting the households in our sample. More specifically, we examine the interaction with the incidence of the large flood in 2013 and with household shocks (namely deaths, serious health problems or job losses in the family) as reported in the 2014 survey. The increase in migration among treated households in the first year after treatment is indeed concentrated in the regions affected by the flood that took place six months after the introduction of mobile money. In these regions, the probability of household migration went up by 16.9pp and the number of migrants in the household increased by 0.26, while there was no significant increase in migration in treated areas unaffected by floods, as shown in columns (1) and (3), Panel B. While effects on those hit by shocks remained high over time, the probability of having a migrant in the household increased by 7pp relative to the control among treated households who were not affected by negative household shocks in the second year after treatment.

[17] Migrants are defined as household members (household head, spouse, and their children) who have lived away from the household location for at least three months.

These effects show complementarity between the availability of mobile money and the incidence of negative shocks as determinants of household migration. This is consistent with a theoretical explanation we propose in the Appendix, based on an adaptation of the model originally proposed by Munshi and Rosenzweig (2016). In this framework, in the absence of a transfer technology like mobile money, rural household members can insure locally against idiosyncratic risks, but this insurance is more difficult to guarantee if household members migrate - because of the transaction costs associated with long-distance transfers. This is precisely the context of our rural sample at the time of the baseline survey, before mobile money was made available. In this setting, migration decisions depended on the tradeoff between losing insurance provided by household members when migrating and accruing income gains when there are migrants in the family. When mobile money becomes available, there is a substantial decrease in the transaction costs associated with migrant remittances. The possibility of safe, low-cost, and instant transfers when a household is hit by negative shocks provides insurance possibilities that can more than offset the loss in local insurance caused by migration. Migration should therefore increase when households are provided with mobile money, particularly in face of negative shocks, which is what we observe in the data.

We checked for the robustness of our findings using an alternative definition of migrant that includes all remitters in addition to the core household members as in our benchmark specification. These alternative estimates are presented in Appendix Table A4. As could be expected, treatment effects on migration are larger when adopting this broader definition. Interestingly, the migration impact of mobile money decreases over time when this definition of migrants. These results are consistent with the aggregate flood shocks prompting the financial support of extended household members who were already migrants outside the treated rural villages in the first year after the introduction of mobile money. This financial support decreased one year after in the absence of major aggregate shocks, but migration flows of core household members kept increasing throughout.

4.2 Migrant transfers

Both the probability of rural households receiving migrant transfers and the value of these transfers increased significantly after mobile money became available. One year after, a household was 32.5pp more likely to receive remittances, and the value of these remittances was 303.9% higher than those received by the control group, as shown in Table 2, Panel A. Two years after, the probability of receiving remittances

also increased significantly, but only by 14.2pp relative to the control. Similarly, the value of remittances was 133.4% higher.[18]

The fact that remittances increased the most in the first year after mobile money was introduced can be explained by the large floods that took place at the time. Panel B of Table 2 shows that the initial increase in remittances was indeed concentrated among treated households affected by floods. For those households, the probability of receiving remittances increased by 44.9pp relative to the control, which contrasts with an increase by only 6pp (marginally significant) for treated households not affected by the floods. In the same way, households in flooded treated areas saw an increase in the value of remittances received by 422.5% compared to the control, whereas the estimated increase for those not affected by floods was not statistically significant. Two years after mobile money became available, we can observe an increase in migrant remittances received by treated households who were negatively hit by idiosyncratic shocks, which are easier to insure locally. As could be expected given the idiosyncratic nature of these shocks, total remittances received by shock-hit treated households increased but by a lower magnitude: the probability of receiving remittances increased by 21.9pp and the value increased by 228.1% relative to the control. This is again evidence of a substantial role of remittances in supporting shock-hit households. One interesting result in the longer horizon provided by the second period is the significant increase in remittances received by treated households not affected by shocks, consistently with the build-up in migration.

Total remittances can be decomposed into cash and in-kind remittances, where the former can be further broken down into regular and occasional remittances. Appendix Table A6 displays the treatment effects on these components of total remittances, as well as on transfers received via mobile money. We find that cash remittances, in particular occasional transfers (likely to be sent in response to emergency requests), were the strongest driver of the increase in total remittances after mobile money was made available. Regular cash remittances also increased substantially in treated areas, although by smaller magnitudes, increasing over time following the build-up in migration. There were no clear effects on in-kind remittances.[19]

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[18] Differently from the impact on remittances received, saving behavior of households was not substantially affected by mobile money availability. As displayed in Appendix Table A5, there was a small (not always significant) increase in the probability and value of household savings relative to control.

[19] When examining the heterogeneity of treatment effects relative to the incidence of negative shocks (Panel B of Table A6), we reinforce our previous findings that occasional cash remittances sent to households affected by negative shocks drove most of the increase in total remittances received, particularly in face of the 2013 aggregate shocks.

The treatment effects on mobile money transfers received by households in our sample display a pattern like that of total remittances, in terms of probability and value, for both years available (Panel A of Table A6). In terms of heterogeneous treatment effects relative to the incidence of negative shocks, we find that mobile transfers received by treated households increased substantially in presence of negative shocks, with point estimates higher for aggregate than for idiosyncratic shocks.

4.3 Geographical occupational change

The population in our rural sample is predominantly dedicated to subsistence agriculture in small farms. Since the introduction of mobile money facilitated out-migration from these areas, it could either happen that agricultural activity subsided because it was a less attractive option than activities in the migration destination areas, or that remittances sent by migrants contributed to additional investment in in agriculture.

The results in Table 3 lend support to the first hypothesis. Agricultural activity, measured as the percentage of households actively farming their own agricultural plots, decreased by 3.9pp and 4.4pp, respectively in the first and second years after the introduction of mobile money. When we look at an index of agricultural investment for those who are actively farming their land, which includes the use of improved seeds, inorganic fertilizer, pesticides, paid labor and extension advice, we find evidence of a negative impact of mobile money for households still farming: this index fell 2.4pp one year after mobile money was introduced, and 6.5pp two years after.[20] There is no evidence that the treatment effects interact significantly with the aggregate or the idiosyncratic negative shocks affecting households over the period of our analysis.

Overall, our results on increased migration together with these findings on decreased agricultural activity and investment were both strengthened in the second year after mobile money was introduced. This evidence supports the possibility that the absence of core household members to farm the household's land led to less agriculture activity and less investment in complementary agricultural inputs. We can then argue that introducing mobile money produced a specific form of geographical occupational change: a shift from subsistence agricultural activities in rural areas to preferred, presumably more productive, occupations performed by migrants outside of the rural areas of origin.[21]

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[20] Appendix Table A7 shows the treatment effects on the different components of the investment index: these are relatively homogeneous across components.
[21] Appendix Table A8 shows no statistically significant treatment effects on overall business activity.

4.4 Welfare, expenditure, and vulnerability

An important question is whether the availability of mobile money improved the welfare of rural households. To assess this question, we examine the impact of the introduction of mobile money on subjective well-being, household expenditures, and an index of vulnerability of the households in our sample.

There is a clear positive impact of the treatment on all these variables. As shown in Panel A of Table 4, subjective well-being increased by 8.5% of the subjective welfare scale relative to the control group in the first year after mobile money was introduced, and by 5.4% in the second year. Household expenditure followed the same pattern, increasing by 35.2% and 24.3% in the first and second years. An index of non-vulnerability, averaging the degree of access to food, water, medicines, and school supplies, improved by 6.1% and 7.3% of the corresponding subjective scale in the referred years. Table A9 in the Appendix shows that mobile money was particularly effective reducing instances of hunger, although the other considered components of the non-vulnerability index were positively impacted as well. Access to medicines and school supplies were very positively impacted in the second year after mobile money was introduced.

Looking at the interaction between treatment effects and negative shocks in Panel B of Table 4, we find that the positive treatment effect on household expenditure was concentrated in households hit by shocks, particularly those affected by the 2013 floods, whose expenditure increased by 47.7% relative to the control. A similar pattern emerged in the same year for subjective wellbeing although with marginal statistical significance. In the second year after mobile money became available, the expenditure of households hit by negative household shocks increased by 43% relative to the control, whereas the expenditure of households not affected by shocks was marginally statistically significantly increased.

To understand the overall increased expenditure for those treated and hit by shocks, note that negative shocks imply extra expenditure (construction materials in the case of a flood, medicines when there is a health problem, etc.) that may require cutting other expenditures, like food. As displayed in Appendix Table A9, both aggregate and idiosyncratic shocks have a significant negative impact on increasing the frequency of episodes of hunger suffered by control households. The availability of mobile money improves their food security for those hit by negative shocks.

5. Concluding remarks

This paper reports on a field experiment measuring the impact of the introduction of mobile money for the first time in rural areas of Mozambique. The availability of these services implies a substantial reduction in the transaction costs of remittances. Our results show that mobile money changed important behaviors of rural households, who became more likely to send out-migrants and to receive remittances, particularly when suffering negative aggregate and idiosyncratic shocks. We argue that these movements are the product of improved risk-sharing through mobile money.

We also show impacts on occupational change out of subsistence agriculture, and welfare improvements in rural areas. The potential long-run effects of accessing simple remittance technologies on occupations are of primary importance. The effects we document for rural households in the two years after the introduction of mobile money on decreased agricultural activity and investment, driven by the absence of core household members to farm the household plot, place mobile money as a likely driver of urbanization and structural change. The effects on decreased vulnerability, are suggestive of lasting impacts on welfare in rural areas. These are central leads in the direction of identifying mobile money as a solid source of economic development. Future research should measure the general equilibrium and structural change effects accruing from the introduction of mobile money over time.

Our findings are likely to be informative in the context of poor countries with substantial fractions of the population still engaged in subsistence agriculture, where mobile money is not yet available – a common context beyond Sub-Saharan Africa. While mobile money adoption has been increasing significantly in recent years, 73% of the adult population in low-income countries did not have a mobile money account in 2021 and almost one third reports this is because no agents exist at a reasonable distance (Demirgüç-Kunt et al., 2022). The expansion of mobile money services should be a priority for policy in these countries.

References

Aggarwal, Shilpa, Valentina Brailovskaya, and Jonathan Robinson. 2020. *Cashing In (and Out): Experimental Evidence on the Effects of Mobile Money in Malawi.* American Economic Association, Papers and Proceedings, 110: 599-604.

Aker, Jenny, Rachid Boumnijel, Amanda McClelland, and Niall Tierney (2016). *Payment Mechanisms and Anti-Poverty Programs: Evidence from a Mobile Money Cash Transfer Experiment in Niger*, Economic Development and Cultural Change, 65(1): 1–37.

Bastian, Gautam, Iacopo Bianchi, Markus Goldstein, and Joao Montalvao (2018). *Improving Access to Savings through Mobile Money, with and without Business Training: Experimental Evidence from Tanzania*, World Bank, mimeograph.

Batista, Catia, and Pedro C. Vicente (2020a). *Improving Access to Savings through Mobile Money: Experimental Evidence from African Smallholder Farmers,* World Development, 129, 104905.

Batista, Catia, and Pedro C. Vicente (2020b). *Adopting Mobile Money: Evidence from an Experiment in Rural Africa*, American Economic Association, Papers and Proceedings, 594–598.

Batista, Catia, Aitor Lacuesta, and Pedro C. Vicente (2012). *Testing the 'Brain Gain' Hypothesis: Micro Evidence from Cape Verde*, Journal of Development Economics, 97(1): 32-45.

Batista, Catia, Tara McIndoe, and Pedro C. Vicente (2017). *Return Migration, Self-selection, and Entrepreneurship*, Oxford Bulletin of Economics and Statistics, 79(5): 797-821.

