
Digital Collateral

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Motivation

About 590 million Africans live off the grid. Most of them rely on flame-based lamps powered by fossil fuels like kerosene. The light from these lamps is dim and comes with significant health and financial costs. A kerosene lamp may cost less than \$5, but fuel averages about \$57 per year. Sub-Saharan Africans burn up about \$10 billion annually on kerosene, and worldwide, kerosene costs people without electricity \$36 billion.

—Study by the International Finance Corporation (World Bank)

The Problem



Low quality light, burns fossil fuel (\$\$\$), fire hazard

The Solution



A \$30 solar lantern pays for itself in 8-10 weeks

The (Product Adoption) Puzzle

In LMICs, household investment in many basic technologies has extremely high returns

- ▶ Yet adoption has been slow and is not widespread

There are a number of explanations for why

- ▶ Both on the supply and demand side
- ▶ Today will focus on credit market frictions

Isn't microfinance the answer?

- ▶ Traditional microfinance
 - ▶ Expensive (and unsecured)
 - ▶ Inconvenient (high transaction costs)
 - ▶ Low uptake
 - ▶ Modest effects on the average borrower (Banerjee, 2015)
- ▶ Digital financial products are becoming increasingly popular. The growth has been facilitated by technology:
 - ▶ Access to mobile phones
 - ▶ Digital payments (mobile money)

What are the effects on households and firms? How best should they be utilized?

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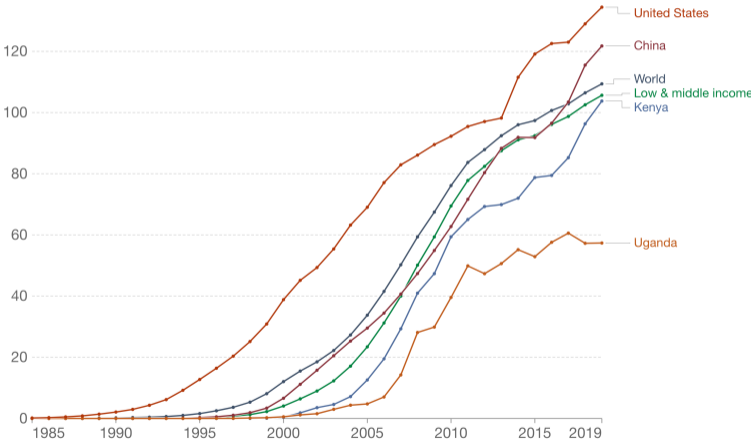
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Adoption has been Rapid

Mobile cellular subscriptions, 1985 to 2019

Mobile phone subscriptions, measured as the number per 100 people.



Source: International Telecommunication Union (via World Bank)

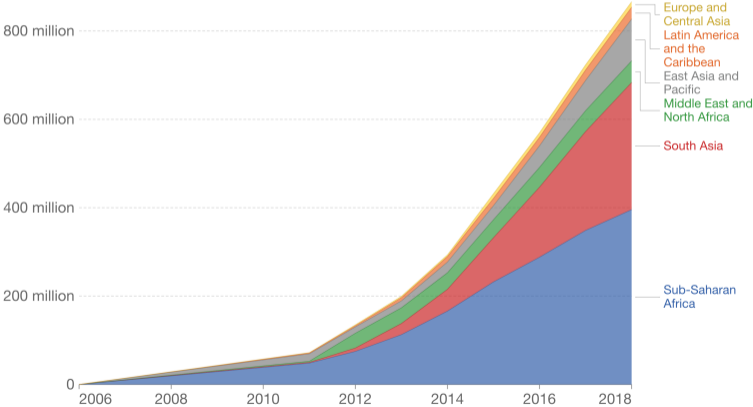
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Adoption has been Rapid

Registered Mobile Money Accounts by Region, 2006 to 2018



The cumulative number of mobile money accounts at the end of the year by region. Mobile money services include transferring money and making payments using a mobile phone, without a formal account at a financial institution. North America is not shown since mobile money accounts are not utilised across this region.



Source: GSMA (2017). Global Mobile Money Database.

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What about secured lending?

Collateralized lending is the predominant source of credit for households in rich countries

- ▶ More than 80% of US household debt is secured

Why? Collateral alleviates credit market frictions.

1. Moral hazard: incentives to repay
2. Adverse selection: screening device

Collateralized lending is much less common in poor countries.

