Digital Financial Services and Women's Empowerment: Experimental Evidence from Tanzania

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Abstract

Can increasing women's use of digital financial services raise their empowerment? We test this hypothesis using a randomized control trial with 152 female microfinance groups in Tanzania where treated groups were randomly switched to repay their loan using mobile money instead of cash. This exogenous shift in women's use of mobile money for loan repayment substantially increases their use for other types of transactions. Women's control over their finances increases, they have higher levels of empowerment in the household and expenditures shift towards goods plausibly aligned with their preferences. These findings highlight the benefits of greater use of digital technologies for women.

JEL codes: O33, D13, O12, J16

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1 Introduction

Women's empowerment is a frequent goal of policy-makers, both as an important outcome in its own right and as a channel towards other outcomes such as improved children's health and education (Doepke and Tertilt, 2019, Duflo, 2012). Many programs aiming to raise women's empowerment have focused on increasing women's income or income-generating potential through programs like cash transfers (Almås et al., 2018, Haushofer et al., 2019, Hidrobo et al., 2016) and graduation programs (Angelucci et al., 2023, Bedoya et al., 2019). However, women must retain *control* over this income for their status in the household to improve (Anderson and Eswaran, 2009). Increasing women's control over their resources, even in the absence of changes in the total amount of resources, may therefore raise their empowerment. Digital financial services like mobile money offer a potential way to increase women's control over their resources by providing them with a private, secure place to store money in their name (Aker et al., 2016, Field et al., 2021, Riley, 2024).[1] However, despite the popularity of mobile money, there are large gender gaps in usage, with women less likely to use mobile money, use it less often, and make fewer types of transactions, of smaller value (Demirgüç-Kunt et al., 2022).

In this study, we examine whether increasing women's use of digital financial services improves their empowerment. We exogenously increase women's use of digital financial services by permanently switching the weekly loan repayments of microfinance borrowers from cash to mobile money. We examine the impact of this change on women's wider use of mobile money services, women's financial control and women's decision making power within the household using survey data collected after 10 months.

To do this, we use a Randomised Controlled Trial (RCT) with 750 female clients from 152 microfinance groups in Tanzania. Microfinance groups, and all the members of those groups, were randomly assigned to switch their loan repayment method from cash to mobile money.[2] Microfinance loans are repaid weekly at group meetings,[3] so this represents a large increase in women's use of mobile money, both in terms of the frequency of payments and the size of those transactions.[4] Repayment with mobile money was voluntary in the treatment group, but we see high take-up of this method, with 66% of the treatment group making at least one loan repayment with mobile money, and treated women making on average 8 out of 23 loan repayments using mobile money during the

[1] Use of mobile money services has been shown to lead to many benefits for households, particularly with regards to smoothing consumption shocks and facilitating migration through remittances (Batista and Vicente, 2023, Jack and Suri, 2014, Lee et al., 2021, Riley, 2018, Suri and Jack, 2016). Mobile money services have also been shown to benefit women by facilitating entrepreneurship (Suri and Jack, 2016).

[2] This is a context where 98% of women had ever used mobile money before, though they predominantly used it for sending or receiving remittances.

[3] The requirement to physically attend a group meeting was not changed in the treatment arm.

[4] On average women made weekly loan repayments of USD 40 PPP, compared to average transaction values of 110 USD PPP a month through their mobile money accounts. Treatment therefore almost doubled their monthly mobile money transaction values on average.

study.

We find that switching the groups' loan repayment method to mobile money results in a large increase in women's use of mobile money services for other types of transactions. We see a 0.33 standard deviation increase in women's use of mobile money services, driven by increases in the likelihood they allow mobile money payments in their business, increases in the frequency and value of transactions, and increases in their savings with mobile money. The increase in use is accompanied by improvements in comfort using mobile money services, and women are more likely to make mobile money transactions by themselves.

This increased use of mobile money services results in large improvements in an index of women's control over their finances of 0.37 standard deviations, driven by improvements in their stated control over their money, reductions in reported pressure to share money with family members and decreased willingness to pay to control money in an incentivised game. Women's empowerment, measured as their decision-making involvement in the household, increases by 0.22 standard deviations, with decision-making about food and clothing and their general involvement in financial decisions increasing significantly. Heterogeneous treatment effects show that these improvements are concentrated in women who had the lowest levels of empowerment at baseline, consistent with the mechanism of increased financial control. We see no evidence that women experience a backlash as a result of this increased financial control and decision-making, as there are no changes in their reported well-being or discord with their spouses.

While total household consumption does not change, we observe changes in the allocation of expenditure to different categories, consistent with a shift towards categories that women value.[5] Spending on food outside the household, primarily snacks, and personal care items declined, while spending on women's and children's clothing and children's schooling increased.[6] Similar effects are seen when examining the share of expenditure by category. Increased spending on women's and children's clothing and children's schooling has previously been used in the literature as suggesting women's preferences are being better reflected, and so we interpret this as also supporting an increase in women's decision-making within the household (Bobonis, 2009, Hidrobo et al., 2016). These kinds of spending are also more "lumpy", requiring the woman to accumulate savings before making the expenditure, and so may only be possible if the woman has sufficient financial control and a place to accumulate saving, such as the mobile money account.

There is no evidence that the increase in savings on the mobile money account is coming from a reduction in savings in other forms, with, in fact, savings in all forms increasing. This suggests that our intervention is "crowding in" other forms of savings,

[5]These outcomes were not pre-specified.

[6]We also see increases in the value of mobile money transactions on school fees consistent with this, suggesting treated women may be saving on the mobile money account and then using the balance to pay their children's school fees.

potentially through the increase in women's financial control.

We see no effects on women's business outcomes suggesting improved financial control is not necessarily translating into increased investment in women's businesses. This is likely because the increase in digital transactions and corresponding increase in savings is small relative to the size of the women's businesses and loans.[7] We also see no effects on the income of other household members, ruling out negative effects from reducing their access to the wife's resources (Bernhardt et al., 2019).

There are no negative effects of treatment on women's loan repayment behaviour or changes in women's overall access to credit. We also see no significant change in an index of social cohesion in the groups as a result of treatment, though there is some indication that interaction with group members increased: women report talking to more group members outside their group, being willing to assist more members financially and visiting the home of more group members. This increase in interaction may be due to group meetings leaving more time for social interaction when the need to count cash is removed. Group meetings were also 10 minutes shorter in the treated groups, on a mean of two hours, leaving more time for interaction among group members. This suggests there could be other unintended benefits of shifting to digital methods of loan repayment. However, treated women also shift their preferences away from weekly group meetings to less frequent biweekly or monthly group meetings. If implemented, this may negatively affect social cohesion.

In our conceptual framework, we argue that increased use of mobile money could enhance women's financial control through three potential channels: transaction costs, earmarking and privacy. We argue that privacy is an unlikely channel to explain the effects seen here since treatment increases the likelihood the woman discusses her income with her spouse. We also see no heterogeneity by whether anyone else knew the woman's mobile money pin number, and hence could access her account, at baseline. Similarly, we find no heterogeneity by whether the woman and her spouse share the same mobile money operator at baseline, a proxy for transaction costs, since fees are higher for transferring funds to a different mobile money operator. This leaves earmarking as the most plausible channel through which the use of mobile money services enhances women's empowerment. We also rule out other mechanisms through which our treatment could have raised women's empowerment, such as changes in time use, loan access, loan investment behaviour or income changes.

Our study makes three important contributions. We first contribute to a literature on the determinants of women's empowerment. Most of this literature has focused on the role of the woman's outside option through her income, income-generating-potential

[7]The increase in the value of digital transactions in the treatment groups, excluding loan repayments, is 36 USD PPP a month and savings are 16 USD higher. This contrasts with (Riley, 2024) where disbursing a loan of 1,200 USD PPP (400 USD) on average via mobile money led to 210 USD PPP (70 USD) higher investment in the woman's business.

and resources, in the form of variables like job availability (Majlesi, 2016), the receipt of inheritances (Harari, 2019, Heath and Tan, 2020), cash transfers given to women (Almås et al., 2018, Attanasio and Lechene, 2002, Haushofer et al., 2019, Hidrobo et al., 2016) or comprehensive graduation-type interventions that change women's ability to generate an independent income (Angelucci et al., 2023, Bedoya et al., 2019).[8] However, *control* over income and resources determines women's ultimate status within the household (Anderson and Eswaran, 2009).[9] We contribute to this literature by showing that increasing a woman's control over her resources increases her empowerment. Compared to previous literature, we isolate the impact of increasing control over funds without any changes in the relative economic position of the woman and household.[10] We also provide evidence in support of earmarking as the mechanism through which mobile money use improves financial control, rather than privacy or transaction costs.[11]

Second, we highlight that increasing women's use of digital financial services can increase their savings. This links to a mixed literature highlighting that lowering the transaction costs of formal savings is an important determinant of savings, but is not always sufficient (Aggarwal et al., 2020, Bachas et al., 2021, Bastian et al., 2018, De Mel et al., 2022, Riley et al., 2024).[12] Given nearly all women in our study already had mobile money accounts at baseline, there must be additional barriers to saving on these accounts. We provide evidence in support of the need to gain experience with financial accounts through learning-by-doing and a need to repeatedly transact on the accounts

[8]See Chang et al. (2020) for a comprehensive review on policy interventions' impact on women's empowerment.

[9]Indeed, many programs such as microfinance, savings groups and job programs that have tried to increase women's access to income and resources without corresponding increases in their control have found mixed success (Banerjee et al., 2015, Beaman et al., 2014, Bernhardt et al., 2019, Fiala et al., 2017).

[10]For example, many studies have compared the effects of giving cash transfers to mothers versus fathers, but these also change the relative income of the woman and man as well as overall household income, affecting women's empowerment through multiple mechanisms (Almås et al., 2018, Attanasio and Lechene, 2014, Bobonis, 2009). Field et al. (2021) look at making wage payments to a bank account in the woman's name rather than her husband's and see expansions in women's labor supply and income, with empowerment increasing for women constrained from working at baseline. Riley (2024) looks at making loan disbursements with mobile money instead of cash and sees an increase in the woman's business investment, profits and household income. She argues that the positive effects on women's empowerment from disbursing loans onto mobile money accounts are driven by the increased income of the woman. She finds no changes in financial control, with use of the mobile money accounts diminishing rapidly after loan disbursement, and the mobile money accounts are not used for subsequent loan deposit, suggesting different mechanisms to those seen in this study.

[11]See Table A1 for a summary of papers examining financial accounts and women's empowerment. Compared to these, our study examines a fuller set of outcomes in the causal chain between financial account use, financial control and women's empowerment and is able to rule out effects from changes in other financial resources, such as income and credit access (e.g. Bastian et al. (2018)). We also provide evidence on the mechanism through which financial control is enhanced, whereas the existing literature can only speculate on the potential mechanisms.

[12]Much of the literature on encouraging saving with mobile money has provided strong short term incentives to save on the account in the form of bonus interest rates or temporary withdrawal fee waivers (Aggarwal et al., 2020, Batista et al., 2022, Dizon et al., 2020).

(Breza et al., 2020, Giné and Goldberg, 2023). Our findings highlight an important role for policymakers and organisations who, through integrating digital financial services into other financial products, can increase women's experience and use of them.

Third, we show that the introduction of digital financial services is compatible with maintaining social cohesion and low default rates within microfinance groups. Unlike Harigaya (2017), who also studied the effects of changing loan repayments from cash to digital, our study did not remove the requirement to attend group meetings. However, the time spent at group meetings shifted from counting cash, which women in focus groups described as a substantial and tedious part of group meetings, to social interaction. We see no impact on repayment or default rates in the medium term time frame of our study. Our finding is important given the work of Feigenberg et al. (2013), who highlighted the key role of social interaction among microfinance clients for maintaining low loan default rates by facilitating risk sharing. This is a consequential finding for the microfinance industry, which is increasingly shifting from cash to digital, and its ability to maintain low default rates while doing so.

The paper is organized as follows. Section 2 describes the conceptual framework, Section 3 discusses the background to the study, Section 4 discusses the intervention and study design, Section 5 discusses the data and empirical specification and Section 6 the results. Section 7 discusses alternative mechanisms and Section 8 concludes.

2 Conceptual framework

We see that mobile money loan repayment increases respondents' use of mobile money in general. This could affect women's empowerment by increasing a woman's *control* over her income and resources, thus raising her outside option by increasing the resources she would take with her upon exiting the marriage, or by increasing her income directly.[13] Women's ability to enact their preferences could also be enhanced if, for example, use of mobile money accounts increases women's ability to enact their saving preferences (Anderson and Baland, 2002, Ashraf et al., 2010) or make spending decisions independently (Ashraf, 2009). We consider here three main mechanisms through which use of mobile money could raise women's financial control: transaction costs, earmarking and privacy. In section 6.5.1 we provide evidence that patterns of heterogeneity in the data are most consistent with the earmarking channel described here.

[13]While we don't see increases in business profits in the time frame measured by the experiment, mobile money could still increase women's expected earnings if they anticipate that it will increase the set of future profitable business opportunities available to them. Hence we cannot rule out that increases in women's empowerment could still be due to *potential* income increases due to increased use of mobile money.

Transaction costs

A husband might take money from his wife if it is stored in the form of cash, but not be willing to pay the cost to do so when it is stored as mobile money and thus require some cost to access it for himself (namely, going to visit a mobile money agent and paying a fee to cash out). This could represent the travel cost of visiting the mobile money agent and fee to cash out in a neo-classical framework,[14] or some sort of psychological cost if storage of funds on an account in the wife's name increases the salience that he is taking the wife's money and he does not think this is acceptable behaviour. Indeed, Schaner (2017) finds that the provision of ATM cards that allow easier access to savings increased men's saving but not women's, presumably because women think it will be harder to resist their spouse's claims on the money when it is less costly to do so. By raising transaction costs, our intervention may increase women's ability to accumulate funds, allowing them to save for purposes they value and determine how those savings are spent.

Earmarking

A related channel is earmarking. Prior literature has highlighted the importance of earmarking for enabling women to save (Anderson and Baland, 2002, Ashraf et al., 2010). Money stored on a mobile money wallet may be better earmarked as the woman's money and so she may have more control over it than cash. In a recent study, Lee et al. (2024) find evidence that mobile money is earmarked for certain purposes and so less fungible than cash. Riley (2024) provides evidence for such a mechanism in her study of disbursing microfinance loans with mobile money. She argues that the loan is unlikely to be private given the visibility of group meetings in the community. This makes the likely mechanisms through which mobile disbursement changes the use of the loan either earmarking or transaction costs. This is also likely to be the case for money stored on a mobile money wallet, again increasing the woman's ability to save and determine how money is spent.

Privacy

Previous literature has found that an individual's ability to conceal outcomes from other household members affects household outcomes (Ashraf, 2009, Ashraf et al., 2014, Carranza et al., 2022, Jakiela and Ozier, 2016). Mobile money is plausibly more concealable than cash and thus may allow a woman to keep her financial resources hidden from her spouse. The treatment may have given women a plausible excuse to substantially increase their use of mobile money, thus increasing their ability to use mobile money to hide funds.[15] This ability to hide could allow a woman to retain a greater share of her

[14]While travel costs are relatively low in this setting, with 99% of women reporting living within 15 minutes walk of a mobile money agent, transaction fees for using mobile money can be high, particularly for transactions to other networks. Fees are typically 2-5% of the transaction amount.

