Unlocking Access to Credit with Lockout Technology*

Paul Gertler Brett Green Catherine Wolfram

September 11, 2020

Preliminary and Incomplete

Abstract

A new form of collateralized lending has emerged, most prominently in developing countries, that is facilitated by a "lockout" technology, which allows the lender to temporarily disable the flow value of the collateral to the borrower without physically repossessing it. We explore the effect of this new technology both theoretically and in a randomized controlled trial in Uganda using school-fee loans collateralized with a solar home power system. We find that securing a loan with lockout drastically reduces default rates (by 15 pp) and increases the lender's rate of return (by 5 pp per month). Employing a variant of the Karlan and Zinman (2009) methodology, we decompose the total effect and find that roughly one-third of the total effect is attributable to (ex-ante) adverse selection and two-thirds of the effect is attributable to (ex-post) moral hazard. We also find that access to a school-fee loan significantly increases school enrollment and school-related expenditures without detrimental effects to a household's balance sheet.

*This research was supported by USAID, the World Bank and JPAL's Post-Primary Education program. We are very grateful to Jenya Kahn-Lang, Sanghamitra Mukherjee, Derek Wolfson, Hilary Yu, and especially Robert Pickmans for excellent research assistance. Laura Steiner provided exceptional project management, and we are also grateful to the whole team at IPA Uganda.

1 Introduction

There is a general consensus that households in poor countries have insufficient access to credit. Twenty years ago, economists were optimistic that microfinance would fill this void. However, most of the evidence suggests that microfinance loans do not have transformative effects on the average borrower (Banerjee et al., 2015).

Traditional microfinance loans are characterized by high interest rates, large transaction costs, and low uptake. They are also unsecured. In contrast, most debt is secured by collateral in rich countries . Using collateral to secure debt helps overcome economic frictions thereby reducing the cost of credit provision. Yet, secured debt is virtually non-existent in poor countries. Why? In economies with weak legal enforcement, property rights are difficult to establish, which leads to high costs of repossessing collateral relative to its value. Also, for poor households in remote areas the transaction costs associated with repossession can be prohibitive.

However, collateral need not be physically repossessable in order to serve a useful role in the provision of credit. Provided the lender can disable the benefits of the asset to the borrower, it can serve as a useful role. A leading example is pay-as-you-go financing (PAYGO), which has emerged as a common financial contract for the sale of solar home systems (SHSs) in the developing world (International Finance Corporation, 2017), and more recently as a way to finance the purchase of smartphones. The typical PAYGO contract requires a nominal down payment to take possession of the product, followed by frequent small payments made via a mobile payment system to unlock the product for some amount of time or usage. PAYGO financing crucially relies on an embedded "lockout technology" that allows the seller to remotely, cheaply, and temporarily make the product unusable.

In this paper we will explore this new form of collateralized lending. To fix ideas, we start by analyzing a simple model of lockout. In the model, firms produce a good that is of value to households. Households have a private value of consuming the good that is realized after they take possession of it. They are also subject to unobservable income shocks. Due to their financial constraints and limited wealth, households cannot afford to purchase the good outright. Therefore, in order to recoup their costs, firms offer a loan contract that is

collateralized by the good: if the household does not repay the loan then the firm repossess the good.

Repossessing collateral serves two roles in the model: (1) it provides the firm with something of value should the household default, and (2) it provides incentives to the household to repay the loan in order to avoid repossession. A loan collateralized with lockout involves no recovery value, but also little to no value for customers who fail to repay. We demonstrate that relative to an unsecured loan, a loan collateralized with lockout can reduce lending costs via two channels. First, the technology increases the borrower's incentive to repay compared to an unsecured loan. Thereby, for the same borrower, we anticipate significantly higher repayment rates when the lockout is employed. Second, lockout serves as a useful screening mechanism to help overcome adverse selection. That is, a borrower that is more likely to face a negative income shock will have less incentive to accept a loan collateralized with lockout. By increasing repayment rates and screening out borrowers who are more likely to default, lenders can provide loans to credit-worthy borrowers at more affordable interest rates. Despite the two (aforementioned) attributes, a stronger lockout technology does not necessarily increase welfare. The reason is that stronger lockout leads to more surplus destruction when it is employed, which can offsets the gains of mitigating the economic frictions.

To measure the effects of lockout, we partnered with Fenix International, the largest solar-home system provider in Uganda. Our study examines the effects of lockout with Fenix's most popular follow-up product, a school fee loan that is offered to customers around the beginning of each school term. Specifically, we are interested in (1) the effect of lockout on loan take-up, repayment and default, (2) the decomposition of the repayment effect into moral hazard and adverse selection, and (3) the impact of a loan on the household – e.g., education investments, asset ownership, ability to smooth shocks, etc. Our study sample is made up of Fenix customers who have never been offered a supplemental education loan. Our experimental design randomizes the sample into 3 treatment groups plus a control group. In the first treatment, the customer is offered a loan that utilizes the lockout technology. The second treatment is a loan without a lockout facility. In the third treatment, a customer is offered a lockout loan, but if accepted, is (positively) "surprised" and receives an unlocked loan. The "surprise" unlocked group is used to identify the effect of adverse selection from

moral hazard a la Karlan and Zinman, (2009).

Our experiment demonstrates four main results. First, customer interest and take-up rates are reasonably high. More than 12% of the over 27,000 customers who received an SMS about the loan indicated they were interested. Of the 2,200 customers that were offered a loan, 49% took-up the offer and received a loan. Consistent with our hypothesis that lockout reduces adverse selection, the take-up rate was about 7 percentage points (pp) higher for customers offered an unlocked loan than those offered a locked loan (47% vs 40%).

Second, lockout significantly increases loan repayment. The average repayment rate (fraction of principal repaid) increased by 12 pp and the loan completion rate by 14pp when the loan was collateralized with lockout compared to being unsecured. About one-third of the effect can be attributed to adverse selection while two-thirds is driven by moral hazard. From a profitability standpoint, lockout increased the (annualized) internal rate of return on school-fee loans by 5 percentage points. The reduction in moral hazard effects was concentrated among borrowers that were higher risk (based on repayment of previous loans) whereas the reduction in adverse selection was concentrated among lower risk borrowers. Consistent with our theoretical framework, the effect of lockout was larger on households with a higher willingness to pay for the service flow from the SHS system.

Third, the school-fee loan had positive impact on both enrollment and school expenditures. Children in households that were offered a school-fee loan were significantly more likely to be enrolled at school compared to children in the control group. Accounting for loan take up, our results suggest that the loans cut the share of children who were not enrolled by half (from 12% to 6%). In addition, households with loans increased schooling related expenditures by 36%. Increases in enrollment were concentrated among males while increases in expenditures were concentrated on females.

Fourth, the loans did not have a significant effect on household balance sheets. Asset purchases (sales) increased (decreased) moderately, but not significantly, and household borrowing was unchanged. Our estimates are precise enough to rule out large negative impacts.

On net, our results suggest that lockout increases the share of customers to whom a company can profitably offer loans. And, these loans had significant impact on household decisions around schooling, suggesting that the customers did not have access to other sources

of credit for an important expenditures like school fees.

While our study focuses on solar-home systems, there are other existing applications of the lockout technology. For example, PayJoy, a FinTech firm based in San Francisco, provides financing for smartphones enabled with lockout. PayJoy has been offering credit for the purchase of smart phones since 2016 and has a new product that offers loans to customers who have completed the phone loan repayment. They have large scale operations in Mexico, and a small but growing customer base in South Africa, India, Indonesia, and Zambia.

A similar technology has been deployed in the United State for subprime auto loans. Several firms have developed starter interrupt devices, which allow the lender to remotely disable the ability to start the car if the borrower is not in good standing on the loan. According to an article in the NY Times, these devices have been installed in more than two million vehicles.[1]

More broadly with the proliferation of smart devices, the PAYGO model could easily be extended to a wide range of devices such as laptops, refrigerators, and televisions. Moreover, after the initial loan has been repaid, the same piece of collateral can be "reused" for future loans, which expands the potential impact of the innovation.

1.1 Related Literature

XXXX To be completed XXX

2 Background

2.1 Fenix overview

Our partner for this study is Fenix International. As of mid-2019, Fenix had over 500,000 solar home system (SHS) customers across 6 countries in Sub-Saharan Africa.[2] They are the largest SHS provider in Uganda, accounting for a good share of the nearly 200,000 SHS units sold there (see Table 8 of GOGLA doc). Fenix's smallest, and most popular, system

[1] See https://dealbook.nytimes.com/2014/09/24/miss-a-payment-good-luck-moving-that-car.
[2] See Fenix international blog.

is 10 Watts and is able to power LED lamps and charge a cell phone. Its biggest system is 34 Watts and can support a custom built 18.5-inch television.[3]

Like most SHS providers, Fenix offers its units through a PAYGO model.[4] Customers make a small down payment, less than $10, and can bring home a Fenix SHS. They then make daily payments using mobile money until they have paid for the system. If a customer does not make a payment, the SHS will temporarily lock, preventing the customer from using it until they make their next payment. [Mention implicit interest rate?]

Fenix also uses the remote payment and locking technology to offer additional loans, such as their "school-fee loan." These are cash loans offered to the better-paying customers three times a year at the beginning of school terms. As with the original SHS loan, customers make a small down payment and then Fenix transfers money to the customer's mobile money account.[5] The deposit covers administrative fees and gives the customer a seven day grace period before the device is subject to being locked. After the grace period, if the customer does not make a daily payment, the system will lock and the customer will not be able to use it until the make their next payment.

Our study focused on a 300,000 Ugandan Shilling (UGX) loan (just over $80). The down payment was 20% (60,000 UGX) and then daily payments were 3,000 UGX for 100 days. Fenix considers the loan to be paid off provided the customer makes nominal payments totaling 300,000 UGX within 145 days of the loan issue date. This arrangement implies that customers who take longer to repay face a lower interest rate. For instance, a customer who pays every day faced an annual percentage rate of 168%, whereas a customer who pays only two out of every three days faced an annual percentage rate of only 112% (though is locked out 1/3 of the time while in repayment).

Customers who do not pay off the loan within 45 days of the target repayment date face interest charges of 2% per month on any remaining principal. In addition, failure to repay the loan in a timely manner renders customers ineligible for futures loan offers. After 180

[3]Information about Fenix's system can be found here. Note that Fenix's solar home systems differ in several ways from the solar panels on homes in the US and Western Europe. For one, they are roughly two orders of magnitude smaller than the typical solar panel installation on a US or Western European home and they are standalone, meaning they are not interconnected with the nationwide grid.

[4]Over 85% of solar home systems are sold on PAYGO.

[5]Explain that Fenix agrees the down payment doesn't make much sense, but administratively easier to fit into their existing processes?

days of no payments, the loan is considered to be in default and Fenix reserves the right to repossess the SHS system.[6]

2.2 Fenix's customer base

Table 1, columns (1) and (2) compare our sample of Fenix customers to population-wide statistics from rural Uganda based on the World Bank Living Standards Measurement Study (LSMS). Fenix customers are more likely to be male and married and have more children than the typical rural Ugandan household. They also are more likely to be employed outside the agricultural sector and more likely to come from the (relatively more wealthy) central region.

2.3 Primary and secondary schooling in Uganda

Rural Ugandans typically pay approximately XX for school fees, and incur additional costs for uniforms, books and other supplies.

3 A Model of Lockout

In this section, we propose a stylized model of collateralized lending in order to illustrate three main points. Our framework is similar in spirit to the work of Bester (1985, 1987) and Besanko and Thakor (1987).First, lockout increases borrowers repayment incentives thereby the reducing the moral hazard problem. Second, lockout also mitigates the adverse selection, i.e., borrowers with sufficiently high (ex-ante) income risk will be unwilling to accept a loan collateralized by lockout. In combination, these finding imply that the lockout technology makes it easier for firms to recover productions costs and should lead to more entry. Our third point is more subtle. Despite the two (aforementioned) attributes, a stronger lockout technology does not necessarily increase welfare. The reason is that stronger lockout leads to more surplus destruction when it is employed, which can offsets the gains of mitigating the economic frictions.

[6]Although customers are told that their SHS will be repossesed in default, in practice, only a small fraction of defaults result in physical repossession.

The model has two dates (date 0 and date 1) and two types of agents (households and firms). Households would like to purchase a durable good produced by firms, but have limited wealth. Firms produce the good and can also provide financing for it. However, due to incomplete markets (e.g., moral hazard, adverse selection), firms require collateral in order underwrite household debt.

Households. There is a unit mass of households, indexed by $i \in [0, 1]$. Household i derives (random) utility from consuming the production good at date 1, denoted by $\tilde{v}_i$, which is distributed according to F on support $[\underline{v}, \bar{v}] \in \mathbb{R}$. Household i privately observes $\tilde{v}_i$ at the beginning of date 1.[7]

Each household has date-1 income denoted by $\tilde{y}_i$. Households are heterogeneous with respect to income risk: with probability q_i, household i experiences an income shock and $\tilde{y}_i = 0$. With the complimentary probability, household i has sufficient income, $\tilde{y}_i = y > \bar{v}$, but may still choose to strategically default. Thus, higher q_i correspond to riskier households. Without out loss, assume that q_i is increasing in i. Households know their risk type. Let G and g denote the distribution and density of risk types in the population, which has support $[0, \bar{q}]$. For simplicity, we assume that all households have the same wealth $w_i = w$ for all i and that households are risk-neutral utility maximizers with a discount factor normalized to 1.[8]

Firms. There are $N \geq 1$ identical firms. Each firm has the technology to produce a good that generates value for households at date 1. Each firm has a marginal production cost c. Firms have deep pockets so they have the ability to provide financing to their customers. At the beginning of date 0, firms first decide whether to enter (pay c to produce the good). Conditional on entry, firms design a contract, which is a pair (d, p), where d is the downpayment required at date 0 to take possession of the good and p is the price of consuming the good at date 1. If a household takes possession at date 0, but does not make

[7] A higher realization of $\tilde{v}_i$ can be interpreted either as deriving from a shock leading to a particularly high value for consuming the good or from a positive income shock and thus a lower marginal utility from consumption of other goods.