Batista, Catia, Sandra Sequeira, and Pedro C. Vicente (2022). *Closing the Gender Profit Gap*, Nova SBE and LSE, mimeograph.

Blumenstock, Joshua, Michael Callen, and Tarek Ghani (2018). *Why Do Defaults Affect Behavior? Experimental Evidence from Afghanistan*, American Economic Review, 108(10): 2868–2901.

Blumenstock, Joshua, Nathan Eagle, and Marcel Fafchamps (2016). *Airtime Transfers and Mobile Communications: Evidence in the Aftermath of Natural Disasters*, Journal of Development Economics, 120: 157–181.

Breza, Emily, Martin Kanz, and Leora Klapper (2020). *Learning to Navigate a New Financial Technology: Evidence from Payroll Accounts*, NBER working paper 28249.

Demirgüç-Kunt, Asli, Leora Klapper, Dorothe Singer, and Saniya Ansar (2022). Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. Washington, DC: World Bank.

De Mel, Suresh, Craig McIntosh, Ketki Sheth, and Christopher Woodruff (2020). *Can Mobile-Linked Bank Accounts Bolster Savings? Evidence from a Randomized Controlled Trial in Sri Lanka.* Review of Economics and Statistics, forthcoming.

Jack, William, and James Habyarimana (2018). *High Hopes: Experimental Evidence on Saving and the Transition to High School in Kenya*, Georgetown University, mimeograph.

Jack, William, and Tavneet Suri (2011). *Mobile Money: The Economics of M-PESA*, NBER Working Paper No. 16721.

Jack, William, and Tavneet Suri (2014). *Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution*, American Economic Review, 104(1): 183-223.

Lee, Jean, Jonathan Morduch, Saravana Ravindran, Abu Shonchoy, and Hassan Zaman (2020). *Poverty and Migration in the Digital Age: Experimental Evidence on Mobile Banking in Bangladesh*, American Economic Journal: Applied Economics, forthcoming.

Mbiti, Isaac, and David N. Weil (2013). *The Home Economics of E-Money: Velocity, Cash Management, and Discount Rates of M-Pesa Users*, American Economic Review, Papers and Proceedings, 103(3): 369-74.

McKenzie, David (2012). *Beyond Baseline and Follow-up: The Case for more T in Experiments*, Journal of Development Economics, 99(2): 210-221.

Munshi, Kaivan, and Mark Rosenzweig (2016). *Networks and Misallocation: Insurance, Migration, and the Rural-Urban Wage Gap*, American Economic Review, 106(1): 46-98.

Riley, Emma (2018). *Mobile Money and Risk Sharing against Village Shocks*, Journal of Development Economics, 135: 43-58.

Romano, Joseph P. and Michael Wolf (2016). *Efficient Computation of Adjusted P-values for Resampling-based Stepdown Multiple Testing*, Statistics & Probability Letters, 113: 38–40.

Suri, Tavneet, and William Jack (2016). *The Long Run Poverty and Gender Impacts of Mobile Money*, Science, 354(6317): 1288-1292.

Vicente-Serrano, Sergio M., Santiago Beguería, Juan I. López-Moreno (2010). *A Multiscalar Drought Index Sensitive to Global Warming: The Standardized Precipitation Evapotranspiration Index*. Journal of Climate, 23: 1696–1718.

Yang, Dean (2008). *International Migration, Remittances, and Household Investment: Evidence from Philippine Migrants' Exchange Rate Shocks*, Economic Journal, 118: 591-630.

Yang, Dean (2011). *Migrant Remittances*, Journal of Economic Perspectives, 25(3): 1-24.

Yang, Dean, and HwaJung Choi (2007). *Are Remittances Insurance? Evidence from Rainfall Shocks in the Philippines*, World Bank Economic Review, 21(2): 219–48.

Table 1: Household migration. Migrants include only household head, spouse(s) and their children.

Panel A: Average Effects

Dependent variable		Probability of Having Migrant		Number of Migrants	
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
Treatment	Coefficient	0.119***	0.145***	0.194***	0.188***
	Standard error	(0.021)	(0.019)	(0.033)	(0.038)
	Q-value	[0.001]	[0.001]	[0.001]	[0.003]
Mean dep. variable (control group)		0.168	0.368	0.223	0.602
R-squared adjusted		0.062	0.107	0.064	0.119
Number of observations		1,261	1,323	1,261	1,323

Panel B: Effects Interacted with Shocks

Dependent variable		Probability of Having Migrant		Number of Migrants	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
β1: Treatment * Negative shock	Coefficient	0.169***	0.182***	0.262***	0.390***
	Standard error	(0.048)	(0.052)	(0.066)	(0.110)
	Q-value	[0.023]	[0.003]	[0.018]	[0.003]
β2: Treatment	Coefficient	0.004	0.070***	0.016	0.029
	Standard error	(0.032)	(0.026)	(0.039)	(0.058)
	Q-value	[0.940]	[0.056]	[0.860]	[0.697]
β3: Negative shock	Coefficient	-0.025	0.001	-0.024	-0.011
	Standard error	(0.039)	(0.030)	(0.064)	(0.062)
	Q-value	[0.789]	[0.977]	[0.797]	[0.977]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.000	0.000	0.000	0.000
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.000	0.000	0.000	0.000
Mean dep. variable (control group)		0.168	0.370	0.223	0.605
R-squared adjusted		0.068	0.119	0.071	0.130
Number of observations		1,261	1,319	1,261	1,319

Notes: All specifications estimated using OLS. All regressions include as control the value of the dependent variable at baseline and strata fixed effects. The Village Flood Shock is defined as a binary variable taking value 1 if the SPEI rainfall measure in the EA in the 2012-2013 season was above two standard deviations relative to the 1981-2010 average. The Household Shock is defined as a binary variable taking value 1 if there was a death in the family, significant health problems in the household, or job losses in the household in 2013-2014. The number of observations is lower in the regressions where there is an interaction with Household Shock because these shocks were not reported by all households. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2: Total remittances received by household

Panel A: Average Effects

Dependent variable		Binary		Value	
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
Treatment	Coefficient	0.325***	0.142***	3.039***	1.334***
	Standard error	(0.027)	(0.021)	0.243	0.190
	Q-value	[0.001]	[0.001]	[0.001]	[0.001]
Mean dep. variable (control group)		0.208	0.484	1.692	4.173
R-squared adjusted		0.188	0.108	0.195	0.120
Number of observations		1,261	1,323	1,261	1,323

Panel B: Effects Interacted with Shocks

Dependent variable		Binary		Value	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
β1: Treatment * Negative shock	Coefficient	0.388***	0.127**	3.728***	1.590***
	Standard error	(0.044)	(0.056)	(0.406)	(0.516)
	Q-value	[0.001]	[0.047]	[0.001]	[0.017]
β2: Treatment	Coefficient	0.061*	0.091***	0.498	0.691**
	Standard error	(0.033)	(0.030)	(0.306)	(0.288)
	Q-value	[0.270]	[0.019]	[0.306]	[0.060]
β3: Negative shock	Coefficient	-0.052	0.048	-0.409	0.201
	Standard error	(0.051)	(0.039)	(0.425)	(0.335)
	Q-value	[0.553]	[0.311]	[0.553]	[0.596]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.000	0.000	0.000	0.000
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.000	0.000	0.000	0.000
Mean dep. variable (control group)		0.208	0.486	1.692	4.184
R-squared adjusted		0.218	0.119	0.231	0.133
Number of observations		1,261	1,319	1,261	1,319

Note: All specifications estimated using OLS. All regressions include as control the value of the dependent variable at baseline and strata fixed effects. The binary dependent variable takes value 1 when remittances are received by the household. The value of remittances is obtained using the inverse hyperbolic sine transformation. The Village Flood Shock is defined as a binary variable taking value 1 if the SPEI rainfall measure in the EA in the 2012-2013 season was above two standard deviations relative to the 1981-2010 average. The Household Shock is defined as a binary variable taking value 1 if there was a death in the family, significant health problems in the household, or job losses in the household in 2013-2014. The number of observations is lower in the regressions where there is an interaction with Household Shock because these shocks were not reported by all households. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3: Agricultural activity and investment

Panel A: Average Effects

Dependent variable		**Active farm**		**Index of agricultural investment**	
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
Treatment	**Coefficient**	-0.039***	-0.044***	-0.024**	-0.065***
	Standard error	(0.011)	(0.015)	(0.011)	(0.014)
	Q-value	[0.018]	[0.043]	[0.104]	[0.005]
Mean dep. variable (control)		0.048	0.036	0.068	0.150
R-squared adjusted		0.945	0.933	0.163	0.190
Number of observations		1,017	1,109	812	872

Panel B: Effects Interacted with Shocks

Dependent variable		**Active farm**		**Index of agricultural investment**	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
β1: Treatment * Negative shock	**Coefficient**	-0.003	-0.061	-0.040	0.008
	Standard error	(0.026)	(0.039)	(0.026)	(0.031)
	Q-value	[0.925]	[0.206]	[0.489]	[0.779]
β2: Treatment	**Coefficient**	-0.035*	-0.021	0.004	-0.067***
	Standard error	(0.020)	(0.023)	(0.016)	(0.021)
	Q-value	[0.469]	[0.473]	[0.873]	[0.022]
β3: Negative shock	**Coefficient**	-0.048*	0.052**	0.011	0.029
	Standard error	(0.025)	(0.023)	(0.019)	(0.021)
	Q-value	[0.382]	[0.057]	[0.682]	[0.180]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.005	0.002	0.028	0.005
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.001	0.269	0.136	0.169
Mean dep. variable (control group)		0.048	0.040	0.067	0.153
R-squared adjusted		0.945	0.935	0.163	0.190
Number of observations		1,017	1,108	812	872

Note: All specifications estimated using OLS. All regressions include as control the value of the dependent variable at baseline and strata fixed effects. The dependent variable active farm takes value 1 when the respondent reports having an active farm in the previous 12 months. This question is only asked to households reporting owning a farm. The index of agricultural investment is the arithmetic average of binary variables indicating use of improved seeds, fertilizer, pesticides, hired workers, and extension advice in the previous 12 months. This question is only asked to households reporting having an active farm in the previous 12 months. The Village Flood Shock is defined as a binary variable taking value 1 if the SPEI rainfall measure in the EA in the 2012-2013 season was above two standard deviations relative to the 1981-2010 average. The Household Shock is defined as a binary variable taking value 1 if there was a death in the family, significant health problems in the household, or job losses in the household in 2013-2014. The number of observations is lower in the regressions where there is an interaction with Household Shock because these shocks were not reported by all households. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Well-being, expenditure, and vulnerability

Panel A: Average Effects

Dependent variable		Subjective Well-being		Total Expenditure		Non-Vulnerability Index	
Year		2013	2014	2013	2014	2013	2014
		(1)	(2)	(3)	(4)	(5)	(6)
Treatment	Coefficient	0.276***	0.181***	0.352***	0.243***	0.152***	0.175***
	Standard error	(0.056)	(0.052)	(0.045)	(0.038)	(0.032)	(0.034)
	Q-value	[0.002]	[0.004]	[0.001]	[0.001]	[0.003]	[0.004]
Mean dep. variable (control group)		3.245	3.381	8.490	8.272	2.480	2.405
R-squared adjusted		0.011	0.036	0.146	0.133	0.045	0.080
Number of observations		1,229	1,285	1,075	1,247	1,046	1,075