[15]Note that the primary potential difference here is privacy over the woman's income and savings given increased use of mobile money: we do not think privacy of the loan itself would have changed. The fact

personal income in the context of, for instance, a model in which there is a sunk cost to having a conversation with a spouse about how to spend money in their control or to co-opting a share of that income for oneself.

3 Background

3.1 Mobile Money in Tanzania

Mobile money allows money to be stored and transferred from a basic (non-smart) mobile phone. It works over the USSD cellular system, meaning an internet connection and smartphone is not required. Cashing in and out of the system takes place through a network of agents, who are usually existing airtime sellers or operate small businesses and offer mobile money services on the side. Users pay a fee for withdrawal services of 1-6%, from which agents receive a commission. Users also pay fees for transferring funds directly from their mobile money wallet to other individuals or businesses, with fees tied to the size of the transfer, and typically greater for off-network transfers or to non-registered users.

Worldwide, there are 1.6bn registered mobile money accounts, and accounts are growing rapidly at 13% a year, driven by growth in Sub-Saharan Africa (GSMA, 2023). In Sub-Saharan Africa, 42% of the population and 37% of women now have a mobile money account, and for 70% of them, their mobile money account is their only financial account (Demirgüç-Kunt et al., 2022). Tanzania looks typical for a Sub-Saharan African country, with 50% of the population, and 46% of women, owning a mobile money account. In Tanzania, the mobile money agent network grew quickly and is extremely dense: in 2020, 85% of villages nationally had a mobile money agent (Tanzania National Panel Survey 2020-2021). For people in villages without agents, the median distance to the nearest agent was only 3km.

However, despite these high rates of uptake and rapid growth of mobile money services, usage of mobile money for savings and business transactions remains low, particularly among women. As of 2021, only 36% of mobile money users in Tanzania reported using mobile money for savings, and women are half as likely as men to save using mobile money. Only 4% of men and 1% of women reported making digital merchant payments (Demirgüç-Kunt et al., 2022). Gender gaps in use and use for a limited range of services therefore limit women's ability to benefit from mobile money services.

that the woman has a microfinance loan is highly visible due to the weekly in-person group meetings, and the woman's husband is frequently the guarantor on her loan.

3.2 BRAC Microfinance

BRAC is the largest microfinance institution in Tanzania with over 200,000 clients in 162 branches across 25 regions and 116 districts throughout Tanzania. 99% of clients are women. Microfinance loans are given for an existing small enterprise. As part of the loan application process, the business is verified by the credit officer. Loans range in size from $150-800, with a mean loan size of $350 and women progress to larger loans by successfully repaying smaller loans. Loans are for 40 weeks with a 25% interest rate. Disbursement of the loan is made in cash at the microfinance branch.

Women apply for microfinance loans by creating or joining an existing group within their community. Groups contain between 8 and 30 members, with an average of 23 members. Loans are individual liability loans,[16] with the group playing a role in screening members and, through social pressure and local knowledge, ensuring loan repayment. Loan repayments are made at weekly group meetings in the women's communities as cash, with a credit officer travelling to the community to collect the loan repayments. In peri-urban and rural settings such as those in this study, there is typically only one microfinance group per community.

4 Experimental Design

4.1 Sample

The study took place at microfinance branches of BRAC in Tanzania. For this study, 7 branches were selected in one region, Mwanza, to minimise travel costs between groups. 152 microfinance groups were selected randomly from the 176 groups at these branches, with between 18-25 groups selected per branch depending on the number of groups at that branch. Out of the 3,500 women in these 152 microfinance groups at the start of the study, 5 women per group, 750 women total, were randomly selected to be surveyed.[17] Since the sample was selected from existing microfinance clients, all the women in the study had already received a loan from BRAC. Note that within the same microfinance group, women generally received loans at different times from each other.[18]

[16] Women have a guarantor on their loans, who is often their husband.

[17] We excluded women who were in default on their loan from the study sample. There were no other criteria to be in the sample.

[18] While new groups initially all start out with all members getting a loan at the same time, some repay their loans early and are then eligible to take a new loan, and some women pause borrowing between loans for a couple of weeks or months. New members also join over time, resulting in women in established groups rarely receiving loans at the same time.

4.2 Intervention

Women in the treatment arm received information on how to use mobile money to repay their loan, administered by the microfinance group credit officer at their group meeting. This information was very narrowly focused on loan repayment, telling women the number they needed to send the payment to and how to enter their loan ID so that the payment would be matched to them.[19] Women were asked to use mobile money to make all their weekly loan repayments. Repayment using mobile money was voluntary, with women free to continue cash repayment. However, women were encouraged to use mobile money and told this was the preferred repayment method. Women incurred a 1% fee for making a loan repayment using mobile money. Nothing else was changed about the loan contract or loan disbursement. Women still attended the group meeting in person, where they would show the credit officer the text message confirming they had successfully sent their loan repayment using mobile money. This was a permanent shift allowing mobile money loan repayment in the treatment groups, and continued beyond the study end.[20]

We view the intervention as changing women's intensity of using mobile money services, rather than introducing them to mobile money for the first time or teaching them new skills, as baseline use of mobile money was very high. In addition, women regularly conducted simple mobile money transactions like sending and receiving money and checking their balance at baseline, and usually conducted these by themselves. See Section 5.2 for a discussion of use, comfort, preferences and trust in mobile money services at baseline.

Women in the control group continued to repay their loans as cash at the weekly microfinance group meeting.

4.3 Randomisation

The randomisation was done at the microfinance group level.[21] The 152 microfinance groups were randomly assigned to the treatment or control arms using a stratified randomisation. As strata, we used three criteria: women's stated preference for using mobile money for loan repayment; women's stated preference for weekly over fortnightly group meeting frequency; and the profitability of the women's businesses. For each criterion, we calculated the mean at the microfinance group level and used a median split by whether the group's mean was above the median calculated over all groups. 101 groups were

[19]The credit officers did not provide any broader information on how to use mobile money. The assumption was that women already knew how to use mobile money or could easily find out how by asking other women in their groups.

[20]Indeed, after the end of the study, mobile money repayment was also introduced in the control groups, and all microfinance groups at the 7 study branches can now use mobile money to repay their loans.

[21]Groups do not typically have contact with each other and so this design minimises spillovers between treatment arms.

assigned to treatment and 51 to control.[22] All the women in the group received the same treatment assignment and, in treatment groups, every group member was offered the treatment.

5 Data and empirical strategy

5.1 Data

We have 4 sources of data for the analysis: a baseline and endline survey carried out with the sample of 750 women in the 152 microfinance groups, focus groups carried out with 30 women at 6 treatment groups, and administrative data from BRAC capturing the repayment method used for every loan repayment and the loan repayment status for all 3,500 women in the study groups. The administrative data from BRAC was used to select the 152 groups and 5 women per group randomly for the baseline survey. The baseline survey was carried out in April 2022, the intervention began in May 2022 and the endline survey took place in February 2023. This interval was chosen as BRAC loans run for approximately 10 months (40 weeks). The focus groups took place in September 2022, 4 months into the intervention. The selection of the focus groups was stratified by takeup, such that we had 3 high-use of mobile money loan repayment groups and 3 low use groups. The loan repayment data means that we have the universe of loan repayments for all the approximately 3,500 women in the 152 microfinance groups in the study from May 2022-February 2023.

An incentivised game used frequently in similar contexts was played during both the baseline and endline surveys to measure willingness to pay to control money (Almås et al., 2018, Fiala et al., 2017, Jayachandran et al., 2023, Riley, 2024). In this game, women make a series of real choices between receiving $3 themselves and their spouse receiving increasing amounts of money: $3.2, $4, $5.2, $6.4, $9.6 and $12.8.[23] Either payment is via mobile money tomorrow. If the woman selects herself instead of her spouse when, for example, offered the choice of $3 herself or $3.2 to her spouse, this is interpreted as being willing to pay $0.2 to control the money herself. In this game, we see that 46% of women would rather get $3 themselves than have their spouse receive $12.8 - a similar high willingness to pay as seen in previous contexts (Fiala et al., 2017, Riley, 2024).[24]

[22]Those assigned to treatment were additionally randomly assigned to attend group meetings weekly or bi-weekly, holding repayment fixed at weekly. Women in the bi-weekly arm had the option of skipping every other group meeting if they repaid their loan using mobile money in advance of the meeting. 51 groups were assigned to treatment with weekly group meetings and 50 groups to treatment with bi-weekly meetings. After the treatment assignment, BRAC decided to not implement the bi-weekly meeting skip option, due to concerns about this reducing repayment rates. We therefore pool the treatments together for most analysis. Table A9 confirms no differential effects on our main outcomes by sub-treatment.

[23]One in ten women were selected to have a randomly chosen choice actually paid.

[24]It is possible that willingness to pay to control money is higher in this artificial context than it would be without a windfall payment, but the game still suggests a very high willingness to give up money at

5.2 Baseline mobile money use and preferences

In Table A2 we report summary statistics of key variables capturing women's baseline use of mobile money, comfort, preferences and trust. In general, women use mobile money services regularly for remittances and airtime topup, and are comfortable performing basic transactions themselves. However, they do not make payments or save using mobile money, and prefer to make payments as cash. They have high trust in mobile money services and agents, but think costs are high.

96% of women reported ever using mobile money before, with 41% using the service in the past week. On average, women used 2.4 services a month, with sending and receiving money and making airtime purchases the most common transactions. Only 6% of women reported paying for a good or service using mobile money, though 40% paid a bill using mobile money. Only 17% received a payment from a customer and 4% made a payment to a supplier using mobile money. Less than 5% of women made school fee payments, received a benefit from the government or received a wage through mobile money. Taking digital loans was relatively common, with 27% of women reporting ever having had a loan from a mobile money provider. Only 15% of women reported saving with mobile money, and on average their savings were only 16 USD PPP.

Women are quite comfortable using mobile money: they are willing to store 30,000 UGX ($10) of money on their mobile money account for 30 days, one-third regularly leave money on their account for a month or longer, and they are generally comfortable completing transactions, sending money and checking their balance. 80% perform mobile money themselves. However, 44% have told family members the pin number to their mobile money account.

While they frequently use and are comfortable using mobile money, most prefer cash. Only 10% of women would choose to receive $8 as mobile money rather than as cash. However, 50% of women would be willing to make loan repayments using mobile money. Trust in mobile money is high, and women are not overly worried about experiencing fraud, though some think the cost is unfair.

5.3 Experimental integrity

We confirm the validity of the experiment by performing a balance test on a range of covariates, results for which are shown in Table A3.[25] As well as reporting the mean and standard deviation of each covariate for the treatment and control group, the final column shows the difference and standard error from a regression of each outcome on the treatment indicator, controlling for strata dummies and with standard errors clustered by group. We see that out of the 20 variables, only one is statically significantly different

the household level in order to receive it personally.

[25] A balance table by sub-treatment is shown in the Appendix Table A4.

at the 5% level: Women in the treatment group are 3 percentage points less likely to have used mobile money ever, on a mean of 98% in the control group. We control for mobile money use in subsequent analysis. We also perform an omnibus test regressing all the covariates on the treatment variables and testing if they are jointly significant. The F-statistic and p-value from this test are 1.26 and 0.21, implying that the characteristics do not jointly predict treatment assignment.

This table also provides summary statistics of the sample and for key outcomes. The women are 40 years old on average, and nearly all have completed primary school but only 24% have completed secondary school. 70% of them are married, and they live in households with 4.2 other people, of which 1.3 are under 12 years old. They make 340 USD PPP a month profit in their business, on sales of 800 USD PPP and inventory of 700 USD PPP. They have been operating their businesses for almost 7.5 years, but only one-third of them employs anyone else in their business. 64% of women have a retail business, mainly small stores or market stalls, 17% make and sell food and 16% operate a service such as tailoring or hairdressing.[26]

Their household income is 700 USD PPP, meaning that the woman's business contributes half of household income on average. Monthly consumption is 400 USD PPP.[27] Women have 400 USD PPP saved on average and their outstanding loans are 1,100 USD PPP.

Attrition was extremely low due to the outstanding efforts of the survey team to find all the respondents. The team completed phone surveys with women who had moved out of the study area, further reducing attrition. Attrition by treatment status is shown in Table A5. Only 3% of the sample could not be found at endline and this did not differ by treatment. We also examine characteristics that predict attrition in Table A6. Given the low rate of attrition, we do not find strong predictors of attrition. Women with businesses with larger inventory values are less likely to attrit, as are women with higher scores on the mobile money use index at baseline. Women with higher household income and who saved with mobile money at baseline are slightly more likely to attrit.

5.4 Empirical Strategy

To assess the impact of the treatment, we estimate:

$$Y_{ig} = \beta_0 + \beta_{MM}\text{MM}_g + Y_{0ig} + X_{0ig} + \alpha_s + \epsilon_{ig} \tag{1}$$

Where Y_{ig} is an outcome of interest for a woman i in group g, Y_{0ig} is the equivalent measure, or a close proxy, if available in the baseline survey, MM is an indicator for the woman's group being randomly assigned to mobile money repayment, X_{0ig} is a vector of

[26]The other 3% do manufacturing or agriculture.

[27]The baseline measure of consumption excluded spending on school fees and durable goods.

covariates measured at baseline, α_s are stratification fixed effects and ϵ_{ig} is a random error term clustered at the microfinance group level. The parameter of interest is β_{MM} i.e. the impact of the group being assigned to mobile money loan repayment (Intention-to-treat estimate).

All outcomes were pre-specified in a pre-analysis plan and any departures from this are clearly specified.[28] The vector of controls X_{0ig} is selected using post double selection LASSO from the variables included in the baseline survey for each outcome.

As we consider three primary outcomes, we adjust the p-values of the coefficients of interest for multiple statistical inference by calculating sharpened q-values that control for the false discovery rate (FDR) (Benjamini et al., 2006). For summary measures of outcome families and when looking at heterogeneous effects, we group several related variables into index variables following Anderson (2008).

5.5 Takeup

Women in the treatment group were free to make loan repayments using mobile money or cash. We therefore examine takeup of the option to repay the loan using mobile money. We define takeup in three different ways, the first two of which were pre-specified: 1) any use of mobile money to repay the loan 2) making at least 10 loan repayments using mobile money (out of 23 on average)[29] and 3) the number of loan repayments made using mobile money.

Takeup by treatment status is shown in Table 1. The mean in the control group is not always zero as in one of the groups assigned to the control arm, women were accidentally instructed to repay their loan using mobile money. This was stopped as soon as it was observed. We see that 66% of the treatment group ever made a loan repayment using mobile money, compared to 2% of the control group. 42% of the treatment group made more than 10 loan repayments using mobile money, compared to none of the control group. On average, women in the treatment group made 8 loan repayments out of 23, or 1/3 of their loan repayments, using mobile money, compared to 0.04 loan repayments using mobile money in the control group. On average, 36% of treated women made a loan repayment with mobile money in any given week of the study. This varied from 10% in the first week of the study to 58% at a peak in week 40 of the study (Figure A1).[30] Overall, takeup was high in the treatment group and extremely small in the control group, highlighting the success of the encouragement design.