[8] Risk-neutrality simplifies the space of relevant contracts since there is no demand for intra- nor inter-temporal consumption smoothing.

the payment at date 1, then the firm "repossesses" the good.[9]

Repossession. Repossessing the good has two implications

1. *Recovery.* It provides the firm with something of value should the borrower fail to repay.

2. *Incentives.* It takes something of value away from households should they fail to repay.

In most models of collateralized lending, these two roles are inseparable and characterized by a single parameter (e.g., Kiyotaki and Moore (1997)). The lockout technology facilitates a decoupling of the two roles. This decoupling can be useful when the cost of recovery outweighs the recovery value. It can also be useful in a dynamic model as a means of preserving the option to collect future revenues.

To separate the two roles, we parameterize firms repossession technology by the pair (κ, λ), where κ denotes the effectiveness of recovery—it is the fraction of the production cost that the firm recovers from repossession, and λ denotes the effectiveness on incentives—the borrower enjoys only the fraction $1 - \lambda$ times her value of the good in repossession.[10]

We refer to a repossession technology as *perfect* if $\kappa = \lambda = 1$. As discussed earlier, physical repossession is prohibitively costly in economies with weak legal enforcement. Therefore, a (traditional) collateralized loan, where the asset is physically repossessed in default, is characterized by relatively low values of both κ and λ. A loan collateralized with lockout involves no physical repossession in default (i.e., $\kappa = 0$), but also little to no value for customers who default (i.e., λ close to 1). Our primary interest will be to explore how an improvement in the lockout technology (i.e., increasing λ) affects household incentives and the equilibrium outcome.

To fix ideas, we will make the following parametric assumptions.

[9] We take the form of contract as given because it is representative of what is used in practice by PAYGO providers and in our experiment. If households are identical (e.g., $q_i = q$ for all i) or risk is observable, then, under the Myerson's (1981) regularity condition, this contract is optimal within a more general class of mechanisms in which the date-1 transfer and repossession are contingent on the household's reported value. With heterogenous households and unobservable risk, it can be optimal to offer a menu of contracts.

[10] One can interpret λ as the probability with which the good is successfully repossessed from the borrower and $(1 - \kappa)/\lambda$ as the rate of depreciation or the cost of repossession the good (as a fraction of c).

Assumption 1 *Trade is ex-ante efficient:* $\mathbb{E}[\tilde{v}_i] > c$.

Assumption 2 *Repossession is inefficient ex-post:* $\lambda v > \kappa c$ *for all* $v \in [\underline{v}, \bar{v}]$.

Given these assumptions, the first-best outcome is for all households to purchase the good and for firms to never repossess the good. This outcome can be sustained as an equilibrium even without lockout if households have sufficient wealth. Assumption 3 rules out this possibility.

Assumption 3 *Households are financially constrained:* $w < c - \underline{v}$*, but (at least) some households have enough wealth and income to afford the good:* $w + y > c$.

3.1 Household Behavior

We begin by considering the behavior of households taking the contract (d, p) as given. Suppose that household i purchases the good at date 0. The household will repay at date 1 provided that (i) it does not experience an income shock (i.e., $y_i = y$), and (ii) $\tilde{v}_i - p \geq (1 - \lambda)\tilde{v}_i$, or equivalently

$$\tilde{v}_i \geq \frac{p}{\lambda} \tag{1}$$

The right hand side is decreasing in λ, meaning that a more effective lockout technology leads to a higher probability of repayment, thereby illustrating the incentive role of repossesion.

Proposition 1 (Lockout Reduces Moral Hazard) *Fixing a contract, a more effective lockout technology (i.e., higher* λ*) decreases the probability that household* i *strategically defaults.*

Consider now the purchase decision of households. The expected date-1 surplus to household i is given by

$$S_i(p) \equiv (1 - q_i) \left[\int_{\underline{v}}^{\bar{v}} \max\{v - p, (1 - \lambda)v\} dF(v) \right] + q_i(1 - \lambda)\mathbb{E}(\tilde{v}_i)$$

Household i will purchase the good if they can afford to do so and the surplus from purchasing is non-negative. More concisely, household i will purchase the good if

$$d \leq \min\{w, S_i(p)\}. \tag{2}$$

Let $U_i(d,p) = S_i(p) - d$ denote household i's expected utility from purchasing the good. When facing a menu of contracts, household i selects contract the contract that maximizes expected utility provided that it satisfies (2). Otherwise, the household does not purchase the good. Noting that $S_i(p)$ is decreasing in both q_i and λ, we have the following result.

Proposition 2 (Lockout Reduces Adverse Selection) *Fixing a contract, there exists $\underline{q}$ such that only households with income risk $q_i \leq \underline{q}$ choose to purchase. Moreover, $\underline{q}$ is decreasing in λ.*[11]

This results shows that lockout leads to *positive selection*. Households with more credit risk prefer not to purchase the good because they anticipate a higher chance of being locked out.

3.2 Firm Profits

The lowest utility type that strategically defaults when the price is p is $v(p) = p/\lambda$. For any p, the probability that household i repays is $(1-q_i)(1-F(v(p)))$ and a firms expected revenue at date-1 from selling to household i is

$$R_i(p) = \kappa c + (1-q_i)(1-F(v(p)))(p - \kappa c)$$

Date-1 revenue is increasing in both κ and λ and decreasing in q_i. The profit from selling to household i is

$$\pi_i(d,p) = \begin{cases} d + R_i(p) - c & \text{if } d \leq \min\{w, S_i(p)\} \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

Because it will play a role in the equilibrium analysis, consider the problem of maximizing date-1 revenue with respect to the lowest type the strategically defaults, v. The marginal

[11] Proposition 2 can be strengthened if $S_1(p) < d \leq w < S_0(p)$, which is necessary and sufficient to guarantee that some but not all households purchase the good (i.e., $\underline{q} \in (0,1)$). In this case, $\underline{q}$ is *strictly* decreasing in λ.

revenue to the firm of increasing v for household i is

$$(1 - q_i) \left[(1 - F(v))\lambda - f(v)(\lambda v - \kappa c) \right].$$

The first order condition for an interior solution is

$$v^* - \frac{1 - F(v^*)}{f(v^*)} = \frac{\kappa c}{\lambda}, \tag{4}$$

which has a unique solution under the standard regularity condition used in auction theory and mechanism design (Myerson, 1981). Notice that v^* is independent of q_i, and increases with κ, but decreases with λ. Intuitively, higher κ or higher λ correspond to a "better" repossession technology, but they can have different effects on v^*; higher κ gives the firm more incentive to repossess which always increases v^*, whereas higher λ decreases v^*. Let $p^* \equiv \lambda v^*$.

3.3 Equilibrium

The equilibrium will naturally depend both on the degree of competition among firms ($N = 1$ or $N > 1$) as well as the whether firms can observe households' risk type. We begin by considering the case with observable household risk type. It is perhaps the most relevant case for our experiment; Fenix obtains a significant amount of repayment data on their existing customers prior to offering them additional loans and uses repayment history to determine eligibility.

When firm's can observe household risk types, they will tailor the pricing of the contract to the household as well as screen housholds with too much income risk.

3.3.1 Single Firm

When the firm is a monopolist, it will offer the contract that maximizes the profit from selling to household i. That is, the contract offered to household i solves

$$(d_i, p_i) \in \arg\max_{d,p} \pi_i(d, p)$$

We can decompose the problem into two steps. First, maximize profit conditional on selling to household i. Then decide whether to sell to household i.

Clearly, the firm's profit is increasing in d. So, conditional on selling, it will be optimal to set $d_i = \min\{w, S_i(p)\}$. Thus, the firm's problem can be written as

$$\max_p \left(\min\{w, S_i(p)\} + R_i(p) - c\right)$$

When $w \leq S_i(p^*)$, the solution is to set $p_i = p^*$ and charge $d_i = w$. This leaves the household with surplus $S_i(p^*) - w \geq 0$. When $w > S_i(p^*)$, the household will be unwilling to purchase at these terms. In order to induce the household to purchase, the firm charges less than p^* at date 1. In particular, by setting the price such that $S_i(p) = w$ and charging a downpayment $d = w$.[12] The following lemma summarizes these finding.

Lemma 1 (Monopoly Prices) *Conditional on selling to household i, the solution to the monopolist problem involves $d_i = w$ and*

$$p_i^m = \begin{cases} p^* & \text{if } w \leq S_i(p^*) \\ S_i^{-1}(w) & \text{otherwise} \end{cases}$$

If the implied profit from the contract in Lemma 1 is positive, then it is optimal for the firm to sell to household i. Otherwise, the household will reject any offers that the firm is willing to make.

Proposition 3 (Monopoly Quantities) *With observable household risk, the monopolist will sell to household i if and only if either*

(i) $w + R_i(p^*) \geq c$ *when* $S_i(p^*) \geq w$, *or*

(ii) $w + R_i(S_i^{-1}(w)) \geq c$ *otherwise.*

Noting that both R_i and S_i are decreasing in q_i, we have the immediate following corollary.

Corollary 1 *For any $\lambda > 0$, there exists q^* such that only households with $q_i < q^*$ will purchase the good.*

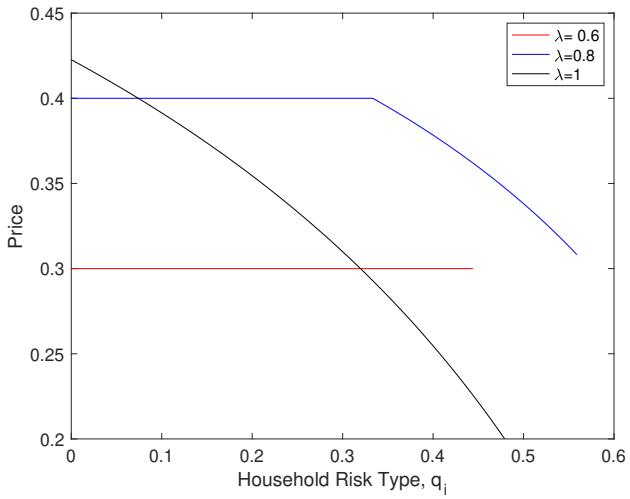


Figure 1: Monopoly prices, p_i^m. All households who purchase the good face a downpayment equal to their wealth: (i.e., $d_i^m = w$).

Figure 1 illustrates the solution to the monopolist's problem as it depends on both household risk type as well as λ. For $\lambda = 0.6$, the firm sells only to households with $q_i \leq 0.45$ and all household who purchase the good get the same price p^*. For $\lambda = 0.8$, the firm sells to more households and (mostly) at higher prices; households with $q_i < 0.33$ face a price of p^*, those with intermediate income risk ($q_i \in (0.33, 0.58)$) are unwilling to purchase at p^*, but are still profitable so the firm sells to them at $S_i^{-1}(w)$. For $\lambda = 1$, even more households are profitable under the contract (w, p^*), but none of them are unwilling to purchase at those terms. Therefore, the firm has to charge a price less than p^* to all customers in order to induce them to purchase. As a result, the profitability of each customers falls and fewer households end up being served (i.e, q^* falls).

Since the downpayment is simply a transfer, we can ignore it when computing total suplus. The total surplus in the economy is given by

$$TS = \int_0^{q^*} (R_i(p_i) + S_i(p_i) - c) dG(q_i).$$

Total firm profit and consumer suruplus are given by $\Pi = \int_0^{q^*} \pi_i(d_i, p_i) dG(q_i)$ and $CS = \int_0^{q^*} U_i(d_i, p_i) dG(q_i)$.

[12] Assumption 3 ensures that it will not be profitable to sell to any household i at $p_i = 0$.

3.3.2 Competitive Firms

When firms compete for households, they offer the contract that maximizes each households welfare subject to breaking even. That is, the contract offered to household i solves

$$(d_i, p_i) \in \arg\max_{d,p} U_i(d, p)$$
$$s.t. \quad \pi_i(d, p) = 0$$

Household expected utility is decreasing in both d and p. However, the deposit is purely a transfer while a higher p destroys more surplus. Therefore, to maximize household utility, firms minimize p_i subject to breaking even.

Proposition 4 (Competitive Equilibrium) *In a competitive equilibrium with observable household risk, the following are true:*

1. *The household purchases the good if and only if condition (i) or (ii) from Proposition 3 is satisfied. Otherwise, there does not exist a contract such that both the firm breaks even and the household is willing to purchase.*

2. *If the household purchases the good then $d_i^c = w$ and p_i^c is the lowest price such that $R_i(p_i^c) = c - w$.*

Notice that the household purchases under the exact same conditions as when the firm is a monopolist. Thus, Corollary 1 also holds with competitive firms. Of course, the price offered by competitive firms is lower for all but the marginal household.

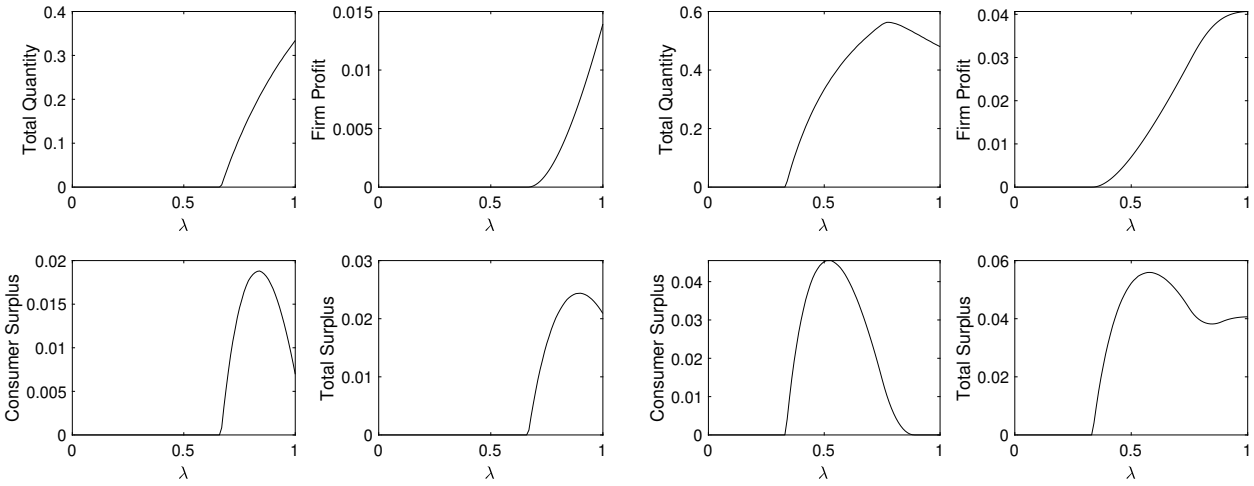
Example 1 *Suppose that $\tilde{v}_i \sim U[0,1]$, $q_i \sim U[0,1]$, $\kappa = 0$, $c = \frac{1}{4}$.*

Then $v^* = \frac{1}{2}$, $p^* = \frac{\lambda}{2}$, and

$$R_i(p^*) = \frac{1}{4}\lambda(1 - q_i),$$
$$S_i(p^*) = \frac{1}{2} - \frac{\lambda(3 + q_i)}{8}.$$

There are two possible cases depending on λ relative to $c - w$.