Panel B: Effects Interacted with Shocks

Dependent variable		Subjective Well-being		Total Expenditure		Non-Vulnerability Index	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014	2013	2014
		(1)	(2)	(3)	(4)	(5)	(6)
β1: Treatment * Negative shock	Coefficient	0.262*	0.128	0.407***	0.320***	0.022	0.201**
	Standard error	(0.143)	(0.155)	(0.107)	(0.100)	(0.070)	(0.080)
	Q-value	[0.385]	[0.393]	[0.055]	[0.008]	[0.816]	[0.040]
β2: Treatment	Coefficient	0.112	0.124	0.070	0.110*	0.139***	0.088*
	Standard error	(0.113)	(0.076)	(0.084)	(0.058)	(0.048)	(0.050)
	Q-value	[0.501]	[0.237]	[0.829]	[0.343]	[0.212]	[0.237]
β3: Negative shock	Coefficient	-0.316***	-0.187	-0.088	-0.088	-0.054	-0.241***
	Standard error	(0.116)	(0.118)	(0.092)	(0.062)	(0.075)	(0.069)
	Q-value	[0.208]	[0.145]	[0.560]	[0.723]	[0.626]	[0.005]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.000	0.028	0.000	0.000	0.001	0.000
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.585	0.572	0.000	0.000	0.127	0.423
Mean dep. variable (control group)		3.245	3.384	8.490	8.274	2.480	2.407
R-squared adjusted		0.012	0.038	0.154	0.138	0.043	0.094
Number of observations		1,229	1,284	1,075	1,246	1,046	1,074

Note: All specifications estimated using OLS. All regressions include as control the value of the dependent variable at baseline and strata fixed effects. The subjective well-being dependent variable is categorical, ranging between 1-5. The total expenditure dependent variable is measured as log household expenditure per capita. The non-vulnerability index is the arithmetic average of four indices of access to food, clean water, medicines and school supplies, ranging between 0-3. The components of the non-vulnerability index are categorical variables ranging between 0-3, where 0 denotes having suffered more than 5 episodes of no access over the year prior to the survey and 3 denotes never having suffered lack of access in the year prior to the survey. The Village Flood Shock is defined as a binary variable taking value 1 if the SPEI rainfall measure in the EA in the 2012-2013 season was above two standard deviations relative to the 1981-2010 average. The Household Shock is defined as a binary variable taking value 1 if there was a death in the family, significant health problems in the household, or job losses in the household in 2013-2014. The number of observations is lower in the regressions where there is an interaction with Household Shock because these shocks were not reported by all households. Other variations in the number of observations across variables in the same year are due to differential response rates to the different questions. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

ONLINE APPENDIX TO

IS MOBILE MONEY CHANGING RURAL AFRICA? EVIDENCE FROM A FIELD EXPERIMENT

Migration and mobile money: a theoretical framework

In this section, we provide a simple theoretical framework predicting migration as a result of introducing mobile money. For this purpose, we use a modified version of the model proposed by Munshi and Rosenzweig (2016). In our framework, rural household members can perfectly insure against idiosyncratic risks (such as getting ill) within their household, but this full insurance is lost if household members migrate because of the transaction costs associated with long-distance transfers – including time delays, transfer unreliability, and high transfer fees (as found in our baseline survey). In this setting, migration decisions are made as a result of the tradeoff between losing the insurance provided by household members when they migrate and accruing income gains when there are migrants in the family.

When mobile money is made available, there is a substantial decrease in the transaction costs of time-sensitive remittances – which can be sent safely, cheaply, and instantaneously when shocks occur. This possibility of low-cost instant transfers provides additional insurance possibilities that can offset the insurance loss taking place when a rural household member migrates. Ceteris paribus, migration should therefore increase when households concerned with consumption-smoothing are faced with this improved technology for short-run transfers.

In our model, we assume a household is composed of several income earning members, which can migrate to higher earning occupations in urban areas.[1] Migration decisions are made at the household level. The household has logarithmic preferences, which allow expressing the expected utility function from consumption as an additively separable function of mean consumption M and normalized risk $R \equiv \frac{V}{M^2}$, where V is the variance of consumption:[2]

$$EU = \log(M) - \frac{1}{2}\frac{V}{M^2}$$

We assume that the income of individual household members varies over time and so risk-averse individuals benefit from insurance between household members to smooth consumption. We also postulate that household members can completely risk share ex-post in case they live together. If they do not live together, i.e., there are household members who migrate, we hypothesize that full risk sharing is not possible anymore. This is due to the distance separating household members and to the limitations of the transfer technology between household members.

For simplicity, we make two important assumptions. First, we assume storage and savings are not possible, so that total income of the household is equal to total consumption at any point in time. In addition to being standard in similar models of mutual insurance, this assumption does not seem overly restrictive in our context where savings and investment are very low. Second, we rule out information asymmetries between household members. This is a potentially restrictive assumption given that international migrant remittances have been shown to strongly respond to improved information flows within the household (Ashraf et al., 2015; Batista et

[1] These assumptions closely match the reality in the rural areas where our project was conducted, from where there are strong migration corridors to the capital city of Maputo.

[2] This expression is obtained by evaluating log consumption at mean consumption M and ignoring higher-order terms. For the Taylor expansion to be valid with CRRA preferences, consumption must be in the interval $[0,2M]$.

al., 2015; Batista and Narciso, 2018). However, in our context, there is widespread internal migration to Maputo (about one third of households in our baseline sample had at least one migrant), which facilitates information flows within households.

Migration decisions made by the household trade-off a household income gain generated by migration with the limitations on risk sharing imposed by long-distance migration. To formalize this decision, suppose first that there is no migration in the household. In this case, there is complete risk sharing within the household and household members have the same expected income - which equals consumption given the assumption that there is no available savings or storage technology. Let M_H, V_H denote the mean and variance of a household's income when there is no migration in the household.

If there is migration, we assume the household's mean income increases to $M_H(1+\tilde{G})$ where $\tilde{G}$ is a random variable representing the gain in income from migration (net of any loss in income due to migration costs). The distribution of $\tilde{G}$ is a continuous and differentiable function over its non-negative support. This gain from migration must be compared to the increased risk that the household faces since it cannot fully insure due to the transaction costs associated with sending long-distance transfers between household members. We assume that in this case the normalized consumption risk becomes $\beta\frac{V_H}{M_H^2}$, where $\beta > 1$ represents the transaction costs of sending long-distance remittances.

In this setting, the household will choose migration if the expected utility from migration is above the expected utility from staying home, i.e., if the expected gain from migration is above the added consumption risk of imperfect risk-sharing due to transaction costs of remittances. This can be described as:

$$\log(M_H) - \frac{1}{2}\beta\frac{V_H}{M_H^2} + G > \log(M_H) - \frac{1}{2}\frac{V_H}{M_H^2} \Leftrightarrow G > \frac{1}{2}\frac{V_H}{M_H^2}(\beta - 1),$$

where $G \equiv \log(1+\tilde{G})$. Denoting the probability distribution of G as $F(.)$, we derive that the probability of migration is given by:

$$Prob(Migration) = 1 - F\left[\frac{1}{2}\frac{V_H}{M_H^2}(\beta - 1)\right].$$

In this setting, the introduction of mobile money will decrease parameter β, since it generates a clear reduction in the transaction costs of long-distance remittances between household members, i.e., migrants and household members who stayed home. This implies that the probability of migration increases when β decreases, i.e.,

$$\frac{\partial Prob(Migration)}{\partial \beta} < 0.$$

This is the main prediction that we take to the data. By decreasing remittance transaction costs, mobile money may have facilitated migration of active household members who saw increasingly attractive opportunities to migrate and share risk with their home households. These migrants may have changed their occupation from agriculture at home (in the rural setting) to more productive activities in urban areas, which is consistent with our observed empirical response – a pattern of geographical occupational change.

Additional references

Ashraf, Nava, Diego Aycinena, Claudia Martinez, and Dean Yang (2015). *Savings in Transnational Households: A Field Experiment Among Migrants from El Salvador*, Review of Economics and Statistics, 97(2): 332-351.

Batista, Catia, and Gaia Narciso (2018). *Migrant Remittances and Information Flows: Evidence from a Field Experiment,* World Bank Economic Review, 32 (1):. 203–219.

Figures

Figure A1: mKesh leaflet and menus

Self-registration.

Cash-in.

Cash-out.

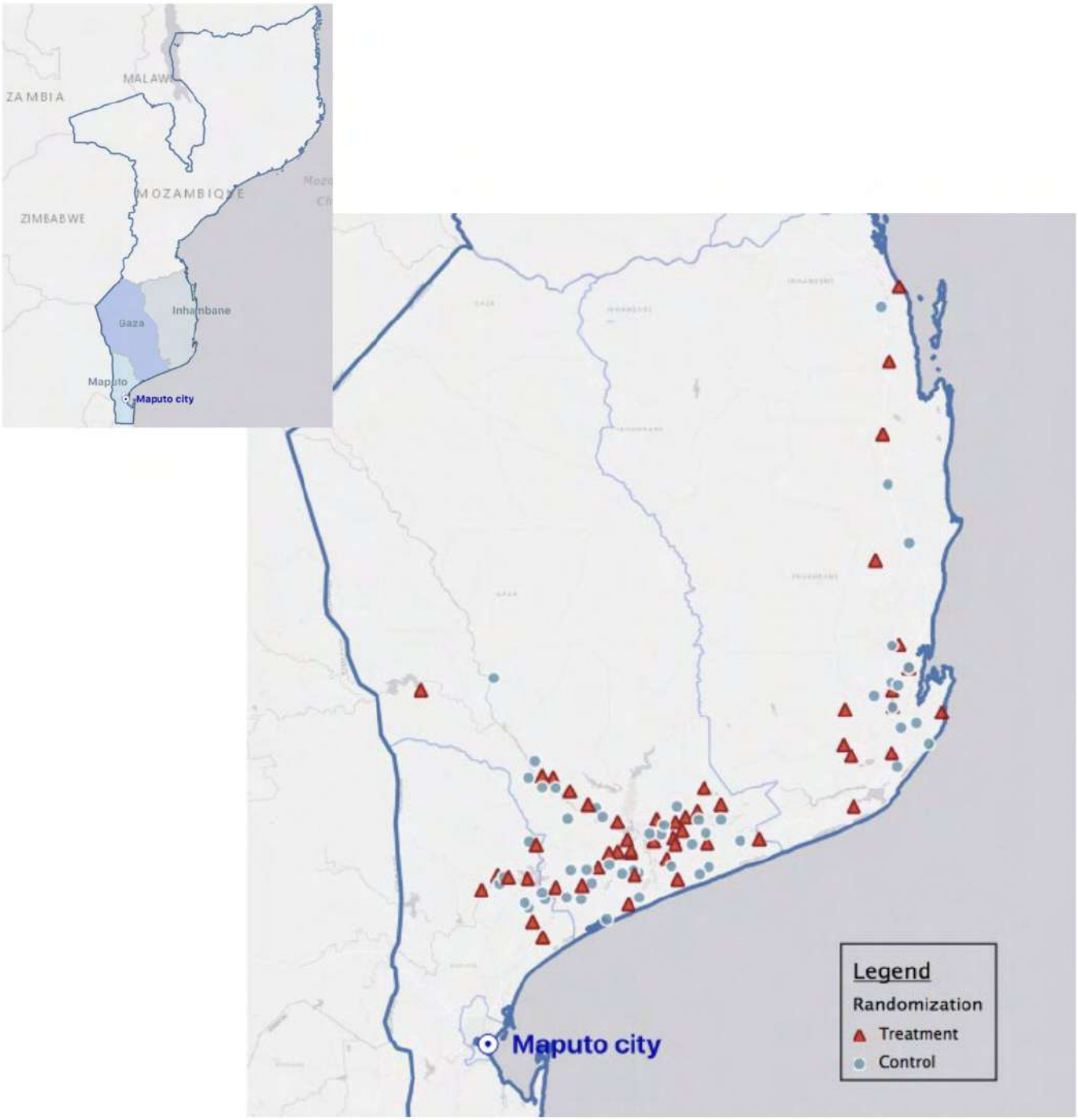
Checking balance.