[28]The pre-analysis plan is available here. Departures are outlined in Appendix B.

[29]The maximum number of possible payments a woman could make during the study was 39. However, due to gaps between loans and some women ceasing to be clients during the study, most women did not make this many payments. The median number of payments made during the study by women was 26, mean 23 and standard deviation 11.

[30]Implementation of the treatment took a few weeks to get going, with most treatment groups not actually training and offering mobile money repayment until 3 months into the study.

Figure A2 shows the percentage of women by treatment arm making a given proportion of their payments using mobile money.[31] The distribution amongst treatment women is relatively flat, with approximately 15% of the sample making each of 20-40%, 40-60%, 60-80% and more than 80% of their loan repayments using mobile money.

Table A7 shows predictors of each of the three takeup definitions in the treatment group. Richer clients as measured by their business asset value make more repayments with mobile money. At the extensive margin, being in a larger household, having fewer children under 12 and having used mobile money before also predicts any use of mobile money for loan repayment, suggesting family composition may create barriers to using mobile money for loan repayment. Those who had used mobile money before (96% of the sample) were more likely to make any loan repayments using mobile money, though intensive margin measures of use of mobile money and preference for loan repayment with mobile money do not predict any of the takeup measures. Women who had higher decision making power in the household at baseline are less likely to make any and at least 10 loan repayments with mobile money, and women who had higher financial control are less likely to make any loan repayment with mobile money.

Takeup is highly correlated within group. Figure A3 shows that in 50% of treatment groups between 80 and 100% of women made any payment with mobile money. In 8% of treatment groups less than 20% of women made a payment using mobile money. The correlation within treatment group in any use of mobile money for loan repayment is 0.51. The reason for this is that the credit officer was essential to pass on the required information to make mobile money repayments and encourage women to use this payment method. Consistent with this, we see that the most common reason women in treated groups gave for not making loan repayments with mobile money was that they did not know they could repay their loan with mobile money (33%), followed by preferring cash (28%), high fees (19%) and not knowing how to make the loan repayment with mobile money (9%).

6 Results

As outlined in the pre-analysis plan, the three primary outcomes of this study are an index of use of mobile money services (excluding loan repayment or money accumulated for loan repayment in the treatment group), an index of women's empowerment and the woman's last month's business profits. We examine each of these primary outcomes and the component measures below (See Table A8 for the three outcomes together with a multiple hypothesis test).

[31] Note that due to varying times remaining on women's loans at the start of the study, women varied considerably in how many loan repayments they made during the study. Hence it is more informative to look at the proportion of loan repayments made with mobile money than the number of loan repayments.

6.1 Mobile Money use

We look at indicators of mobile money use in Table 2. Our measures of mobile money use focus on capturing intensive margin changes, given nearly all women had used mobile money before at baseline. Note that all the measures of mobile money use exclude the mechanical effects of making loan repayment and any savings intended for making a loan repayment.

We see a large increase in an index of mobile money use for treated women of 0.34 standard deviations. Looking at the drivers of the increase in mobile money use, we see that multiple dimensions of mobile money use are increasing in the treatment arm. Women in treated groups are 7.3 percentage points more likely to allow customers to pay for items using mobile money,[32] a 50% increase on the control mean of 15%. They are 15 percentage points more likely to have used mobile money in the last week, compared to 49% in the control group using mobile money in the last week. While they have not carried out more mobile money transactions in the last month, the value of their transactions is 36 USD PPP (32%) larger. They are 6.2 percentage points more likely to save using mobile money, and they have nearly 16 USD PPP more saved in their mobile money wallet, a 130% increase on the control mean of 12 USD PPP.[33] Overall, we see strong evidence of substantially increased use of mobile money services as a result of being able to make loan repayments using mobile money.

We breakdown the value of transactions with mobile money in the last 30 days from column (6) by each category in Table A10. Interestingly, we can see that the increase in value is being driven roughly equally by increases in the value of transactions intended for saving, payments from customers and school fee payments of 10 USD PPP each. This is consistent with the effects of treatment on the stock of savings and willingness to accept mobile money payments seen in Table 2. The increase in school fee payments with mobile money could suggest a use for the women's savings on their mobile money accounts, and represents a particularly big shift in behaviour given payments of school fees in the control group are only 0.70 USD PPP.

The increase in use of mobile money is accompanied by an increase in comfort with using mobile money of 0.16 standard deviations (Table A11). We see that treated women feel more comfortable with most transactions related to mobile money, completing transactions and sending money. The woman is also 5.9 percentage points more likely to make mobile money transactions herself, on a mean of 76% in the control group.

[32]The share of sales made using mobile money is still only 2%, compared to 1% in the control group (Table A21). We also see that treated women are less likely to have to pay a premium to pay a supplier using mobile money, suggesting they may be selecting into suppliers that accept mobile money without charging a surcharge.

[33]The saving effects are encouraging as they suggest that incentives or bonus interest rates do not need to be offered to induce women to save with mobile money, as seen in other studies Batista et al. (2022), Batista and Vicente (2020).

Interestingly, we see a decrease in preference for digital payments in the treatment groups of 0.17 standard deviations (Table A12). The change in the preference for digital payments is driven by treated women having a lower preference for repaying their loan with mobile money. This is somewhat counter-intuitive, given we see a large increase in use of mobile money. The main reason women gave for this preference is the cost of making mobile money loan repayments.[34] This is concerning, as the salience of the fee may deter women from adopting this payment method going forward.

There is no significant change in women's trust in mobile money (Table A13). This contrasts with studies like Bachas et al. (2021) and Breza et al. (2020) which see changes in trust as a key mechanism in their studies of debit card introduction and paying wages through mobile money respectively. This could be because trust in mobile money was already high in this setting: in the control group, women scored 4.4 out of 5 for how safe mobile money is and 4.38 out of 5 for their trust in their mobile money operator (Table A13 columns (2) and (3)). We see no significant change in women's experience of problems using mobile money, though the point estimate suggests treated women encountered more problems, in particular a significant at the 10% level higher likelihood of experiencing problems with agent float (Table A14).[35]

6.2 Financial control and women's empowerment

We see a large increase in women's empowerment of 0.21 standard deviations in the treatment group, driven by increases in financial control and household decision making (Table 3). Treated women see a 0.37 standard deviation increase in an index of financial control. Examining this increase in financial control further in Table 4, we see that treated women are more likely to report deciding how to spend their own income, report less pressure to share money with their spouse and are more likely to discuss their income with their spouse. An increased willingness to discuss income with the spouse is suggestive that privacy might not be the main channel through which mobile money use increases financial control. Treated women are less likely to choose themselves in every choice in an incentivised game measuring willingness to pay to control money, which is interpreted as women having higher empowerment (Almås et al., 2018) (see description of this game in Section 5.1).[36] Overall, this suggests that treated women feel more in control of their money, and hence are more comfortable discussing it with their spouse and less willing to pay to control additional money. This highlights that increased use of

[34]Women incurred a 1% fee on all mobile money loan repayments. The cost of making repayments with mobile money also came up during all the focus group discussions, with women asking for this fee to be removed.

[35]Treatment required women to find agents with a large enough float to cover the average loan repayment of 40,000 TSH (40 USD PPP) each week.

[36]This increased willingness to choose their spouse in the incentivised game could be consistent with women's bargaining power increasing because their outside option has improved.

digital financial services can meaningfully increase women's financial control and mitigate sharing pressure.

An index of women's decision making in the household increase by 0.22 standard deviations for women in treated groups (Table 5). The increase in women's household decision-making in the treatment arm is driven by an increase in decisions about clothing and food and an increase in their general involvement in financial decisions. We do not see any changes in an index of requiring spousal permission to carryout different activities or in decision making in the woman's business (Tables A15 and A16).

Consistent with the reported increase in decision-making within the household, we see changes in the allocation of expenditures (Tables A17 and A18).[37] In particular, in value terms, we see reductions in spending on food outside the home (primarily snacks and treats), and personal care (tooth paste, soap) and increases in spending on women's, girls and boys clothing and children's schooling by women in treated groups. These shifts are relatively large: The reduction in spending on snacks is almost 5 USD PPP, a 14% decline, while the increases in spending on school fees for boys and girls are 5.4 USD and 6.7 USD, around 19-23% increases from the control mean of 29 USD on each. The increases in expenditure on clothing and schooling balance out against the decreases in expenditure on food and personal care, such that there is no overall change in expenditure. We see the same pattern when looking at expenditure shares. This could indicate a shift in spending towards things women indicate they value, and thus signal an improvement in their empowerment, as has been used in the literature (Bobonis, 2009, Hidrobo et al., 2016). Further, spending on clothing and schooling is more "lumpy" than on snacks and treats, so shifts in expenditure in this direction are consistent with the idea that women can save up for larger, less frequent expenditures.

Reassuringly, we see no change in discord with the spouse for treated women (Table A19), suggesting women are not experiencing a backlash as a result of their greater financial control and input into decision making. If anything, the coefficient on discord suggests a reduction in major arguments with the spouse. We see no significant effect on women's happiness, which could suggest that the increase in women's preferences being represented in household decision-making may not be enough to improve women's assessments of their overall well-being.

6.3 Business, household and saving outcomes

We do not see any impacts of treatment on women's business profits (Table A20). Though the standard errors are large, the coefficients are economically small and vary between positive and negative for the last month's profit, last week's profit and profit every month of the last 6 months.

[37] These outcomes were not pre-specified. Note that there is no change in total expenditure.

At first glance, the lack of impact on profit is surprising given the increase in women's use of mobile money services, including for business transactions. However, there are two main mechanisms through which increased use of digital payments could have translated into higher profits: 1) increased transactions due to increased digital transactions with their customers or (lower cost) suppliers 2) increased business investment due to better ability to save profit and reinvest into the business. On the first, we saw that only 7% of suppliers allow mobile money payments, and treatment does not change this (Table 2). Hence women are not able to access more suppliers by accepting digital payments. Treatment does increase the likelihood that they accept payments from customers with mobile money, but as a percentage of sales, those through mobile money go from 1% of sales to 2% of sales in the treatment group (Table A21). It is therefore unsurprising that the tiny increase in digital sales is not translating into higher profits.[38] In Riley (2024), business profits increased because digital loans resulted in greater investment of the loan in the business: there was no indication that subsequent business profits were put onto the mobile money account or reinvested into the business, with most of the increased profit appearing to be consumed. Our findings here are consistent with the mobile money account not being used to facilitate reinvestment into the business. They also align with those of Bastian et al. (2018) who provided a labelled mobile money account for savings to female entrepreneurs, and found no effects on business outcomes despite high use of the account. Instead, we see savings being used for lumpy consumption, such as clothing and school fees. This could be because business investments require larger balances to be accumulated than the women are able, or willing, to do.[39]

Consistent with the lack of impact on profits, we see no impact of treatment on sales, expenses, business capital, hours worked, employees or operating days (Tables A22 and A23). Note though that the coefficient on sales is large and positive (79 USD PPP - 9% of the control mean), though the standard error is large. The coefficient on business capital is large and negative (-113 USD PPP - 12% of the control mean), with again a large standard error. Overall, it seems that the treatment is not having an impact on women's businesses, though estimates are noisy.

We see no significant changes in average household outcomes, either household total consumption nor total income (Table A24). Importantly, this suggests no negative effects on the income of other household members, particularly the spouse, from greater financial control on the part of the woman.

Savings on the mobile money account do not crowd out other forms of saving, and if anything we see a crowd-in of savings: Total savings increased by 66 USD PPP, driven

[38]This is consistent with the finding that larger interventions at the market level are needed to encourage businesses and customers to use mobile money simultaneously due to complementarities in digital payment adoption (Alvarez et al., 2023, Higgins, 2022).

[39]It could also be that savings for business investment take longer to accumulate than the 10 months of this study.

by the increase in savings with mobile money (Table A25).[40] We see that there are insignificant increases in saving with friends (10 USD PPP), at home (10 USD PPP) and in VSLAs (14 USD PPP). The crowd-in of other kinds of saving suggests that increasing financial control through increased mobile money account use allows women's preferences for greater saving to be reflected in the household.

How are savings increasing when there are no changes in income? We see in Table A17 that spending on food declines around 13 USD PPP while spending on education increases around 16 USD PPP. Education spending is more "lumpy" than food spending, requiring savings before payment at the start of the school term.[41] It appears that women are cutting down on small, regular food expenditures, particularly snacks, saving on their mobile money account and then spending more on their children's schooling, as well as clothing. This pattern is also consistent with the increase in the value of monthly transaction on the mobile money account for school fees of 10 USD, seen in Table A10.

6.4 Loan and group behaviour

There are no negative impacts of treatment on BRAC loan repayment outcomes, as captured in BRAC's administrative data (Table A26). Women in treated groups have similar loan amounts outstanding, similar sized subsequent loans disbursed by BRAC, saving balances with BRAC and amounts overdue on their loans, are 10 fewer days late on their loan repayments on a control mean of 14 days, are as likely to be in default on their loan and no more likely to not have a current loan with BRAC.[42] We see similar patterns if we look the same administrative outcomes for all the women in the study microfinance groups, rather than just the study sample (Table A27). This reassuringly suggests that BRAC will not see any negative consequences for loan repayment from switching to mobile money loan repayment, at least in the short term. Likewise, we see no changes in women's loan access from BRAC or other sources in the survey data (Table A28).

There is some indication that social interaction increased in treated groups, though an index of social cohesion is not statistically significant (Table A29). Treated women talk to more group members at least once a week, are willing to give financial help to more group members and visit the homes of more group members. This increase is from a relatively low base in the control group, with women only talking to 20% of group

[40] Prior literature has not found consistent overall increases in savings from interventions involving the provision of mobile money accounts when strong incentives to save on the mobile money account are provided, such as waiving withdrawal fees, paying bonus interest rates, setting saving goals and sending reminders to save (Aggarwal et al., 2020, Batista et al., 2022, Dizon et al., 2020). Such incentives may therefore encourage crowding out of other forms of saving.

[41] For this reason, food expenditures were asked on a 7 day recall and educational expenditures on a 6 month recall. Both are then scaled to 30 days.

[42] There are also no changes in the size of the groups between treatment and control groups (results not shown).

member once a week outside the group meeting, willing to help 12% of them financially and only visiting 9% of group member's homes. There is no significant change in trust in group members, though the point estimate is negative and p-value 0.103.

We do not see any changes in sentiment about BRAC, likely as trust was already so high in BRAC at 4.53/5 for their trust in the credit office and 4.83/5 for trust in BRAC microfinance overall in the control group (Table A30). However, we do observe a decrease in preference for weekly group meetings (as opposed to biweekly or monthly) of 10 percentage points on a control group mean of 80% preferring this option. Since we did not vary meeting frequency, we are unable to examine the effects of actually allowing women who repay with mobile money to attend group meetings less often, but it is interesting to note that, despite the gains in interaction at group meetings, women perceive less need to meet weekly if they are repaying digitally. Anecdotally, in the focus groups, women expressed a desire to separate out loan repayment from the group meetings if repayments were made using mobile money, focusing the meeting on sharing and social interaction around their businesses on a fortnightly basis. We also see that group meetings take 10 minutes less for women in treated groups, as the need to count cash was removed, though this balances out against the 12 minutes they on average spent making the loan repayment with mobile money.

