Increasing mobile banking use among rural populations in Ghana
Pre-analysis plan

Robert Darko Osei, Emma Riley and Abu S. Shonchoy

August 2021

Abstract

Integrating banking access into mobile money services (mobile banking0 combines the perceived safety and security of a bank account with the deep reach into rural villages of mobile money services. We employ a training and incentivised encouragement design RCT to increase the knowledge, adoption and use of mobile banking service amongst the microfinance clients of a bank in Ghana. We examine the mechanisms that determine the decision to adopt mobile banking services such as trust in and confidence about using mobile banking and understand preferences between cash and digital payments.

Keywords: Mobile Banking, Ghana, Micro-finance, Small business, Micro-enterprises, Female, Mobile Money.

1 Introduction

Mobile money services have accelerated progress in global financial inclusion. However, a majority of mobile money customers perceive it just as a money transfer instrument and do not make use of features such as storing money for future needs – which could particularly be useful for remote, rural populations. Integrating banking access into mobile money services – mobile banking - combines the perceived safety and security of a bank account with the deep reach into rural villages through mobile money services.

We use a Randomised Control Trial (RCT) to examine whether providing information and training on mobile banking services coupled with monetary incentives for transactions

can induce adoption, greater usage, improved knowledge and higher confidence/trust in mobile banking services. Further we examine whether this can lead to impacts on downstream outcomes such as increased digital savings, digital business transactions and women's empowerment. We work with existing microfinance clients of Opportunity International Saving and Loans (OISL), a leading bank and microfinance agency in Ghana.

2 Intervention

The study uses a cluster randomisation design with 136 rural microfinance groups equally distributed into four treatment/control arms (34 groups per arm) as follows:

1. **Personal incentive (T1 - Individual)**: Clients in this arm receive a one-time small monetary incentive if they carry out a mobile banking transaction (withdrawal or deposit to/from the account) within a one month period. They also receive basic information and training on mobile banking from their OISL credit officer.

2. **Peer-led training and incentive + Personal incentive (T2 - Peer)**: Microfinance group leaders receive a comprehensive training on the mobile banking use and its benefits. The group leader then train the rest of her microfinance group members on mobile banking. The group leader (trainer) also receive an incentive for each member (trainee) of her microfinance group who completed a mobile banking transaction (deposit to a bank account or withdrawal from a bank account). Each member of the microfinance group (including the leader), is also eligible to receive an individual monetary incentive if they can carry out a mobile banking transaction themselves during a one-month period.

3. **Peer-led training and incentive + Personal incentive + Consumer Protection training (T3 - Consumer protection)**: This intervention contains T2 above plus the additional consumer protection (CP) training module — covering components

on how to identify and be aware of fraud, fraud protection measures and what to do if someone experiences fraud (redress options).

4. **Control (C)**: Clients in this arm do not receive any encouragement to use mobile banking. However, clients can still use mobile banking services if they choose to.

3 Sample, randomisation and consent

The sample selection and randomisation was done using OISL administrative data extracted on February 2021. The sample is selected from the universe of OISL clients based on the following criteria:

1. Clients are from the branches Akim Oda, Koforidua, Konongo or Nkawkaw.
2. Clients are members of an active microfinance group.
3. Clients were women
4. Groups have at least 3 members but fewer than 7 (the median number of group members in the data was 5)
5. At least 1 of the group members was already registered for mobile banking

There were 555 active microfinance groups at the 4 branches selected. 282 of these had entirely female members, of which 205 had more than 2 members and 159 had at least one member registered for mobile banking already. These criteria ensured we had a relatively homogeneous set of microfinance groups containing only female clients. We included the restriction of at least one member already being registered for mobile banking so we would be powered to look at heterogeneous effects by this variable.

We assigned microfinance groups, and all the clients of that group, to treatment using a stratified randomisation. The stratification is based on three variables:

1. a dummy variable capturing if the group had a mobile banking agent within 10 minutes walk of the group meeting place

2. a dummy variable capturing if the group had a less than 45 minute travel time to the nearest branch from the group meeting point

3. a dummy capturing if the average balance in the OISL bank account of the group members is less then 15 cedis.