Paying for expenses at the mKesh shop.

Transfer.

Pricing.

Figure A2: Map of experimental locations



Source: Basemaps created using ArcGIS software by Esri. Basemaps are used in line with the Esri Master License Agreement, specifically for the inclusion of screen captures in academic publications. We make use of the World Light Gray Base. (Sources: Esri, HERE, Garmin, ® OpenStreetMap contributors, and the GIS User Community).

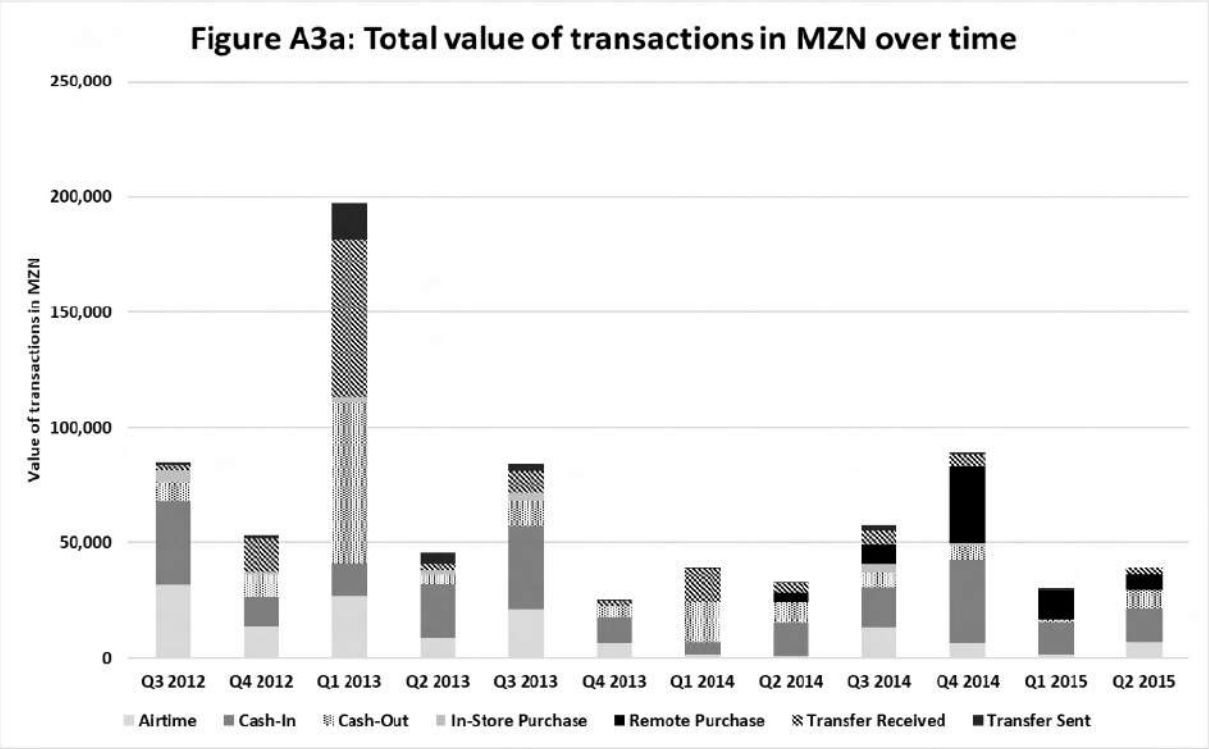


Figure A3a: Total value of transactions in MZN over time
250,000
200,000
150,000
100,000
50,000
0
Value of transactions in MZN
Q3 2012
Q4 2012
Q1 2013
Q2 2013
Q3 2013
Q4 2013
Q1 2014
Q2 2014
Q3 2014
Q4 2014
Q1 2015
Q2 2015
Airtime
Cash-In
Cash-Out
In-Store Purchase
Remote Purchase
Transfer Received
Transfer Sent

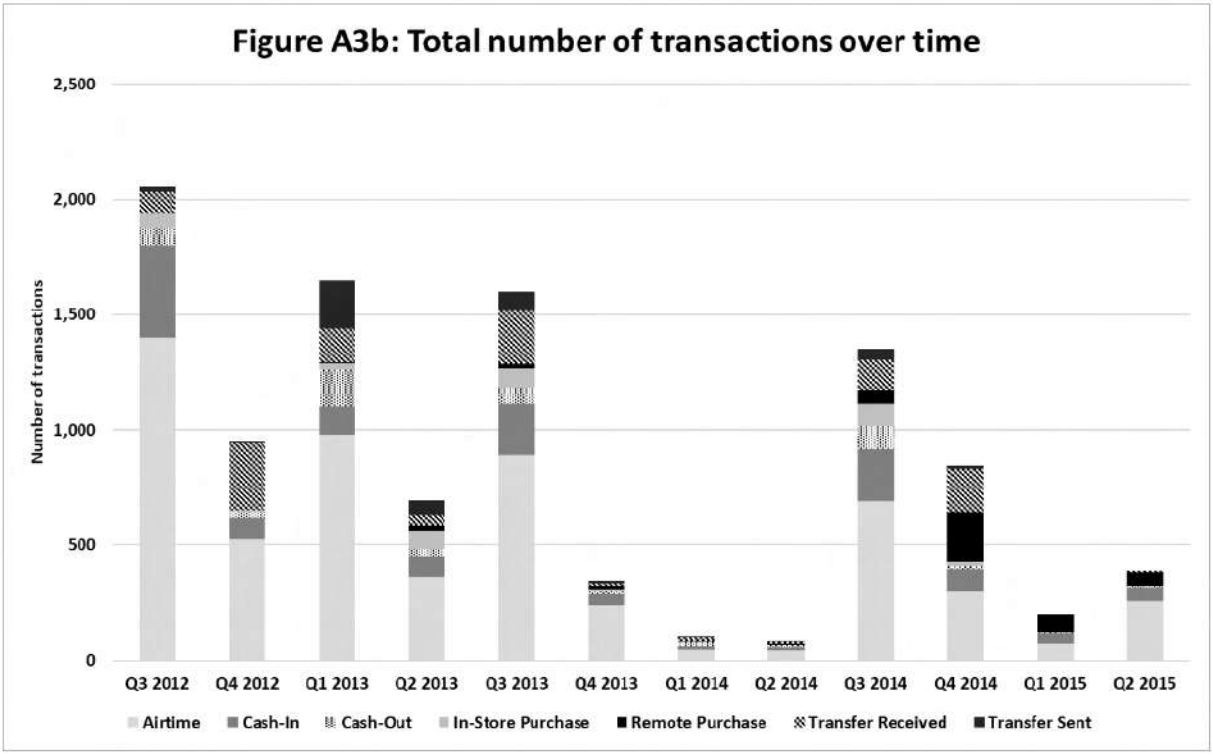


Figure A3b: Total number of transactions over time
2,500
2,000
1,500
1,000
500
0
Number of transactions
Q3 2012
Q4 2012
Q1 2013
Q2 2013
Q3 2013
Q4 2013
Q1 2014
Q2 2014
Q3 2014
Q4 2014
Q1 2015
Q2 2015
Airtime
Cash-In
Cash-Out
In-Store Purchase
Remote Purchase
Transfer Received
Transfer Sent

Table A1a: Differences between locations in treatment and control groups at baseline

	Control Mean	Difference in Means between Treatment and Control
	(1)	(2)
Has primary school	0.941	0.039
	(0.238)	(0.039)
Has secondary school	0.392	-0.137
	(0.493)	(0.093)
Has health center	0.647	0.078
	(0.483)	(0.092)
Has market vendors	0.608	-0.039
	(0.493)	(0.098)
Has police	0.510	0.000
	(0.505)	(0.100)
Has church	0.980	0.000
	(0.140)	(0.028)
Has meeting point	0.471	-0.078
	(0.504)	(0.099)
Has electricity supply	0.627	-0.196**
	(0.488)	(0.098)
Has sewage removal	0.137	-0.039
	(0.348)	(0.064)
Quality of mcel coverage (scale 1-5)	4.725	-2.392
	(13.537)	(1.906)
Has paved road access	0.255	-0.039
	(0.440)	(0.085)
Has land road access	0.706	0.020
	(0.460)	(0.090)
Price of transportation to the nearest bank (MZN)	31.508	-3.397
	(17.946)	(3.156)
Time distance to nearest bank (in minutes)	61.801	43.915
	(47.920)	(39.331)
Number of observations	51	102

Note: Standard deviations in parentheses in column (1). Standard errors reported in parentheses, clustered at the EA level, in column (2). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A1b: Differences between individuals in treatment and control groups at baseline

		Control Mean	Difference in Means between Treatment and Control
		(1)	(2)
Basic demographics	Age	38.543	-1.636
		(14.391)	(1.056)
	Gender (female)	0.627	-0.032
		(0.484)	(0.032)
	Years of education	5.547	0.178
		(3.582)	(0.315)
	Single	0.176	0.025
		(0.381)	(0.023)
	Married	0.665	-0.020
		(0.472)	(0.029)
	Separated	0.052	0.003
		(0.222)	(0.011)
	Widowed	0.107	-0.008
		(0.310)	(0.019)
Occupation	Farmer	0.464	-0.039
		(0.499)	(0.040)
	Vendor	0.086	0.020
		(0.281)	(0.019)
	Manual worker	0.065	0.007
		(0.247)	(0.015)
	Teacher	0.049	0.014
		(0.216)	(0.015)
Religion and ethnic group	Non-religious	0.046	0.015
		(0.210)	(0.014)
	Catholic	0.349	-0.041
		(0.477)	(0.036)
	Zion	0.167	0.026
		(0.374)	(0.035)
	Other christian	0.355	0.017
		(0.479)	(0.036)
	Religious intensity (scale 1-5)	3.796	-0.073
		(1.116)	(0.104)
	Changana	0.699	-0.015
		(0.459)	(0.082)
	Bitonga	0.075	-0.011
		(0.263)	(0.041)
	Chitsua	0.130	-0.005
		(0.336)	(0.054)
	Chopi	0.057	0.025
		(0.232)	(0.040)
Number of observations		1,021	1,819

Note: Standard deviations in parentheses in column (1). Standard errors reported in parentheses, clustered at the EA level, in column (2). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A1c: Differences between individuals in treatment and control groups at baseline

		Control Mean	Difference in Means between Treatment and Control
		(1)	(2)
Income and property	Per capita monthly expenditure (MZN)	6,421.067	-188.535
		(7,217.013)	(445.412)
	Owns plot of land (*machamba*)	0.864	0.019
		(0.343)	(0.028)
	Owns mosquito net	0.550	0.004
		(0.498)	(0.049)
	Owns fridge	0.145	-0.038
		(0.352)	(0.023)
	Owns sewing machine	0.031	0.011
		(0.172)	(0.010)
	Owns radio	0.512	0.006
		(0.500)	(0.031)
	Owns tv	0.395	-0.038
		(0.489)	(0.044)
	Owns bike	0.161	0.018
		(0.368)	(0.031)
	Owns motorcycle	0.017	0.011*
		(0.128)	(0.007)
	Owns car	0.068	-0.023**
		(0.252)	(0.010)
Technology and finance	Frequency of mobile phone use (scale 1-5)	4.824	0.003
		(0.467)	(0.032)
	Has bank account	0.265	0.042
		(0.441)	(0.036)
	Participates in rosca	0.166	0.015
		(0.372)	(0.028)
	Total savings (MZN)	4,726.001	574.254
		(13,590.305)	(986.943)
	Probability of saving	0.593	0.034
		(0.492)	(0.033)
	Has bank loan	0.041	-0.008
		(0.199)	(0.010)
	Has family loan	0.056	-0.015
		(0.230)	(0.012)
Number of observations		1,021	1,819

