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Incentives and endorsement for technology adoption: Evidence from mobile banking in Ghana[☆]

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ABSTRACT

How can we encourage the adoption of digital financial services? We use an RCT with 115 microfinance groups in Ghana to understand the respective roles of individual incentives to adopt a technology and endorsement of the technology by a peer. We study mobile banking services, a technology which allows deposits and withdrawals between a mobile phone and bank account, dramatically lowering the transaction costs of saving in the bank account. We find that while individual incentives increase adoption of mobile banking services by 60% (6 percentage points) over 6 months, adding endorsement by a peer doubles the impact of the incentives alone. Peer endorsement significantly enhances confidence in dealing with fraud and increases peer support in using mobile banking. Those encouraged to adopt mobile banking by a peer save 30% (\$4) more in the linked bank account 6 months later. Our study highlights the power of peers in encouraging technology adoption and facilitating formal financial inclusion.

1. Introduction

Bank account ownership is a frequent goal of policymakers, and ownership has risen dramatically in the last 10 years from 50% of adults to 76% of adults owning an account worldwide. However, for bank accounts to benefit individuals they have to be used, and studies have documented low use even of free accounts (Dupas et al., 2018b; Dupas and Robinson, 2013). One potential explanation for this is that even with access to low-cost bank accounts, individuals may struggle to use them in part due to the high transaction costs of travelling to bank branches that are far away. The rapid spread of digital financial services in developing countries offers a solution to the problem of far away bank branches, as users gain the ability to link their bank account and their mobile phone. However, individuals may under-adopt these novel financial services despite their potential benefits for reducing transaction costs.

Low adoption of new digital financial services may stem from the need for hands-on learning through repeated practical experience to understand their benefits (Breza et al., 2020; Bachas et al., 2021). Subsidies, or one-off incentives, may provide a sufficient push to experiment

with new technology and spark adoption (Dalton et al., 2024; Cole et al., 2011; Bryan et al., 2014; Meriggi et al., 2021). However subsidies alone may not be sufficient to spur adoption, particularly for those with the least experience with such technology. Alternatively, a large literature has highlighted the crucial role that peers play in encouraging the adoption of new agricultural technologies (Griliches, 1957; Conley and Udry, 2010; Besley et al., 1994; Munshi, 2004; BenYishay and Mobarak, 2019). However, this organic adoption through “passive learning” can take years due to slow knowledge diffusion and lack of incentives to encourage others to adopt.

In this study, we examine how to encourage the adoption of a new digital financial product and study whether the adoption of this digital financial service facilitates saving in a formal financial institution. Specifically, we test whether a small, one-off incentive for trying out the technology is sufficient to encourage the adoption and continued usage of the digital financial service. Further, we examine whether utilising a peer who receives incentives to endorse the new technology generated greater adoption and usage. We find that while individual incentives are effective at encouraging technology adoption in both the immediate

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and medium term, utilising a peer to endorse the technology results in twice as much adoption as incentives alone, and increases formal bank saving by 30% over 6 months.

We study this using a cluster randomised controlled trial (RCT) with female microfinance groups in rural Ghana. The microfinance group setting is attractive because it consists of real-world groups that meet regularly and with an existing individual, the group leader, who can act as a focal person for endorsing technology adoption. The technology we consider, mobile banking services, allows deposits and withdrawals to a linked bank account directly from a mobile phone, dramatically lowering the costs of saving in a formal bank account.¹

To encourage mobile banking adoption, we randomly assigned 400 women from 115 microfinance groups to one of the two treatment arms or a control arm. In groups assigned to the “Incentive” treatment arm, women received a one-off payment for their own use of mobile banking within a one month period, alongside information on how to use mobile banking. The “Endorsement” treatment arm included the same payment and information as in the Incentive treatment plus the encouragement of knowledge transfer and adoption within the group, through intensive training and referral incentives for the group leader. Women in control groups received no encouragement to adopt mobile banking, but were free to use it if they chose to, and received the same information about the technology as the other treatment arms. This design allows us to isolate the effect of incentives alone from the additional impact of incentivised endorsement.

We use rich monthly administrative data from our microfinance partner during the intervention period and six months after it ended to examine the impact of these treatments on use of mobile banking services and saving in the linked bank account in the short and medium term. We combine this high-frequency administrative data with a detailed survey one month after the intervention ended, in order to study the mechanisms that explain the adoption decision, specifically knowledge of how to use mobile banking, trust in mobile banking and concerns about fraud, assistance amongst peers in using the technology and preferences for digital transactions.

We see significant increases in mobile banking use from both interventions in the short and medium term, though effects are significantly larger in the Endorsement arm, suggesting that the peer endorsement is more effective for encouraging technology adoption than own incentives alone. The Incentive treatment more than doubled (15 percentage points) and the Endorsement arm tripled (27 percentage points) mobile banking use, from a base of 10% use by the control group, in the month during which use was incentivised. This increase in mobile banking transactions is entirely driven by deposit transactions to the linked bank account. Positive effects of both treatments are also seen on the number and value of (deposit) mobile banking transactions. Significant positive effects on use persist six months after the end of the interventions, with mobile banking use in the Incentive treatment remaining 50% greater and use in the Endorsement treatment remaining double that in the control group of 10% carrying out a mobile banking transaction. While our treatment effects are relatively large, in absolute terms, use of mobile banking is still low in the treatment groups, with only at most 37% making a transaction during the incentivised period and only 21% making mobile banking transactions in the 6 months after the intervention takes place. This suggests that neither of our interventions were able to overcome all constraints to using mobile banking, with

¹ The median cost of the round trip to the bank branch in our sample is \$1.25 and takes 50 min. The cost of a mobile banking transaction is a fixed charge of \$0.16 and takes seconds. We consider mobile banking services as lowering the transaction costs of saving, rather than affecting remittances, because a superior remittance transfer technology, mobile money, was already established in this context. As a result, we also do not consider this a network technology, where the benefits of use increase with the number of users in the individual’s network, unlike related technologies such as mobile money or digital payment technologies.

lack of knowledge of how to use mobile banking and an inability to set up the mobile banking platform PIN remaining barriers to adoption.

The increased use of mobile banking for bank deposits translates into increased savings in the linked bank account: Savings in the bank increased by an average of 48 cedis (\$7.68) - a 28% rise in bank saving - in the Endorsement group compared to the control and Incentive groups over a six month period. As a share of their total savings, this represents a 6% increase, a moderately large effect from an intervention that only provided a lower transaction cost method of accessing an existing bank account. When we break down the increase in saving by month, we see that the positive effect of the Endorsement intervention on savings appears three months after the end of the intervention, with savings in the bank account 65 cedis (\$10.4, 44%) higher in the Endorsement arm than in the control group. The Incentive treatment has no positive effect on savings in the linked bank account, potentially because saving impacts materialised after a period of use and use was not high enough in the Incentive arm to lead to savings impacts. While we cannot say for sure if these bank savings crowd-out or are in addition to other forms of saving in the medium term,² we present evidence suggesting that total savings increase in the short term and we see an increase in the formality of savings, as women are more likely to report saving in their OISL bank account. This may bring benefits, as formal savings are at less risk of theft, social sharing pressure and self-control difficulties than cash savings (Alvarez et al., 2022; Riley, 2024; Economides and Jeziorski, 2017).³

Why is the Endorsement arm more effective than Incentives alone at encouraging sustained adoption of mobile banking and increased savings in the bank? Examining mechanisms using our survey data, we find that the Endorsement intervention resulted in significant improvements in knowledge about mobile banking, interaction and help with mobile banking with other members of the microfinance group, and confidence in preventing fraud and safely carrying out digital transactions.⁴ The Incentive treatment only resulted in an increase in knowledge. This suggests that the Endorsement arm was more effective than the Incentive arm at facilitating active learning from others within the microfinance group about how to use mobile banking, leading to greater adoption and continued use. This is despite those in the Incentive arm having a strong motivation to seek out information on how to use mobile banking.⁵ The Endorsement arm was also more effective at removing a key constraint to adopting the technology: concerns about fraud. We see no effects of either treatment on trust in mobile banking or preferences for digital payments over cash.⁶

The Endorsement intervention was a bundled intervention containing both training of the group leader and incentives for the group leader to encourage others in her group to use mobile banking (referrals). As a result, we cannot say definitively whether the training component

² Our endline survey took place only one month after the end of the intervention. At this point, the increase in bank savings in the Endorsement arm is positive but not statistically significant. However, the treatment effect of the Endorsement arm on total savings is positive, though insignificant, suggesting no crowd-out is taking place.

³ Schaner (2017) however cautions that lowering costs of accessing bank savings may make bank savings less attractive for women with low intra-household bargaining power.

⁴ Fraud was a topic that frequently came up organically at group meetings when women discussed using the mobile banking technology. It seems that the Endorsement intervention was more effective at making women feel they could confidently deal with fraud and so overcame this as an obstacle to technology adoption.

⁵ Group members in all study arms could always ask the credit officer for assistance performing mobile banking transactions.

⁶ We see that trust in the technology is very high, with women in the control group on average scoring the mobile banking technology 4.84/5 on trust. This contrasts with other studies of technology adoption, particularly digital technologies, which have found low trust to be a key barrier to adoption, for example Bachas et al. (2021).

or the referral component was most important for the larger treatment effects of this intervention compared to Incentives alone. However, we provide three pieces of suggestive evidence that the training component mattered, at least in groups where the leader had not previously used mobile banking, and that the referral incentives may not have added a significant inducement to knowledge transfer beyond the individual incentives.

Firstly, we can utilise natural variation across groups in whether the group leader was already experienced in using mobile banking. Groups assigned to the Incentive treatment where the group leader was experienced with mobile banking received an intervention closer to the Endorsement treatment, but absent the referral incentive. We see substantial heterogeneity by the group leader's prior use of mobile banking and this heterogeneity is particularly large for the Incentive arm. This suggests that the group leader's knowledge of mobile banking was vital for group members to take advantage of the individual incentives, with knowledge acquired by the leader through the training or through own prior experience partially substitutes for each other. If the group leader had this knowledge and members were incentivised to ask for this, adoption is high, regardless of the presence of referral incentives. Secondly, compliance with the training was incomplete, allowing us to look at the impact of the Endorsement arm by whether the leader actually did the training or not.⁷ This analysis is suggestive that the effect of the Endorsement arm was significantly larger when the leader complied with the training than when she did not, highlighting the importance of the training. Further, the effects of the Endorsement arm are not significantly different to the Incentive arm when the leader did not attend the training,⁸ suggesting the referral bonus had limited effectiveness without the leader also being trained. Consistent with this, using our endline survey, we see substantially greater reported information sharing and assistance with mobile banking from the group leader when the leader was present at the training. While these approaches have limitations, we take this as suggestive that the training component of the Endorsement arm was key for its positive effect, particularly if the leader had not previously used mobile banking.

