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E-Payment Technology and Business Finance: A Randomized Controlled Trial with Mobile Money*

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Abstract

We conducted a randomized controlled trial with small and medium-sized enterprises in Kenya to estimate the causal impact of an e-payment technology on business finance. Using an encouragement design, we exogenously increased e-payment usage among a random subset of firms by relaxing adoption transaction costs and information barriers. Sixteen months after the intervention, we find that the e-payment technology increased access to mobile loans (in number of loans, as well as in the amount borrowed) by at least 50% (0.17 sd), likely due to the reduction of information asymmetries brought by an increase in digital transactions. We find no effect of the e-payment technology on sales and profits, but we do find a reduction of sales volatility and precautionary investment, especially for smaller firms. This suggests that mobile loans help smaller firms cope with short-term negative shocks. We provide a stylized model of business finance that rationalizes these findings.

Keywords: SME Finance; Financial Integration; Mobile-Money; E-Payments.
JEL Classification: G00, G21, D22, D25, O33.

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§This paper is dedicated to the memory of our dear friend and co-author Ravindra Ramrattan, who inspired us to begin research on Mobile Money and who lost his life at the tragic Westgate Mall terrorist attacks in Nairobi, Kenya. Ravi's soul has guided us until the completion of this paper.

1 Introduction

Electronic payment (hereafter e-payment) instruments have the potential to increase financial access. Electronic transactions get recorded, hence businesses that use e-payment instruments may have easier access to credit because of reduced information asymmetries. In addition, e-payment instruments may be able to improve business performance, reduce sales volatility and alleviate safety concerns with respect to holding cash balances in store.

Despite their promise, adoption of e-payment instruments has been slow among small and medium sized establishments (SMEs), especially in developing countries.[1] Surprisingly, little is known about what prevents businesses from adopting e-payment instruments and even less about their impact on business outcomes, including financial access.

This paper provides unique evidence of the causal impact of e-payment technologies on SME finance. We take advantage of a particular moment in time in which Kenya's major mobile money provider, *Safaricom*, launched a new e-payment instrument, *Lipa Na M-Pesa* (hereafter LPN), specially designed to facilitate retail transactions by SMEs. Since the product was relatively new in the market, we were able to increase uptake by mitigating adoption barriers like transaction costs and information deficiencies among a random sample of merchants. Specifically, we randomly assigned restaurants and pharmacies in Nairobi, Kenya, to a treatment (615 firms) and a control group (607 firms). We encouraged merchants assigned to treatment to adopt LPN by informing them about the technology and by offering to open an account on their behalf. Merchants assigned to control, in contrast, received nothing. The design of our Randomized Controlled Trial (RCT) allows us to address our main research question on the impact of e-payment instruments on SME finance but it also provides, as a byproduct, causal insights into the joint relevance of key adoption barriers.

We observe high interest from merchants in our offer to open an LPN account, with an average acceptance rate of 41.5% (62% among restaurants and 21% among pharmacies). This high interest suggests not only a considerable unmet demand for the technology, but

[1] According to estimates of The World Bank (2016a), the fraction of e-payments in SME transactions is 20% in South Asia, 25% in Sub-Saharan Africa, 46% in Latin America, while the same ratio is about 71% in high income OECD countries.

also that the adoption barriers that we lifted were binding. We also observe heterogeneity in the willingness to adopt the technology. Merchants who, at baseline, were less distrusting and had more prior experience with using standard M-Pesa for business purposes, reported higher interest in the technology. Moreover, our data suggest that privacy concerns were a deterrent factor. Merchants who were more averse to disclose their sales and profits at baseline, also reported lower interest in the technology.

To study the impact of LPN on business finance, we estimate intention-to-treat (ITT) effects using data from an endline survey conducted sixteen months after the intervention. Although the actual adoption in the treatment group observed at endline (31%) was lower than the willingness to adopt reported at baseline (41.5%), it was significantly and substantially higher than that in the control group observed at endline (23%). The net take-up rate was about 26% (or 0.14 sd.) higher in the treatment than in the control group, and actual usage was 34% (or 0.17 sd.) higher.

As a key result, we find that LPN increased access to mobile loans, both in the number of loans (50% increase and 0.17 sd.) and in the amount borrowed (57% increase and 0.18 sd.). The mechanism via which LPN increased merchants' access to mobile loans is as follows. Merchants with LPN were more likely to receive digital payments than merchants without LPN. The increase in the number of digital transactions improved merchants' credit score and, hence, the likelihood to receive more mobile loans with a higher limit. We provide empirical evidence consistent with such mechanism by estimating the effect of digital sales and digital book-keeping on mobile loans outcomes, using treatment assignment as an instrument. Also consistent with this mechanism, we find that improvements in access to mobile loans were more pronounced in smaller firms, who likely suffer most from opacity and the lack of hard information to attract external finance. Interestingly, we find no reduction in access to loans from other formal or informal financial institutions, indicating that there was no substitution but rather an overall increase in access to finance.

We find no effect of LPN on sales and profits levels, presumably because in our study sample using LPN does not necessarily increase customer attraction to a business. We do find, however, that LPN reduced sales volatility and precautionary investment of smaller firms, suggesting that the higher access to mobile loans strengthened their capacity to cope

with short-term liquidity risk and to curb business fluctuations. In Appendix A we present a stylized model that provides a theoretical rationale for the linkage between mobile loans, sales volatility and precautionary investment (and, more generally, business performance) utilizing a framework for liquidity-constrained household-firms.

Finally, we also document a significant increase in perceived safety, as measured by the fear for theft and robbery. This effect is especially pronounced among SMEs operating in relatively unsafe areas. Overall, this paper provides novel causal evidence of key benefits of adopting e-payment technologies for SMEs in developing countries: higher financial connectedness, lower sales volatility and higher perceived safety.

The rest of the paper is organized as follows. Section 2 relates the paper to the existing literature. Section 3 introduces M-Pesa and LPN. Section 4 sets up the hypotheses of the study and Section 5 describes the empirical identification strategy. Section 6 presents the results and Section 7 concludes.

2 Contribution to the Literature

This paper contributes to several strands of literature. First, it contributes to the fast-growing research on the economic effects of mobile money in developing countries. The vast majority of studies in this literature focuses on consumption and savings decisions by households. The overall conclusion is that mobile money increases savings and facilitates consumption smoothing (Mbiti and Weil, 2011; Jack et al., 2013; Jack and Suri, 2014; Suri and Jack, 2016; Batista and Vicente, 2018; Wieser et al., 2019). We contribute to this literature in two fundamental ways. First, while the extant literature typically uses observational data, our RCT offers clean identification of the causal impact of e-payment usage. Second, we focus on the effect of mobile money on SME finance, as opposed to households.[2]

Second, our paper contributes to the broad literature of cashless payment instruments by conducting what constitutes, to our knowledge, the first RCT with a payment technology.

[2]One exception in this line of research is Beck et al. (2018a), who developed a dynamic general equilibrium model, calibrated for Kenya, to study the interaction between mobile money, entrepreneurial finance and macroeconomic activity.

Existing studies in this literature use observational data from surveys or administrative sources (Humphrey et al., 1996; Schuh and Stavins, 2010; Bolt et al., 2010; Agarwal et al., 2019) or data from laboratory experiments (Camera et al., 2016; Arifovic et al., 2017), but do not utilize field experiments as part of a causal identification strategy. The paper that is perhaps closest to ours is Gosh et al. (2022), who use data on loan applications to a leading FinTech lender in India and find that a higher share of non-cash payments is associated with better access to loans. The mechanism they propose is similar to the one we put forward in this paper: non-cash payments produce traceable and verifiable information about the expenditure stream (and hence credit-worthiness) of potential borrowers. The findings of Gosh et al. (2022), with different methods and in a different context, thus provide support for the external validity of the mechanism we uncovered. Our paper complements theirs by providing causal (as opposed to observational) evidence on the impact of a different e-payment technology on a different country, and by identifying the (relevance of the) barriers preventing the diffusion of mobile money technology in the field.

Third, our paper relates to the technology adoption literature in the context of developing countries. The studies most relevant for our research are the field experiments on adoption of new and more efficient technologies. Most studies in this literature concentrate on the agricultural sector and in particular on the adoption of farming technologies by small and micro enterprises (Duflo et al., 2004, 2008, 2011; Foster and Rosenzweig, 2010; Dupas, 2014; Emerick and Dar, 2020; Olivia et al., 2020; Cole and Fernando, 2021). We add to this line of research by studying technology adoption decisions of SMEs in the services sector to better understand the barriers to and the business consequences of mobile payment technology adoption.

Finally, this paper adds to the broader literature on SME finance. In particular, our findings are especially relevant for the literature on relationship lending. The seminal papers in this literature suggest that because of the apparent difficulty associated with collateral-based lending, extending loans to small and opaque businesses requires the build-up of soft information, necessitating the formation of long-term bank-firm relations (Petersen and Rajan, 1994; Berger and Udell, 1995; Degryse and Cayseele, 2000; Norden and Weber, 2010). In particular, in a recent paper, Beck et al. (2018b) show that long-term lending

relationships are especially important during business downturns and significantly more so for the smallest firms with non-transparent operations. Our paper does not only provide support for the insights provided by Beck et al. (2018b); we also offer a novel angle – that transaction frictions hampering the formation of lending relations can be overcome by connecting spending and loan information, and that the subsequent improvement in access to loan products is beneficial for especially smaller business.

3 Institutional Context: Mobile Money in Kenya

Over the past decade, the diffusion of mobile money triggered a profound transformation in the economies of developing countries. In 2007, Kenya's *Safaricom* introduced the first mobile-phone based payment instrument, called *M-Pesa*, to enhance person-to-person (P2P) money transfers. In this section we first provide a brief overview of M-Pesa and subsequently introduce LPN, an extension of M-Pesa that was specifically designed to facilitate person-to-business (P2B) money transfers.

3.1 M-Pesa

M-Pesa is the brand name of the most commonly utilized P2P mobile money service in Kenya, which allows users to transfer money via mobile phone text messages (SMS) to other users.[3] The way M-Pesa works is as follows. Users sign up for an M-Pesa account and top it up by converting cash into M-Pesa units at so-called M-Pesa kiosks.[4] M-Pesa units can be used to make payments to other mobile money accounts, they can be cashed out at M-Pesa kiosks or they can be kept in the M-Pesa account of the account holder for future use.

Signing up for an M-Pesa account does not entail any financial cost. All that is required is to visit an M-Pesa kiosk with an ID and a mobile phone. Cash can be converted into M-Pesa units free of charge, and receiving M-Pesa units from another user is also costless. Fees

[3] At the time this study was implemented, there were other mobile money providers in Kenya like Airtel Money, Orange Money, Equitel, Mobikash, and Tangaza. According to the Communications Authority of Kenya (2015), 77% (about 21 million) of the mobile account holders in June 2015 were M-Pesa users.

[4] In December 2014, there were about 124,000 M-Pesa kiosks scattered across all Kenya (FSP interactive maps, 2013).

apply when M-Pesa units are converted to cash or transferred to another M-Pesa account. Figure 1 shows the fees applied when cashing out from an M-Pesa account, and Figure 2 (the dashed line) shows the fees that apply when transferring M-Pesa units to another M-Pesa account. Both the transfer and cash-out fees are step-wise increasing functions of the size of the transaction, and are paid by the person who executes the transaction.

With the introduction of M-Pesa, Safaricom has revolutionized P2P money transfers in Kenya. In 2013, just six years after its launch, more than 70% of Kenyan households had an account (Jack and Suri, 2014).[5] Despite the high adoption rate by households, businesses did not show the same enthusiasm to use M-Pesa as an e-payment instrument for P2B and B2B transactions. According to a nation-wide survey conducted by FSD-K in 2013-2014, only 35% of SMEs accepted M-Pesa as a common method of payment (FinAccess Business Survey, 2014).

3.2 Lipa Na M-Pesa (LPN)

Due to the relatively low popularity of M-Pesa as an e-payment instrument among merchants, Safaricom introduced LPN in 2014, a mobile money facility developed to stimulate P2B transactions. In contrast to M-Pesa, LPN accounts are registered under the name of the business. In addition to reducing cash-based transfer frictions in the same way as M-Pesa does, LPN offers monetary and technological benefits that make the product attractive for P2B purposes.

Regarding monetary benefits, opening up an LPN account is free of charge for a merchant, and users of M-Pesa do not incur any fees when making payments to an LPN account. This is a major difference compared to the P2P transactions made between two M-Pesa accounts, where the account holder making the transaction (in this case, the customer) needs to pay a fee. Whereas with M-Pesa it is the person making the payment that incurs a fee, with LPN it is the recipient (i.e., the merchant) who has to pay a fee. This fee equals 1% of the transaction value (Figure 2, straight line), and hence for all transactions below 8500 KSh (just over US$ 80) the LPN costs incurred by the merchant are lower than those

[5] In 2013, 733 million M-Pesa transactions took place, with an aggregate value of about 1.9 trillion Kenyan shillings (about 22 billion US$), an equivalent of 40% of Kenyan GDP at the time. https://www.centralbank.go.ke/national-payments-system/mobile-payments/.

incurred by the customer when transferring to another M-Pesa account (Figure 2, dashed line). Importantly, the typical transaction of the merchants in our sample is about 60 US$, well below that threshold.[6]

All this implies that customers are better off paying via LPN than via M-Pesa. The merchant, on the other hand, incurs a cost when receiving payments via LPN. However, since the fees are lower than the fees the customer would pay via M-Pesa, transacting via LPN would result in an increase in the merchant's and customer's joint surplus. Alternatively, a customer who would pay with cash in the absence of LPN has reasons to prefer paying with LPN instead of cash, to avoid theft or cash-withdrawal transaction costs, where theft is an important concern also for the merchants. Finally, it is important to note that to convert payments received via LPN into cash, the merchant needs to transfer the amount to an M-Pesa account (free of charge), after which the M-Pesa units can be cashed out. For this cash-out, standard M-Pesa fees apply (Figure 1).

Why would merchants want to adopt and use LPN? First, offering an alternative method of payment to customers at no cost is arguably a good marketing practice. Second, LPN offers key technological advantages for the merchant over M-Pesa. For instance, while with an M-Pesa account there are restrictions on the amount of money one can store, such restrictions are virtually absent for LPN. This implies that a merchant with LPN does not need to cash out as often as with M-Pesa, reducing the costs of cash withdrawals. In addition, Safaricom records all the transactions made via LPN, which allows the business owner access, free of charge, to daily transaction records over the past six months. LPN thus offers business owners the option of an advanced bookkeeping technology at zero cost.

4 Hypotheses

In this section we lay out the hypotheses that we test with the experimental intervention. We consider two groups of hypotheses: (i) adoption-related hypotheses (denoted with A), and (ii) impact-related hypotheses (denoted with I).

[6] This amount is calculated by dividing monthly sales at baseline by the number of customers per month, also at baseline.

4.1 Determinants of LPN Adoption

The literature on technology adoption has systematically shown that adoption of a new technology tends to be slow mainly due to pecuniary and non-pecuniary barriers (Duflo et al. 2004, 2008, and 2011; Foster and Rozenzweig 2010). In the case of LPN, we identify three sets of factors affecting LPN adoption.

4.1.1 Information, Transaction Costs and Technology Know-how

Lack of accurate information about the technology, transaction costs associated to open an LPN account and technology know-how may impede LPN adoption. The intervention we developed was specifically targeted at lifting these three potential barriers (see Section 5.1.2 for more details). We hypothesize that treated merchants are more likely to adopt and use the technology than non-treated merchants (**Hypothesis A-1**). If the hypothesis is confirmed, we can conclude that these barriers were jointly binding. Because all merchants in the treatment group received the same package aimed at encouraging adoption, we cannot identify the relative importance of the various components. However, in Section 6.1.1 we make use of the information gathered in the surveys to shed light on the relative importance of each of these three barriers.

4.1.2 Financial Transparency Aversion

A key feature of e-payment instruments is that transactions get recorded, and in this particular case, they are recorded as business activity by Safaricom. This could pose a concern for merchants who are averse to disclosing their financial activities, as also argued by Brockmeyer and Saenz (2022). We hypothesize that merchants who are more transparency averse are also less willing to adopt LPN (**Hypothesis A-2**).

4.1.3 Other Determinants of Adoption

Merchants who had been already exposed to use other forms of e-money for business purposes (e.g, M-Pesa), are more likely to be willing to upgrade to LPN technology (**Hypothesis A-3**). This hypothesis relates to the inherent heterogeneity of preferences for digital payment technologies (Arifovic et al., 2017).

Next, we conjecture that merchants who are more exposed to internal or external theft or who feel unsafe, are more likely to adopt LPN. This is because offering the option to pay via LPN is expected to reduce both the frequency and size of cash payments (**Hypothesis A-4**) (Jack and Suri, 2014; Economides and Jeziorski, 2016).[7] We also study heterogeneity in the willingness to adopt LPN by business size. However, we do not pose a formal hypothesis for this, because the way size correlates with adoption is ex-ante ambiguous. While smaller firms might benefit more from a reduction in fixed adoption costs, bigger firms might benefit more from the technology due to higher sales, a larger pool of customers and higher likelihood of theft by employees. We study the role of savings behavior as well. However, we do not formalize a hypothesis to that end either, because LPN adoption and savings behavior could well be substitutes but also complements.

Finally, we expect LPN adoption to be partly explained by merchants' specific behavioral characteristics. In particular, we expect that merchants with stronger cognitive abilities to internalize the benefits of the technology (**Hypothesis A-5**), who are more future oriented (**Hypothesis A-6**) and who have more trust in the mobile money technology provider (**Hypothesis A-7**) are more willing to adopt LPN.

4.2 Impact of LPN

LPN has the potential to affect a number of business outcomes. In this section, we present hypotheses regarding the impacts we expect on business finance, sales and profits (both in levels and volatility), investments, expenditures and (perceived) safety.

4.2.1 Impact on Business Finance

LPN can alleviate information frictions and, as a result, can facilitate business finance. Our first hypothesis is that LPN increases access to, as well as the amount of, *mobile loans* **(Hypothesis I-1)**. Mobile loans are loans provided via M-Pesa by Commercial Bank of Africa (M-Shwari) or Kenya Commercial Bank (KCB M-Pesa) and in partnerships with Safaricom. The mechanism we propose is the same for both lenders - Commercial Bank

[7] Png and Tan (2020) show that cashiers require a wage premium for holding cash due to the stress generated from handling cash payments.

of Africa and Kenya Commercial Bank. In the rest of the paper, we use the brand name M-Shwari without loss of generality.

Mobile loans are of short-term maturity (30 days), relatively small (100-100,000 KSh) and have a 7.5% fee (independent of the size of the loan). According to a survey reported by Cook and McKay (2015) among M-Shwari borrowers, the vast majority of respondents answered that the low cost of loans was a key benefit of M-Shwari. In addition, the authors highlight that, compared to formal bank loans, a key advantage of M-Shwari is that there are hardly any transaction costs involved. Normally, applying for a loan requires having a bank account, asking for an appointment with a loan officer, travelling to a bank branch, assembling all required paperwork or documents (as well as less tangible costs) and waiting for an eventual loan approval. In case of M-Shwari, customers can readily apply for a loan via their mobile phone. Transaction costs for most M-Shwari loans are thus practically zero, and this feature makes mobile loans especially appealing when business owners face adverse short-run income shocks.

We conjecture that LPN increases access to and the amount of mobile loans for the following reason. While it is not necessary to have an LPN account to be eligible to receive a mobile loan, having LPN helps improving the credit score in a non-trivial way (Cook and McKay, 2015). The possibility to receive payments via LPN (indirectly) raises the number of digital transactions in the merchant's M-Pesa account, which increases her credit score and hence the eligibility to receive more mobile loans with a higher limit.

Two types of customers are likely to switch to pay via LPN. First, customers who would pay via the merchant's personal M-Pesa in the absence of LPN, may decide to switch to paying via LPN because it is free of charge. Second, customers who in the absence of LPN would pay with cash, may realize the convenience of paying with LPN, also because it is a free and safe method of payment for the customer. For these two reasons, merchants with LPN are more likely to receive digital payments than merchants without LPN.

With the digital money in her LPN account, the merchant has two options: a) to store (keep) the money in her LPN account and use it to pay bills or purchase inputs and/or b) to cash the money out. If the merchant cashes the money out, she must first transfer the money (free of charge) to her personal M-Pesa account. These transfers increase the

number of digital transactions in the merchant's M-Pesa account, which, according to Cook and McKay (2015), increases her credit score and hence the likelihood of receiving more mobile loans with a higher limit.[8]

4.2.2 Impact on Sales and Profits (Levels)

There can be direct as well as indirect effects of LPN on sales and profits. If LPN simply crowds out cash payments (or payments via standard M-Pesa), it will not have a first-order effect on sales. In principle, however, merchants with LPN might attract customers from other businesses in their neighborhood who prefer paying digitally at no fee. This can result in an increase in sales and profits.[9] In terms of indirect effects, LPN could also increase sales (and profits) through its effect on mobile loans. Mobile loans provide merchants with liquidity and thus can reduce the likelihood of having to forego profitable business opportunities due to liquidity constraints. This would be especially important for smaller firms, as they are typically more likely to face (severe) liquidity constraints. The model presented in Appendix A formalizes this link. Therefore, we conjecture that LPN is likely to increase sales and profits **(Hypothesis I-2)**.

4.2.3 Impact on Sales and Profits (Volatility)

If LPN increases access to mobile loans, we expect the volatility of both sales and profits to decrease. Mobile loans are of a short-term nature and their main aim is to help businesses cope with cyclical shocks (e.g. shortages of inventory and sudden demand for liquidity) by reducing sales volatility. As such, mobile loans are expected to be particularly beneficial for smaller firms, as they are more likely to be liquidity constrained **(Hypothesis I-3)**. The model in Appendix A formalizes the link between mobile loans and sales volatility.

[8]Note that merchants who open an LPN account do not receive additional advertisement about the loan products. This is because M-Shwari are personal loans available to any M-Pesa account holder, regardless of whether the person has an LPN account or not. This rules out the possibility that LPN increases loans through an increased exposure to loan advertisements.

[9]Higgins (2022) shows an alternative channel through which an e-payment technology can increase sales and profits. He shows that debit cards increase small retailers' sales and profits in Mexico because richer households' shift their consumption from larger to smaller retailers now that they can also use debit cards at smaller retail shops as well. This channel is not applicable to our context.

4.2.4 Impact on Investment and Expenses

If LPN leads to an expansion in mobile loan access, interest expenses may increase. In addition, if LPN offers a new channel to attract customers, it may lead to an expansion of the firm's long-run business operations and hence to an increase in its overall business investment and expenses **(Hypothesis I-4)**. However, a higher access to mobile loans may also reduce precautionary investment and input storage used in the absence of mobile loans to insure against unexpected liquidity shocks **(Hypothesis I-5)**. The model in Appendix A formalizes the link between mobile loans and precautionary investment.

4.2.5 Impact on Perceived Safety

If LPN reduces cash transactions, it is expected to improve perceived safety, especially for those businesses which operate in relatively unsafe neighborhoods. We also expect larger establishments to benefit more from such improvements in perceived safety, because they have larger volumes of daily cash transactions and more employees, and hence face stronger internal and external safety concerns (**Hypothesis I-6**).

5 Identification Strategy

The main aim of this paper is to estimate the causal impact of LPN on business finance. An essential part of the methodology is to induce LPN adoption among a randomly selected sample of firms. For that purpose, we stimulated firms in the treatment group to adopt LPN using a Randomized Encouragement Design. As stated in Section 4.1.1, we aimed to foster adoption by mitigating three key adoption barriers identified in the literature: information about the technology, transaction costs associated with adopting the technology, and a lack of implementation know-how.

The intuition behind this identification strategy is as follows. The random allocation of a large number of firms to the treatment and control groups implies that the two groups of firms are expected to be similar in all respects. If the two groups are identical, then absent any intervention, their average behavior would be identical too – in terms of the share of firms deciding to adopt LPN (for example because of Safaricom's marketing activities), and

also in terms of their performance indicators. By mitigating potential adoption barriers in the treatment group, we expect to increase the share of firms adopting LPN above and beyond the share that would otherwise have adopted the technology. Any difference in average business outcomes can then be attributed to treated firms having adopted LPN more than their peers in the control group. As such, our identification strategy is able to provide causal inference on the impact of LPN on business outcomes. For more information on the method please see Online Appendix A.

Our design allows us to estimate the causal impact of LPN on business outcomes, but it also provides, as a byproduct, insights into the causal effect of lifting potentially binding (informational, transaction costs and know-how) barriers on the willingness to adopt LPN. Are these barriers binding? If so, for which type of firms? We also address these questions as part of our adoption analysis.

5.1 Randomized Encouragement Design

5.1.1 Sampling and Randomization

The study took place in the periphery of Nairobi's central business district.[10] We focus on the service sector, particularly on retailers, for several reasons. First, the service sector makes up almost half of Kenyan GDP and it is growing fast at about 6% per year.[11] Second, retailers are intermediary businesses - connected to both the household and producer sides of the economy - and they represent the largest portion of aggregate value added from the services sector (see economiesafricaines.com). Third, retailers have the potential to benefit substantially from a cashless payment technology because their transaction frequency is high, they are vulnerable to internal and external theft, and their access to finance tends to be hampered by the lack of transparency associated with the informal ways these businesses typically operate. Within the retail sector, to construct a sample of comparable firms, we focus on two types of businesses: restaurants and pharmacies. The choice of only two sectors was the result of the trade-off between external and internal validity. With respect

[10] We did not implement the study in Nairobi's city center because the associated higher business densities might have given rise to substantial spillovers between treated and control businesses.

[11] 47.5% in 2017, compared to 34.5% for Agriculture and 17.8% for Manufacturing (World Factbook, 2019)

to the latter, selecting just two sectors increases power because the variance in outcomes is plausibly smaller within sectors than between sectors.

To draw a list of eligible firms for the study, we randomly assigned enumerators to visit specific areas in the city's periphery and requested them to list restaurants and pharmacies (i) with one or more employees, (ii) located at a distance not less than 50 meters from the closest business in the same sector, (iii) that did not have an LPN account yet, and (iv) whose owner or manager was willing to participate in a study on mobile money use by businesses.[12] We implemented a minimum distance requirement to mitigate spillover effects between treatment and control firms, such as information dissemination or business stealing. Following this procedure, we listed in total 1222 SMEs, 669 restaurants and 553 pharmacies, half of which were randomly assigned to the treatment group, and the other half to the control group. Random assignment was stratified by sector, geographic location and firm size (measured by the number of employees).[13] Figures 3, 4 and 5 provide the geographic distribution of the sample of businesses over districts of Nairobi, for both the treatment and control groups.

5.1.2 Encouragement Intervention

The encouragement intervention was conducted immediately after the baseline survey. The intervention was targeted at mitigating (or completely removing) three potential barriers to LPN adoption. We aimed at mitigating the information barrier by providing information on the advantages and disadvantages of LPN compared to other payment methods. While most merchants were aware of the existence of LPN, this does not necessarily imply that they were correctly and fully informed about the technology (including costs, usage and potential benefits). The purpose of this part of the intervention was to complement (and maybe correct) the prior information the merchants had about the product.

[12]The vast majority of merchants agreed to participate. When merchants were approached and asked for their willingness to participate, they did not know that the study was about mobile money technology, to avoid potential selection into the study correlated with some interest with the technology. The sample of restaurants and pharmacies is likely to be fairly representative of the businesses located in (the periphery of) Nairobi's Central Business District.

