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.

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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). One dimension of women's empowerment is women's ability to enact their preferences within the household, for which women's control over their funds is an important determinant (Anderson and Baland, 2002, Ashraf, 2009, Field et al., 2021). Digital financial services like mobile money offer a potential way to increase women's control over their funds by providing them with a private, secure place to keep their money (Aker et al., 2016, Field et al., 2021, Riley, 2022).[1] However, despite their popularity, there are large gender gaps in use of mobile money, with only one-third of women having ever used them compared to almost half of men (Global Findex, 2021). Women are less likely to use mobile money, use it less often, and make fewer types of transactions, of smaller value.

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 switching their weekly loan repayments 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 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 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 64% of the treatment group making any loan repayment with mobile money, and treated women making on average 8 out of 25 loan repayments using mobile money during the 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,

[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 & Vicente, 2020; Jack & Suri, 2014; Lee, Morduch, Ravindran, Shonchoy, & Zaman, 2021; Riley, 2018; Suri & Jack, 2016). Mobile money services have also been shown to benefit women by facilitating entrepreneurship (Suri & Jack, 2016).

[2] This is a context where 98% of women had used mobile money before, though they used it infrequently and mainly 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 115 USD PPP a month through their mobile money accounts.

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 improvements in women's empowerment. Treated women score 0.24 standard deviations higher in an index of women's empowerment. This effect is driven by improvements in control over finances and increased household decision-making. Treated women see 0.37 standard deviation increases in their control over their own finances, 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. Treated women see a 0.22 standard deviation increase in their decision-making in the household, driven by increases in decision-making about food and clothing and their general involvement in decisions. Heterogeneous treatment effects show that these improvements are driven by women who had the lowest levels of empowerment at baseline. We see no evidence that women experience a backlash as a result of this increased financial control and decision-making, with no changes in their reported well-being or discord with their spouses.

While total household consumption and expenditure on food does not change, we observe some changes in the allocation of expenditure to different categories. Spending on food outside the household, primarily snacks and personal care items, declined, while spending on women's and children's clothing increased. Similar effects are seen when examining the share of expenditure by category. Increased spending on women's and children's clothing 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).

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, potentially through the reduction in sharing pressure. We see no effects on women's business outcomes, though estimates are noisy, suggesting improved financial control is not necessarily translating into increased investment in women's businesses. We also see no effects on the income of other household members.

There are no negative effects of treatment on women's loan repayment behaviour, with if anything some evidence that treated women were less likely to be behind on loan repayments, though from a very small mean in the control group. We also see improvements in social cohesion in the groups as a result of treatment, with women reporting talking to group members more often, about both their businesses and their

personal lives, and being more likely to consider a group member a close friend. This may be due to group meetings leaving more time for interaction when the need to count cash is removed. Group meetings were 10 minutes shorter in the treated groups, on a mean of two hours, also 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 counteract the gains in social cohesion.

We 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 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, 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).[5] However, recent evidence has pointed out that variables that likely have little effects on a woman's outside option, such as exposure to a successful woman role model (Uckat, 2023) or negotiation training (Ashraf et al., 2020), also affect her empowerment. We argue that likewise, our intervention affects empowerment through a woman's "ability to enact her preferences" (Ashraf, 2009, Garz et al., 2020) rather than her outside option and detail two potential channels (privacy and transaction costs) in section 2. We therefore contribute to the literature on the determinants of women's empowerment by showing that mobile money can increase a woman's ability to control money, exert her preferences and thus increase 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.[6]

Secondly, we show that the introduction of digital financial services is compatible with maintaining and even enhancing social cohesion within microfinance groups. Unlike in 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. Our findings, therefore, align with those of Feigenberg et al. (2013), who highlighted

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

[6]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 (Almås et al., 2018, Attanasio and Lechene, 2014, Bobonis, 2009). Field et al. (2021) see expansions in women's labor supply and Riley (2022) an increase in the woman's business profits and household income. Riley (2022) thus argues that the effects on women's empowerment from disbursing loans onto mobile money accounts, are driven by the increased income of the woman, and no changes in financial control were observed, with use of the accounts diminishing rapidly after loan disbursement.

the importance of social interaction among microfinance clients for maintaining low loan default rates by facilitating risk sharing.

Third, 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). Given nearly all women 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 in the accounts (Breza et al., 2020, Giné and Goldberg, 2023, Riley et al., 2024).[7] 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.

2 Conceptual framework

Women's empowerment is frequently conceptualised as "the ability to make choices" (Kabeer, 1999). A wide class of bargaining models (both cooperative and non-cooperative) and corresponding empirical evidence predict that increasing a woman's outside option improves her welfare – and thus, measures of her empowerment – within a marriage.[8] However, there is also empirical evidence that interventions that likely have minimal changes to a woman's outside option also improve her empowerment,[9] a channel that Garz et al. (2020) call a woman's "ability to enact her preferences".

We view this paper as fitting most closely with this latter channel. It posits that household bargaining is a complex process influenced by each household member's choice set, bargaining ability, and the transaction costs of enacting different outcomes, and mobile money has potential effects on each of these influences. In this context, there are several ways in which loan repayment via mobile money could increase a woman's use of mobile money more generally and correspondingly increase her empowerment. We focus here on privacy and transaction costs as channels that we believe are particularly important in our context.

[7] Riley (2022) did not see continued use of the mobile money accounts provided in her experiment, with, in particular, very little deposit of own money onto the mobile money account or use of the mobile money account for subsequent loans. This is likely why she did not see changes in women's financial control.