This yielded eight strata blocks. We carried out the randomisation on the 26th April 2021 in STATA using the *randtreat* command with 4 treatment groups and no allocation of misfits. This results in 136 groups allocated equally to the 4 treatment/control arms (34 groups per arm). After randomisation, we learnt from OISL that 21 of the randomised groups were delinquent and no longer have active client status with OISL. Members of these groups were not told their assigned treatment status or received any part of the intervention. We drop these 21 groups from the study and from all analysis. This resulted in 115 groups being included in the study with the following allocation; 27 in control (C), 29 in individual (T1), 28 in peer (T2) and 31 in consumer protection (T3).

After randomisation, the group leader in groups assigned to the T2 or T3 arms was invited to a training session. The training of the group leaders for the T2 and T3 groups took place in the morning or afternoon of the 20th May 2021 at a location near to the microfinance branch of that group.

After the group leader training, we approached all the 115 groups selected to take part in the study to carryout the consent process with the group members. The consent process was carried out with all group members present at the microfinance group meeting on that day. 407 women consented to take part in the study, 114 in the control group, 99 in T1 (Individual), 97 in T2 (Peer) and 97 in T3 (Consumer protection).[1] During the consent process, we also collected some data on clients' prior knowledge and use of mobile banking.

[1]We did not experience any non-consent. Not every group member was present when we did the consent fielding and any member not present was not included in our study sample

After consenting to take part in the study, group members were told about the individual incentive for those in the Individual (T1), Peer (T2) or Consumer Protection (T3) arms and everyone in these groups received a hands-on training on mobile banking provided by either the OISL credit officer (T1) or group leader with assistance from the OISL credit officer (T2 and T3).

4 Data

The sources of data for this study are participant responses from the consent enrolment, OISL administrative records, and an endline survey. The endline survey was conducted in July and August 2021. The endline survey instruments cover background characteristics (marital status, education), business outcomes, saving behaviour, mobile money knowledge, mobile banking use, fraud and women's empowerment — asked at the end of the study, after the intervention had concluded.

We supplement this collected data with administrative records from our banking partner OISL. The administrative data are composed of three types of data source:

1. **Mobile Banking transactions**: all the monthly deposit and withdrawal transactions using the OISL Mobile Banking platform.

2. **Saving account balance:** the end of month saving balance in all OISL held accounts.

3. **Loan records:** the end of month loan status, including the outstanding amount, repayments and details of any late payments for all loan clients.

Additionally, basic demographic data is obtained from OISL records, including gender, age and associated branch (location). The Administrative data-sets are collected for the months proceeding the randomisation (February and March 2021), and during and after the intervention (May-July 2021). We will also collect admin data for the post intervention period (August - December 2021) in order to examine persistent effects.

5 Outcomes

This section details the primary and secondary outcomes within each family. We consider four outcomes of mobile banking use at the extensive and intensive margin. We consider five key mechanisms that could explain how the interventions impacted mobile banking use: general understanding of mobile banking, trust in mobile banking as well as fraud knowledge, peer effects and preferences for digital transactions. We also consider 5 families of secondary outcomes capturing savings, loan repayment, confidence in mobile money, business outcomes and women's empowerment. We will multiple-test correction within the primary outcomes across the family of primary measures and within the mechanisms across the primary measures. Since the pilot study is over a short time horizon, we do not necessarily expect to see immediate impacts on the secondary outcomes and consider them exploratory only. No multiple- test correction will be applied to secondary outcomes or secondary measures of a primary outcome or mechanisms. All monetary values will be winsorized at the top 1% level and we will look in levels and also transformed by the inverse hyperbolic sine transformation.

5.1 Primary outcomes: Mobile banking use

All transaction outcomes, collected from administrative records, are defined over a time period from the intervention until the endline survey, or approximately 2 months. Please note that secondary measures are shown as bullet points after each primary measure.

Administrative outcomes:

1. Dummy variable if made any transaction with Mobile Banking
    - Dummy if made any deposit (from mobile money wallet to account) transaction
    - Dummy if made any withdrawal (from account to mobile money wallet) transaction

2. Sum of value of transactions made using mobile banking
    - Sum of value of deposit transactions
    - Sum of value of withdrawal transactions
3. Number of mobile banking transactions made
    - Number of deposit transactions
    - Number of withdrawal transactions

Survey Outcomes:

4. Mobile Banking Activity Index (standardised index of the following):
    - Travelled to the bank to register with Opportunity Mobile (dummy variable)
    - Travelled to the bank to reset the Opportunity Mobile PIN (dummy variable)
    - Used Opportunity Mobile in the last 30 days (dummy variable)
    - Likelihood of using Opportunity Mobile in the next 30 days (scale 1-5)

5.2 Mechanisms:

Here we explore how the interventions could have affected use of mobile banking services by examining different potential channels of impact. We do not expect all of these to have been affected by the intervention, nor do we expect them to move in a certain direction. Secondary measures are shown as bullet points after each primary measure.