6.5 Heterogeneity Analysis

We pre-defined 6 dimensions of heterogeneity to examine treatment effects by: whether the woman was above the median in profits, a mobile money use index, a group social cohesion index, an empowerment index, a business management index and a psychological score index. Results for these are shown in Table 6. There is heterogeneity in the treatment effects on empowerment, with women who had above median empowerment, better-managed businesses or higher psychological empowerment at baseline seeing smaller treatment effects.[43] Women with higher empowerment at baseline also see (insignificantly) smaller treatment effects on mobile money use. This suggests that the treatment benefits are concentrated amongst more vulnerable women, and is consistent with the mechanism of increased mobile money use leading to gains empowerment via financial control. There is no significant evidence of heterogeneity by baseline business profits, use of mobile money or group social cohesion.

[43]The heterogeneity by empowerment is further broken down in Table A31, where it appears the treatment effects on empowerment are driven by women with lower household decision making power who needed to ask their spouse for permission to do more activities at baseline.

6.5.1 Privacy, earmarking or transaction costs

To understand how financial control is increasing, we look at two potential channels: privacy and transaction costs. We examine privacy using heterogeneity by whether the woman said others knew her mobile money account pin number at baseline, though note that women could have easily changed their pin at any point. 46% of women said that someone else in their household knew their pin number at baseline. We explore transaction costs by looking at heterogeneity by whether the woman and her spouse have the same mobile money network provider: It is more expensive to transfer money to a different mobile money network, and so transaction costs are higher for spouses who use different providers. These fees are relatively high, of the order of 2-5%. If transaction costs are the mechanism by which financial control improves, we would expect larger treatment effects for women who had a different mobile operator to their spouse at baseline. 31% of women's spouses had a different network operator to them at baseline.

We see no evidence of heterogeneous treatment effects by whether others knew the woman's mobile money PIN at baseline (Table A32), suggesting that privacy might not be the main channel through which financial control increases. This is also consistent with treated women being more likely to discuss their income with their spouses, which also goes against privacy as the channel. Note though that women could change their PIN easily, and may have done so in response to treatment, though, unfortunately, we did not ask this at follow-up.

Likewise, we see little evidence of heterogeneity by whether the woman's spouse had the same mobile money provider as her at baseline (Table A33, with similar caveats that the woman and her spouse could have switched providers during the study. While the point estimate on the interaction for household decision making is relatively large, it is not statistically significant. The point estimate for the interaction for the mobile money use index is also negative (though not statistically significant). This is suggestive that transaction costs may not be the main mechanisms through which financial control increases.

Overall, this is suggestive that earmarking may be the most likely channel through which use of mobile money leads to improvements in women's empowerment, although far from definitive.

6.5.2 Treatment intensity

We examine two dimensions of treatment intensity: loan length and loan size. The treatment began mid-way through women's loan cycles. As a result, women had different lengths remaining on their current loan, and the length remaining weakly determined how

long they would be treated for.[44] We therefore can examine heterogeneity by the quasi-random variation in how long the woman had left on her existing loan when treatment started. This analysis will indicate if treatment effects are larger for women who are potentially treated for longer. Women also had varying loan sizes determined by how long they had been borrowers from BRAC. Women with larger loans had to put more money through their mobile money account, and so may experience larger treatment effects.

In Table A34 we see that there is limited heterogeneity by whether the woman's loan ends within 5 months of treatment starting: women whose loans ended earlier see smaller gains in comfort using mobile money, though their use of mobile money services is similar. Their empowerment gains are no different than women who had longer left on their loan. This suggests that even a potentially short period of using mobile money for loan repayment was sufficient to increase women's use, comfort and financial control. However, this should be caveated that most women went on to receive subsequent loans and hence received treatment for longer.

In Table A35 we look at heterogeneity by baseline loan size. Women with larger loans have to put more money through their mobile money account for loan repayments and so may experience larger treatment effects, though note that loan size is directly related to the length of time that a woman has been a microfinance loan client, and so correlated with experienced business owners who have larger businesses. There is some evidence that women with larger loans see larger treatment effects on mobile money use, which could indicate that they became more comfortable with holding large balances on their mobile money account and so gain more financial control, though the effects are not statistically significant.[45]

Overall, this evidence is suggestive that even a couple of months of treatment, for women with small loans, was sufficient for benefits to materalise.

7 Alternative channels

We argue that the improvements in women's empowerment in the treatment group are primarily driven by the increase in financial control that greater use of mobile money

[44]Women could go on to receive a subsequent loan, and if they did they would continue to receive their assigned treatment for longer, making the amount of time left on the loan only weakly correlated with treatment time. On average, women whose loans ended within 5 months of the intervention starting made 22 loan repayments, while women whose loans ended more than 5 months after the intervention started made 24 loan repayments, with the difference significant at the 1% level. 60% of women went on to receive a subsequent loan from BRAC during the study. However, this choice is endogenous, and so we cannot use it to examine treatment intensity.

[45]Mechanically since the fee was 1% of the payment amount, women with larger loans had to pay higher fees to use mobile money for loan repayment, which could explain why we do not see a strong positive effect by loan size.

facilitates. Here we discuss alternative mechanisms through which the use of mobile money services for loan repayment could have affected women's empowerment. We argue that time savings, loan access, changes in loan investment and income effects are unlikely to be channels for the effects seen. We then turn to social interaction, for which we saw a small, insignificant increase in treated groups. We argue that while we cannot rule out effects on women's empowerment through increased social interaction entirely, the (insignificant) magnitude of the increase in social cohesion is too small to fully explain our findings and could in fact be a result of greater empowerment allowing women to interact more socially with other women.

7.1 Time savings

A reduction in the time required to make loan repayments is one possible alternative mechanism through which the treatment could have improved outcomes for women. However, we think that this is unlikely to have played a large role here for a number of reasons. Firstly, women still had to attend group meetings despite making their loan repayments with mobile money. Secondly, the reduction in the time that group meetings took was only 10 minutes on average for a meeting that took over 2 hours. This is a small time saving even on a weekly basis. Third, treated women also had to go to an agent to deposit money to their mobile money account if they did not have a sufficient balance for their loan repayment. On average this took 12 minutes (median 10), which almost exactly compensates for the reduced meeting time. As a result, there isn't evidence that the treatment increased the time that women could dedicate to other activities. Finally, if time savings was the relevant mechanism, we would expect effects on women's empowerment to only materialise through increases in income. We do not see any changes in women's income, leaving no clear mechanism through which time savings could have empowered women.

7.2 Loan access

If mobile money repayment improved women's repayment behaviour, it may have improved their access to credit. This could potentially increase their empowerment through enhanced access to financial resources. Tables A26- A28 suggest that treated women saw no changes in their loan outcomes, including their outstanding loan balances, default and likelihood of having subsequent loans from BRAC. Similarly, in Table 2 we do not see a significant increase in treated women's access to mobile money (digital) loans.[46] We therefore think it's unlikely that women's access to credit has meaningfully changed, and

[46] Almost the entirety of the women's credit is from BRAC: 96% of the value of women's outstanding loans is the BRAC loan. No women reported having an outstanding mobile money loan at endline.

therefore it is unlikely that this is a mechanism that could explain the improvements in women's empowerment.

7.3 Loan investment behaviour

In this study, the loan disbursement method did not change and remained as cash. The treatment also began mid-way through women's loan cycles, after their loan had already been disbursed, sometimes many months ago. As a result, we think it unlikely that women are depositing their loan onto their mobile money account and so increasing their control over the loan, as in Riley (2024). However, without transaction records from the mobile money accounts, we cannot rule this out. We note though that Riley (2024) did not find effects of disbursing loans on mobile money accounts on financial control, as women did not learn to use the mobile money accounts for other types of transactions. In her study, women also did not deposit subsequent loans onto the mobile money account, suggesting women are unlikely to start doing this here. She does find large positive effects on business outcomes due to increased investment of the loan in the business. This contrasts with our findings here, and so it seems unlikely that our treatment could be working through a similar mechanism. We also think it unlikely that the treatment increased the privacy of the loan, for the reasons already mentioned above, and because the fact the woman had a loan is highly public due to the weekly in-person group meetings.[47]

7.4 Income changes

We do not see any effects of treatment on either the woman's or the household's income. As a result, it is unlikely that improvements in empowerment are driven by increased income under the woman's control. However, we cannot rule out that an increase in empowerment could be due to an increase in a woman's potential to earn income (in the event of leaving the marriage) due to increased use of mobile money services, which increases her outside option.

7.5 Social cohesion

The increase in empowerment could be a result of improvements in social cohesion of the women in the groups, and thus an improvement in their ability to call on support from others (Feigenberg et al., 2013). However, in our context women were already in established groups and had moderate levels of interaction with group members. We therefore think that the (insignificant) improvements in social cohesion are too small to be driving the improvement in empowerment. Rather, increased empowerment could be enabling women to interact more with each other outside of the group setting. Further,

[47]Women also frequently list their husband as the guarantor on their loan.

we do not see significant heterogeneity by baseline social cohesion (Table A31), which we would have expected if greater social cohesion (the potential for which was higher among groups with low social cohesion at baseline) was leading to improvements in empowerment. Overall, we cannot rule out that small increases in social cohesion are also feeding back into women's empowerment, but this seems unlikely to explain the entire effect.

8 Conclusion

Women's empowerment is a frequent goal of policy-makers. Most prior research has sought to raise women's empowerment by increasing their income or resources, assuming that women retain control over some portion of that income or resource. Here we focus on the control of resources itself, and the idea that raising financial control can empowerment women even in the absence of any changes in their resources. Using a randomised controlled trial, we encourage women to increase their use of mobile money, a ubiquitous financial service offering enhanced financial control by providing a secure, private place to store money. We encourage the use of mobile money services by shifting women's weekly microfinance loan repayments from cash to via mobile money. We find that treatment raises women's use of mobile money services and comfort using them substantially. Women's control of their finances increases by 0.37 standard deviation and their decision-making in the household by 0.22 standard deviations. Household expenditure shares shift to be more aligned with women's preferences despite there being no change in total household income or expenditure. Women are able to save up for lumpier expenditures such as clothing and school fees. Our findings show the importance of increasing women's financial control for enhancing their empowerment.

Our results highlight that new technology can have significant welfare consequences for women. An important policy conclusion of our work is that shifting more payments and transactions to digital forms will benefit women.[48]

We see that shifting to digital loan repayment leads to no changes in group social cohesion, with some indication that interaction between group members may have in fact increased. This is because women still met weekly in their groups in the treated groups. However, treated women had a strong preference to reduce meeting frequency to bi-weekly or monthly meetings. It is possible that our findings would be different amongst new groups who never repaid in cash, if new clients selected in because digital repayment would allow them to not attend group meetings in person or if BRAC accompanied digital loan repayment with a reduction in meeting frequency. More concerning, treated women were less likely to prefer repaying their loan with mobile money over cash, driven by the need to pay a fee to utilise mobile money repayment. This suggests that cost could be a barrier to women choosing to utilise digital loan repayment despite their potential benefits.

[48] On the basis of our findings, BRAC has rolled out the option to repay loans with mobile money across all groups at the study branches.

Table 1: Takeup by treatment status

	(1) Any payment	(2) At least 10	(3) Number payments
Treated	0.635***	0.423***	7.993***
	(0.032)	(0.033)	(0.603)
Observations	750	750	750
Control Mean	0.020	0.000	0.040

All regressions control for stratification fixed effects. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Any payment is any loan repayment made using mobile money. At least 10 is 10 or more loan repayments made using mobile money. Number of payments is the number of loan repayments made using mobile money. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2: Impact of treatment on Mobile Money Use

	(1) Use index	(2) Pay supplier	(3) Allow customer pay	(4) Used last week	(5) Transaction count	(6) Transaction value	(7) Digital loan	(8) Any saving	(9) Amount saved
Treated	0.344***	0.031	0.073**	0.147***	0.066	35.751**	0.067	0.062*	15.670**
	(0.092)	(0.022)	(0.031)	(0.044)	(0.110)	(16.704)	(0.042)	(0.036)	(6.225)
Observations	722	722	722	722	722	722	722	722	722
Control Mean	0.00	0.07	0.15	0.49	2.44	110.64	0.26	0.17	11.83

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index of columns (2)-(9). Pay supplier is a dummy variable capturing if the women pays suppliers using mobile money. Allow customer pay is a dummy variable if the woman allows customers to make payments in her business using mobile money. Last used week is a dummy variable capturing if the woman used mobile money in the last week (excluding for loan repayment). Transaction count is the number of different types of mobile money transactions performed in the last month from a list of 12 types. Transaction value is the sum of the value of the transactions made using mobile money in the last month. Digital loan refers to whether the woman has ever taken a loan through her mobile money provider. Any savings captures if the woman reports saving on the mobile money account and Amount saved is the value of savings on the mobile money account. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3: Impact of treatment on Empowerment

	(1) Empowerment index	(2) Financial Control index	(3) Permission index	(4) HH decision index	(5) Bus decision index
Treated	0.213**	0.368***	0.014	0.215**	-0.023
	(0.086)	(0.102)	(0.120)	(0.090)	(0.090)
Observations	722	722	487	722	722
Control Mean	-0.00	-0.00	0.00	-0.00	0.00

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is composed of the elements of columns (2)-(5). Financial control is an index capturing (less) pressure to share money with the spouse and willingness to pay to control money. Permission is an index capturing whether the woman requires the spouse permission to do different activities (married women only). HH decision is an index capturing who makes decisions in the household across 8 domains. Bus decision is an index capturing who makes the decisions in the woman's business across 4 domains. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Impact of treatment on Financial Control

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Index	Decides spend income	Pressure share money	Discusses income spouse	Chooses self 1	Chooses self 2	Chooses self 3	Chooses self 4	Chooses self 5	Chooses self 6
Treated	0.368***	0.279*	-0.587**	0.245**	-0.109***	-0.091*	-0.108**	-0.114**	-0.138***	-0.146***
	(0.102)	(0.149)	(0.297)	(0.108)	(0.039)	(0.048)	(0.046)	(0.048)	(0.049)	(0.049)
Observations	722	722	441	441	722	722	722	722	722	722
Control Mean	-0.00	3.83	3.09	3.04	0.83	0.70	0.63	0.59	0.58	0.58

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index composed of columns (2)-(10). Decides spend income is a self assessment from 1-5 on whether the woman decides how to spend her own income. Pressure share money is a self assessment from 1-5 of whether the woman experiences pressure to share money with her spouse (married women only). Discusses income spouse is a 1-4 measure of how frequently (never-often) the woman discusses her income with her spouse (married women only). Chooses self 1-6 are indicators for whether the woman chose herself when offered the choice between USD 3 for herself and USD 3.2, USD4, USD5.2, USD6.4, USD9.6 and USD12.8 to her spouse. Choosing herself is interpreted as a measure of her willingness to pay to control money. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Impact of treatment on household decision making