[8] While there are interesting questions of unmarried women's empowerment (e.g., their bargaining power vis-a-vis their parents or other household members), we focus here on the empowerment of married women, which corresponds to our empirical focus on measuring empowerment among married women.

[9] for example Ashraf et al. (2020), Uckat (2023).

2.1 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). 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 her use of mobile money. This ability to hide could allow a woman to retain a greater share of her 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. If husbands are risk averse or they systemically underestimate the wife's resources,[10] they are less likely to pay this cost if they do not know how much resources the wife currently has in her control.

2.2 Transaction costs

A related mechanism is 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). This could represent the travel cost of visiting the mobile money agent in a neo-classical framework, or some sort of behavioural cost if it 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.

3 Background

3.1 Mobile Money in Tanzania

Mobile money allows money to be stored and transferred from a basic mobile phone. It works over the USSD 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 transfer and withdrawal services, from which agents receive a commission. In Tanzania, the mobile money agent network grew quickly and is extremely dense: in 2020, 85% of villages nationally had a mobile money agent

[10] There is precedent for systematic misperceptions, e.g. of gender norms (Bursztyn et al., 2023).

(Tanzania National Panel Survey 2020-2021). For people in villages without agents, the median distance to the nearest agent was only 3km.

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 (Findex, 2021). Tanzania looks typical for a Sub-Saharan African country, with 50% of the population, and 46% of women, owning a mobile money account. 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 (Findex, 2021). This suggests that while use of mobile money is increasingly common, the range of services that mobile money is used for is very limited, particularly for women.

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 her community. Groups contain between 8 and 30 members, with an average of 23 members. Loans are individual liability loans, 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 this, there is typically only one microfinance group per village.

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 branches. 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 3,471 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. 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.

4.2 Intervention

Women in the treatment arm received training on how to use mobile money to repay their loan, administered by the microfinance group credit officer at their group meeting. They 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.

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.[11] The 152 microfinance groups were randomly assigned to the treatment or control arms using a stratified randomisation in Stata. 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.

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

101 groups were assigned to treatment and 51 to control.[12] 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 women. 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 and the endline survey in February 2023, 10 months later. This interval was chosen as BRAC loans run for approximately 10 months (40 weeks). The focus groups took place in September 2022. 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, 2022). 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.[13] 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, 2022).[14]

[12]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 A7 confirms no differential effects on our main outcomes by sub-treatment.

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

[14]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 the household level in order to receive it personally.

5.2 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 A1.[15] As well as reporting the mean and standard deviation of each covariate for the treatment and control group, the final column shows the p-value from a test of whether the coefficient on the treatment indicator is equal to zero in a regression. We see that out of the 20 variables, only one is statically significantly different at the 5% level: Women in the treatment group are 3 percentage points less likely to have used mobile money 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 p-value from this test is 0.52, implying that the characteristics do not jointly predict treatment assignment.

Attrition was extremely low due to the 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 A3. 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 A4. 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.

5.3 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) 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 control group women were accidentally instructed to repay their loan using mobile money. This was stopped as soon as it was observed. We see that 64% 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 24, or 1/3 of their loan repayments, using mobile money, compared to 0.04 loan repayments using mobile money in the control

[15] A balance table by sub-treatment is shown in the Appendix Table A2.

group. Overall, takeup was high in the treatment group and extremely small in the control group, highlighting the success of the encouragement design.

Figure A1 shows the percentage of women by treatment arm making a given proportion of their payments using mobile money.[16] 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 A5 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. Having young children may therefore 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 at least 10 loan repayments with mobile money, but otherwise measures of women's empowerment and financial control do not predict takeup.

Takeup is highly correlated within group. Figure A2 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.

5.4 Empirical Strategy

To assess the impact of the treatment, we estimate:

$$\begin{aligned} Y_{ig} &= \beta_0 + \beta_{MM}\mathrm{MM}_g + \\ &\quad Y_{0ig} + X_{0ig} + \alpha_s + \epsilon_{ig} \end{aligned} \tag{1}$$

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 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 $\beta_{MM} = 0$ i.e. the impact of the group being assigned to mobile money loan repayment (Intention-

[16]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.

to-treat estimate).

All outcomes were pre-specified in a pre-analysis plan and any departures from this are clearly specified.[17] 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) within an outcome family. Rather than pre-specifying a single q, we report the minimum q-value at which each hypothesis is rejected, following Anderson (2008b) and 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 (2008a).

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 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 A6 for the three outcomes together with a multiple hypothesis test).

6.1 Mobile Money use

We see a large increase in an index of mobile money use for treated women of 0.33 standard deviations (Table 2).[18][19] 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 nearly 7.5 percentage points more likely to allow customers to pay for items using mobile money,[20] a 50% increase on the control mean of 15%. They are 14 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 the transactions they have done are 48 USD PPP (46%) larger. They are 6 percentage points more likely to save using mobile money, and they have 15 USD PPP more saved

[17] The pre-analysis plan is available here.

[18] Note that all the measures of mobile money use excluded the loan repayment and any savings for making a loan repayment and thus can be considered increases in use of mobile money for other kinds of transactions.

[19] This result survives a multiple hypothesis test (Table A6).

[20] The share of sales made using mobile money is still only 2%, compared to 1% in the control group. 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.

in their mobile money wallet, a 125% increase on the control mean of 12 USD PPP.[21][22] 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.