(i) For $\lambda < 4(c - w)$, then $q^* = 0$ meaning that no households purchase.



(a) Low household wealth, $w = \frac{1}{12}$.

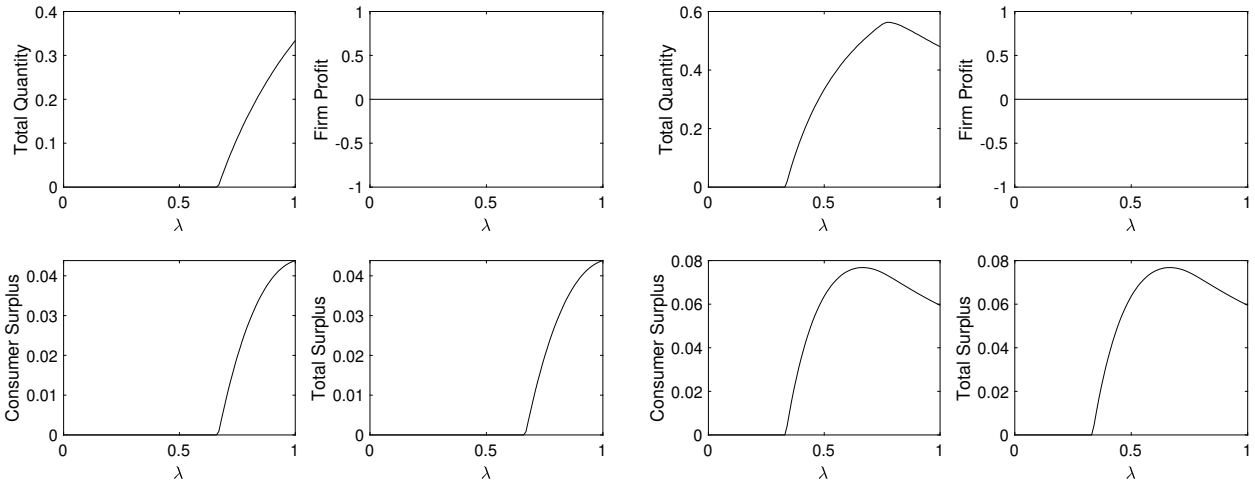
(b) High household wealth, $w = \frac{1}{6}$.

Figure 2: Illustrating the role of lockout with a monopolist firm.

(ii) For $\lambda \geq 4(c-w)$, $q^* = 1 - \frac{4(c-w)}{\lambda}$ and the mass of households that purchase is $G(q^*) = 1 - \frac{4(c-w)}{\lambda}$.

Quantity and profit is increasing in λ as illustrated in the top panels of Figure 2. Household welfare increases with λ on the extensive margin ($q_i = q^*$) as more households get served. However, households that were already purchasing the good ($q_i < q^*$) face higher date-1 prices. As a result, aggregate household welfare can decrease with λ. This possibility is clearly illustrated in Figure 2(b), where both household and total surplus decreases for λ large enough. Intuitively, a stronger lockout technology increases the incentive to repay, but also destroys more value when the household defaults. This effect is most pronounced on households with more higher income risk as they are more likely to default for non-strategic reasons.

Perhaps surprisingly, the decrease in household welfare and total surplus can also obtain when firms are perfectly competitive as illustrated in Figure 3(b). These findings suggests that a more lenient repossession policy may be preferable. For example, the firm could reposess the good only after a certain number of missed payments or only with some probability less than one.



(a) Low household wealth, $w = \frac{1}{12}$.

(b) High household wealth, $w = \frac{1}{6}$.

Figure 3: Illustrating the role of lockout with competitive firms.

Indeed, a key innovation of the PAYGO model is that the punishment for missing a payment is not too severe. Failure to make a payment results in a punishment that is proportional to the flow value of consuming the good rather than the stock value, which is what happens with physical repossession.

4 Experimental Design

We construct an experiment to test the effect of lockout on loan repayment and on loan recipients. We decompose the repayment effect into improvements via reduction in moral hazard and adverse selection. Figure 4 lays out the experimental design. We first define the universe of eligible loan recipients. Fenix was unwilling to unlock a customer's device unless they had fully repaid the loan on their solar home system (labeled "completed") and we further excluded customers who already had an outstanding school fee loan.[13] In May 2019 we sent an SMS message to the 27,081 eligible customers inviting them to reply if they were interested in a school fee loan and 3,300 customers (12%) responded. We next

[13]Before our study, Fenix offered school fee loans to customers who had fewer than 30% of the days locked on their solar home system loan. Also, Fenix first offered customers 100,000 UGX loans, and, if those were successfully repaid, they would offer them larger loans. To increase the sample size for this study, Fenix relaxed both of these requirements.

randomly allocated the interested customers into four groups - a control group, a choice group, a locked group and an unlocked group. We collected administrative data on all of the customers in all four groups and we also sent our field teams to administer a baseline survey to households in each group to collect data on demographics (including number of school-aged children), socioeconomic variables, educational outcomes (including school enrollment, day to-day attendance, grade repetition, and expenditures), household borrowing, lending, and saving behavior, and access to financial services. Separately, our call center reached out to the households in each treatment group using the phone numbers to which we had sent the SMS messages. In the two main groups - locked and unlocked - the call center explained that the customers were eligible for either a locked or unlocked loan and asked if they were interested in proceeding. A larger share of households said, "Yes" if they were allocated to the unlocked group (83%) than households allocated to the locked group (75%).

After the household had said yes to the loan, the field team explained to the set of households randomly allocated to the surprise unlock group that they would in fact be unlocked even though they had signed up for a locked loan. This surprise, following Karlan and Zinman (2009), allows us to separately identify a pure moral hazard effect by comparing households that had selected into a locked loan, but then were randomly allocated into a surprise group that was in fact unlocked, to households that remained locked. In some cases, however, the field team reached the household and revealed the surprise before they had made the deposit. Essentially, we observed a multi-stage decision process, in which households first verbally expressed interest in the loan (labeled said "Yes" to a loan in Figure 4), but then only about half of those customers made the deposit and completed the paperwork to secure the loan. Given that some of the households in the "Surprise Unlock" group knew the surprise before they made the second decision (to pay the deposit and complete the paperwork), we consider households that were truly surprised as a robustness check below.

The bottom row of Figure 4 indicates the share of households in each group that took the loan as a share of households that IPA reached.[14] We see clear indication that the locked loan is less attractive than the unlocked loan as only 40-42% of households take the locked loan compared to 47% who take the unlocked loan. Table A.1 in the Appendix explores

[14]The choice group is not a central part of the experiment and discussed briefly below.

whether there are significant differences in the characteristics of the households that took up the loan in the locked and unlocked categories. Altogether, most baseline characteristics are statistically indistinguishable across the two groups, suggesting that the locking may be screening on household characteristics that are not captured by other household variables. (Results are not dependent on whether we include the households in the surprise unlocked group.)

5 Results

We are interested in the impact of the locking technology on both firm-level and customer-level outcomes and separate our discussion into those two categories.

5.1 Firm-level Outcomes

In our context, Fenix has set the loan pricing described in Section 2 (20% deposit and 100-day loan term), so its profitability will be a direct function of customers' repayment rates.[15] Figure 5(a) plots the repayment rates over time for customers in the locked, surprise unlocked and unlocked treatment groups and Figure 5(b) plots the differences between the 3 groups. We begin the x-axis at 50 days to highlight the differences as the loans are coming due and in the 100 subsequent days.

Consistent with our model's suggestion that lockout increases firm profits, we see that repayment rates in the locked group are consistently higher than repayment rates in either the surprise unlocked group or unlocked group. Overall lockout appears to lead to nearly 13 percentage points higher repayments at 100 days, improving repayment rates from just above 45% to almost 60%. The moral hazard effect is derived by comparing repayment rates in the locked group to repayment rates in the surprise unlocked group, on the assumption that the selection mechanisms were the same in these groups as they both thought they would have locked loans when they enrolled. This accounts for the bulk of the overall effect,

[15] We define the "repayment rate" as a customers' cumulative payments towards the principal divided by the total loan principal. Fenix credits commissions to customers who refer other customers to Fenix, and we include payments from these commissions, although they account for less than 0.05% of total payments towards principal.

leading to a 9 percentage point difference around 100 days. The adverse selection effect is derived by comparing repayment rates in the surprise unlocked group to the unlocked group, on the assumption that both groups faced the same incentive to repay conditional on signing up for the loan since they were both unlocked. This accounts for roughly 3 percentage points higher repayment.

Table 2 presents results from regression specifications of the following form:

$$r_i = \alpha + \beta * Treatment\ group_i + \epsilon_i \tag{5}$$

Where r_i is the repayment rate for household i, α is a constant and ϵ_i is an error term. Every cell in the last three columns reflects a different specification of equation (5). The column labeled "Lockout" captures the overall lockout effect. Specifications in this column include households in the locked group and unlocked group and $Treatment\ group_i$ is equal to one for households in the locked group. Specifications in the column labeled "Adverse Selection" include households in the surprise unlocked group and the unlocked group and $Treatment\ group_i$ is equal to one for households in the surprise unlocked group. Specifications in the columns labeled "Moral Hazard" include households in the locked group and the surprise unlocked group and $Treatment\ group_i$ is equal to one for households in the locked group.

The results reflect the same differences as Figure 5 and the standard errors indicate that the overall lockout effect is significant at the 1% level, the moral hazard effect significant at the 5% level (CHECK with day = 200) while the adverse selection effect is not statistically significant.

Table 3 contains results from versions of equation (5) where we replace repayment rate as the dependent variable and analyze loan completion rates, where a loan is recorded as completed when the repayment rate equals one. We do this because Fenix's profits are a function of the share of customers that eventually repay their loans more than differences in the timing of when customers make payments. The results suggest that lockout leads to a 15 percentage point increase in the share of completed loans after 150 days, with moral hazard accounting for slightly more than one third of the effect.

The results in Tables 2 and 3 reflect Local Average Treatment Effects (LATE) estimates, accounting for the fact that some customers who were supposed to be locked were unlocked for some days and vice versa. Altogether, fewer than 10% of the loan days were in the wrong category. There were two general types of imperfect compliance: (1) administrative errors at the beginning of the experiment, and (2) customers who had additional transactions with Fenix over the study period, for example to upgrade their solar home system, and were sometimes switched to the wrong locking arrangement. See Appendix A Tables A.4, A.5, and A.6 for more details and for the Intent to Treat (ITT) estimates of the specifications reported in Tables 2 and 3, respectively.

5.1.1 Heterogeneity across customers

The key measure of Fenix's profitability is the internal rate of return (IRR) on the loans. As we explained in Section 4, Fenix expanded eligibility for their school fee loans to generate the sample for this study, which meant that households who had a larger number of days when their SHS was locked were included even though Fenix would not have offered cash loans to them under their usual business practices. To account for that, Table 4 reports the IRRs by tercile of the number of days the household's SHS was locked.[16] Focusing on the first tercile, where the range of days locked is 0 to 6%, we see that locked loans lead to a nearly 5 percentage point higher IRR than unlocked loans, but the returns on the loans are all negative, even for the locked loans. For the second and third terciles, the difference between locked and unlocked is similar and even larger for the third tercile, and the returns are lower. For perspective on the extent to which the negative IRRs are a function of the expanded loan eligibility criteria, we calculated IRRs for school fee loans that Fenix had offered in prior school terms (in 2018) , broken in to terciles in days locked for that portfolio of loans. Based on the range of days locked, reported in brackets, the prior school fee loans in the first two terciles are comparable to the loans in the first tercile of the study sample (if anything worse), yet the IRRs on the prior loans are considerably higher (and positive). This

[16]Loans in each tercile are formed into a portfolio. The internal rate of return (IRR) is the discount rate that makes the net present value of cash flows on the portfolio equal to zero. Figure A.2 in the Appendix depicts repayment rates as a continuous function of days locked and suggests that the tercile cutoffs are sensible.

could be explained by the fact that the study offered 300,000 UGX loans to customers who had never had a cash loan, while the prior loans were smaller (100,000 UGX) for first-time borrowers.

We also explored heterogeneity as a function of how quickly households accepted the loan. In particular, as noted above, some of the households in the surprise unlocked group were notified by our field staff that they would be unlocked before they made their deposits. It is possible that among these households, there were some differences in the households that followed through with the deposits for the loans compared to the locked group, meaning that the moral hazard effect in Figure 5 and Table 2 are overstated and the adverse selection effect understated. (Note, though, that this does not impact the estimate of the overall lockout effect.) To explore by how much this is driving our decomposition results, we re-estimated versions of the specifications in Table 2 using only those households that committed to loan before they were visiting by our field staff. These results are reported in Table A.7 in the Appendix. Interestingly, the overall lockout effect is almost two times as large among this set of people – pointing to considerable heterogeneity which we explore more fully below. The moral hazard effect is slightly smaller, but the overall conclusion that moral hazard explains the bulk of the effect remains.

5.2 Household-level Outcomes

While the results presented thus far clearly suggest that lockout can improve firm profits, we are also interested in the impacts of the loans on household-level outcomes. At a high level, access to credit may facilitate welfare-enhancing investments for households. On the other hand, cash loans with high interest rates, especially if they are misunderstood by customers, may cause households to forego expenditures on other essential items, lowering their overall welfare. Because the cash loans were offered at the beginning of the school term and marketed as "school fee loans," we first examine schooling outcomes, and then present results on households' overall financial position and ability to withstand shocks.