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Index	Clothing	Food	Education	Small purchase	Work	Ferility	Saving	Involvement
Treated	0.215**	0.070**	0.076**	-0.003	0.006	0.033	0.015	0.043	0.103*
	(0.090)	(0.031)	(0.038)	(0.035)	(0.025)	(0.033)	(0.037)	(0.028)	(0.061)
Observations	722	722	722	722	722	722	722	722	722
Control Mean	-0.00	0.85	0.81	0.82	0.92	0.90	0.86	0.90	3.05

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index of columns (2)-(9). Columns (2)-(8) show results for dummy variables capturing if the woman made decisions relating to that domain either jointly or alone. Column (10) captures the woman's overall perception of involvement in household decisions on a 1-5 scale where 5 is more involvement. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: Heterogeneous treatment effects

	(1) MM use	(2) Empowerment	(3) Profit
Treated	0.271**	0.277**	10.443
	(0.113)	(0.112)	(35.738)
Profit * Treated	0.172	-0.125	-11.556
	(0.165)	(0.145)	(53.347)
Treated	0.338***	0.195*	14.204
	(0.111)	(0.115)	(33.364)
MM use * Treated	0.016	0.033	-18.844
	(0.162)	(0.130)	(46.228)
Treated	0.283**	0.343**	11.520
	(0.117)	(0.135)	(38.627)
Social cohesion * Treated	0.116	-0.257	-16.571
	(0.162)	(0.163)	(52.657)
Treated	0.460***	0.342***	-6.765
	(0.112)	(0.115)	(37.404)
Empowerment * Treated	-0.227	-0.266**	23.064
	(0.147)	(0.134)	(52.100)
Treated	0.383***	0.346***	3.607
	(0.112)	(0.111)	(37.347)
Business management * Treated	-0.072	-0.259*	2.431
	(0.153)	(0.147)	(53.876)
Treated	0.391***	0.349***	12.612
	(0.123)	(0.118)	(33.748)
Psychological index * Treated	-0.093	-0.269*	-15.327
	(0.176)	(0.142)	(47.185)
Control Mean	0.00	-0.00	307.25
Observations	722	722	722

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Each dimension of heterogeneity captures if the woman was above the median in that dimension at baseline. Profit is monthly business profits, MM use is an index of 8 dimenstions of mobile money use, social cohesion is an index of 7 dimensions of social interaction with group members, Empowerment is an index of 4 domains of women's empowerment, business management is an index of 7 dimensions of business management practices, psychological is an index of women's aspirations, self-efficacy and goal settings. Regressions also control for the dimension of heterogeneity being examined. Mobile money use index is an index of 8 dimensions of mobile money use excluding loan repayment. Women's empowerment is an index capturing four domains of women's empowerment: financial control, household decision making, requiring the spouse's permission to do certain activities and business decision making. Business profits is from the last 30 days in USD PPP. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

References

Aggarwal, S., Brailovskaya, V., and Robinson, J. (2020). Cashing in (and out): Experimental evidence on the effects of mobile money in malawi. *AEA papers and proceedings*, 110:599–604.

Aker, J. C., Boumnijel, R., McClelland, A., and Tierney, N. (2016). Payment mechanisms and antipoverty programs: Evidence from a mobile money cash transfer experiment in niger. *Economic Development and Cultural Change*, 65(1):1–37.

Almås, I., Armand, A., Attanasio, O., and Carneiro, P. (2018). Measuring and changing control: Women's empowerment and targeted transfers. *The Economic Journal*, 128(612):F609–F639.

Alvarez, F. E., Argente, D., Lippi, F., Méndez, E., and Van Patten, D. (2023). Strategic complementarities in a dynamic model of technology adoption: P2p digital payments. Technical report, National Bureau of Economic Research.

Anderson, M. L. (2008). Multiple inference and gender differences in the effects of early intervention: A reevaluation of the abecedarian, perry preschool, and early training projects. *Journal of the American Statistical Association*, 103(484):1481–1495.

Anderson, S. and Baland, J.-M. (2002). The economics of roscas and intrahousehold resource allocation. *The quarterly journal of economics*, 117(3):963–995.

Anderson, S. and Eswaran, M. (2009). What determines female autonomy? evidence from bangladesh. *Journal of development Economics*, 90(2):179–191.

Angelucci, M., Heath, R., and Noble, E. (2023). Multifaceted programs targeting women in fragile settings: Evidence from the democratic republic of congo. *Journal of Development Economics*, 164:103146.

Ashraf, N. (2009). Spousal control and intra-household decision making: An experimental study in the philippines. *American Economic Review*, 99(4):1245–1277.

Ashraf, N., Field, E., and Lee, J. (2014). Household bargaining and excess fertility: an experimental study in zambia. *American Economic Review*, 104(7):2210–2237.

Ashraf, N., Karlan, D., and Yin, W. (2010). Female empowerment: Impact of a commitment savings product in the philippines. *World development*, 38(3):333–344.

Attanasio, O. and Lechene, V. (2002). Tests of income pooling in household decisions. *Review of economic dynamics*, 5(4):720–748.

Attanasio, O. P. and Lechene, V. (2014). Efficient responses to targeted cash transfers. *Journal of Political Economy*, 122(1):178–222.

Bachas, P., Gertler, P., Higgins, S., and Seira, E. (2021). How debit cards enable the poor to save more. *The Journal of finance*, 76(4):1913–1957.

Banerjee, A., Karlan, D., and Zinman, J. (2015). Six randomized evaluations of microcredit: Introduction and further steps. *American Economic Journal: Applied Economics*, 7(1):1–21.

Bastian, G., Bianchi, I., Goldstein, M., and Montalvao, J. (2018). Short-term impacts of improved access to mobile savings, with and without business training: Experimental evidence from tanzania.

Batista, C., Sequeira, S., and Vicente, P. C. (2022). Closing the gender profit gap? *Management Science*, 68(12):8553–8567.

Batista, C. and Vicente, P. C. (2020). Improving access to savings through mobile money: Experimental evidence from african smallholder farmers. *World Development*, 129:104905.

Batista, C. and Vicente, P. C. (2023). Is mobile money changing rural africa? evidence from a field experiment. *Review of Economics and Statistics*, pages 1–29.

Beaman, L., Karlan, D., and Thuysbaert, B. (2014). Saving for a (not so) rainy day: A randomized evaluation of savings groups in mali. Technical report, National Bureau of Economic Research.

Bedoya, G., Coville, A., Haushofer, J., Isaqzadeh, M., and Shapiro, J. P. (2019). No household left behind: Afghanistan targeting the ultra poor impact evaluation. Technical report, National Bureau of Economic Research.

Benjamini, Y., Krieger, A. M., and Yekutieli, D. (2006). Adaptive linear step-up procedures that control the false discovery rate. *Biometrika*, 93(3):491–507.

Bernhardt, A., Field, E., Pande, R., and Rigol, N. (2019). Household matters: Revisiting the returns to capital among female microentrepreneurs. *American Economic Review: Insights*, 1(2):141–160.

Bobonis, G. J. (2009). Is the allocation of resources within the household efficient? New evidence from a randomized experiment. *Journal of Political Economy*, 117(3):453–503.

Breza, E., Kanz, M., and Klapper, L. F. (2020). Learning to navigate a new financial technology: Evidence from payroll accounts. Technical report, National Bureau of Economic Research.

Carranza, E., Donald, A., Grosset, F., and Kaur, S. (2022). The social tax: Redistributive pressure and labor supply. Technical report, National Bureau of Economic Research.

Chang, W., Diaz-Martin, L., Gopalan, A., Guarnieri, E., Jayachandran, S., and Walsh, C. (2020). What works to enhance women's agency: Cross-cutting lessons from experimental and quasi-experimental studies. *J-PAL Working Paper*, 87.

De Mel, S., McIntosh, C., Sheth, K., and Woodruff, C. (2022). Can mobile-linked bank accounts bolster savings? evidence from a randomized controlled trial in sri lanka. *Review of Economics and Statistics*, 104(2):306–320.

Demirgüç-Kunt, A., Klapper, L., Singer, D., and Ansar, S. (2022). The global findex database 2021: Financial inclusion, digital payments, and resilience in the age of covid-19. Technical report.

Dizon, F., Gong, E., and Jones, K. (2020). The effect of promoting savings on informal risk sharing: experimental evidence from vulnerable women in kenya. *Journal of Human Resources*, 55(3):963–998.

Doepke, M. and Tertilt, M. (2019). Does female empowerment promote economic development? *Journal of Economic Growth*, 24:309–343.

Duflo, E. (2012). Women empowerment and economic development. *Journal of Economic literature*, 50(4):1051–1079.

Feigenberg, B., Field, E., and Pande, R. (2013). The economic returns to social interaction: Experimental evidence from microfinance. *Review of Economic Studies*, 80(4):1459–1483.

Fiala, N. et al. (2017). Business is tough, but family is worse: Household bargaining and investment in microenterprises in uganda.

Field, E., Pande, R., Rigol, N., Schaner, S., and Troyer Moore, C. (2021). On her own account: How strengthening women's financial control impacts labor supply and gender norms. *American Economic Review*, 111(7):2342–2375.

Giné, X. and Goldberg, J. (2023). Experience in financial decision-making: Field evidence from malawi. *Journal of Development Economics*, 161:103036.

Harari, M. (2019). Women's inheritance rights and bargaining power: Evidence from kenya. *Economic Development and Cultural Change*, 68(1):189–238.

Harigaya, T. (2017). Effects of digitization on financial behaviors: Experimental evidence from the philippines. Technical report, mimeo.

Haushofer, J., Ringdal, C., Shapiro, J. P., and Wang, X. Y. (2019). Income changes and intimate partner violence: Evidence from unconditional cash transfers in kenya. Technical report, National Bureau of Economic Research.

Heath, R. and Tan, X. (2020). Intrahousehold bargaining, female autonomy, and labor supply: Theory and evidence from india. *Journal of the European Economic Association*, 18(4):1928–1968.

Hidrobo, M., Peterman, A., and Heise, L. (2016). The effect of cash, vouchers, and food transfers on intimate partner violence: evidence from a randomized experiment in northern ecuador. *American Economic Journal: Applied Economics*, 8(3):284–303.

Higgins, S. (2022). Financial technology adoption: Network externalities of cashless payments in mexico. *Northwestern University: Kellogg School of Management*.

Jack, W. and Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review*, 104(1):183–223.

Jakiela, P. and Ozier, O. (2016). Does africa need a rotten kin theorem? experimental evidence from village economies. *The Review of Economic Studies*, 83(1):231–268.

Jayachandran, S., Biradavolu, M., and Cooper, J. (2023). Using machine learning and qualitative interviews to design a five-question survey module for women's agency. *World Development*, 161:106076.

Kipchumba, E. and Sulaiman, M. (2020). Digital finance and intra-household decision-making: Evidence from mobile money use in kenya.

Lee, J. N., Morduch, J., Ravindran, S., Shonchoy, A., and Zaman, H. (2021). Poverty and migration in the digital age: Experimental evidence on mobile banking in bangladesh. *American Economic Journal: Applied Economics*, 13(1):38–71.

Lee, J. N., Morduch, J., Ravindran, S., and Shonchoy, A. S. (2024). The social meaning of mobile money: Earmarking reduces the willingness to spend in migrant households. *Journal of Economic Behavior & Organization*, 221:675–688.

Majlesi, K. (2016). Labor market opportunities and women's decision making power within households. *Journal of Development Economics*, 119:34–47.

Riley, E. (2018). Mobile money and risk sharing against village shocks. *Journal of Development Economics*, 135:43–58.

Riley, E. (2024). Resisting social pressure in the household using mobile money: Experimental evidence on microenterprise investment in uganda. *American Economic Review*, 114(5):1415–1447.

Riley, E., Shonchoy, A., and Darko Osei, R. (2024). Incentives or endorsement for technology adoption: Evidence from mobile banking in ghana. Technical report, Working Paper.

Schaner, S. (2017). The cost of convenience?: Transaction costs, bargaining power, and savings account use in kenya. *Journal of Human Resources*, 52(4):919–945.

Suri, T. and Jack, W. (2016). The long-run poverty and gender impacts of mobile money. *Science*, 354(6317):1288–1292.

Appendix

For Online Publishing

A Additional tables and figures

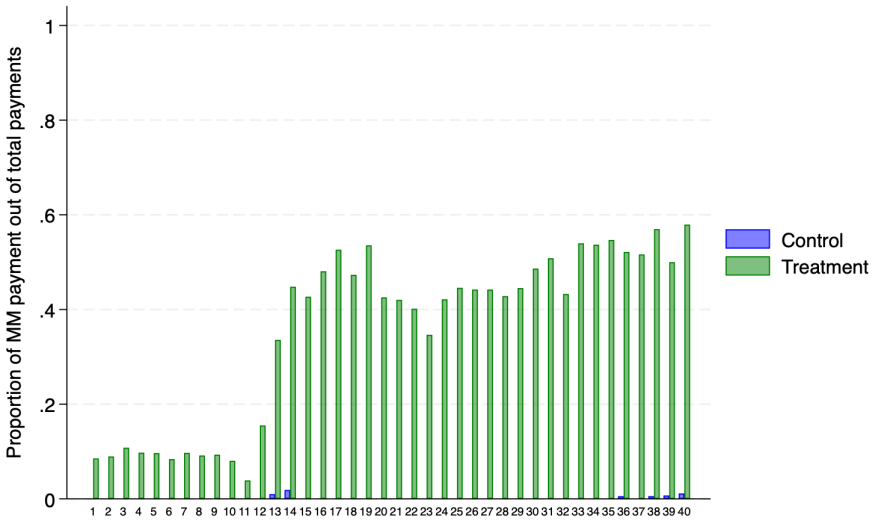

Figure A1: Proportion of payments with mobile money by treatment arm by week
Notes: Proportion of payments made using mobile money each week of the study, by treatment.

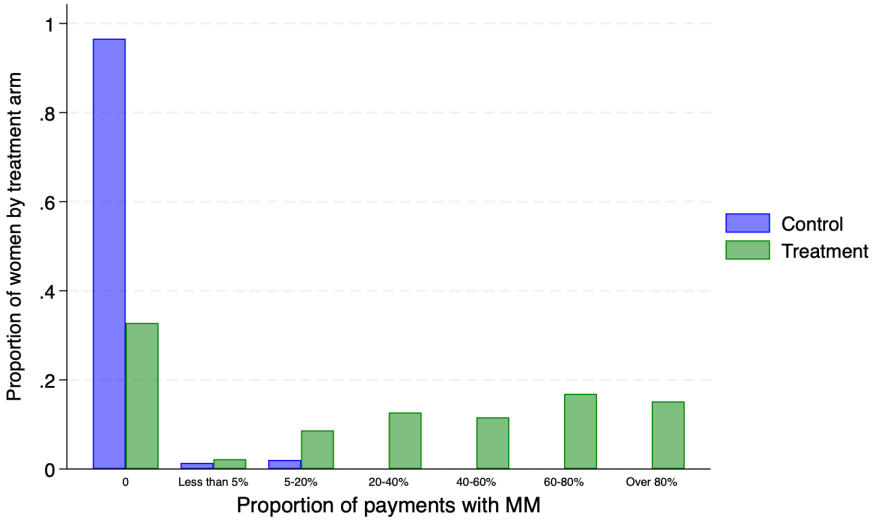

Figure A2: Proportion of payments with mobile money by treatment arm
Notes: Percentage of women making at least that proportion of payments using mobile money.