The increase in use of mobile money is accompanied by an increase in comfort with using mobile mone of 0.17 standard deviations (Table A8). We see that treated women feel more comfortable with most transactions related to mobile money, completing transactions and sending money. The woman is also 6.0 percentage points more likely to make mobile money transactions herself, suggesting an important mechanisms for how the treatment may translate into increased financial control for women.

Interestingly, we see a decrease in preference for digital payments in the treatment groups of 0.17 standard deviations (Table A9). 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.[23] 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 A10). 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 A10 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, and a significant at the 10% level higher likelihood of experiencing problems with agent float (Table A11).[24]

6.2 Women's empowerment

An index of women's empowerment increases by 0.26 standard deviations in the treatment group (Table 3).[25] The increase in women's empowerment seen in the treatment group

[21]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).

[22]The increase in saving excludes any mechanical increase in the balance held on the mobile money account for treated women and only counted money the woman considered set aside for saving.

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

[24]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. This compares with average monthly transactions of 120 USD PPP in the control group.

[25]This result survives a multiple hypothesis test (Table A6).

is driven by a 0.37 standard deviation increase in financial control and an 0.22 standard deviation increase in decision making in the household. We see no changes in the need for married women to ask their spouse's permission to do different activities nor in an index of decision making in the woman's business.

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

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 involvement in all household decisions (Table 5). Consistent with the reported increase in decision-making within the household, we see changes in the allocation of expenditures in Tables A14 and A15. In particular, in value terms we see reductions in spending on food outside the home, and personal care and increases in spending on women's, girls and boys clothing. In terms of expenditure shares, we see increases in the share of expenditure on women's, girls and boys clothing and household non-durables (representing 10%, 15%, 10% and 10% of the control means of each category, respectively) and a reduction in spending on personal care (10% of the control mean). These shifts are relatively small in absolute terms, given 60% of expenditure goes on food. However, they could also indicate a shift in spending towards things the woman indicate they value, and thus signal an improvement in her empowerment, as has been used in the literature (Bobonis, 2009, Hidrobo et al., 2016). Further, spending on clothing is more "lumpy" than on personal care items and food outside the household, 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 increase in discord with the spouse for treated women (Table A16), 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 outcomes

We do not see any impacts on treatment on women's business profits (Table A17). 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.

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 see that only 7% of suppliers allows mobile money payments, and treatment does not change this. 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 A18). It is therefore unsurprising that the tiny increase in digital sales is not translating into higher profits.[26] In Riley (2022), 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. Instead, we see savings being used for lumpy consumption, such as clothing. This could be because business investments require larger balances to be accumulated than the women are able, or willing, to do.[27]

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 A19 and A20). Note though that the coefficient on sales is large and positive (104 USD PPP - 13% of the control mean), though the standard error is large. The coefficient on business capital is large and negative (-91 USD PPP - 10% 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.

[26]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 complementaries in digital payment adoption (Alvarez et al., 2023, Higgins, 2019).

[27]It could also be that savings for business investment take longer to accumulate than the 9 months of this study.

6.4 Household outcomes

Consistent with the lack of impact on women's business outcomes, we see no significant changes in average household outcomes, either household consumption nor household income (Table A21). Note though that the point estimates on consumption is negative and on income is positive, which could explain how treated women are able to save more over the 9 month period.

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 65 USD PPP, driven by the increase in savings with mobile money (Table A22). We see that there is are insignificant increases in saving with friends (10 USD PPP), at home (10 USD PPP) and in VSLAs (14 USD PPP). This could suggest that enabling saving and improved financial control through increased mobile money account use allows women's preferences for greater saving to be reflected in the household. Through being better able to save up for expensive purchases, this could also explain how treated women can spend a larger share of consumption on relatively lumpy expenditures such as clothing.

6.5 Loan and group behaviour

There are no negative impacts of treatment on BRAC loan repayment outcomes, as captured in BRAC's administrative data (Table A24). Women in treated groups have slightly larger subsequent loans disbursed by BRAC, saving balances with BRAC, similar 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 have left their microfinance group after the loan end[28]. None of these are statistically significant. 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 **??**).

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 A25). The decrease in days late on loans becomes smaller but marginally significant at 5.4 days less late. Anecdotally, women in the focus group described that sometimes a woman is called away on an emergency. When repayments were in cash the woman would then make her payment that week, whereas now mobile repayment is available the woman can still make her payment. As a result, it seems there were some improvements in on-time loan repayment in treatment groups. This is suggestive that use of digital financial services by microfinance clients can lead to improvements in loan repayment behaviour, mirroring a

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

finding in Riley and Shonchoy (2022).

There is interestingly an increase in social cohesion in the treatment group of 0.19 standard deviations (Table A26), with treated women being more likely to talk to other group members at least once a week, to discuss their business and personal lives with other group members and to say they have a close friend in the group. A possible reason for this is increased time during group meetings, as members no longer had to count cash,[29] and so had more time to interact with each other and discuss other topics. We also see that group meetings take 10 minutes less for women in treated groups. In general, women were very supportive of group meetings, in both the quantitative survey and focus groups, as an opportunity to interact with other women and discuss their businesses.[30] This suggests an unexpected benefit of shifting from cash to digital loan repayments - more time for interaction at group meetings.[31]

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 A27). 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 latter on sharing and social interaction around their businesses on a fortnightly basis.

6.6 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

[29] BRAC requires each woman to verify the repayment of every other, which takes a great deal of time in large groups.

[30] A few quotes from the focus group discussions illustrate this well. One woman said "I like to meet as we, women have been given priority, and we meet and advise one another in the group", another "when we are in the group we share ideas" and a third "when we talk about business issues, the challenges of business, we discuss what is going in life".