5.2.1 Schooling outcomes

As discussed in Section 4, the loans we study were offered in May 2019, just before school fees were due in XXX. The product was marketed as a school fee loan, though Fenix offered them to all eligible customers, regardless of whether they had school-aged children. In practice, almost 90 % of our sample households had school-aged children and 91 % who accepted a school-fee loan reported using it for education-related expenditures.

To understand whether the loans had an impact on schooling outcomes, we estimated version of the following equations:

$$\begin{aligned} y_i &= \alpha + \beta * \textit{Loan Offer}_i + \epsilon_i \\ y_i &= \alpha + \beta * \textit{Loan}_i + \epsilon_i \end{aligned} \tag{6}$$

where y_i is an outcome variable for household i. The first equation yields the intent to treat estimates, where $\textit{Loan Offer}_i$ is an indicator for a household that was offered a loan through one of the three (locked, surprise unlocked, unlocked) groups. The second equation, estimated with *Loan Offer* as an instrument for $\textit{Loan}_i$ yields the local average treatment effect for households that accepted loans.[17]

Table 5 reports results from estimates of (6) for several schooling-related outcomes. The first two columns report impacts on the share of 5 to 20-year-old children within a household who are enrolled in school and is estimated for households that had at least one child in that age range at baseline. The ITT in table A.9 results suggest that the loan offer increases the share enrolled by almost 3 percentage points, and the LATE results indicate that households that took loan had 6 percent more children enrolled at school. Given that 88 percent of children in the control group are enrolled, this suggests that access to the loan cuts the share of children who are not enrolled by half.

The third and fourth columns on Table 5 analyze the impact on monthly absences from school for households that had at least one child enrolled. The coefficient estimates suggest no meaningful impact on days absent, and we can rule out a reduction of more than 0.7

[17] We also estimated specifications that allowed the loan impacts to vary by treatment group but saw no significant differences between the groups.

days given the standard errors. In the fifth and sixth columns, we see that expenditures for school-related items (including school fees, uniforms, supplies, transport and meals) increased considerably, by over 40 % for households that received loans. This increase is too large to reflect the results from the first two columns - that 6 % of the households started paying for school fees - and suggests that the loans allowed households whose children were already fully enrolled to increase expenditures.

These are in Table 6.

The fact that Fenix's loans had such a large impact suggests that households did not have another source of liquidity to use for schooling-related expenditures.

5.2.2 Overall household financial position

While the results on schooling suggest that the school fee loans had beneficial impacts on households, we are also interested in understanding affects on households' overall financial positions.

Table 7 reports results on household asset purchases and sales, as well as borrowing. The results are noisy and statistically insignificant. For additional perspectives on household's financial position, we asked a series of questions about shocks households had experienced, including financial shocks, and their ability to weather those shocks. The results are summarized in the Appendix. Again, we see no systematic or significant difference between households that were offered loans and the control group.

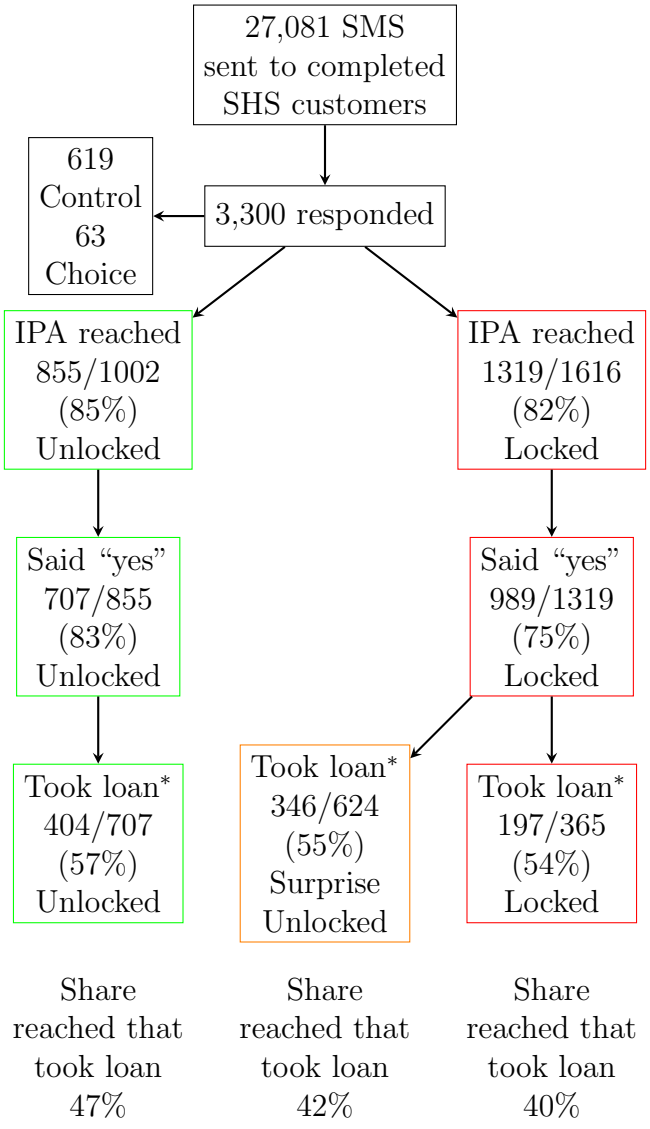
6 Conclusion

In this paper, we explore a novel form of financial contracting facilitated by lockout technology. Rather than permanently repossess collateral, the lender temporarily disables the flow value of the collateral to the borrower when the borrower fails to repay the loan. We show that loans collateralized with lockout exhibit significantly higher repayment. About 1/3 of the increase in repayment can be attributed to (ex-ante) selection and about 2/3 to (ex-post) moral hazard. Access to these loans had positive effects on educational outcomes and did not have negative effects on household's overall balance sheet. There are numerous other

potential applications in which this innovation could be utilized to provide cheaper access to credit, which are especially promising in economies with an underdeveloped banking and financial system.

7 Figures and Tables

Figure 4: Consort Statement



Note: * refers to signing the necessary paperwork for a loan and paying the required deposit.

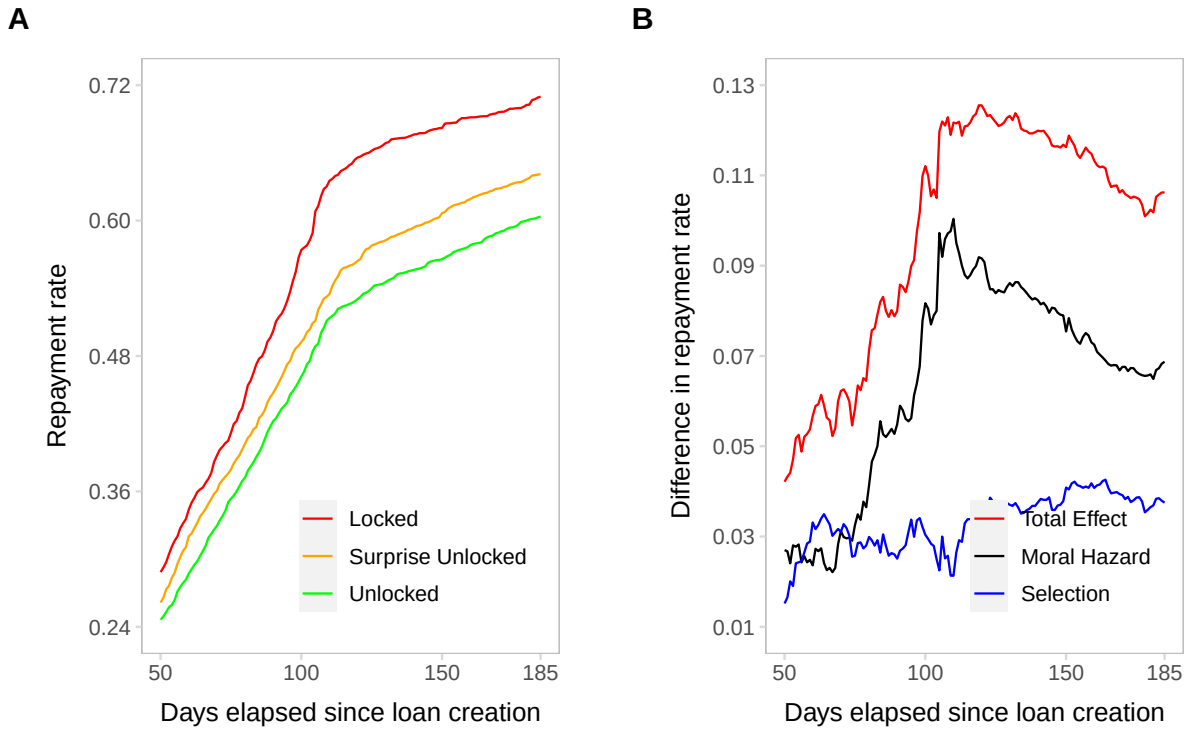
Table 1: Descriptive Statistics of Enrollee Characteristics from Administrative Data

Characteristic	(1) Uganda LSMS	(2) SMS sent to	(3) Said yes to loan	(4) Took up loan
Risk				
Proportion of days locked at SMS	-	0.13	0.16***	0.16
		(0.15)	(0.15)	(0.16)
Demographics				
Age (years)	47	46***	45***	45
	(21)	(12)	(11)	(11)
Female (proportion)	0.33	0.23***	0.14***	0.13
	(0.59)	(0.42)	(0.35)	(0.34)
Married (proportion)	0.69	0.90***	0.92***	0.93
	(0.60)	(0.30)	(0.27)	(0.25)
Number of children	3.0	4.3***	4.1***	3.9
	(3.1)	(2.9)	(2.8)	(2.5)
Occupation (proportion)				
Agriculture or Non-employed	0.64	0.37***	0.25***	0.23
	(0.59)	(0.48)	(0.43)	(0.42)
Non-professional	0.23	0.39***	0.37*	0.38
	(0.51)	(0.49)	(0.48)	(0.48)
Other	0.05	0.08***	0.09**	0.08
	(0.28)	(0.27)	(0.29)	(0.28)
Professional	0.08	0.17***	0.29***	0.31
	(0.33)	(0.38)	(0.46)	(0.46)
Region (proportion)				
Central	0.39	0.44***	0.35***	0.36
	(0.60)	(0.50)	(0.48)	(0.48)
Eastern	0.29	0.28	0.37***	0.36
	(0.52)	(0.45)	(0.48)	(0.48)
Western	0.32	0.28***	0.28	0.29
	(0.59)	(0.45)	(0.45)	(0.45)
n	2341	27081	1696	947

Note: Standard deviations in parentheses. The World Bank Living Standards Measurement Study (LSMS) - Uganda National Panel Survey information featured in (1) comes from the 2015/2016 wave. Columns (2) through (4) comes from Fenix administrative data. Sample statistics for the UNPS sample are weighted

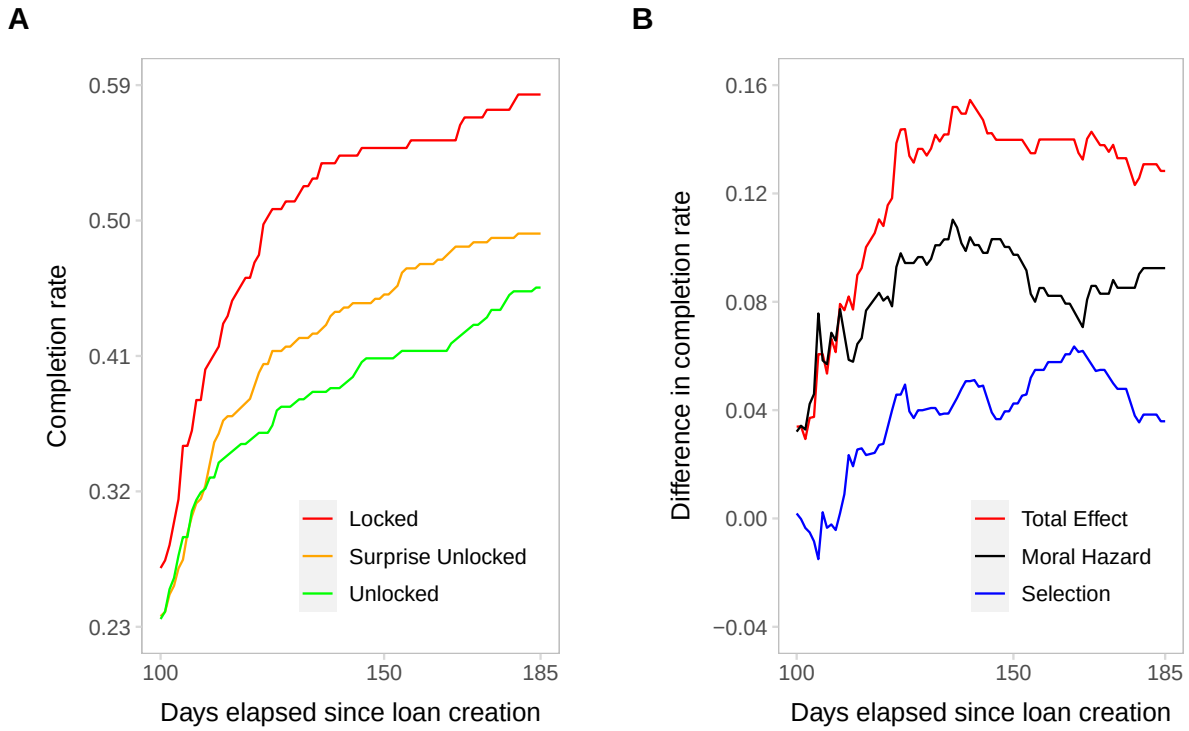
using probability weights. For Demographics, the UNPS sample statistics relate to the head of household, while the Fenix customer statistics relate to the customer who signed with Fenix. For Occupation using the Fenix data, "Agriculture or Non-employed" includes Cattle Trader, Farmer, Fisherman, and Not Employed; "Professional" includes Accountant, Banker, Broker, Electrician, Engineer, Government / Civil Servant, Health Worker, Journalist, Mechanic / Technician, NGO Worker, Office Work, Police, Security Guard, Teacher, Tour Guide, UPDF, and Uganda Prisons; "Non-professional" includes Boda Boda, Butcher, Carpenter, Construction, Driver, Herbalist, MM Agent, Market Trader, Money Changer, Religious Leader, Shop Keeper, Small Business Owner, Tailor, and Taxi Operator. Occupation for the UNPS sample followed a similar categorization. (3) is a subset of (2) and (4) is a subset of (3). The results from tests of differences that compare (1) to (2), (2) to (3), and (3) to (4) are displayed in (2), (3), and (4), respectively. Customers who were assigned to a Menu of Choice treatment are dropped from (2), (3), and (4) and only comprised 2% of those samples. Although the sampling strategy was to drop individuals living in the Northern region, (2) includes 29 individuals who were registered as having lived in the Northern region and who were targeted for the SMS messages. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure 5: Loan repayment rates and differences in repayment rates



Note: Average loan repayment rates over days elapsed since loan creation, by treatment, are in Panel A, and difference in average loan repayment rates over days elapsed since loan creation, by effect, are in Panel B. In Panel B, "Total Effect" displays the difference in average repayment rates between the Locked and Unlocked groups, "Moral Hazard" displays the difference in average repayment rates between the Locked and Surprise Unlocked groups, and "Selection" displays the difference in average repayment rates between the Surprise Unlocked and Unlocked groups. (Difference in) average repayment rates are displayed over the sample of 947 loans, of which 197 are Locked loans, 346 are Surprise Unlocked loans, and 404 are Unlocked loans.