1. Knowledge of Mobile Banking (standardised index of the following)
    - Correct answer to each question on knowledge of mobile banking (number of correct answers out of 5)
    - Has heard about Opportunity Mobile (dummy variable)
    - Confidence in using mobile banking (scale 1-10)

2. Trust in OISL mobile banking (standardised index of scale 1-5)

3. Fraud index (standardised index of the following)

    - Worries about fraud when using mobile banking (scale 1-10)
    - Knowledge of correct ways to handle suspected fraud scenarios index (identification of appropriate ways to handle fraud in 5 different scenarios, each answer graded 0-2)
    - Knowledge of personal information that should not be given out (correctly named each type of personal information that should not be revealed - score out of 2)
    - perceptions of risk of experiencing different types of fraud incidences index (rating from 1-10 of likelihood of experiencing fraud in 3 different scenarios)

4. Peer effects index (standardised index of the following)

    - Knows someone else in their microfinance group (leader or member) who uses Opportunity Mobile (dummy variable)
    - Knows someone outside their microfinance group who uses Opportunity Mobile (dummy variable)
    - Received help to perform an Opportunity Mobile transaction (dummy variable)
    - Helped someone use Opportunity Mobile (dummy variable)

5. Attributes and Preference for digital transactions (standardised index of the first three variables below)

    - Prefers mobile money to cash now (Dummy variable if prefers a payment as mobile money to an equal sized or larger payment as cash)
    - Prefers mobile money to cash in 2 weeks (Dummy variable if prefers a payment as mobile money to an equal sized or larger payment as cash)

- Non-incentivized Willingness to Pay (WTP) measures for commodity purchases index (dummy variable if WTP is higher for purchases done in mobile money compared with cash for 4 types of purchase.)
- The value or willingness to pay (WTP) placed on different dimensions of mobile money services, including: the cost of transactions; gender of the mobile money agent; customer service quality; liquidity of the mobile money agent; and the density of the mobile money agent network, measured using a discrete choice instruments.
- Ranking of 5 dimensions of mobile money services.[2]

5.3 Secondary outcomes

1. Total savings in all forms (amount, GHS)
    - Net savings in the last 30 days (amount, GHS)
    - savings in a mobile money account (amount, GHS)
    - Satisfaction with financial situation (scale 1-5)
    - Bank saving account balance, admin data 31st July 2021 (amount, GHS)
    - Bank saving account balance, admin data 31st July 2021 (amount, inverse hyperbolic sine transformation)
2. Late payment indicator: dummy equal to one if a loan repayment is late
    - Amount in arears: value of (cumulative) amount that is late (zero if no late payment)
    - Number of days in arears: number of days client has been late with a payment (zero if no late payment)

[2]we will examine these outcome using an ordered logit regression of the ranking of each feature

3. Mobile money confidence and trust index (standardised index of the following:)

    - Trust leaving money in a mobile money wallet (scale 1-10)
    - Comfort with mobile money index of 7 statements (scale 1-5)
    - Confidence in using mobile money index of 6 actions (scale 1-5)
    - Trust in network provider (scale 1-5)
    - Trust in mobile money agents in general (scale 1-5)
    - Used mobile money last 30 days (dummy variable)

4. Business profits 30 days (amount, GHS)

    - Inventory value (amount, GHS)
    - fixed assets value (amount, GHS)
    - sales 30 days (amount, GHS)
    - Shut the business to go to the bank (dummy variable)
    - Lost a sale due to no change (dummy variable)
    - Allows mobile money payments in business (dummy variable)
    - Pays suppliers with mobile money (dummy variable)

5. Women's empowerment index (standarised index of the following:)

    - Chooses how to spend the money she earns (dummy variable)
    - when has money on hand spouse takes is (scale 1-10)
    - when has money on hand other family members take it (scale 1-100
    - Woman decides alone or jointly with spouse or other family member on 7 household decisions index (dummy variable for each decision made alone or jointly, aggregated into a decision making index)

6 Analysis

To estimate the effect of the treatment, we will estimate the following Intention-to-treat (ITT) ANCOVA equation:

$$\begin{aligned} Y_{ig} &= \beta_0 + \beta_I \text{Individual}_g + \beta_P \text{Peer}_g + \beta_C \text{CP}_g \\ &+ \beta_y Y_{ig}^0 + \mu_s + \epsilon_{ig} \end{aligned} \tag{1}$$

Where Y_{ig} is the outcome variables of interest for OISL client i, in strata s, in microfinance group g.