[31] These were already established groups, and it is possible that effects would be different amongst new groups who only ever made loan repayments using mobile money.

or better-managed businesses at baseline seeing smaller treatment effects.[32] Women with higher empowerment at baseline also see smaller treatment effects on mobile money use. This suggests that the treatment benefits are concentrated amongst more vulnerable women.

6.7 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 determined how long they would be treated for.[33] 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 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 A29 we see that there is limited heterogeneity by whether the woman's loan ends within 5 months of treatment starting (month 10 being October, when treatment started in May): 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 insignificantly smaller than women who had longer left on their loan. This suggests that even a short period of using mobile money for loan repayment was sufficient to increase women's use, comfort and financial control.

In Table A30 we also 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. 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.[34]

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 facilitates. Here we discuss alternative mechanisms through which the use of mobile

[32]The heterogeneity by empowerment is further broken down in Table A28, where it appears the treatment effects are driven by women with lower household decision making power.

[33]Women could go onto receive a subsequent loan, and if they did they would continue to receive their assigned treatment for longer. However, this choice is endogenous.

[34]Mechanically since the fee was 1%, 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.

money services for loan repayment could have affected women's empowerment. We argue that time savings, loan access, income effects, and loan privacy are unlikely to be channels for our affects. We then turn to social interaction, arguing that while we cannot rule out effects through increased social interaction when meeting time was freed up from counting cash, we believe they are unlikely to explain the majority of the estimated effects on women's empowerment.

7.1 Time savings

A reduction in the time requested 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 repayment 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.

7.2 Loan access

We see in Tables A24 and A23 that treated women appear to have higher outstanding loan amounts than women in control groups. The coefficients are moderate but not statistically significant. When we instead look at all the women in the study microfinance groups, which we are able to do for administrative outcomes, we do not see any significant effect of treatment in the larger sample (Table A25). Further, treated women are no more likely to have a loan with BRAC. We therefore think it's unlikely that women's access to credit has changed, and therefore it is unlikely that this is a mechanism that could explain the improvements in women's empowerment.

7.3 Income effects

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.

7.4 Loan privacy

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 (2022). However, without transaction records from the mobile money accounts, we cannot rule this out. We note though that Riley (2022) 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, and she does find large positive effects on business outcomes due to increased investment of the loan in the business. This contacts with our findings here, and so it seems unlikely that our treatment could be working through a similar mechanism.

7.5 Social cohesion

The increase in empowerment may be a result of improvements in social cohesion of the women in the groups, made possible by the shorter group meetings. However, we think that the improvements in social cohesion are unlikely to be entirely driving the improvement in empowerment since women were already meeting in groups on a weekly basis. It therefore seems difficult for a lot more interaction to be generated by 10 minutes of extra meeting time each week. In addition, we do not see heterogeneity by baseline social cohesion, whereas if social cohesion was a key driver of the increase in women's empowerment we would expect to see larger effects for women who had the lowest social cohesion at baseline. Overall, we cannot rule out that the increased social cohesion is also increasing women's empowerment, but it seems unlikely to explain the whole effect.

8 Conclusion

Women's empowerment is a frequent goal of policy-makers. Given evidence that women's ability to control income and store it privately from other family members is an important determinant of women's ability to enact their preferences within the household, mobile money is a potential channel towards women's empowerment. We conduct a randomised control trial to study whether prompting women to repay loans through mobile money increases their use of and comfort with mobile money and in turn increases women's empowerment. We find indeed that treatment raises use of mobile money services, increases women's control of their finances 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 spending. Mobile money can thus be an effective tool for empowering women by giving them greater control over their money.

Our results highlight that, while a woman's outside option in the context of a standard bargaining model does matter for empowerment, so do factors that allow a woman privacy and control of income. New technology can thus provide 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.[35]

Interestingly, we see that shifting to digital loan repayment leads to increases in group social cohesion. This is because women still met weekly in their groups and had more time to interact when there was no need to count cash. Despite the shift to digital repayment opening up the possibility of less frequent group meetings, women had a strong preference for weekly group meetings that did not change with treatment. However, it is possible that this finding 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.[36] 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.

[35]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.

[36]BRAC has no current plans to discontinue in-person group meetings or reduce meeting frequency.

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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table 2: Impact of treatment on Mobile Money Use

	(1) Use index	(2) Pay supplier	(3) Allow customer pay	(4) Last used week	(5) Transaction count	(6) Transaction value	(7) Digital loan	(8) Any saving	(9) Amount saved
Treated	0.327***	0.031	0.075**	0.147***	0.043	47.804***	0.067	0.062*	15.393**
	(0.092)	(0.022)	(0.031)	(0.044)	(0.108)	(17.839)	(0.042)	(0.036)	(6.267)
Observations	722	722	722	722	722	722	722	722	722
Control Mean	-0.00	0.07	0.15	0.49	2.44	114.54	0.26	0.17	11.83

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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 - not asked at baseline. 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.

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	0.240***	0.371***	0.010	0.215**	-0.023
	(0.091)	(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

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. Column (1) is composed of the elements of columns (2)-(5). Sharing pressure is an index capturing 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.

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	0.371***	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

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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 measure of if at all and how frequently 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.