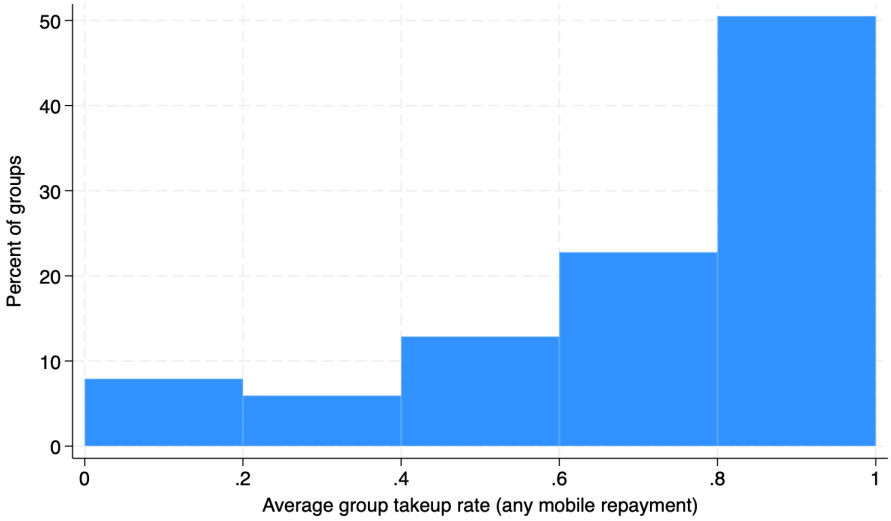

Figure A3: Average takeup rate by group: any mobile payment
Notes: Treatment groups only. Percentage of groups where on average women made at least that proportion of payments using mobile money.

Table A1: Results from experiments on financial accounts and women's empowerment

			Findings					
	Setting	**Intervention**	**Financial account use**	**Financial control**	**Income (woman)**	**Saving**	**Empowerment**	**Mechanism**
Published								
Aker et al. (2016)	Female social protection recipients Niger	Social protection monthly transfers as mobile money compared to cash.	+***	-	na (all arms receive transfer)	na	+**	Time savings from digital disbursement, plus enhanced privacy of the transfer, increased women's empowerment.
Field et al. (2021)	Married women from rural areas India	Bank account deposit of MGNREGS earnings + training versus bank account provision alone.	+***	+***	+* (earnings past month)	na	+** Only constrained women	Increased financial control over wages raises women's empowerment, increasing labour supply and earnings of women previously constrained from working by their spouse.
Riley (2024)	Urban Uganda, female microfinance clients	Mobile money deposit of microfinance loan to a labelled mobile money account versus cash loan.	- (accounts used short term only)	-	+*** (profits)	-	+***	Increased control over the loan at disbursement led to higher business investment and profits, and empowerment. No persistent effects on mobile money use or deposit of subsequent loas to the account.
Working papers								
Bastian et al. (2018)	Female entrepreneurs Tanzania	Mobile money saving account encouragement and training, with and without business training. Use of the saving account enabled eligibility for digital credit.	+***	+** (say in how business money is spent)	-	+***/-*** (save more in mobile money and less in other forms, net effect not shown).	+**	Posits financial control enhanced due to privacy of saving on the mobile money account. Access to digital loans also improves in treatment group.
Related but did not look at empowerment directly								
Batista et al. (2022)	Female entrepreneurs Mozambique	Mobile savings account (incentivised) cross-cut with financial management training	+***	na	+*** (profits)	+*** mobile money savings. Total saving not reported	na	Increased saving through the mobile money accounts allowed women to invest in their businesses and raise profits.
Aggarwal et al. (2020)	Entrepreneurs in Malawi	Opened and trained in first mobile money accounts. Withdrawal fees waived	+***	na	-*** (not gender de-aggregated)	+***	na	Increased savings led to shifts from entrepreneurship to agriculture. No effects on transfers. No gender breakdown.
Breza et al. (2020)	Female garment workers Bangladesh	Switched wage payments from cash to a bank or mobile money account.	+***	na	na	+***	na	See improved shock coping ability from higher savings due to wage payments via mobile money.
Non-experimental								
Kipchumba and Sulaiman (2020)	Kenya	NA - instrumented for use of mobile money with roll out	na	+***	na	na	+***	Suggestive evidence that privacy is the mechanism through which financial control increases.

Where a study has multiple treatment arms, only arms including financial accounts and discussed in the intervention description are included in this table. + denotes positive effect on outcome. − denotes negative effect on outcome. - denotes outcome examined and no effect. Na denotes outcome not examined. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2: Summary statistics mobile money and empowerment

	Mean	Std dev.	Min	10th	90th	Max
Mobile Money Use						
Used mobile money	0.96	0.20	0.00	1.00	1.00	1.00
Used mobile money this week	0.41	0.49	0.00	0.00	1.00	1.00
Number of services used 30 days	2.35	1.93	0.00	0.00	5.00	10.00
Sent money 30 days	0.60	0.49	0.00	0.00	1.00	1.00
Received money 30 days	0.83	0.38	0.00	0.00	1.00	1.00
Deposited money 30 days	0.30	0.46	0.00	0.00	1.00	1.00
Purchased airtime 30 days	0.54	0.50	0.00	0.00	1.00	1.00
Paid bill 30 days	0.39	0.49	0.00	0.00	1.00	1.00
Purchased good/service 30 days	0.06	0.24	0.00	0.00	0.00	1.00
Payment customer 30 days	0.17	0.37	0.00	0.00	1.00	1.00
Paid supplier 30 days	0.04	0.20	0.00	0.00	0.00	1.00
Paid school fees 30 days	0.01	0.12	0.00	0.00	0.00	1.00
Received benefit gov 30 days	0.05	0.21	0.00	0.00	0.00	1.00
Received wage 30 days	0.01	0.07	0.00	0.00	0.00	1.00
Mobile money loan ever	0.27	0.44	0.00	0.00	1.00	1.00
Saves with MM	0.15	0.36	0.00	0.00	1.00	1.00
Savings value MM	16.01	57.57	0.00	0.00	28.07	449.15
Mobile Money Comfort						
Comfort leave 30,000 UGX 30 days	6.29	3.57	0.00	1.00	10.00	10.00
Happy leave month	0.35	0.48	0.00	0.00	1.00	1.00
Comfort complete transactions	4.11	1.43	0.00	2.00	5.00	5.00
Comfort correct error	3.82	1.56	0.00	1.00	5.00	5.00
Comfort reverse transaction	3.98	1.49	0.00	1.00	5.00	5.00
Comfort send money	4.09	1.47	0.00	2.00	5.00	5.00
Comfort check balance	4.19	1.41	0.00	2.00	5.00	5.00
Easily access mobile money wallet	4.23	1.30	0.00	2.00	5.00	5.00
Makes mobile money transactions herself	0.81	0.40	0.00	0.00	1.00	1.00
Others know PIN number	0.44	0.50	0.00	0.00	1.00	1.00
Mobile Money Preferences						
Chooses mobile money in game	0.10	0.30	0.00	0.00	1.00	1.00
Easier to save in mobile money	3.71	1.50	0.00	1.00	5.00	5.00
Willing make loan repayments mobile money	0.51	0.50	0.00	0.00	1.00	1.00
Mobile Money Trust						
Trust in mobile money network provider	4.33	0.94	1.00	3.00	5.00	5.00
Trust in mobile money agent	4.67	0.68	2.00	4.00	5.00	5.00
Likelihood to experience fraud	6.25	3.26	1.00	1.00	10.00	10.00
Not worried about experiencing fraud	6.22	3.33	1.00	1.00	10.00	10.00
Confidence to detect fraud attempts and cope	7.73	2.75	1.00	3.00	10.00	10.00
Agrees cost fair	3.02	1.54	1.00	1.00	5.00	5.00
Observations	750					

This table shows baseline summary statistics for variables related to mobile money use and preferences.

Table A3: Summary statistics and balance test - combined treatment

Variable	(1) Control	(2) Treatment	(3) Difference
Age	39.337	38.228	-1.135
	(9.223)	(9.168)	(0.870)
Completed Primary Education	0.924	0.942	0.018
	(0.266)	(0.234)	(0.020)
Completed Secondary Education	0.245	0.220	-0.025
	(0.431)	(0.414)	(0.035)
Married	0.695	0.643	-0.050
	(0.461)	(0.480)	(0.036)
HH size	5.177	5.158	-0.021
	(1.928)	(1.930)	(0.189)
Children under 12	1.309	1.395	0.081
	(0.923)	(0.931)	(0.081)
Last 30 days profit	327.533	299.443	-27.603
	(294.845)	(271.424)	(19.375)
Business sales value	788.648	755.505	-31.842
	(834.696)	(829.132)	(60.709)
Inventory value	685.947	784.431	103.392
	(974.057)	(997.740)	(77.346)
Business experience (yr)	7.455	6.983	-0.475
	(5.985)	(6.176)	(0.494)
Has employees	0.341	0.331	-0.011
	(0.475)	(0.471)	(0.040)
Retail	0.610	0.653	0.043
	(0.489)	(0.477)	(0.046)
Food vendor	0.189	0.158	-0.035
	(0.392)	(0.365)	(0.031)
Services	0.149	0.168	0.019
	(0.356)	(0.374)	(0.032)
Used mobile money	0.980	0.950	-0.032**
	(0.141)	(0.218)	(0.014)
Mobile money use index	0.011	-0.005	-0.018
	(0.999)	(1.001)	(0.089)
Empowerment index	-0.023	0.011	0.036
	(1.031)	(0.985)	(0.086)
HH total monthly income	677.398	618.204	-57.521
	(510.105)	(513.021)	(35.601)
Total monthly consumption	415.645	401.003	-13.457
	(235.447)	(264.331)	(25.065)
Total savings value	418.686	351.967	-65.147
	(786.896)	(551.168)	(50.971)
Saves with MM	0.161	0.146	-0.017
	(0.368)	(0.353)	(0.029)
Savings value MM	17.037	15.496	-1.679
	(55.423)	(58.656)	(4.074)
Net loans value	1,123.621	1,097.898	-27.948
	(756.381)	(694.994)	(73.922)
Observations	249	501	750

All monetary amounts in USD PPP. Column (1) shows the mean and standard deviation in parentheses in the control group. Column (2) shows the mean and standard deviation in parentheses in the treatment group. Column (3) shows the difference and standard error from a regression of each variable on a treatment indicator, controlling for strata and clustering the standard errors at the group level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A4: Summary statistics and balance test - separate treatments

	Control		MM weekly		MM bi-weekly		T-test p-value			F- test p-value	
	(1)		(2)		(3)		(1)-(3)	(1)-(2)	(3)-(2)	(4)	(5)
	mean	sd	mean	sd	mean	sd				joint	pooled
Age	39.34	9.22	37.94	9.11	38.52	9.24	0.41	0.17	0.57	0.39	0.20
Completed primary education	0.92	0.27	0.95	0.21	0.93	0.25	0.72	0.23	0.35	0.42	0.39
Completed secondary education	0.24	0.43	0.22	0.42	0.22	0.41	0.51	0.56	0.94	0.78	0.48
Married	0.69	0.46	0.66	0.47	0.62	0.49	0.10	0.45	0.38	0.26	0.16
HH Size	5.18	1.93	5.12	1.93	5.19	1.93	0.93	0.80	0.71	0.93	0.92
Number of child under 12	1.31	0.92	1.35	0.98	1.44	0.88	0.18	0.65	0.34	0.37	0.32
Last 30 days profit	340.97	324.40	321.42	320.10	293.10	264.95	0.19	0.61	0.39	0.39	0.31
Business sales	892.55	1267.93	875.46	1237.77	750.18	929.44	0.28	0.91	0.28	0.41	0.52
Business experience	7.46	5.99	7.48	6.68	6.50	5.61	0.08	0.97	0.10	0.13	0.36
Has employees	0.34	0.48	0.33	0.47	0.34	0.47	0.93	0.75	0.80	0.95	0.80
Ever used mobile money	0.98	0.14	0.94	0.24	0.96	0.20	0.20	0.07	0.39	0.12	0.04
Prefers repayment using MM	0.52	0.50	0.49	0.50	0.51	0.50	0.86	0.56	0.68	0.83	0.67
MM Use index	0.00	0.97	0.04	1.12	-0.04	0.90	0.74	0.75	0.51	0.81	1.00
Empowerment Index	-0.02	1.03	0.03	1.03	-0.00	0.94	0.82	0.68	0.80	0.92	0.70
Total income	694.98	562.68	652.70	556.47	588.93	467.68	0.10	0.52	0.30	0.24	0.20
HH total consumption	415.65	235.45	412.09	275.73	390.04	252.63	0.43	0.91	0.52	0.71	0.59
Total savings	418.69	786.90	345.71	492.08	364.56	606.25	0.41	0.20	0.73	0.44	0.25
Saves with MM	0.16	0.37	0.16	0.36	0.13	0.34	0.47	0.91	0.58	0.75	0.62
Saving value MM	17.04	55.42	22.49	89.07	15.00	71.64	0.72	0.43	0.33	0.62	0.74
Net loans value	1123.62	756.38	1102.62	682.53	1093.23	708.42	0.74	0.80	0.91	0.94	0.74
Obs	249.00		249.00		252.00						

MM Biweekly is an indicator for the woman's group being randomly assigned to mobile moneyrepayment with biweekly group meetings. MM Weekly is an indicator for the woman's group being randomly assigned to mobile money repayment with weekly group meetings. All monetary amounts in USD PPP. T-test p-value displays the p-values from t-tests of the equality of the coefficients between the pairs of columns. Joint F test is a p value from an F test of equality of the means across all three groups for each covariate. Pooled F-test is the p-value from a test of pooled assignment to either treatment. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A5: Attrition

	(1)
	Attrition
Treated	0.012
	(0.013)
Observations	750
Control Mean	0.028

All regressions control for stratification fixed effects. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A6: Attrition by baseline characteristics

	(1) attrition
Age	-0.00114
	(0.000991)
Completed Primary Education	-0.00595
	(0.0318)
Completed Secondary Education	-0.0240
	(0.0180)
Married	-0.0105
	(0.0188)
HH size	-0.00677
	(0.00466)
Children under 12	0.00380
	(0.00978)
Last 30 days profit	-0.00819
	(0.0281)
Business experience (yr)	-0.000787
	(0.00116)
Inventory value	-0.0120***
	(0.00454)
Asset value	0.000402
	(0.00379)
Has employees	-0.00661
	(0.0150)
Mobile money use index	-0.00630
	(0.00690)
Used mobile money	0.0119
	(0.0352)
Willing make loan repayments mobile money	-0.0195
	(0.0134)
Empowerment index	0.00163
	(0.00697)
Social cohesion index	-0.00495
	(0.00623)
HH total monthly income	0.0232
	(0.0183)
HH food consumption	-0.0381
	(0.0312)
Saves with MM	0.0429*
	(0.0246)
Net loans value	-0.0144
	(0.00897)
Constant	0.165**
	(0.0702)
Observations	750