Figure 6: Loan completion rates and differences in completion rates



Note: Average loan completion rates over days elapsed since loan creation, by treatment, are in Panel A, and difference in average loan completion rates over days elapsed since loan creation, by effect, are in Panel B. In Panel B, "Total Effect" displays the difference in average completion rates between the Locked and Unlocked groups, "Moral Hazard" displays the difference in average completion rates between the Locked and Surprise Unlocked groups, and "Selection" displays the difference in average completion rates between the Surprise Unlocked and Unlocked groups. (Difference in) average completion rates are displayed over the sample of 947 loans, of which 197 are Locked loans, 346 are Surprise Unlocked loans, and 404 are Unlocked loans.

Table 2: Tests of Lockout, Adverse Selection and Moral Hazard on Loan Repayment

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.46	0.13***	0.03	0.10**
		(0.04)	(0.03)	(0.04)
150	0.57	0.13***	0.05	0.09**
		(0.04)	(0.03)	(0.04)
185	0.60	0.12***	0.04	0.08*
		(0.04)	(0.03)	(0.04)
n		601	750	543

Note: Standard errors in parentheses. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan repayment for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 3: Tests of Lockout, Adverse Selection and Moral Hazard on Loan Completion

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.32	0.09*	0.002	0.09*
		(0.05)	(0.04)	(0.05)
150	0.41	0.16***	0.05	0.11**
		(0.05)	(0.04)	(0.05)
185	0.46	0.15***	0.04	0.11**
		(0.05)	(0.04)	(0.05)
n		601	750	543

Note: Standard errors in parentheses. Loan completion describes whether the loan principal has been repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan completion for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the

completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 4: Monthly IRRs of Loan Portfolios

Treatment Group	Account percent locked			All	n
	1st tercile	2nd tercile	3rd tercile		
Locked	-0.6%	-3.7%	-8.2%	-4.3%	197
	[0.00, 0.06]	[0.06, 0.19]	[0.20, 0.57]	[0.00, 0.57]	
Surprise Unlocked	-0.5	-6.8	-13.4	-7.1	346
	[0.00, 0.05]	[0.06, 0.19]	[0.19, 1.00]	[0.00, 1.00]	
Unlocked	-5.3	-7.0	-14.7	-9.0	404
	[0.00, 0.06]	[0.06, 0.20]	[0.20, 0.64]	[0.00, 0.64]	
Prior School Fee Loans	6.7	6.3	3.0	5.1	1377
	[0.00, 0.04]	[0.04, 0.13]	[0.13, 0.30]	[0.00, 0.30]	

Note: Loans in each treatment group are sorted by proportion of days locked at SMS and divided into equal-sized terciles. Loans in each tercile are formed into a portfolio. The internal rate of return (IRR) is the discount rate that makes the net present value of cash flows on the portfolio equal to zero. The IRRs of portfolios formed using all loans in each treatment group are also reported. The range of the fraction of days locked is reported in square brackets.

Table 5: Education Outcomes, Household-level

	Enrollment	Days absent	Log school expenditures
Loan	0.0614**	0.0294	0.359**
	(0.0303)	(0.342)	(0.169)
Constant	0.875***	1.277***	12.22***
	(0.0147)	(0.167)	(0.0825)
n	1698	1636	1636

Note: Standard errors in parentheses. Results relate to Term 2 outcomes. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect for compliers, using actual receipt of a school fee loan as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). "Enrollment" describes the share of school-aged children (individuals aged 5-20) enrolled in Term 2 within the household, and is conditional on having at least one school-aged child within the household at endline. "Days absent" describes the average days of school missed per month, per enrolled school-aged child, and is conditional on having at least one school-aged child enrolled at endline in Term 2. "School expenditures" describes the average school expenditure per enrolled school-aged child and is conditional on having at least one school-aged child enrolled at endline in Term 2. School expenditures include expenditures on school fees, supplies (uniforms, pens, pencils, notebooks, etc), transport, and school meals. School expenditures are winsorized at the 99th percentile. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 6: Education Outcomes for School Aged Children

	Enrollment		Log school expenditures	
	Male	Female	Male	Female
Loan	0.0741**	-0.0239	0.250	0.602**
	(0.0373)	(0.0357)	(0.204)	(0.284)
P value from Chow test		0.03		0.25
Outcome mean	0.911	0.900	12.10	12.15
n	2780	2927	2522	2625

Note: Standard errors in parentheses. Standard errors are clustered at the household level. Results relate to Term 2 outcomes. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect for compliers, using actual receipt of a school fee loan as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). School expenditures are conditional on enrollment at endline in Term 2. School expenditures include expenditures on school fees, supplies (uniforms, pens, pencils, notebooks, etc), transport, and school meals. School expenditures are winsorized at the 99th percentile. The p value from the Chow test compares the treatment effect for males to that of females. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 7: Household Balance Sheet Effects, calculated (semi-)elasticities

	Asset purchases (IHST)	Asset sales (IHST)	Money borrowed (IHST)	Net difference (IHST)
Loan	1.010	-0.451	0.037	-0.570
	(1.471)	(0.486)	(0.899)	(0.788)

Note: Standard errors in parentheses. Asset purchases, asset sales, and money borrowed are winsorized at the 99th percentile. The above analysis uses the Local Average Treatment Effect (LATE) to derive semi-elasticities. The LATE measures the average treatment effect for compliers, using actual receipt of a school fee loan type (or any school fee loan) as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). "Net difference" records the difference between asset purchases and asset sales, minus money borrowed. Winsorizing takes place before IHST transformation. For 31 individuals who reported a source of a loan as ReadyPay, the amount of the school fee loan was added back into the total amount reported to have been borrowed. Loan refers to the semi-elasticity calculated following the exact method from Bellemare and Wichman (2019), following arguments from Halvorsen and Palmquist (1980), Kennedy (1981) and Giles (1982). * $p < .10$, ** $p < .05$, *** $p < .01$

Table 8: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, Below Median Risk (< 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.54	0.13**	0.09*	0.04
		(0.05)	(0.05)	(0.05)
150	0.65	0.11**	0.10**	0.01
		(0.06)	(0.05)	(0.05)
185	0.69	0.08	0.08*	-0.0006
		(0.05)	(0.04)	(0.05)
n		294	368	270

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for less than 11 percent of its history by early May 2019, right before the start of the experiment. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan repayment for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 9: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, At Median Risk or Above (≥ 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.39	0.13**	-0.02	0.16***
		(0.05)	(0.04)	(0.06)
150	0.49	0.15**	-0.007	0.17***
		(0.06)	(0.05)	(0.06)
185	0.52	0.16***	-0.0006	0.17**
		(0.06)	(0.05)	(0.07)
n		307	382	273

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for 11 percent or more of its history by early May 2019, right before the start of the experiment (APL). Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above

results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan repayment for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 10: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, Below Median Risk (< 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.39	0.08	0.08	-0.007
		(0.07)	(0.06)	(0.07)
150	0.49	0.16**	0.13**	0.02
		(0.07)	(0.06)	(0.07)
185	0.55	0.13*	0.08	0.05
		(0.07)	(0.06)	(0.07)
n		294	368	270

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for less than 11 percent of its history by early May 2019, right before the start of the experiment (APL). Loan completion describes whether the loan principal has been repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan completion for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

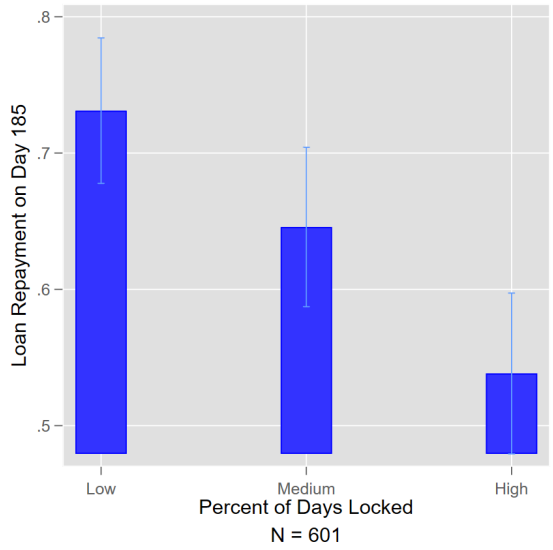
Table 11: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, At Median Risk or Above ($\geq$ 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.25	0.10	-0.08*	0.19***
		(0.06)	(0.05)	(0.07)
150	0.33	0.16**	-0.04	0.21***
		(0.07)	(0.05)	(0.07)
185	0.37	0.16**	-0.004	0.17**
		(0.07)	(0.06)	(0.07)
n		307	382	273

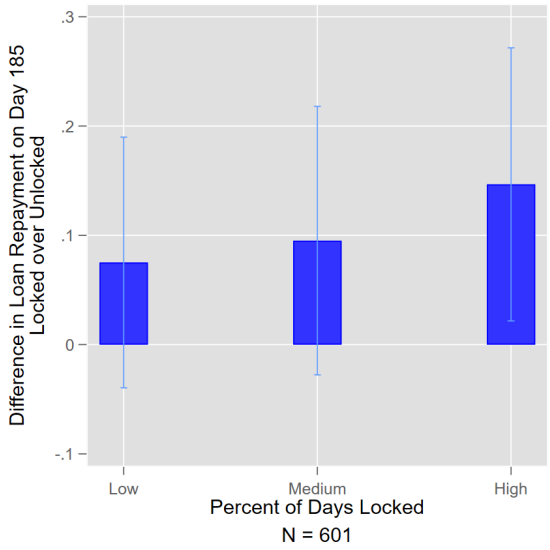
Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for 11 percent or more of its history by early May 2019, right before the start of the experiment (APL). Loan completion describes whether the loan principal has been repaid. The above results display the

Local Average Treatment Effect (LATE), which measures the average treatment effect on loan completion for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure 7: Loan repayment on day 185 by the percent of days locked



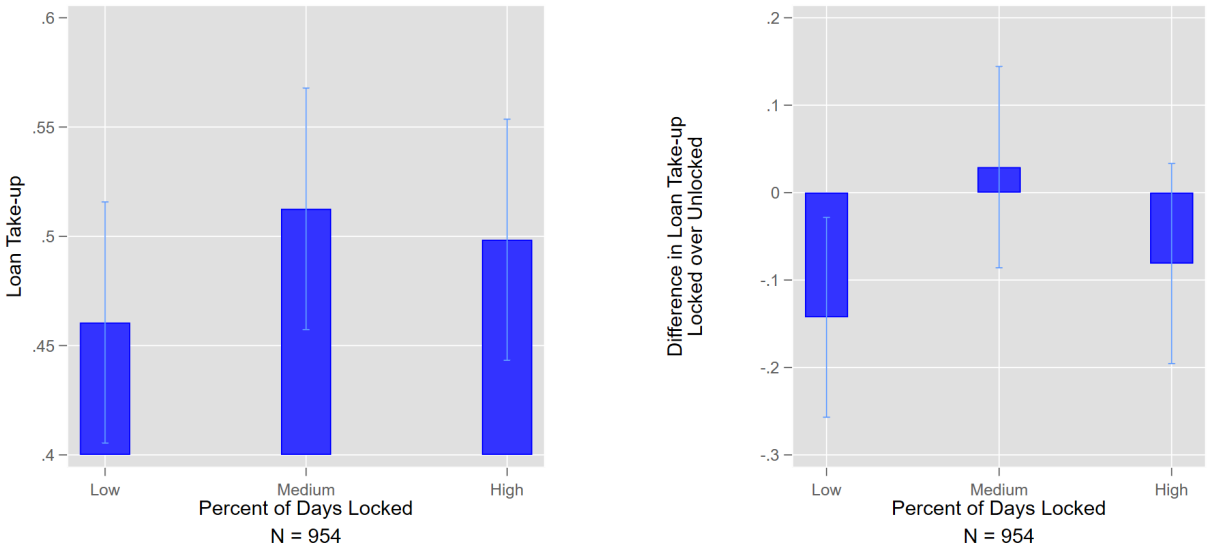
(a) Loan repayment, pooled



(b)Locked over Unlocked

Note: This figure covers the sample of 601 loans, of which 197 are Locked loans and 404 are Unlocked loans. Surprise unlocked loans are excluded from this figure. Individuals are divided into three terciles based on the percent of days locked. The Low tercile is considered as less risky borrowers and the High tercile is considered as more risky borrowers. Panel (a) plots the average loan repayment on day 185 and Panel (b) plots the differences between individuals treated with Locked and Unlocked loans. 95% confidence interval are along with the bars.