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

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table 6: Heterogeneous treatment effects

	(1) MM use	(2) Empowerment	(3) Profit
Treated	0.260**	0.316***	4.965
	(0.115)	(0.119)	(35.644)
Profit * Treated	0.197	-0.141	4.485
	(0.167)	(0.153)	(53.309)
Treated	0.335***	0.232*	19.570
	(0.113)	(0.120)	(33.782)
MM use * Treated	-0.008	0.016	-25.156
	(0.166)	(0.138)	(45.941)
Treated	0.250**	0.342**	-24.877
	(0.121)	(0.138)	(37.988)
Social cohesion * Treated	0.153	-0.204	60.700
	(0.152)	(0.166)	(45.392)
Treated	0.421***	0.390***	-5.010
	(0.121)	(0.123)	(37.123)
Empowerment * Treated	-0.184	-0.304**	23.861
	(0.157)	(0.140)	(52.661)
Treated	0.385***	0.411***	1.417
	(0.112)	(0.113)	(37.005)
Business management * Treated	-0.073	-0.334**	10.829
	(0.153)	(0.154)	(52.827)
Treated	0.374***	0.408***	12.158
	(0.124)	(0.124)	(33.816)
Psychological index * Treated	-0.088	-0.332**	-10.006
	(0.175)	(0.152)	(48.045)
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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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. 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.

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Appendix

For Online Publishing

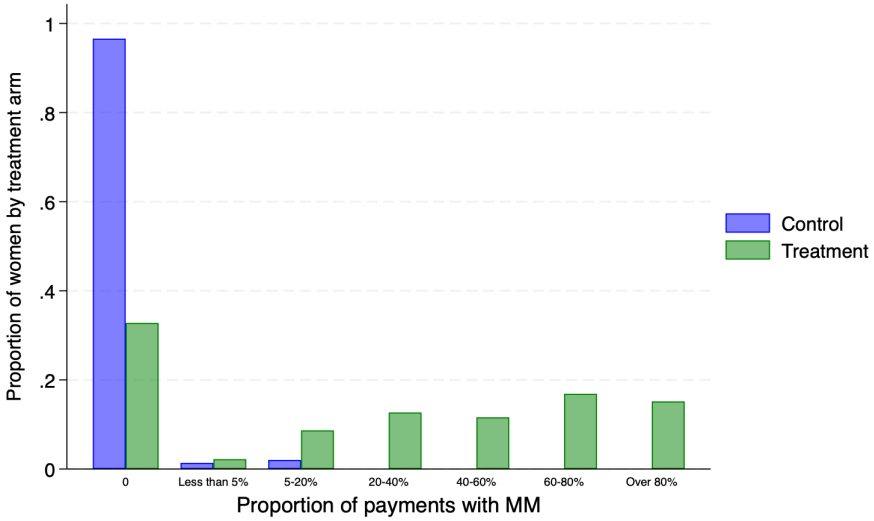

Figure A1: Proportion of payments with mobile money by treatment arm
Notes: Percentage of women making at least that proportion of payments using mobile money.

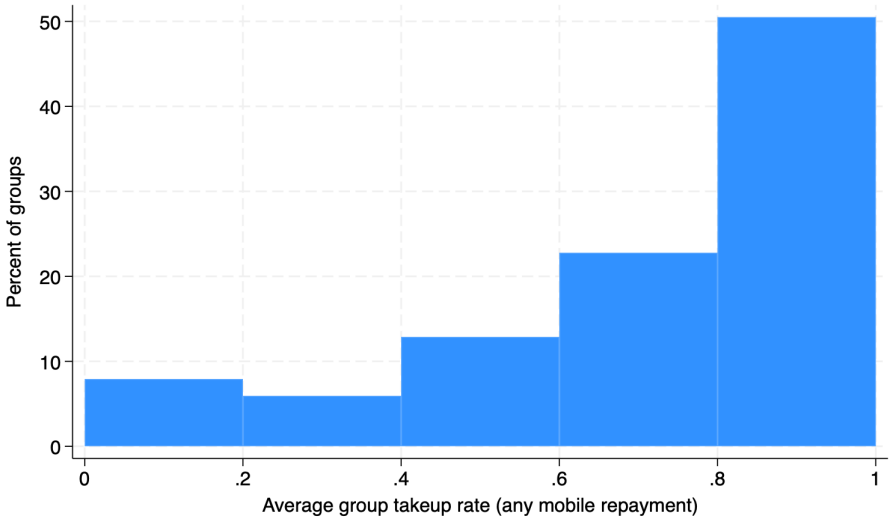

Figure A2: Average takeup rate by group: any mobile payment
Notes: Treatment groups only. Percentage of groups where on average women made at least that proportion of payments using mobile money.

Table A1: Summary statistics and balance test - combined treatment

	Control		Treatment		p-values
	Mean	SD	Mean	SD	
Age (yrs)	39.34	9.22	38.23	9.17	0.20
Completed primary education	0.92	0.27	0.94	0.23	0.39
Completed secondary education	0.24	0.43	0.22	0.41	0.48
Married	0.69	0.46	0.64	0.48	0.16
HH Size	5.18	1.93	5.16	1.93	0.92
Number of child under 12	1.31	0.92	1.40	0.93	0.32
Last 30 days profit (USD)	340.97	324.40	307.18	293.71	0.31
Business sales	892.55	1267.93	812.45	1094.30	0.52
Business experience (yrs)	7.46	5.99	6.98	6.18	0.36
Has employees	0.34	0.48	0.33	0.47	0.80
Ever used mobile money	0.98	0.14	0.95	0.22	0.04**
Prefers loan repayment using MM	0.77	0.44	0.79	0.46	0.69
MM Use index	0.00	0.51	-0.00	0.53	1.00
Empowerment Index	-0.02	0.30	-0.01	0.29	0.72
Total monthly income (USD)	916.62	747.05	813.34	632.66	0.12
HH food consumption	62.55	40.54	62.49	48.40	0.99
Total savings	394.16	448.97	389.59	421.22	0.90
Saves with MM	0.16	0.37	0.15	0.35	0.62
Saving value MM	17.04	55.42	18.72	80.78	0.74
Net loans value	1111.79	722.92	1096.55	690.10	0.84
Present biased	0.33	0.47	0.33	0.47	0.92
Patient	0.48	0.50	0.45	0.50	0.63
Obs	249.00		501.00		

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 '000 USD PPP. p-value from t-test of equality of the coefficients.