[13]A restaurant (respectively pharmacy) with more than four (respectively three) employees (their median) is considered big and we used this categorization to stratify the sample. The geographic division of the area was made ad-hoc by the survey company for logistical reasons.

The information was provided by means of a leaflet and a video. The leaflet highlighted the benefits of using LPN (see Online Appendix C). It emphasized the benefits for the customer, because she does not have to pay a transaction fee, but also for the merchant. These benefits related to (i) the business becoming more attractive to customers, (ii) reduced chance of theft and robbery because of having less cash in house (there is no limit to the amount of money that can be stored in an LPN account), and (iii) easier bookkeeping (LPN registers all transactions). The video complemented the leaflet by featuring an interview with a business owner, active in the same sector as the interviewee, who had already adopted LPN. We did so because the literature provides strong evidence that successful peers can act as role models and are particularly effective in the context of low-income households in developing countries (Bernard et al., 2014; La Ferrara, 2016).[14]

We aimed at reducing the transaction costs associated with opening an LPN account by offering to handle all the paperwork necessary for the application. While opening an LPN account is free of charge, seemingly small transaction cost barriers may hinder people taking advantage of efficient investment opportunities (Bertrand et al., 2004). Specifically, we offer the merchant to have a trained enumerator (i) pick up the copies of the documents from the merchant required to open an account, (ii) do all the paperwork at Safaricom, and (iii) once the application is approved, collect all the materials from Safaricom and deliver them to the merchant.

When delivering the material, the enumerator would help the merchant install the account, verify its functionality and explain how to use it. The training also included assisting the merchant in performing a test transaction, that is, charging our (standard) M-Pesa account for a sum of 100 KShs and completing the transaction. This is how we tried to address the third potential adoption barrier – the lack of technological know-how.[15] Further details about the intervention are presented in Online Appendix B. For a summary of the timing of the events, please see Figure 6 in the Appendix.

After having presented this encouragement package to the merchant in the treatment

[14] All materials were produced by the research team in close cooperation with DDD-Kenya and a professional producer company.

[15] The intervention was carried out by enumerators hired and trained by DDD Kenya and by the research team. We made it very clear to the merchant that we did not have any commercial ties with Safaricom. We explicitly stated that our aim was purely scientific.

group, the enumerator asked the merchant if she would be interested in us opening an LPN account on her behalf. The answer to this question is what constitutes our measure of merchant's willingness to adopt LPN. With this information, the enumerators started the paperwork with Safaricom to open an LPN account on behalf of the merchant. Only then, we learned that Safaricom had just introduced an additional requirement for LPN applications to be approved – the need to have a formal business license. This new requirement was known neither by us nor the merchants at the time of the intervention. Of the 1222 firms surveyed at baseline, 870 had an official business license. While we were able to gauge interest in the LPN technology for all firms (licensed and non-licensed), we could complete the application process only for the licensed firms. That means that the estimation of the impact of LPN is restricted to the subset of licensed firms. While this is unfortunate, it does not affect the internal validity of our study, as random assignment implies that the share of licensed firms is the same in both the treatment and control groups (72%; see Table 1).

5.2 Behavioral Survey Measures

For the baseline and endline surveys, we interviewed either the owner or the manager of the businesses in our sample. Next to gathering information on business characteristics and performance, a key objective of the baseline survey was to measure the *behavioral* factors that could be associated with the adoption of LPN but were not exogenously varied by the experimental intervention. This subsection describes the way these factors were measured in the survey instruments.[16]

To collect information about behavioral factors, we asked the merchant to participate in a series of tasks. First, we measured each merchant's cognitive function with the *Digit Span Task* (Daneman and Carpenter 1980, 1983), in which the merchant is read a list of numbers and then asked to repeat these numbers in the same order. Outcomes for this

[16]Interviewees received 500 Kenyan Shillings as a token of appreciation, both at baseline and at endline, and independent of whether they were part of the treatment or the control groups. At baseline, interviewees could earn up to 2150 Kenyan Shillings through the incentivized behavioral games to measure risk and time preferences. These preferences were not measured at endline. The texts of the baseline and endline survey instruments can be found here and here, respectively.

task are the longest correctly remembered span, as well as overall accuracy.[17]

Second, we elicited time preferences, as well as present bias and future orientation in an incentive-compatible way.[18] We adopted the method used by Dupas and Robinson (2013). Merchants were asked a series of questions regarding whether they preferred receiving 500 KSh (US$4.93) the next day, or receiving a larger amount in 31 days, where the questions differed in the size of the latter amount. The larger the amount needed to induce the merchant to choose for the later payment, the more impatient she is coded to be. To measure time inconsistency, we also asked merchants to choose between KSh 500 in 31 days and a larger amount in 61 days. A merchant is defined to be present biased if she is more impatient in the present than in the future, i.e. exhibits a higher discount rate between tomorrow and 31 days than between 31 days and 61 days. If the reverse holds, the merchant is defined to be future oriented.

We also measure trust, as we hypothesized it to be a determinant of LPN adoption. In particular, we asked questions on trust in customers, in people when meeting them for the first time, in Safaricom, and in institutions in general.

As a final behavioral factor of interest, we measure the merchants' transparency aversion. We capture this variable through the un-willingness of the agent to share sales and profits figures with the enumerator during the survey interview.

5.3 Sample Characteristics

Table 1 provides descriptive statistics of all 1222 businesses in the sample and compares firms assigned to treatment and control. Table 2 provides the same information, but then for just the sub-sample of firms with a business license. Online Appendix Tables OA1-OA2 provide the definitions and descriptive statistics for the baseline variables used in regression analysis and Table OA3 presents the definitions and descriptive statistics of our endline variables. Table OA4A replicates Table 1 for the sub-samples of restaurants and pharmacies. Finally, Table OA4B provides the comparison across restaurants and

[17] This task is widely used in field experiments in economics as a proxy for cognitive ability, particularly in the context of developing countries. See Dean et al. (2017) for a review.

[18] By *incentive-compatible* elicitation we mean that the decisions made by the merchants had real monetary consequences for them, with the amounts they are entitled to being paid as announced in the choice question.

pharmacies.

We proceed describing restaurants and pharmacies separately. As Table OA4A shows, 43% of restaurants and 31% of pharmacies reported that mobile money was the most frequently used method to pay suppliers, while 40% of restaurants and 25% of pharmacies stated that they had received payments from their customers through the business owner's M-Pesa account. With respect to the size of firms, on average pharmacies employ three workers and restaurants six. The average monthly sales and profits of pharmacies are about 145,000 and 59,000 KSh (or 1470 and 600 US$ PPP) respectively, and restaurants have about 317,000 KSh in sales per month and about 80,000 KSh in profits (or 3225 US$ PPP in sales and 820 US$ PPP in profits). Only 19% of the pharmacies and 37% of restaurants had made investments in their businesses in the past six months and only few businesses (10%) had received loans in the past twelve months. Moreover, 92% of the pharmacies and 56% of the restaurants in our sample had a business license.

More than 90% of pharmacies and restaurants knew about the existence of LPN. The primary reason stated for not having an LPN account was a perceived lack of net benefits. Merchants also reported that it was too costly to open the account, that LPN transaction fees were too high, and that they did not have the time to do the registration paperwork. This pre-treatment information is enlightening in two ways. First, it reveals that merchants may have had incorrect beliefs about the cost and benefits of adopting and subsequent usage of the technology, which our encouragement intervention aimed to remedy. Second, the paperwork for the registration was perceived as an impediment to opening an account, an aspect that was also directly targeted by the encouragement intervention.

5.4 Sample Balance

As expected, firms in treatment and control groups were very similar in almost all dimensions. There is only one statistically significant difference when we use the full sample ("use mobile money to receive payments"; see Table 1), and three differences in the sample of licensed firms ("use mobile money for business purposes", "use mobile money to receive payments", and "use mobile money to pay salaries"; see Table 2). For each of the two samples we test for joint orthogonality by regressing the treatment status on all firm char-

acteristics. We cannot reject the null of the coefficients of all firm characteristics being jointly zero for neither of the two samples as the p-values of the relevant F-tests equal 0.51 and 0.16 for Tables 1 and 2, respectively.

When we look at the two sub-sectors independently in Table OA4A, we observe that the sample of restaurants is almost perfectly balanced between treatment and control, except for "having a bank loan over the past 12 months". Treated pharmacies had higher sales and profits and were also more likely to have signed up for an LPN account in the period between the listing and the baseline survey. Therefore, to be conservative, we control for having had bank loans in the past 12 months, sales and LPN self-adoption variables in our regression analyses to mitigate any possible issues associated with imbalance. In addition, in the regressions we also control for the three variables that exhibit imbalances based on Table 2.[19]

We also looked at the size of the imbalances, rather than focusing only on the statistical differences. For that purpose, following Imbens and Rubin (2015), we computed the normalized differences defined as the difference in means between the treatment and control groups, divided by the square root of half the sum of the treatment and control group variances. We computed these differences for the six variables that were found to be unbalanced. Online Appendix Table OA4C reports the results. According to Imbens and Rubin (2015), differences of 0.25 or less would indicate good balance, which is the case for all but one of these six variables.

6 Results

We report the empirical analysis and results in two parts. In Section 6.1 we show the outcomes for testing the hypotheses on *determinants* of LPN adoption, stated in Section 4.1, and in Section 6.2 we present results for testing the hypotheses on *impact* of LPN, stated in Section 4.2.

[19]The key findings of the paper are very similar with and without these additional controls; see Tables OA5A-B, OA6A-C, OA7A, OA8A-C and OA9A-C in the Online Appendix.

6.1 On Barriers to LPN Adoption

We report results on barriers to adoption in two ways. In Section 6.1.1, we show results on the effect of experimentally relaxing information, transaction costs and know-how barriers on adoption. If merchants accept our offer to open an LPN account on their behalf, it implies that at least some of the three barriers jointly manipulated were binding for those merchants. Because of the random assignment of treatment, this provides evidence of a *causal* impact of jointly relaxing those barriers on LPN adoption. In Section 6.1.2 we utilize baseline data to study the association between the potential adoption determinants hypothesized in Section 4.1 and the acceptance of our offer to open an LPN account. These latter results are interpreted as *correlational* evidence.

6.1.1 Information, Transaction Costs and Technology Know-how Barriers

Interest of treated merchants in LPN was gauged from their responses to the offer to open an account on their behalf. Acceptance rates were 62% among restaurants and 21% among pharmacies. These rates are high, given that at the time of the intervention the technology had been available in the market for a year. This means that there was a substantial "unmet demand" for the technology.[20] It also shows that at least some of the adoption barriers relaxed experimentally were important in preventing adoption, **confirming Hypothesis A-1**.[21]

We first study the relevance of the informational barrier. As shown in Table 1 and Figure 7, a significant proportion of merchants were skeptical about the technology: 26% did not think that LPN would bring benefits to their business, 16% thought that the transaction fees were very high (especially among pharmacies), 11% reported that the cost of opening an LPN account was too high (especially among pharmacies), 12% reported that they did

[20] Following Crouzet et al. (2021) it is plausible that the size of the response of our intervention may be due to the high ex-ante adoption of M-Pesa from the demand (customer) side of the market. According to a nationwide household survey conducted by FSD Kenya in 2014 (the year in which LPN was launched and this research was initiated), the household-side of the M-Pesa market had already reached saturation: 96% of the respondents to this survey had at least one M-Pesa account, with little variation between the different regions in the country.

[21] A higher willingness to adopt LPN by restaurants than by pharmacies can be explained because both sectors are different in many dimensions, as shown in Table OA4B. Restaurants employ more workers, have higher sales (and hence more transactions in LPN and personal M-Pesa), and are more likely to use mobile money for business purposes (e.g., paying suppliers). These differences imply that restaurants stand to gain more from the use of LPN than pharmacies, consistent with their greater interest in LPN.

not have the time to open an account (especially among restaurants) and 10% believed that LPN was too complex to use.

The information in the leaflet and video may have complemented the information merchants had and, in some cases, corrected their misconceptions. For example, the video explained that LPN was easy to use, and illustrated this by showing an example of a customer paying a bill to a LPN account. In the video, merchants also explained that having LPN was convenient for the customer because transferring money from M-Pesa to LPN was free of charge for the customer, and because the customer does not need to worry about all the issues associated with paying in cash (including concerns about having the correct change). Additionally, the video emphasized that receiving payments in mobile money reduces theft as there is less cash in the shop to be stolen. It was also stated that it eliminates the risk of receiving counterfeit money, and makes running the business easier, especially with respect to record keeping. The leaflet also highlighted how simple it was to use LPN, that opening an account was free of charge, that there was no limit to the amount of money the merchant could keep in her account and that no fees were levied on money transferred from the LPN account to the merchant's personal M-Pesa account. Much of this information was new to the merchants and, in some cases, it was likely to have helped correct prior misconceptions.

To learn whether misconceptions were likely to be corrected, we focus on the merchants who were pessimistic about LPN but then, after receiving the encouragement package, answered "Yes" to the question "do you want us to open an LPN account for you". This provides insight into whether the information provided plausibly changed their mind to the extent of wanting the technology. We observe that 26% of merchants who reported at baseline that LPN would not bring benefits, accepted the offer to open an account for them. The same happened with 16% of the merchants who reported at baseline that the transaction fees were too high. We take this as an indication that the information we provided was effective to tilt the beliefs of these merchants in favor of adopting LPN.

Finally, we also find that 11% of the merchants who reported at baseline that the cost of opening an LPN account was too high or that they did not have time to open an account, accepted our offer. As Figure 8 shows, our intervention increased take-up among

restaurants especially because it solved the time constraint, but we did not manage to convince all respondents of the benefits of the technology. The latter was also the case with the pharmacies, as shown in Figure 9.

Arguably, firms tend to differ in the extent to which they suffer from the various adoption barriers. While we have suggestive evidence that lack of information and transaction costs are barriers to adoption for quite a large share of our sample of merchants, this is not the case for the merchants in the control group that ended up adopting LPN or for the merchants in the treatment group that refrained from adopting LPN despite our intervention.[22]

6.1.2 Other Determinants of Adoption

In this subsection we test Hypotheses A-2 to A-7. For that purpose, we specify the following regression model:

$$\begin{aligned} Adopt_i &= \alpha + \beta' MMoney_i + \theta' Safety_i + \gamma' Saving_i + \omega' Transparency_i \\ &+ \lambda' Behavior_i + \phi' Size_i + \upsilon' Reasons_i + \chi_d + \mu_j + \epsilon_i, \end{aligned} \tag{1}$$

where subscript i enumerates the business, $Adopt_i$ is a dummy variable that equals one if business i accepted the offer to open an account (and zero otherwise)[23], $MMoney_i$ is a vector of measures of past experience with (standard) mobile money, $Safety_i$ is a vector of variables measuring business safety concerns, $Saving_i$ is a vector of variables measuring saving behavior, $Transparency_i$ is a vector of financial transparency measures, $Behavior_i$ is a vector of behavioral factors, $Size_i$ is a vector of business size measures, and $Reasons_i$ is a vector of variables that capture the ex-ante reasons for not having adopted the Lipa

[22]Note that our conclusions on the (joint) relevance of the three barriers of adoption are predicated on the assumption that firms in the treatment and control group only differ in the treatment they received, and also that the intervention was set up such that it not only encouraged some firms to adopt LPN but also that it *did not* discourage adoption by those treatment firms that would have decided to adopt LPN had they been assigned to the control group (Bradlow 1998). Our encouragement design is unlikely to have resulted in a violation of this so-called monotonicity assumption. Furthermore, spillovers (and other forms of the Stable Unit Treatment Value Assumption; Pearl 2009) should be limited too. We present formal tests of these in Section 6.2.4, and find no evidence of SUTVA being violated.

[23]The dependent variable can thus be interpreted as the willingness to open an account. Opening an account does not necessarily imply using it though. The analysis of frequency of use is presented in Section 6.2.2.

Na M-Pesa before our experimental intervention. Furthermore, μ_j controls for sectoral differences (pharmacies vs restaurants) and χ_d captures the enumerator-and-district fixed effects.[24] Estimation is done via OLS.[25]

We estimate five specifications of eq. (1). In the first specification, we use aggregated indices for mobile money use and transparency concerns, whereas in the second and third specifications they are replaced by the indices' individual components. In the fourth we also control for the ex-ante reasons for not having adopted the Lipa Na M-Pesa. Finally, in the fifth specification we consider an alternative measure for financial sophistication.

Table 3A provides results from the full sample of firms, while Tables 3B and 3C report results for restaurants and pharmacies separately. In all tables the variables in panel A measure standard mobile money usage. Variables in panels B and C contain the proxies for business safety and saving behavior, respectively. Variables in panel D capture transparency concerns, whereas those in panel E capture the behavioral aspects. Finally, the variables in panel F and G are business size indicators and ex-ante concerns related to technology adoption.

Regarding (aversion to) financial transparency (see Panel D in Table 3A), merchants who are unwilling to disclose their sales and profit information during the baseline interview are also less likely to accept the offer to open LPN, **confirming Hypothesis A-2**. This is stronger for pharmacies (Table 3C). While other transparency aversion proxies (like not having an official business license, or measures of financial sophistication) turn out to be insignificant, all coefficient estimates have the expected signs. To the best of our knowledge this is a novel finding, which is critical both for the design of electronic financial products as well as for policies aiming to promote electronic payment usage.[26]

[24]Table OA1 in Online Appendix provides the full list of variables utilized in this analysis and Table OA2 provides summary statistics of the main variables. With regard to covariates having missing values, we follow Bruhn et al. (2016) by (i) replacing them by the covariate's median and (ii) adding a covariate-specific dummy variable that equals 1 if the value for the covariate is missing for the observation, and zero otherwise. The dummy's coefficient then captures the average difference between the median value of the dependent variable for those firms for which data on the covariate are available, and those for which the covariate data are missing.

[25]We use OLS despite the fact that our dependent variable is binary. We do not expect regression results to be markedly different when using Probit for two reasons: because the mean value of our dependent variable is sufficiently bounded away from 0 and 1, and because the number of observations is sufficiently large. Indeed, we find that our OLS results are robust to using Probit not just for the results in Tables 3A–3C, but also for those in Tables 5A and 7A; outcomes available upon request. We decided to present the OLS results for ease of interpretation.

[26]In Table OA11 we investigate whether there are any differences in a-priori reasons for not adopting

Results reported in Panel A of Table 3A **confirm Hypothesis A-3**: "pre-treatment use of mobile money" is significantly associated with merchants' willingness to adopt LPN, echoing recent findings from laboratory experiments from Camera et al. (2016) and Arifovic et al. (2017). This is true for restaurants (Table 3B) and pharmacies (Table 3C), although more so for restaurants. Column (1) of Table 3A shows that merchants who use standard mobile money for business purposes are 14.1 percentage points (pp.) more likely to accept the technology. As shown in column (3), the more detailed measures of prior mobile money usage indicate, for example, that firms that use mobile money to buy inputs are more prone to accept an LPN account, as well as businesses which do not surcharge when transacting with standard mobile money.

Contrary to what we expected, being exposed to internal or external thefts or feeling unsafe (in Panel B of Tables 3A-3C) are not correlated to the willingness to open LPN, thus **rejecting Hypothesis A-4**.

The behavioral factors (in Panel E in Tables 3A-3C) perform more unevenly across various specifications, though one behavioral aspect stands out: the coefficient on cognitive ability of the merchant (as measured by the number of digits remembered) is (borderline) significant in all specifications in Table 3A, **confirming Hypothesis A-5**, especially for pharmacies (Table 3C). While we **reject Hypothesis A-6** on the role of future orientation, we observe that trust in the mobile money technology provider is correlated with a higher willingness to adopt among pharmacies in Table 3C (**confirming Hypothesis A-7**), but trust in courts (Table 3A) and in strangers (Table 3B) are negatively correlated with willingness to adopt.

With respect to other business characteristics, we observe that the willingness to adopt is independent of (indicators of) firm size (Panel F in Tables 3A-3C). We also observe that businesses that make use of savings accounts with a bank are less willing to adopt (Panel C in Tables 3A-3C). Moreover, not having time to open the account and not expecting an impact on sales before the experiment (Panel G in Tables 3A-3C) are significantly correlated with the willingness to accept our offer (Table 3A, column 4). Finally, in column 5 of Tables

LPN among transparent and non-transparent firms. We see no substantial differences to that end, with the exception that transparent firms are more likely to find the technology too complex to use and had less time to open an LPN account prior to our experimental intervention.

3A-3C we observe that exploiting an alternative measure of financial sophistication (Panel D) does not alter the key findings with respect to the transparency concerns.

6.2 Impact of LPN on Business Outcomes

We now present the analysis of the causal impact of LPN on business outcomes. As stated in Section 5.1.2, this analysis is restricted to the sub-set of those 870 firms that owned a business license at baseline. Table 1 already indicated that the treatment and control groups were strongly balanced on the share of firms with business licenses, and hence it is not surprising that this subsample is also well-balanced with respect to the vast majority of characteristics we collected; see Table 2.

Since firms cannot be forced to have an account opened on their behalf, we estimate the Intention-to-Treat (ITT) effect on outcome variable Y. Using subscripts 1 and 2 to capture baseline and endline values respectively, we estimate the following ANCOVA regression model:[27]

$$Y_{i2} = \alpha + \beta' T_i + \gamma' X_{i1} + \zeta' Y_{i1} + \lambda' Controls_{i1} + \mu_j + \epsilon_i, \tag{2}$$

where Y_{i1} and Y_{i2} respectively denote the baseline and endline values of the dependent variable of interest for business i. T_i is a firm-level dummy variable equal to one if business i was assigned to the treatment group. X_{i1} is the vector with the variables used to stratified the randomization (number of employees and geographic location) (Bruhn and McKenzie, 2009). $Controls_{i1}$ is a vector of baseline variables that were not well-balanced at baseline. These are "Use mobile money for business purposes", "Use mobile money to receive payments", "Use mobile money to pay salaries" (see Table 2), and "Having LPN", "Monthly sales" and "Having a bank loan" (see Table O4A).[28] Finally, μ_j is a sector dummy (with $\mu_j = 1$ if the firm is a pharmacy and zero otherwise) and ϵ_i is a firm-level error term. We estimate eq. (2) using OLS (even if the dependent variable is binary; see footnote 25),

[27] ANCOVA allows the regression model to determine the structure of the relationship between the baseline and endline levels of the outcome, rather than imposing it by using differences. ANCOVA is thus more efficient than difference-in-differences estimators in determining treatment effects with noisy outcome measures (see McKenzie, 2012a).

[28] We do not include profits in the control vector because of their high correlation with sales. Results are robust to limiting the set of controls to just the strata and lagged dependent variables; see Tables OA5A-OA9C in the Online Appendix.

and report robust standard errors. When we use multiple outcomes to estimate treatment effects, we also report p-values of the estimates after correcting for multiple hypothesis testing (MHT) using the Dubey/Armitage-Parmar approach summarized in Sankoh et al. (1997). This MHT correction procedure takes into account correlations among outcome variables as well the number of outcome variables used to test the hypothesis.

6.2.1 Endline Attrition

Before proceeding to report the ITT results, we present an analysis for endline attrition. Of the initial 870 licensed businesses in the treatment and control groups, 620 participated in the endline survey: 309 in treatment, and 311 in control.[29] This implies that the endline attrition was 29%. To check whether attrition at endline is non-random, we regress "not having participated in the endline survey" on the treatment dummy as well as on other business characteristics.

As shown in Table 4, we observe slightly higher attrition among restaurants than among pharmacies, and there is less attrition for firms who, at baseline, are larger, experienced more external theft, received mobile loans, and are more likely to have adopted LPN in between the baseline survey and the start of the intervention. Most importantly, however, attrition rates are not significantly different between treatment and control, implying that endline attrition does not bias our impact estimates for the treatment.[30] Moreover, if we run these regressions by treatment group (not shown here, available upon request), we find no evidence of heterogeneous attrition by treatment; none of the co-variates show up significantly in these treatment-specific analyses. This implies that those treatment and control firms that did not participate in our endline survey are similar to those firms that responded to the endline survey. Finally, we also test whether there is any difference between treatment and control in the likelihood of firms having gone out of business by the time we implemented our endline survey. Again, we find no significant differences in this respect either.

[29] Table OA3 in Online Appendix provides summary statistics for the endline survey.

[30] As noted by McKenzie (2012b), even if attrition is large but with equal rates for treatment and control, the bounds by Lee (2009) and Behaghel et al. (2015) collapse to a point estimate, and is equivalent to ignoring attrition and assuming the sample that participates in the endline is similar in both treatment and control.

6.2.2 LPN Adoption and Usage

We analyze to what extent our intervention was successful in stimulating adoption and usage of LPN by firms assigned to treatment compared to those assigned to control (Table 5A). We do so for various measures of take-up: "registration of LPN", "usage of LPN over the last 30 days", "usage of LPN to receive payments from the customers over the last 30 days", and "sales through LPN over the last 30 days".[31] All four adoption measures are significantly higher in the treatment group. Having received the treatment resulted in an increase of the number of businesses ending up having an LPN account at endline by 6 pp. (see column 1), or a 26% (0.14 sd.) increase with respect to the control group. Usage of LPN was 7 pp. higher among treated businesses (a 34% increase, or 0.17 sd., compared to the control group; see column 2), and the same holds for the increase in the propensity to receive payments via LPN (in column 3). Treated firms also have about 28 pp. higher monthly sales via LPN (a 37% or 0.17 sd. increase; see column 4), which translates into an additional (3492 Ksh (34 US$) in revenues.[32] Overall, Table 5A shows that our intervention was effective in stimulating LPN uptake.[33,34]

Given our previous result that non-transparent firms are less willing to open an LPN account, we tested whether these firms are less likely to effectively adopt LPN. Table 5B shows the ITT estimates for a split sample based on merchants' aversion towards financial transparency. Panel A shows the results for transparent firms and Panel B for the non-transparent ones. As expected, the intervention was especially effective in inducing LPN adoption among transparent firms.[35] This reveals potentially persistent effects of a

[31] For presentational purposes, the coefficients of control variables have been omitted from the tables.

[32] To take into account also those firms with zero sales, we run our regressions using the inverse hyperbolic sine (IHS) transformation of LPN sales as the dependent variable, rather than natural logarithms. As the IHS is very close to the natural logarithm, the coefficients derived based on IHS-transformed variables can be interpreted as percentage changes too. See also Bellemare and Wichman (2020) for the interpretation of the coefficients of linear specifications with dummy independent variables.

[33] We also estimated the effect of treatment assignment on personal M-Pesa use for business purposes and found no significant treatment effect on that variable. Regression results available upon request. We study heterogeneous treatment effects on LPN outcomes with respect to firm size, but we do not detect any impact heterogeneity (Table OA5C). We also test the impact of LPN on LPN usage for payments made by the merchants, but we find no significant result there either (Tables OA5D-OA5E).

[34] Estimates of minimum detectable effects for outcome variables of interest can be found in Table OA10.

[35] Recall that transparent firms are defined as those willing to disclose their sales figures to the enumerators during the baseline interview. Note that merchants were first asked whether they were willing to disclose their sales figures, and only then were offered to have an LPN account opened on their behalf. That means that by design we can rule out that these results emanate from reversed causality, i.e. the results are not due to these merchants' refusing to share their sales figures because they were not interested

preference for opacity in understanding the diffusion of e-payment technologies.