Taken together, our findings highlight the power of utilising focal members of existing groups to encourage active learning and sustained technology adoption. Encouraging existing knowledge sharing between those who have already adopted and those who have not could significantly increase technology uptake.

Our study contributes to the literature in three key areas. Firstly, our study contributes to the literature on peer influence on technology adoption (Conley and Udry, 2010; Duflo et al., 2008; Foster and Rosenzweig, 1995; Oster and Thornton, 2012).⁹ Rather than allow learning to occur only passively through observation of peer adoption decisions (Griliches, 1957), we encourage active learning from a peer through training and incentives. Our design therefore builds upon (Benyishay and Mobarak, 2019), but in the context of digital technology adoption rather than agricultural technology adoption. We add to this further by comparing incentives on their own to incentives

and encouragement to actively learn from a peer. This allows us to unpick whether it is sufficient to encourage a potential adopter to seek out information or whether encouragement is also needed for a peer to communicate the information. We show that active learning encouragement from peers leads to higher rates of experimentation and subsequent adoption than providing incentives for individual adoption alone.

This approach also has important policy implications: While prior papers have used a complete network mapping to identify the central person (and influential peers) (Beaman et al., 2021; Banerjee et al., 2013), or surveys to identify the most likely central individual to promote information transfer and technology adoption (Banerjee et al., 2019; Benyishay and Mobarak, 2019), this is a costly and time-consuming process, making the policy implications of such approaches challenging. Our experiment shows that the knowledge diffusion process within a network can be facilitated by training and incentivising a pre-existing, easy-to-identify group member. Given the prevalence of group structures in developing countries, from microfinance and Village Saving and Loan Associations (VSLAs) to cooperatives and faith-based institutes (such as churches, mosques, or temples), using focal people within the known group to encourage technology adoption has broader policy relevance.

Secondly, we document increases in bank savings as a result of linking a bank account to the mobile money infrastructure, thus contributing to the literature on how to increase formal savings through lowering transaction costs. While prior research has looked at lowering bank account opening fees (Dupas et al., 2018b), transaction costs remained an obstacle to use.¹⁰ Mobile money services are an effective way to lower transactions costs and therefore could enable saving, though prior studies have found mixed evidence on whether mobile money accounts are used for saving, with large incentives often required to induce people to save (Suri and Jack, 2016; Batista and Vicente, 2020).¹¹ Habyarimana and Jack (2024) study a service allowing a separate interest-earning saving account for school fees within a mobile money wallet, observing high use, increased savings and higher child school enrolment. Our study generalises theirs to savings beyond one specific type. Our findings align with those of Bachas et al. (2021), who show that debit cards, which also substantially lower the costs of accessing a bank account in a context with widespread ATMs, lead to increased saving in the bank account over time. Our results contrast with De Mel et al. (2022), who study an early technology using airtime scratch cards to deposit (but not withdraw) to a bank account and found limited effects on savings. This suggests that perceived ease of access might also be vital for people to be willing to save in the account, potentially due to the risk of adverse shocks and the need to be able to also withdraw funds quickly and cheaply.

Lastly, our detailed data on mechanisms highlights the importance of fraud awareness and confidence in addressing it for financial technology adoption, even when people have high trust in the technology itself. Other studies have documented widespread over-charging by mobile money agents (Annan, 2021), particularly for women (Annan, 2020), and poor consumer protection in developing countries (Garz et al., 2021). Attempts to improve people's ability to detect scams have had mixed success and found that people become over-cautious (Kubilay et al., 2023), which could potentially further reduce their willingness to adopt new digital financial services. However, there is evidence that increasing users' experience with a technology can reduce market-level over-charging by agents (Breza et al., 2020). We show that peer

⁷ The decision by the group leader of whether to attend the training may be endogenous, so these results should be interpreted with caution and taken as suggestive. However, we think attendance at the trainings was quasi-random, as we only carried out the training on a single day and provided a large incentive to leaders to attend.

⁸ Leaders always received the referral incentives regardless of whether they attended the training or not.

⁹ A large literature also examines network complementarities in the adoption of digital technologies, where the benefits of adoption increase in the number of users within an individual's network (Crouzet et al., 2023; Alvarez et al., 2023; Björkegren, 2019). Mobile banking services do not display network complementarities, as the benefits of use are principally lower transaction costs of depositing and withdrawing funds to an individual bank account, the technology cannot be used for payments and its transfer capabilities are limited.

¹⁰ Other studies have studied the role of transaction costs to saving by visiting individuals in person each week to save, finding this increases saving substantially, but these approaches are costly to scale (Callen et al., 2019).

¹¹ Mobile money accounts are not a natural saving account as they are primarily designed to facilitate transactions and interest is not earned on the account.

interaction around new technologies and learning to use them together can also increase general knowledge of fraud, and confidence in the ability to use financial accounts safely, supporting the adoption of a new financial service.

The paper is organised as follows. Section 2 describes the setting and background, Section 3 the intervention and study design, Section 4 discusses the data and empirical specification and Section 5 the results. Section 6 discusses the findings and concludes.

2. Setting

2.1. Financial inclusion in Ghana

Mobile money services were introduced in Ghana in 2013 and have taken off dramatically since then, rising to 60% of the population having an account in 2021 (Demirguc-Kunt et al., 2022). Mobile money allows the transfer of money from one mobile phone to another. Cash is deposited and withdrawn via widespread agent networks, which can be individual kiosks within shops or service centres run by the telecom provider. Like most countries where mobile money is first introduced, it is primarily used for remittance transfers: only 13% of users have used mobile money to make a purchase in a store, 6% have received wages through mobile money and 8% made a utility payment, though 37% report saving with mobile money (Demirguc-Kunt et al., 2022).

Bank account ownership is also moderately high in Ghana, with 39% owning a bank account (Demirguc-Kunt et al., 2022). However, active use of mobile money accounts is much higher than use of bank accounts, with 86% of mobile money users using the account multiple times a month while only 60% of bank account owners made a deposit in the last year. This discrepancy can be attributed in part to accessibility, with 80% of bank users residing over 30 min travel (by their usual means of transport) from their branch, whereas 90% have a mobile money agent within a 30 min walk. (FII, 2015).

2.2. OISL microfinance

We partner with Opportunity International Saving and Loans (OISL), the largest microfinance provider in Ghana with 40 microfinance branches across the country. OISL targets poor, traditionally un-banked populations for its loans, and focuses on rural areas that would not be served by other financial institutions. The loan is meant to develop a small enterprise. Three-quarters of all OISL microfinance clients are women.

In order to receive a microfinance loan, women must first form a group with others in their community of 4–6 members. They must select a leader in their group, who is responsible for organising their meetings and ensuring all members of the group attend them. On average, we see that group leaders are slightly more educated, have larger loans from the bank and are more likely to have used mobile banking services before, but are a similar age, have similar household compositions and have been running a business for as long as group members (Appendix Table B1). The group leader does not have any additional power compared to the other group members, for example in determining who can join the group or who gets a loan. While clients must form a group in order to obtain a loan, the loans are given under individual liability contracts.

The clients receive a bank account at OISL when they take out a loan, which the loan is deposited into. Women must go to the branch to complete paperwork when the loan is disbursed and usually withdraw the loan as cash at disbursement. Loan repayments are made in cash to the credit officer during group meetings in the client's community. 55% of the OISL groups repay their loans fortnightly, 20% weekly and 25% monthly and loans are given for 4–8 months. The average loan size is \$350, starting from \$75 to a maximum of \$1,500. Upon loan repayment, clients become eligible for a subsequent loan, with progressively increasing amounts.

2.3. Mobile banking

Mobile banking services allow bank deposit and withdrawal services using a mobile phone, substantially reducing the costs of accessing a bank account.

Mobile banking requires both an existing bank account and an existing mobile money account to link together. The mobile banking platform that we consider here, Opportunity Mobile, works over the USSD system on the cellular network, so no smartphone or internet data is needed. It uses the mobile money infrastructure, and so is a familiar system to existing mobile money users. In order to deposit cash into your bank account, you first visit any mobile money agent to deposit cash into your mobile money wallet. The mobile banking platform is then used to move money from the mobile money account to the bank account, paying a fixed cost of 1 cedi (\$0.16).¹² To withdraw money from your bank account, you use the mobile banking platform to withdraw money from your bank account and deposit it into your mobile money account, after which you can withdraw it from an agent as cash or send it to someone else using mobile money services. There is no fee for withdrawals, beyond the usual mobile money fee.

This technology substantially reduces the time and money cost of saving in a formal bank account compared to in-person transactions.¹³ In our sample, the median cost of a round trip to the local bank branch was 15 cedis (\$2.4) and took 50 min. Carrying out the same transaction using mobile banking costs 1 cedi and takes less than a minute.

While in principle mobile money could be used to save, cutting out the requirement to move funds from the mobile money wallet to the bank account, saving in a bank account has several key advantages over using mobile money to save: (1) interest is earned on the bank account,¹⁴ (2) the account is protected by banking regulation against losses, (3) there is no limit to the balance you can hold, and 4) banks offer different types of saving accounts and access to other financial products such as loans to account holders. Further, mobile money is designed for transfers, and so there are mental accounting benefits to keeping savings in a separate account earmarked for saving. Consistent with this, saving with mobile money is uncommon in our sample despite high (95%) use of mobile money services, with only 12% of savers reporting using mobile money to save (Table B2).