Figure 8: Loan take-up by the percent of days locked



(a) Loan repayment, pooled

(b)Locked over Unlocked

Note: This figure covers the sample of 954 individuals, of which 345 are treated with Locked loans and 609 are treated with Unlocked loans. Individuals treated with Surprise unlocked loans are excluded from this figure. Individuals are divided into three terciles based on the percent of days locked. The Low tercile is considered as less risky borrowers and the High tercile is considered as more risky borrowers. Panel (a) plots the average loan take-up and Panel (b) plots the differences between individuals treated with Locked and Unlocked loans. 95% confidence interval are along with the bars.

Table 12: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, Below Median WTP (< 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.48	0.11	0.01	0.10
		(0.07)	(0.06)	(0.07)
150	0.58	0.11	0.01	0.10
		(0.07)	(0.06)	(0.07)
185	0.61	0.120*	0.02	0.10
		(0.07)	(0.06)	(0.07)
n		183	235	186

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at most 2,000 Ugandan Shillings to unlock their hypothetically-locked solar home system the next day. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan repayment for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 13: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, At Median WTP or Above (≥ 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.48	0.20***	0.06	0.13**
		(0.06)	(0.05)	(0.06)
150	0.60	0.18***	0.06	0.12**
		(0.06)	(0.05)	(0.06)
185	0.65	0.15***	0.05	0.10*
		(0.06)	(0.05)	(0.06)
n		285	360	251

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at least 3,000 Ugandan Shillings to unlock their hypothetically-locked solar home system the next day. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan repayment for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table 14: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, Below Median WTP (< 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.35	0.07	-0.0006	0.08
		(0.08)	(0.07)	(0.09)
150	0.45	0.10	0.006	0.10
		(0.09)	(0.07)	(0.09)
185	0.47	0.11	-0.01	0.12
		(0.09)	(0.07)	(0.09)
n		183	235	186

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at most 2,000 Ugandan Shillings to unlock their hypothetically-locked solar home system the next day. Loan completion describes whether the loan principal has been repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan completion for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

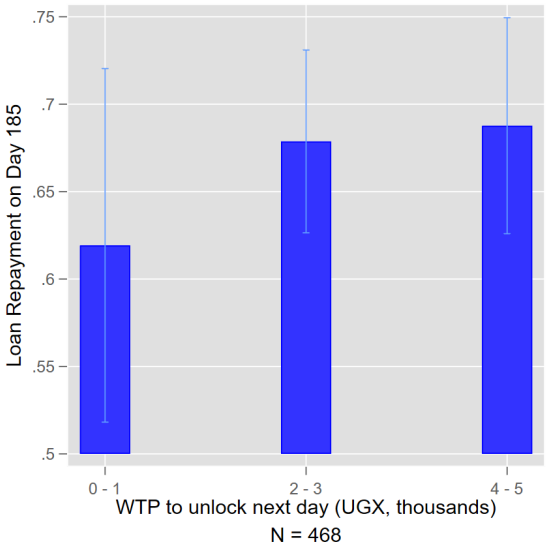
Table 15: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, At Median WTP or Above (≥ 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.34	0.12*	0.01	0.11
		(0.07)	(0.06)	(0.07)
150	0.42	0.25***	0.07	0.17**
		(0.07)	(0.06)	(0.07)
185	0.49	0.20***	0.05	0.15**
		(0.07)	(0.06)	(0.07)
n		285	360	251

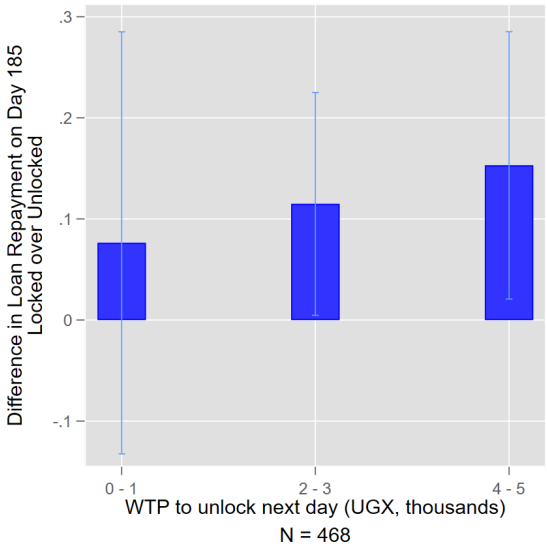
Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at least 3,000 Ugandan Shillings to unlock their hypothetically-locked solar home

system the next day. Loan completion describes whether the loan principal has been repaid. The above results display the Local Average Treatment Effect (LATE), which measures the average treatment effect on loan completion for compliers, using the share of days in compliance as the endogenous variable (see the Appendix for Intent to Treat (ITT) results). The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure 9: Loan repayment on day 185 by willingness to pay



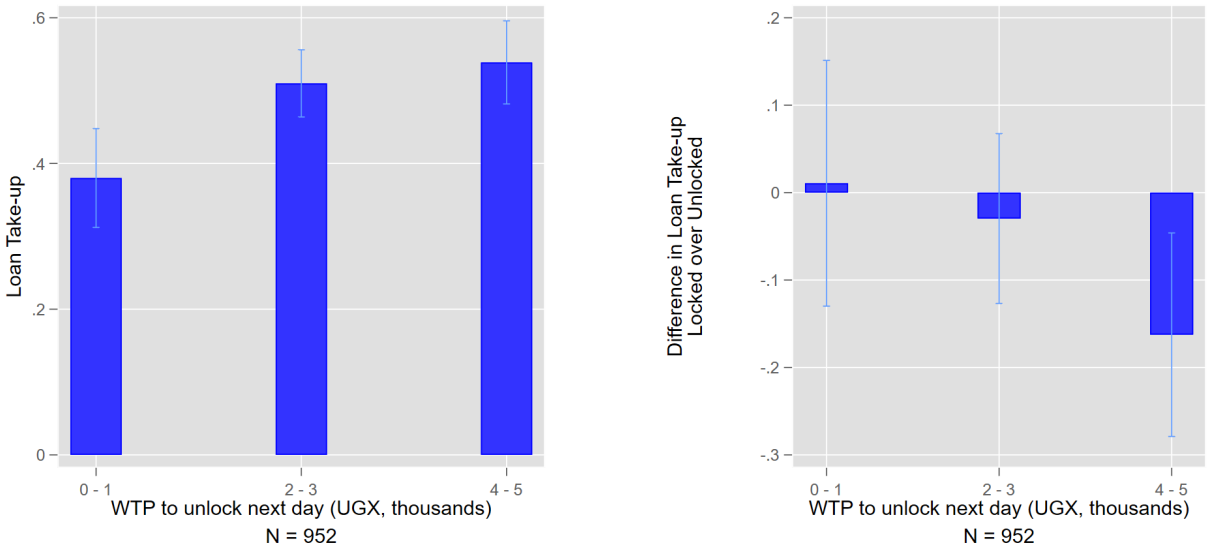
(a) Loan repayment, pooled



(b)Locked over Unlocked

Note: This figure covers the sample of 468 loans, of which 155 are Locked loans and 313 are Unlocked loans. Surprise unlocked loans are excluded from this figure. Individuals with willingness to pay to unlock next day being 0 or 1,000 UGX are in the first group, being 2,000 or 3,000 UGX in the second group, and being 4,000 or 5,000 in the third group. Panel (a) plots the average loan repayment on day 185 and Panel (b) plots the differences between Locked and Unlocked loans. 95% confidence interval are along with the bars.

Figure 10: Loan take-up by willingness to pay



(a) Loan repayment, pooled

(b)Locked over Unlocked

Note: This figure covers the sample of 952 individuals, of which 344 are treated with Locked loans and 608 are treated with Unlocked loans. Individuals treated with Surprise unlocked loans are excluded from this figure. Individuals with willingness to pay to unlock next day being 0 or 1,000 UGX are in the first group, being 2,000 or 3,000 UGX in the second group, and being 4,000 or 5,000 in the third group. Panel (a) plots the average loan take-up and Panel (b) plots the differences between individuals treated with Locked and Unlocked loans. 95% confidence interval are along with the bars. The sample size is smaller than the prediction regressions of loan take-up by 2 individuals, as the willingness to pay of those 2 individuals in the regressions are imputed.

Table 16: Characteristics of those who take-up loans (dropping Surprise Unlocked)

	Unlocked	Locked	N
Percent of days locked at SMS	16.2	14.5	468
	(15.6)	(14.1)	
Household head characteristics			
Age	42.9	44.2	468
	(10.0)	(11.3)	
Female	0.11	0.10	468
	(0.31)	(0.31)	
Household head occupation			
Family business or farm	0.50	0.65***	468
	(0.50)	(0.48)	
Self-employed	0.60	0.64	468
	(0.49)	(0.48)	
Outside the home	0.36	0.33	468
	(0.48)	(0.47)	
Number of school aged children	3.1	3.2	468
	(2.1)	(2.1)	
Total yearly household income per adult equivalent (UGX, millions)	1.3	1.1	468
	(1.2)	(0.9)	
Value of assets per adult equivalent (UGX, millions)	1.1	1.2	468
	(1.4)	(1.5)	
Share of 5k UGX kept in risk game	0.36	0.37	468
	(0.25)	(0.25)	
WTP to unlock next day (UGX, thousands)	3.0	2.9	468
	(1.5)	(1.5)	
Hours to nearest ReadyPay Service Center	0.9	1.0	468
	(0.8)	(0.8)	

Standard deviations in parentheses. Values in UGX are winsorized at the 99th percentile. Tests of differences in means are carried out between Unlocked and Locked. * $p < .10$, ** $p < .05$, *** $p < .01$

A Appendix

Table A.1: Characteristics of those who take-up loans (dropping Surprise Unlocked)

	Unlocked	Locked	N
Percent of days locked at SMS	16.2	14.5	468
	(15.6)	(14.1)	
Household head characteristics			
Age	42.9	44.2	468
	(10.0)	(11.3)	
Female	0.11	0.10	468
	(0.31)	(0.31)	
Household head occupation			
Family business or farm	0.50	0.65***	468
	(0.50)	(0.48)	
Self-employed	0.60	0.64	468
	(0.49)	(0.48)	
Outside the home	0.36	0.33	468
	(0.48)	(0.47)	
Number of school aged children	3.1	3.2	468
	(2.1)	(2.1)	
Total yearly household income per adult equivalent (UGX, millions)	1.3	1.1	468
	(1.2)	(0.9)	
Value of assets per adult equivalent (UGX, millions)	1.1	1.2	468
	(1.4)	(1.5)	
Share of 5k UGX kept in risk game	0.36	0.37	468
	(0.25)	(0.25)	
WTP to unlock next day (UGX, thousands)	3.0	2.9	468
	(1.5)	(1.5)	
Hours to nearest ReadyPay Service Center	0.9	1.0	468
	(0.8)	(0.8)	

Standard deviations in parentheses. Values in UGX are winsorized at the 99th percentile. Tests of differences in means are carried out between Unlocked and Locked. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.2: Baseline Characteristics

Characteristic	Locked	Surprise Unlocked	Unlocked	Control	n
Risk					
Percent of days locked at SMS (%)	14.7 (15.3)	15.2 (15.5)	16.1 (15.2)	14.0 (14.5)	2133
Household head					
Age (years)	43.0 (11.0)	43.8 (11.1)	43.3 (10.6)	43.5 (11.1)	2122
Female (proportion)	0.13 (0.34)	0.12 (0.32)	0.11 (0.32)	0.11 (0.31)	2125
Married (proportion)	0.89 (0.32)	0.88 (0.32)	0.85 (0.35)	0.86 (0.34)	2125
Household head occupation (proportion)					
Family business or farm	0.59 (0.49)	0.56 (0.50)	0.53 (0.50)	0.56 (0.50)	2125
Self-employed	0.60 (0.49)	0.63 (0.48)	0.60 (0.49)	0.59 (0.49)	2123
Outside the home	0.35 (0.48)	0.36 (0.48)	0.37 (0.48)	0.34 (0.47)	2125
Demographics					
Number of people in household	6.6 (2.7)	6.6 (3.0)	6.6 (2.7)	6.6 (2.7)	2125
Number of children aged 5-20 enrolled in school	2.7 (1.9)	2.7 (2.0)	2.7 (1.9)	2.7 (2.0)	2125
Financial information					
Amount spent on lighting, year (UGX, millions)	0.1 (0.3)	0.1 (0.3)	0.2 (0.4)	0.2 (0.4)	2121
Total household income, year (UGX, millions)	5.2 (4.7)	5.5 (5.0)	5.3 (5.0)	5.8 (5.5)	2094
Value of assets (UGX, millions)	5.3 (7.2)	4.8 (6.0)	5.1 (7.0)	5.3 (7.0)	2125
Borrowing					
Borrowed in last 12 months (proportion)	0.60 (0.49)	0.60 (0.49)	0.62 (0.49)	0.63 (0.48)	2120

Money borrowed in last 12 months (UGX, millions)	1.2 (2.7)	1.1 (2.5)	1.3 (2.7)	1.2 (2.5)	2117
Ever refused for loan in last 12 months (proportion)	0.13 (0.34)	0.14 (0.35)	0.15 (0.35)	0.20 (0.40)	2119
Took a microfinance loan in last 12 months (proportion)	0.07 (0.26)	0.06 (0.25)	0.08 (0.28)	0.07 (0.26)	2120

Note: Standard deviations in parentheses. Values in UGX are winsorized at the 99th percentile.