6.2.3 Results on Business Outcomes

In Section 4.2 we presented hypotheses with respect to the expected consequences of LPN on access to mobile loans, sales and profits (levels and volatility), investment, expenses and perceived safety. In this section, we report the results of estimating eq. (2) for these outcomes.

Mobile Loans and Access to Finance

Our first hypothesis is that LPN increases access to and amount of mobile loans (Hypothesis I-1). Table 6A reports results from estimating eq. (2) for formal (Panel A) and informal loans (Panel B), on the extensive margin (columns 1 and 3) and on the intensive margin (columns 2 and 4).[36]

We observe that LPN increases the likelihood of businesses having a mobile loan (the extensive margin; see column 1) as well as the amount borrowed (the intensive margin; see column 2), **confirming Hypothesis I-1**. Both effects are statistically significant at the 10% level and economically large.[37] Both the financial inclusion and financial deepening effects correspond to an increase of about 50% (0.17 sd.) compared to the control group mean. The amount of mobile loans the control firms had at baseline was about 30 US$ (3106 Kenyan Shillings), which LPN increased by 57% (that is, an additional 17 US$, or 1763 Kenyan Shillings). Importantly, there is no contraction in any of the other sources of external finance, neither formal nor informal (see columns 3 and 4), implying that LPN unambiguously improved access to finance.

How does LPN increase access to and amount of mobile loans? In Section 4.2.1, we hypothesized that LPN can increase merchants' financial transparency and hence their credit score, thus improving their access to and amount of mobile loans. In brief, a merchant

in adopting LPN.

[36] To take into account the businesses that did not borrow any money, the intensive margin is measured by computing the inverse hyperbolic sine transformation (IHS) of the borrowed amount. Since we use the IHS, the interpretation of the intensive margin also includes the extensive margin. Loan amounts are winsorized at 5% level.

[37] The effects are bigger and statistically significant at the 5% level if we only include our strata dummies and the lagged dependent variable as controls (see Table OA7A in the Online Appendix).

with LPN is more likely to receive electronic payments than one without. When the merchant wants to cash out the digital money received via LPN, she needs to make a transfer (free of charge) from her LPN account to her personal M-Pesa account, as LPN does not allow for direct conversion of digital money to cash. This transfer increases the volume and number of transactions in her M-Pesa account, and hence, her credit score when obtaining mobile loans.

We test this channel in two ways (see Table 6B). With respect to the extensive margin loan access, we estimate an IV-Probit, where in the first stage we estimate the impact of treatment assignment on LPN sales and in the second stage we estimate the effect of LPN sales on extensive margin mobile loans. We implement the same procedure for the intensive margin estimating a 2SLS method. Both IV-Probit and 2SLS regressions show that LPN sales cause an expansion in mobile loans for both the extensive margin (with $p < 0.05$; see column 2 of Table 6B) and the intensive margin (see column 4 of Table 6B) although this effect just fails to be significant (with $p = 0.12$). In addition, we also estimate the effect of having an LPN account on LPN sales, using treatment assignment as an instrument. Again we find a positive and significant impact, as shown in Table OA5F in the Online Appendix. Consistent with the increase in LPN sales, treated firms also increase record keeping via LPN and keeping records via LPN increases mobile loans at the extensive and intensive margins (see Table 6C).

Besides transferring the money from her LPN account to her personal M-Pesa account, the merchant can also use the money in her LPN to pay bills, salaries or inputs. However, as Tables OA5D-OA5E show, this is not what seems to happen: treated firms are *not* more likely to pay business expenses with LPN. So effectively, what treated firms do is to transfer the digital money in LPN to their personal M-Pesa account and improve their credit score.

One potential alternative mechanism consistent with LPN increasing access to mobile loans is that LPN strengthened the merchants' trust in Safaricom or affected their attitudes towards digital sophistication. While we do not have the data to rule this out, we do not think of it as a plausible mechanism. The vast majority of the merchants in our study were using M-Pesa at baseline (and hence were already customers of Safaricom), and using LPN is not technically different from using M-Pesa. So it is unlikely that LPN would have

changed trust or digital sophistication, as it is just an additional feature of a digital system already provided by Safaricom.

If LPN increases access to mobile loans because it resolves financial opacity and information constraints, we should expect that the impact of LPN on both the extensive and intensive margin of mobile loans is stronger for smaller firms. Defining a business as small if its baseline number of employees is lower than the median number of employees in the respective sector, we find that that LPN increases the probability of receiving a loan as well as the size of the loan more for smaller firms than for larger firms (see Table 6D). This result is consistent with the literature that argues that smaller establishments likely suffer more from credit market exclusion because of financial opacity. For instance, the literature on relationship-lending suggests that extending loans to small and non-transparent businesses requires the build-up of soft information and trust and therefore necessitates either the formation of long-term bank-firm relations (Petersen and Rajan, 1994; Berger and Udell, 1995; Degryse and Cayseele, 2000 and Beck et al., 2018), or close monitoring of financial operations (Norden and Weber, 2010). Indeed, the latter study shows how monitoring checking account activity and credit line usage can help bankers to assess the creditworthiness of potential borrowers. We thus find that an e-payment technology, such as LPN, can help to prove creditworthiness and thereby allow for fast and low-cost access to external finance to compensate short-term liquidity needs.

A potential alternative interpretation consistent with LPN being more effective in helping smaller firms to get mobile loans, is that small firms are less likely to know about mobile loans, so access to LPN comes hand in hand with knowledge about the existence of mobile loans. While we do not have baseline data on mobile loans knowledge, we have good reasons to believe that most merchants, small or not, are likely to be aware of M-Shwari (mobile) loans. This is because the option of "M-Shwari" appears very visibly in the main menu of the personal M-Pesa account as the drop-down menu presented in Online Appendix Figure 1 illustrates (see Cook and McKay, 2015, p. 4).

Next, there is a literature suggesting that access to formal loans (such as mobile loans in our analysis) can work as a signalling device for creditworthiness and enhance access to informal loans as well (see e.g., Demirguc-Kunt and Maksimovic, 2001; Burkart and

Ellingsen, 2004 and Burkart et al., 2011). Consistent with this literature, Table 6D shows that LPN also stimulated small businesses' informal finance, such as loans from informal financial networks (Panel B, column 3).

Table 6E shows the impact of LPN on *aggregate* loans, at both the extensive and intensive margin. The extensive margin of having overall access to loans is captured by a dummy equal to one if the firm received a loan (whether it was an informal loan, a bank loan, trade credit or a mobile loan) over the last 12 months, and zero otherwise. Similarly, we define the intensive margin of aggregate loans as the total amount of informal loans, mobile loans, bank loans and trade credit received over the last 12 months. We observe that although the treatment dummy itself is not significant, the interaction term "Small x Treated" shows up significantly as a determinant of both the extensive and intensive margin. Together with the results in Table 6D, this implies that LPN improves the overall financial connectedness for especially the smaller firms.

Finally, given that the increase in financial connectedness caused by LPN is more pronounced for smaller firms, we test whether smaller firms are more likely to adopt and use LPN. To answer this question, we look at heterogeneous treatment effects (HTEs) using both the adoption and use of LPN as dependent variables. The results are presented in Table OA5C. We find that larger and smaller firms are both equally likely to adopt LPN, and the same holds for its usage. A plausible reason is that while smaller firms gain disproportionately in terms of mobile loan access, larger firms may also have relative advantages from adopting LPN compared to small firms in other domains. For example, larger firms have larger cash volumes and therefore they are likely to have more to lose from cash theft. As we will show below, our data is consistent with this. This result, in combination with the heterogeneous effect of LPN on mobile loan access by firm size, suggests that both large and small firms benefit from electronic payment adoption - but for different reasons.

Business Sales, Profits, Investment and Expenses (Levels)

As shown in Table 7, LPN does not affect sales of treated firms (column 1), neither in smaller nor in bigger ones (column 2), and hence we **reject Hypothesis I-2**. The lack of an effect on sales can be explained by at least two reasons. First, the study is

conducted in the peripheral neighborhoods of Nairobi where customers' loyalty towards merchants is expected to be high. Second, the closest business in the same sector is at least 50 meters away from any of the merchants listed for this study, which reduces the possibility of spillovers.[38]

Next, we also find that total investments were unaffected by the treatment (Table 8A, column 1), and the same holds for expenses (Tables 8B and 8C) and profits (neither for the average firm nor for small versus large firms; see Table 7, columns 7 and 8, respectively). Furthermore, we also do not observe a change in interest expenses, despite adoption of LPN resulted in an increase in the amount borrowed.[39] So, overall we **cannot confirm Hypothesis I-4**.

However, the heterogeneous treatment effects regarding firm size yield interesting results with respect to total investments (in column 2 of Table 8A) and input expenses (in column 1 of Table 8C). **Confirming Hypothesis I-5**, in both regressions the coefficients on the "small x treatment" interaction terms are negative and statistically significant. The fact that these two variables are affected in the same direction (and thus turn out to be complementary) is not surprising. As input purchases go down, the merchant needs less shelf space and/or refrigeration capital to store the merchandise. Such joint contraction of inputs and capital is consistent with the model in Appendix A. In developing countries, liquidity constraints induce merchants to engage in precautionary savings and investments. Keeping *extra* merchandise in the store could be part of such precautionary motives. Once additional liquidity becomes available (in this case through improved access to mobile loans), precautionary motives become less relevant. Relatedly, note that there is no treatment-

[38] In Online Appendix Table OA12 we check whether those businesses which are located in relatively denser areas, as measured in terms of the number of customers by the time of the baseline, stand to gain in terms of sales. We argued that peripheral neighborhoods as in our study are not likely to create an environment which would allow for customer switches across shops due to LPN adoption, which might be the reason for why we did not capture an impact on sales. Customer loyalty and distance between shops are two common features of rural Africa. Having said this, there may be some degree of geographic heterogeneity, and some locations may exhibit larger customer pools than others. We check in Table OA12 whether baseline customer base could be an important channel to induce a treatment effect on sales (possibly due to allowing for customer switches), but we do not detect an effect either.

[39] That we do not detect treatment effects on interest expenses may be related to the relatively low fees charged on mobile loans. Banerjee and Duflo (2010) provide references regarding the interest payments incurred by relatively lower income households/firms. For instance, in the context of India and in informal financial markets, Banerjee and Duflo (2010, p. 65) state that the average interest rate firms pay on (informal) loans is about 57% per year, while formal banks charge 20% annual interest rates.

induced reduction in the levels of sales and profits for small firms, despite the decrease in investments (Table 8A) and input purchases (Table 8C). The observed reductions in investments thus did not reduce business performance, suggesting that these investments were of a precautionary (rather than of a productive) nature. This is in line with the prediction of our model that improved access to finance reduces the need for precautionary savings and investments (see Results 8 and 9 in Appendix A).

Business Sales and Profits (Volatility)

Hypothesis I-3 states that mobile loans should help businesses cope with cyclical shocks, which should reduce the volatility of sales, particularly in smaller firms that are likely to be liquidity constrained. This is also the prediction of the model in Appendix A. To test this hypothesis, we estimate eq. (2) using sales volatility as the dependent variable, measured as the difference between the log maximum and log minimum sales over the past 12 months (i.e., $ln(Sales_{max}) - ln(Sales_{min})$). Table 7 (columns 4 and 6) presents the results.

As shown in Table 7, LPN reduces sales volatility for small businesses, but not for larger firms.[40] This result complements findings by Jack and Suri (2014) who show that personal M-Pesa helps smooth household consumption by allowing easy access to liquidity whenever funds are needed. Our research shows that an analogous effect exists for SMEs. However, we cannot confirm a treatment effect on the volatility of profits. This could be due to the dynamics in the volatility in business expenses. Unfortunately, our survey does not contain a question to measure the volatility of business expenses, and hence we cannot test whether this is indeed the reason why we fail to find a significant reduction in profit volatility.

A significant impact of LPN on sales volatility and a non-significant impact on sales themselves are jointly consistent with the model presented in Appendix A. The model shows that the indirect effect of LPN through mobile loan access on sales volatility is predicted to be more pronounced than its effect on the level of sales (Result 5 in Appendix A). This is because mobile loans are designed (first and foremost) to cope with short-run fluctuations, with secondary repercussions for the level of business performance.

[40]Since there is a limited number of businesses in column 3 due to missing baseline values for sales volatility, columns 5 and 6 of Table 7 provide a robustness check and test the sensitivity of our findings with respect to replacing those missing values using average monthly sales data.

Business Safety

Table 9A presents the results of using eq. (2) to estimate the impact of LPN on perceived safety, as proxied by the response to "feeling more safe when conducting business operations" (with 1 reflecting "feeling very insecure" and 10 indicating "feeling very secure"). To study plausible heterogeneous effects of LPN on perceived safety, we split the sample in two types of sub-groups. We first look at the subsample of firms that reported having experienced external theft six months previous to our intervention (Table 9B, column 1). We find that the treatment improves these firms' perceived safety (a 17.8% increase compared to the control group, or 0.58 sd.), **confirming Hypothesis I-6**. Next, we look at heterogenous effects on perceived safety by firm size (Table 9C) among firms which experienced theft prior to our intervention. The coefficient on the interaction term (small x treatment) is large and of the opposite sign of the overall treatment coefficient, but it is too noisy to be significant. Strictly speaking we thus find no heterogeneous treatment effect for firm size on safety, but the results do suggest that bigger firms gain more in terms of perceived safety. This is consistent with the argument that larger firms, with larger cash-flows, have more to lose from cash theft compared to their smaller counterparts.

6.2.4 Robustness of Results and Mechanisms

Randomization Inference. As a robustness check of our main results, we perform randomization inference (Fisher, 1935; Rosenbaum, 2002) using 1000 runs to test the robustness of the each of the results presented in Tables 5A and 6A. As shown in Table OA13, the significance levels obtained using randomization inference are very close to those of the main estimates. Our results are therefore robust to using this alternative method of detecting impact.

Spillovers. While we minimized spillovers by focusing on the periphery of central Nairobi and by requiring a minimum geographical distance between firms, spillovers may still be present in the study. We consider two types of spillovers. First, the possibility that treatment firms induce, directly or indirectly, LPN adoption and usage by control firms. While this type of spillovers would not affect internal validity of our study, it would reduce the differential take-up rate between treatment and control, affecting the statistical

power to detect an effect. From a policy perspective, spillovers on adoption are relevant as they would allow us to understand whether LPN naturally diffuses once it is randomly introduced to some firms. Second, we test for possible spillovers affecting mobile loan uptake and usage. If we find evidence of positive spillovers in this analysis, the treatment impact we reported is an underestimate of the true effect of LPN on financial access.

We perform both types of analyses using two different specifications. First, in the spirit of Miguel and Kremer (2004) we focus only on the control group firms and use the density of treated firms within a 500 m radius of each of the control firms as the independent variable; in the second specification, the independent variable is the distance to the nearest treatment firm. In addition, we consider spillovers between firms within the same sector, and also between firms from different sectors. We run these analyses separately for restaurants (Tables 10A and 10B) and pharmacies (Tables 11A and 11B). As can be inferred from these four tables, all coefficients are economically very small and statistically insignificant for both proximity measures, for within- and between-sector spillovers, and for both the extensive and intensive margins. We therefore conclude that we find no evidence of spillovers in our sample.

The Stable Unit Treatment Value Assumption (SUTVA). Treatment estimates are unbiased if firms in the treatment and control group only differ in the treatment they received. In what follows, we discuss two potential sources of SUTVA violations in our context, and also the extent to which such potential violations can challenge the identification of the causal effects we find. First, SUTVA might be violated if Safaricom's marketing office targeted the control group after our intervention. This is unlikely to have happened, as Safaricom did not know which firms were included in the RCT and hence which firms were in the treatment and control group. So, by design, it is not possible for Safaricom to differentiate their marketing strategy based on treatment assignment. In addition, as far as we are aware of, rather than targeting individual firms, Safaricom used public marketing campaigns that reached the general population of firms equally (e.g., streets and media ads). Hence, we are confident that the control firms did not have more exposure to Safaricom marketing campaigns than the treated firms.

The second potential source of SUTVA violations comes from "reversed" spillovers, from

control to treatment firms. To address this concern, we tested whether firms assigned to treatment were more likely to adopt LPN when they are located closer to firms in control. Similar to the results about spillovers from treatment firms to control firms, we do not find any evidence of the reverse either (see Online Appendix Tables OA14A-B and OA15A-B). The only coefficient that shows up significantly is "distance to the nearest control restaurant" in the analysis of LPN uptake and usage by treatment restaurant (see columns (2) and (4) of Table OA14A). However, note that this coefficient is positive, suggesting that the *further away* the nearest control restaurant is, the higher the likelihood of a treatment restaurant accepting to have an LPN account opened on their behalf. Given the fact that all other coefficients in Tables OA14A-OA15B are economically small and statistically insignificant, we conclude that we find no evidence of reversed spillovers either in our sample.

7 Conclusions

This paper is one of the first to use a Randomized Controlled Trial to study both e-payment adoption and impact among firms. On adoption, we find causal evidence that information, transaction and know-how barriers affect interest in and adoption of the technology. Moreover, we find that financial transparency concerns of the business owner is negatively associated with the interest in the technology and its usage. On impact, we find that adoption of the e-payment instrument improves access to finance through mobile loans, both at the extensive and intensive margin. The impact on mobile loan usage is especially pronounced for small-size establishments, which also improve access to other sources of finance and a reduction in their sales volatility and precautionary investment.

Overall, our results on adoption and impact together suggest that the electronic visibility of business transactions is a double-edged sword. On the one hand, it can impede the adoption of e-payment instruments among business owners who prefer to keep transactions anonymous. However, if the technology is adopted, electronic visibility has a positive impact on financial integration. This lesson is likely to apply not just for the case of LPN and Kenya, but for other e-payment technologies in other countries, since allowing visibility

of transactions is an inherent general feature of electronic payment technologies.

Our paper opens new avenues for future research. First, while we show that information, transaction and know-how barriers together impede the adoption of the technology, it would be interesting to disentangle the relative importance of each of these barriers. We also show that a formal barrier to adopt the technology is having a business license. We highlight that remaining unlicensed comes with an additional cost of staying out of the mobile credit market. A study of the preferences of and potential barriers to SMEs becoming licensed would be an important contribution, especially when taking into account the benefits of mobile money technologies offer, as documented in this paper.

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Tables

Table 1: Businesses Characteristics and Balance Tests: Full Sample

	All (1)	Control (2)	Treatment (3)	Diff. (4)
Standard Mobile Money Use				
Use Mobile Money for business purposes (Yes=1; No=0)	0.51	0.49	0.53	-0.04
Use Mobile Money to receive payments (Yes=1; No=0)	0.33	0.30	0.36	-0.05*
Use Mobile Money to store money (Yes=1; No=0)	0.18	0.18	0.17	0.01
Use Mobile Money to pay bills (Yes=1; No=0)	0.32	0.32	0.32	0.01
Use Mobile Money to pay salaries (Yes=1; No=0)	0.06	0.05	0.06	-0.02
Use Mobile Money to pay inputs (Yes=1; No=0)	0.38	0.37	0.38	-0.01
Awareness of Lipa Na M-Pesa and Reasons for not Having an Account				
The business is aware of Lipa Na M-Pesa (Yes=1; No=0)	0.95	0.95	0.96	-0.00
The business has Lipa Na M-Pesa (Yes=1; No=0)	0.09	0.07	0.10	-0.03
The business does not see the benefits of Lipa Na M-Pesa (Yes=1; No=0)	0.26	0.27	0.25	0.02
The cost of opening a Lipa Na M-Pesa account is too high (Yes=1; No=0)	0.11	0.11	0.11	-0.00
The transaction fees via Lipa Na M-pesa are too high (Yes=1; No=0)	0.16	0.16	0.16	-0.00
The business owner does not have time to open an account (Yes=1; No=0)	0.12	0.12	0.11	0.01
Lipa Na M-Pesa would not increase sales (Yes=1; No=0)	0.08	0.07	0.08	-0.01
The business owner does not trust the mobile money provider (Yes=1; No=0)	0.02	0.02	0.03	-0.00
Lipa Na M-Pesa is too complex to use (Yes=1; No=0)	0.10	0.09	0.11	-0.02
Business Size				
Monthly Sales, in 1000 Ksh. (winsorized 5%)	245.26	237.14	253.06	-15.92
Monthly Profits, in 1000 Ksh. (winsorized 5%)	71.13	68.36	73.79	-5.43
Number of employees	4.91	4.88	4.94	-0.05
Investment and Access to Finance				
Investment in the past 6 months (Yes=1; No=0)	0.29	0.30	0.28	0.02
Bank loan in the past 12 months (Yes=1; No=0)	0.10	0.09	0.11	-0.02
Informal loan in the past 12 months (Yes=1; No=0)	0.04	0.03	0.04	-0.00
Mobile loan in the past 12 months (Yes=1; No=0)	0.10	0.10	0.11	-0.01
Informality				
The business has a business license (Yes=1; No=0)	0.72	0.72	0.72	0.00

Notes: This table presents summary statistics for the baseline survey data of the full sample of restaurants and pharmacies. Columns 1, 2 and 3 show mean values for the full sample, control group, and treatment group respectively. Column 4 presents p-values for equality-of-means tests between treatment and control groups. * p<0.10, ** p<0.05, *** p<0.01. *Monthly Sales* is the log of the total revenues in the past month; *Monthly Profits* is the log of the total income earned in the past month after paying all expenses; *Number of Employees* is the log of the total number of employees plus the owner; *Investment* is the total capital invested for business purposes; *Bank Loans = 1* if the business ever received a new loan from a commercial bank, SACCO, or other formal financial institution in the last 12 months; *Informal Loans = 1* if the the business borrowed money from any business association, moneylender, family or friend in the last 12 months; *Mobile loan = 1* if the business or business owners borrowed money from Mobile Microfinance sources like KCB-Mpesa, M-Kesha and M-Shwari in the last 12 months. The other variables are self-explanatory.

Table 2: Business Characteristics and Balance Test: Sub-sample of **Merchants with Business License**

	All	Control	Treatment	Diff.
	(1)	(2)	(3)	(4)
Standard Mobile Money Use				
Use Mobile Money for business purposes (Yes=1; No=0)	0.52	0.49	0.55	-0.06*
Use Mobile Money to receive payments (Yes=1; No=0)	0.35	0.3	0.4	-0.1***
Use Mobile Money to store money (Yes=1; No=0)	0.15	0.16	0.14	0.01
Use Mobile Money to pay bills (Yes=1; No=0)	0.35	0.33	0.38	-0.05
Use Mobile Money to pay salaries (Yes=1; No=0)	0.06	0.04	0.08	-0.03**
Use Mobile Money to pay inputs (Yes=1; No=0)	0.39	0.38	0.41	-0.02
Awareness of Lipa Na M-Pesa and Reasons for not Having an Account				
The business is aware of Lipa Na M-Pesa (Yes=1; No=0)	0.97	0.97	0.96	0.01
The business has Lipa Na M-Pesa (Yes=1; No=0)	0.11	0.1	0.12	-0.02
The business does not see the benefits of Lipa Na M-Pesa (Yes=1; No=0)	0.25	0.26	0.24	0.02
The cost of opening a Lipa Na M-Pesa account is too high (Yes=1; No=0)	0.13	0.13	0.13	-0.01
The transaction fees via Lipa Na M-pesa are too high (Yes=1; No=0)	0.20	0.20	0.20	0.0
The business owner does not have time to open an account (Yes=1; No=0)	0.12	0.13	0.11	0.02
Lipa Na M-Pesa would not increase sales (Yes=1; No=0)	0.09	0.07	0.1	-0.03
The business owner does not trust the mobile money provider (Yes=1; No=0)	0.03	0.03	0.03	0
Lipa Na M-Pesa is too complex to use (Yes=1; No=0)	0.1	0.09	0.11	-0.02
Business Size				
Monthly Sales, in 1000 Ksh. (winsorized 5%)	271.35	263.75	278.62	-14.87
Monthly Profits, in 1000 Ksh. (winsorized 5%)	79.76	76.79	82.61	-5.82
Number of employees	5.10	5.02	5.17	-0.15
Investment and Access to Finance				
Investment in the past 6 months (Yes=1; No=0)	0.29	0.3	0.28	0.02
Bank loan in the past 12 months (Yes=1; No=0)	0.08	0.07	0.1	-0.02
Informal loan in the past 12 months (Yes=1; No=0)	0.04	0.04	0.03	0
Mobile loan in the past 12 months (Yes=1; No=0)	0.09	0.08	0.09	-0.01
Informality				
The business has a business license (Yes=1; No=0)	1	1	1	0

Notes: This table presents summary statistics for the baseline survey data of the sub-sample of restaurants and pharmacies with a business license at baseline. Column 1 presents the sample's overall mean value, column 2 provides the average values for the control group and column 3 for the treatment group. Column 4 presents p-values for the equality-of-means-tests between treatment and control groups. * p<0.10. ** p<0.05. *** p<0.01. For a description of all variables, see the notes in Table 1.