- ▶ Supply side: Repossession costs
 - ▶ Contracts hard to enforce; property rights are difficult to establish
- ▶ Demand side: Income risk
 - ▶ Threat of repossession unattractive to households

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Enter PAYGO financing and "Digital Collateral"

New *ReadyPay* Rates.

Enjoy **DISCOUNTS** when you complete your loan early!



10W <i>ReadyPay</i> Home Eco 2	
Deposit:	19,000/-
Daily Rate:	600/-
Monthly Rate:	18,000/-
Duration:	35 months
Buy in Cash:	519,000/-
Buy on Loan:	649,000/-

Complete in 12 months for a 100,000/- DISCOUNT



10W <i>ReadyPay</i> Home Plus	
Deposit:	39,000/-
Daily Rate:	1,000/-
Monthly Rate:	30,000/-
Duration:	25 months
Buy in Cash:	631,000/-
Buy on Loan:	789,000/-

Complete in 12 months for a 100,000/- DISCOUNT



17W <i>ReadyPay</i> Home Comfort	
Deposit:	49,000/-
Daily Rate:	1,350/-
Monthly Rate:	40,500/-
Duration:	24 months
Buy in Cash:	799,000/-
Buy on Loan:	999,000/-

Complete in 12 months for a 110,000/- DISCOUNT

Home Eco customers who pay well can upgrade to a Home Comfort in 3 months



34W <i>ReadyPay</i> Home Deluxe	
Deposit:	99,000/-
Daily Rate:	1,800/-
Monthly Rate:	54,000/-
Duration:	24 months
Buy in Cash:	1,116,000/-
Buy on Loan:	1,395,000/-

Complete in 12 months for a 180,000/- DISCOUNT



34W <i>ReadyPay</i> TV Deluxe (Zuku)	
Deposit:	149,000/-
Daily Rate:	3,000/-
Monthly Rate:	90,000/-
Duration:	26 months
Buy in Cash:	1,999,000/-
Buy on Loan:	2,539,000/-

Complete in 12 months for a 270,000/- DISCOUNT

Includes 1 Year Zuku subscription

Includes 1 Year Zuku subscription

Pay well to be eligible for **UPGRADES** in 3 months!

SCHOOL FEES LOANS



Warranty:

- All systems come with a **3-year** limited warranty on the battery and panel.
- Accessories come with a **2-year** limited warranty.
- Any faults caused during manufacturing will be replaced for **FREE** at a *ReadyPay* service centre.



Finance for the Next Billion



Phone Finance

Buy a smartphone on installment payments and build your credit history.

GET A PHONE



Cash Loans

Apply for a cash loan from your smartphone and receive your money in minutes

GET A LOAN

Research Questions

Experimental

- ▶ How valuable is securing loans with digital collateral to the lender?
 - ▶ Quantify the effect on repayment and profitability
- ▶ What is the channel?
 - ▶ Moral hazard vs adverse selection
- ▶ What are the impacts of the loans on households?

Theoretical

- ▶ What is the optimal way to utilize digital collateral?
 - ▶ Insurance vs incentives

Summary of Experimental Results

1. Securing loans with DC significantly increases repayment and profitability
 - ▶ Default rates decrease by 19pp
 - ▶ Loan profitability (IRR) increases by 38pp
2. Decomposition
 - ▶ $\approx 2/3$ due to moral hazard
 - ▶ $\approx 1/3$ due to selection
3. Household outcomes appear promising
 - ▶ Reasonably high take-up
 - ▶ No evidence of a “debt trap”
 - ▶ More work to be done here
4. Securing loans with DC is not without cost
 - ▶ Production and installation costs of the technology
 - ▶ Median household is locked 25% of first 200 days
 - ▶ Flexible repayment: feature or bug? but potential room for improvement...