Note: Standard deviations in parentheses in column (1). Standard errors reported in parentheses, clustered at the EA level, in column (2). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A1d: Differences between individuals in treatment and control groups at baseline

		Control Mean	Difference in Means between Treatment and Control
		(1)	(2)
Remittances	Received remittances (Value)	4,925.206	-985.206
		(15,638.580)	(871.315)
	Regular Cash	4,240.333	-356.641
		(18,609.465)	(1,077.409)
	Occasional Cash	221.327	68.692
		(1,405.455)	(85.275)
	In-kind	1,355.759	-327.983
		(6,974.108)	(319.771)
	Received remittances (Binary)	0.434	0.035
		(0.496)	(0.025)
	Regular Cash	0.145	0.024
		(0.352)	(0.019)
	Occasional Cash	0.072	0.018
		(0.259)	(0.016)
	In-kind	0.241	0.040
		(0.428)	(0.024)
Agriculture	Active Farming	0.907	0.016
		(0.291)	(0.023)
	Agricultural Investment	0.154	0.020
		(0.233)	(0.021)
	Improved Seeds	0.211	-0.001
		(0.408)	(0.031)
	Fertilizer	0.176	0.020
		(0.381)	(0.031)
	Pesticides	0.086	0.015
		(0.281)	(0.024)
	Extensive Advice	0.058	0.015
		(0.234)	(0.017)
	Hired Labor	0.234	0.058**
		(0.424)	(0.028)
Number of observations		1,021	1,819

Note: Standard deviations in parentheses in column (1). Standard errors reported in parentheses, clustered at the EA level, in column (2). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A1e: Differences between individuals in treatment and control groups at baseline

		Control Mean (1)	Difference in Means between Treatment and Control (2)
Business Activity	**Any Business Activity**	0.221	0.009
		(0.415)	(0.029)
	Vendor	0.158	-0.003
		(0.365)	(0.023)
	Restaurant/Bar	0.028	-0.007
		(0.164)	(0.008)
	Manual Services	0.011	0.007
		(0.104)	(0.007)
	Personal Services	0.025	0.006
		(0.155)	(0.009)
Migration	**Migrant in household (excl remitters)**	0.449	0.005
		(0.498)	(0.029)
	Number of migrants in household (excl remitters)	0.712	0.022
		(1.103)	(0.053)
	Migrant in household (incl remitters)	0.702	-0.014
		(0.457)	(0.019)
	Number of migrants in household (incl remitters)	1.190	0.038
		(1.212)	(0.056)
Well-being	**Subjective Well-being**	3.019	-0.020
		(1.206)	(0.068)
	Vulnerability Index	0.884	-0.005
		(0.882)	(0.055)
	Food Access	0.857	-0.069
		(1.110)	(0.057)
	Clean Water Access	0.674	-0.012
		(1.024)	(0.064)
	Medicines Access	1.040	-0.041
		(1.126)	(0.070)
	School Supplies Access	1.000	-0.015
		(1.146)	(0.068)
Number of observations		1,021	1,819

Note: Standard deviations in parentheses in column (1). Standard errors reported in parentheses, clustered at the EA level, in column (2). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A2a: Differences between individuals in treatment and control groups at baseline for households surveyed in Year 2 and Year 3

		2013		2014	
		Control Mean	Difference in Means between Treatment and Control	Control Mean	Difference in Means between Treatment and Control
		(1)	(2)	(3)	(4)
Basic demographics	Age	39.462	-1.909	39.815	-2.267*
		(14.673)	(1.181)	(14.435)	(1.147)
	Gender (female)	0.622	-0.032	0.611	-0.001
		(0.485)	(0.036)	(0.488)	(0.034)
	Years of education	5.452	0.271	5.366	0.344
		(3.570)	(0.350)	(3.519)	(0.347)
	Single	0.157	0.028	0.162	0.054**
		(0.364)	(0.025)	(0.369)	(0.026)
	Married	0.682	-0.013	0.670	-0.048
		(0.466)	(0.028)	(0.470)	(0.032)
	Separated	0.052	0.002	0.055	-0.004
		(0.222)	(0.013)	(0.228)	(0.012)
	Widowed	0.109	-0.017	0.113	-0.003
		(0.312)	(0.019)	(0.316)	(0.023)
Occupation	Farmer	0.476	-0.053	0.485	-0.062
		(0.500)	(0.046)	(0.500)	(0.047)
	Vendor	0.084	0.030	0.088	0.024
		(0.278)	(0.022)	(0.284)	(0.021)
	Manual worker	0.067	0.012	0.062	0.010
		(0.251)	(0.016)	(0.241)	(0.017)
	Teacher	0.052	0.016	0.044	0.016
		(0.222)	(0.017)	(0.206)	(0.015)
Religion and ethnic group	Non-religious	0.043	0.016	0.046	0.006
		(0.203)	(0.014)	(0.210)	(0.014)
	Catholic	0.350	-0.030	0.353	-0.056
		(0.477)	(0.040)	(0.478)	(0.040)
	Zion	0.163	0.025	0.179	0.020
		(0.370)	(0.035)	(0.384)	(0.037)
	Other christian	0.365	-0.005	0.339	0.040
		(0.482)	(0.040)	(0.474)	(0.040)
	Religious intensity (1-5)	3.817	-0.035	3.807	0.031
		(1.093)	(0.097)	(1.111)	(0.095)
	Changana	0.693	-0.024	0.700	0.003
		(0.461)	(0.085)	(0.458)	(0.084)
	Bitonga	0.077	-0.015	0.080	-0.012
		(0.267)	(0.041)	(0.271)	(0.045)
	Chitsua	0.127	0.014	0.131	-0.009
		(0.333)	(0.057)	(0.338)	(0.055)
	Chopi	0.062	0.021	0.052	0.014
		(0.241)	(0.043)	(0.223)	(0.036)
Number of observations		727	1,261	764	1,324

Note: Standard deviations in parentheses in column (1) and (3). Standard errors reported in parentheses, clustered at the EA level, in column (2) and (4). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A2b: Differences between individuals in treatment and control groups at baseline for households surveyed in Year 2 and Year 3

		Year 2		Year 3	
		Control Mean	Difference in Means between Treatment and Control	Control Mean	Difference in Means between Treatment and Control
		(1)	(2)	(3)	(4)
Income and property	Per capita monthly expenditure (MZN)	6,407.012	-333.036	6,279.001	-301.788
		(7,479.466)	(508.287)	(7,343.351)	(457.890)
	Owns plot of land (*machamba*)	0.880	0.005	0.887	-0.000
		(0.325)	(0.027)	(0.316)	(0.027)
	Owns mosquito net	0.562	0.014	0.563	-0.024
		(0.497)	(0.051)	(0.496)	(0.052)
	Owns fridge	0.150	-0.032	0.142	-0.041
		(0.357)	(0.026)	(0.350)	(0.025)
	Owns sewing machine	0.033	0.009	0.036	0.010
		(0.179)	(0.012)	(0.185)	(0.011)
	Owns radio	0.533	0.004	0.531	-0.016
		(0.499)	(0.037)	(0.499)	(0.035)
	Owns tv	0.410	-0.026	0.395	-0.034
		(0.492)	(0.048)	(0.489)	(0.047)
	Owns bike	0.174	0.023	0.170	0.008
		(0.380)	(0.035)	(0.376)	(0.033)
	Owns motorcycle	0.018	0.010	0.017	0.010
		(0.133)	(0.008)	(0.130)	(0.007)
	Owns car	0.068	-0.019	0.066	-0.025**
		(0.253)	(0.012)	(0.249)	(0.012)
Technology and finance	Frequency of mobile phone use (scale 1-5)	4.824	0.027	4.822	-0.001
		(0.478)	(0.032)	(0.486)	(0.036)
	Has bank account	0.273	0.070*	0.260	0.038
		(0.446)	(0.040)	(0.439)	(0.039)
	Participates in rosca	0.175	0.016	0.171	-0.002
		(0.380)	(0.032)	(0.377)	(0.031)
	Total savings (MZN)	4,662.880	711.152	4,411.044	421.572
		(12,780.207)	(915.245)	(10,607.118)	(828.848)
	Probability of saving	0.595	0.034	0.576	0.044
		(0.491)	(0.038)	(0.495)	(0.040)
	Has bank loan	0.049	-0.014	0.041	-0.007
		(0.215)	(0.012)	(0.199)	(0.011)
	Has family loan	0.060	-0.031**	0.056	-0.023
		(0.239)	(0.014)	(0.231)	(0.014)
Number of observations		727	1,261	764	1,324

Note: Standard deviations in parentheses in column (1) and (3). Standard errors reported in parentheses, clustered at the EA level, in column (2) and (4). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A2c: Differences between individuals in treatment and control groups at baseline for households surveyed in Year 2 and Year 3

		Year 2		Year 3	
		Control Mean	Difference in Means between Treatment and Control	Control Mean	Difference in Means between Treatment and Control
		(1)	(2)	(3)	(4)
Remittances	Received remittances (Value)	5,183.232	-1,102.465	4,470.079	-612.721
		(16,621.195)	(960.586)	(13,629.323)	(839.308)
	Regular Cash	4,606.121	-1,004.743	3,715.995	-325.663
		(19,861.703)	(1,137.681)	(15,920.021)	(864.172)
	Occasional Cash	204.161	123.667	251.407	51.870
		(1,400.376)	(93.211)	(1,564.130)	(98.722)
	In-kind	1,485.530	-475.745	1,456.459	-531.968
		(7,744.286)	(365.790)	(7,736.390)	(360.677)
	Received remittances (Binary)	0.444	0.016	0.440	0.033
		(0.497)	(0.029)	(0.497)	(0.029)
	Regular Cash	0.147	0.034	0.151	0.037
		(0.355)	(0.024)	(0.358)	(0.023)
	Occasional Cash	0.070	0.023	0.075	0.022
		(0.256)	(0.018)	(0.263)	(0.018)
	In-kind	0.254	0.010	0.245	0.028
		(0.436)	(0.027)	(0.430)	(0.028)
Agriculture	Active Farming	0.908	0.037*	0.907	0.036*
		(0.290)	(0.022)	(0.291)	(0.021)
	Agricultural Investment	0.157	0.038	0.162	0.011
		(0.231)	(0.024)	(0.238)	(0.021)
	Improved Seeds	0.215	0.028	0.231	-0.016
		(0.411)	(0.038)	(0.422)	(0.034)
	Fertilizer	0.175	0.058	0.177	0.023
		(0.380)	(0.036)	(0.382)	(0.033)
	Pesticides	0.078	0.049	0.089	0.018
		(0.269)	(0.030)	(0.284)	(0.025)
	Extensive Advice	0.060	0.009	0.067	-0.006
		(0.239)	(0.017)	(0.250)	(0.018)
	Hired Labor	0.249	0.052	0.237	0.043
		(0.433)	(0.032)	(0.426)	(0.029)
Number of observations		727	1.261	764	1.324

Note: Standard deviations in parentheses in column (1) and (3). Standard errors reported in parentheses, clustered at the EA level, in column (2) and (4). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A2d: Differences between individuals in treatment and control groups at baseline for households surveyed in Year 2 and Year 3