Individual, Peer and CP are the Individual treatment, Peer treatment and Consumer Protection treatment assignment to the client's microfinance group. β_I, β_p and β_C are the ITT effects of the Individual, Peer and Consumer Protection treatments. Y_{ig}^0 is the value of the outcome measure at the baseline, if available.[3] μ_s is a vector of strata dummies and ϵ_{ig} are clustered standard errors at the microfinance group level.

We will perform the following hypothesis tests:

1. $\beta_I = 0$
2. $\beta_P = 0$
3. $\beta_C = 0$
4. $\beta_I = \beta_P$
5. $\beta_I = \beta_C$
6. $\beta_C = \beta_P$
7. $\beta_I = \beta_P = \beta_C = 0$

[3] We have administrative data on the mobile banking transactions in the period before the intervention, and so we can control for the relevant mobile banking transaction in the month before the intervention took place.

8. $\beta_P = \beta_C = 0$

6.1 Compliance adjusted treatment effects

Compliance with the individual intervention is defined as that individual consented to be eligible for the reward payment. We define compliance with the Peer and CP interventions as: The peer leader for that microfinance group attended the training session. As a secondary measure, we will also check robustness to defining compliance as: the peer leader for that microfinance group provided some training to her group. To be considered a complier with the Peer or CP interventions, the individual must also have consented to the reward payment.

We will estimate the treatment-on-the-treated (TOT) estimates of the treatment interventions using the following model for all the primary outcome variables of interest:

$$\begin{aligned} Y_{ig} &= \alpha_0 + \alpha_I \text{ComplierIndividual}_g \\ &+ \alpha_P \text{ComplierPeer}_g \\ &+ \alpha_C \text{ComplierCP}_g \\ &+ \beta_y Y_{ig}^0 + \mu_s + \epsilon_{ig}, \end{aligned} \tag{2}$$

where we will instrument the intervention compliance indicators with allocation to treatment.

Here $\alpha_I, \alpha_P, \alpha_C$ are our parameters of interest, which estimate the ToT for the Individual, Peer and Consumer Protection interventions respectively.

Additionally, we will look at the impact of using mobile banking during the two months following the intervention on the secondary outcomes:

$$\begin{aligned} Y_{ig} &= \gamma_0 + \gamma_1 \text{UsedMB}_{ig} \\ &+ \mu_s + \epsilon_{ig}, \end{aligned} \tag{3}$$

where we will instrument the use of mobile banking indicator (UsedMB_{ig} - primary outcome 1) with allocation to treatment.

6.2 Long-term effects

To examine long term effects, we will also examine the same administrative outcomes defined in Section 5.1 monthly for 6 months after the intervention, from July -December 2021, as compared to during the intervention, June 2021, using the following specification:

$$\begin{aligned} \text{Y}_{igt} &= \beta_0 + \beta_I \text{Individual}_g + \beta_P \text{Peer}_g + \beta_C \text{CP}_g \\ &+ \sum_{t=1}^{t=6} \beta_{It}(\text{Individual}_g \times \theta_t) \\ &+ \sum_{t=1}^{t=6} \beta_{Pt}(\text{Peer}_g \times \theta_t) \\ &+ \sum_{t=1}^{t=6} \beta_{Ct}(\text{Peer}_g \times \theta_t) \\ &+ \beta_y Y_{ig}^0 + \mu_s + \theta_t + \epsilon_{ist} \end{aligned} \tag{4}$$

where θ_t are dummy variables for months July - December 2021, enabling us to examine how the treatment effect changes over time as compared to during the intervention period.