Table 3A: Willingness to Open an LPN Account: **All Businesses** Assigned to Treatment

Panel A: Standard M-Money Use	Use for business	0.138***	(0.044)							0.138***	(0.044)
	Receive payments			0.094*	(0.053)			0.075	(0.052)		
	Store money			0.093	(0.064)			0.065	(0.063)		
	Pay bill			-0.073	(0.057)			-0.060	(0.057)		
	Pay input			0.123**	(0.056)			0.121**	(0.057)		
	Pay salaries			-0.025	(0.092)			-0.035	(0.090)		
	Saving in mob. mon. account					-0.048	(0.074)				
	% of utility exp. via pers. mob.					-0.090	(0.057)				
	% of input exp. via pers. mob.					0.241***	(0.080)				
	Paying wages via mpesa					-0.023	(0.118)				
	No surcharge to mobile payments					0.203***	(0.061)				
Panel B: Safety	Theft and safety	0.023	(0.022)							0.025	(0.022)
	Internal theft			0.012	(0.054)	-0.004	(0.062)	0.017	(0.055)		
	External theft, fire, etc.			0.040	(0.079)	0.088	(0.080)	0.038	(0.076)		
	Feeling safe			-0.008	(0.012)	-0.009	(0.014)	-0.003	(0.012)		
Panel C: Saving Behavior	Saving at a bank or micro.	-0.032	(0.048)								
	Saving at a pers. bank acc.			0.029	(0.048)	0.031	(0.054)	0.048	(0.048)		
	Saving at a bus. bank acc.			-0.189***	(0.068)	-0.191**	(0.075)	-0.160**	(0.067)		
	Saving at a microf. inst.			-0.031	(0.122)	0.044	(0.136)	-0.018	(0.126)		
Panel D: Visibility	Business license	0.041	(0.054)	0.034	(0.058)	0.099	(0.067)	0.046	(0.057)	0.040	(0.054)
	Financial Sophistication	0.021	(0.020)								
	Final Sophistication Alternative									0.006	(0.022)
	Bank loan			0.054	(0.061)	-0.027	(0.072)	0.090	(0.063)		
	Mobile loan			0.022	(0.075)	0.064	(0.080)	-0.019	(0.078)		
	Business records			0.083	(0.064)	0.068	(0.072)	0.075	(0.064)		
	Sells on credit to cust.	0.058	(0.042)	0.048	(0.041)	0.062	(0.046)	0.039	(0.041)	0.063	(0.041)
	Not shared sales	-0.136**	(0.068)	-0.150**	(0.069)			-0.161**	(0.069)	-0.133*	(0.069)
	Not shared profits					-0.213***	(0.074)				
Panel E: Behavioral Factors	Present bias	0.026	(0.071)	0.054	(0.069)	0.045	(0.078)	0.033	(0.070)	0.028	(0.071)
	Future Orientation	-0.022	(0.054)	-0.000	(0.055)	-0.022	(0.058)	-0.009	(0.055)	-0.021	(0.054)
	# of digits remembered	0.031*	(0.017)	0.028*	(0.017)	0.040**	(0.020)	0.027	(0.017)	0.031*	(0.017)
	Trust in strangers	-0.025	(0.025)	-0.037	(0.025)	-0.015	(0.029)	-0.039	(0.025)	-0.024	(0.025)
	Trust in customers	0.018	(0.034)	0.020	(0.034)	0.006	(0.038)	0.021	(0.033)	0.018	(0.034)
	Trust in courts	-0.046*	(0.026)	-0.035	(0.028)	-0.048*	(0.029)	-0.025	(0.027)	-0.044*	(0.026)
	Trust in mob. mon. comp.	0.042	(0.035)	0.042	(0.035)	0.030	(0.038)	0.031	(0.036)	0.043	(0.035)
Panel F: Business size	log(Employees)	0.046	(0.069)	0.097	(0.069)			0.086	(0.071)	0.044	(0.070)
	log(Sales,monthly, win. 5%)	0.037	(0.030)	0.056*	(0.029)			0.037	(0.029)	0.033	(0.029)
	log(Profits, monthly, win. 5%)					0.024	(0.032)				
Panel G: Reasons of not opening a Lipa na M-pesa account	Not seeing the benefits of Lipa Na M-Pesa							-0.096*	(0.052)		
	Too costly to open an account							-0.095	(0.073)		
	High transaction fees via Lipa Na M-pesa							-0.038	(0.066)		
	Don't have time to open an account							0.156**	(0.061)		
	Would not increase my sales							-0.128*	(0.076)		
	No trust in mobile money provider							-0.022	(0.110)		
	Too complex to use							-0.016	(0.069)		
Enumerator and district FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		493		490		392		490		493	
R-squared		0.284		0.316		0.350		0.339		0.282	

Notes: This table presents the coefficient estimates resulting from estimating the following equation: $Y_i = \beta_0 + X_i^{'}\beta_1 + \epsilon_i$, where Y_i is a dummy that equals 1 if business i answered YES to our offer to open an LPN account, and equals zero otherwise. X_i is a vector of co-variates grouped in different categories labelled in each panel, and ϵ_i is the error term. Restaurants and pharmacies are pooled. A description of each co-variate can be found in the Online Appendix, Tables OA1 and OA2. We report robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 3B: Willingness to Open an LPN Account: **Restaurants** Assigned to Treatment

Panel A: Standard M-Money Use	Use for business	0.161**	(0.066)							0.163**	(0.065)
	Receive payments			0.050	(0.074)			0.028	(0.074)		
	Store money			0.038	(0.082)			-0.008	(0.080)		
	Pay bill			-0.038	(0.074)			-0.042	(0.072)		
	Pay input			0.198**	(0.079)			0.210***	(0.078)		
	Pay salaries			-0.069	(0.122)			-0.074	(0.123)		
	Saving in mob. mon. account					-0.054	(0.094)				
	% of utility exp. via pers. mob.					0.002	(0.087)				
	% of input exp. via pers. mob.					0.262**	(0.104)				
	Paying wages via mpesa					-0.053	(0.185)				
	No surcharge to mobile payments					0.153*	(0.079)				
Panel B: Safety	Theft and safety	0.018	(0.027)							0.019	(0.027)
	Internal theft			0.029	(0.062)	0.011	(0.077)	0.031	(0.062)		
	External theft, fire, etc.			-0.017	(0.095)	0.045	(0.099)	-0.030	(0.094)		
	Feeling safe			-0.004	(0.017)	0.001	(0.021)	-0.004	(0.017)		
Panel C: Saving Behavior	Saving at a bank or micro.	0.033	(0.067)								
	Saving at a pers. bank acc.			0.077	(0.070)	0.122	(0.082)	0.095	(0.070)		
	Saving at a bus. bank acc.			-0.121	(0.105)	-0.093	(0.120)	-0.080	(0.104)		
	Saving at a microf. inst.			-0.033	(0.122)	0.052	(0.172)	-0.024	(0.137)		
Panel D: Visibility	Business license	0.017	(0.063)	0.011	(0.071)	0.074	(0.085)	0.014	(0.069)	0.018	(0.063)
	Financial Sophistication	0.022	(0.026)								
	Final Sophistication Alternative									0.022	(0.030)
	Bank loan			0.017	(0.081)	-0.062	(0.103)	0.044	(0.082)		
	Mobile loan			0.064	(0.095)	0.169	(0.116)	-0.008	(0.098)		
	Business records			0.074	(0.080)	0.045	(0.093)	0.071	(0.081)		
	Sells on credit to cust.	0.093	(0.061)	0.099	(0.062)	0.088	(0.071)	0.096	(0.062)	0.095	(0.061)
	Not shared sales	-0.107	(0.129)	-0.083	(0.131)			-0.134	(0.127)	-0.107	(0.128)
	Not shared profits					-0.164	(0.178)				
Panel E: Behavioral Factors	Present bias	-0.018	(0.106)	0.015	(0.100)	0.049	(0.116)	-0.003	(0.099)	-0.016	(0.105)
	Future orientation	0.097	(0.077)	0.113	(0.079)	0.097	(0.093)	0.077	(0.078)	0.096	(0.078)
	# of digits remembered	0.023	(0.024)	0.025	(0.024)	0.035	(0.029)	0.019	(0.024)	0.022	(0.023)
	Trust in strangers	-0.048	(0.039)	-0.069*	(0.039)	-0.043	(0.048)	-0.078**	(0.039)	-0.048	(0.039)
	Trust in customers	0.071	(0.047)	0.061	(0.048)	0.036	(0.058)	0.053	(0.047)	0.072	(0.047)
	Trust in courts	-0.060	(0.037)	-0.052	(0.039)	-0.060	(0.046)	-0.029	(0.040)	-0.060*	(0.036)
	Trust in mob. mon. comp.	-0.013	(0.051)	-0.010	(0.054)	-0.036	(0.059)	-0.032	(0.058)	-0.012	(0.051)
Panel F: Business size	log(Employees)	0.043	(0.085)	0.087	(0.086)			0.071	(0.090)	0.043	(0.085)
	log(Sales,monthly, win. 5%)	0.061	(0.040)	0.057	(0.040)			0.037	(0.040)	0.062	(0.039)
	log(Profits, monthly, win. 5%)					0.017	(0.042)				
Panel G: Reasons of not opening a Lipa na M-pesa account	Not seeing the benefits of Lipa Na M-Pesa							-0.120	(0.082)		
	Too costly to open an account							0.012	(0.150)		
	High transaction fees via Lipa Na M-pesa							-0.040	(0.118)		
	Don't have time to open an account							0.136*	(0.075)		
	Would not increase my sales							-0.342***	(0.116)		
	No trust in mobile money provider							-0.177	(0.302)		
	Too complex to use							-0.039	(0.090)		
Enumerator and district FE		Yes		Yes		Yes		Yes		Yes	
Observations		277		276		214		276		277	
R-squared		0.211		0.249		0.281		0.293		0.210	

Notes: This table runs same specifications described in Table 3A but with the sub-sample of restaurants only. * p<0.10, ** p<0.05, *** p<0.01.

Table 3C: Willingness to Open an LPN Account: **Pharmacies** Assigned to Treatment

Panel A: Standard M-Money Use	Use for business	0.116**	(0.059)							0.121**	(0.059)
	Receive payments			0.132	(0.084)			0.096	(0.095)		
	Store money			0.167	(0.144)			0.142	(0.134)		
	Pay bill			-0.057	(0.094)			0.010	(0.111)		
	Pay input			0.053	(0.091)			0.017	(0.106)		
	Pay salaries			0.095	(0.174)			0.066	(0.172)		
	Saving in mob. mon. account					-0.229**	(0.088)				
	% of utility exp. via pers. mob.					-0.155*	(0.082)				
	% of input exp. via pers. mob.					0.161	(0.138)				
	Paying wages via mpesa					0.073	(0.201)				
	No surcharge to mobile payments					0.225**	(0.113)				
Panel B: Safety	Theft and safety	0.037	(0.052)							0.039	(0.053)
	Internal theft			-0.022	(0.124)	-0.078	(0.129)	-0.016	(0.128)		
	External theft, fire, etc.			0.179	(0.171)	0.039	(0.150)	0.102	(0.166)		
	Feeling safe			-0.005	(0.020)	-0.035	(0.023)	-0.002	(0.021)		
Panel C: Saving Behavior	Saving at a bank or micro.	-0.106	(0.075)								
	Saving at a pers. bank acc.			-0.038	(0.080)	-0.040	(0.085)	-0.030	(0.082)		
	Saving at a bus. bank acc.			-0.237**	(0.091)	-0.192*	(0.106)	-0.217**	(0.100)		
	Saving at a microf. inst.			-0.097	(0.212)	-0.099	(0.187)	-0.100	(0.202)		
Panel D: Visibility	Business license	-0.024	(0.133)	-0.016	(0.140)	0.080	(0.168)	0.001	(0.138)	-0.044	(0.134)
	Financial Sophistication	0.034	(0.038)								
	Final Sophistication Alternative									-0.015	(0.032)
	Bank loan			0.098	(0.127)	0.028	(0.121)	0.169	(0.131)		
	Mobile loan			0.017	(0.150)	-0.126	(0.123)	0.012	(0.168)		
	Business records			0.172**	(0.083)	0.199	(0.130)	0.163**	(0.077)		
	Sells on credit to cust.	0.006	(0.061)	-0.008	(0.061)	0.038	(0.068)	-0.020	(0.060)	0.015	(0.060)
	Not shared sales	-0.173**	(0.083)	-0.221**	(0.089)			-0.211**	(0.089)	-0.180**	(0.084)
	Not shared profits					-0.261***	(0.086)				
Panel E: Behavioral Factors	Present bias	0.086	(0.126)	0.082	(0.119)	0.065	(0.135)	0.093	(0.121)	0.096	(0.129)
	Future orientation	-0.197***	(0.076)	-0.182**	(0.079)	-0.164**	(0.076)	-0.167**	(0.083)	-0.189**	(0.076)
	# of digits remembered	0.045	(0.028)	0.040	(0.028)	0.058*	(0.031)	0.041	(0.027)	0.052*	(0.028)
	Trust in strangers	-0.015	(0.036)	-0.011	(0.038)	-0.010	(0.039)	-0.007	(0.037)	-0.017	(0.036)
	Trust in customers	-0.074	(0.063)	-0.057	(0.062)	-0.072	(0.060)	-0.051	(0.061)	-0.071	(0.061)
	Trust in courts	-0.034	(0.041)	-0.029	(0.044)	-0.058	(0.045)	-0.039	(0.043)	-0.032	(0.041)
	Trust in mob. mon. comp.	0.101**	(0.051)	0.094*	(0.052)	0.106**	(0.053)	0.094*	(0.054)	0.099*	(0.052)
Panel F: Business size	log(Employees)	0.140	(0.131)	0.182	(0.133)			0.136	(0.140)	0.160	(0.135)
	log(Sales,monthly, win. 5%)	0.023	(0.049)	0.063	(0.051)			0.054	(0.052)	0.009	(0.048)
	log(Profits, monthly, win. 5%)					0.064	(0.061)				
Panel G: Reasons of not opening a Lipa na M-pesa account	Not seeing the benefits of Lipa Na M-Pesa							-0.076	(0.085)		
	Too costly to open an account							-0.170*	(0.096)		
	High transaction fees via Lipa Na M-pesa							-0.081	(0.082)		
	Don't have time to open an account							0.176	(0.144)		
	Would not increase my sales							-0.088	(0.110)		
	No trust in mobile money provider							-0.147	(0.139)		
	Too complex to use							0.062	(0.128)		
Enumerator and district FE		Yes		Yes		Yes		Yes		Yes	
Observations		216		214		178		214		216	
R-squared		0.169		0.218		0.288		0.262		0.160	

Notes: This table runs same specifications described in Table 3A but with the sub-sample of pharmacies only. * p<0.10, ** p<0.05, *** p<0.01.

Table 4: Business Attrition

Baseline characteristics	(1) coef	(2) se	(3) coef	(4) se
Assigned Treatment	-0.012	(0.031)	-0.010	(0.031)
Pharmacy	-0.018	(0.031)	-0.145***	(0.044)
Has an LPN account			-0.129***	(0.049)
Saves in mobile money			-0.032	(0.062)
Pays % of utility exp. via m-money			-0.029	(0.038)
% of input exp. via stand. m-money			-0.002	(0.022)
Paying wages via m-money			0.036	(0.034)
Internal theft			-0.007	(0.044)
External theft			-0.117**	(0.053)
Feeling safe			0.001	(0.009)
Saving at a pers. bank acc.			-0.059	(0.036)
Saving at a bus. bank acc.			0.014	(0.040)
Saving at a microf. inst.			0.030	(0.124)
Bank loan			0.004	(0.058)
Mobile loan			-0.100*	(0.052)
Business records			-0.102	(0.074)
Present bias			-0.050	(0.050)
Future orientation			-0.069	(0.044)
Cognitive ability			-0.007	(0.012)
Trust in strangers			0.030	(0.020)
Trust in customers			0.028	(0.027)
Trust in courts			0.027	(0.018)
Trust in m-money comp.			-0.033	(0.024)
# of Employees (log)			-0.136***	(0.036)
Constant	0.304***	(0.028)	0.677***	(0.174)
Observations	870		855	
R-squared	0.001		0.075	

Notes: This table presents the results on the relationship between business attrition at endline and baseline business characteristics. The sample consists of businesses with a business license by the time of the baseline. We estimate $Y_i = \beta_0 + X_i^{'}\beta_1 + \epsilon_i$ through OLS for all specifications where Y_i equals 1 if business i did not participate in the endline survey. X_i is the vector of co-variates listed in column 3. We replace missing values of the co-variates with median values and control for the missing values with dummy variables. We report robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 5A: ITT Estimates for LPN Usage

	(1)	(2)	(3)	(4)
	Opened LPN (0/1)	Used LPN (0/1)	Received payment via LPN (0/1)	LPN sales, inverse hyperbolic sine (IHS) transformed
Treatment	0.06*	0.07**	0.07**	0.28**
	(0.03)	(0.03)	(0.03)	(0.13)
	[0.201]	[0.090]	[0.097]	[0.098]
Control Mean	0.23	0.21	0.20	0.75
Control StDev	0.42	0.40	0.40	1.66
N	619	618	618	618

Notes: This table presents the ITT estimates for the indicators of LPN use. Dependent variables are having an LPN account (0/1) (column 1), using LPN for business purposes in the past 30 days (column 2), receiving payment via LPN in the past 30 days (column 3) and LPN sales (column 4), which is inverse hyperbolic sine (IHS) transformed ($\log(x+\sqrt{(x^2+1)})$). The control vector includes the following variables measured at baseline: dependent variable, use of mobile money for business purposes, use of mobile money to pay salaries, use of mobile money to receive payments, has Lipa Na M-Pesa, had a bank loan in the past 12 months, ln(sales-winsorized), not reporting sales and stratification controls. * p<0.1, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table 5B: LPN Usage for Transparent and Non-transparent Businesses

	(1)	(2)	(3)	(4)
Panel A: Transparent firms: shared sales figures at baseline				
	Opened LPN (0/1)	Used LPN (0/1)	Received payment via LPN (0/1)	LPN sales IHS transformed
Treatment	0.08**	0.09**	0.09**	0.37**
	(0.04)	(0.04)	(0.04)	(0.15)
	[0.14]	[0.05]	[0.05]	[0.04]
Control Mean	0.24	0.21	0.21	0.76
Control StDev	0.43	0.41	0.41	1.69
N	488	487	487	487
Panel B: Non-transparent firms: did not share sales figures at baseline				
	Opened LPN (0/1)	Used LPN (0/1)	Received payment via LPN (0/1)	LPN sales, IHS transformed
Treatment	-0.03	-0.02	-0.02	-0.10
	(0.08)	(0.08)	(0.08)	(0.27)
	[0.99]	[1.00]	[1.00]	[0.99]
Control Mean	0.19	0.18	0.18	0.70
Control StDev	0.40	0.39	0.39	1.59
N	131	131	131	131

Notes: This table presents the ITT estimates for the indicators of LPN use, separately for the sub-samples of transparent (Panel A) and non-transparent (Panel B) firms. Dependent and control variables are described in Table 5A. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table 6A: Treatment Effects for Business Finance

	(1)	(2)	(3)	(4)
	Panel A: External finance (Formal)			
	Mobile loans (Yes/No)	Mobile loans (IHS transformed)	Bank loans (Yes/No)	Bank loans (IHS transformed)
Treatment	0.05*	0.46*	0.01	0.06
	(0.03)	(0.24)	(0.02)	(0.27)
	[0.08]	[0.06]	[0.58]	[0.86]
Control Mean	0.10	0.81	0.08	0.89
Control StDev	0.30	2.55	0.26	3.05
N	612	581	609	580
	Panel B: External finance (Informal)			
	Trade credit (Yes/No)	Trade credit (IHS transformed)	Informal loans (Yes/No)	Informal loans (IHS transformed)
Treatment	-0.02	-0.51	0.01	-0.03
	(0.04)	(0.40)	(0.02)	(0.11)
	[0.63]	[0.20]	[0.79]	[0.77]
Control Mean	0.35	3.39	0.05	0.16
Control StDev	0.48	5.03	0.22	1.21
N	619	564	576	575

Notes: This table presents the ITT estimates on financial access. Amounts of loans (columns 2 and 4) are IHS transformations of winsorized values (5%). The control vector is described in Table 5A. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table 6B: IV-Probit and 2SLS Estimates: Effect of Lipa Na M-pesa Sales on Mobile Loans

	(1)	(2)	(3)	(4)
	IVProbit		2SLS	
	LPN sales IHS transformed	Mobile loan (Yes/No)	LPN sales IHS transformed	Mobile Loans (IHS transformed)
Treatment	0.28**		0.32**	
	(0.13)		(0.14)	
LPN sales (IHS transformed)		0.17**		1.52
		(0.08)		(0.99)
	First stage	Second stage	First stage	Second stage
N	575	575	545	545

Notes: This Table shows IV-Probit and 2SLS estimates for the (treatment on treated) effect of sales through Lipa Na M-pesa on receiving mobile loans and on the amount of mobile loans received. Columns 1 and 3 show the first stage estimates from IVProbit and 2SLS estimations respectively and columns 2 and 4 report the second stage estimates. Both estimations include the following control variables: use of mobile loans at baseline, use of mobile money for business purposes, use of mobile money to pay salaries, use of mobile money to receive payments, has LPN, had a bank loan in the past 12 months, ln(sales-winsorized), not reporting sales and stratification controls. * p<0.10, ** p<0.05, *** p<0.01.

Table 6C: IV-Probit and 2SLS Estimates: Effect of Keeping Business Sales and Payment Records via Lipa Na M-pesa Sales on Mobile Loans

	(1)	(2)	(3)	(4)
	IVProbit		2SLS	
	Business records via Na M-pesa Lipa (Yes/No)	Mobile loan (Yes/No)	Business records via Na M-pesa Lipa (Yes/No)	Mobile Loans (IHS transformed)
Treatment	0.03**		0.03**	
	(0.02)		0.02	
Business records via Na M-pesa Lipa (Yes/No)		1.35**		13.83
		(0.69)		(9.45)
	First stage	Second stage	First stage	Second stage
N	575	575	545	545

Notes: This Table shows IV-Probit and 2SLS estimates for the (treatment on treated) effect of keeping business sales and payments records via Lipa Na M-pesa a on receiving mobile loans and the amount of mobile loans received. Columns 1 and 3 show the first stage estimates from IV-Probit and 2SLS estimations respectively and columns 2 and 4 report the second stage estimates. Both estimations include the following control variables: use of mobile loans at baseline, use of mobile money for business purposes, use of mobile money to pay salaries, use of mobile money to receive payments, has LPN, had a bank loan in the past 12 months, ln(sales-winsorized), not reporting sales and stratification controls.. * p<0.10, ** p<0.05, *** p<0.01.

Table 6D: Heterogeneous Treatment Effects for Business Finance

	(1)	(2)	(3)	(4)
	Panel A: External finance (Formal)			
	Mobile loans (Yes/No)	Mobile loans (IHS transformed)	Bank loans (Yes/No)	Bank loans (IHS transformed)
Treatment	0.04	0.37	0.01	0.07
	(0.03)	(0.25)	(0.02)	(0.27)
	[0.22]	[0.16]	[0.59]	[0.82]
Small x Treatment	0.28**	2.02**	-0.00	-0.30
	(0.11)	(1.00)	(0.11)	(1.30)
	[0.01]	[0.05]	[0.99]	[0.85]
Control Mean	0.11	0.85	0.08	0.89
Control StDev	0.31	2.61	0.26	3.05
N	612	581	609	580
	Panel B: External finance (Informal)			
	Trade credit (Yes/No)	Trade credit (IHS transformed)	Informal loans (Yes/No)	Informal loans (IHS transformed)
Treatment	-0.03	-0.62	-0.00	-0.09
	(0.04)	(0.41)	(0.02)	(0.11)
	[0.49]	[0.13]	[0.88]	[0.41]
Small x Treatment	0.19	2.26	0.18*	1.12
	(0.15)	(1.51)	(0.10)	(0.75)
	[0.20]	[0.14]	[0.08]	[0.14]
Control Mean	0.36	3.45	0.05	0.17
Control StDev	0.48	5.05	0.22	1.24
N	619	564	576	575

Notes: This table presents the HTE estimates for financial access. Amounts of loans (columns 2 and 4) are IHS transformations of winsorized values (5%). *Small* is a dummy that equals 1 if a firm has number of employees below the median. Regressions also include the dummy *Small* as well as additional controls; for details, see Table 5A. . * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table 6E: Treatment and Heterogeneous Treatment Effects for Aggregate Loan Access

	Aggregate loans (Yes/No)	Aggregate loans (Yes/No)	Aggregate Loans (IHS Transformed)	Aggregate Loans (IHS Transformed)
Treatment	0.003	-0.01	-0.092	-0.26
	(0.039)	(0.04)	(0.476)	(0.49)
Small x Treatment		0.35**		3.48*
		(0.17)		(2.00)
Control Mean	0.47	0.48	4.96	5.07
Control StDev	0.50	0.50	6.11	6.12
N	619	619	618	618

Notes: This table presents the ITT estimates (column 1) and HTE estimates (column 2) for aggregate loan access, where aggregate loans=1 if firm received a loan from mobile loan provider and/or bank and/or suppliers (trade credit) and/or informal sources over the last 12 months, and aggregate loans=0 if firm has not received loans from any external source over the last 12 months. Amounts of loans (columns 3 and 4) are IHS transformations of winsorized values (5%) for the total sum of informal, mobile loans, bank loans and trade credit over the last 12 months. The control vector is defined in Table 5A. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Treatment and Heterogeneous Treatment Effects for Business Sales and Profits (Levels and Volatility)

	(1) ln(Sales)	(2) ln(Sales)	(3) Sales Volatility	(4) Sales Volatility	(5) Sales Volatility Robust	(6) Sales Volatility Robust	(7) ln(Profits)	(8) ln(Profits)	(9) Profits Volatility	(10) Profits Volatility	(11) Profits Volatility robust	(12) Profits Volatility robust
Treatment	-0.04	-0.04	-0.00	0.00	-0.00	0.00	-0.08	-0.06	-0.00	-0.00	-0.00	-0.00
	(0.07)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.07)	(0.01)	(0.01)	(0.01)	(0.01)
	[0.78]	[0.79]	[0.83]	[0.97]	[0.99]	[0.81]	[0.43]	[0.56]	[0.85]	[0.85]	[0.72]	[0.76]
Small x Treatment		-0.02		-0.04**		-0.04*		-0.31		-0.01		-0.00
		(0.35)		(0.02)		(0.02)		(0.37)		(0.02)		(0.02)
		[1.00]		[0.06]		[0.07]		[0.60]		[0.78]		[0.96]
Control Mean	4.91	4.90	1.06	1.06	1.06	1.06	3.84	3.83	1.08	1.07	1.07	1.07
Control StDev	0.96	0.95	0.05	0.05	0.04	0.04	0.89	0.89	0.06	0.07	0.06	0.06
N	539	539	436	436	515	515	531	531	389	389	494	494

Notes: This table presents the ITT estimates (odd columns) and HTE estimates (even columns) for sales and profits (levels and volatility). Sales and profits volatility are computed using the difference between $ln(Sales_{max})$ and $ln(Sales_{min})$, $ln(Profits_{max})$ and $ln(Profits_{min})$ where $ln(Sales_{max})$, $ln(Profits_{max})$, $ln(Sales_{min})$, and $ln(Profits_{min})$ stand for the maximum and the minimum sales and profits, respectively, during a particular month over the last 12 months. Sales and profits are winsorized at 5% level. The control vector is described in Table 5A. The dummy *Small* (defined in Table 6B) is included as a co-variate in HTE estimations. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table 8A: Treatment and Heterogeneous Treatment Effects for Business Investment

	Total Investment IHS transformed	Total Investment IHS transformed	Inventory Investment IHS transformed	Inventory Investment IHS transformed
Treatment	0.27	3.80	0.16	0.50
	(0.20)	(7.06)	(0.17)	(2.74)
	[0.47]	[0.29]	[0.51]	[0.51]
Small x Treatment		-1.58*		-0.05
		(0.92)		(0.74)
		[0.14]		[0.99]
Control Mean	1.76	1.73	1.20	1.23
Control StDev	2.26	2.27	1.93	1.95
N	526	526	546	546

Notes: This table presents the ITT estimates (odd columns) and HTE estimates (even columns) for investment. The control vector is described in Table 5A. The dummy *Small* (defined in Table 6B) is included as a co-variate in the HTE estimations. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table 8B: Treatment Effects for Business Expenses

	(1)	(2)	(3)	(4)	(5)	(6)
	Input expenses IHS transformed	Building expenses IHS transformed	Transportation expenses IHS transformed	Utility expenses IHS transformed	Employee expenses IHS transformed	Interest expenses IHS transformed
Treatment	-0.31	0.17	-0.06	-0.19	0.19	-0.04
	(0.26)	(0.17)	(0.28)	(0.13)	(0.21)	(0.19)
	[0.29]	[0.31]	[0.90]	[0.18]	[0.41]	[0.66]
Control Mean	10.54	9.42	1.82	8.12	9.14	0.70
Control StDev	3.53	2.64	3.57	1.57	3.07	2.23
N	585	608	591	610	619	577

Notes: This table presents the ITT estimates for business expenses. The control vector is described in Table 5A. All expenses are IHS transformations of winsorized values (5%). * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets. Outcome variables are IHS transformed.

