Joint Liability, Asset Collateralization, and Credit Access

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Thin Financial Markets in Low-Income Countries

- Extensive credit markets in most high-income countries
  - Many asset purchases financed with loans that use asset as collateral - e.g. mortagages, car loans
- In many low-income countries, credit markets thin
- Often difficult to finance asset purchases with loans collateralized by the asset
  - Strict borrowing requirements.
- Do tight borrowing requirements constrain investment? Technology adoption?

Joint Liability as a Solution?

- Could joint liability (guarantor contracts, MFIs) expand credit access?
- Limited uptake of joint liability contracts
  - Limited investment opportunities?
  - Reluctance to enter joint liability contracts?

Questions

- What proportion of farmers who want to borrow at existing interest rate are prevented from doing so by deposit requirements?
- What proportion of farmers who are prevented from borrowing by deposit requirements would borrow if these requirements were converted to joint liability requirements?
- Do tighter borrowing requirements *incentivize* repayment?
- Do these requirements *select* safer borrowers?
  - If so, Stiglitz-Weiss style adverse-selection model suggests lenders will choose tighter borrowing requirements than socially optimal

Dairy Cooperative

- Worked with dairy cooperative that randomized loan offers to farmers.
- Typically requires $\frac{1}{3}$ deposit, $\frac{2}{3}$ joint liability
- Two waves of loans.

Preview of Results

- Substituting deposit with joint liability does not increase access
- Allowing collateralization with the asset increased loan take-up dramatically
- Principal and interest repaid in full tank repossession rate.
- Some evidence borrowing requirements select safer borrowers (p = 5.3%), but no treatment effect on tank repossession
- Allowing collateralized loans with purchased assets had real effects on water access, time use, and girls' school enrollment
- Although nearly 95% of borrowers were subject to credit constraints, many repaid loans early
- After experiment, lender moved to 25% but not 4% deposit

Outline

Background

- 900 million people lack access to water at home (WHO and UNICEF 2010)
  - Time costs, especially for girls and women.
  - Health impact
- High capital costs for household water access
- Evidence from urban Morocco that households are willing to borrow to finance access (Devoto et al.)

Our Setting

- Kenyan dairy farmers
  - Need water for both cows and people
  - 32% of HHs have piped water, though service is intermittent (apprx. 3 days a week)
  - 24% of households have water tank with more than 2500 liter capacity
    - Mostly stone or metal, susceptible to cracking and rust
  - Farmers sell milk through dairy cooperative, with associated savings and credit association
    - Can facilitate debt collection by deducting debt from milk payments

The Technology: Water Tanks

- New tanks lightweight, durable plastic, filled from roof (mostly corrugated iron in this area), or with piped water; 5000 liter capacity
- Introduced about 10 years ago, now dominate the market
- Cost: 24,000 KSh = \$320, about 20% of annual household consumption
- Farmers install gutter system, platform
- Well-suited as collateral
  - Hard to hide or transport without truck
  - Durable

Outline

Sketch of Model

- Farmers have distribution of tank valuation, $\theta_i \sim F[\underline{\theta}, \overline{\theta}]$, (private info)
  - If $\theta_i \geq \theta^R(D)$, farmer borrows to pay tank, repays loan
  - If $\theta^* \leq \theta_i \leq \theta^R(D)$, farmer will borrow; repay in good state, allow repossession in bad state
  - If $\theta_i < \theta^*(D)$, farmer does not borrow
- Iff farmers have higher return from alternate use of funds than deposit on loan, then cutoffs will depend on deposit requirement
- Similarly, if obtaining a guarantor is costly, then guarantor requirements influence take up

Sketch of Model

- Deposit requirement may select safer borrowers, incentivize repayment
- Stiglitz-Weiss style adverse selection model:
  - If lenders compete on interest rate and deposit, competitive equilibrium generally will not be efficient
  - To see intuition, consider case where socially efficient deposit is zero.
  - Raising deposit requirements and lowering interest rates attract better borrowers since borrowers who fail to repay will particularly dislike deposit requirements
- Formal model has monopolist with institutionally determined interest rate
  - IO Intuition: reducing borrowing requirements from profit-maximizing level creates second-order change in profits, first-order welfare gain for inframarginal borrowers
- Key result: profit-maximizing deposit requirement generically exceeds welfare-maximizing deposit requirement
- In empirically relevant case, FOC for deposit requirement simplifies to
  - number of marginal bad borrowers X cost of bad borrower = number of marginal good borrowers X profits from good borrowers
- Model nests case of prospect theoretic preferences