All regression include stratification fixed effects. All values in USD PPP. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A7: Takeup by baseline characteristics in the treatment group

	(1) Any payment	(2) At least 10	(3) Number payments
Age	-0.000256	-0.000902	-0.0766
	(0.00272)	(0.00298)	(0.0486)
Completed Primary Education	-0.0456	-0.0393	0.248
	(0.0832)	(0.0897)	(1.397)
Completed Secondary Education	-0.0610	-0.0411	-0.858
	(0.0537)	(0.0543)	(0.894)
Married	-0.0332	-0.00941	-0.260
	(0.0513)	(0.0507)	(0.917)
HH size	0.0269**	0.0107	0.0896
	(0.0135)	(0.0157)	(0.277)
Children under 12	-0.0786**	-0.0458	-0.636
	(0.0305)	(0.0326)	(0.509)
Last 30 days profit	0.102	-0.0944	-0.636
	(0.0978)	(0.105)	(2.000)
Inventory value	0.0170	0.0404*	0.376
	(0.0232)	(0.0218)	(0.457)
Asset value	0.0329	0.0594***	1.001***
	(0.0221)	(0.0209)	(0.321)
Used mobile money	0.222**	0.114	1.742
	(0.104)	(0.0896)	(1.472)
Mobile money use index	-0.0280	-0.00133	0.0788
	(0.0238)	(0.0262)	(0.474)
Willing make loan repayments mobile money	-0.0224	-0.0374	-0.511
	(0.0439)	(0.0492)	(0.778)
Financial control index	-0.0422*	-0.0307	-0.201
	(0.0233)	(0.0246)	(0.458)
HH decision index	-0.0369*	-0.0640***	-0.568
	(0.0219)	(0.0235)	(0.376)
HH food consumption	-0.0446	-0.00916	0.940
	(0.119)	(0.145)	(3.072)
Disbursed amount	0.0129	0.00475	-1.233
	(0.0420)	(0.0457)	(0.757)
Observations	501	501	501

All regressions control for stratification fixed effects. Any payment is any loan repayment made using mobile money. At least 10 is 10 or more loan repayments made using mobile money. Number of payments is the number of loan repayments made using mobile money. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A8: Impact of treatment on mobile money use, empowerment and business profits

	(1) Mobile money use index	(2) Empowerment index	(3) Business profits
Treated	0.344	0.213	4.756
	(0.092)	(0.086)	(26.911)
	[0.000]	[0.013]	[0.860]
	{0.001}	{0.035}	{1.000}
Observations	722	722	722
Control Mean	0.00	-0.00	307.25

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Robust p-value in square brackets. False discovery rate (FDR) adjusted p-values, also known as q-values, were used to correct for multiple hypothesis testing. They are shown in curly brackets. These were calculated following the method of Benjamini et al. (2006). Mobile money use index is an index of 8 dimensions of mobile money use excluding loan repayment. Women's empowerment is an index capturing four domains of women's empowerment: financial control, household decision making, requiring the spouse's permission to do certain activities and business decision making. Business profits is from the last 30 days in USD PPP. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A9: Impact of treatment on mobile money use, empowerment and business profits by sub-treatment

	(1) Mobile money use index	(2) Empowerment index	(3) Business profits
MM Weekly	0.352***	0.242**	-2.263
	(0.107)	(0.095)	(29.777)
MM Biweekly	0.336***	0.184*	11.946
	(0.105)	(0.102)	(31.955)
P-value Biweekly=Weekly	0.88	0.55	0.64
Control Mean	0.00	-0.00	307.25
Observations	722	722	722

All regression include stratification fixed effects use of mobile money at baseline and control variables selected by LASSO. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Mobile money use index is an index of 8 dimensions of mobile money use excluding loan repayment. Women's empowerment is an index capturing four domains of women's empowerment: financial control, household decision making, requiring the spouse's permission to do certain activities and business decision making. Business profits is from the last 30 days in USD PPP.

Table A10: Impact of treatment on the value of mobile money transactions

	(1) Total Value	(2) Money sent	(3) Money received	(4) Savings/ Deposits	(5) Airtime	(6) Bill payment	(7) Purchase goods	(8) Payments customers	(9) Purchase supplier	(10) School fees	(11) Gov benefit	(12) Receive wage
Treated	35.751**	3.811	1.595	12.104*	-0.019	0.243	-4.186	8.163**	1.815	9.819**	0.161	1.013
	(16.704)	(7.120)	(7.656)	(6.332)	(0.488)	(0.927)	(2.812)	(3.396)	(4.271)	(4.141)	(0.162)	(1.004)
Observations	722	722	722	722	722	722	722	722	722	722	722	722
Control Mean	110.64	27.32	48.14	13.52	1.55	4.26	7.06	3.22	4.87	0.70	0.00	0.00

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All outcomes refer to the USD PPP value of mobile money transactions in the last 30 days for that purpose. Money sent and received is remittances sent and received. Savings/deposits is money deposited to the mobile money account (excluding for loan repayment). Airtime is spending on airtime topups. Bill payment is making a payment for a bill. Purchase goods is using mobile money to make purchases for goods and services. Payments customers is receiving payments from customers for purchases. Purchase suppliers is making payments to suppliers for purchases. School fees is making school fee payments. Gov benefits is receiving a payment for a government benefit. Receive wage is receiving a wage payment. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A11: Impact of treatment on Mobile Money Comfort

	(1) Comfort	(2) Leave 30,000	(3) Leave month	(4) Complete transaction	(5) Correct error	(6) Reverse transaction	(7) Send Money	(8) Check Balance	(9) Ease transact	(10) Makes transactions herself
Treated	0.164*	0.230	0.053	0.168	0.201	0.237*	0.219*	0.115	0.059	0.059**
	(0.086)	(0.233)	(0.044)	(0.112)	(0.142)	(0.133)	(0.114)	(0.104)	(0.084)	(0.029)
Observations	722	722	722	722	722	722	722	722	722	722
Control Mean	-0.00	6.17	0.29	3.95	3.42	3.45	4.00	4.20	4.38	0.76

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index composed of the components of columns (2)-(10). All variables are coded such that higher is more comfortable. Column (2) captures a 1-10 scale of whether the woman would be comfortable having 30,000 TSH in her mobile money account. Column (3) is a dummy variable for whether the woman would be happy leaving money on her mobile for a month or longer. Columns (4)-(9) after different types of actions that a woman might have to do using mobile money and her comfort on a 1-5 scale with doing this. Column (10) is a dummy variable for whether the woman makes mobile money transactions herself. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A12: Impact of treatment on Mobile Money Preference

	(1) Preference	(2) Selects MM incentive	(3) Easier save MM	(4) Prefers MM loan repay
Treated	-0.165**	-0.001	-0.112	-0.126***
	(0.083)	(0.027)	(0.140)	(0.045)
Observations	722	722	722	722
Control Mean	0.00	0.15	3.90	0.51

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index composed of the components of columns (2)-(4). Column (2) is a dummy variable for whether when offered 20,000 TSH as cash or mobile money the woman selects mobile money. Column (3) is the extent to which the woman agrees that it's easier to save with mobile money on a 1-5 scale. Column (4) is whether the woman would prefer to make loan repayments using mobile money instead of cash. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A13: Impact of treatment on Mobile Money Trust

	(1) Trust	(2) MM safe	(3) trust MNO	(4) trust own agent	(5) trust agents	(6) fraud unlikely	(7) Not worried fraud	(8) Deal fraud	(9) Cost fair
Treated	0.029	0.045	-0.158	-0.187	0.106	0.410	0.183	-0.224	-0.152
	(0.088)	(0.089)	(0.097)	(0.217)	(0.160)	(0.260)	(0.302)	(0.325)	(0.144)
Observations	693	693	693	392	392	693	693	693	690
Control Mean	-0.00	4.40	4.38	3.04	3.84	5.71	5.96	6.56	3.52

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index composed of the components of columns (2)-(9). The sample size is lower because wuestions on trust were only asked to people who had every used mobile money and questions on agent trust were only asked if the respondent had a regular agent that they used. All questions are coded such that higher values correspond to greater trust. Columns (1)-(5) are statements capturing whether the woman thinks mobile money is safe, if she trusts mobile money operators, if she trusts her own mobile money agent and if she trusts mobile money agents in general, all answered on a 1-5 scale. Columns (6)-(8) capture the woman's likelihood of experiencing fraud, worries about fraud and ability to deal with fraud, all on a 1-10 scale. Column (9) is a 1-5 scale of whether the woman thinks the cost of mobile money services is fair. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A14: Impact of treatment on Mobile Money Problems

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Problems	System Down	Unclear Transaction	Delay Transaction	Difficulty Contact	Wrong Number	Transaction Often Fails	Agent Absent	Agent No Float	Agent System Down	Agent Overcharge
Treated	0.094	0.042	0.040	0.047	0.019	0.013	0.076	0.007	0.068*	-0.039	0.021
	(0.093)	(0.044)	(0.031)	(0.040)	(0.032)	(0.019)	(0.068)	(0.035)	(0.041)	(0.032)	(0.018)
Observations	644	520	520	520	520	520	644	520	520	520	520
Control Mean	0.00	0.19	0.11	0.17	0.12	0.03	1.31	0.16	0.18	0.15	0.03

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index composed of the components of columns (2)-(11). Columns (2)-(6) are dummy variables capturing if the woman experienced that problem when making a transaction. Column (7) is a 1-5 scale for how much the woman agrees that transactions often fail, where higher is disagrees. Columns (8)-(11) are dummy variables capturing problems experienced with mobile money agrents. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A15: Impact of treatment on business decisions

	(1) Index	(2) Loan	(3) Purchases	(4) Pricing	(5) Employees
Treated	-0.023	-0.023	0.005	-0.022	-0.004
	(0.090)	(0.036)	(0.039)	(0.025)	(0.040)
Observations	722	722	722	722	722
Control Mean	0.00	0.40	0.76	0.89	0.76

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index of columns (2)-(5). Columns (2)-(5) show dummy variables for whether the woman makes different decisions in her business alone. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Table A16: Impact of treatment on spousal permission

	(1) Index	(2) Bank account	(3) Take Loan	(4) Visit Market	(5) Visit Friend Locally	(6) Visit Friend Far	(7) Work
Treated	0.014	-0.025	-0.029	-0.026	0.026	0.017	0.105*
	(0.120)	(0.057)	(0.047)	(0.043)	(0.052)	(0.049)	(0.053)
Observations	487	487	487	487	487	487	487
Control Mean	0.00	0.43	0.22	0.16	0.25	0.60	0.51

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index of columns (2)-(7). Each column shows a regression of a dummy variable for whether the woman requires her husband's permission to do that activity. Regressions restricted to married women only. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Table A17: Impact of treatment on expenditures

	(1) Food home	(2) Food outside	(3) Housing, utilities	(4) Personal care	(5) Clothing women	(6) Clothing men	(7) Clothing girls	(8) Clothing boys	(9) School fees (boys)	(10) School fees (girls)	(11) School supplies (boys)	(12) School supplies (girls)
Treated	-7.966	-4.943***	0.153	-0.873***	1.108***	-0.000	1.133***	0.925***	5.370*	6.667**	4.004***	-0.009
	(12.659)	(0.373)	(1.457)	(0.098)	(0.084)	(0.000)	(0.079)	(0.048)	(2.798)	(2.955)	(1.212)	(1.112)
Observations	722	722	722	721	722	722	722	722	722	722	722	722
Control Mean	270.01	34.54	118.54	14.90	7.44	2.00	7.40	6.42	28.53	28.97	9.13	10.30

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All values in USD PPP in the last 30 days. Columns (1) and (2) captured on a weekly recall and scaled to 30 days, Columns (3) and (4) on a monthly recall and the remainder asked on a 6 month recall and scaled to 30 days. Not pre-specified. Not all categories of expenditure shown. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A18: Impact of treatment on expenditures shares

	(1) Food home	(2) Food outside	(3) Housing, utilities	(4) Personal care	(5) Clothing women	(6) Clothing men	(7) Clothing girls	(8) Clothing boys	(9) School fees (boys)	(10) School fees (girls)	(11) School supplies (boys)	(12) School supplies (girls)
Treated	-0.007	-0.011***	-0.003	-0.003***	0.002***	0.000	0.002***	0.002***	0.009*	0.009*	0.007***	-0.000
	(0.013)	(0.001)	(0.004)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.005)	(0.005)	(0.002)	(0.002)
Observations	722	722	722	721	722	722	722	722	722	722	722	722
Control Mean	0.46	0.06	0.21	0.03	0.01	0.00	0.01	0.01	0.05	0.05	0.02	0.02

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Regressions also control for total expenditure and household composition at baseline. Not all categories of expenditure shown - excluded categories represent 7% of expenditure. All columns report expenditure shares on a monthly basis. Not pre-specified. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A19: Impact of treatment on Well-being

	(1) Well-being Index	(2) Happiness scale	(3) Discord with spouse (r)
Treated	0.008	-0.205	0.064
	(0.091)	(0.187)	(0.063)
Observations	722	722	486
Control Mean	-0.00	5.76	0.71

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index of columns (2)-(3). Column (2) is a 1-10 scale for the woman's happiness. Column (3) is a dummy variable for any major argument with the spouse in the last 30 days - reversed. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A20: Impact of treatment on Profits

	(1) Last 30 days	(2) Weekly	(3) July	(4) August	(5) Sep	(6) Oct	(7) Nov	(8) Dec
Treated	4.756	4.731	9.358	11.220	2.119	10.165	-28.391	-16.077
	(26.911)	(7.222)	(30.710)	(29.279)	(30.053)	(32.366)	(39.459)	(38.443)
Observations	722	722	722	722	722	722	722	722
Control Mean	307.25	72.37	289.23	271.06	279.12	280.40	324.80	341.30

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Monthly woman's business profits in USD PPP. Last 30 days profits approximately corresponds to January. Weekly profits is the week before the survey. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A21: Impact of treatment on mobile money payments to customers and suppliers

	(1) Price same mobile customers	(2) Price same mobile suppliers	(3) Value sales mobile	(4) Value expenses mobile	(5) Share sales mobile	(6) Share expenses mobile
Treated	0.029	0.021*	8.163**	1.815	0.009	-0.005
	(0.021)	(0.012)	(3.396)	(4.271)	(0.007)	(0.012)
Observations	722	722	722	722	722	722
Control Mean	0.05	0.02	3.22	4.87	0.01	0.02

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Price sale mobile customers and suppliers are dummy variables for if the business both allows mobile money payments and charges the same or a lower price for mobile payments. Value sales and expenses mobile are the monetary vlaues of monthly sales and expenses through the mobile money account. Share sales and expenses mobile are the share of total monthly sales and expenses received through mobile money. None of these outcomes were pre-specified in the pre-analysis plan. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Table A22: Impact of treatment on Other Business Outcomes

	(1) Business Sales	(2) Business Expenses	(3) Business Capital
Treated	78.731	38.220	-113.635
	(101.501)	(79.011)	(106.147)
Observations	722	722	722
Control Mean	869.40	605.55	910.59