6.3 Heterogeneity

We will test whether the impact of the treatment varies with pre-determined characteristics, measured at the baseline and denoted by X_i

$$\begin{aligned} \text{Y}_{ig} &= \beta_0 + \beta_I \text{Individual}_g + \beta_P \text{Peer}_g + \beta_C \text{CP}_g \\ &+ \beta_{IX}(\text{Individual}_g \times X_i) + \beta_{PX}(\text{Peer}_g \times X_i) + \beta_{CX}(\text{CP}_g \times X_i) \\ &+ \beta_y Y_{ig}^0 + X_i + \mu_s + \epsilon_{ig} \end{aligned} \tag{5}$$

We will consider heterogeneous effects along the following dimensions available in the pre-intervention admin data(A), at the baseline consent (C) or time invariant variables collected at endline (E):

Heterogeneity:

- Dummy if heard of OISL mobile banking (C)
- Dummy if ever used OISL mobile banking (C)
- Dummy if group leader of the microfinance group had previously ever used mobile banking (C)
- Distance of the microfinance group to the nearest OISL branch: median split (C)
- Distance of the microfinance group to the nearest mobile money agent: median split (C)
- Dummy if used OISL mobile banking in the month before the intervention (A)
- Dummy if registered for OISL mobile banking (A)
- Bank account savings amount: median split (A)
- Age: median-split (E)
- Education: dummy for only primary schooling, secondary or tertiary (E)
- Marital status: dummy for married or in a partnership (E)
- Present biased dummy variable,as measured in an incentivised time preference game (E)
- Risk taking as measured in an incentivised game: median split (E)

6.4 Multiple test correction

We will also correct for multiple testing hypotheses, by implementing Q-values adjust p-values (sharpened p-values), which can adjust the false discovery rate – implementing Benjamini, Krieger and Yekutieli (2006) method.

6.5 Index construction

For some summary measures of outcome families, we will group several related variables into index variables following Anderson, 2008. We will construct the indices in three steps. First, we will re-code all contributing outcomes so that higher values correspond to treatment effects in the same direction ("better" outcomes). Second, we will standardize the individual outcomes using the control group mean and standard deviation for that outcome. Third, we will calculate the average of the standardized constituent outcomes, weighted by the inverse covariance matrix. We will estimate the covariance matrix and hence the weights using only observations that have non-missing values for all outcomes in the index. Where a specific outcome value is missing for a respondent, we calculate the value of the index for that respondent using the remaining outcomes.

7 Robustness

7.1 Controls

We will use LASSO to select controls variables from the set of variables available in admin data before the intervention, at the baseline consent or variables collected at endline that would not have changed since baseline. We will show robustness to running out results including these controls.

7.2 Attrition

To check for systematic attrition between treatment arms, we will execute the following regression:

$$Attrition_i = \beta_0 + \beta_I \text{Individual}_g + \beta_P \text{Peer}_g + \beta_C \text{CP}_g + \mu_s + \epsilon_{ig} \tag{6}$$

Where $Attrition_{ig}$ is one if client i has not completed the survey questionnaire and zero otherwise.

To understand if the composition of the sample changes because of attrition, we will regress an indicator of attrition on a vector of baseline characteristics using the following specification:

$$Attrition_i = \beta_0 + X_i + \mu_s + \epsilon_{ig} \tag{7}$$

For any specification outcome where responses are missing for more than 10% of the sample, we will use two analyses to assess the sensitivity of our results to missing data: 1. We will use the estimates from the previous analysis to construct the predicted probability of missing data for each observation, estimate model (1) using inverse probability weights, and implement the same hypothesis tests described in section 6. We will construct standard errors using a two-stage bootstrap algorithm where we estimate both the weights and the regression parameters in each bootstrap iteration. 2. We will construct bounds on treatment parameters using the trimming procedure described in Lee (2009).

8 Reference

Anderson, M. L. (2008). Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects. Journal of the American Statistical Association, 103(484):1481-1495.

Benjamini, Y., Krieger, A. M., and Yekutieli, D. (2006). Adaptive Linear Step-Up Procedures that Control the False Discovery Rate. Biometrika, 93(3):491-507.

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

Bharadwaj, Prashant, William Jack, and Tavneet Suri. 2019. "Fintech and Household Resilience to Shocks: Evidence from Digital Loans in Kenya." Working paper.

Jack, William, and Tavneet Suri. 2014. "Risk Sharing and Transactions Costs: Evidence From Kenya's Mobile Money Revolution." American Economic Review, 104: 183–223.

Riley, Emma. 2018. "Mobile Money and Risk Sharing Against Village Shocks." Journal of Development Economics, 135: 43–58.

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

Kling, J, Liebman, L, and Katz, L. 2007. "Experimental Analysis of Neighborhood Effects." Econometrica, 75(1): 83-119.

Lee, J., J. Morduch, S. Ravindran, A. Shonchoy, and H. Zaman (2020): Poverty and Migration in the Digital Age: Experimental Evidence on Mobile Banking in Bangladesh," American Economic Journal: Applied Economics.