3. Intervention and study design

The study uses a cluster randomisation design with 115 microfinance groups distributed into three treatment/control arms. Our treatments arms utilise an encouragement design through the provision of incentives and additional training to the group leader, while the control group holds constant the information environment related to mobile banking

3.1. Interventions

1. Personal incentive (I - Incentive):

¹² This compares favourably to the 1% fee and minimum charge of 0.5 cedis for mobile money transfers.

¹³ Note that we do not consider this a technology with network effects since its function is not to ease sending transfers to other people, but rather to ease saving in an existing bank account. Transfers are possible, but only to other OISL bank account holders, and take 1–2 days. Mobile money services are already established in this setting and represent a superior transfer technology, taking seconds. Mobile banking cannot be used for payments.

¹⁴ OISL accounts pay 2%–5% annual interest depending on the account balance.

- (a) **Own Incentive:** Clients in this arm received a one-time 10 cedi (\$1.66) monetary incentive if they carried out a mobile banking transaction (withdrawal or deposit to/from the account) within a one-month period. This incentive was sent as mobile money. Clients were provided with a flyer containing this information during their group meeting (see Appendix B1 for this).
- (b) **Information:** Clients received basic information on mobile banking covering what it is, how to sign up and transaction types eligible for the incentive from their OISL credit officer during the group meeting. This is the standard information that OISL shares with clients to encourage them to start to use its mobile banking service.

2. Leader training and referral incentive + Personal incentive (E - Endorsement):

- (a) **Leader training:** Group leaders received a comprehensive half-day training on mobile banking use and its benefits.¹⁵ OISL implemented this training themselves, with enumerators observing. This training involved practical exercises where leaders conducted transactions using provided funds, which were then verified by enumerators. The group leader was asked to share knowledge gained during the training with her group members and support her group members in using mobile banking. No mention of either the own or referral incentives for using mobile banking was made during the training.
- (b) **Information:** The group leader was asked to provide information about mobile banking to the rest of their microfinance group at the next group meeting. The OISL credit officer also provided standard information about mobile banking services at the same group meeting.
- (c) **Referral incentive:** The group leader received an incentive of 10 cedi (\$1.66) for each member of her microfinance group who completed a mobile banking transaction (withdrawal or deposit to/from the account) during a one-month period, up to a maximum of 50 cedis (\$8.3). Group leaders were provided with a flyer containing information on the referral incentive during the next group meeting after the training. The referral incentive information and flyer were given to the group leader regardless of whether they had attended the training or not. Group members were informed at the same time that the leader would receive an incentive for their use of mobile banking.¹⁶
- (d) **Own Incentive:** Each member of the microfinance group (including the leader) was eligible for the same personal incentive as in the Incentive arm and received a flyer with details of this on it during the group meeting.

3. Control (C):

- (a) Clients in this arm received no encouragement to use mobile banking, though they were free to utilise the service if they chose.

- (b) **Information:** Clients were provided with standard information about mobile banking services by the credit officer at the group meeting.¹⁷

Table 1 summarises the intervention design.

All the women who were offered the individual incentive accepted the treatment in both the Incentive and Endorsement arms. In the Endorsement arm, 36 out of 59 group leaders attended the group training (61% attendance). All group leaders were offered the referral incentive, regardless of whether they attended the training, and all leaders accepted this. We discuss compliance extensively in Appendix A.

3.2. Sample and randomisation

We selected 4 branches for this study, and included all active microfinance groups that were composed of only women,¹⁸ had at least 3 members and had at least one member already registered for mobile banking.¹⁹ These criteria ensured that we had a relatively homogeneous set of microfinance groups containing only female clients.

We assigned microfinance groups, and all the clients of that group, to treatment using a stratified randomisation in STATA with median splits of the distance to the nearest mobile money agent, distance to the OISL branch and saving balance in the OISL saving account as strata. We conducted the randomisation at the microfinance group level since this is the level at which women would interact with each other and hence spillovers could occur.²⁰ This resulted in 115 groups being included in the study with the following allocation; 27 in control (C), 29 in Incentive (I) and 59 in Endorsement (E).²¹

After randomisation, the group leader in groups assigned to the Endorsement arm was invited to a training session, which took place on a single day at a location near to the microfinance branch of that group. The invitation to the training described it as a training in how to use OISL's mobile banking platform that OISL would like all group leaders to attend, and leaders were incentivised to come by receiving a 100 cedi payment.²² Simultaneously, we approached all the 115 groups selected to take part in the study to carry out the consent process with their members. 407 women consented to take part in the study, 114 in the control group, 99 in the Incentive arm and 194 in the Endorsement arm.²³ After consenting to take part in the study, group members were told about their assigned intervention in the treatment arms.

¹⁷ OISL had been and continued to provide information to clients about their mobile banking services. This information was refreshed to the control group at the same time as the other interventions took place to hold the information environment constant. Note that all women in all treatment arms could ask the credit officer about mobile banking at any time during the study. Additionally, if a client went to the bank branch, OISL were advertising their mobile banking services to clients.

¹⁸ 75% of OISL's microfinance clients are women.

¹⁹ At the time OISL was registering all clients for mobile banking automatically, such that 70% of clients were registered for mobile banking. This restriction only resulted in 40 out of 555 groups being dropped.

²⁰ Microfinance groups are usually located in different villages or far apart from each other, so we would not expect women from different groups to interact with each other.

²¹ The Endorsement group was further divided into two subtreatments, which differed only in the inclusion of an additional training module during the group leader training on consumer protection. We pool these for all analysis presented here.

²² No mention of incentives for using mobile banking (either for the individual or for referring group members) were mentioned either in the invitation or during the training.

²³ 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.

¹⁵ Half of the group leaders also received an additional training module on consumer protection. We do not find any differences depending on whether the group leader received this additional fraud module, and so pooled these arms for all analysis. Anecdotally, fraud came up as a discussion topic frequently even at the trainings that did not cover fraud explicitly, which may have diluted the difference between these treatment arms.

¹⁶ Unlike Deserranno et al. (2023) we do not have any variation in whether the incentive structure for the group leader was known by members. However, we do not expect the mechanisms they find of trust in agents to be prominent here, as the group leader is well-known to the group members and there is very high trust in mobile banking (see Table 6).

Table 1
Intervention design.

Arm	Information on Mobile Banking	Incentive (own)	Training	Incentive (referral)
Control	All group members - provided by credit officer	–	–	–
Incentive	All group members - provided by credit officer	All group members	–	–
Endorsement	All group members - provided by credit officer and group leader	All group members	Group leader	Group leader

4. Data and empirical specification

The sources of data for this study include responses from the consent survey, group leader comprehension questions from the training (Endorsement arm only), OISL monthly administrative records (Feb–Dec 2021), and an endline survey one month after the intervention (August 2021). A timeline for the study is shown in Appendix Figure B2.

Basic demographic data was obtained from OISL records, including gender, age and associated branch (location). During the consent process, we collected data on clients' prior knowledge and use of mobile banking. The endline survey instruments cover background characteristics (marital status, education), business outcomes, saving behaviour, mobile money knowledge, and mobile banking use, trust, preference and fraud confidence. The administrative data are composed of two data source:

- 1. Mobile Banking transactions:** The universe of deposit and withdrawal transactions each month using the OISL Mobile Banking platform.
- 2. Saving account balance:** The month-end saving balance in all OISL accounts.

Note that we cannot see in-person transactions in the datasets available to us. We can make inferences about in-person transactions based on the value of mobile banking transactions and changes in the overall account balance.

4.1. Outcome measures

We pre-specified four primary outcomes capturing use of mobile banking. Three captured use of mobile banking at the intensive and extensive margin from the administrative data, all captured at the monthly level: whether mobile banking was used, the value of mobile banking transactions, and the number of mobile banking transactions. We examine these outcomes for the intervention period to study takeup and for the 6 months after the intervention ended to study medium-term adoption. The fourth measure was an index of expected use of mobile banking from the endline survey. The index captured self-reported measures of registering for mobile banking, resetting the mobile banking pin, using mobile banking in the last 30 days and likelihood of using mobile banking in the next 30 days.

We also consider the end-of-the-month saving balance in the OISL account every month during and for 6 months after the end of the intervention, as our primary measure of formal savings.²⁴

We specified five indexes capturing potential mechanisms through which the interventions might have worked that were captured in the endline survey: knowledge of mobile banking, trust in mobile banking, fraud knowledge and confidence, peer interaction around mobile

²⁴ This was specified as a secondary not primary outcome in our pre-analysis plan because of the need to build up balances over time to see any changes in savings and because when we first wrote the pre-analysis plan, we did not know we would be able to obtain data on savings balances for 6 months after the end of the intervention.

banking and preferences for digital payments over cash. We further specified we would examine five downstream secondary outcomes captured in the endline survey (total savings, loans, business outcomes and women's empowerment), taking these as exploratory given the short period between our intervention and endline survey.

All indices are constructed following Anderson (2008) with the components coded to be the same sign and standardised against the control group.

4.2. Baseline balance and descriptive statistics

We do not see any imbalance by treatment across the variables examined in Table 2. We also perform an omnibus test where we regress each treatment on all covariates and examine whether they jointly predict treatment. The F-statistics from these tests for the Incentive and Endorsement arms are 1.13 and 0.77 respectively, which are not statistically significant.

This table also displays some summary statistics. Nearly everyone in the sample had a mobile money account (95%), which is necessary to use mobile banking services. 80% of women had heard of OISL mobile banking, confirming that OISL had previously provided information to clients about the service, but only 7% reported using it. In the transaction data, we see a slightly higher percentage of mobile banking use (12%), suggesting some women might be asking others to conduct transactions on their behalf. 70% of women are registered for mobile banking, as OISL have been automatically registering all clients when they visited a branch for other matters.²⁵

The women are on average 43 years old, 13% have no education, 24% have only primary and 62% have secondary schooling or above. 58% of them are married. They have 0.65 children aged 5 or younger on average, 1 child aged between 6–12, and 1 child aged between 13–18. Their businesses have been operating for 103 months (8.5 years). We can also document that while the groups are on average only 11 min walk from a mobile money agent, they are 51 min travel from the nearest branch. 11% of women are in groups where the group leader has used mobile banking before. The average loan amount is 2159 cedis (\$350) and the average balance in the OISL account is 115 cedis (\$18.4).²⁶

Since we did not do a baseline survey in this study, we present additional summary statistics for the control group only at endline in Table B2, noting the small sample size of only 113 women for this analysis. These statistics focus on savings in different forms, business characteristics and use of mobile money. We see that only 26% of clients report having savings in their OISL bank account, while 14% report having savings with another bank. This supports the idea that most OISL clients are not using their bank account with OISL for savings, potentially due to the large travel time to the branch. 32% report saving using Susu collectors, who take deposits directly from

²⁵ If a client was not registered and wanted to use it, they would have to go into a branch to complete the registration process.