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Values in USD PPP. Columns (1) and (2) are for the last 30 days. Column (3) is a stock. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Table A23: Impact of treatment on Labour and Operating Outcomes

	(1) Business hours	(2) Has employees	(3) Last 30 days operating	(4) Closed bus 30 days	(5) Business operating
Treated	2.385	0.003	0.629	-0.073	0.041
	(2.869)	(0.044)	(0.890)	(0.053)	(0.026)
Observations	722	722	722	655	722
Control Mean	135.72	0.33	19.46	0.51	0.89

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is the number of hours worked in the business in the last 30 days by anyone (owner and/or employees). Column (2) is a dummy variable for whether the business has any employees. Column (3) is the number of days in the last 30 that the business was operating. Column (4) is a dummy variable for whether the business ever had to be closed during a normal operating day for more than 1 hour to get change (pre-specified as part of the business mismanagement index. Column (5) is whether the business is still operating (not-prespecified). Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A24: Impact of treatment on HH outcomes

	(1) Total consumption	(2) Total income	(3) Spouse total income	(4) Woman's work income
Treated	3.596	38.431	29.415	14.996*
	(14.368)	(52.754)	(45.866)	(8.775)
Observations	722	722	487	722
Control Mean	574.93	624.34	439.72	22.74

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is household total consumption scaled to the last 30 days. Column (2) is total household monthly income. Column (3) is the income of the spouse in the last 30 days, as reported by the woman in married households only. Column (4) is the woman's income from wage work in the last 30 days. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A25: Impact of treatment on Savings

	(1) Total	(2) Bank	(3) MM account	(4) Friends	(5) Home	(6) VSLA
Treated	65.889*	10.778	15.670**	9.332	10.597	14.184
	(38.177)	(33.104)	(6.225)	(7.051)	(10.076)	(11.784)
Observations	722	722	722	722	722	722
Control Mean	352.46	239.95	11.83	11.42	53.84	35.41

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is the total of columns (2)-(6). Values in USD PPP. Column (2) is savings in the BRAC or other bank account. Column (3) is savings in the mobile money account. Column (4) is savings with friends. Column (5) is savings kept at home. Column (6) is saving with a saving group. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A26: Impact of treatment on BRAC adminstrative outcomes

	(1) Principle outstanding	(2) Disbursed amount	(3) Saving amount	(4) Overdue amount	(5) Days late	(6) Default	(7) Left group
Treated	53.869	21.708	6.826	-6.109	-9.757	0.003	0.016
	(56.668)	(71.541)	(7.542)	(10.436)	(5.984)	(0.019)	(0.042)
Observations	722	722	722	722	722	722	722
Control Mean	601.05	1001.99	104.26	22.86	13.63	0.04	0.38

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Administrative outcomes from February 2023. Column (1) is the remaining principle on a current loan. Column (2) is the size of the most recently disbursed loan. Column (3) is the required savings with BRAC, set at 10% of the disbursed amount. Column (4) is the amount overdue on the loan, which is the amount of any late payments. Column (5) is the number of days that the woman is late on a loan repayment. Column (6) is whether the loan is in default, defined as being any days late on a loan repayment (BRAC's definition of a loan being in default by more than 90 days meant that no loans meet the definition.) No loan is a dummy variable for whether the woman no longer has a current active loan from BRAC. No loan is not defined at baseline as all women were in groups and were up to date on loan repayments. All variables are 0 for women without a current active loan. Only default was included in the pre-analysis plan. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A27: Impact of treatment on BRAC adminstrative outcomes - all women in study groups

	(1) Principle outstanding	(2) Disbursed amount	(3) Saving amount	(4) Overdue amount	(5) Days late	(6) Default	(7) No loan
Treated	11.459	21.702	2.540	-1.715	-3.763	0.004	0.000
	(28.209)	(41.656)	(4.203)	(6.621)	(3.856)	(0.012)	(0.026)
Observations	3460	3460	3460	3460	3460	3460	3460
Control Mean	472.46	839.46	85.99	24.17	13.94	0.05	0.48

All regressions include stratification fixed effects. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Administrative outcomes from February 2023. Column (1) is the remaining principle on a current loan. Column (2) is the size of the most recently disbursed loan. Column (3) is the required savings with BRAC, set at 10% of the disbursed amount. Column (4) is the amount overdue on the loan, which is the amount of any late payments. Column (5) is the number of days that the woman is late on a loan repayment. Column (6) is whether the loan is in default, defined as being any days late on a loan repayment (BRAC's definition of a loan being in default by more than 90 days meant that no loans meet the definition.). No loan is a dummy variable for whether the woman no longer has a current active loan from BRAC. Loan is not defined at baseline as all women were in groups and were up to date on loan repayments. All variables are 0 for women without a current active loan. Sample includes only women present in the group at baseline i.e. new joiners to the groups are excluded. Sample composition differs from the study sample as women in default on their loan at baseline were excluded from the study sample, but are included here. Only default was included in the pre-analysis plan. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A28: Impact of treatment on Loans

	(1) Loan last 6 months	(2) Loans outstanding	(3) BRAC loans outstanding
Treated	0.076	79.394	59.714
	(0.056)	(58.140)	(56.230)
Observations	722	722	722
Control Mean	0.57	485.59	465.10

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is a dummy variable for whether the woman took out a loan in the last 6 months. Column (2) is the value of all outstanding loans and column (3) is the value of outstanding loans from BRAC. The other main loan sources are other MFI (USD10), saving groups/VSLAs (USD 9), NGOs (USD 4), money lender (USD 3.5) and friends (USD 2). No one reported an outstanding mobile money loan. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A29: Impact of treatment on Social Cohesion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Index	Talk once week	Ask financial help	Give financial help	Discuss business	Discuss personal	Visit house	Trust group members
Treated	0.109	0.041*	0.007	0.030**	0.024	0.005	0.031**	-0.163
	(0.102)	(0.021)	(0.012)	(0.015)	(0.015)	(0.007)	(0.014)	(0.101)
Observations	722	722	722	722	722	722	722	722
Control Mean	0.00	0.20	0.12	0.12	0.13	0.05	0.09	4.11

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All regressions also control for group size. Column (1) is an index composed of columns (2)-(8). Column (2) is the share of group members the woman talked to outside the group meeting in the past week. Columns (3) and (4) are the share of group members the woman would ask for and give financial help to. Columns (5) and (6) are the share of group members the woman talked to about business and personal matters in the last 30 days. Column (7) is the share of group members who have visited the woman's home in the last 30 days. Column (8) is a 1-5 scale of trust in group members. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A30: Impact of treatment on BRAC and meeting experience

	(1)	(2)	(3)	(4)	(5)
	Index	Trust in BRAC officer	Trust in BRAC microfinance	Prefers weekly meeting	Meeting Time
Treated	-0.050	-0.005	-0.038	-0.103**	-10.027*
	(0.088)	(0.074)	(0.043)	(0.041)	(5.523)
Observations	722	722	722	722	722
Control Mean	-0.00	4.53	4.83	0.80	133.35

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Column (1) is an index composed of columns (2)-(3). Columns (2) and (3) are 1-5 scales where 5 is the highest level of trust. Column (4) is a dummy variable if the woman would prefer weekly group meetings over bi-weekly or monthly (in the pre-analysis plan this was included with social cohesion measures). Column (5) is group meeting time in minutes. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A31: Heterogeneous treatment effects by and on empowerment

	(1) Empowerment	(2) Financial Control	(3) Permission	(4) Decision- HH	(5) Decision-Business
Treated	0.342***	0.408***	-0.108	0.283**	0.063
	(0.115)	(0.114)	(0.150)	(0.128)	(0.141)
Empowerment * Treatment	-0.266**	-0.065	0.293	-0.137	-0.169
	(0.134)	(0.128)	(0.194)	(0.147)	(0.147)
Treated	0.152	0.377**	-0.234	0.165*	-0.106
	(0.109)	(0.152)	(0.187)	(0.097)	(0.098)
Control * Treatment	0.127	-0.011	0.380*	0.107	0.154
	(0.153)	(0.173)	(0.207)	(0.144)	(0.151)
Treated	0.042	0.313**	0.189	0.097	-0.204**
	(0.111)	(0.130)	(0.175)	(0.105)	(0.083)
Permission * Treatment	0.325**	0.108	-0.231	0.218	0.345**
	(0.152)	(0.155)	(0.197)	(0.156)	(0.158)
Treated	0.391**	0.339**	-0.319*	0.364**	-0.052
	(0.157)	(0.144)	(0.165)	(0.146)	(0.171)
HH decision * Treatment	-0.254	0.059	0.528***	-0.225	0.044
	(0.173)	(0.158)	(0.198)	(0.161)	(0.189)
Treated	0.298*	0.469***	0.133	0.411**	0.011
	(0.167)	(0.155)	(0.182)	(0.166)	(0.184)
Business decision index * Treatment	-0.112	-0.116	-0.146	-0.258	-0.046
	(0.179)	(0.161)	(0.182)	(0.166)	(0.185)
Control Mean	-0.00	-0.00	0.00	-0.00	0.00
Observations	722.00	722.00	487.00	722.00	722.00

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Each dimension of heterogeneity captures if the woman was above the median in that dimension at baseline. Regressions also control for the dimension of heterogeneity being examined. Column (1) is composed of the elements of columns (2)-(5). Financial control is an index capturing less pressure to share money with the spouse and lower willingness to pay to control money. Permission is an index capturing whether the woman requires the spouse permission to do different activities (married women only). Decision-hh is an index capturing who makes decisions in the household across 8 domains. Decision-business is an index capturing who makes the decisions in the woman's business across 4 domains. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A32: Heterogeneous treatment effects by Others know PIN

	(1) Mobile money use index	(2) Mobile money comfort index	(3) Financial control index	(4) HH decision index
Treated	0.414***	0.167	0.369***	0.189*
	(0.127)	(0.120)	(0.128)	(0.101)
Others know PIN * Treated	-0.155	-0.010	0.017	0.056
	(0.160)	(0.170)	(0.179)	(0.147)
Control Mean	0.00	-0.00	-0.00	-0.00
Hetero mean	0.46	0.46	0.46	0.46
Observations	722	722	722	722

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Others know PIN*Treated is an interaction term for that dimension of heterogeneity. The mean value for the heterogeneity variable is shown in the bottom panel. Regression also controls for the heterogeneity variable, output not shown. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A33: Heterogeneous treatment effects by Spouse diff network

	(1) Mobile money use index	(2) Mobile money comfort index	(3) Financial control index	(4) HH decision index
Treated	0.375***	0.188	0.377***	0.259*
	(0.116)	(0.127)	(0.120)	(0.133)
Spouse diff network * Treated	-0.196	0.014	-0.038	0.193
	(0.235)	(0.196)	(0.174)	(0.209)
Control Mean	0.00	-0.00	-0.00	-0.00
Hetero mean	0.31	0.31	0.31	0.31
Observations	467	467	467	467

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Spouse diff network*Treated is an interaction term for that dimension of heterogeneity. The mean value for the heterogeneity variable is shown in the bottom panel. Regression also controls for the heterogeneity variable, output not shown. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Table A34: Heterogeneous treatment effects by Loan ends earlier

	(1) Mobile money use index	(2) Mobile money comfort index	(3) Financial control index	(4) HH decision index
Treated	0.313**	0.314***	0.404***	0.270**
	(0.125)	(0.118)	(0.131)	(0.125)
Loan ends earlier * Treated	0.057	-0.274*	-0.055	-0.105
	(0.154)	(0.156)	(0.146)	(0.158)
Control Mean	0.00	-0.00	-0.00	-0.00
Hetero median	10.00	10.00	10.00	10.00
Observations	722	722	722	722

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Loan ends earlier*Treated is as interaction term for being below the median in that dimension of heterogeneity. The median value for the heterogeneity variable is shown in the bottom panel. Regression also controls for the hetoergeneity variable, output not shown. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

Table A35: Heterogeneous treatment effects by Larger loan

	(1) Mobile money use index	(2) Mobile money comfort index	(3) Financial control index	(4) HH decision index
Treated	0.238**	0.140	0.327***	0.179
	(0.119)	(0.116)	(0.123)	(0.113)
Larger loan * Treated	0.211	0.052	0.083	0.071
	(0.154)	(0.154)	(0.143)	(0.160)
Control Mean	0.00	-0.00	-0.00	-0.00
Hetero median	1122.86	1122.86	1122.86	1122.86
Observations	722	722	722	722

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. Larger loan*Treated is as interaction term for being below the median in that dimension of heterogeneity. The median value for the heterogeneity variable is shown in the bottom panel. Regression also controls for the hetoergeneity variable, output not shown. Control mean is the mean of the outcome in the control group at endline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B PAP deviations

B.1 Outcome definitions

There are no deviations from the pre-specified primary outcomes. Deviations from the pre-specified secondary outcomes are shown in Table B1.

B.2 Analysis

Members of groups assigned to treatment arm two were meant to have the option of skipping every other group meeting if they made their repayment using mobile money. However, after randomisation it was decided to not implement this option. As a result, treatment arm two is identical to treatment arm one, and so both treatments are pooled together for all the analysis. Table A9 shows treatment effects on the primary outcomes by the two original treatment assignments and Table A4 shows that the original randomisation was balanced.

Lasso controls were selected for each outcome shown, rather than by family of outcome, as pre-specified.

Table B1: Deviations from pre-specified outcomes

Outcome family	Deviation	Reason
Deviations		
2a) Mobile Money Comfort Index	Components "vi. Has a mobile money account registered in own name" and "vii. Has a regular mobile money agent that she uses" excluded from index	No or negative correlations with other components.
4. Social Cohesion Index	"(c) Prefers weekly group meetings" excluded from index.	Negatively correlated with other components.
5 BRAC Sentiment and repayment index	"c) late loan repayment" excluded from index	shown separately with additional admin data outcomes.
Results not reported		
3.c)i. Asset value	Not reported separately.	Reported as part of business capital.
3.c)ii.Inventory value	Not reported separately.	Reported as part of business capital.
3d)ii. Hours spent by employees last 30 days	Not reported separately.	Reported as part of business hours.
3d)iii. Hours owner spent working in business last week	Not reported separately.	Reported as part of business hours.
3e) Business mis-management index	Not reported.	No significant effects on index or components.
6a)i. Household income from work	Not reported separately.	Reported as part of total income.
6a)ii. Household income from non-work	Not reported separately.	Reported as part of total income.
6a)iii. Household income from remittances	Not reported separately.	Reported as part of total income.
6a)iv. Spouse income from work	Not reported separately.	Reported as part of spouse total income.
6a)v. Spouse income from business	Not reported separately.	Reported as part of spouse total income.
6b) Household food consumption	Not reported in aggregate.	Shown as household food at home and food outside.
7. Time use	Not reported	No significant effects.
8b) Financial security index	Not reported.	No significant effects on index or components.
9.c) Gave a loan in the last 6 months	Not reported.	Question was cut from survey.
9.d) Loans given (value outstanding)	Not reported.	Question was cut from survey.
9.e) Allows customers to pay for goods on credit	Not reported.	Question was cut from survey.