Table A.3: Baseline Characteristics

Characteristic	Locked	Surprise Unlocked	Unlocked	Control	n
Risk					
Percent of days locked at SMS (%)	14.7 (15.3)	15.2 (15.5)	16.1 (15.2)	14.0 (14.5)	2133
Household head					
Age (years)	43.0 (11.0)	43.8 (11.1)	43.3 (10.6)	43.5 (11.1)	2122
Female (proportion)	0.13 (0.34)	0.12 (0.32)	0.11 (0.32)	0.11 (0.31)	2125
Married (proportion)	0.89 (0.32)	0.88 (0.32)	0.85 (0.35)	0.86 (0.34)	2125
Household head occupation (proportion)					
Family business or farm	0.59 (0.49)	0.56 (0.50)	0.53 (0.50)	0.56 (0.50)	2125
Self-employed	0.60 (0.49)	0.63 (0.48)	0.60 (0.49)	0.59 (0.49)	2123
Outside the home	0.35 (0.48)	0.36 (0.48)	0.37 (0.48)	0.34 (0.47)	2125
Demographics					
Number of people in household	6.6 (2.7)	6.6 (3.0)	6.6 (2.7)	6.6 (2.7)	2125
Number of children aged 5-20 enrolled in school	2.7 (1.9)	2.7 (2.0)	2.7 (1.9)	2.7 (2.0)	2125
Financial information					
Amount spent on lighting, year (UGX, millions)	0.1 (0.3)	0.1 (0.3)	0.2 (0.4)	0.2 (0.4)	2121
Total household income, year (UGX, millions)	5.2 (4.7)	5.5 (5.0)	5.3 (5.0)	5.8 (5.5)	2094
Value of assets (UGX, millions)	5.3 (7.2)	4.8 (6.0)	5.1 (7.0)	5.3 (7.0)	2125
Borrowing					
Borrowed in last 12 months (proportion)	0.60 (0.49)	0.60 (0.49)	0.62 (0.49)	0.63 (0.48)	2120

Money borrowed in last 12 months (UGX, millions)	1.2 (2.7)	1.1 (2.5)	1.3 (2.7)	1.2 (2.5)	2117
Ever refused for loan in last 12 months (proportion)	0.13 (0.34)	0.14 (0.35)	0.15 (0.35)	0.20 (0.40)	2119
Took a microfinance loan in last 12 months (proportion)	0.07 (0.26)	0.06 (0.25)	0.08 (0.28)	0.07 (0.26)	2120

Note: Standard deviations in parentheses. Values in UGX are winsorized at the 99th percentile.

Table A.4: Share of Days in Compliance, by Treatment

Loan day	Locked	Surprise Unlocked	Unlocked
50	0.92	0.91	0.93
	(0.27)	(0.23)	(0.21)
100	0.92	0.93	0.94
	(0.27)	(0.20)	(0.20)
150	0.92	0.94	0.95
	(0.27)	(0.20)	(0.20)
185	0.92	0.94	0.95
	(0.26)	(0.20)	(0.20)
n	197	346	404

Note: Standard deviations in parentheses. The analysis is run on samples of the share of days in compliance at either the 50th, 100th, 150th day, or 185th day from origination for the Completed customer sample.

Table A.5: Tests of Lockout, Adverse Selection and Moral Hazard on Loan Repayment

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.46	0.11***	0.03	0.08**
		(0.03)	(0.03)	(0.03)
150	0.57	0.12***	0.04	0.08**
		(0.04)	(0.03)	(0.04)
185	0.60	0.11***	0.04	0.07*
		(0.04)	(0.03)	(0.04)
n		601	750	543

Note: Standard errors in parentheses. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan repayment. The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.6: Tests of Lockout, Adverse Selection and Moral Hazard on Loan Completion

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.32	0.08*	0.002	0.08*
		(0.04)	(0.03)	(0.04)
150	0.41	0.14***	0.04	0.10**
		(0.03)	(0.04)	(0.04)
185	0.46	0.13***	0.04	0.09**
		(0.04)	(0.04)	(0.04)
n		601	750	543

Note: Standard errors in parentheses. Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between

the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.7: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, Early Adopters

Loan day	Mean Unlocked	Lockout		Adverse Selection		Moral Hazard	
		ITT	LATE	ITT	LATE	ITT	LATE
100	0.47	0.13**	0.17**	0.02	0.02	0.12**	0.15**
		(0.06)	(0.07)	(0.05)	(0.06)	(0.06)	(0.07)
150	0.55	0.18***	0.22***	0.08	0.09	0.10*	0.13*
		(0.06)	(0.07)	(0.05)	(0.06)	(0.06)	(0.07)
185	0.60	0.17***	0.21***	0.08	0.09	0.09	0.11
		(0.06)	(0.07)	(0.05)	(0.06)	(0.06)	(0.07)
n		220	220	269	269	193	193

Note: Standard errors in parentheses. The samples are further restricted to those individuals who had received the baseline survey after placing the loan deposit or who had not received a baseline survey (Early Adopters). Loan repayment is measured by the cumulative proportion of the loan principal repaid. The Intention to Treat (ITT) measures the average effect of assignment on loan repayment, while the Local Average Treatment Effect (LATE) measures the average treatment effect on loan repayment for compliers, using the share of days in compliance as the endogenous variable. The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples.
* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.8: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, Early Adopters

Loan day	Mean Unlocked	Lockout		Adverse Selection		Moral Hazard	
		ITT	LATE	ITT	LATE	ITT	LATE
110	0.34	0.10	0.12	-0.01	-0.02	0.11	0.14
		(0.07)	(0.09)	(0.06)	(0.07)	(0.07)	(0.09)
150	0.42	0.16**	0.20**	0.08	0.09	0.09	0.11
		(0.07)	(0.09)	(0.06)	(0.07)	(0.07)	(0.09)
185	0.47	0.20***	0.24***	0.07	0.09	0.13*	0.16*
		(0.07)	(0.09)	(0.06)	(0.07)	(0.07)	(0.09)
n		220	220	269	269	193	193

Note: Standard errors in parentheses. Loan completion describes whether the loan principal has been repaid. The samples are further restricted to those individuals who had received the baseline survey after placing the loan deposit or who had not received a baseline survey (Early Adopters). The Intention to Treat (ITT) measures the average effect of assignment on loan completion, while the Local Average Treatment Effect (LATE) measures the average treatment effect on loan completion for compliers, using the share of days in compliance as the endogenous variable. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.9: Education Outcomes, Household-level

	Enrollment	Days absent	Log school expenditures
Loan	0.0277**	0.0133	0.163**
	(0.0137)	(0.155)	(0.0758)
Constant	0.880***	1.280***	12.25***
	(0.0124)	(0.140)	(0.0687)
n	1698	1636	1636

Note: Standard errors in parentheses. Results relate to Term 2 outcomes. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment to a loan. "Enrollment" describes the share of school-aged children (individuals aged 5-20) enrolled in Term 2 within the household, and is conditional on having at least one school-aged child within the household at endline. "Days absent" describes the average days of school missed per month, per enrolled school-aged child, and is conditional on having at least one school-aged child enrolled at endline in Term 2. "School expenditures" describes the average school expenditure per enrolled school-aged child and is conditional on having at least one school-aged child enrolled at endline in Term 2. School expenditures include expenditures on school fees, supplies (uniforms, pens, pencils, notebooks, etc), transport, and school meals. School expenditures are winsorized at the 99th percentile. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.10: Education Outcomes for School Aged Children

	Enrollment		Log school expenditures	
	Male	Female	Male	Female
Loan	0.0346**	-0.0108	0.119	0.279**
	(0.0172)	(0.0161)	(0.0970)	(0.130)
P value from Chow test		0.03		0.27
Outcome mean	0.911	0.900	12.10	12.15
n	2780	2927	2522	2625

Note: Standard errors in parentheses. Standard errors are clustered at the household level. Results relate to Term 2 outcomes. School expenditures are conditional on enrollment at endline in Term 2. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment to a loan. School expenditures include expenditures on school fees, supplies (uniforms, pens, pencils, notebooks, etc), transport, and school meals. School expenditures are winsorized at the 99th percentile. The p value from the Chow test compares the treatment effect for males to that of females. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.11: Shocks over the past 6 months

	(1) Proportion shocks experienced	(2) Proportion shocks experienced	(3) How worried are you about this?	(4) How worried are you about this?
Shock Category A: Problem With Money				
Assigned Locked loan	0.0171		0.0361	
	(0.0255)		(0.0233)	
Assigned Surprise Unlocked loan	-0.00327		0.0113	
	(0.0227)		(0.0209)	
Assigned Unlocked loan	0.0229		0.00704	
	(0.0225)		(0.0205)	
Assigned any loan		0.0117		0.0151
		(0.0199)		(0.0182)
Constant	0.414***	0.414***	0.729***	0.729***
	(0.0180)	(0.0180)	(0.0165)	(0.0165)
n	1895	1895	1409	1409
Shock Category B: Money Matters For Coping				
Assigned Locked loan	-0.00433		0.00952	
	(0.0168)		(0.0185)	
Assigned Surprise Unlocked loan	-0.00707		-0.00613	
	(0.0150)		(0.0167)	
Assigned Unlocked loan	0.0139		0.0107	
	(0.0149)		(0.0165)	
Assigned any loan		0.00184		0.00416
		(0.0131)		(0.0146)
Constant	0.343***	0.343***	0.832***	0.832***
	(0.0119)	(0.0119)	(0.0131)	(0.0131)
n	1895	1895	1660	1660
Shock Category C: Money Doesn't Help				
Assigned Locked loan	-0.00791		0.0652	
	(0.0120)		(0.0463)	

Assigned Surprise Unlocked loan	-0.0123 (0.0107)		0.0577 (0.0407)	
Assigned Unlocked loan	-0.0163 (0.0106)		0.0317 (0.0403)	
Assigned any loan		-0.0129 (0.00937)		0.0490 (0.0350)
Constant	0.0896*** (0.00847)	0.0896*** (0.00847)	0.694*** (0.0311)	0.694*** (0.0311)
n	1895	1895	458	458

Note: Standard errors in parentheses. Shock Category A gathers together the following experiences over the last 6 months: not having enough money for basic needs such as food and clothing; not having enough money for other living home expenses; being unable to educate all of your children; not having enough money for medicines and medical treatment; debts owed to others. Shock Category B gathers together the following experiences over the last 6 months: health problems or illness; an accident or disaster; difficulty finding work; death of a family member; job loss; weather affecting your crops. Shock Category C gathers together the following experiences over the last 6 months: problems at home with relatives; problems with people in other tribes; idleness of your children or spouse; alcohol consumption of your children or spouse. Columns (1) and (2) use the proportion of shocks within a category that one is said to have experienced over the last 6 months as the dependent variable. Columns (3) and (4) use the average value of the likert-scale values transformed to 0-1 scales, out of the shocks experienced within a category, as the dependent variable. The reference group is the Control group that was not assigned any school fee loan. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.12: Household Balance Sheet Effects (LATE)

	Asset purchases (IHST)	Asset purchases (IHST)	Asset sales (IHST)	Asset sales (IHST)	Money borrowed (IHST)	Money borrowed (IHST)	Net difference (IHST)	Net difference (IHST)
Assigned locked loan	0.566		-0.158		0.0294		0.618	
	(0.836)		(1.014)		(0.991)		(2.060)	
Assigned surprise unlocked loan	0.190		-1.319		-0.0759		0.467	
	(0.710)		(0.861)		(0.842)		(1.750)	
Assigned unlocked loan	0.956		0.0602		0.128		0.905	
	(0.665)		(0.807)		(0.789)		(1.639)	
Assigned any loan		0.698		0.698		0.0364		0.810
		(0.732)		(0.732)		(0.867)		(1.802)
Constant	10.55***	10.49***	4.831***	10.49***	9.274***	9.271***	-1.886***	-1.955**
	(0.290)	(0.347)	(0.352)	(0.347)	(0.344)	(0.411)	(0.714)	(0.854)
Outcome mean (level)	901450	901450	356959	356959	888500	888500	-344009	-344009
n	1852	1852	1852	1852	1852	1852	1852	1852

Note: Asset purchases, asset sales, and money borrowed are winsorized at the 99th percentile. The LATE measures the average treatment effect for compliers, using actual receipt of a school fee loan type (or any school fee loan) as the endogenous variable. "Net difference" records the difference between asset purchases and asset sales, minus money borrowed. Winsorizing takes place before IHST transformation. For 31 individuals who reported a source of a loan as ReadyPay, the amount of the school fee loan was added back into the total amount reported to have been borrowed. The above analysis uses the Intent to Treat (ITT). * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.13: Household Balance Sheet Effects (ITT)

	Asset purchases (IHST)	Asset purchases (IHST)	Asset sales (IHST)	Asset sales (IHST)	Money borrowed (IHST)	Money borrowed (IHST)	Net difference (IHST)	Net difference (IHST)
Assigned locked loan	0.279		-0.0776		0.0145		0.304	
	(0.412)		(0.499)		(0.489)		(1.015)	
Assigned surprise unlocked loan	0.0981		-0.682		-0.0392		0.241	
	(0.367)		(0.444)		(0.436)		(0.904)	
Assigned unlocked loan	0.524		0.0330		0.0700		0.496	
	(0.364)		(0.441)		(0.433)		(0.898)	
Assigned any loan		0.307		-0.264		0.0160		0.356
		(0.321)		(0.389)		(0.381)		(0.792)
Constant	10.55***	10.55***	4.831***	4.831***	9.274***	9.274***	-1.886***	-1.886***
	(0.290)	(0.290)	(0.351)	(0.351)	(0.344)	(0.344)	(0.715)	(0.714)
Outcome mean (level)	901450	901450	356959	356959	888500	888500	-344009	-344009
P value from K-W H test	0.607		0.442		0.961		0.984	
P value from M-W U test		0.978		0.493		0.968		0.859
n	1852	1852	1852	1852	1852	1852	1852	1852

Note: Asset purchases, asset sales, and money borrowed are winsorized at the 99th percentile. The above analysis uses the Intent to Treat (ITT). "Net difference" records the difference between asset purchases and asset sales, minus money borrowed. Winsorizing takes place before IHST transformation. For 31 individuals who reported a source of a loan as ReadyPay, the amount of the school fee loan was added back into the total amount reported to have been borrowed. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.14: Household Balance Sheet Effects, calculated (semi-)elasticities

	Asset purchases (IHST)	Asset sales (IHST)	Money borrowed (IHST)	Net difference (IHST)
Loan	0.359	-0.232	0.016	-0.314
	(0.437)	(0.299)	(0.388)	(0.565)