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- ▶ Partnership with Fenix International (recently acquired by Engie)
 - ▶ Largest SHS supplier in Uganda
 - ▶ Operations in Kenya, Zambia, Mozambique, Cote D'Ivoire and Nigeria
 - ▶ Range of SHS products, 10-34W
 - ▶ LED bulb \approx 4-7W,
 - ▶ Refrigerator \approx 500W
 - ▶ Third largest user of mobile money in Uganda

Loan Product – School Fee Loans

In 2017, Fenix began offering “school fee” loans to existing SHS customers that were in good standing on their account

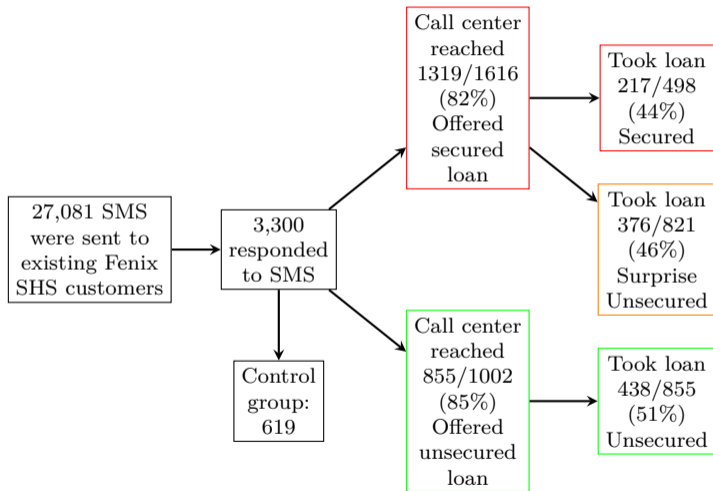
- ▶ Ranging from 100k-500k (\$25-\$125) loan size, 3x per year
- ▶ 100 day maturity, 15-20% deposit,
- ▶ PAYGO structure, e.g., on 300k loan
 - ▶ Make 50k deposit
 - ▶ Receive 300k a few days later
 - ▶ 3k per day, completed after 100 payments
 - ▶ If delinquent -> device locks
- ▶ Implied interest rate depends on repayment
 - ▶ 118% with 100% on time repayment
 - ▶ 64% with 50% repayment (1 out of every 2 days)

Experimental Design

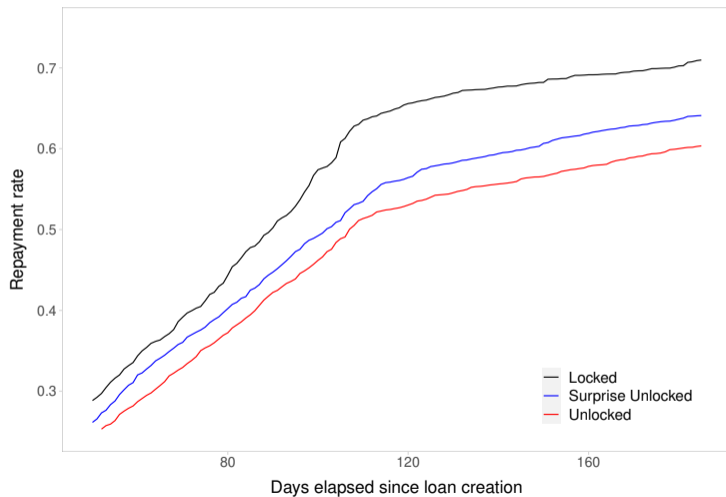
- ▶ Sample randomly divided into 4 groups
 1. Secured: Offered a loan secured by digital collateral (their SHS)
 2. Unsecured: Offered an unsecured loan
 3. Surprise Unsecured: Offered secured loan, if they accepted, we “surprised” them (ala Karlan and Zinman, 2009)
 4. Control: No offer

- ▶ Difference in repayment between Secured and Unsecured captures MH + AS
 - ▶ Secured - Surprise Unsecured: same offer \implies only MH
 - ▶ Surprise Unsecured - Unsecured: different offer \implies only AS