		Year 2		Year 3	
		Control Mean	Difference in Means between Treatment and Control	Control Mean	Difference in Means between Treatment and Control
		(1)	(2)	(3)	(4)
Business Activity	Any Business Activity	0.223	0.020	0.225	-0.000
		(0.417)	(0.031)	(0.418)	(0.032)
	Vendor	0.165	0.002	0.161	-0.008
		(0.371)	(0.025)	(0.368)	(0.025)
	Restaurant/Bar	0.025	-0.002	0.032	-0.012
		(0.156)	(0.009)	(0.176)	(0.009)
	Manual Services	0.011	0.010	0.012	0.008
		(0.105)	(0.009)	(0.109)	(0.009)
	Personal Services	0.022	0.008	0.021	0.008
		(0.147)	(0.010)	(0.144)	(0.010)
Migration	Migrant in household (excl remitters)	0.461	-0.009	0.453	0.006
		(0.499)	(0.034)	(0.498)	(0.032)
	Number of migrants in household (excl remitters)	0.755	-0.029	0.743	0.007
		(1.167)	(0.061)	(1.156)	(0.061)
	Migrant in household (incl remitters)	0.700	-0.022	0.712	-0.025
		(0.459)	(0.026)	(0.453)	(0.022)
	Number of migrants in household (incl remitters)	1.190	0.009	1.211	0.020
		(1.226)	(0.062)	(1.219)	(0.066)
Well-being	Subjective Well-being	3.048	-0.004	2.999	0.007
		(1.221)	(0.077)	(1.202)	(0.071)
	Vulnerability Index	0.889	-0.054	0.923	-0.053
		(0.881)	(0.062)	(0.885)	(0.061)
	Food Access	0.860	-0.103	0.896	-0.111*
		(1.110)	(0.069)	(1.130)	(0.064)
	Clean Water Access	0.699	-0.065	0.707	-0.071
		(1.034)	(0.076)	(1.045)	(0.072)
	Medicines Access	1.035	-0.102	1.081	-0.088
		(1.125)	(0.074)	(1.117)	(0.079)
	School Supplies Access	1.009	-0.089	1.036	-0.052
		(1.140)	(0.072)	(1.145)	(0.080)
Number of observations		727	1.261	764	1.324

Note: Standard deviations in parentheses in column (1) and (3). Standard errors reported in parentheses, clustered at the EA level, in column (2) and (4). * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3a: Administrative adoption - at least one transaction performed per individual

Dependent variable:	Year	2012/2013	2013/2014	2014/2015
		(1)	(2)	(3)
Any transaction	Coefficient	0.758***	0.526***	0.535***
	Standard error	(0.016)	(0.017)	(0.016)
	Mean dep. variable (control)	0.012	0.006	0.005
	R-squared adjusted	0.636	0.384	0.393
Types of transactions:				
Cash-in	Coefficient	0.235***	0.185***	0.199***
	Standard error	(0.018)	(0.015)	(0.015)
Transfer received	Coefficient	0.429***	0.250***	0.213***
	Standard error	(0.017)	(0.013)	(0.013)
Transfer sent	Coefficient	0.290***	0.095***	0.068***
	Standard error	(0.013)	(0.009)	(0.007)
Airtime purchase	Coefficient	0.602***	0.343***	0.315***
	Standard error	(0.018)	(0.016)	(0.015)
In-store purchases	Coefficient	0.158***	0.084***	0.122***
	Standard error	(0.018)	(0.012)	(0.018)
Remote payments	Coefficient	0.006***	0.009*	0.051***
	Standard error	(0.002)	(0.005)	(0.008)
Cash-out	Coefficient	0.265***	0.106***	0.121***
	Standard error	(0.018)	(0.011)	(0.012)
	Number of observations	1,819	1,819	1,819

Note: All specifications estimated using OLS. All regressions include strata fixed effects. The dependent variable is a binary variable taking value 1 when the corresponding transaction was performed. Standard errors reported in parentheses are clustered at the EA level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3b: Administrative adoption - number of transactions performed per individual

Dependent variable:	Year	2012/2013	2013/2014	2014/2015
		(1)	(2)	(3)
Any transaction	Coefficient	6.669***	2.626***	3.353***
	Standard error	(0.970)	(0.256)	(0.410)
	Mean dep. variable (control)	0.055	0.047	0.163
	R-squared adjusted	0.057	0.135	0.041
Types of transactions:				
Cash-in	Coefficient	0.871***	0.352***	0.494***
	Standard error	(0.163)	(0.060)	(0.125)
Transfer received	Coefficient	0.713***	0.332***	0.406***
	Standard error	(0.039)	(0.022)	(0.027)
Transfer sent	Coefficient	0.375***	0.123***	0.079***
	Standard error	(0.019)	(0.016)	(0.009)
Airtime purchase	Coefficient	4.084***	1.525***	1.605***
	Standard error	(0.759)	(0.152)	(0.150)
In-store purchases	Coefficient	0.240***	0.110***	0.145***
	Standard error	(0.035)	(0.016)	(0.023)
Remote payments	Coefficient	0.031**	0.037	0.478***
	Standard error	(0.016)	(0.025)	(0.173)
Cash-out	Coefficient	0.354***	0.146***	0.145***
	Standard error	(0.031)	(0.019)	(0.019)
	Number of observations	1,819	1,819	1,819

Note: All specifications estimated using OLS. All regressions include strata fixed effects. The dependent variable is the number of transactions performed per individual. Standard errors reported in parentheses are clustered at the EA level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3c: Administrative adoption - value of transactions performed per individual

Dependent variable:	Years	2012/2013	2013/2014	2014/2015
		(1)	(2)	(3)
Any transaction	Coefficient	513.766***	257.790***	244.195***
	Standard error	(72.397)	(47.745)	(67.711)
	Mean dep. variable (control)	1.012	7.109	29.257
	R-squared adjusted	0.065	0.033	0.006
Types of transactions:				
Cash-in	Coefficient	121.824***	81.400***	89.537***
	Standard error	(29.097)	(22.319)	(32.397)
Transfer received	Coefficient	109.555***	39.313***	17.536***
	Standard error	(13.614)	(6.820)	(2.782)
Transfer sent	Coefficient	29.223***	5.240***	5.553***
	Standard error	(4.200)	(0.800)	(1.946)
Airtime purchase	Coefficient	101.085***	37.543***	33.055***
	Standard error	(15.570)	(4.410)	(3.744)
In-store purchases	Coefficient	13.483***	5.454***	6.124***
	Standard error	(4.055)	(0.807)	(1.588)
Remote payments	Coefficient	22.887**	36.384**	68.626**
	Standard error	(10.462)	(15.676)	(29.565)
Cash-out	Coefficient	115.709***	52.456***	23.764***
	Standard error	(15.247)	(10.320)	(7.114)
	Number of observations	1,819	1,819	1,819

Note: All specifications estimated using OLS. All regressions include strata fixed effects. The dependent variable is the value of transactions performed per individual (in MZN). Standard errors reported in parentheses, clustered at the EA level. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A4: Household migration. Migrants include all remitters.

Panel A: Average Effects

Dependent variable		Probability of Having Migrant		Number of Migrants	
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
Treatment	Coefficient	0.251***	0.154***	0.418***	0.323***
	Standard error	(0.025)	(0.019)	(0.047)	(0.065)
	Q-value	[0.001]	[0.001]	[0.001]	[0.002]
R-squared adjusted		0.344	0.658	0.000	1.257
Mean dep. variable (control group)		0.134	0.154	0.094	0.199
Number of observations		1,261	1,323	1,261	1,323

Panel B: Effects Interacted with Shocks

Dependent variable		Probability of Having Migrant		Number of Migrants	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014
		(1)	(2)	(3)	(4)
β1: Treatment * Negative shock	Coefficient	0.196***	0.064	0.373***	0.432***
	Standard error	(0.055)	(0.050)	(0.089)	(0.137)
	Q-value	[0.001]	[0.072]	[0.001]	[0.001]
β2: Treatment	Coefficient	0.115***	0.128***	0.162***	0.147*
	Standard error	(0.041)	(0.029)	(0.055)	(0.089)
	Q-value	[0.011]	[0.001]	[0.011]	[0.025]
β3: Negative shock	Coefficient	0.031	0.033	-0.014	0.032
	Standard error	(0.051)	(0.040)	(0.107)	(0.095)
	Q-value	[0.680]	[0.601]	[0.903]	[0.090]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.000	0.004	0.000	0.000
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.000	0.000	0.000	0.000
R-squared adjusted		0.143	0.159	0.102	0.209
Mean dep. variable (control group)		0.344	0.661	0.476	1.262
Number of observations		1,261	1,319	1,261	1,319

Note: All specifications estimated using OLS. All regressions include the value of the dependent variable at baseline as control, and strata fixed effects. The dependent binary variable takes value 1 when the respondent reports a migrant in the household. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A5: Household savings

Dependent variable ------>			Probability of saving (binary variable)		Value of savings (inverse hyperbolic sine transformation)	
		Year	2013	2014	2013	2014
			(1)	(2)	(4)	(5)
	Treatment	Coefficient	0.051***	0.035**	0.426**	0.260
		Standard error	(0.018)	(0.017)	(0.172)	(0.161)
		Q-value	[0.047]	[0.155]	[0.060]	[0.214]
		Mean dep. variable (control)	0.809	0.741	6.530	5.683
		R-squared adjusted	0.011	0.015	0.030	0.066
		Number of observations	813	1,146	813	1,146
Total savings components:						
		Coefficient	-0.035	-0.010	0.262	0.162
Saves using bank account	Treatment	Standard error	(0.024)	(0.023)	(0.195)	(0.175)
		Q-value	[0.995]	[0.958]	[0.876]	[0.888]
		Coefficient	0.021	-0.039*	0.114	-0.227
Saves at home	Treatment	Standard error	(0.022)	(0.020)	(0.250)	(0.222)
		Q-value	[0.876]	[0.836]	[0.933]	[0.836]
		Coefficient	-0.021	0.026	-0.180	0.361
Saves in rosca	Treatment	Standard error	(0.023)	(0.023)	(0.250)	(0.258)
		Q-value	[0.990]	[0.836]	[0.995]	[0.828]
		Coefficient	0.008	0.020**	0.030	0.114*
Saves with shopkeeper	Treatment	Standard error	(0.011)	(0.009)	(0.053)	(0.065)
		Q-value	[0.898]	[0.665]	[0.933]	[0.836]
		Coefficient	-0.001	-0.000	0.066	0.087
Lends money	Treatment	Standard error	(0.018)	(0.016)	(0.130)	(0.136)
		Q-value	[0.995]	[0.997]	[0.985]	[0.888]
		Coefficient	0.648***	0.519***	3.214***	2.641***
Saves using mkesh (survey)	Treatment	Standard error	(0.018)	(0.015)	(0.098)	(0.080)
		Q-value	[0.001]	[0.001]	[0.001]	[0.001]
		Coefficient	0.711***	0.802***	2.841***	3.124***
Saves using mkesh (admin)	Treatment	Standard error	(0.016)	(0.013)	(0.080)	(0.079)
		Q-value	[0.001]	[0.001]	[0.001]	[0.001]

Note: All specifications estimated using OLS. All regressions include strata fixed effects. The regression on total savings includes the dependent variable at baseline as control; the regressions on savings components do not include the dependent variable at baseline as control as these questions were not asked at baseline. The value of savings is obtained using the inverse hyperbolic sine transformation. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A6: Impact on type of remittances received by household