Time Periods

- Period $t = 1$
  - Monopoly lender chooses required deposit D
  - Farmers allocate assets to deposit on loan, other investments
- Period $t = 2$
  - Farmer income y_i is realized
  - Loan and interest payments are due
  - Farmers choose whether to repay loan, either out of income, or by allowing repossession or liquidation
- Period $t = 3$
  - Utility from tank and other investments realized

Model Assumptions I

- **Farmers**
  - Continum of farmers with tank valuation $\theta_i \sim F[\underline{\theta}, \bar{\theta}]$ (private info)
  - Wealth w at $t = 1$; Stochastic income $\tilde{y}_i$ at $t = 2$

$$\tilde{y}_i = \begin{cases} y_L & \text{with probability } \pi_L \in (0,1) \\ y_H & \text{with probability } 1 - \pi_L \end{cases}$$

  - Non-tank investment opportunities yielding R_B at $t = 1$
  - If deposit interest $R_D < R_B$, then tying up funds in deposit is costly, take up sensitive to deposit (Focus on this case, given empirical results)
  - Denote tank price as C and interest payments as Q
  - We assume that $y_H > C + Q$ and $y_L < Q$
  - Can liquidate non-tank investment to repay the loan, but this is costly. (Farmer keeps capital, loses return)

Prospect Theoretic Preferences

- Nest case of reference-dependent prospect theoretic preferences
  - Greater weight on losses than on gains
  - In case of repossession, farmer incurs additional losses $(\lambda - 1)\theta_i$, where $\lambda geq 1$

Model Assumptions II

- **Lender**
  - One monopoly lender with cost of capital R_L charges institutionally determined interest rate to borrowers
  - Repossessed tanks can be resold for δC
  - Repossession cost $K \geq$ max repossesion fee to borrowers K_{maxB}
  - Lender is risk-neutral and chooses required deposit value D^* to maximize ex-ante profits

The Farmers' Problem

- Farmers utility depends on their income and repossession decision
  - Utility in case of high income and no repossession:
    $U_{repay}(Y_H, D; \theta_i) = \theta_i + Y_H - (C + Q) + R_B(w - D) + R_D D$
  - Utility in case of low income if liquidate assets to pay tank loan:
    $U_{repay}(Y_L, D; \theta_i) = \theta_i + R_B(w - C - Q + Y_L)$
  - Utility in case of low income if allow tank repossession:
    $U_{default}(y_i, D; \theta_i) = -(\lambda - 1)\theta_i + Y_L + (w - D)R_B + \max\{D + \delta)C - Q - K_{maxB}, 0\}$
- We solve backwards. In low income, farmers will fail to repay loan possession if

$$U_{default}(y_i, D; \theta_i) > U_{repay}(Y_L, D; \theta_i, \lambda) \tag{1}$$

  - Defines cutoff value of θ above which replay loan: $\theta^R(D, \lambda)$
  - θ^R and repossession rate fall with deposit size, D, and loss-aversion , λ

The Farmers' Problem

- Now solve for loan take-up. A farmer will borrow if alternative investment less attractive than borrowing to buy tank

$$\mathbb{E}y_i + R_B w \leq (1 - \pi_L) U_{repay}(Y_H, D; \theta_i) + \pi_L \max\{U_{default}(y_i, D; \theta_i), U_{repay}(Y_L, D; \theta_i)\} \quad (2)$$

  - Assuming $R_B > R_D$,take-up rate falls with deposit size, D, individual valuation, θ_i, and loss-aversion rate, λ
- This defines an indifferent farmer $\theta^*(D, lambda \leq \theta^R(0, lambda)$ which is increasing in $Dand\lambda$. Higher valued farmers will borrow while lower types will not
- Loss-aversion reduces take-up and repossession

The Lenders' Problem

- Lenders choose D to maximize return on good loans net losses on bad loans
- Profit from a good loan

$$P_{loan}(D) = Q + C - (R_L(C - D) + R_D D) + \pi_L(R_D - 1)D \tag{3}$$

  - Term $\pi_L(R_D - 1)D$ stands for liquidated deposit in case of low income
- Loss in case of default

$$L_{default}(D) = K - D + \max\{D - K_{maxB}, Q + (1 - \delta)C\} \tag{4}$$

- Total profit

$$(1 - F(\theta^*(D)))R_{loan}(D) - \left(F(\theta^R(D)) - F(\theta^*(D))\right)\pi_L L_{default}(D) \tag{5}$$