Sample Sizes and Take-up



Loan Repayment



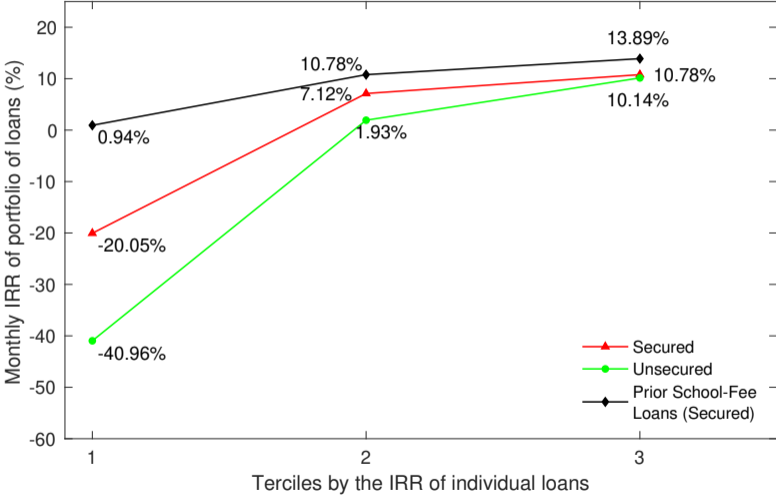
Loan Repayment

Loan day	Mean Unsecured	Secured	Adverse Selection	Moral Hazard
100	0.46	0.13*** (0.04)	0.04 (0.03)	0.09** (0.04)
150	0.57	0.13*** (0.04)	0.05 (0.03)	0.09** (0.04)
200	0.62	0.11*** (0.04)	0.04 (0.03)	0.07* (0.04)
<i>n</i>		655	814	593

Loan Completion

Loan day	Mean Unsecured	Secured	Adverse Selection	Moral Hazard
110	0.31	0.10** (0.05)	0.01 (0.04)	0.09* (0.05)
150	0.41	0.17*** (0.05)	0.05 (0.04)	0.12** (0.05)
200	0.47	0.19*** (0.05)	0.05 (0.04)	0.13** (0.05)
<i>n</i>		655	814	593

Profitability



Educational Outcomes

	<u>Enrollment</u>		<u>Days absent</u>		<u>Log school expenditures</u>	
Secured	0.11*** (0.03)		-2.39*** (0.77)		0.47*** (0.16)	
Surprise Unsecured	0.08*** (0.03)		-1.31* (0.74)		0.32** (0.15)	
Unsecured	0.10*** (0.03)		-2.00*** (0.74)		0.37** (0.15)	
Pooled		0.09*** (0.03)		-1.83** (0.72)		0.37** (0.15)
Pooled × Children	-0.02*** (0.01)	-0.02*** (0.01)	0.37** (0.19)	0.38** (0.19)	-0.05 (0.04)	-0.05 (0.04)
Outcome control mean	0.88	0.88	2.77	2.77	81	81
<i>n</i>	1683	1683	1683	1683	1683	1683

Effect on Household Balance Sheet

	<u>Asset</u> <u>purchases</u>		<u>Asset</u> <u>sales</u>		<u>Money</u> <u>borrowed</u>		<u>Net</u> <u>difference</u>	
Secured (β_1)	15		-10		23		2	
	(44)		(20)		(47)		(62)	
Surprise Unsecured (β_2)	-23		-4		28		-47	
	(39)		(18)		(42)		(55)	
Unsecured (β_3)	33		14		17		2	
	(39)		(18)		(42)		(55)	
Pooled (β)		8		2		23		-17
		(34)		(16)		(37)		(48)
Outcome control mean	236	236	96	96	283	283	-143	-143
<i>n</i>	1877	1877	1877	1877	1877	1877	1877	1877

► No significant impact on household finances.

What is the real innovation?

Two possibilities:

1. Better technology for repossession
 - ▶ Provides repayment incentives without incurring repossession costs
 - ▶ Plausible (even likely)...but straightforward
2. Facilitates a richer space of contracts (e.g., "temporary" repossession) by lowering the cost of dynamically controlling household's consumption of the good.
 - ▶ Question: is this actually valuable?
 - ▶ Answer: Yes! (Green and Sraer, 2022)

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Conclusion

- ▶ Firms: Securing loans with DC significantly increases repayment and profitability
- ▶ Households: Relatively high demand for credit secured by DC
 - ▶ Access to credit increases school enrollment and expenditures
- ▶ But not without cost: median HH locked 25% of first 200 days
 - ▶ Room for improvement? Overall welfare effect on households?
- ▶ Temporary repossession (as in PAYGO) can be optimal

Current and Future Directions

Contract Design

- ▶ Is it possible to reduce locking without sacrificing incentives for repayment?
 - ▶ Arrears vs Paygo
 - ▶ Implementation of optimal contract with loyalty program/virtual currency

Quantify the Welfare Effects

- ▶ Estimate a model of households and firms
 - ▶ Employs data from a randomized pricing experiment of smartphone contracts
- ▶ Counterfactual: no lockout, perfectly competitive pricing
- ▶ Current estimates
 - ▶ Current pricing: Household welfare \uparrow 10-15% income for customers with 60% take up