²⁶ There is a large distribution of balances in the OISL account, with the median 14.96 cedis (\$2.39) and standard deviation 236.00 (\$36.76). 27% of the women have zero balance in their OISL account.

Table 2
Balance on Baseline Variables.

	(1) Control Mean	(2) Control SD	(3) Incentive	(4) Endorsement	(5) p-value I=E	(6) N
<i>Panel A: Individual Characteristics</i>						
Used Mobile money	0.95	0.23	−0.02 (0.04)	−0.02 (0.03)	0.92	398
Heard MB	0.80	0.40	−0.00 (0.08)	0.00 (0.07)	0.98	398
Registered MB	0.71	0.46	−0.09 (0.07)	−0.03 (0.06)	0.37	398
Used MB	0.07	0.26	−0.01 (0.05)	−0.01 (0.04)	0.83	398
Any MB Transaction ^a	0.12	0.32	−0.01 (0.08)	0.03 (0.07)	0.53	398
No. MB Transactions ^a	0.35	1.07	−0.10 (0.23)	0.04 (0.23)	0.45	398
Value MB Transaction ^a	61.83	203.13	15.65 (54.60)	23.33 (47.32)	0.88	398
Age	43.27	10.65	−0.15 (1.62)	2.66* (1.48)	0.06	398
Primary School	0.24	0.43	0.05 (0.06)	−0.06 (0.05)	0.07	398
Secondary School	0.62	0.49	0.01 (0.06)	0.09 (0.06)	0.22	398
No Schooling	0.13	0.34	−0.05 (0.05)	−0.03 (0.04)	0.61	398
Married	0.58	0.50	0.05 (0.06)	0.01 (0.06)	0.51	398
Children under 5	0.65	0.75	−0.02 (0.13)	−0.01 (0.10)	0.98	398
Children 6–12	1.06	1.04	−0.18 (0.16)	−0.03 (0.14)	0.27	398
Children 13–18	1.00	0.92	−0.04 (0.11)	0.10 (0.11)	0.29	398
Business age (months)	103.42	115.85	−5.14 (16.61)	18.10 (14.48)	0.16	398
<i>Panel B: Group Variables</i>						
Distance to Agent (mins)	10.97	9.13	−2.64 (2.43)	−1.36 (2.32)	0.39	398
Distance to Branch (mins)	50.65	20.28	0.02 (6.02)	−2.69 (5.17)	0.63	398
Leader Used MB ^a	0.11	0.31	−0.00 (0.08)	0.04 (0.07)	0.61	398
<i>Panel C: Account Variables</i>						
Loan Amount (GHS) ^a	2159.43	1366.32	−74.20 (275.10)	15.75 (274.27)	0.69	398
Account Balance (GHS) ^a	115.47	235.99	21.11 (50.40)	31.06 (44.51)	0.85	398
F-statistic Incentive					1.13	
F-test p-value Incentive					0.31	
F-statistic Endorsement					0.77	
F-test p-value Endorsement					0.76	

Notes: The mean and standard deviation of each covariate in the control group is shown in columns (1) and (2). Coefficients and standard errors shown in columns (3) and (4) are obtained from the regression of the covariate on each treatment indicator and the test of the null that the coefficient on each treatment indicator equals zero. Column 5 shows the p-value of the t-test that the coefficients on Incentive and Endorsement are equal in the same regression. Each row is a separate regression. All values in Ghana Cedis. The F-statistics and p-values in the bottom panel are from a regression of all covariates shown on each treatment indicator and a test of whether the variables are jointly insignificant. Standard errors clustered at the group level in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

^a Denotes a variable from administrative data.

individuals. 22% report saving at home while only 12% report saving with mobile money. 8% have no savings. Most of the women operate retail businesses (42%), followed by food vendor (27%) hawking (20%) and operating a market stall (12%). Women make 600 Ghanaian cedis (\$96) of profit a month in their businesses on average, on sales of 3200 cedis (\$500). Only half of businesses allow customers to make payments using mobile money despite 75% of individuals having used mobile money in the last month. 80% of women have a regular mobile money agent that they use.

4.3. Attrition

Attrition was minimal in our study: the endline survey was only carried out 2 months after the study consent, and we only lost 9 women at followup, or 2% of the sample. Attrition did not vary systematically by treatment arm, as shown in Appendix Table B3. We also examine predictors of attrition in Appendix Table B4 using the small set of variables from the admin data or captured during the consent process. Clients who had heard of Opportunity Mobile were less likely to attrit, as were clients in groups where the leader had previously used mobile

Table 3
Effect of treatment on mobile banking use during the incentivised period.

	(1) Any Transaction	(2) Value Transactions	(3) No. Transactions	(4) MoB Use Index
Incentive	0.148 (0.069) [0.035]** {0.211}	18.153 (52.886) [0.732] {1.000}	0.338 (0.171) [0.051]* {0.211}	0.227 (0.136) [0.097]* {0.269}
Endorsement	0.267 (0.062) [0.000]*** {0.000}***	62.507 (54.502) [0.254] {0.529}	0.329 (0.121) [0.007]*** {0.021}**	0.391 (0.099) [0.000]*** {0.001}***
Observations	398	398	398	398
Control Mean	0.106	105.575	0.319	0.000
Incentive = Endorsement	0.071	0.154	0.961	0.196

Notes: Individual mobile banking use from administrative data during the incentivised period (Jun 2021). All regressions include strata fixed effects and controls for mobile banking use at baseline. Columns (1)–(3) is administrative data during the incentivised period (Jul 2021). Column (1) is a dummy variable for use of mobile banking, column (2) is the value of all mobile banking transactions in Ghanaian cedis, and column (3) the number of mobile banking transactions — all defined over a 1 month period. Column (4) shows an index of mobile banking use capturing self-reported measures of registering for mobile banking, resetting the mobile banking pin, using mobile banking and likelihood of using mobile banking in the future. Control mean is the mean of each outcome in the control group. Incentive= Endorsement is the p-value from a t-test of equality of the Incentive and Endorsement coefficients. Clustered standard errors in parentheses. p-values in square brackets. q-values in curly brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

banking. Own use of mobile banking and loan characteristics do not predict attrition.

Since the administrative data contained the universe of mobile money transactions, there is no attrition when examining this data source. If no mobile banking transactions took place we code these outcomes as zero. No accounts were closed for our study sample during the study, and so we always observe the saving balance in the OISL accounts, including if it is zero.

4.4. Empirical strategy

As stated in the pre-analysis plan,²⁷ to estimate the effect of the treatments, we estimated the following intention-to-treat (ITT) ANCOVA equation :

$$Y_{ig} = \beta_0 + \beta_I \text{Incentive}_g + \beta_E \text{Endorsement}_g + \beta_y Y_{ig}^0 + \mu_s + \epsilon_{ig} \tag{1}$$

Where Y_{ig} is the outcome variables of interest for OISL client i , in strata s , in microfinance group g . Incentive and Endorsement are the Incentive treatment and Endorsement treatment assignments of the client’s microfinance group. β_I and β_E are the ITT effects of the Incentive and Endorsement treatments. Y_{ig}^0 is the value of the outcome measure at the baseline, if available. μ_s is a vector of strata dummies and ϵ_{ig} are clustered standard errors at the microfinance group level.

For the data on mobile banking adoption and saving in the OISL account, where we have monthly administrative data for a 6 month period, we estimate the following:

$$Y_{igt} = \beta_0 + \beta_I \text{Incentive}_g + \beta_E \text{Endorsement}_g + \beta_y Y_{ig}^0 + \mu_s + \sum_2^6 \theta_t + \epsilon_{igt} \tag{2}$$

where t denotes the month and θ_t are month dummies. All outcomes are calculated for a given month.

Multiple test corrections are carried out according to the procedure outlined in Benjamini et al. (2006) to calculate q-values adjusting for

²⁷ Note that our pre-analysis plan splits the Endorsement intervention into two based on whether the consumer protection (CP) component was included in the training. We pre-specified that if we found no differences between the impact of the interventions including this additional component (“Peer” and “CP”) or not, we would pool them. As a result, all analysis shown here pools the Peer and CP arms together as the Endorsement intervention.

the false discovery rate. We do this across the four primary outcomes and five mechanisms that we pre-specified.

5. Results

5.1. Use of mobile banking during incentivised period

Table 3 shows that both treatments were successful at encouraging use of mobile banking services during the incentivised period, though the Endorsement arm was significantly more effective. The Incentive intervention resulted in a 14.8 percentage point increase in the likelihood of making a mobile banking transaction in the incentivised month, more than double the control group mean of 10.6%. However, the Endorsement intervention resulted in a significantly higher 26.7 percentage point increase in the likelihood of making a mobile banking transaction, more than triple the control group use. The significantly increased likelihood of mobile banking use in the Endorsement arm also survives a multiple test correction at the 1% level, while the Incentive intervention does not.

The value and number of transactions (columns (2) and (3)) during the incentivised month are also greater in both treatment arms, though they are not significantly different from each-other and the value of transactions is not significantly different from the control group for either treatment. Given only one transaction was incentivised and it is a relatively short time period, this is not unexpected. The increase in mobile banking transactions is driven by deposit transactions to the bank account rather than withdrawals (see Appendix Table B5).

The index of mobile banking use increases by 0.4 standard deviations in the Endorsement arm (column (4)). The Incentive arm only leads to a significant increase in the likelihood of making a mobile banking transaction of 0.23 standard deviations that does not survive a multiple hypothesis test correction, though we cannot reject equality with the Endorsement intervention. The increase in the index is coming from increases in all components, including travelling to the branch to register²⁸ for mobile banking or to reset a forgotten pin, self-reported use over the last 30 days and perceived likelihood of using mobile banking in the next 30 days (Appendix Table B6).