Table A2: 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	0.77	0.44	0.76	0.48	0.82	0.44	0.30	0.76	0.19	0.37	0.69
MM Use index	0.00	0.51	0.02	0.59	-0.02	0.47	0.74	0.75	0.51	0.81	1.00
Empowerment Index	-0.02	0.30	-0.01	0.30	-0.02	0.27	0.84	0.69	0.80	0.92	0.72
Total income	916.62	747.05	823.12	673.44	803.67	590.79	0.12	0.23	0.78	0.28	0.12
HH food consumption	62.55	40.54	62.67	46.63	62.32	50.18	0.97	0.98	0.96	1.00	0.99
Total savings	394.16	448.97	395.60	399.94	383.64	441.95	0.82	0.97	0.79	0.96	0.90
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	1111.79	722.92	1101.72	678.25	1091.45	702.93	0.82	0.90	0.90	0.98	0.84
Present biased	0.33	0.47	0.33	0.47	0.34	0.47	0.86	1.00	0.86	0.98	0.92
Patient	0.48	0.50	0.49	0.50	0.42	0.49	0.28	0.84	0.18	0.34	0.63
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 '000 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.

Table A3: Attrition

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

All regressions control for stratification fixed effects. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment.

Table A4: Attrition by baseline characteristics

	(1) attrition
Age	-0.00116
	(0.000991)
Completed Primary Education	-0.00502
	(0.0320)
Completed Secondary Education	-0.0234
	(0.0181)
Married	-0.00778
	(0.0179)
HH size	-0.00661
	(0.00461)
Children under 12	0.00334
	(0.00982)
Last 30 days profit	0.00697
	(0.0250)
Business experience (yr)	-0.000740
	(0.00116)
Inventory value	-0.00970**
	(0.00405)
Asset value	-0.000118
	(0.00393)
Has employees	-0.00685
	(0.0148)
Mobile money use index	-0.00854
	(0.00650)
Used mobile money	0.0129
	(0.0351)
Prefer loan repayments mobile money	-0.0205
	(0.0136)
Empowerment index	-0.0000454
	(0.00761)
Social cohesion index	-0.00732
	(0.00599)
HH total income	0.0134
	(0.0118)
HH food consumption	-0.0342
	(0.0321)
Saves with mobile money	0.0468*
	(0.0250)
Net loans value	-0.0150*
	(0.00902)
Constant	0.162**
	(0.0699)
Observations	750

All regression include stratification fixed effects. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. All values in '000 USD PPP.

Table A5: Takeup by baseline characteristics in the treatment group

	(1) Any payment	(2) At least 10	(3) Number payments
Age	-0.000159	-0.000849	-0.0751
	(0.00271)	(0.00298)	(0.0485)
Completed Primary Education	-0.0419	-0.0415	0.227
	(0.0823)	(0.0900)	(1.389)
Completed Secondary Education	-0.0636	-0.0426	-0.917
	(0.0538)	(0.0547)	(0.906)
Married	-0.0346	-0.00652	-0.234
	(0.0511)	(0.0498)	(0.903)
HH size	0.0266*	0.0112	0.0966
	(0.0135)	(0.0158)	(0.277)
Children under 12	-0.0778**	-0.0454	-0.626
	(0.0304)	(0.0323)	(0.508)
Last 30 days profit	0.0538	-0.102	-0.862
	(0.0872)	(0.0948)	(1.826)
Inventory value	0.0198	0.0441**	0.528
	(0.0180)	(0.0190)	(0.381)
Asset value	0.0352	0.0597***	0.994***
	(0.0218)	(0.0198)	(0.308)
Used mobile money	0.220**	0.110	1.739
	(0.103)	(0.0896)	(1.472)
Mobile money use index	-0.0254	0.00114	0.0455
	(0.0235)	(0.0249)	(0.455)
Prefer loan repayments mobile money	-0.0257	-0.0374	-0.516
	(0.0437)	(0.0489)	(0.770)
Financial control index	-0.0444*	-0.0362	-0.260
	(0.0231)	(0.0243)	(0.451)
HH decision index	-0.0342	-0.0622***	-0.553
	(0.0218)	(0.0232)	(0.373)
HH food consumption	-0.0357	-0.0167	0.871
	(0.120)	(0.145)	(3.051)
Disbursed amount	0.0117	0.00222	-1.293*
	(0.0419)	(0.0457)	(0.756)
Observations	501	501	501

All regressions control for stratification fixed effects. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. All values in '000 USD PPP. 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.