Panel A: Average Effects

Dependent variable		Regular Cash Remittances				Occasional Cash Remittances				In-kind remittances				Total Remittances received via Mkesh (All Types)			
		Binary		Value		Binary		Value		Binary		Value		Binary		Value	
Year		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Treatment	Coefficient	0.075***	0.079***	0.727***	0.915***	0.311***	0.166***	2.828***	1.423***	0.024	0.037	0.211*	0.325	0.550***	0.576***	2.891***	3.031***
	Standard error	(0.015)	(0.015)	0.155	0.159	(0.028)	(0.018)	0.250	0.158	(0.015)	(0.023)	0.107	0.205	(0.019)	(0.018)	(0.126)	(0.121)
	Q-value	[0.006]	[0.002]	[0.006]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.221]	[0.261]	[0.199]	[0.261]	[0.001]	[0.001]	[0.001]	[0.001]
Mean dep. variable (control group)		0.066	0.110	0.658	1.055	0.048	0.077	0.350	0.572	0.117	0.372	0.765	3.030	0.010	0.010	0.043	0.047
R-squared adjusted		0.032	0.050	0.040	0.068	0.231	0.056	0.242	0.065	0.022	0.079	0.020	0.087	0.353	0.198	0.389	0.406
Number of observations		1,261	1,323	1,261	1,323	1,261	1,323	1,261	1,323	1,261	1,323	1,261	1,323	1,265	1,330	1,265	1,330

Panel B: Effects Interacted with Shocks

Dependent variable		Regular Cash Remittances				Occasional Cash Remittances				In-kind remittances				Total Remittances received via Mkesh (All types)			
		Binary		Value		Binary		Value		Binary		Value		Binary		Value	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
β1: Treatment * Negative shock	Coefficient	-0.014	0.035	0.089	0.724	0.444***	0.427***	3.992***	3.901***	0.063	-0.030	0.440	0.056	0.121***	0.083*	0.828***	0.616***
	Standard error	(0.038)	(0.044)	(0.368)	(0.444)	(0.035)	(0.054)	(0.301)	(0.452)	(0.039)	(0.055)	(0.290)	(0.445)	(0.041)	(0.042)	(0.211)	(0.211)
	Q-value	[0.836]	[0.750]	[0.862]	[0.345]	[0.001]	[0.001]	[0.001]	[0.001]	[0.505]	[0.750]	[0.505]	[0.916]	[0.452]	[0.056]	[0.171]	[0.011]
β2: Treatment	Coefficient	0.082***	0.064***	0.635**	0.617**	0.006	-0.005	0.071	-0.141	-0.016	0.050	-0.079	0.304	0.395***	0.246***	1.757***	0.982***
	Standard error	(0.029)	(0.024)	(0.274)	(0.242)	(0.018)	(0.019)	(0.144)	(0.152)	(0.031)	(0.032)	(0.241)	(0.283)	(0.032)	(0.023)	(0.149)	(0.101)
	Q-value	[0.282]	[0.125]	[0.411]	[0.138]	[0.961]	[0.792]	[0.951]	[0.612]	[0.951]	[0.404]	[0.961]	[0.612]	[0.004]	[0.001]	[0.004]	[0.001]
β3: Negative shock	Coefficient	0.072**	-0.016	0.644*	-0.238	0.028	0.015	0.333	0.090	-0.057*	0.045	-0.262	0.204	0.094**	-0.006	0.510**	-0.016
	Standard error	(0.034)	(0.028)	(0.349)	(0.257)	(0.035)	(0.019)	(0.301)	(0.176)	(0.032)	(0.038)	(0.264)	(0.306)	(0.044)	(0.007)	(0.253)	(0.034)
	Q-value	[0.525]	[0.906]	[0.614]	[0.808]	[0.753]	[0.876]	[0.750]	[0.906]	[0.614]	[0.692]	[0.753]	[0.906]	[0.085]	[0.674]	[0.108]	[0.738]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.017	0.625	0.004	0.267	0.000	0.000	0.000	0.000
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.733	0.102	0.703	0.087	0.000	0.000	0.000	0.000
Mean dep. variable (control group)		0.066	0.111	0.658	1.060	0.048	0.078	0.350	0.575	0.117	0.372	0.765	3.035	0.007	0.000	0.028	0.000
R-squared adjusted		0.033	0.048	0.042	0.069	0.307	0.205	0.324	0.240	0.022	0.078	0.020	0.086	0.364	0.202	0.349	0.197
Number of observations		1,261	1,319	1,261	1,319	1,261	1,319	1,261	1,319	1,261	1,319	1,261	1,319	1,265	1,326	1,265	1,326

Note: All specifications estimated using OLS. All regressions include as control the value of the dependent variable at baseline and strata fixed effects. The binary dependent variable takes value 1 when remittances are received by the household. The value of remittances is obtained using the inverse hyperbolic sine transformation. The Village Flood Shock is defined as a binary variable taking value 1 if the SPEI rainfall measure in the EA in the 2012-2013 season was above two standard deviations relative to the 1981-2010 average. The Household Shock is defined as a binary variable taking value 1 if there was a death in the family, significant health problems in the household, or job losses in the household in 2013-2014. The number of observations is lower in the regressions where there is an interaction with Household Shock because these shocks were not reported by all households. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A7: Agricultural activity and investment

		Year	2013	2014
Dependent variable:			(1)	(2)
Active farm	Treatment	Coefficient	-0.039**	-0.044**
		Standard error	(0.011)	(0.015)
		Q-value	[0.018]	[0.043]
	Mean dep. variable (control)		0.945	0.933
	R-squared adjusted		0.048	0.036
	Number of observations		1,017	1,109
Index of agricultural investment (conditional on farm being active)	Treatment	Coefficient	-0.024**	-0.065***
		Standard error	(0.011)	(0.014)
		Q-value	[0.104]	[0.005]
	Mean dep. variable (control)		0.163	0.190
	R-squared adjusted		0.068	0.150
	Number of observations		812	872
Investment index components:				
Improved seeds	Treatment	Coefficient	-0.045***	-0.061***
		Standard error	(0.016)	(0.022)
		Q-value	[0.206]	[0.094]
Fertilizer	Treatment	Coefficient	-0.049**	-0.074***
		Standard error	(0.024)	(0.022)
		Q-value	[0.247]	[0.059]
Pesticides	Treatment	Coefficient	-0.036**	-0.067***
		Standard error	(0.015)	(0.019)
		Q-value	[0.247]	[0.051]
Hired labor	Treatment	Coefficient	0.052**	-0.057***
		Standard error	(0.022)	(0.021)
		Q-value	[0.247]	[0.094]
Extension advice	Treatment	Coefficient	-0.028*	-0.045***
		Standard error	(0.014)	(0.015)
		Q-value	[0.247]	[0.094]

Note: All specifications estimated using OLS. All regressions include the value of the dependent variable at baseline as control, and strata fixed effects. The dependent variable active farm takes value 1 when the respondent reports having an active farm. The index of agricultural investment is the arithmetic average of binary variables indicating use of improved seeds, fertilizer, pesticides, hired workers, and extension advice. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A8: Business activity

Dependent variable		Any active business	
	Year	2013	2014
		(1)	(2)
	Coefficient	-0.006	-0.018
	Standard error	(0.019)	(0.022)
	Q-value	[0.832]	[0.519]
	Mean dep. variable (control)	0.251	0.335
	R-squared adjusted	0.092	0.108
	Number of observations	1,242	1,256
Types of businesses:			
Vendors	**Coefficient**	-0.021	0.003
	Standard error	(0.017)	(0.019)
	Q-value	[0.749]	[0.933]
Restaurants/bars	**Coefficient**	0.002	-0.020***
	Standard error	(0.004)	(0.006)
	Q-value	[0.852]	[0.068]
Manual services (e.g., mechanic, tailor)	**Coefficient**	0.002	0.006
	Standard error	(0.003)	(0.005)
	Q-value	[0.852]	[0.739]
Personal services (e.g., hairdresser)	**Coefficient**	0.011**	0.003
	Standard error	(0.005)	(0.007)
	Q-value	[0.352]	[0.933]

Note: All specifications estimated using OLS. All regressions include the value of the dependent variable at baseline as control and strata fixed effects. Active business is a binary variable taking value 1 when the respondent reports having an active business. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A9: Impact on components of the Non-vulnerability Index

Panel A: Average Effects

Dependent variable		Food		Water		Medicine		School	
Year		2013	2014	2013	2014	2013	2014	2013	2014
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	Coefficient	0.339***	0.206***	0.116***	0.105***	0.093**	0.155***	0.092*	0.174***
	Standard error	(0.031)	(0.043)	(0.028)	(0.036)	(0.043)	(0.043)	(0.053)	(0.044)
	Q-value	[0.001]	[0.006]	[0.012]	[0.031]	[0.165]	[0.012]	[0.167]	[0.009]
Mean dep. variable (control group)		2.421	2.414	2.699	2.684	2.378	2.204	2.404	2.318
R-squared adjusted		0.072	0.088	0.042	0.031	0.024	0.045	0.024	0.048
Number of observations		1,220	1,294	1,225	1,295	1,208	1,285	1,074	1,093

Panel B: Effects Interacted with Shocks

Dependent variable		Food		Water		Medicine		School	
Negative shock		Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock	Village Flood Shock	Household Shock
Year		2013	2014	2013	2014	2013	2014	2013	2014
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β1: Treatment * Negative shock	Coefficient	0.212***	0.310***	-0.071	0.026	-0.110	0.241*	-0.038	0.190*
	Standard error	(0.062)	(0.101)	(0.073)	(0.085)	(0.095)	(0.123)	(0.121)	(0.108)
	Q-value	[0.104]	[0.022]	[0.767]	[0.759]	[0.767]	[0.180]	[0.818]	[0.180]
β2: Treatment	Coefficient	0.204***	0.074	0.161***	0.095**	0.163*	0.052	0.120	0.093
	Standard error	(0.048)	(0.056)	(0.052)	(0.045)	(0.082)	(0.070)	(0.083)	(0.057)
	Q-value	[0.113]	[0.421]	[0.195]	[0.273]	[0.332]	[0.551]	[0.370]	[0.377]
β3: Negative shock	Coefficient	-0.217***	-0.363***	0.084*	-0.068	0.120	-0.274***	-0.092	-0.286***
	Standard error	(0.072)	(0.086)	(0.050)	(0.061)	(0.124)	(0.094)	(0.114)	(0.081)
	Q-value	[0.222]	[0.002]	[0.555]	[0.288]	[0.682]	[0.017]	[0.682]	[0.007]
p-value of tests	$\beta_1 + \beta_2 = 0$	0.000	0.000	0.808	0.076	0.297	0.001	0.276	0.001
	$\beta_1 + \beta_2 + \beta_3 = 0$	0.002	0.754	0.030	0.406	0.139	0.819	0.929	0.976
Mean dep. variable (control group)		2.421	2.416	2.699	2.684	2.378	2.207	2.404	2.318
R-squared adjusted		0.074	0.107	0.041	0.031	0.024	0.054	0.023	0.058
Number of observations		1,220	1,293	1,225	1,294	1,208	1,284	1,074	1,092

Note: All specifications estimated using OLS. All regressions include as control the value of the dependent variable at baseline and strata fixed effects. The components of the non-vulnerability index are categorical variables ranging between 0-3, where 0 denotes having suffered more than 5 episodes of no access over the year prior to the survey and 3 denotes never having suffered lack of access in the year prior to the survey. The Village Flood Shock is defined as a binary variable taking value 1 if the SPEI rainfall measure in the EA in the 2012-2013 season was above two standard deviations relative to the 1981-2010 average. The Household Shock is defined as a binary variable taking value 1 if there was a death in the family, significant health problems in the household, or job losses in the household in 2013-2014. The number of observations is lower in the regressions where there is an interaction with Household Shock because these shocks were not reported by all households. Other variations in the number of observations across variables in the same year are due to differential response rates to the different questions. Standard errors reported in parentheses are clustered at the EA level. Q-values adjusted for multiple hypothesis testing following Romano and Wolf (2016) are presented in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A10a: Questionnaire