We also look descriptively at predictors of using mobile banking during the incentivised period. For this analysis, we focus on the two

²⁸ 70% of women were already registered for mobile banking, which OISL had been doing automatically when a woman visited a branch for any purpose.

treatment arms, and look at whether women made a mobile banking transaction that qualified them for the incentive. Results are shown in Table B7. We split the predictors into three types and add them sequentially. Firstly, we examine whether knowledge and use of mobile money and mobile banking are predictive of making an eligible transaction. Indeed, prior use of mobile banking is strongly predictive, with treated women who have previously used mobile banking 68 percentage points more likely to make an incentive-eligible transaction. Interestingly, being registered for mobile banking or having heard of it are not predictive. Adding in demographic characteristics of the woman, we see that older women, with fewer children 6–12 and more aged 13–18 are more likely to make an incentivised mobile banking transaction.

Finally, we add in group and loan characteristics. Now we see that whether the group leader has used mobile banking before is strongly predictive, and own use of mobile banking is no longer predictive, of conducting a mobile banking transaction when offered an incentive. Women with higher account (saving) balances and secondary or higher education are also more likely to make an incentive-eligible mobile banking transaction, suggesting having sufficient funds and digital literacy are important determinants of takeup. Overall, while we find some weak predictors of whether a woman carried out an incentive eligible transaction or not, own prior mobile banking use and the group leader's prior mobile banking use as by far the strongest predictors. This suggests that experience with this type of transaction was crucial, with group leader experience substitutable for one's own experience.

Our predictors beyond prior use of mobile banking have limited power to explain the decision to use mobile banking during the incentivised period. What therefore explains this decision? In the endline survey, we asked treated women why they did not complete a mobile banking transaction during the incentivised period. 36% of women said they did not know how to use mobile banking, 27% that they were not registered for mobile banking, 20% that they did not know how to use mobile money, 14% that they forgot about the reward and 8% that they did not understand the reward.²⁹ We also asked all women who had not why they had never performed a mobile banking transaction. The most common reason given was that they do not know how to, given by 65% of the control group, 60% of the Incentive arm and 57% of the Endorsement arm.³⁰ Women in the treatment arms who did not use mobile banking are more likely to say there was a technical barrier to use, with 34% of the Endorsement arm and 29% of the Incentive arm reporting that their Opportunity Mobile account had not been set up compared to 22% in the Control group.³¹ This could suggest that amongst women with a desire to use mobile banking, technical barriers and an absence of information on how to overcome these barriers also contributed to them not being able to use mobile banking. These explanations suggest that lack of knowledge specifically about how to get the account set up and carry out transactions is the main reason why women were not able to complete the incentivised mobile banking transaction. This suggests barriers within groups in terms of information flowing from the credit officer and/or group leader, who could have assisted members with this. In addition to information barriers, the need to go into the branch in the event of set-up failures may have been a deterrent for some women. It also suggests that higher takeup would likely require a more intensive intervention, such as training women individually in how to use mobile banking, ensuring their account is set up correctly, providing large incentives and practising transactions, as done in other studies with higher takeup rates (Lee et al., 2021; Batista and Vicente, 2023).

²⁹ Women could select multiple explanations. No one said that the reward amount was insufficient or that they did not think it would be paid.

³⁰ These differences are not statistically significant.

³¹ While all women in the study were registered for mobile banking, if the woman had forgotten her PIN she would have to go into a branch to have this reset. This is most likely what women mean by the account had not been set up.

Table 4
Effect of treatment on mobile banking use after the incentivised period.

	(1) Any Transaction	(2) Value Transactions	(3) No. Transactions
Incentive	0.061 (0.025) [0.017]** {0.075}*	35.015 (15.799) [0.027]** {0.075}*	0.114 (0.067) [0.092]* {0.168}
Endorsement	0.116 (0.025) [0.000]*** {0.000}***	70.246 (16.235) [0.000]*** {0.000}***	0.158 (0.059) [0.007]*** {0.014}**
Observations	2388	2388	2388
Control Mean	0.103	46.599	0.201
Incentive = Endorsement	0.047	0.065	0.509

Notes: Individual adoption of mobile banking during the 6 months after the incentives ended (Jul–Dec 2021) from administrative data. Outcomes at the monthly level, pooled over all months. All regressions include strata fixed effects, control for mobile banking use at baseline and include month dummies. Column (1) is a dummy variables for use of mobile banking, column (2) is the value of mobile banking transactions in Ghanaian cedis, and column (3) is the number of mobile banking transactions, all defined on a monthly basis. Control mean is the mean of each outcome in the control group. Incentive= Endorsement is the p -value from a t -test of equality of the Incentive and Endorsement coefficients. Clustered standard errors in parentheses. p -values in square brackets. q -values in curly brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.2. Adoption of mobile banking services in the medium term

Did the interventions result in sustained mobile banking adoption beyond the incentivised period? Table 4 demonstrates continued adoption of mobile banking services in the six months following the interventions, with effects significantly larger for the Endorsement arm compared to the Incentive arm. This suggests that the incentives did not encourage use of mobile banking only once in order to receive the payment, but that they caused individuals to experiment with the technology, learn about its benefits and continue to use it over the subsequent months.

The Incentive intervention resulted in women being on average 6.1 percentage points more likely to use mobile banking services each month (column (1)). The Endorsement intervention had significantly larger treatment effects and resulted in women being 11.6 percentage points more likely to use mobile banking services each month.³² These compare to a control group mean of 10.3% using mobile banking each month, meaning the interventions led to a 60%–120% increase in adoption of mobile banking. The likelihood of any use of mobile banking in a month is significantly higher for women in the Endorsement arm compared to women in the Incentive arm. Similar patterns are seen for the value and number of transactions (columns (2) and (3)), with the Endorsement intervention leading to a significantly higher value of transactions than the Incentive intervention. These results survive multiple hypothesis testing corrections.

A cumulative density function for the value and histogram for the number of transactions using mobile banking by treatment arm are shown in Figures B3 and B4.³³ Here we can clearly see the shift to the right in the distributions of both these outcomes in the Endorsement arm, compared to both the control and Incentive arms. In terms of the value of transactions, women in the Endorsement arm make more mid-value transactions of between 400 and 1200 cedis (\$63–190), as well as some much larger transactions above 2000 cedis (\$317). The increase in the value of transactions in the Incentive arm seems to mainly be driven by the top of the distribution. In terms of the number of

³² In Table B8 we show robustness of these results to controlling for variables selected by LASSO.

³³ Note that deposits constitute nearly all transactions, by both value and number.

transactions, women in both treatment arms are shifting from making no transactions in the month to making between 1 and 4 transactions.

As during the incentivised period, the increase in use in both treatment arms is driven by an increase in deposits (Table B9). Less than 1% of the control group make a withdrawal in a month using mobile banking, compared to 10% making a deposit, their value is 1 cedi on average compared to 45 cedis for deposits and they number only 0.025 a month compared to 0.18 for deposits. There are no treatment effects on withdrawals. This suggests that either the saving balance in the bank account will rise, or that women were making larger withdrawals in-person.³⁴ In Section 5.3 we see that indeed savings in the linked bank account increase in the Endorsement arm.

When we break down treatment effects by month in Table B10, we see that treatment effects are initially constant then decline slightly in the Incentive arm from October. Use of mobile banking services also began to increase strongly in the control group from October as OISL began encouraging all microfinance groups to adopt mobile banking,³⁵ resulting in them catching up with the Intervention arm. In contrast, mobile banking use and the value of transactions increases initially over time in the Endorsement arm. From October, the gap in use between the Endorsement and control groups remains constant despite use in the control group increasing by 12 percentage points. This suggests that the Endorsement arm was better able to encourage continued adoption and use amongst group members over time, whereas the Incentive arm did not encourage use beyond those who responded initially to the incentive.

Overall, this implies our interventions were successful at encouraging sustained use of mobile banking services over a six month period, though the Endorsement intervention led to significantly larger effects that grow and persist more strongly over time.

5.3. Savings

We examine two forms of savings. Firstly the saving balance in the OISL bank account, for which we have the monthly end-of-month balance during and for six months after the intervention ended. We complement this rich admin data with survey data on total savings in all forms, one month after the end of the intervention, to provide suggestive evidence on whether crowding-out of savings is occurring.

Results for the effect of the treatments on the account balance in the OISL bank account during and for six months after the end of the intervention are shown in Table 5 following specification 2. We see in column (1) that women in the Endorsement arm save 49 cedis (\$7.68) more a month on average, significant at the 10% level, a 28% increase in bank savings. The Incentive arm does not increase savings on average.

This average over all months hides changes in savings over time, as seen in column (2) (and shown graphically in Figure B6). From October onwards, women in the Endorsement arm save 64 cedis-82 cedis (\$10-13) per month more than the control group, significant at the 1% level, approximately a 44%–55% increase in bank savings. This is consistent

Table 5
Effect of treatment on savings.

	(1) Account Balance	(2) Account Balance
Incentive	-11.484 (31.122)	-9.339 (31.860)
Endorsement	48.639* (28.357)	30.714 (28.257)
Incentive × Jul		-7.178 (9.216)
Incentive × Aug		-7.471 (11.286)
Incentive × Sep		0.972 (12.723)
Incentive × Oct		-2.222 (13.670)
Incentive × Nov		-1.629 (15.605)
Incentive × Dec		2.513 (15.944)
Endorsement × Jul		-8.335 (8.397)
Endorsement × Aug		-2.844 (9.972)
Endorsement × Sep		3.662 (11.105)
Endorsement × Oct		33.872*** (12.407)
Endorsement × Nov		50.636*** (14.197)
Endorsement × Dec		48.484*** (14.899)
Jul		-7.661 (6.388)
Aug		11.798 (7.868)
Sep		22.068*** (8.428)
Oct		34.943*** (9.044)
Nov		55.685*** (10.300)
Dec		40.629*** (11.151)
Observations	2779	2779
Control Mean	171.169	148.675
Incentive = Endorsement	0.023	0.120

Notes: End of month saving balance in Ghanaian cedis in OISL bank account from administrative data. Pooled over all months from June–Dec 2021. All regressions include strata fixed effects and control for the baseline value of the outcome. Column (2) also includes month dummies. Control mean in column (1) is an average over all months and in column (2) for June only. Incentive= Endorsement is the p -value from a t -test of equality of the Incentive and Endorsement coefficients. Standard errors in parentheses. p -values in square brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

with the pattern of coefficients seen in column (2) of Table B10, where the value of transactions with mobile banking is increasing over time in the Endorsement arm, and suggests it takes time to increase savings after starting to use mobile banking.³⁶ This positive result on savings is also consistent with the finding that the increase in use of mobile banking in the treatment arms is driven by deposits (Table B9).³⁷ The

³⁴ We do not have transaction records for in-person transactions, only the end of month account balance, so we cannot test the second explanation directly, only infer it from changes in the account balance. Note that women must go to the branch when they receive their loan, so they are almost certainly withdrawing it in person then.