Table 8C: Heterogenous Treatment Effects for Business Expenses

	(1)	(2)	(3)	(4)	(5)	(6)
	Input expenses IHS transformed	Building expenses IHS transformed	Transportation expenses IHS transformed	Utility expenses IHS transformed	Employee expenses IHS transformed	Interest expenses IHS transformed
Treatment	-0.21	0.17	-0.03	-0.12	0.19	-0.08
	(0.27)	(0.18)	(0.28)	(0.13)	(0.22)	(0.19)
	[0.51]	[0.33]	[0.95]	[0.45]	[0.44]	[0.50]
Small x Treatment	-2.06*	0.03	-0.50	-1.54	0.08	0.78
	(1.15)	(0.55)	(1.43)	(1.04)	(0.67)	(0.94)
	[0.09]	[0.95]	[0.80]	[0.19]	[0.94]	[0.28]
Control Mean	10.49	9.41	1.78	8.13	9.10	0.71
Control StDev	3.60	2.63	3.54	1.52	3.13	2.24
N	585	608	591	610	619	577

Notes: This table presents the HTEs for business expenses. The control vector is described in Table 5A. All expenses are IHS transformations of winsorized values (5%). The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.1. ** p<0.05. *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets. Outcome variables are IHS transformed.

Table 9A: Treatment Effects for Business Safety

	Feeling safe
Treatment	0.22
	(0.14)
Control Mean	6.89
Control StDev	1.84
N	619

Notes: This table presents the ITT estimates for business safety feeling (1 not feel safe - 10 feel safe). The control vector is described in Table 5A. * p<0.10, ** p<0.05, *** p<0.01.

Table 9B: Business Safety and Theft Exposure

	(1)	(2)
	Experienced theft at baseline	No theft at baseline
	Feeling safe	Feeling safe
Treatment	1.13**	0.15
	(0.48)	(0.15)
Control Mean	6.36	6.96
Control StDev	1.95	1.82
N	75	543

Notes: This table presents the ITT estimates for business safety feeling (1 not feel safe - 10 feel safe) for sub-samples of firms based on theft exposure in the baseline. The first column reports the coefficient estimate for the sub-sample of businesses which reported in the baseline survey that they had experienced external theft in the 12 months prior to the survey, and the second column for those that did not report having experienced any external theft in the pastyear. The control vector is described in Table 5A. * p<0.10, ** p<0.05, *** p<0.01.

Table 9C: Heterogenous Treatment Effects for Business Safety
Theft Exposed Businesses

	Feeling safe
Treatment	1.25**
	(0.51)
Small x Treatment	-1.55
	(1.82)
Control Mean	6.40
Control StDev	2.02
N	75

Notes: This table presents the HTE estimates for business safety (1 not feel safe - 10 feel safe) for businesses that experienced theft in the baseline. The control vector is described in Table 5A. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01.

Table 10A: Spillovers within and between sectors - Restaurants: LPN adoption and use

	(1) Opened LPN	(2) Opened LPN	(3) Used LPN	(4) Used LPN
Number of treatment firms < 500m	-0.024		-0.021	
	(0.015)		(0.015)	
Number of treatment restaurants < 500m	0.038		0.036	
	(0.026)		(0.026)	
Shortest distance to a treated firm		0.766		0.422
		(0.676)		(0.654)
Shortest distance to a treated restaurant		-0.354		-0.075
		(0.479)		(0.437)
Constant	-0.378	-0.538**	-0.213	-0.357
	(0.239)	(0.237)	(0.229)	(0.233)
Observations	129	114	129	114
R-squared	0.269	0.294	0.309	0.322

Notes: This table assesses the importance of adoption spillovers by testing whether proximity of control units in the same sector affects uptake of Lipa Na M-Pesa by treatment restaurants. Proximity is measured by the number of control restaurants within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control restaurant (in columns (2) and (4)). Uptake is measured by either whether the treatment restaurant opened a Lipa Na M-Pesa account (the extensive margin, in columns (1) and (2)), or the frequency with which the treatment restaurant makes use of its Lipa Na M-Pesa account (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table 10B: Spillover within sector and between sectors - Restaurants: Mobile Loans

	(1) Mobile loan (Yes/No)	(2) Mobile loan Yes/No)	(3) Mobile loan (IHS transformed)	(4) Mobile loan (IHS transformed)
Number of treatment firms < 500m	0.012		0.106	
	(0.011)		(0.096)	
Number of treatment restaurants < 500m	-0.025		-0.22	
	(0.018)		(0.156)	
Shortest distance to a treated firm		0.441		3.328
		(0.423)		(3.360)
Shortest distance to a treated restaurant		-0.161		-1.421
		(0.223)		(2.005)
Constant	0.264	0.124	0.596	1.507
	(0.173)	(0.259)	(1.946)	(2.172)
Observations	127	112	124	110
R-squared	0.249	0.258	0.254	0.257

Notes: This table assesses the importance of adoption spillovers by testing whether proximity of treatment units in the same sector affects uptake of Mobile Loans by treatment restaurants. Proximity is measured by the number of control restaurants within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control restaurant (in columns (2) and (4)). Uptake is measured by either whether the treatment restaurant has a mobile loan (the extensive margin, in columns (1) and (2)), or the amount of mobile loan (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table 11A: Spillover within sector and between sectors - Pharmacies: LPN adoption and use

	(1) Opened LPN	(2) Opened LPN	(3) Used LPN	(4) Used LPN
Number of treatment firms < 500m	-0.004		0.001	
	(0.010)		(0.009)	
Number of treatment pharmacies < 500m	-0.002		-0.003	
	(0.017)		(0.016)	
Shortest distance to a treated firm		0.008		-0.04
		(0.056)		(0.048)
Shortest distance to a treated pharmacy		-0.032		0.009
		(0.047)		(0.039)
Constant	0.320	0.221	0.128	0.116
	(0.329)	(0.308)	(0.313)	(0.302)
Observations	182	182	182	182
R-squared	0.097	0.096	0.099	0.102

Notes: This table assesses the importance of adoption spillovers by testing whether proximity of control units in the same sector affects uptake of Lipa Na M-Pesa by treatment pharmacies. Proximity is measured by the number of control restaurants within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control restaurant (in columns (2) and (4)). Uptake is measured by either whether the control restaurant opened a Lipa Na M-Pesa account (the extensive margin, in columns (1) and (2)), or the frequency with which the treatment restaurant makes use of its Lipa Na M-Pesa account (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

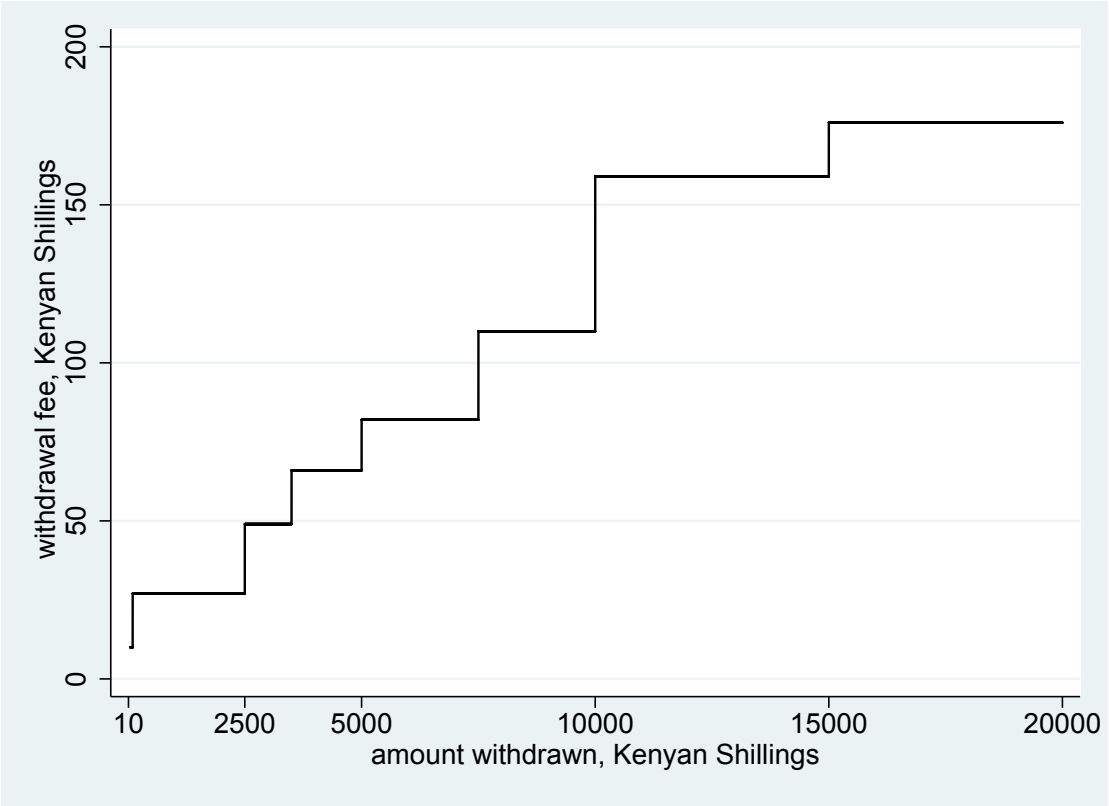
Table 11B: Spillovers within sector and between sectors - Pharmacies: Mobile Loans

	(1) Mobile loan (Yes/No	(2) Mobile loan Yes/No)	(3) Mobile loan (IHS transformed)	(4) Mobile loan (IHS transformed)
Number of treatment firms < 500m	0.011		0.111	
	(0.010)		(0.101)	
Number of treatment pharmacies < 500m	-0.013		-0.170	
	(0.014)		(0.145)	
Shortest distance to a treated firm		-0.023		-0.391
		(0.069)		(0.635)
Shortest distance to a treated pharmacy		-0.004		0.235
		(0.058)		(0.539)
Constant	0.170	0.168	2.273	2.225
	(0.266)	(0.244)	(2.279)	(2.075)
Observations	180	180	169	169
R-squared	0.118	0.113	0.13	0.121

Notes: This table assesses the importance of adoption spillovers by testing whether proximity of treatment units in the same sector affects uptake of Mobile Loans by control pharmacies. Proximity is measured by the number of control pharmacies within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control restaurant (in columns (2) and (4)). Uptake is measured by either whether the control pharmacy has a mobile loan (the extensive margin, in columns (1) and (2)), or the amount of mobile loan (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

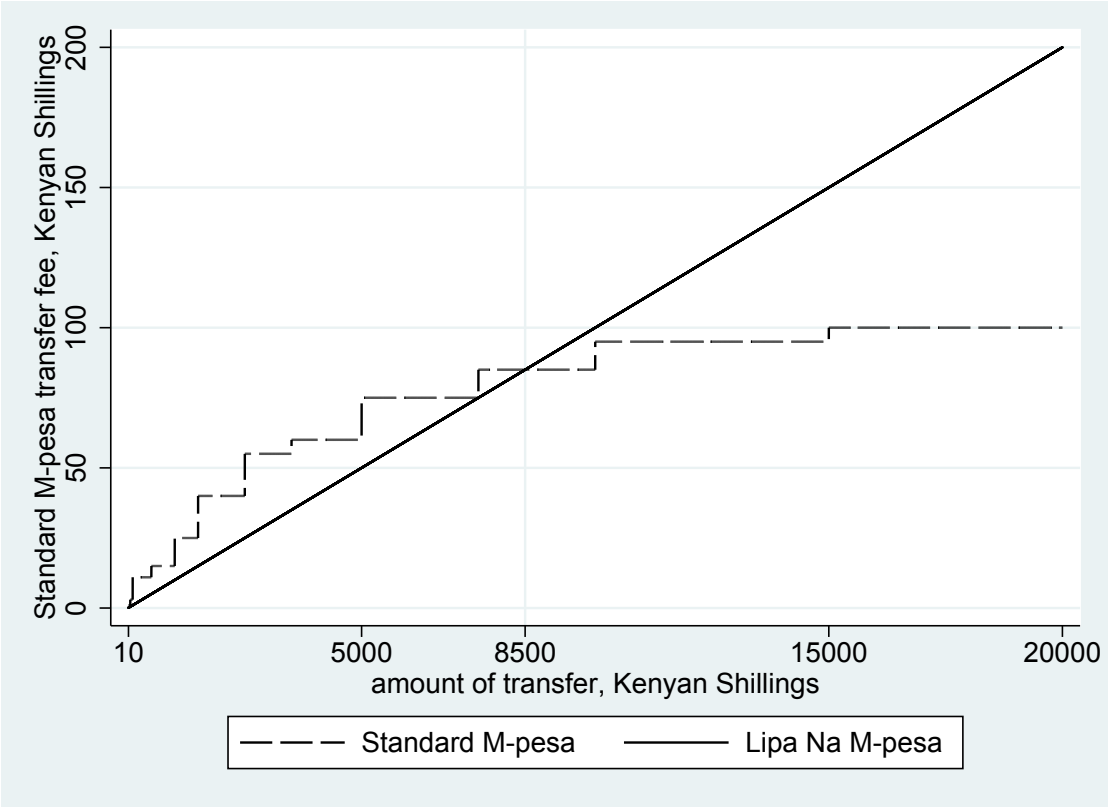
Figures

Figure 1: Fees to Cash-out M-Pesa Units



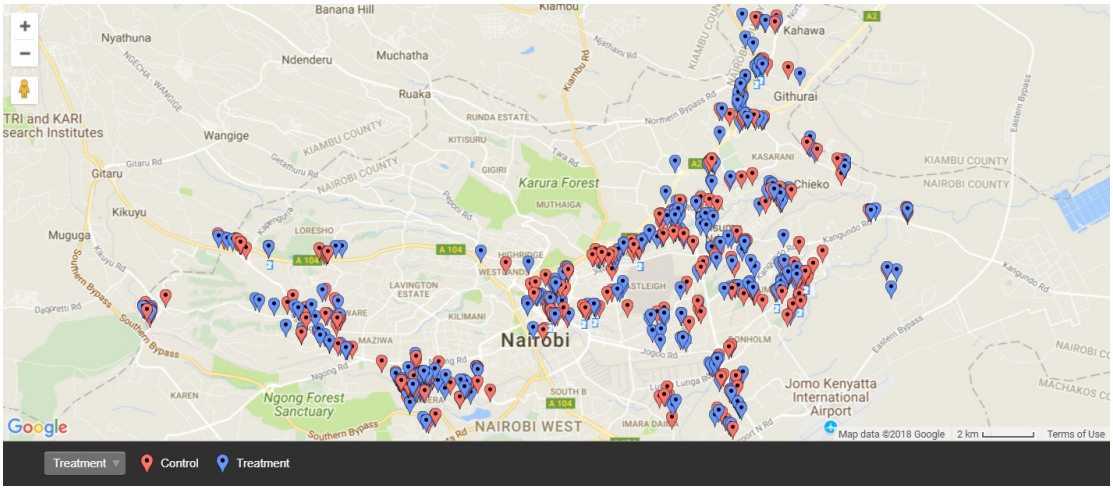
Notes: Fees levied to cashed out M-Pesa units as a function of the amount cashed out.

Figure 2: Fees Levied on Transfers from an M-Pesa Account to Another M-Pesa Account or to a Lipa Na M-Pesa Account.



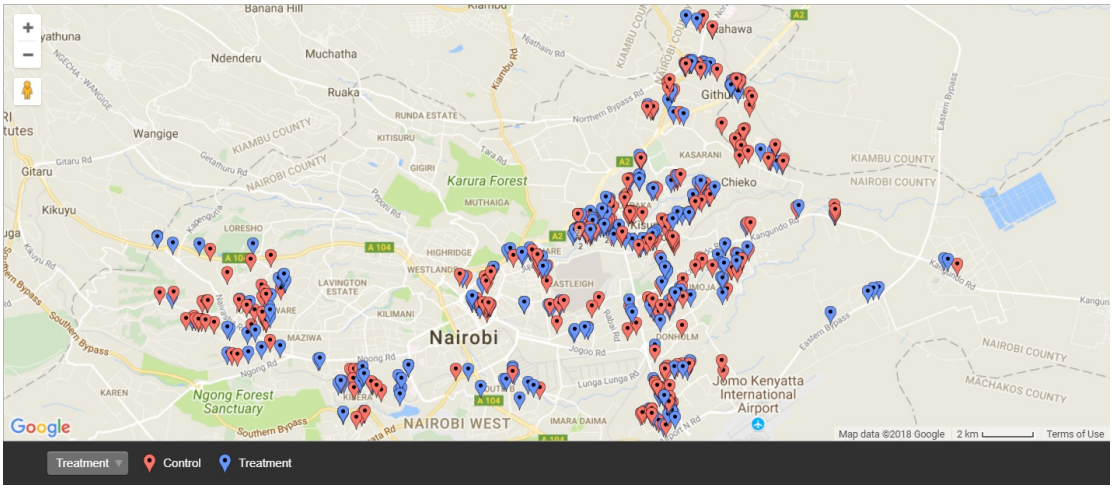
Notes: This figure depicts fees paid for transfers from Standard M-Pesa to another Standard M-Pesa account (dashed line) or to an Lipa Na M-Pesa account (straight line).

Figure 3: Geographic Distribution of Restaurants



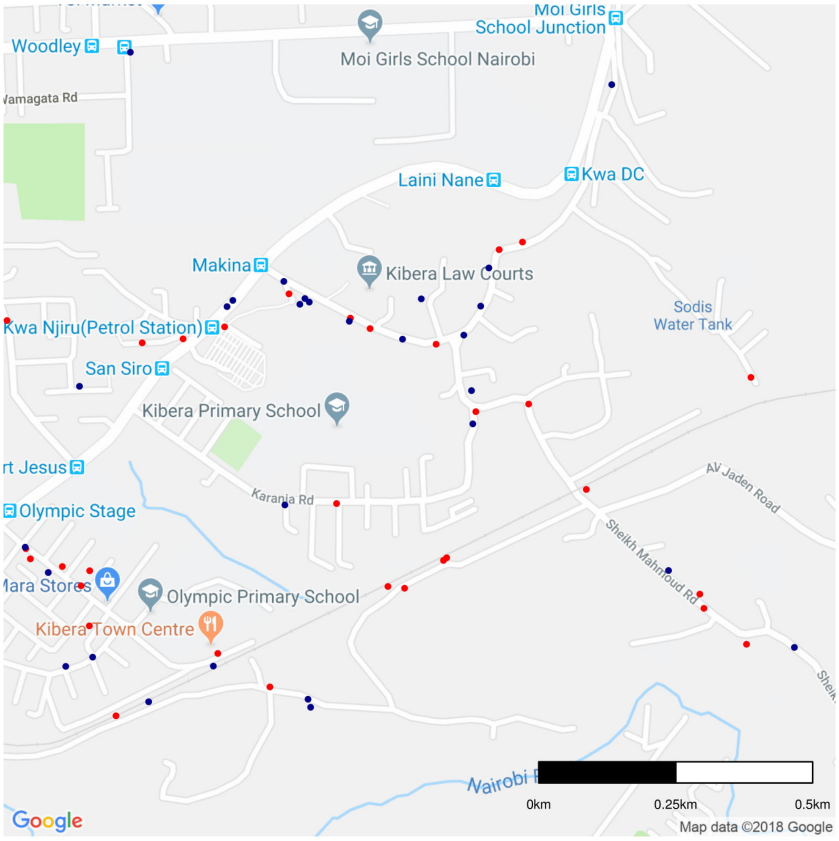
Notes: This figure shows the geographic distribution of restaurants in treatment (blue) and control (red) groups.

Figure 4: Geographic Distribution of Pharmacies



Notes: This figure shows the geographic distribution of pharmacies in treatment (blue) and control (red) groups.

Figure 5: Geographic Distribution of a Random Sub-sample of Merchants



Notes: The figure shows the geographic distribution of a random sub-sample of merchants in treatment (blue) and control (red) groups.

Figure 6: Timeline of the Field Work

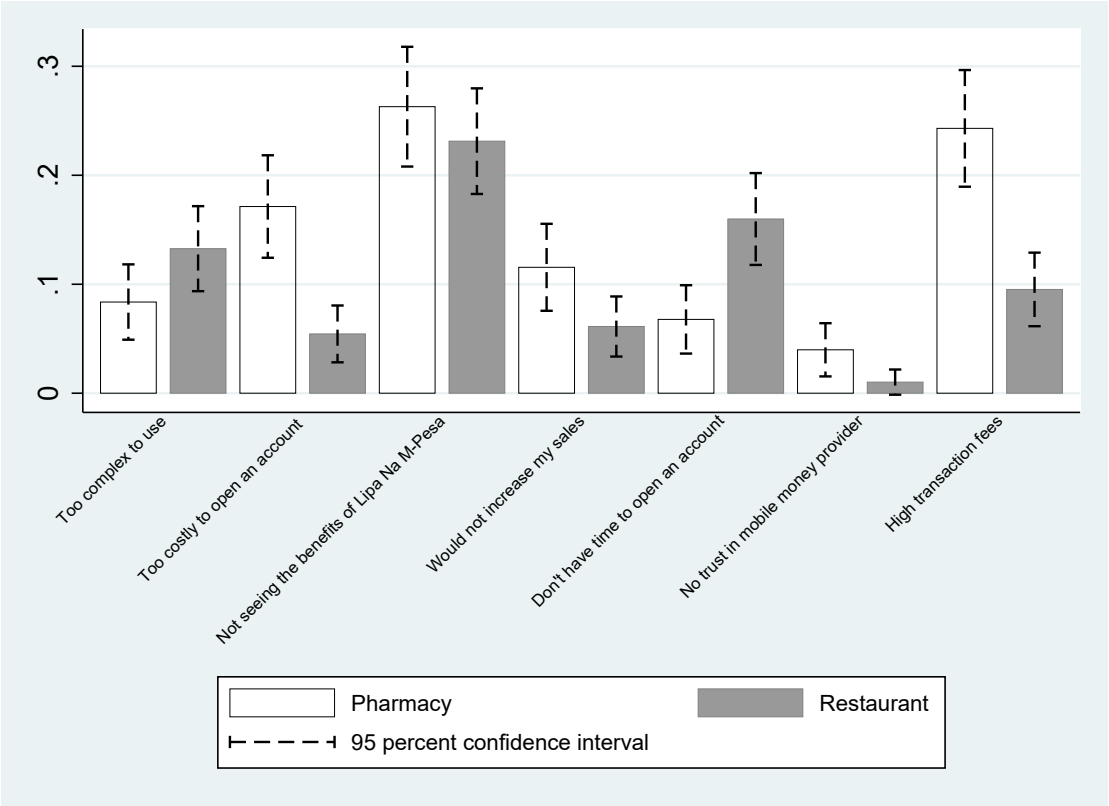
Restaurants

May 2015-June 2015	Listing
July 2015-August 2015	Baseline and Intervention
September 2015-February 2016	Accounts Opening
March 2017-May 2017	Endline

Pharmacies

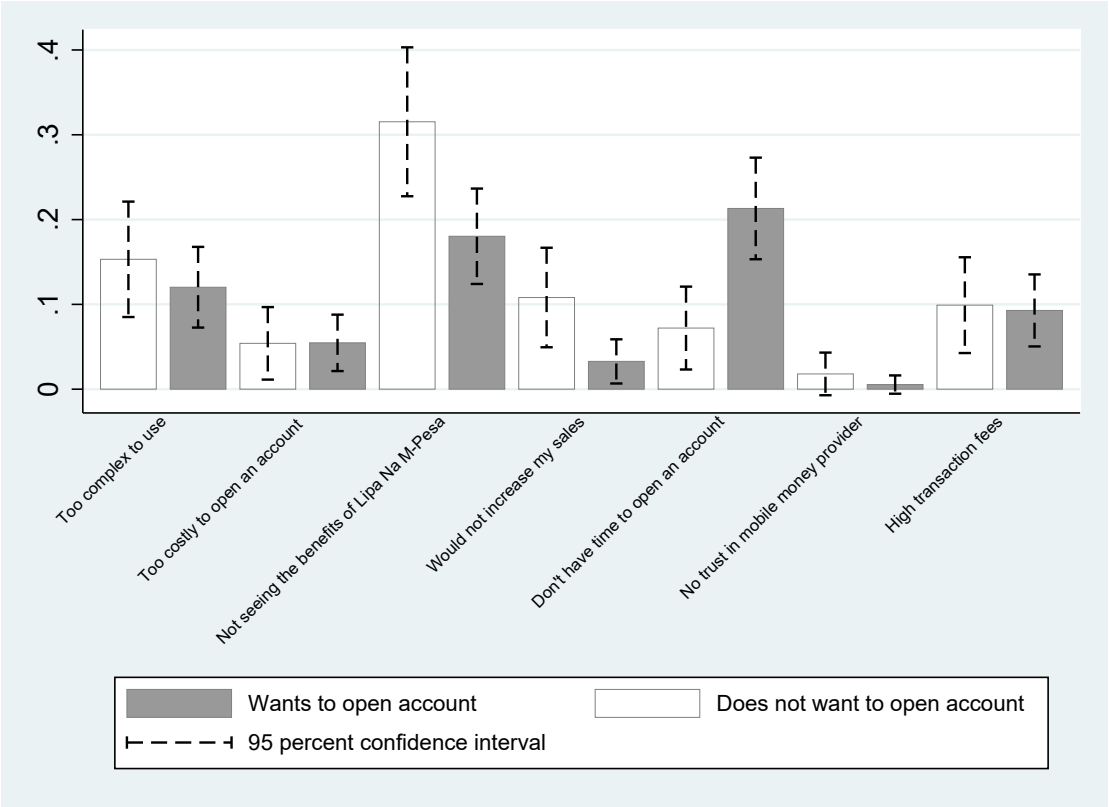
August 2015	Listing
September 2015-November 2015	Baseline and Intervention
October 2015-February 2016	Accounts Opening
March 2017-May 2017	Endline

Figure 7: Reasons for not Having a Lipa Na M-Pesa Account



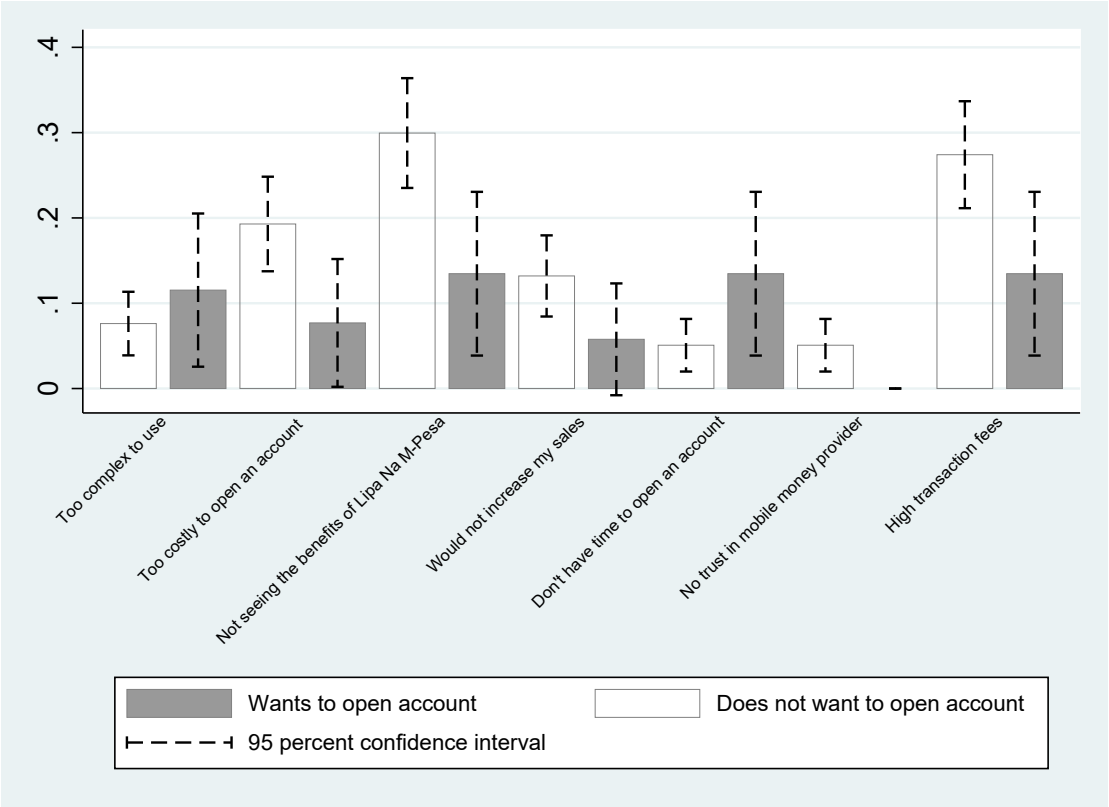
Notes: This figure shows the fraction of restaurants and pharmacies that stated a particular reason for not having a Lipa Na M-Pesa account at baseline (with 95% statistical confidence levels).