Table A6: Impact of treatment on mobile money use, empowerment and business profits

	(1) Mobile money use index	(2) Empowerment index	(3) Business profits
Treated	0.33	0.26	5.49
	(0.10)	(0.10)	(27.87)
	[0.00]	[0.01]	[0.84]
	{0.00}	{0.02}	{1.00}
Observations	723	723	723
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. 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 **?**. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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 A7: 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	0.353***	0.266***	1.685
	(0.105)	(0.100)	(29.939)
MM Biweekly	0.301***	0.214*	12.166
	(0.108)	(0.110)	(31.904)
P-value Biweekly=Weekly	0.63	0.62	0.72
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 A8: Impact of treatment on Mobile Money Comfort

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Comfort	Leave 30,000	Leave month	Complete transaction	Correct error	Reverse transaction	Send Money	Check Balance	Ease transact	Makes transactions herself
Treated	0.165**	0.230	0.053	0.161	0.192	0.237*	0.209*	0.102	0.056	0.059**
	(0.084)	(0.233)	(0.044)	(0.112)	(0.141)	(0.133)	(0.115)	(0.105)	(0.083)	(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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A9: 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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A10: 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	0.028	0.032	-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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A11: Impact of treatment on Mobile Money Problems

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Problems	System Down	Unclear Transaction	Delay Transaction	Difficulty Contact	Wrong Number	Transaction Often Fails	Agent Absent	Agent No Float	Agent System Down
Treated	0.093	0.042	0.040	0.047	0.019	0.013	0.076	0.007	0.068*	-0.039
	(0.091)	(0.044)	(0.031)	(0.040)	(0.032)	(0.019)	(0.068)	(0.035)	(0.041)	(0.032)
Observations	644	520	520	520	520	520	644	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

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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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). 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)-(10) are dummy variables capturing problems experienced with mobile money agrents.

Table A12: 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

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A13: Impact of treatment on spousal permission

	(1) Index	(2) Bank account	(3) Send Money	(4) Visit Market	(5) Visit Friend Locally	(6) Visit Friend Far	(7) Work
Treated	0.010	-0.025	-0.029	-0.035	0.026	0.017	0.105*
	(0.120)	(0.057)	(0.047)	(0.042)	(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

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A14: 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) Medical	(10) Household	(11) Durables	(12) Gifts, transfers	(13) Recreation
Treated	-9.619	-1.237***	0.153	-0.873***	1.089***	-0.000	1.145***	0.925***	0.219	0.143	-0.040	-0.039	-0.024
	(12.643)	(0.395)	(1.457)	(0.098)	(0.082)	(0.000)	(0.078)	(0.048)	(0.661)	(0.130)	(0.213)	(0.108)	(0.159)
Observations	722	722	722	721	721	704	721	722	722	722	722	722	722
Control Mean	270.19	34.54	118.54	14.90	7.47	2.06	7.40	6.42	9.23	3.56	7.44	12.23	4.37

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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A15: 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) Medical	(10) Household	(11) Durables	(12) Gifts, transfers	(13) Recreation
Treated	0.006	-0.003	-0.004	-0.004***	0.002***	0.000	0.003***	0.002***	-0.003	0.001*	-0.001	0.000	-0.000
	(0.011)	(0.002)	(0.006)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)	(0.000)
Observations	722	722	722	721	721	704	721	722	722	722	722	722	722
Control Mean	0.53	0.07	0.24	0.04	0.02	0.00	0.02	0.01	0.02	0.01	0.01	0.03	0.01

All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. Regressions also control for total expenditure and household composition at baseline. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All columns report shares on a monthly basis.

Table A16: 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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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, not asked at baseline.

Table A17: Impact of treatment on Profits

	(1) Last 30 days	(2) Weekly	(3) July	(4) August	(5) Sep	(6) Oct	(7) Nov	(8) Dec
Treated	6.872	4.731	9.358	5.177	-5.391	6.834	-36.887	-28.703
	(27.138)	(7.222)	(30.710)	(28.517)	(29.817)	(33.291)	(38.476)	(38.836)
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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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. Questions on monthly profits from July-Dec were not asked at baseline.

Table A18: 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	0.031	0.023*	7.674**	1.732	0.010	-0.008
	(0.021)	(0.013)	(3.213)	(4.245)	(0.007)	(0.017)
Observations	723	723	723	723	630	556
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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A19: Impact of treatment on Other Business Outcomes

	(1) Business Sales	(2) Business Expenses	(3) Business Capital
Treated	89.228	38.220	-116.095
	(101.047)	(79.011)	(105.461)
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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A20: 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	0.589	-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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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. Column (5) is whether the business is still operating - not defined at baseline.

Table A21: Impact of treatment on HH outcomes

	(1) Total consumption	(2) Total income	(3) Spouse total income	(4) Woman's work income
Treated	-8.572	47.208	36.092	14.014
	(13.208)	(51.573)	(45.171)	(8.695)
Observations	722	722	487	722
Control Mean	498.19	624.34	439.72	22.74

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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment.. Column (1) is household total consumption in 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. 441 women are married. Column (4) is the woman's income from wage work in the last 30 days.

Table A22: Impact of treatment on Savings

	(1) Total	(2) Bank	(3) MM account	(4) Friends	(5) Home	(6) VSLA
Treated	64.562*	10.778	15.393**	9.332	10.597	14.184
	(38.109)	(33.104)	(6.267)	(7.051)	(10.076)	(11.784)
Observations	722	722	722	722	722	722
Control Mean	353.16	239.95	11.83	11.42	53.84	35.41

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. All regressions also control for group size. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A23: Impact of treatment on Net Loans

	(1) Loan last 6 months	(2) Loans outstanding	(3) BRAC loans outstanding
Treated	0.055	71.851	35.530
	(0.045)	(55.169)	(53.742)
Observations	722	722	722
Control Mean	0.57	486.47	465.98

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A24: 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	56.563	21.708	6.826	-6.109	-9.757	0.003	0.016
	(57.070)	(71.541)	(7.542)	(10.436)	(5.984)	(0.019)	(0.042)
Observations	722	722	722	722	722	722	722
Control Mean	601.84	1001.99	104.26	22.86	13.63	0.04	0.38

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.[37] Left group is a dummy variable for whether the woman no longer has a current active loan from BRAC. Left group is not defined as 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.