³⁵ OISL began a campaign to encourage mobile banking adoption in all microfinance groups from October utilising group leader training and encouragement for group members to adoption, but without any incentives. This occurred in all microfinance groups, including treatment and control groups that took part in this study. From November, OISL transitioned groups to start making their loan repayments using mobile banking. As a result, we see a large increase in use of mobile banking in all microfinance groups by the end of the year. This change in policy also prohibits us from looking beyond December 2021.

³⁶ Interestingly, savings are rising in the control group from September–December, which could be due to seasonality as people save for school fees due in January, although it also corresponds with the increased use of mobile banking seen in the control group in Table B10.

³⁷ We confirm that this result is not driven by the referral payments given to the group leaders in the Endorsement arm by excluding them from the analysis

Incentive arm never led to a significant increase in savings in any month.

Unfortunately, we do not have the data to understand whether these medium term increases in savings are in addition to or crowding-out saving in other forms. Regardless, they represent an increase in the formality of women's savings, as they shift to saving in a bank account. To shed light on this, we can use total savings captured in the endline survey, one month after the intervention, to suggest whether these bank savings are in addition to or crowding out other savings in the short term.

Results for the effect of the treatments on aggregate saving outcomes measured in the endline survey are shown in Table B13 and by account type in Table B14.³⁸ We see that none of the saving outcomes are statistically significant for either treatment group, though very noisy. Total reported savings, total savings excluding the reported portion in the OISL bank account, net savings (deposits minus withdrawals in the last 30 days), and financial satisfaction are all higher but not statistically significant for the Endorsement group (Table B13). Column (5) also shows the same administrative data on the OISL account balance for July 2023, where the coefficient on the Endorsement arm is positive but not statistically significant. These results are not inconsistent with the possibility that in the short term, total savings alongside bank savings are increasing in the Endorsement arm, though they are also consistent with a net zero effect on savings.³⁹

We also see no significant effects of the treatments on the value of savings in any form in Table B14 Panel A, although estimates are noisy and some coefficients are large. In particular, the size and direction of the coefficients are suggestive of substitution away from SACCOs and Susu savings and towards bank account savings and savings at home. While SACCOs are formal institutions similar to cooperative banks, Susu savings are informal accounts where an individual comes to your home to collect money on a regular basis. This suggests that the interventions could be leading to shifts in savings between different types of formal and informal accounts. In Table B14 Panel B, we see that women in both treatment arms are more likely to report saving in their OISL bank account, with the effects a relatively large 12–16 percentage point increase on the control group mean of 26%. We also see women in the Endorsement arm being 12 percentage points more likely to report saving at home. This could be consistent with women keeping money at home before transferring it to their OISL bank account, rather than immediately putting it into other saving forms, such as susu. The increase in the likelihood of saving with the OISL bank account without any equivalent declines in the likelihood of saving with other bank accounts or SACCOs means that women are more likely to be saving in a formal account.

Given only 25% of the Endorsement arm and 15% of the Incentive arm were induced by the treatment to make a mobile banking transaction, it is also informative to look at LATE estimates where we instrument for making a mobile banking transaction during the incentivised period with assignment to treatment. Note that these should be interpreted with caution, given that treated women could

in Table B11. The results are very similar. We also confirm that changes in loan behaviour are not driving the saving increase in Table B12. We see no differences in the amount borrowed by treatment arm, the amount overdue or the number of days overdue.

³⁸ We also pre-specified four additional downstream outcomes capturing loan repayment, business profit, trust in mobile money and empowerment outcomes. We pre-specified these as speculative given the short time frame of one month that our survey took place after, and so would not interpret null effects as indicative of null long-term effects. We see no significant impacts on any of these outcomes. Loan outcomes are shown in Table B12. Business outcomes, trust in mobile money services and empowerment are shown in Table B15.

³⁹ Other studies have also found evidence that bank savings do not completely crowd out other forms of saving (Dupas et al., 2018b).

have been affected by the treatment even in the absence of using mobile banking themselves, such as through changing their impression of digital financial services through learning about mobile banking, or through observing others in their group using mobile banking over time. Taking this caveat in mind, we show LATE estimates for three savings outcomes in Table B16: self-reported total savings in the endline survey (column (1)), savings in all OISL accounts in the short and long run (columns (2) and (3)).⁴⁰ We see that the effect of making a mobile banking transaction on savings is large and positive in all cases, with total savings increasing by just over 25% (column (1)), and account savings doubling (columns (2) and (3)). However, only for the long run savings is the effect statistically significant. This suggests that amongst those induced by the treatment to use mobile banking, savings in the OISL account and overall increased substantially.

5.4. Mechanisms: Why was the endorsement intervention more effective?

Results for our five pre-specified mechanisms are shown in Table 6.⁴¹ The knowledge index captures knowledge about and confidence in performing mobile banking transactions, the trust scale is self-assessed trust in OISL mobile banking on a 1–5 scale, the fraud confidence index captures knowledge and confidence in dealing with fraud when conducting digital transactions, the peer interaction index captures interaction and support from others about mobile banking and the preferences index captures preferences for digital over cash transactions.

We see that the Endorsement intervention leads to large and significant increases in knowledge about mobile banking of 0.43 standard deviations, fraud knowledge of 0.44 standard deviations and peer interaction around mobile banking of 0.64 standard deviations, all of which survive multiple test corrections. The Incentive intervention leads to an increase in knowledge of 0.31 standard deviations that is significant at the 10% level and does not survive the multiple test correction. The increases in fraud knowledge and the peer interaction are significantly higher in the Endorsement arm than the Incentive arm, though the later is true only when the controls selected by lasso are included (Table B17). There is no change in trust in mobile banking for either treatment, likely as trust was already 4.84 on average out of 5, nor is there any change in preferences for digital transactions.

All the components of the knowledge index increased significantly for women who received the Endorsement intervention, while there are smaller increases in the Incentive arm that are marginally statistically significant (Table B18). Women score 0.48 standard deviations higher in a test of knowledge about how to perform mobile banking transactions, are 26 percentage points more likely to report having heard of mobile banking (on a mean of 65% in the control group) and are 2.1 points more confidence about using mobile banking (on a mean of 3.5 out of 10 in the control group) in the Endorsement arm compared to control. However, we cannot reject equality of the Incentive and Endorsement interventions for most of the knowledge measures.

Likewise most of the components of the fraud index increase in the Endorsement arm (Table B19), particularly those around worries of losses due to fraud and confidence in detecting it, compared to both the control group and the Incentive arm. However, correct scores on an index of responding to fraud scenarios do not change in either treatment arm, though women in the Endorsement arm score insignificantly higher than women in the Incentive arm (p-value=0.11). This pattern could be driven by clients trusting in redress options more if

⁴⁰ Column (2) is the same outcome measured at the same point at column (5) in Table B13, the end of month saving balance in June 2021. Column (3) is equivalent to column (1) of Table 5 but excluding the month of June (since this is shown in column (2)).

⁴¹ In Table B17 we show robustness of these results to controlling for variables selected by LASSO. The components of each mechanism index are shown in Appendix Tables B18–B21.

Table 6
Effect of treatment on mechanisms.

	(1) Knowledge MB	(2) Trust MB	(3) Fraud Knowledge Index	(4) Peer Interaction Index	(5) Preferences Index
Incentive	0.314 (0.159) [0.051]* {0.579}	-0.013 (0.080) [0.876] {1.000}	0.061 (0.150) [0.682] {1.000}	0.276 (0.234) [0.241] {1.000}	0.045 (0.200) [0.821] {1.000}
Endorsement	0.432 (0.126) [0.001]*** {0.005}***	-0.035 (0.077) [0.648] {1.000}	0.443 (0.117) [0.000]*** {0.003}***	0.649 (0.218) [0.004]*** {0.014}**	0.109 (0.160) [0.499] {1.000}
Observations	398	398	398	398	398
Control Mean	0.000	4.841	0.000	-0.000	0.000
Incentive = Endorsement	0.365	0.773	0.006	0.124	0.694

Notes: Survey data. All regressions include strata fixed effects and controls for mobile banking use at baseline. All columns are indices except column (2), which is a 1–5 scale. The knowledge index captures knowledge about and confidence in performing mobile banking transactions, the trust scale is self-assessed trust in OISL mobile banking, fraud confidence captures knowledge and confidence in dealing with fraud, peer interaction is interaction with others about mobile banking and preferences is incentivised measures of choosing digital payments over cash and unincentivised measures of willingness to pay for goods with cash or mobile money. Control mean is the mean of each outcome in the control group. Incentive = Endorsement is the p-value from a t-test of equality of the Incentive and Endorsement coefficients. Standard errors in parentheses. p-values in square brackets. q-values in curly brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

they experience fraud. Experience of fraud by individuals in developing countries is widespread (Garz et al., 2021), but attempts to directly improve it have had limited success (Kubilay et al., 2023). Like Breza et al. (2020), our findings support the idea that more widespread adoption of a technology can lead to improvements in consumers' experience using it and reduce fraud.

Increases in the peer interaction index in the Endorsement arm are driven by women reporting knowing more members using mobile banking in the group and increased likelihood of receiving help from others in the group on how to use mobile banking (Table B20). We also see evidence that knowing other members using mobile banking increased in the Incentive arm, but is significantly higher in the Endorsement arm, consistent with the stronger effects on adoption of mobile banking in this arm. The Endorsement arm is significantly better than the Incentive arm at enabling members to receive help from others in the group. There are no general effects on reports of giving help to others in the group — but when we restrict the regression to group leaders only, we see that leaders in the Endorsement arm are significantly more likely to report giving help on mobile banking than leaders in the Control or Incentive arms. This suggests that the Endorsement arm is enabling social learning, where group members actively receive help from the leader about how to conduct transactions, rather than more passive forms of learning where members only observe each others' use. The Incentive intervention, on the other hand, seems to only promote passive observational learning.