Figure 8: Reasons for not Having a Lipa Na M-Pesa Account (Stated at Baseline) and Willingness to Open one after Intervention: Restaurants



Notes: This figure compares reasons for not having an LPN account stated by restaurants who, after our intervention, want to open an account and those that do not want to open an account (see also 95% statistical confidence levels for each bar).

Figure 9: Reasons for not Having a Lipa Na M-Pesa Account (Stated at Baseline) and Willingness to Open one after Intervention: Pharmacies



Notes: This figure compares reasons for not having an LPN account stated by pharmacies who, after our intervention, want to open an account and those that do not want to open an account (see also 95% statistical confidence levels for each bar).

Appendix

Appendix A: A Model of Finance and Business Performance

In this appendix we first present a stylized model that (a) formalizes the relationship between finance and sales volatility in the type of firms that constitute our study and (b) shows how such relationship is mediated by firm size. In addition, we study how formal and informal finance interact in our setting. We then extend this set-up to incorporate precautionary investment and capture the relationship between finance and precautionary motives as an additional theoretical channel.

Because of our study's focus on SME, we focus our analysis on household-firms (hereafter HF): households that own a firm, and that can use their firm's profits (or sales revenues) to purchase consumption goods.[41] The HF is infinitively-lived, and makes decisions in a discrete time environment. We denote periods using subscript t, and each time period is divided in two sub-periods, denoted by s_1 and s_2.

Preferences. The HF has life-time preferences represented by the following utility function:

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^t[\rho_t v(x_t)+c_t], \tag{3}$$

where β is the discount factor, x_t and c_t are consumption levels in respectively s_1 and s_2 of period t; $v(x_t)$ is a utility function with $v'>0$ and $v''<0$; and ρ_t is an iid shock that is realized at the beginning of any time period t with $\rho_t \in \{0,1\}$ and $prob(\rho=1)=\frac{1}{2}$. This shock can be interpreted as a preference shifter for early consumption. If $\rho=0$, there are no benefits to consume "early" (i.e., in s_1); if $\rho=1$, the associated event is such that it may become optimal to facilitate early consumption. A necessary condition for this is that $v'(0)>1$. This formulation captures the empirical observation that in developing countries, HFs face shocks (related to, for example, health and employment) that may affect their immediate needs for liquidity.

Production. In each period, the HF has access to a production technology that yields output that can be sold early (in s_1) or late (s_2). In each period, the production technology takes h_t units of inputs (e.g. labor, capital) and the HF decides when to sell its products and obtain the revenues. The HF is assumed to prefer to sell her output at the end of the period (i.e., in s_2), unless a shock causes the HF to have early liquidity needs. In the latter case, she may decide to "rush" and sell all her output early (i.e., in s_1), obtaining lower sales revenues than she would have obtained if she decided to sell in s_2. In practice, this early liquidation can be implemented, for example, with sales promotions (e.g. discounts, bundling, etc.) that allow the HF to have liquidity by selling her products too early, without waiting for the market demand to saturate. This theoretical concept has been utilized extensively in the macro-banking literature that builds upon the seminal work by

[41] We believe that HFs is the appropriate representation of the type of firms in our sample, for two reasons. First, small firms in developing countries are typically family firms which oftentimes do not distinguish between their firm's finances and those of their household. For example, Drexler et al. (2014) report that only half of the small businesses in their sample have separate business and personal accounts, and they focus their training intervention on helping businesses to separate their business and personal finances. McKenzie and Woodruff (2014) also recognize this problem, and highlight that the most common set of topics of business training rely on encouraging small business owners to separate household and business finances. Second, mobile loans are extended to M-Pesa account holders (in our case, firm owners) and not to the firm itself. For this reason, mobile loans can in principle be used to cover both household and firm needs over the short-run.

Diamond and Dybvig (1983) on fire sales. We formalize the impact of the timing of sales on revenues as follows:

$$y_t = \begin{cases} A^L h_t & \text{if production is rushed and all output is sold in } s_1, \\ A^H h_t & \text{if output is sold in } s_2, \end{cases} \tag{4}$$

where $A^H > A^L > 1$. This production specification captures the idea that sales can be "rushed" to finance the HF's liquidity needs in those periods t in which she has a preference for early consumption ($x_t > 0$ in s_1). Note that selling early comes at a "liquidation cost", $(A^H - A^L)h_t$. For simplicity, we assume that the HF can either sell early or late, but that it cannot liquidate just part of its quantity produced in either sub-period.

Before we study the role of finance in this setting, we impose a few additional assumptions. First, we assume that the HF's product can be sold within period t (either early, or late), but not between periods. This assumption is likely to hold for restaurants and pharmacies in our study whose products are perishable. Second, we assume that the production factor $h_t = h > 1$ is a fixed-level endowment that the HF receives at the beginning of each time period, so we concentrate on a stationary framework. Fixing the endowment of the firm also facilitates comparing outcomes across firms of different sizes, as we do in our empirical analysis in the main body of the paper.

External Finance. The HF can finance early consumption needs (x_t in s_1) by liquidating sales in s_1, or by external finance. If she wishes to access external finance and if finance is available, she could either borrow b_t^I units from an informal source at the gross interest rate of $r_t^I \geq 1$, or borrow b_t^F units from a formal source at the gross rate $r_t^F \geq 1$. Consistent with evidence, we assume $r_t^I > r_t^F > 1$ (see e.g. Banerjee and Duflo, 2007; and also Gosh et al. (2022), who show that a higher share of non-cash payments is associated with better access to loans.). Furthermore, formal finance may not be available for the HF: denoting the availability of formal external finance in period t with θ_t, we let $\theta_t = 1$ if the HF has access to formal finance and $\theta_t = 0$ if the HF is excluded from external finance. The HF takes both r_t^F and r_t^I as given in her optimization problem. The interest repayment for each unit borrowed in s_1 of any period t are made in s_2 of the same period t. Finally, we use the indicator $\chi_t \in \{0, 1\}$ for HF's production liquidation (or fire sale) decision, with $\chi_t = 1$ denoting that all output is sold early (i.e., in s_1), and zero otherwise.

Timing of Events. The sequence of events in any period t is as follows:

1. In s_1:
   i. The HF uses inputs h_t to start producing output.
   ii. ρ_t is realized.
   iii. θ_t is realized.
   iv. The HF decides whether and how much to borrow formally (b_t^F) and/or informally (b_t^I).
   v. The HF decides whether to sell its output early (with $\chi_t = 0$, or 1).
   vi. If $\chi_t = 1$, the HF receives sales revenues $A^L h_t$, and (at least some) early consumption takes place; all revenues that are not consumed in s_1, denoted by d_t, are transferred to s_2.
2. In s_2:

i. If $\chi_t = 0$, the HF receives sales revenues $A^H h_t$.

ii. The HF repays formal and informal loans, i.e. $r_t^F b_t^F$ and $r_t^I b_t^I$.

iii. Late consumption takes place.

Optimization Program

Since the model is stationary and there are no dynamic interactions, we characterize within-period optimization programs of the HF for $\rho = 0$ and $\rho = 1$ periods separately.

In periods when $\rho_t = 0$ (i.e. when there are no early liquidity needs), the HF solves the following problem:

$$\max_{c_t, \chi_t} \quad c_t \tag{5}$$

$$s.t. \quad c_t \leq \chi_t A^L h + (1 - \chi_t) A^H h, \tag{6}$$

$$\chi_t \in \{0, 1\}, \tag{7}$$

which, based on the standard budget constraint argument, immediately yields $\chi_t = 0$ and $c_t = A^H h$.

In periods when $\rho_t = 1$ (that is, when there are early liquidity needs), the HF solves the following problem:

$$\max_{x_t, c_t, \chi_t, b_t^F, b_t^I} \quad v(x_t) + c_t \tag{8}$$

$$s.t. \quad x_t \leq \chi_t A^L h + \theta_t b_t^F + b_t^I - d_t, \tag{9}$$

$$c_t \leq (1 - \chi_t) A^H h - \theta_t r_t^F b_t^F - r_t^I b_t^I + d_t, \tag{10}$$

$$\chi_t \in \{0, 1\}. \tag{11}$$

Note that it is never in the HF's interest to both sell early *and* borrow in s_1 (neither formally nor informally) because $r^i > 1$ for $i = \{F, I\}$. That means that this optimization program has two possible solutions:

Case 1: The HF liquidates production in s_1 and does not borrow.

Case 2: The HF does not liquidate in s_1 and borrows (formal and/or informally).

Given entrepreneur-specific components, sales are higher and sales volatility is lower in case 2 than in case 1. This is because early sales never occur when $\rho_t = 0$, while having access to external finance reduces the chance of the HF being forced to sell early when $\rho_t = 0$. Additionally, we will show below that under a wide range of parameter constellations, the decrease in volatility will be more pronounced than the rise in the level of sales. We cover the detailed solution and the resulting implications of access to finance in the next sub-section.

Solution I: Formal and Informal Finance, Firm Size and Sales Volatility

Let us start with a model specification where the HF has access to informal finance ($b^I \geq 0$), but not to formal finance ($\theta = 0$ implying that $b^F = 0$). The solution to this model will then be used below to study the implications of introducing access to formal finance. We impose that $v(x) = ln(x)$, so we can focus on closed form solutions resulting from the optimization program (8)-(11). Since we will characterize a stationary solution we also

suppress the time subscripts and observe the following based on first-order conditions with respect to the two optimal solution cases described above.
Case 1: $v'(x) = 1$ and with log-utility we get $x = 1$ and $c = A^L h - 1 > 0$ and the HF's period welfare equals $W = A^L h - 1$. Note that $c = A^L h - 1 > 0$ is guaranteed by the assumptions on A^L and h.
Case 2: $v'(x) = r^I$ and with log-utility $b^I = x = \frac{1}{r^I}$ and $c = A^H h - 1$ and the HF's period welfare is characterized as $W = ln\left(\frac{1}{r^I}\right) + A^H h - 1$.

Note that since $r_t^I \geq 1$, once the HF liquidates her production early, she uses her sales revenues in s_1 to satisfy her consumption needs rather than relying on external finance. Since at the optimum $v'(x) = 1$, $A^L h - 1 > 0$ ensures the ability to satisfy such consumption, implying that an HF that liquidates her product does not need to borrow externally.

The final part of the solution characterizes under which parameter values of the model the HF chooses to borrow rather than to liquidate her production ($\chi = 0$). This characterization comes from the comparison of the level of welfare that arise in cases 1 and 2.

Result 1: The HF chooses to turn to informal borrowing (rather than liquidate her production early) if and only if:

$$ln\left(\frac{1}{r^I}\right) + A^H h - 1 \geq A^L h - 1, \tag{12}$$

$$\Rightarrow h \geq \bar{h} \equiv \frac{ln(r^I)}{A^H - A^L}. \tag{13}$$

Result 2: As a corollary of Result 1, we also obtain that for HFs with $h > \bar{h}$ (e.g., HFs with larger businesses, albeit restaurants or pharmacies), the volatility of sales is lower – as they do not need to sell early even if $\rho = 1$, and hence their revenues are always $A^H h$. Smaller HFs, with $h < \bar{h}$, earn $A^H h$ in periods when $\rho = 0$ and $A^L h$ in those periods when $\rho = 1$ and therefore exhibit volatile sales.

The intuition for these two results is straightforward. In the presence of informal finance, larger HFs have a larger opportunity cost of rushing to sell early; they rely on external funding to finance their early consumption needs. Our data are indeed consistent with this result. At baseline, smaller firms report higher sales volatility than bigger firms.[42]

Experiment that Improves Access to Formal (mobile) Finance. Let us now consider the case that a technology, like Lipa Na M-Pesa, becomes available to the HF. Such technology, due to reasons discussed in the paper, improves the chance for the HF to access formal finance (e.g. mobile loans), at the gross interest rate r^F, with $r^F < r^I$ (i.e. $\theta = 1$). If the interest rate difference between formal and informal loans is the only source of heterogeneity across the two forms of finance, it is easy to note the following results.

Result 3: All large HFs that satisfied (13) before the intervention and also smaller HFs

[42]When we regress sales volatility, measured as the difference between the maximum and the minimum level of sales reported by the business over the last year, on a dummy for firm size (which equals 1 if the total number of employees of the firm is larger than the median employment level in the respective sector of the business as of the baseline, and zero otherwise) as well as a sector dummy, the coefficient on firm size is positive and significant (with a p-value < 0.10).

who satisfy the following condition

$$\hat{h} \equiv \frac{ln(r^F)}{A^H - A^L} < h \leq \frac{ln(r^I)}{A^H - A^L} \tag{14}$$

use formal loans as the source of external finance when formal loans become available, since $r^F < r^I$.

Result 4: While the level of sales and the volatility of sales of large HFs (satisfying (13)) do not change through formal loan access, access to formal finance reduces the sales volatility and increases the level of revenues for smaller HFs (satisfying 14).

Result 5: For all firms for which condition (14) holds, the impact of access to formal loans on reducing sales volatility tends to be larger than on the increase in average sales revenues. The level effect of improved financial inclusion is $A^H h - \frac{1}{2}(A^H h + A^L h) = \frac{1}{2}(A^H h - A^L h)$ while the volatility of sales is reduced by $A^H h - A^L h$. Because by definition $A^H > A^L$, the sales volatility impact is larger than the level effect.

The intuition for Result 5 relates to the property of the model that finance is needed to compensate only short-term liquidity needs of HFs. Results 3, 4 and 5 match with the experimental findings of our study. As shown in Table 6D and irrespective of their size, firms in our treatment group have better access to formal loans than those in the control group (although the effect is somewhat stronger for small firms) - as predicted by Results 3 and 4. Also consistent with Results 3 and 4, the impact on sales volatility is more pronounced for smaller than for larger firms (Table 7). Finally, Table 7 also confirms the prediction (in Result 5) that the impact on small firms' sales volatility is larger than that on their sales level.

Solution II: Co-existence of Formal and Informal Finance

The solution provided in the previous subsection is predicated on the implicit assumption that formal and informal loans are perfect substitutes. This is because we assumed that $r^F < r^I$ is the only difference between the two types of loans. However, evidence suggests that informal and informal sources of finance may differ in more dimensions other than just the interest rate charged. Indeed, the two forms of finance co-exist and possibly also complement each other (see Biais and Gollier (1997), Burkart and Ellingsen (2004), Madestam (2014) and Beck, Hoseini and Uras (2020)). This is particularly true when formal loans are small in size (as is the case with the mobile loans in our study) and informal loans are larger. To account for this feature, we extend the model and assume that:

$$b_t^F \leq \bar{b}^F, \tag{15}$$

where $\bar{b}^F$ is the formal loan size limit. This additional constraint gives rise to three possible equilibrium outcomes:

Case 1: The HF sells early and does not borrow: $v'(x) = 1$. Because of log-utility we then have $x = 1$ and $c = A^L h - 1$, and the HF's welfare is $W = A^L h - 1$.

Case 2: The HF does not sell early and does not borrow formally, but takes out a formal loan: $v'(x) = r^F$. With log-utility we then have $x = b^F = \frac{1}{r^F}$ and $c = A^H h - 1$, and the HF's welfare equals $W = ln\left(\frac{1}{r^F}\right) + A^H h - 1$.

Case 3: The HF does not sell early but takes out both formal and informal credit. Because $r^F < r^I$ we have $b^F = \bar{b}^F$. The first-order condition then postulates that the amount of informal credit is implicitly determined by $v'(\bar{b}^F + b^I) = r^I$. Using log utility we have $x = \frac{1}{r^I}$, $b^I = \frac{1 - \bar{b}^F r^I}{r^I}$ and $c = A^H h - 1 + \bar{b}^F(r^I - r^F)$. The HF's level of welfare is then given

by $W = ln\left(\frac{1}{r^I}\right) + A^H h - 1 + \bar{b}^F(r^I - r^F)$.

These three cases give rise to Results 6 and 7.

Result 6: When formal loans are constrained, improved access to formal finance (such as via M-Shwari) induces HFs that meet condition (13) to substitute some informal finance with formal finance - though at the extensive margin there is no change (when considering the impact of formal loans on informal finance).
Result 7: When formal loans are constrained, HFs that meet condition (14) will use both formal and informal loans after formal loans become accessible - as long as $\bar{b}^F < \frac{1}{r^F}$.

Result 7 prevails due to the complementarity between formal and informal finance: formal loans are cheaper, but they only cover fraction of the liquidity needs. Since the fraction covered by formal loans comes at low cost, firms would then find it optimal to have some partial access to relatively expensive informal loans and satisfy the needs for early consumption.

The experimental findings that we present in Table 6D are consistent with Results 6 and 7. This table shows that the treatment raises both informal and formal finance access among small firms, while the same coefficient is insignificant for large firms.

Extended Model with Precautionary Investment

So far the only mechanisms in the model that allow to cope with liquidity shocks are *ex post* in nature (sales liquidation or borrowing). Precautionary investment could also help to cope with shocks *ex ante*. Given this insight, we extend the model to allow for intertemporal investment across periods, that could serve precautionary motives. Specifically, we keep the half-a-period half-time (storability) property of the consumption good as in the benchmark specification. But different from the benchmark set-up, we allow that the consumption good can be invested in between s_2 of a time-period t and the adjacent s_1 of $t+1$ to insure against a potential early consumption shock.

We denote intertemporal investment with I_t and assume that I_t units of goods invested from the sales flow in s_2 in t can be utilized for consumption purposes in s_1 of $t+1$. Each unit of investment in t yields γ units of the consumable good in $t+1$, where γ captures the investment efficiency of the HF and takes on a value within $[0, \bar{\gamma}]$, with $\bar{\gamma} > 1$. Under this extended specification, in periods when $\rho_t = 0$ (no early liquidity needs), the HF solves:

$$\max_{c_t, \chi_t, I_t} \quad c_t + \beta E[V(c_{t+1}, x_{t+1})] \tag{16}$$

$$s.t. \quad c_t \leq \chi_t A^L h + (1 - \chi_t) A^H h - I_t, \tag{17}$$

$$x_{t+1} \leq \gamma I_t + \chi_t A^L h + \theta_t b^F_{t+1} + b^I_{t+1} - d_{t+1}, \tag{18}$$

$$\chi_t \in \{0, 1\}, \tag{19}$$

where $E[V(c_{t+1}, x_{t+1})]$ is the expected continuation value of consumption. In periods when

$\rho_t = 1$ (early liquidity needs), the HF solves:

$$\max_{x_t, c_t, \chi_t, b_t^F, b_t^I, I_t} \quad v(x_t) + c_t + \beta E[V(c_{t+1}, x_{t+1})] \tag{20}$$

$$s.t. \quad x_t \leq \gamma I_{t-1} + \chi_t A^L h + \theta_t b_t^F + b_t^I - d_t, \tag{21}$$

$$c_t \leq (1 - \chi_t) A^H h - \theta_t r_t^F b_t^F - r_t^I b_t^I + d_t - I_t, \tag{22}$$

$$x_{t+1} \leq \gamma I_t + \chi_t A^L h + \theta_t b_{t+1}^F + b_{t+1}^I - d_{t+1}, \tag{23}$$

$$\chi_t \in \{0, 1\}. \tag{24}$$

Before we characterize the extended set-up, please note that precautionary investment is costly for all firms (also for those with $\gamma = 1$). This is because sales-revenue invested in s_2 of t gets consumed in next period's s_1 with *probability* ρ (when the HF is hit with an early consumption shock). With probability $1 - \rho$ the invested resources fully depreciate before they can be consumed, since the investment does not last until s_2 of $t + 1$. Given this key remark we prove the following two results.

Result 8: The HF does not engage in precautionary investment if and only if she chooses to liquidate production.

Proof. Let us consider an HF who chooses to liquidate production in equilibrium (i.e. an HF who expects to liquidate when faced with an early consumption shock). We already know from the benchmark analysis that such an HF consumes the first-best optimal quantity in s_1, which is $x = 1$ - satisfied by log-utility and the assumption of $A^L h - 1 > 0$. This means if the HF were also to engage in precautionary investment, at boundary the additional unit of investment would yield an expected marginal utility of less than $\beta\rho < 1$ (guaranteed by log-utility and taking into account the size of the discount factors) in s_1, while the marginal utility from consuming in previous s_2 would have equaled to 1. Therefore, in our model a liquidator is never a precautionary investor (and vice versa). □

Result 9: (i) Relatively smaller firms or firms with a lower investment efficiency have a preference for production liquidation. (ii) Firms with higher investment efficiency or larger firms prefer borrowing or precautionary investment over production liquidation and whether they would prefer investment or borrowing depends on their investment efficiency. (ii) When formal (low cost) finance becomes available, firms with low investment efficiency switch from precautionary investment to formal finance.

Proof. First using the extended optimization program (16)-(24), we note that in a stationary equilibrium the first order condition with respect to investment solves:

$$-1 + \beta\rho\frac{1}{I} = 0, \tag{25}$$

where the first term on LHS is the marginal cost of investing as of s_2 in t and the second term is the expected marginal benefit (utility) from investment, characterizing the optimal $I = \frac{1}{\beta\rho}$. Using (25), Result-8 and the first order conditions with respect to χ and b, which remain as in the benchmark, next we characterize the expected period welfare of a "production liquidator" (L), a "precautionary investor" (I), and a "borrower" (B) (starting with informal-finance-only case as we did in the benchmark analysis). In this characterization, we first guess that a precautionary investor would not choose to borrow and then show

that this indeed would be the case in equilibrium:

$$EW^L = \rho\left[\ln(1) + A^L - 1\right] + (1-\rho)A^H, \tag{26}$$

$$EW^I = \rho \ln\left(\frac{\gamma}{\beta\rho}\right) + A^H h - \frac{1}{\beta\rho}, \tag{27}$$

$$EW^B = \rho\left[\ln\left(\frac{1}{r^I}\right) - 1\right] + A^H h. \tag{28}$$

Equations (26)-(27) imply that an HF would prefer precautionary investment over liquidation if:

$$h > \tilde{h}(\gamma) \equiv \frac{1}{A^H - A^L}\left[\frac{1}{\beta\rho^2} - \ln\left(\frac{\gamma}{\beta\rho}\right) - 1\right], \tag{29}$$

which is a threshold that is a decreasing function of HF-specific investment efficiency γ: There are HFs that are small in size but prefer precautionary investment over liquidation due to a relatively high level of investment efficiency. The condition for an HF to prefer borrowing over liquidation remains the same as in (13), which characterizes $\bar{h}$. That means any small firm with $h < \min\{\tilde{h}(\gamma), \bar{h}\}$ prefers liquidation over borrowing and precautionary investment - proving the first part of the statement in the result.

Using (27)-(28), the condition to prefer precautionary investment over borrowing is given by:

$$\rho \ln\left(\frac{\gamma}{\beta\rho}\right) - \frac{1}{\beta\rho} > \rho\left[\ln\left(\frac{1}{r^I}\right) - 1\right], \tag{30}$$

which shows that among relatively larger firms those with higher investment efficiency (γ) prefer precautionary investment over borrowing - proving the second part of the statement in the result.

Furthermore, inequality (30) implies that a financial innovation that reduces r^I to r^F would cause a switch from precautionary investment to borrowing, and the first type of firms who would reduce precautionary investment would be those with relatively lower levels of investment-efficiency - proving the third part of the statement in the result. Finally, as easily noted, the quantity of investment does not show up neither on LHS nor on RHS of (30), and thus an HF would either go for precautionary investment or for borrowing, but not for both. □

Results 8 and 9 imply that the qualitative findings that we presented in the previous sections continue to hold in the extended model: smaller firms prefer to liquidate production and when low cost formal finance becomes accessible they switch to borrowing - with positive consequences for their sales volatility. Furthermore, Result 9 shows that when low-cost formal finance becomes available, firms with relatively lower investment efficiency switch to borrowing formally. Again, these predictions are confirmed by our experimental results. Tables 8A and 8C show that our treatment reduced both the investments and input expenditures of the smaller firms in our sample (alongside access to finance implications of the treatment), which could be tied to the precautionary investment reduction that we capture in our model.

In order to formalize this connection, we would like to note two important features of the analysis.

1) The threshold $\tilde{h}(\gamma)$ differs from $\bar{h}$ and given the HF-specific value of γ there are HFs for whom $\tilde{h}(\gamma) < \bar{h}$ holds. This implies that depending on the distribution of investment efficiency there are some "small" firms who prefer precautionary investment over production

liquidation. Therefore, within the small firm size-class, there are production liquidators as well as precautionary investors - selecting into different options based on the level of their idiosyncratic investment efficiency γ. 2) Our model also predicts that precautionary investors with relatively lower investment efficiency would switch to borrowing when formal finance becomes available. That means when low cost formal finance becomes accessible, some small firms (within the size domain of $[\tilde{h}(\gamma), \bar{h}]$ and low enough investment efficiency) would stop with precautionary behavior as we empirically capture in Tables 8A and 8C and reduce investment and input storage. One could of course argue that larger precautionary investors who satisfy $h > \max\{\tilde{h}(\gamma), \bar{h}\}$ might also switch to borrowing when formal finance becomes accessible. However, it is quite plausible that investment efficiency positively correlates with firm size. In that respect smaller size HFs are more likely to exhibit low levels of investment efficiency - especially in the context of a developing country - and thus small firms are more prone to switching from precautionary investment to formal borrowing compared to their larger counterparts.

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Online Appendix

Online Appendix A: Randomized Encouragement Designs - Definition, Analysis and Examples

In this appendix, we provide background for the empirical method we use in the paper. We first define Randomized Encouragement Designs (REDs) as one type of a broader set of Randomized Controlled Trials (RCTs). Next, we briefly review some seminal examples of studies that have used RED, and discuss how RED data can be analyzed. We conclude this appendix by discussing how the RED methodology does not only allow us to estimate the causal impact of a program/technology, but also, as a byproduct, to study barriers to adoption of the particular program/technology.

Definition and Examples of REDs

Field experiments, also known as RCTs, are able to provide estimates of the causal impact of programs/technologies on key economic outcomes (Duflo et al., 2007; Khandker et al., 2010). The method relies on randomly assigning units (in our case, SMEs) to either a treatment or a control group. If the number of units in the sample is sufficiently large, random assignment results in the two groups being very similar in all respects – observable characteristics (like sector, size and location), but also unobservable characteristics (like technology-savviness). If the (distributions of) characteristics in the two groups are the same, average outcomes will be the same, too. Random assignment thus results in the control group providing the counterfactual outcome had the units in the treatment group not received the intervention, and the difference in average outcomes between the two groups is thus the impact of the treatment under consideration (Rubin, 1974).