Table A25: 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) Left group
Treated	5.493	-18.397	-1.540	-3.685	-5.345*	-0.003	0.002
	(23.533)	(38.162)	(3.881)	(5.313)	(2.845)	(0.010)	(0.019)
Observations	3460	3460	3460	3460	3460	3460	3460
Control Mean	329.81	553.56	56.69	17.11	10.85	0.03	0.29

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All regressions include stratification fixed effects. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.[38] Left group is a dummy variable for whether the woman no longer has a current active loan from BRAC. Left group is not defined as 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.

Table A26: Impact of treatment on Social Cohesion

	(1) Index	(2) Talk once week	(3) Ask financial help	(4) Discuss business	(5) Discuss personal	(6) Visit house	(7) Close friends	(8) Meeting Time
Treated	0.187**	0.041*	0.007	0.030**	0.024	0.005	0.031**	-10.027*
	(0.089)	(0.021)	(0.012)	(0.015)	(0.015)	(0.007)	(0.014)	(5.523)
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	133.35

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. All regression include stratification fixed effects, use of mobile money at baseline and control variables selected by LASSO. All regressions also control for group size. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. Column (1) is an index composed of columns (2)-(7). Columns (2)-(6) capture different activities women do with their fellow group members. Column 7 captures if they consider any group members close friends. Column (8) is group meeting time in minutes - not asked at baseline.

Table A27: Impact of treatment on BRAC Sentiments

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

Treated is an indicator for the woman's group being randomly assigned to mobile money repayment treatment. 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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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. These outcomes were not asked at baseline. Column (4) is a dummy variable if the woman would prefer weekly group meetings over bi-weekly or monthly.

Table A28: Heterogeneous treatment effects by and on empowerment

	(1) Empowerment	(2) Financial Control	(3) Permission	(4) Decision- HH	(5) Decision-Business
Treated	0.390***	0.433***	-0.066	0.288**	0.022
	(0.123)	(0.128)	(0.158)	(0.122)	(0.128)
Empowerment * Treatment	-0.304**	-0.113	0.186	-0.146	-0.090
	(0.140)	(0.147)	(0.185)	(0.139)	(0.139)
Treated	0.219*	0.400***	-0.239	0.166*	-0.106
	(0.115)	(0.148)	(0.187)	(0.096)	(0.098)
Control * Treatment	0.048	-0.029	0.383*	0.103	0.155
	(0.163)	(0.171)	(0.207)	(0.144)	(0.151)
Treated	0.217	0.427**	0.082	0.223	-0.072
	(0.177)	(0.191)	(0.200)	(0.192)	(0.203)
Permission * Treatment	0.027	-0.078	-0.096	-0.016	0.058
	(0.181)	(0.211)	(0.210)	(0.191)	(0.201)
Treated	0.411**	0.356**	-0.324**	0.364**	-0.052
	(0.166)	(0.148)	(0.164)	(0.146)	(0.171)
HH decision * Treatment	-0.243	0.037	0.528***	-0.225	0.044
	(0.179)	(0.163)	(0.198)	(0.161)	(0.189)
Treated	0.349*	0.506***	0.133	0.411**	0.011
	(0.179)	(0.160)	(0.182)	(0.166)	(0.184)
Business decision index * Treatment	-0.143	-0.151	-0.151	-0.258	-0.046
	(0.190)	(0.164)	(0.182)	(0.166)	(0.185)
Control Mean					
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. Heteroskedasticity-robust standard errors clustered at microfinance group level are in parentheses. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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). Sharing pressure is an index capturing 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.

Table A29: Heterogeneous treatment effects by Loan ends earlier

	(1) Mobile money use index	(2) Mobile money comfort index	(3) Empowerment index	(4) Financial control index	(5) HH decision index
Treated	0.281**	0.312***	0.255*	0.423***	0.270**
	(0.125)	(0.117)	(0.132)	(0.133)	(0.125)
Loan ends earlier * Treated	0.091	-0.267*	-0.027	-0.074	-0.105
	(0.152)	(0.157)	(0.155)	(0.149)	(0.158)
Control Mean	-0.00	-0.00	-0.00	-0.00	0.00
Hetero median	10.00	10.00	10.00	10.00	10.00
Observations	722	722	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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.

Table A30: Heterogeneous treatment effects by Larger loan

	(1) Mobile money use index	(2) Mobile money comfort index	(3) Empowerment index	(4) Financial control index	(5) HH decision index
Treated	0.240**	0.134	0.223*	0.355***	0.179
	(0.119)	(0.113)	(0.122)	(0.126)	(0.113)
Larger loan * Treated	0.209	0.068	0.040	0.054	0.071
	(0.154)	(0.158)	(0.150)	(0.150)	(0.160)
Control Mean	-0.00	-0.00	-0.00	-0.00	0.00
Hetero median	1122.86	1122.86	1122.86	1122.86	1122.86
Observations	722	722	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. Control mean is the mean of the outcome in the control group at endline. Mean baseline is the mean of the outcome in all study arms at baseline. 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.