There are no changes in any components of the preference index (Table B21), including no change in willingness to accept mobile money over cash in an incentivised game or increases in willingness to pay with goods using mobile money over cash (unincentivised). This may be because it takes longer than one month to affect these preferences or that use of mobile banking does not change preferences for cash in what is still a largely cash based society.

Overall, the mechanisms analysis suggests that the Endorsement intervention was better able to increase knowledge of mobile banking and confidence in redress options if money was lost while using mobile banking than the Incentive arm. The Endorsement intervention also led to more interaction and help with others in the group in using mobile banking, suggesting active learning was taking place, compared to only passive forms of learning in the Incentive. Overall, this led to substantially higher adoption and persistent use in the Endorsement arm compared to the Incentive intervention. Since both arms included own incentives for carrying out a transaction, the different impacts must be due to the intensive training of the group leader, creating a source of knowledge within the group, or the referral incentives for the group leader, creating a strong reason for them to pass-on their knowledge and encourage adoption amongst the group, or the combination. We explore this further in the next section.

5.5. Unpacking the bundle: Training, referrals, or both?

An important question is whether the Endorsement intervention worked primarily through training a focal individual who can then pass-on her knowledge to other peers in the microfinance group, or through the referral incentives, or the combination. We use four sets of findings to shed light on this question. All have weaknesses, but together they provide suggestive evidence of the importance of the training component, though we acknowledge that without randomisation of these features we cannot say for sure which element mattered the most. We examine: (1) heterogeneity analysis by the group leader's prior experience with mobile banking, (2) LATE analysis by whether the group leader attended the training, (3) examination of treatment effect heterogeneity dependent on whether the group leader attended the training or not, and (4) endline measures of the leader's support of group members in using mobile banking by whether the group leader attended the training or not.

We utilise natural variation in the group leader's prior experience with mobile banking to study the importance of the referral component of the Endorsement intervention and the degree to which own experience of mobile banking and the training were substitutes. Groups assigned to the Incentives arm but where the group leader was already experienced with mobile banking received an intervention similar to the Endorsement intervention, but absent the referral incentives, in the sense that they could call upon the group leader for help with using mobile banking. Examining heterogeneity by group leader prior use of mobile banking therefore allows us to test if the group leader's prior experience and the training were partially substitutes, and to assess the degree to which the referral incentives encouraged the communication of knowledge.

We document large heterogeneity by whether the group leader had previously used mobile banking before (Table 7). 12% of groups had a leader with prior experience of mobile banking at baseline. In the Incentive arm, women in groups where the leader had used mobile banking before were 54 percentage points more likely to use mobile banking and in the Endorsement arm they were 37 percentage points more likely to use mobile banking when the group leader already had. There remains a significant impact of the Endorsement intervention on the likelihood of using mobile banking for groups where the leader had not previously used mobile banking of 7 percentage points, suggesting the training is able to partially compensate for lack of knowledge about mobile banking of the group leader. Importantly, while we can reject equality of the Incentive and Endorsement interventions when the group leader had no prior experience with mobile banking, we cannot when the group leader had prior experience with mobile banking. Similar patterns are seen for the value and number of transactions

Table 7
Mobile Banking use after the incentivised period: Heterogeneity by group leader experience with mobile banking.

	(1) Any transaction	(2) Value transactions	(3) No. transactions
Incentive	0.001 (0.042)	0.160 (17.460)	-0.033 (0.073)
Endorsement	0.071* (0.039)	47.335** (20.986)	0.027 (0.070)
Incentive × Leader Used MB	0.541*** (0.125)	318.526*** (85.429)	1.325*** (0.498)
Endorsement × Leader Used MB	0.373*** (0.124)	194.803** (78.745)	1.074** (0.487)
Leader Used MB	-0.063 (0.135)	-19.753 (70.456)	-0.063 (0.411)
Observations	2388	2388	2388
Control Mean het = 0	0.083	35.035	0.144
Heterogeneity Mean	0.119	0.119	0.119
Incentive het = Endorsement het	0.212	0.127	0.603
Incentive = Endorsement	0.026	0.016	0.152
Incentive het = Endorsement	0.488	0.340	0.647

Notes: Individual adoption of mobile banking during the 6 months after the incentives ended (Jul-Dec 2021) from administrative data. Outcomes at the monthly level, pooled over all months. All regressions include strata fixed effects, control for mobile banking use at baseline and include month dummies. Column (1) is a dummy variables for use of mobile banking, columns (2) is the value of mobile banking transactions in Ghanaian cedis, and columns (3) is the number of mobile banking transactions — all defined on a monthly basis. Control mean is the mean of each outcome in the control group. Incentive = Endorsement is the p -value from a t -test of equality of the Incentive and Endorsement coefficients. Incentive het = Endorsement het is the p -value from a t -test of equality of the Incentive and Endorsement coefficients interaction with the group leader's prior mobile banking use. Incentive het = Endorsement is the p -value from a t -test of equality of the Incentive and Endorsement coefficients when the group leader had previously used mobile banking in the incentive arm. Clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(columns 2 and 3, respectively, in Table 7). Interestingly, women in control groups where the leader had used mobile banking before are if anything less likely to adopt mobile banking than women in control groups where the leader has not used mobile banking before, suggesting the leader is not passing on knowledge without the group members having incentives to request this knowledge.⁴² We see similar patterns of heterogeneity for the mechanisms, though estimates are noisy, and during the incentivised period (Appendix Tables B24 and B25).

While this is a small number of groups and clients, and so should be interpreted with caution, it does suggest that prior knowledge of the group leader was extremely important for group members to be able to use mobile banking. Prior use by the group leader mattered more in the Incentive arm, because in the Endorsement arm group leader received a training which provided them with knowledge using mobile banking, substituting for experience. Anecdotally, in focus groups, the women in the Incentive arm described how they could not act to get the incentive unless someone in the group already knew how to use mobile banking. As a result, many women in the Incentive arm who would have liked to use mobile banking struggled to know how to use it. In Incentive groups where the group leader already knew how to use mobile banking, they could support their members in a similar fashion to those in the Endorsement arm.⁴³ This is also suggestive that the referral incentive was not essential for getting the group leader to pass on their knowledge to the rest of the group (we cannot reject equality of the Incentive intervention when the group leader already knew how to use mobile banking and the Endorsement intervention), perhaps because the Individual incentives created enough motivation to request help from the group leader. In the Endorsement arm, the group

leader was better able to pass on knowledge if she was experienced with using mobile banking, but the training was effective enough to enable her to help fellow group members adopt even if she was previously unfamiliar with the technology.

Next, we utilise two pieces of analysis that shed light on the role of the intensive training for the group leader as part of the Endorsement intervention. Compliance with this training was incomplete, with only 36/59 leaders invited in the Endorsement arm attending the training.⁴⁴ In Tables B27 and B28 we show local average treatment effects for those who complied with the intervention. These results should be interpreted with some caution: For the LATE analysis to be valid, we must assume that there was no way for the training in the Endorsement arm to have an effect except through the group leader attending the training. This is a strong assumption and would not be true if, for example, the offer of training led the group leader to seek out more information from the credit officer about mobile banking or changed how they responded to the individual incentive.

LATE estimates are uniformly larger, with, for example, women in groups where the group leader attended the training 18 percentage points more likely to adopt mobile banking beyond the incentivised period than women in control groups. Likewise, increases in mobile banking knowledge, fraud protection confidence and peer interaction in the Endorsement arm are larger in the LATE estimates and significantly different from Incentives. This is supportive that the group leader attending the intensive training was a driver of the impact of the Endorsement intervention. This also supports the findings from the heterogeneity analysis that leader competence with mobile banking (either through prior use or through attending the intensive training) was the key driver of the impact of the Endorsement intervention on group member mobile banking adoption. However, as noted above, there are significant limitations with the LATE analysis, such that these results should be interpreted with caution.

⁴² We also show robustness of the main results to controlling for group leader prior use of mobile banking in the Appendix Tables B22 and B23. The coefficients do not change, though some lose significance.

⁴³ We would expect own mobile banking prior use to also matter for the same reason for the Incentive treatment, and indeed we see in Table B26 a large coefficient on the interaction between the Incentive treatment and own prior use of mobile banking, which is marginally statistically significant for the value of transactions. Own prior use of mobile banking does not matter as much for the Endorsement intervention (and the coefficient is small), as would be expected, since the group leader can provide this knowledge.

⁴⁴ For the Incentive treatment, compliance required accepting the incentive, which everyone did, so we have 100% compliance. For the Endorsement arm, compliance required the group leader to attend the intensive training, which 36 out of 59 did, so we have 61% compliance. All group leaders accepted the peer referral incentive, regardless of whether they attended the intensive training.

Another piece of analysis we can draw on to support the importance of the training in the Endorsement intervention, is to assume that attendance at the training was quasi-random and look at treatment impacts by whether the group leader attended the training or not. This is a strong assumption, but a few features of the implementation make this assumption more plausible. Firstly, we held all the training on a single day, and so if a group leader could not attend that day due to other commitments she would not receive the training. Consistent with this, the main reason given by 83% of leaders who did not attend was that they were not available that day. The second most common reason was that they were not interested in Mobile Banking. Secondly, we provided strong financial incentives to the group leader to attend (100 cedis, or \$16,) in a context where average business profits by the micro-credit clients are 600 cedis a month. Therefore the training was attractive to attend, not only for those interested in mobile banking or without alternative things to do on that day.⁴⁵ Thirdly, we do not see large differences in leader or group member characteristics between group leaders who attended and did not attend (Table B29). In particular, the group leaders and members are as likely to be registered for mobile banking and to have used it before. They are also similar on age and education, which are important determinants of whether someone adopts mobile banking when they receive the treatment (see Table B7). The F-statistics from a regression of whether the leader attended the training on all the leader and member covariates shown in Table B29 is small and insignificant (F-stat 0.79, p -value 0.72). However, this analysis is underpowered with only 58 group leaders, and some differences are moderate in size, particularly those around leader prior mobile banking use.