REDs are a special type of RCTs that allow researchers to evaluate the impact of programs/technologies that are already available in the study area, but whose take up is not universal (Bradlow, 1998). An early application of the technique is Holland (1988), who estimated the impact of preparing better for the GRE test on scores obtained. All candidates were free to prepare themselves as well as they saw fit, but Holland stimulated a random subset of students to put in (even) more effort. Because the two groups of candidates were ex-ante identical, on average they were expected to study equally hard for the test and to receive the same average GRE score. Thus, any difference in test scores between the two groups can only have been caused by candidates in the encouraged group having studied harder than they would otherwise.

A second example is Duflo et al. (2006), who evaluated the impact of demonstrating the use of a novel agricultural technology on subsequent adoption, and of the role of social processes therein. Fertilizer demonstrations were set up on the plots of randomly selected farmers, and all interested farmers in the region were welcome to attend the demonstration. For a random subset of demonstration plots, however, the farmer's friends were actively invited to attend the demonstration. Thus, any difference in percentage uptake rates of the new technology between the two groups can only have been caused by the difference in social interactions.

As third example, Devoto et al. (2012) implemented a RED to estimate the welfare impacts of having access to piped water in Morocco. While all households were free to purchase a connection, not all of them did. The researchers encouraged a random subset of households to purchase a connection – for example by providing information about the service and help with the application procedure. Any measured difference in welfare between the two groups can thus only be the result of some households in the encouraged group having acquired a piped water connection whereas they would not have done so otherwise.

Analysis of Data from REDs: ITT and ToT

Because assignment to the encouraged group is random, the REDs generate exogenous variation in the rate of program/technology adoption. When regressing the variable of interest on the unit's treatment status (having received encouragement, or not), the coefficient on the latter gives the so-called intention-to-treat (ITT) effect: the average impact of having lowered the barriers to adoption on the variable of interest. An alternative measure is the so-called treatment-on-the-treated (TOT) effect: the impact of actually having been induced to adopt the program/technology on the variable of interest. While the two effects may seem very different, they are closely connected. The TOT estimate is equal to the ITT, divided by the difference in take-up rates between the encouraged and non-encouraged groups (Wald, 1940). Any difference in the dependent variable can only be caused by the share of households in the encouraged group ending up adopting the new technology, whereas they would not have done so absent the encouragement. Because the ITT estimate is typically the most policy relevant one since units cannot be forced to adopt the new program/technology, the literature in general and we in particular focus on ITT effects.

This Study: Measuring the Impact of LPN

In this study, we estimate the impact of adopting LPN on variables like sales, sales volatility, and loans. LPN was available to all firms that meet the requirements (e.g., having a business license), so just comparing outcomes of firms who adopted with outcomes of firms who did not adopt LPN would confound treatment with selection effects. For instance, if we observed that firms adopting LPN also increasing their access to loans, this could be because the technology improved access to loans (the treatment effect), or because the firms that adopted the technology were better connected financially a priori (the selection effect).

To address this challenge, we implemented a RED. Even if all licensed firms could in principle access LPN, we estimated its impact by encouraging its adoption in one group (treatment), and not in the other (control). With random allocation of firms to treatment and control, take-up should be the same in both groups without intervening. As pointed out above, encouraging only a random group ensures, under mild assumptions, that any difference in outcomes between the two groups must be due to firms who adopted the technology but would not have done it if they had not been assigned to treatment.

As we explained in the main body of the paper, to encourage adoption, we contacted all firms in our treatment group, and implemented actions to overcome potential barriers for adoption. Our attempt to increase take-up in the encouraged group was successful, as adoption rates in the treatment group were significantly and substantially higher than in the non-encouraged group. Importantly, encouragement designs yield unbiased impacts estimates if and only if the encouragement package affects the key variables of interest only indirectly – i.e., by having induced an exogenous increase in adoption. Arguably, the encouragement package we used plausibly meets this condition.

This study: Analysis of the Barriers to Adoption as a Byproduct of our RED Design

In the context of our study, the RED allowed us to obtain causal inference on the impact of LPN on business outcomes – as is the key objective of our study. Because estimating those impacts required substantially higher adoption rates in the treatment as compared

to the control group, we designed an intervention aimed at fostering adoption, without simultaneously affecting the outcome variables of interest. Providing detailed information on the technology and offering merchants to help them with the application paperwork allowed us to increase adoption, and as a byproduct, it also allows us to test whether reducing some (of the most important) barriers to technology adoption increased adoption.

While there is a literature on the drivers of adoption of electronic payment technologies among consumers, we are not aware of other research studying the causal effect of randomly lifting barriers to the adoption of e-payment technologies by small and medium-sized enterprises. We acknowledge that we are unable to show the relative importance of the various barriers, precisely for the reasons stated above. However, showing that these barriers actually exist and are binding for some firms contributes to advance our knowledge in the existing literature.

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Online Appendix B: Encouragement Interventions

Safaricom launched LPN in 2014, and the key pillars of its marketing campaign were leaflets and TV commercials. Because we randomly assigned businesses to the treatment and control group, the SMEs in both groups were equally exposed to Safaricom's LPN marketing. Obviously, Safaricom's marketing has been successful in convincing (at least some) merchants that adopting LPN is beneficial for their business. The essence of randomized assignment of SMEs to each of the two groups is that, without any additional interventions implemented by us, exposure to Safaricom's marketing is the same in both groups.

The key to our identification strategy is that, on top of Safaricom's advertisement efforts, we set up an additional intervention aimed at inducing take-up – but only among SMEs that had been assigned to the treatment group. We managed to increase to increase LPN adoption from 23% (had we not intervened) to 31%. This increase in take-up is due to the fact that our intervention is complementary to Safaricom's campaign in three respects. First, Safaricom's marketing campaign is fairly generic, while our intervention was developed to provide information that is of specific interest to businesses in the sectors our study focuses on, pharmacies and restaurants. Second, in terms of providing information on how to use the technology, our intervention complemented Safaricom's marketing by our research enumerators demonstrating to the merchants how LPN accounts can be accessed, how money is received and sent, etc., as well as to show how user-friendly the technology is. Third, although Safaricom made an effort to keep the registration process as simple as possible, the necessary work is still quite involved. This is not surprising as opening a bank account typically requires a lengthy registration process, with the applicant being required to hand in (photocopies of) a number of documents, and having to fill out lengthy application forms. The third component of our intervention was to take over, as much as possible, all this work (below we discuss these three components in more detail).

Finally, two further considerations are in order. First, the timing of the intervention was fundamental for the effectiveness of our empirical strategy. We moved fast and implemented the encouragement design soon after the launching of LPN, as it was relatively simply to contact firms without the technology. Second, it is important to note that we are not the only study that involves an intervention encouraging the adoption of a financial product in parallel to marketing efforts of the institution promoting the product. While we are, to our knowledge, the first paper doing this with an electronic payment tool for P2B, there are papers from the broader financial inclusion literature that apply the same method for other financial product. The closest paper in this regard is a recent paper by Cai and Szeidl (2021), who implement an encouragement design to induce the adoption of a loan product launched by Rural Credit Cooperatives (RCC) in China. In addition to the existing marketing efforts of RCC, which stimulated loan applications among the wider population, the researchers took intense efforts to encourage adoption in a treatment group. Similar to our research, Cai and Szeidl (2021) also included elements of "customizing the information on the benefits and ease of loan application for the target SMEs" in their design and provided "help with filling out the loan application document". In their study, the control group also - adopts and - applies for RCC loans; however, the adoption among treated businesses was 33% higher compared to the adoption in the control group.

Provision of Information about the Technology

The objective of this component was to provide information on the advantages and disadvantages of LPN compared to other payment methods. The information was provided by means of a leaflet and a video. All materials were produced by the research team in

close cooperation with DDD-Kenya and a professional producer company.[43]

The leaflet consisted of concrete and easy-to-understand information on LPN's costs and benefits. People only pay attention to that part of the provided information which they think is the most relevant to them, and hence too much information can actually limit adoption. Hanna et al. (2014) thus recommend providing targeted as well as simplified information, and we have tried to follow that advice.

The video complemented the leaflet. It featured an interview with a fellow business owner (i.e., an owner of an SME in the same sector as the merchant) who had already adopted LPN. We thus produced two videos, a 5.2 minute clip for the restaurant sector and a 3.2 minute clip for pharmacists, in which the interviewee summarized the advantages of using LPN as well as their own personal experience with the cashless payment technology.[44] The video was shown in SME premises using enumerator tablets. The inclusion of the video as a component of the intervention is motivated by an emerging literature highlighting the effectiveness of role models in inducing behavioral change. This literature shows that successful peers can act as role models and are particularly effective in the context of low-income households in developing countries (see, for instance, Bernard et al. (2014) and La Ferrara (2016)).

While most merchants knew about the existence of LPN, the purpose of providing information was to complement (and maybe correct) the information the merchants had about the product. For example, the video explained that LPN was easy to use, and illustrated this by showing an example of a customer paying a bill with her M-Pesa account. Likewise, in the video, merchants explained that having LPN was convenient for the customer because transferring money from M-Pesa to LPN was free of charge for the customer, and because the customer does not need to worry about all the issues associated with paying in cash (including concerns about having the correct change). Additionally, the video emphasized that receiving payments in mobile money reduces the chances of theft, and if there is theft, there is less cash in the shop to be stolen. It also reduces the risk of counterfeit money, and makes running the business easier, especially with record keeping. The leaflet also highlighted how simple it was to use LPN, that opening an account was free of charge, that there was no limit to the amount of money the merchant could keep in the account and that transferring money from the LPN account to the merchant's personal M-Pesa account was free. Overall, much of this information was new to the merchants and, in some cases, this information was likely to help correcting prior misconceptions.

Support for the Registration Process

In addition to lifting informational barriers, we also aimed to reduce the transaction costs associated with opening a LPN account. We did so by offering the merchant to handle all the necessary paperwork. After the baseline survey, a trained enumerator would contact those treated businesses that expressed their interest to open an account to pick up the required copies of the documents from the business premises. She would subsequently do all the required paperwork, and deliver the application package to a Safaricom office.[45] When the account was approved, the enumerator would collect all the materials from Safaricom on behalf of the owner of the SME. This component is motivated by the literature pioneered by Bertrand et al. (2004), who argue that (relatively small) transaction barriers

[43] Neither Safaricom nor any other (marketing) company were involved.

[44] As an example, the restaurant video can be accessed by clicking here.

[45] We collaborated with an office of Safaricom during the entire project. This office has trained our enumerator on the registration process, allowed the enumerator to collect documents on behalf of them, and help them opening the account for the businesses.

play a decisive role in preventing people to take advantage of efficient investment opportunities. The paperwork associated with opening an account can be perceived as a hassle for business owners and can prevent them from adopting the technology.

Technology Implementation Assistance

When delivering the LPN material to the business owner, the enumerator made sure that the account would be set to the "transaction ready" mode. Specifically, this component of the intervention consisted of inserting the LPN SIM-card into the mobile phone the business owner would use for her LPN transactions and testing whether the SIM-card was functional. A short training was provided, which ended by assisting the merchant in performing a test transaction – charging our (standard) M-Pesa account for a sum of 100 KShs and completing the transaction.

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Online Appendix C: Information Leaflet

- It's simple and straightforward to use, both to you and your customers.
- It's free to sign up; no set up costs to your business.
- It's available 24/7: hence, can be used outside of core banking hours.
- Other than the small transaction fee of 1%, no other operational costs for your business.
- You have a USSD code to manage the flow of your balances in the merchant account.
- There are no wallet size limits to the amount of money that can be held in your Lipa Na M-PESA merchant account.
- Lipa Na M-PESA minimizes your costs of cash movement, e.g. cash-in-transit, insurance, etc.
- It also minimizes your cost of cash handling, e.g. cash register, money counter, safe machine, etc.
- Lipa Na M-PESA minimizes incidences of internal theft of money by your employees.
- Lipa Na M-PESA helps you maintain good and quality record-keeping using Lipa Na M-PESA transaction statements, for future reference.
- You can then use this statement to apply for credit in a financial institution, when your business needs money.
- With Lipa Na M-PESA, your business has no "change" issues when attending to customers.
- Lipa Na M-PESA gives you the option of rolling up funds from merchant till to either personal M-PESA wallet or bank account, as needed.
- Lipa Na M-PESA ensures security of your business funds against external armed theft/robbery/mugging.
- With Lipa Na M-PESA, there is no risk of fake/counterfeit currency from fraudulent customers.
- Unlike M-PESA P2P, there is no risk of customer reversing funds, claiming they sent the money by mistake, which can inconvenience the smooth running of your business, liquidity-wise.
- Most customers now have mobile handsets, and have registered for M-PESA: most Kenyans keep some money in their M-PESA wallet.
- Depending on type of business, far-away customers can still pay and goods delivered to them, hence increasing your business sales.
- For long-standing relationships, your business can increase sales by offering goods on credit to clients, who then pay later using Lipa Na M-PESA.

- Lipa Na M-PESA ensures that you do not lose customers who have money in their M-PESA and not cash.
- Since it is free to customers, you will have more customers coming to your business; this will increase your sales revenue.
- Your customers earn Bonga (loyalty) points when they use Lipa Na M-PESA in your shop. This can encourage them to buy more, increasing your sales.
- The government wants to go cashless in many sectors, therefore, the earlier you start using Lipa Na M-PESA in your business, the better!
- No stress/worry to you about the safety of your business finances since it is safely kept away in the merchant till.
- No one can access the merchant till account since it is secured by a secret PIN, only known to you.
- Even if the PIN is accidentally made known to some people, the Lipa Na M-PESA merchant funds cannot be transferred to any other M-PESA personal wallet, except that which is official nominated by you or the bank account.

Online Appendix Tables

Table OA1: Variables and their Definitions Used in the Regression Analyses

	Variable	Definiton
Panel A: Standard M-Money Use	For business	=1 if the business uses mobile money to receive payments or store money or pay bills, inputs, salaries.
	To receive payments	=1 if the business receives payments to standard mobile money.
	To store money	=1 if the business store money in standard mobile money beyond business needs.
	To pay bills	=1 if the business pay bills via standard mobile money.
	To pay inputs	=1 if the business pay inputs via standard mobile money.
	To pay salaries	=1 if the business pay salaries via standard mobile money.
	To save	=1 if the business saves revenues in mob. money account.
	% of utility exp. via m-money	% of business utility expenses paid via standard m-money.
	% of input exp. via m-money	% of business input expenses paid via standard m-money.
	Paying wages via m-money	=1 if the business pays wages to the personal m-money accounts of workers.
	No increase in prices	=1 if the business does not increase prices when customer pays via m-money.
Panel B: Safety	Theft and safety index	Summation of internal, external theft, and feeling not safe variables, standardized.
	Internal theft	=1 if employees stole something from the business in the past 6 months.
	External theft	=1 if experienced losses as a result of theft, robbery, fire in the past 6 months.
	Feeling safe	The safety of the area where the business is located (1 very unsafe-10 very safe)
Panel C: Saving Behavior	Savings in a bank or MFI	=1 if the business saves at bank or microfinance account
	Savings in a personal bank account	=1 if the business saves at a personal bank account.
	Savings in a business bank account	=1 if the business saves at a business bank account.
	Savings in an MFI	=1 if the business saves at a microfinance account.
Panel D: Transparency	Not shared sales	=1 if the business has not shared its sales at baseline interview.
	Not shared profits	=1 if the business has not shared its profits at baseline interview.
	Business license	=1 if the business has an up-to-date government business permit.
	Financial soph. index	Summation of bank loan, mobile loan and records, standardized.
	Fin. soph. index alternative	Sum. of bank and, mob. loan.; rec.; sav. at a bank or microf, and a per. b. acc., stand.
	Bank loan	=1 if the business received a bank loan in the past 12 months.
	Mobile loan	=1 if the business received a mobile loan in the past 12 months.
	Business records	=1 if the business keeps business records.
	Sells on credit to customers	=1 if the business makes sales on credit.
Panel E: Behavioral Factors	Present bias	=1 if business owner or manager is present biased.
	Future orientation	=1 if merchant is more patient regarding the timing of future payments than for present payments.
	Cognitive ability	maximum number of digits remembered.
	Trust in strangers	Trust in people you meet for the first time, 1 (not at all) -4 (completely).
	Trust in customers	Trust in customers, 1 (not at all) -4 (completely).
	Trust in courts	Trust in courts, 1 (not at all) -4 (completely).
	Trust in m-money company	Trust in mobile money companies, 1 (not at all) -4 (completely).
Panel F: Business Size	Employees (log)	Number of total employees, logarithm.
	Monthly Sales, in 1000 Ksh. (log-winsorized 5%)	Sales in the past month, 5% winsorized & in logarithm.
	Monthly Profits, in 1000 Ksh. (log-winsorized 5%)	Profits in the past month, 5% winsorized & in logarithm.
Panel G: Reasons of not opening a Lipa Na M-pesa account	Not seeing the benefits of Lipa Na M-Pesa	=1 if bus. does not have an accout, because bus. do not see benefits of Lipa Na M-Pesa
	Too costly to open an account	=1 if bus. does not have account because it is too costly to open
	High transaction fees via Lipa Na M-pesa	=1 if bus. does not have an account because of high transaction fees.
	Don't have time to open an account	=1 if bus. does not have account because of not having time to open account.
	Would not increase my sales	=1 if bus. does not have an account because of thinking it would not increase bus. sales.
	No trust in mobile money provider (0/1)	=1 if bus. does not have have an account because it does not trust in m-money provider.
	Too complex to use (0/1)	=1 if bus. does not have an account because it is too complex to use.

Table OA2: Descriptive Statistics of Variables Used in the Regression Estimations

		All Sample			Pharmacy			Restaurant		
	Variable	N	mean	sd	N	mean	sd	N	mean	sd
***Panel A**: Standard* M-Money Use	For business	543	0.52	0.50	249	0.42	0.49	294	0.60	0.49
	To receive payments	541	0.34	0.47	248	0.27	0.44	293	0.40	0.49
	To store money	541	0.17	0.38	247	0.09	0.29	294	0.24	0.43
	To Pay bill	542	0.30	0.46	248	0.26	0.44	294	0.33	0.47
	To pay input	542	0.37	0.48	248	0.29	0.45	294	0.43	0.50
	To pay salaries	542	0.06	0.24	248	0.06	0.24	294	0.06	0.25
	To save	540	0.10	0.30	247	0.04	0.20	293	0.15	0.36
	% of utility exp. via m-money	472	0.32	0.44	224	0.34	0.46	248	0.30	0.42
	% of input exp. via m-money	480	0.15	0.29	222	0.14	0.28	258	0.15	0.30
	Paying wages via m-money	536	0.05	0.23	242	0.06	0.24	294	0.05	0.21
	No increase in prices	544	0.13	0.34	250	0.11	0.31	294	0.15	0.35
***Panel B**: Safety*	Theft and safety index	535	0.04	1.09	244	-0.27	0.68	291	0.30	1.29
	Internal theft	536	0.27	0.44	245	0.07	0.26	291	0.44	0.50
	External theft	543	0.10	0.30	249	0.02	0.15	294	0.17	0.37
	Feeling safe	543	7.31	1.89	249	7.04	1.87	294	7.54	1.88
Panel C: Saving Behavior	Saving in a bank or micro.	540	0.57	0.50	247	0.52	0.50	293	0.61	0.49
	Saving in a personal bank acc.	540	0.37	0.48	247	0.28	0.45	293	0.45	0.50
	Saving in a business bank acc.	540	0.20	0.40	247	0.25	0.43	293	0.15	0.36
	Saving at a microf. inst.	540	0.03	0.16	247	0.02	0.15	293	0.03	0.16
***Panel D**: Transparency*	Business license	536	0.71	0.46	244	0.91	0.29	292	0.54	0.50
	Financial soph. index	513	-0.03	1.01	227	0.01	0.78	286	-0.06	1.16
	Final soph. index alternative	511	-0.09	1.00	225	-0.12	0.95	286	-0.07	1.04
	Bank loan	520	0.10	0.31	232	0.06	0.25	288	0.14	0.34
	Mobile loan	515	0.10	0.31	229	0.07	0.26	286	0.13	0.34
	Business records	544	0.87	0.34	250	0.96	0.21	294	0.79	0.41
	Sells on credit to cust.	543	0.51	0.50	250	0.45	0.50	293	0.57	0.50
	Not shared sales	544	0.14	0.35	250	0.21	0.41	294	0.09	0.28
	Not shared profits	544	0.14	0.35	250	0.21	0.41	294	0.08	0.27
***Panel E**: Behavioral Factors*	Present bias	541	0.12	0.33	249	0.11	0.32	292	0.13	0.34
	Future orientation	541	0.15	0.35	249	0.12	0.33	292	0.16	0.37
	Cognitive ability	542	3.58	0.64	250	3.42	0.69	292	3.71	0.57
	Trust in strangers	541	2.11	0.85	249	2.16	0.89	292	2.07	0.82
	Trust in customers	542	3.41	0.65	249	3.41	0.61	293	3.41	0.69
	Trust in courts	542	2.39	0.94	250	2.36	0.98	292	2.42	0.91
	Trust in mob. mon. comp.	543	5.20	1.50	250	5.42	1.48	293	5.02	1.49
Panel F: Business size	Employees (log)	544	1.41	0.42	250	1.19	0.27	294	1.59	0.43
	Monthly Sales, in 1000 Ksh. (log-winsorized 5%)	466	5.03	0.95	198	4.73	0.80	268	5.25	0.99
	Monthly Profits, in 1000 Ksh. (log-winsorized 5%)	468	3.84	0.91	198	3.81	0.83	270	3.86	0.97
Panel G: Reasons of not opening a Lipa Na M-pesa M-pesa account	Not seeing the benefits of Lipa Na M-Pesa	543	0.25	0.43	249	0.27	0.44	294	0.23	0.42
	Too costly to open an account	543	0.11	0.31	249	0.17	0.38	294	0.05	0.23
	High transaction fees via Lipa Na M-pesa	543	0.16	0.37	249	0.24	0.43	294	0.10	0.29
	Don't have time to open an account	543	0.12	0.32	249	0.07	0.25	294	0.16	0.37
	Would not increase my sales	543	0.09	0.28	249	0.12	0.32	294	0.06	0.24
	No trust in mobile money provider	543	0.02	0.15	249	0.04	0.20	294	0.01	0.10
	Too complex to use	543	0.11	0.31	249	0.08	0.28	294	0.13	0.34

Table OA3: Descriptive Statistics from Endline survey - All businesses with Business Licenses

Variables	Definition	All sample			Control			Treatment		
		N	Mean	Median	N	Mean	Median	N	Mean	Median
Lipa Na M-pesa use										
Have Lipa na M-pesa account (0/1)	=1 if business have a registered Lipa na M-pesa account	620	0.27	0	311	0.23	0	309	0.31	0
Used Lipa na M-pesa account for business (0/1)	=1 if business used Lipa na M-pesa account over the last 30 days	620	0.25	0	311	0.21	0	309	0.29	0
Received payment via Lipa na M-pesa (0/1)	=1 if business used Lipa na M-pesa account received payments over the last 30 days	620	0.25	0	311	0.20	0	309	0.29	0
Lipa na M-pesa sales, monthly (1000 Ksh.)	Total sales received via Lipa Na M-pesa at a typical month	620	15.50	0	311	12.47	0	309	18.54	0
Fraction of customers pay via Lipa na M-pesa	Number of customers paying via Lipa Na M-pesa divided by total number of customers	612	0.07	0	308	0.08	0	304	0.05	0
Management practices and safety										
Record keeping via mobile money (0/1)	=1 if the business keeps records via personal mobile money or Lipa Na M-pesa	620	0.11	0	311	0.10	0	309	0.12	0
Not having change (0/1)	=1 if the business experienced a foregone opportunity to sell goods due to not having change	620	0.25	0	311	0.26	0	309	0.25	0
Safety (1 not feel safe - 10 feel safe)	Safety of the area where the business is located in terms of the threats of fire, theft, robbery, etc.	620	7.03	7	311	6.89	7	309	7.18	8
Investment and access to finance										
Capital investment, (1000 Ksh.)	Investment in the capital goods in the last 6 months	601	10.17	0	303	9.30	0	298	11.05	0
Bank loan (0/1)	=1 if the business received a loan from a bank. in the past 12 months	610	0.09	0	305	0.08	0	305	0.10	0
Informal loan (0/1)	=1 if the business received a loan from friends, relatives, etc. in the past 12 months	607	0.05	0	304	0.05	0	303	0.06	0
Mobile loan (0/1)	=1 if the business received a loan through mobile money money companies in the past 12 months	613	0.13	0	307	0.10	0	306	0.16	0
Business size										
Sales, monthly (1000 Ksh.)	Sales over the past month	539	213.07	120	267	218.27	135	272	207.96	120
Profits, monthly, (1000 Ksh.)	Profits over the past month.	531	66.91	45	266	68.67	45	265	65.14	48
Employees	Number of total permanent and temporary employees	594	4.38	3	301	4.40	3	293	4.35	3

Table OA4A: Business Characteristics and Balance Test - Pharmacies and Restaurants

	Pharmacy				Restaurant			
	All	Cont	Treat	Diff	All	Cont	Treat	Diff
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Standard Mobile Money Use								
Use Mobile Money for business purposes (Yes=1; No=0)	0.41	0.40	0.43	-0.03	0.59	0.57	0.62	-0.05
Use Mobile Money to receive payments (Yes=1; No=0)	0.25	0.21	0.28	-0.07*	0.40	0.38	0.42	-0.04
Use Mobile Money to store money (Yes=1; No=0)	0.09	0.09	0.10	0.00	0.25	0.26	0.24	0.02
Use Mobile Money to pay bills (Yes=1; No=0)	0.26	0.26	0.27	-0.01	0.36	0.37	0.35	0.02
Use Mobile Money to pay salaries (Yes=1; No=0)	0.04	0.02	0.06	-0.04**	0.07	0.07	0.07	0.00
Use Mobile Money to pay inputs (Yes=1; No=0)	0.31	0.32	0.29	0.03	0.43	0.41	0.45	-0.04
Awareness of Lipa Na M-Pesa and Reasons for not Having an Account								
Aware of Lipa Na M-Pesa (Yes=1; No=0)	0.94	0.95	0.93	0.02	0.96	0.95	0.97	-0.02
Has Lipa Na M-Pesa (Yes=1; No=0)	0.05	0.01	0.08	-0.06***	0.12	0.12	0.12	0.00
Does not see the benefits of LPN M-Pesa (Yes=1; No=0)	0.27	0.27	0.27	0.00	0.25	0.27	0.24	0.03
Cost of opening LPN M-Pesa is too high (Yes=1; No=0)	0.17	0.18	0.16	0.02	0.05	0.03	0.06	-0.02
High transaction fees via Lipa Na M-pesa (Yes=1; No=0)	0.25	0.25	0.24	0.01	0.09	0.08	0.09	-0.01
Doesn't have time to open an account (Yes=1; No=0)	0.09	0.11	0.07	0.04	0.14	0.14	0.15	-0.01
Would not increase my sales (Yes=1; No=0)	0.09	0.08	0.11	-0.02	0.06	0.06	0.06	0.00
No trust in mobile money provider (Yes=1; No=0)	0.03	0.03	0.04	-0.01	0.02	0.02	0.01	0.00
Too complex to use (Yes=1; No=0)	0.08	0.08	0.08	0.00	0.11	0.09	0.13	-0.03
Business size								
Monthly Sales, in 1000 Ksh. (winsorized 5%)	144.90	130.38	158.41	-28.03**	316.17	310.50	321.75	-11.25
Monthly Profits, in 1000 Ksh. (winsorized 5%)	58.68	53.53	63.47	-9.95**	79.88	78.51	81.22	-2.71
Number of employees	3.39	3.32	3.46	-0.14	6.18	6.19	6.16	0.02
Investment and access to finance								
Investment in the past 6 months (Yes=1; No=0)	0.19	0.19	0.20	-0.01	0.37	0.39	0.35	0.04
Bank loan in the past 12 months (Yes=1; No=0)	0.07	0.07	0.06	0.01	0.12	0.10	0.14	-0.04*
Informal loan in the past 12 months (Yes=1; No=0)	0.03	0.03	0.02	0.00	0.04	0.04	0.05	-0.01
Mobile loan in the past 12 months (Yes=1; No=0)	0.08	0.07	0.09	-0.02	0.12	0.12	0.12	0.00
Informality								
Business license (Yes=1; No=0)	0.92	0.93	0.91	0.02	0.56	0.55	0.57	-0.01

Notes: This table reports the baseline characteristics of pharmacies and restaurants assigned to treatment and control groups. * p<0.10, ** p<0.05, *** p<0.01.