	Variable	Scale	Question (English)	Question (Portuguese)
Agriculture	**Owns plot of land (*machamba*)**	1 = Yes; 0 = No	Does your family have a farm?	A sua família tem alguma machamba?
	Active Farm	1 = Yes; 0 = No	During the last agricultural season, did you actively farm?	Na última campanha agrícola cultivaram em alguma machamba?
	Improved Seeds	1 = Yes; 0 = No	Did you use any improved seeds in the last agricultural season?	O(a) senhor(a) usou algumas sementes melhoradas na última campanha agrícola?
	Fertilizer	1 = Yes; 0 = No	Did you use any fertilizers in the last agricultural season?	O(a) senhor(a) usou algum adubo ou fertilizantes (químicos ou naturais) na última campanha agrícola?
	Pesticides	1 = Yes; 0 = No	Did you use any pesticides or herbicides in the last agricultural season?	O(a) senhor(a) usou algum pesticida ou herbicida na última campanha agrícola?
	Extension Advice	1 = Yes; 0 = No	Did you receive any extension advice in the last agricultural season?	Na última campanha agrícola, contou com o aconselhamento de algum extensionista agrícola?
	External Labour	1 = Yes; 0 = No	Did you hire any external labour in the last agricultural season?	Na última campanha agrícola pagou/contratou alguém para trabalhar na sua machamba?
Migration	**Number of Migrants (from household head, spouse(s) and their children)**	Number of persons	How many family members do not live with you at the moment and have been away for at least three months?	Quantos membros da sua família estão a viver fora desta localidade há pelo menos três meses?
	Number of Remitters	Number of persons	How many other persons sent money or goods to your house in the last 12 months, in addition to these closest members of your family mentioned before?	Quantas pessoas, para além destas pessoas mais próximas da sua família de quem falamos agora, enviaram dinheiro ou produtos para alguém na sua casa nos últimos 12 meses?
Remittances	**Total Remittances (Binary)**	1 = Yes; 0 = No	Did your family receive money or presents from {} in the last 12 months?	A sua família recebeu dinheiro ou presentes de {} nos últimos 12 meses?
	Total Remittances (Value)	Value in MZN		
	Regular Cash Remittances (Binary)	1 = Yes; 0 = No	Does this person send money regularly?	Esta pessoa costuma enviar dinheiro com regularidade?
	Frequency of Regular Cash Remittances	1 = weekly; 2 = twice a month; 3 = once a month; 4 = every two months; 5 = every three months; 6 = twice a year; 7 = once a year; 8 = Other, specify	How often does this person send money?	Com que frequência recebeu dinheiro de {}?
	Average Regular Cash Remittances (Value)	Value in MZN	How much money does this person usually send every time they send money?	Quanto dinheiro costuma receber de cada vez?
	Regular Cash Remittances (Value)	*= Frequency of Regular Cash Remittances * Average Regular Cash Remittances (Value)*		
	Occasional Cash Remittances (Binary)	1 = Yes; 0 = No	In the last 12 months, not counting the regular transfers, did you receive any money from {} for special occasions (such as celebrations or funerals)?	Nos últimos 12 meses, tirando os valores regulares, recebeu algum montante em dinheiro de {} para ocasiões especiais (como celebrações ou falecimentos)?
	Occasional Cash Remittances (Value)	Value in MZN	What was the value of money you received for these special occasions (such as celebrations or funerals) in the last 12 months?	Qual foi o valor que recebeu em dinheiro para essas ocasiões especiais (como celebrações ou falecimentos) nos últimos 12 meses?
	In-kind Remittances (Binary)	1 = Yes; 0 = No	In the last 12 month, did you receive any presents (food, clothes or other items apart from money) from this person?	Nos últimos 12 meses, recebeu algum PRESENTE (comida, roupa ou outras coisas que não dinheiro) de {}?
	In-kind Remittances (Value)	Value in MZN	What was the value of these goods you received in the last 12 months?	Qual foi o montante em meticais correspondente a esses bens que recebeu nos últimos 12 meses?
Expenditure	**Household monthly expenditure (MZN)**	Value in MZN	How much money does your household usually spend per day or per month?	Normalmente, quanto dinheiro se gasta na sua casa por dia ou por mês?
Well-being & vulnerability	**Subjective well-being**	1 = very bad; 2 = quite bad; 3 = neither good nor bad; 4 = quite good; 5 = very good	In general, how do you describe your everyday living conditions?	Em geral, como descreve: As suas condições de vida presentes?
			In the last 12 months, how many times, if any, were you or anyone of your household left without:	Durante os últimos 12 meses, quantas vezes, se alguma, o(a) senhor(a) ou alguém na sua casa ficou sem:
	Non-vulnerability index - food	0 = many times (at least 5 or 6 times); 1 = sometimes (2-3 times); 2 = once; 3 = never	· Enough food to eat	· Comida suficiente para comer
	Non-vulnerability index - water	0 = many times (at least 5 or 6 times); 1 = sometimes (2-3 times); 2 = once; 3 = never	· Enough water for domestic use	· Água suficiente para uso doméstico
	Non-vulnerability index - medicine	0 = many times (at least 5 or 6 times); 1 = sometimes (2-3 times); 2 = once; 3 = never	· Medicines or medical treatment	· Medicamentos ou tratamento médico
	Non-vulnerability index - schooling	0 = many times (at least 5 or 6 times); 1 = sometimes (2-3 times); 2 = once; 3 = never	· Money for school expenses of your children (transport, clothes, books)?	· Dinheiro para as despesas escolares das suas crianças (ex. transporte, roupa, livros)?
Business			Do you or anyone from your household own any of the following types of businesses?	O(a) senhor(a) ou alguém da sua casa é proprietário de algum dos seguintes tipos de negócio?
	Shop	1 = Yes; 0 = No	· Shop	· Loja
	Vendors	1 = Yes; 0 = No	· Street vending	· Venda de rua / banca
	Bar/Restaurant	1 = Yes; 0 = No	· Restaurant or bar	· Restaurante / bar / barraca
	Manual services	1 = Yes; 0 = No	· Manual services (e.g., mechanic, tailor)	· Oficina (mecânico, caralizador, sapateiro)
	Personal Services	1 = Yes; 0 = No	· Personal services (e.g. hairdresser)?	· Serviços pessoais (cabeleireiro)?
Savings	**Saves using bank account (Binary)**	1 = Yes; 0 = No	Does anyone in the household currently have a bank account?	Alguém no agregado familiar tem actualmente conta no banco?
	Saves using bank account (Value)	Value in MZN	How much money do they have saved in the bank account?	Quanto dinheiro tem guardado no Banco?
	Saves in rosca (Binary)	1 = Yes; 0 = No	Do you participate in any savings group (xitique)?	Participa em algum grupo de poupança (xitique)?
	Saves in rosca (Value)	Value in MZN	How much do you receive from the xitique when it's your turn?	Qual o valor que tira do xitique quando calha a sua vez?
	Saves with shopkeeper (Binary)	1 = Yes; 0 = No	Do you have any money saved with any merchant or other person in the community?	Tem algum dinheiro guardado com algum comerciante ou outra pessoa na localidade?
	Saves with shopkeeper (Value)	Value in MZN	How much money do you have saved with any merchant or other person in the community?	Qual o valor que tem guardado com algum comerciante ou outra pessoa na localidade?
	Saves at home (Binary)	1 = Yes; 0 = No	Do you have any savings at home?	Tem algum valor guardado em casa?
	Saves at home (Value)	Value in MZN	What is the value of your savings kept at home?	Qual o valor que tem guardado em casa?
	Savings (Binary, Value)	Value in MZN	What is the total value of your savings, not counting animals?	Qual é o valor total das suas poupanças, não contando com animais?

Table A10b: Questionnaire

	Variable	Scale	Question (English)	Question (Portuguese)
Basic demographics			We will now ask some questions about the members of your household (including yourself)	Vamos agora perguntar sobre quem faz parte do seu agregado familiar.
	Age	Age in years	How old is this person turning this year?	Qual é a idade que fazes este ano?
	Gender	1 = female, 2 = male	What is the respondent's gender?	Qual e o genero do respondente?
	Years of education	0 = no schooling; 1 = 1st grade; 2 = 2nd grade; 3 = 3rd grade; 4 = 4th grade; 5 = 5th grade, 6 = 6th grade; 7 = 7th grade; 8 = 8th grade; 9 = 9th grade; 10 = 10th grade; 11 = 11th grade; 12 = 12th grade; 13 = post-secondary qualifications other than university education (e.g. technical or professional school); 14 = non-completed university degree; 15 = completed university degree; 16 = post-graduate studies	What is the highest level of schooling this person completed?	Qual é o nível de educação mais alto que {} completou?
	Civil Status	1 = single; 2 = married, non-marital partnership; 3 = divorced, separated; 4 = widowed; 5 = other	What is this person's civil status?	Qual é o estado civil de {}?
Occupation	**Occupation**	1 = student; 2 =farmer (household's farm); 3 = employed farmer; 4 = works at home; 5 = paid housework; 6 = miner; 7 = fisher; 8 = marchant; 9 = entrepreneur; 10 = craftsman/manual labore (tailor, carpenter, blacksmith); 11 = religious occupation (e.g. pastor or imane); 12 = specialized professional (lawyer, accountant, nurse, engineer); 13 = teacher; 14 = military/police/security; 15 = civil servant; 16 = other employee; 17 = has never had an occupation; 18 = other, specify	What is this person's main occupation?	Qual é a ocupação principal de {}?
Religion and ethnic group	**Religion**	0 = no religion; 1 = Catholic; 2 = Zion; 3 = Other Christian; 4 = traditional religion; 5 = Muslim; 6 = Hindu; 7 = Other, specify	What is your religion, if you have one?	Qual é a sua religião, se tiver alguma?
	Religious intensity (1-5)	1 = never or almost never; 2 = once a year or more often; 3 = once a month or more often; 4 = once a week or more often; 5 = every day or more often;	Excluding weddings and funerals, how often do you attend religious ceremonies?	Excluindo casamentos e funerais, com que frequência vai a cerimónias religiosas?
	Ethnic group	1 = Macua; 2 = Changana; 3 = Lomue; 4 = Sena; 5 = Ajaua/Yao; 6 = Bitonga/Gitonga; 7 = Chironga; 8 = Chuabo; 9 = Chona ou Ndau; 10 = Chopi; 11 = Chuabo; 12 = Maconde; 13 = Manica; 14 = Maravi; 15 = Nguni/Zulu; 16 = Swahili; 17 = European-African; 18 = European; 19 = Indian; 20 = Just Mozambican or "do not think about themselves in these terms"	What is your group of origin? [Interviewer: If necessary add "This is your tribe or your etnic or cultural group."]	Qual é o seu grupo de origem? [Entrevistador: Se necessário adicione "Isto é a sua tribo ou o seu grupo étnico ou cultural."]
Property	**Ownership of goods**	Number of goods owned	How many goods does your household own? (Mosquito nets, fridges, sewing machines, radios, TVs, bikes, motorcycles, cars)	Quantos (bens) é que o AF tem?
Technology and finance	**Frequency of mobile phone use (scale 1-5)**	1 = never; 2 = a few times a year; 3 = a few times a month; 4 = a few times a week; 5 = Every day	How often do the following household members use a mobile phone?	Com que frequência os seguintes membros de sua casa usam telefones celulares?
	Has bank loan	1 = Yes; 0 = No	Do you have an outstanding bank loan?	Tem algum empréstimo no banco?
	Has family loan	1 = Yes; 0 = No	Did you have an outstanding loan from a family member or another person?	Tem algum empréstimo com um familiar ou outra pessoa?