Taking these limitations into account, in Tables B30 and B31 we show treatment effects on the primary outcomes and mechanisms with the Endorsement intervention split into whether the group leader attended the training or not. We see that for adoption of mobile banking we can reject equality of the Endorsement intervention when the group leader did and did not attend the training, with effects larger when the group leader attended. The coefficients on the value and number of transactions, mobile banking knowledge and peer interaction are also larger when the group leader attended the training than when she did not, though not significantly different. While we are underpowered for this analysis, it is also indicative that effects are larger when the group leader did attend the training than when she did not, supporting the importance of the training part of the intervention.

This table also allows us to isolate the role of the referral incentive on its own by comparing the effects of the Endorsement intervention when the leader did not attend the training to the Incentive intervention (the only difference between these interventions now being that the leader received referral incentives in the former). P -values from this test are shown in the second to bottom row of the table, with the p -value from the test comparing women in groups that received the full Endorsement intervention to the Incentive intervention in the bottom row. We can see that while we cannot reject equality of the Incentive and Endorsement when the leader did not attend the training, we can reject equality of the Incentive and Endorsement when the leader did attend the training for whether any mobile banking transaction was made and the value of mobile banking transactions. This suggests that the training of the group leader was the key element of the Endorsement arm that made it more effective than incentives alone, and that the referral incentive is not sufficient alone.

Without variation in whether referral incentives were offered, we are unable to definitely assess the role these played in the impact of

the intervention, but note that since all group members would receive an individual incentive for completing a mobile banking transaction, they were well motivated to ask for help from their group leader if that leader knew how to use mobile banking. This is apparent in the large impact of the Incentive intervention when the group leader had prior knowledge of mobile banking. It is likely that the referral incentives provided additional motivation to the group leader to pass on that knowledge, but we are unable to quantify how important this was. It seems that the referral incentive alone was not sufficient without the leader also receiving training.

Finally, we captured at endline what the group leader reported carrying out to teach their group members about mobile banking. We examine differences in reported support by whether the leader attended the training. This is shown in Table B32, along with the difference from a t -test of equality of those leaders who did and did not attend the training. Peer leaders who attended the training were almost 40 percentage points more likely to show their group how to use mobile banking compared to leaders who did not attend the training. They were also much more comfortable training others, rating themselves 4.6/10 compared to 1.1/10 for those who did not attend the training. Interestingly, leaders who attended the training were more likely to ask for help with mobile banking from the credit officer, suggesting they were more motivated to learn how to pass on knowledge to their group members. They were significantly more likely to report being comfortable answering questions, by 2 points on a 10 point scale. Those who attended training were 40 percentage points more likely to encourage group members to use mobile banking than leaders who did not attend the training. Amongst those who did not attend the training, the main reasons they did not encourage their group to use Mobile Banking were that they forgot to encourage and forgot about the reward.⁴⁶ Overall, this suggests the training was effective in giving group leaders the skills and encouragement they needed to support their fellow group members in mobile banking and hence was an important component of the Endorsement intervention.

We also examine whether the impacts we see in the treatment arms are driven by the group leaders themselves or by the group members.⁴⁷ We do this by interacting the treatments with the client's role in the group, to see if treatment effects differ for group leaders versus other group members. It is an important check that, particularly in the Endorsement arm where the group leader received extensive training, they are not driving the entire treatment effect. These results are shown in Tables B33 and B34.

Looking at adoption of mobile banking, we see similar heterogeneity by group leader role for the Incentive as well as the Endorsement arm, despite there not being any differences in the treatment received by members and leaders in the Incentive arm. Indeed, we fail to reject equality of the treatment effects for the incentive and endorsement arms for group leaders, and the coefficients are extremely similar, suggesting that the Endorsement arm is not providing additional encouragement to group leaders to adopt compared to the Incentive arm alone. This implies that the group leaders may be easier to encourage to adopt a technology using incentives alone, potentially due to their different characteristics, such as higher education (compared to group members). We see an effect of the treatment for group members only in the Endorsement arm. There is no evidence of heterogeneity in the mechanisms, though estimates are more noisy. It seems that the improvements in knowledge, fraud confidence and peer interaction in the Endorsement arm are driven by group members.

⁴⁵ Note that leaders were not told about the individual or referral incentives when invited for training, or that they would be asked to pass on the training to the rest of their group. They only found out about these later. Hence the decision to attend cannot be influenced by the value of expected incentives or perceived ease of training their groups.

⁴⁶ This is despite the reward not being mentioned as part of the training — leaders were only told about the individual and referral incentives at the group meeting so that this did not depend on training attendance. This suggests having attended the training helped reinforce the referral incentives offered later.

⁴⁷ This analysis was not pre-specified.

Overall, we see that the greater effectiveness of the Endorsement arm seems to be driven by its ability to facilitate information flow and interaction around mobile banking within the group, resulting in adoption of mobile banking by group members as well as group leaders. For this to occur, the group leader needs to either have experience using mobile banking themselves or to attend the training, so that they are able to support group members. There is evidence to suggest that the referral incentives were not crucial, given the individual incentives. The (smaller) effects of the Incentive intervention seem to be primarily driven by the leader choosing to adopt, suggesting that leaders are easier to incentivise to adopt new technologies, perhaps due to unobservable characteristics.

6. Conclusion and discussion

We use an RCT to study how to encourage the adoption of a new technology, mobile banking, and examine whether use of mobile banking leads to higher savings in the linked bank account. While individual incentives double adoption from 15 to 30 percent in the short term, utilising endorsement by an influential peer within the microfinance group triples adoption. The positive effects of both treatments on mobile banking use persist over six months, with women in the Incentive arm 50% more likely to use mobile banking and women in the Endorsement treatment 110% more likely to use mobile banking services in a month. The Endorsement treatment leads to a large increase in savings in the linked bank account, with balances increasing by 30% on average and increasing over time.

We show that knowledge acquisition and transfer is significantly higher in the Endorsement arm than the Incentive arm, suggesting active learning is taking place. We also documented that fraud is an important mechanism that determines technology adoption, with a well-trained peer able to support knowledge and confidence in dealing with fraud. This suggests that the Endorsement arm was more effective at encouraging discussion and sharing around how to safely use the technology, which facilitated greater adoption. While our Endorsement intervention was bundled, we provide some suggestive evidence that the training of the group leader was key to its effectiveness, and that the referral incentives may not have added to its effectiveness.

While our interventions meaningfully increase the use of mobile banking relative to the control group, there still remains a puzzle of why all treated women are not able to take advantage of the incentive offered. Only 25% of the Incentive arm and 37% of the Endorsement arm make a transaction during the month that the incentive is offered. This suggests that there must be additional barriers to mobile banking use that incentives and the training of the group leader are unable to address. We provide some evidence from our survey that knowledge barriers are important and remain even in the Endorsement arm, suggesting limits to the effectiveness of the group leader training and to subsequent knowledge transfer to other group members. In addition, technical problems setting up the mobile banking account seem to have prevented some women from completing a transaction, highlighting the importance of having systems in place to help women overcome technical barriers to technology adoption. This suggests that more intensive interventions, perhaps incorporating one-on-one assistance to ensure women can use the technology, may be needed to increase technology adoption beyond the levels seen in this study.

Our study has some limitations. First, our survey data is from only one month after the intervention ended. This means that we cannot fully explore whether bank savings crowd-out other forms of saving, or whether there are longer-term impacts on other downstream outcomes such as households' ability to cope with shocks. Additionally, since our partner organisation continued to train and encourage mobile banking adoption by their microfinance clients, we are unable to examine effects beyond 6 months. Second, our context of microfinance groups is a relatively homogeneous setting, where individuals are in small groups with others that they know well and interact with weekly. Our findings

may not generalise to other contexts with less tightly integrated groups. Third, we do not have any variation in who in the group becomes the "endorser", and so we cannot say if the group leader is the optimal person for this role. Finally, our Endorsement intervention is bundled, and so we are not able to determine the relative importance of training versus referral incentives and how these might have interacted with each other.

The interventions generates a net benefit to clients within a few months. The total cost of the Incentives intervention was 2.5 cedis per client, and the Endorsement intervention 19.5 cedis per client.⁴⁸ The benefit to clients from using mobile banking takes the form of both cost savings from substituted bank trips and the benefits from a better place to save that earns interest. Making a number of assumptions about the magnitude of the benefits of using mobile banking services,⁴⁹ on a monthly basis, clients benefit by 1.6 cedis in the Incentive arm and 2.3 cedis in the Endorsement arm. As a result, the breakeven point for the benefits to equal the costs is two months for the Incentive treatment and 8.5 months for the Endorsement treatment.

In terms of policy recommendations, our study context is highly relevant to any setting with existing, close-knit groups. This includes not just the estimated 300 million microfinance borrowers, but also those in savings groups such as VSLAs and ROSCAs. The ease of identifying a natural focal person in such a group setting makes this a more scalable approach to increasing technology adoption than network-based methods. Our findings are relevant to other MFIs beyond OISL, who have found limited success introducing new technologies through their credit officers, and instead can use the group structure to encourage and facilitate technology adoption.

CRedit authorship contribution statement

Emma Riley: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Abu S. Shonchoy:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Robert Darko Osei:** Conceptualization.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.jdeveco.2025.103511>.

Data availability

Data will be made available on request.

⁴⁸ This analysis uses the probability that the client completed an eligible mobile banking transaction during the incentivised period from Table 3 for both treatments, the average referral payment and a per group member cost of the group leader attending training for the Endorsement treatment.

⁴⁹ We do not have data that could inform us as to the benefit that clients place from being able to save in the bank instead of other forms. We therefore restrict the benefits of saving to interest earned, likely underestimating this benefit. We assume that all mobile banking transactions substituted for in-person transactions, use the average number of mobile banking transactions a month from Table 4, and use the average cost of a round trip to the bank to quantify this benefit. This is likely to overstate the benefits, as clients may have conducted more transactions once mobile banking was available and they may have previously combined trips to the bank branch with other activities.

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