Note: Standard errors in parentheses. Asset purchases, asset sales, and money borrowed are winsorized at the 99th percentile. The above analysis uses the Intent to Treat (ITT) estimates to derive semi-elasticities. "Net difference" records the difference between asset purchases and asset sales, minus money borrowed. Winsorizing takes place before IHST transformation. For 31 individuals who reported a source of a loan as ReadyPay, the amount of the school fee loan was added back into the total amount reported to have been borrowed. Loan refers to the semi-elasticity calculated following the exact method from Bellemare and Wichman (2019), following arguments from Halvorsen and Palmquist (1980), Kennedy (1981) and Giles (1982). * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.15: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, Below Median Risk (< 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.54	0.11**	0.07*	0.03
		(0.05)	(0.04)	(0.05)
150	0.65	0.10**	0.08**	0.01
		(0.05)	(0.04)	(0.05)
185	0.69	0.07	0.07*	-0.0006
		(0.05)	(0.04)	(0.05)
n		294	368	270

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for less than 11 percent of its history by early May 2019, right before the start of the experiment (APL). Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan repayment. The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.16: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, At Median Risk or Above (≥ 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.39	0.11**	-0.02	0.13***
		(0.05)	(0.04)	(0.05)
150	0.49	0.13**	-0.006	0.14***
		(0.05)	(0.04)	(0.05)
185	0.52	0.14***	-0.0005	0.14**
		(0.05)	(0.04)	(0.05)
n		307	382	273

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for 11 percent or more of its history by early May 2019, right before the start of the experiment

(APL). Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan repayment. The analysis is run on samples at either the 100th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the repayment rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the repayment rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the repayment rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.17: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, Below Median Risk (< 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.39	0.07	0.07	-0.006
		(0.06)	(0.05)	(0.06)
150	0.49	0.14**	0.12**	0.02
		(0.06)	(0.05)	(0.06)
185	0.55	0.11*	0.07	0.04
		(0.06)	(0.05)	(0.06)
n		294	368	270

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for less than 11 percent of its history by early May 2019, right before the start of the experiment (APL). Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.18: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, At Median Risk or Above (≥ 11 APL)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.25	0.09	-0.07*	0.16***
		(0.06)	(0.04)	(0.05)
150	0.33	0.14**	-0.03	0.17***
		(0.06)	(0.05)	(0.06)
185	0.37	0.14**	-0.003	0.14**
		(0.06)	(0.05)	(0.06)
n		307	382	273

Note: Standard errors in parentheses. Estimates are run for the subsample that had their solar home system locked for 11 percent or more of its history by early May 2019, right before the start of the experiment

(APL). Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.19: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, Below Median WTP (< 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.48	0.09	0.01	0.08
		(0.06)	(0.05)	(0.06)
150	0.58	0.10	0.01	0.09
		(0.06)	(0.06)	(0.06)
185	0.61	0.11	0.02	0.09
		(0.06)	(0.05)	(0.06)
n		183	235	186

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at most 2,000 Ugandan Shillings to unlock their hypothetically-locked solar home system the next day. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan repayment. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.20: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Repayment, At Median WTP or Above (≥ 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
100	0.48	0.17***	0.05	0.12**
		(0.05)	(0.04)	(0.05)
150	0.60	0.16***	0.06	0.10**
		(0.05)	(0.04)	(0.05)
185	0.65	0.13***	0.04	0.09*
		(0.05)	(0.04)	(0.05)
n		285	360	251

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at least 3,000 Ugandan Shillings to unlock their hypothetically-locked solar home

system the next day. Loan repayment is measured by the cumulative proportion of the loan principal repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan repayment. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.21: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, Below Median WTP (< 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.35	0.06	-0.0005	0.07
		(0.07)	(0.06)	(0.07)
150	0.45	0.09	0.006	0.08
		(0.08)	(0.07)	(0.08)
185	0.47	0.09	-0.01	0.11
		(0.08)	(0.07)	(0.08)
n		183	235	186

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at most 2,000 Ugandan Shillings to unlock their hypothetically-locked solar home system the next day. Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.22: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, At Median WTP or Above (≥ 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.34	0.11*	0.009	0.10
		(0.06)	(0.05)	(0.06)
150	0.42	0.22***	0.06	0.15**
		(0.06)	(0.05)	(0.07)
185	0.49	0.18***	0.05	0.13**
		(0.06)	(0.05)	(0.06)
n		285	360	251

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at least 3,000 Ugandan Shillings to unlock their hypothetically-locked solar

home system the next day. Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Table A.23: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, Below Median WTP (< 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.35	0.06	-0.0005	0.07
		(0.07)	(0.06)	(0.07)
150	0.45	0.09	0.006	0.08
		(0.08)	(0.07)	(0.08)
185	0.47	0.09	-0.01	0.11
		(0.08)	(0.07)	(0.08)
n		183	235	186

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at most 2,000 Ugandan Shillings to unlock their hypothetically-locked solar home system the next day. Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

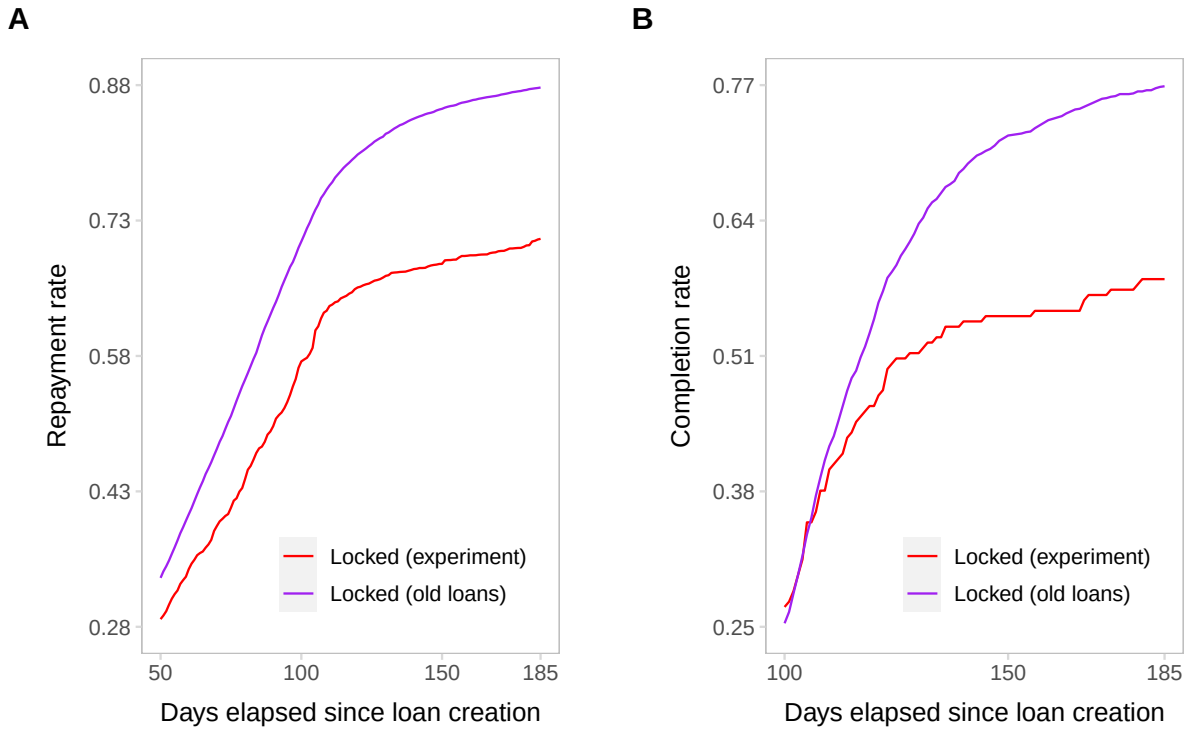
Table A.24: Tests of Lockout, Adverse Selection, and Moral Hazard on Loan Completion, At Median WTP or Above (≥ 3,000 Ugandan Shillings)

Loan day	Mean Unlocked	Lockout	Adverse Selection	Moral Hazard
110	0.34	0.11*	0.009	0.10
		(0.06)	(0.05)	(0.06)
150	0.42	0.22***	0.06	0.15**
		(0.06)	(0.05)	(0.07)
185	0.49	0.18***	0.05	0.13**
		(0.06)	(0.05)	(0.06)
n		285	360	251

Note: Standard errors in parentheses. Estimates are run for the subsample that responded during the endline survey as willing to pay at least 3,000 Ugandan Shillings to unlock their hypothetically-locked solar

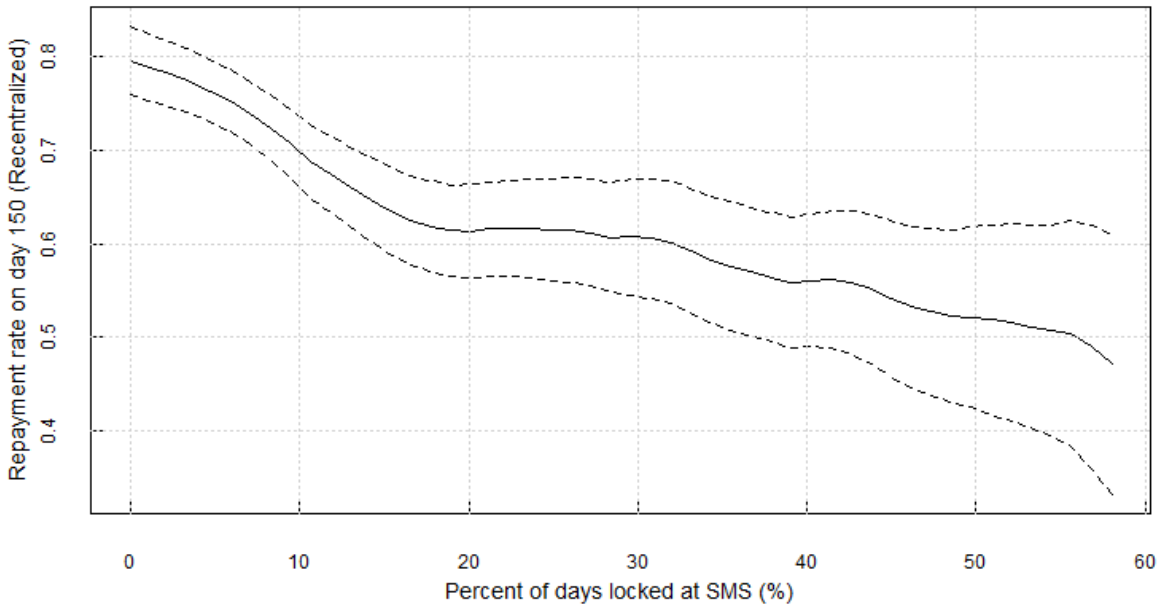
home system the next day. Loan completion describes whether the loan principal has been repaid. The above results display the Intent to Treat (ITT) analysis, which measures the average effect of assignment on loan completion. The analysis is run on samples at either the 110th, 150th, or 185th day from origination for the Completed customer sample. "Lockout" captures the difference in the completion rate between the Unlocked and Locked samples, "Adverse Selection" captures the difference in the completion rate between the Unlocked and Surprise Unlocked samples, and "Moral Hazard" captures the difference in the completion rate between the Surprise Unlocked and Locked samples. * $p < .10$, ** $p < .05$, *** $p < .01$

Figure A.1: Loan repayment and completion rates



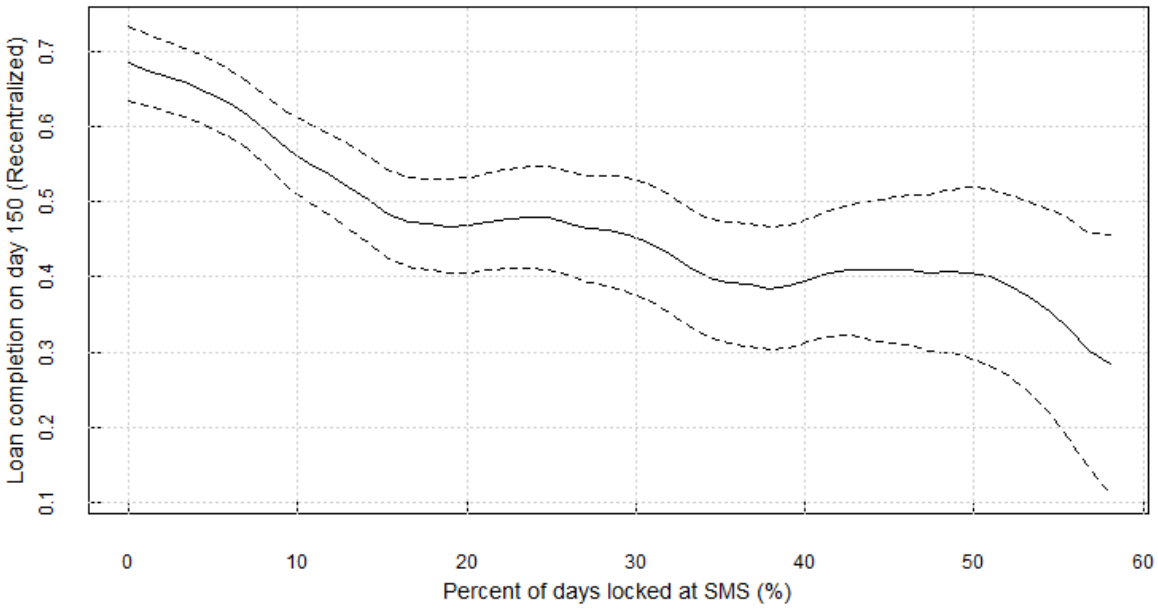
Note: Average loan repayment rates over days elapsed since loan creation are in Panel A, and average loan completion rates over days elapsed since loan creation are in Panel B, for old Fenix school fee loans and current experimental loans. Rates are displayed over the sample of 197 Locked school fee loans from the experiment and on a sample of 1,559 older Fenix loans.

Figure A.2: Repayment by Percent of Days Locked on Day 150



Note: 95% confidence intervals (displayed with dotted lines) are obtained via bootstrapping. Percent of days locked at SMS is trimmed at 1% and 99%. Repayment rate on day 150 is residualized to remove the effects of treatments and recentralized to the mean of the Locked group.

Figure A.3: Completion by Percent of Days Locked on Day 150



Note: 95% confidence intervals (displayed with dotted lines) are obtained via bootstrapping. Percent of days locked at SMS is trimmed at 1% and 99%. Loan completion on day 150 is residualized to remove the effects of treatments and recentralized to the mean of the Locked group.