Table OA4B: Comparison of Pharmacies and Restaurants at Baseline

	All businesses			Businesses with license		
	Pharmacy	Restaurant	Diff.	Pharmacy	Restaurant	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)
Personal mobile money use for business purposes						
Using mob. money for business purposes (0/1)	0.41	0.59	0.18***	0.42	0.65	0.23***
Using mob. money to receive payments (0/1)	0.25	0.40	0.16***	0.25	0.47	0.21***
Share of mobile money customers	0.02	0.03	0.01**	0.02	0.04	0.02***
Using mob. money to store money (0/1)	0.09	0.25	0.15***	0.10	0.22	0.12***
Using mob. money to pay bills (0/1)	0.26	0.36	0.10***	0.27	0.45	0.18***
Using mob. money to pay salaries (0/1)	0.04	0.07	0.03**	0.04	0.08	0.04**
Using mob. money to pay inputs (0/1)	0.31	0.43	0.12***	0.32	0.49	0.17***
Awareness of Lipa Na M-Pesa and reasons of not adopting						
Aware of Lipa Na M-Pesa (0/1)	0.94	0.96	0.02	0.95	0.98	0.03**
Have Lipa Na M-Pesa (0/1)	0.05	0.12	0.08***	0.05	0.18	0.14***
Not seeing the benefits of Lipa Na M-Pesa (0/1)	0.27	0.25	-0.02	0.25	0.24	-0.02
Too costly to open an account (0/1)	0.17	0.05	-0.13***	0.17	0.07	-0.11***
High transaction fees via Lipa Na M-pesa (0/1)	0.25	0.09	-0.16***	0.26	0.10	-0.15***
Don't have time to open an account (0/1)	0.09	0.14	0.05**	0.08	0.19	0.11***
Would not increase my sales (0/1)	0.09	0.06	-0.03*	0.10	0.07	-0.03
No trust in mobile money provider (0/1)	0.03	0.02	-0.02*	0.03	0.02	-0.02
Too complex to use (0/1)	0.08	0.11	0.03*	0.08	0.13	0.05**
Business size						
Monthly Sales	144.90	316.17	171.27***	149.23	415.54	266.30***
Monthly Profits	58.68	79.88	21.20***	60.56	102.43	41.87***
Number of employees	3.39	6.18	2.78***	3.44	7.35	3.91***
Investment and access to finance						
Investment (0/1), in the past 6 months	0.19	0.37	0.17***	0.19	0.40	0.21***
Bank loan (0/1), in the past 12 months	0.07	0.12	0.06***	0.07	0.11	0.04**
Informal loan (0/1), in the past 12 months	0.03	0.04	0.02	0.03	0.04	0.02
Mobile loan (0/1) in the past 12 months	0.08	0.12	0.04**	0.09	0.09	0.00
Informality						
Business license (0/1)	0.92	0.56	-0.36***	1.00	1.00	0.00

Notes: This table compares the baseline characteristics of pharmacies and restaurants. Columns 1-2 report the sample averages for all pharmacies and restaurants and columns 4-5 report the averages for licensed pharmacies and restaurants. Columns 3 and 6 report the differences between Pharmacies and Restaurants. * p<0.10, ** p<0.05, *** p<0.01.

Table OA4C: Normalized Differences in Means of Imbalanced Variables

		Treatment		Control		Normalized
Table Reference	Variable	Mean	SD	Mean	SD	Mean Difference
2	M-Money use	0.55	0.5	0.49	0.5	0.12
2	M-money receive payment	0.4	0.49	0.3	0.46	0.21
2	M-Money pay salaries	0.08	0.27	0.04	0.2	0.17
OA4A	Sales (for Pharmacies)	158.41	135.83	130.63	111.23	0.22
OA4A	LPN (for Pharmacies)	0.08	0.27	0.01	0.12	0.34
OA4A	Bank loan (for Restaurants)	0.14	0.35	0.10	0.30	0.12

Notes: This table reports the normalized differences between treatment and control groups of the five variables that were unbalanced at baseline (Tables 2 and OA4A). The normalized difference is defined as the difference in means between the treatment and control groups, divided by the square root of half the sum of the treatment and control group variances (Imbens and Rubin, 2015).

Table OA5A: LPN Usage - Limited Set of Controls

	(1)	(2)	(3)	(4)
	Opened LPN (0/1)	Used LPN (0/1)	Received payment via LPN (0/1)	LPN sales, IHS transformed
Treatment	0.08**	0.10**	0.10**	0.38**
	(0.03)	(0.03)	(0.03)	(0.13)
Control Mean	0.23	0.21	0.20	0.75
Control StDev	0.42	0.40	0.40	1.66
N	619	618	618	618

Notes: This table replicates Table 5A but using only strata dummies and lagged dependent variable as controls. * p<0.10, ** p<0.05, *** p<0.01.

Table OA5B: LPN Usage for Visible and Non-transparent Businesses - Limited Set of Controls

	(1)	(2)	(3)	(4)
	Opened LPN (0/1)	Used LPN (0/1)	Received payment via LPN (0/1)	LPN sales IHS transformed
Panel A: Transparent Firms: shared sales figures in the baseline				
Treatment	0.09**	0.11**	0.11**	0.45***
	(0.04)	(0.04)	(0.04)	(0.15)
Contol Mean	0.24	0.21	0.21	0.76
Contol StDev	0.43	0.41	0.41	1.69
N	488	487	487	487
Panel B: Non-transparent firms: did not share sales figures in the baseline				
Treatment	-0.01	0.03	0.03	0.02
	(0.08)	(0.08)	(0.08)	(0.28)
Control Mean	0.19	0.18	0.18	0.70
Contol StDev	0.40	0.39	0.39	1.59
N	131	131	131	131

Notes: This table replicates Table 5B but using only strata dummies and lagged dependent variable as controls. * p<0.10, ** p<0.05, *** p<0.01.

Table OA5C: Heterogeneous Treatment Effects for Lipa Na M-Pesa Usage

	(1) Opened LPN (0/1)	(2) Used LPN (0/1)	(3) Received payment via LPN (0/1)	(4) LPN sales IHS transformed
Treatment	0.07**	0.08**	0.08**	0.32**
	(0.03)	(0.03)	(0.03)	(0.13)
	[0.12]	[0.05]	[0.05]	[0.04]
Small x Treatment	-0.18	-0.19	-0.19	-0.98
	(0.18)	(0.18)	(0.17)	(0.67)
	[0.74]	[0.70]	[0.69]	[0.40]
Control Mean	0.22	0.20	0.19	0.70
Control StDev	0.41	0.40	0.39	1.61
N	619	618	618	618

Notes: This table presents the HTE estimates for LPN use indicators. Dependent and control variables are described in Table 5A. The dummy Small (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table OA5D: Heterogeneous Treatment Effects for LPN use for Money Storing, Paying Bills and Input Purchase - Binary Dependent Variables

	(1) Storing money in LPN (Yes/No)	(2) Paying bill via LPN (Yes/No)	(3) Paying inputs via LPN (Yes/No)
Treatment	0.032	-0.008	0.002
	(0.022)	(0.015)	(0.018)
	[0.20]	[0.75]	[0.99]
Small x Treatment	-0.083	-0.050	-0.087
	(0.101)	(0.069)	(0.117)
	[0.52]	[0.62]	[0.63]
Control Mean	0.064	0.030	0.044
Control StDev	0.245	0.172	0.205
N	618	619	619

Notes: This table presents the HTE estimates for LPN use for storing money, paying bills, and input purchase. The control vector is described in Table 5A. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table OA5E: Heterogeneous Treatment Effects for LPN use for Money Storing, Paying Bills, and Input Purchase - Frequency Dependent Variables

	(1) Freq. of storing money in Lipa	(2) Freq. of paying bill via in Lipa	(3) Freq. paying inputs via in Lipa
Treatment	0.095	-0.015	0.006
	(0.080)	(0.039)	(0.062)
	[0.31]	[0.83]	[0.98]
Small x Treatment	-0.421	-0.087	-0.251
	(0.342)	(0.148)	(0.300)
	[0.29]	[0.70]	[0.56]
Control Mean	0.236	0.077	0.145
Control StDev	0.914	0.455	0.695
N	618	619	619

Notes: This table presents the HTE estimates for LPN use for storing money, paying bills, and input purchase. The dependent variable equals 0 when business did not use LPN, 1 when business used a few times a year, 2 when business used once a month, 3 when business used once a week, and 4 when business used at least once a day. The control vector is described in Table 5A. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01. p-values after correction for multiple hypothesis-testing are reported in brackets.

Table OA5F: 2SLS Estimates - Effect of Opening LPN on Sales via LPN

	(1)	(2)
	Opened LPN (Yes/No)	LPN sales, (IHS transfromed)
Treatment	0.07**	
	(0.03)	
Opened LPN (Yes/No)		4.05***
		1.18
	First stage	Second stage
N	618	618

Notes: This Table shows 2SLS estimates for the (treatment on treated) effect of opening a Lipa Na M-pesa account on sales through Lipa Na M-pesa. Column 1 show the first stage estimates and columns 2 reports the second stage estimates. Both estimations include the following control variables: sales through Lipa Na M-pesa at baseline, use of mobile money for business purposes, use of mobile money to pay salaries, use of mobile money to receive payments, has LPN, had a bank loan in the past 12 months, ln(sales-winsorized), not reporting sales and stratification controls.. * p<0.10, ** p<0.05, *** p<0.01.

Table OA6A: Business Finance - Limited Set of Controls

	(1)	(2)	(3)	(4)
Panel A: External finance (Formal)				
	Mobile loans (Yes/No)	Mobile loans IHS transformed	Bank loans (Yes/No)	Bank loans IHS transformed
Treatment	0.06**	0.53**	0.02	0.08
	(0.03)	(0.24)	(0.02)	(0.26)
Control Group Mean	0.10	0.81	0.08	0.89
Control Group StDev	0.30	2.55	0.26	3.05
N	612	581	609	580
Panel B: External finance (Informal)				
	Trade credit (Yes/No)	Trade credit IHS transformed	Informal loan (Yes/No)	Informal loan IHS transformed
Treatment	-0.01	-0.44	0.01	-0.02
	(0.04)	(0.39)	(0.02)	(0.10)
Control Group Mean	0.35	3.39	0.05	0.16
Control Group StDev	0.48	5.03	0.22	1.21
N	619	564	576	575

Notes: This table replicates Table 6A but using only strata dummies and lagged dependent variable as controls. * p<0.10, ** p<0.05, *** p<0.01.

Table OA6B: Heterogeneous Treatment Effects for Business Finance - Limited Set of Controls

	(1)	(2)	(3)	(4)
Panel A: External Finance (Formal)				
	Mobile loans (Yes/No)	Mobile loans IHS transformed	Bank loans (Yes/No)	Bank loans IHS transformed
Treatment	0.04	0.43*	0.02	0.09
	(0.03)	(0.25)	(0.02)	(0.27)
Small x Treatment	0.30***	2.24**	-0.00	-0.10
	(0.11)	(0.97)	(0.10)	(0.97)
Control Group Mean	0.11	0.85	0.08	0.89
Control Group StDev	0.31	2.61	0.26	3.05
N	612	581	609	580
Panel B: External finance (Informal)				
	Trade credit (Yes/No)	Trade credit IHS transformed	Informal loan (Yes/No)	Informal loan IHS transformed
Treatment	-0.02	-0.53	0.00	-0.08
	(0.04)	(0.41)	(0.02)	(0.09)
Small x Treated	0.17	1.91	0.20*	1.19
	(0.15)	(1.50)	(0.10)	(0.78)
Control Group Mean	0.36	3.45	0.05	0.17
Control Group StDev	0.48	5.05	0.22	1.24
N	619	564	576	575

Notes: This table replicates Table 6B but using only strata dummies and lagged dependent variable as controls. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01.

Table OA6C: Aggregate Loan Access - Limited Set of Controls

	Aggregate Loans (Yes/No)	Aggregate Loans (Yes/No)
Treatment	0.01	-0.01
	(0.04)	(0.04)
Small x Treatment		0.35**
		0.16
Control Mean	0.47	0.48
Control Stdev	0.50	0.50
N	619	619

Notes: This table replicates Table 6C but using only strata dummies and lagged dependent variable as controls. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01.

Table OA7: Business Sales and Profits (Levels and Volatility) - Limited Set of Controls

	(1) ln(Sales)	(2) ln(Sales)	(3) Sales Volatility	(4) Sales Volatility	(5) Sales Volatility Robust	(6) Sales Volatility Robust	(7) ln(Profits)	(8) ln(Profits)	(9) Profits Volatility	(10) Profits Volatility	(11) Profits Volatility robust	(12) Profits Volatility robust
Treatment	-0.03	-0.03	-0.00	0.00	-0.00	0.00	-0.07	-0.05	-0.00	-0.00	-0.00	-0.00
	(0.07)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.07)	(0.01)	(0.01)	(0.01)	(0.01)
Small x Treatment		-0.03		-0.03		-0.03		-0.34		-0.00		-0.00
		-0.34		(0.02)		(0.02)		-0.36		(0.02)		(0.02)
Control Mean	4.91	4.90	1.06	1.06	1.06	1.06	3.84	3.83	1.08	1.07	1.07	1.07
Control StDev	0.96	0.95	0.05	0.05	0.04	0.04	0.89	0.89	0.06	0.07	0.06	0.06
N	539	539	436	436	515	515	531	531	389	389	494	494

Notes: This table replicates Table 7 but using only strata dummies and lagged dependent variable as controls. The dummy *Small* (defined in Table 6B) is included as a co-variate in HTEs. * p<0.10, ** p<0.05, *** p<0.01.

Table OA8A: Treatment and Heterogenous Treatment Effects for Business Investment - Limited Set of Controls

	(1)	(2)	(3)	(4)
	Total Investment IHS transformed	Total Investment IHS transformed	Inventory Investment IHS transformed	Inventory Investment IHS transformed
Treatment	0.27	0.35*	0.23	0.50
	(0.20)	(0.20)	(0.17)	(2.74)
Small x Treatment		-1.68*		-0.28
		(0.88)		(0.73)
Control Mean	1.76	1.73	1.20	1.23
Control StDev	2.26	2.27	1.93	1.95
N	526	526	546	546

Notes: This table replicates Table 8A but using only strata dummies and lagged dependent variable as controls. The dummy *Small* (defined in Table 6B) is included as a co-variate in HTEs. * p<0.10, ** p<0.05, *** p<0.01.

Table OA8B: Treatment Effects for Business Expenses - Limited Set of Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	Input expenses IHS transformed	Building expenses IHS transformed	Transportation expenses IHS transformed	Utility expenses IHS transformed	Employee expenses IHS transformed	Interest expenses IHS transformed
Treatment	-0.25	0.20	0.02	-0.22	0.22	-0.03
	(0.27)	(0.17)	(0.27)	(0.13)	(0.21)	(0.19)
Control Mean	10.54	9.42	1.82	8.12	9.14	0.70
Control StDev	3.53	2.64	3.57	1.57	3.07	2.23
N	585	608	591	610	619	577

Notes: This table replicates Table 8B but using only strata dummies and lagged dependent variable as controls. * p<0.10, ** p<0.05, *** p<0.01. Outcome variables are IHS transformed.

Table OA8C: Heterogenous Treatment Effects for Business Expenses - Limited Set of Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	Input expenses IHS transformed	Building expenses IHS transformed	Transportation expenses IHS transformed	Utility expenses IHS transformed	Employee expenses IHS transformed	Interest expenses IHS transformed
Treatment	-0.14	0.20	0.05	-0.13	0.24	-0.06
	(0.28)	(0.18)	(0.28)	(0.13)	(0.22)	(0.19)
Small x Treatment	-2.37**	-0.06	-0.39	-1.76*	-0.30	0.69
	(1.20)	(0.52)	(1.39)	(1.02)	(0.66)	(0.93)
Control Mean	10.49	9.41	1.78	8.13	9.10	0.71
Control StDev	3.60	2.63	3.54	1.52	3.13	2.24
N	585	608	591	610	619	577

Notes: This table replicates Table 8C but using only strata dummies and lagged dependent variable as controls.The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01.

Table OA9A: Business Safety - Limited Set of Controls

	Feeling safe
Treatment	0.27*
	(0.14)
Control Mean	6.89
Control StDev	1.84
N	619

Notes: This table replicates Table 9A but using only strata dummies and lagged dependent variable as controls. * p<0.10, ** p<0.05, *** p<0.01.

Table OA9B: Business Safety and Theft Exposure - Limited Set of Controls

	(1)	(2)
	Theft in Baseline	No Theft in Baseline
	Feeling safe	Feeling Safe
Treatment	1.04**	0.20
	(0.46)	(0.15)
Control Mean	6.36	6.96
Control StDev	1.95	1.82
N	75	543

Notes: This table replicates Table 9B but using only strata dummies and lagged dependent variable as controls. * p<0.10, ** p<0.05, *** p<0.01.

Table OA9C: Heterogenous Treatment Effects on Business Safety for Businesses Exposed to Theft - Limited Set of Controls

	Feeling safe
Treatment	1.157**
	(0.495)
Small x Treatment	-0.951
	(1.617)
Control Mean	6.40
Control StDev	2.02
N	75

Notes: This table replicates Table 9C but using only strata dummies and lagged dependent variable as controls. The dummy *Small* (defined in Table 6B) is included as a co-variate. * p<0.10, ** p<0.05, *** p<0.01.

Table OA10: Minimum Detectable Effect Sizes

Outcome variables	Sample size	Control group mean	Minimum detectable effect size (MDES)
LPN sales, IHS transformed	618	0.75	0.40
Mobile loans (Yes/No)	612	0.10	0.08
Mobile loans, IHS transformed	581	0.81	0.67
Bank loans (Yes/No)	609	0.08	0.06
Bank loans, IHS transformed	580	0.89	0.74
Trade credit (Yes/No)	619	0.35	0.11
Trade credit, IHS transformed	564	3.39	1.14
Informal loan (Yes/No)	576	0.05	0.05
Informal loan, IHS transformed	575	0.16	0.28
Aggregate loans (Yes/No)	619	0.47	0.11
Log(Sales)	539	4.91	0.23
Log(Profitability)	531	3.84	0.22
Sales volatility	515	1.06	0.01
Profits volatility	494	1.07	0.01
Total Investment, IHS transformed	526	1.76	0.56
Inventory Investment, IHS transformed	546	1.20	0.47
Input expenses, IHS transformed	585	10.54	0.83
Building expenses, IHS transformed	608	9.42	0.55
Transportation expenses, IHS transformed	591	1.82	0.82
Utility expenses, IHS transformed	610	8.12	0.42
Employee expenses, IHS transformed	619	9.14	0.65
Interest expenses, IHS transformed	577	0.70	0.52
Feeling safe	619	6.89	0.41

Notes: The table shows the minimum detectable effect (MDE) given the control group mean for each outcome variable that we test the impact of. MDEs are calculated assuming a 5% significance criterion and 80% power.

Table OA11: Transparent and Non-transparent Businesses' Willingness to Open an LPN account: Reasons for Not Opening an Account at BL

	(1)	(2)	(3)
	Transparent	Non transparent	Diff. (1)-(2)
Not seeing the benefits of Lipa Na M-Pesa (0/1)	0.163	0.250	-0.087
Too costly to open an account (0/1)	0.065	0.000	0.065
High transaction fees via Lipa Na M-pesa (0/1)	0.112	0.000	0.112
Don't have time to open an account (0/1)	0.181	0.350	-0.169*
Would not increase my sales (0/1)	0.037	0.050	-0.013
No trust in mobile money provider (0/1)	0.005	0.000	0.005
Too complex to use (0/1)	0.130	0.000	0.130*

Notes: This table compares the fraction of transparent and non-transparent business willing to open a Lipa na M-pesa account in our experiment by reasons of not opening the account before the experimental intervention. Transparent businesses are defined as businesses that shared the sales numbers with our research team. We use baseline data for this analysis. Column 3 is the difference between Columns 1 and 2. * p<0.10, ** p<0.05, *** p<0.01.

Table OA12: Heterogeneous Treatment Effects on Business Sales by Baseline Number of Customers

	(1)	(2)	(3)
	ln(Sales) All	ln(Sales) Restaurants	ln(Sales) Pharmacies
Treatment	-0.01	0.06	-0.14
	(0.10)	(0.18)	(0.14)
Treated x Baseline number of 100 customers	-0.05	-0.10	0.18
	(0.12)	(0.14)	(0.23)
Baseline number of 100 customers	0.03	0.11	-0.02
	(0.11)	(0.12)	(0.20)
Control Mean	4.91	5.30	4.62
Control StDev	0.96	1.05	0.76
N	539	232	307

Notes: This table presents the results of the test how our treatment estimates on sales varies with the number of customers at baseline. Column 1 reports the results for all firms in our sample, and columns 2 and 3 report estimates for just the restaurants and the pharmacies, respectively. We multiply number of customers by 100 to reduce the coefficient estimates' number of decimals. The vector of controls is as defined in Table 5A. * p<0.10, ** p<0.05, *** p<0.01.

Table OA13: Comparison of p-values from OLS and Randomization Inference

	OLS	Randomization inference
Table 5A: LPN Usage		
Opened LPN (0/1)	0.062	0.057
Used LPN (0/1)	0.025	0.017
Received payment via LPN (0/1)	0.027	0.019
LPN sales, (IHS transformed)	0.030	0.034
Table 6B: Business Finance		
Mobile loans (Yes/No)	0.066	0.058
Mobile loans (IHS transformed)	0.057	0.053
Bank loans (Yes/No)	0.549	0.554
Bank loans (IHS transformed)	0.831	0.823
Trade credit (Yes/No)	0.626	0.611
Trade credit (IHS transformed)	0.202	0.183
Informal loans (Yes/No)	0.777	0.790
Informal loans (IHS transformed)	0.763	0.748

Notes: This table compares the p-values of OLS estimates presented in Table 5A and 6A with the p-value for the same treatment effect estimates using randomization inference. For each of the dependent variables used in each of the two tables, columns 1 and 2 present, respectively, the p-values as obtained in the original OLS regressions and those obtained using randomization inference.

Table OA14A: Spillovers from Control to Treatment Restaurants: LPN Adoption

	(1)	(2)	(3)	(4)
	Opened LPN	Opened LPN	Used LPN	Used LPN
Number of control restaurants < 500m	0.001		0.001	
	(0.015)		(0.015)	
Shortest distance to a control restaurant		0.378*		0.387*
		(0.226)		(0.231)
Controls Included	Yes	Yes	Yes	Yes
N	132	112	132	112
R-Squared	0.290	0.362	0.313	0.377

Notes: This table assesses the importance of adoption spillovers by testing whether proximity of control units in the same sector affects uptake of Lipa Na M-Pesa by treatment restaurants. Proximity is measured by the number of control restaurants within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control restaurant (in columns (2) and (4)). Uptake is measured by either whether the treatment restaurant opened a Lipa Na M-Pesa account (the extensive margin, in columns (1) and (2)), or the frequency with which the treatment restaurant made use of its Lipa Na M-Pesa account (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table OA14B: Spillovers from Control to Treatment Restaurants: Mobile Loan Usage

	(1)	(2)	(3)	(4)
	Mobile loan (Yes/No)	Mobile loan (Yes/No)	Mobile loan IHS Transformed	Mobile loan IHS Transformed
Number of control restaurants < 500m	-0.007		-0.030	
	(0.011)		(0.091)	
Shortest distance to a control restaurant		0.028		-0.141
		(0.176)		(1.288)
Controls Included	Yes	Yes	Yes	Yes
N	130	110	124	106
R-Squared	0.275	0.309	0.283	0.325

Notes: This table presents the results of the reverse spillovers analysis in restaurants, and tests whether proximity of restaurants in the control group affects mobile loan usage by treatment restaurants. Proximity is measured by the number of control restaurants within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control restaurant (in columns (2) and (4)). Uptake is measured by either whether the treatment restaurant had a mobile loan (the extensive margin, in columns (1) and (2)), or the amount of mobile loan (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table OA15A: Spillovers from Control to Treatment Pharmacies: LPN adoption

	(1)	(2)	(3)	(4)
	Opened LPN	Opened LPN	Used LPN	Used LPN
Number of control pharmacies < 500m	0.001		-0.000	
	(0.010)		(0.010)	
Shortest distance to a control pharmacy		-0.045		-0.012
		(0.060)		(0.062)
Controls Included	Yes	Yes	Yes	Yes
N	176	176	175	175
R-Squared	0.295	0.297	0.284	0.284

Notes: This table presents the results of the reverse spillovers analysis in pharmacies, and tests whether proximity of pharmacies in the control group affects uptake of LPN by treatment pharmacies. Proximity is measured by the number of control pharmacies within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control pharmacy (in columns (2) and (4)). Uptake is measured by either the treatment pharmacies having opened an LPN account (the extensive margin, in columns (1) and (2)), or by the frequency with which the treatment pharmacy made use of its LPN account (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table OA15B: Spillovers from Control to Treatment Pharmacies: Mobile Loan Usage

	(1)	(2)	(3)	(4)
	Mobile loan (Yes/No)	Mobile loan (Yes/No)	Mobile loan IHS Transformed	Mobile loan IHS Transformed
Number of control pharmacies < 500m	0.008		0.043	
	(0.011)		(0.098)	
Shortest distance to a control pharmacy		-0.074		-0.849
		(0.046)		(0.531)
Controls Included	Yes	Yes	Yes	Yes
N	175	175	164	164
R-Squared	0.103	0.108	0.101	0.108

Notes: This table presents the results of the reverse spillovers analysis in pharmacies, and tests whether proximity of pharmacies in the control group affects mobile loan usage by treatment pharmacies. Proximity is measured by the number of control pharmacies within a 500m radius (in columns (1) and (3)), and by the distance to the nearest control pharmacy (in columns (2) and (4)). Uptake is measured by either whether the treatment pharmacy had a mobile loan (the extensive margin, in columns (1) and (2)), or the amount of the mobile loan (the intensive margin, in columns (3) and (4)). The control vector is described in Table 5A. Robust standard errors are presented in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Online Appendix Figure 1: M-Pesa Drop-Down Menu (Cook and McKay (2015))