  - **Treatment Effect**: a rise in D reduces given borrower incentive to allow tank repossession
  - **Selection Effect**: it also selects out farmers who will allow tank repossession if bad income realization
  - **Direct effects**:
    - lower D implies lender recovers less if farmer fails to repay
    - lower D implies lenders pays less return on the deposit (not the case in the data as $R_D \approx \frac{Q+C}{C}$)

The Lenders' Problem

- The FOC is

$$(1 - F(\theta^*))P'_{loan}(D) - \frac{\partial \theta^*}{\partial D} f(\theta^*) P_{loan}(D) =$$
$$\left(F(\theta^R) - F(\theta^*)\right) \pi_L L'_{default}(D) + \left(\frac{\partial \theta^R}{\partial D} f(\theta^R) - \frac{\partial \theta^*}{\partial D} f(\theta^*)\right) \pi_L L_{default}(D) \quad (6)$$

- When the borrower has positive equity and interest rates on loan and deposit coincide (as observed in the data), the FOC is

$$\frac{\frac{\partial \theta^*}{\partial D} f(\theta^*)}{\pi_L \left(\frac{\partial \theta^*}{\partial D} f(\theta^*) - \frac{\partial \theta^R}{\partial D} f(\theta^R)\right)} = \frac{L_{default}(D)}{P_{loan}(D)} \quad (7)$$

- LHS is the ratio of marginal borrowers to marginal tank repossessions
- RHS is the ratio of the costs of default to the profits per successful loan
- In our context, little gain from repaid loan, high repossession cost
  - Low interest rate: 1% per month (annual inflation ∼10%, deposit rate is 3% quaterly)
  - Repossession costs: KSh 8,500 on average, out of which farmers could be charged no more than KSh 4,000

Main result

Proposition

If the support of the cumulative distribution function $F(\theta_i)$ is such that $\theta^*(D) < \theta^R(D)$, i.e. there are some inframarginal farmers, and assuming that the profit-maximizing deposit is such that $K - (D + K_{maxB} - (1-\delta)C - Q) \neq 0$, then the lender chooses deposit requirements that are too stringent from a social point of view, i.e. $D^* > D^{FB}$ where D^{FB} is the socially optimal deposit requirement.

- Intuition:
  - Second-order change in profit with deposit at profit maximizing level
  - Inframarginal borrowers incur first order increase in costs from increased required deposits
  - This is not internalized by a profit-maximizing lender

Outline

Common Features Across Arms

- Sampled farmers who sold milk to Nyala Dairy Cooperative
- Associated Saving and Loan Cooperative (SACCO) required 100% cash collateralization: $\frac{1}{3}$ deposit, $\frac{2}{3}$ guarantors
- Standard credit terms in all treatment arms
  - Term: 24 months
  - Repayments: 1,000 KSh per month plus 1% interest per month on the declining balance, below market rate
  - Inflation is about 10% p.a.
  - Late fee: 1% per month, for all treatment arms. Interest on late balance in the ballpark of market rate

Loan Types

Loan Type	Deposit Amount	Guarantor Amount	Asset Collateralized	Offers
(1) 100% Cash collateralized	8,000 KSh	16,000 KSh	0 KSh	419
(2) 25% Deposit	6,000 KSh	0 KSh	18,000 Ksh	450
(3) 21% Guarantor, 4% Deposit	1,000 KSh	5,000 KSh	18,000 Ksh	425
(4) 4 % Deposit	1,000 KSh	0 KSh	23,000 Ksh	510

Experimental Design

Loan Type	Deposit Amount	Guarantor Amount	Asset Collateralized	Offers
(1) 100% Cash collateralized	8,000 KSh	16,000 KSh	0	419
(2a) 25% Deposit (maintained)	6,000 KSh	0	18,000 Ksh	225
(2b) 25% Deposit (waived)	1,000 KSh	0	18,000 Ksh	225
(3a) 21% Guarantor, 4% Deposit (maintained)	1,000 KSh	5,000 KSh	18,000 Ksh	225
(3b) 21% Guarantor, 4% Deposit (waived)	1,000 KSh	0 KSh	18,000 Ksh	200
(4) 4 % Deposit	1,000 KSh	0	23,000 Ksh	510

Experimental Design

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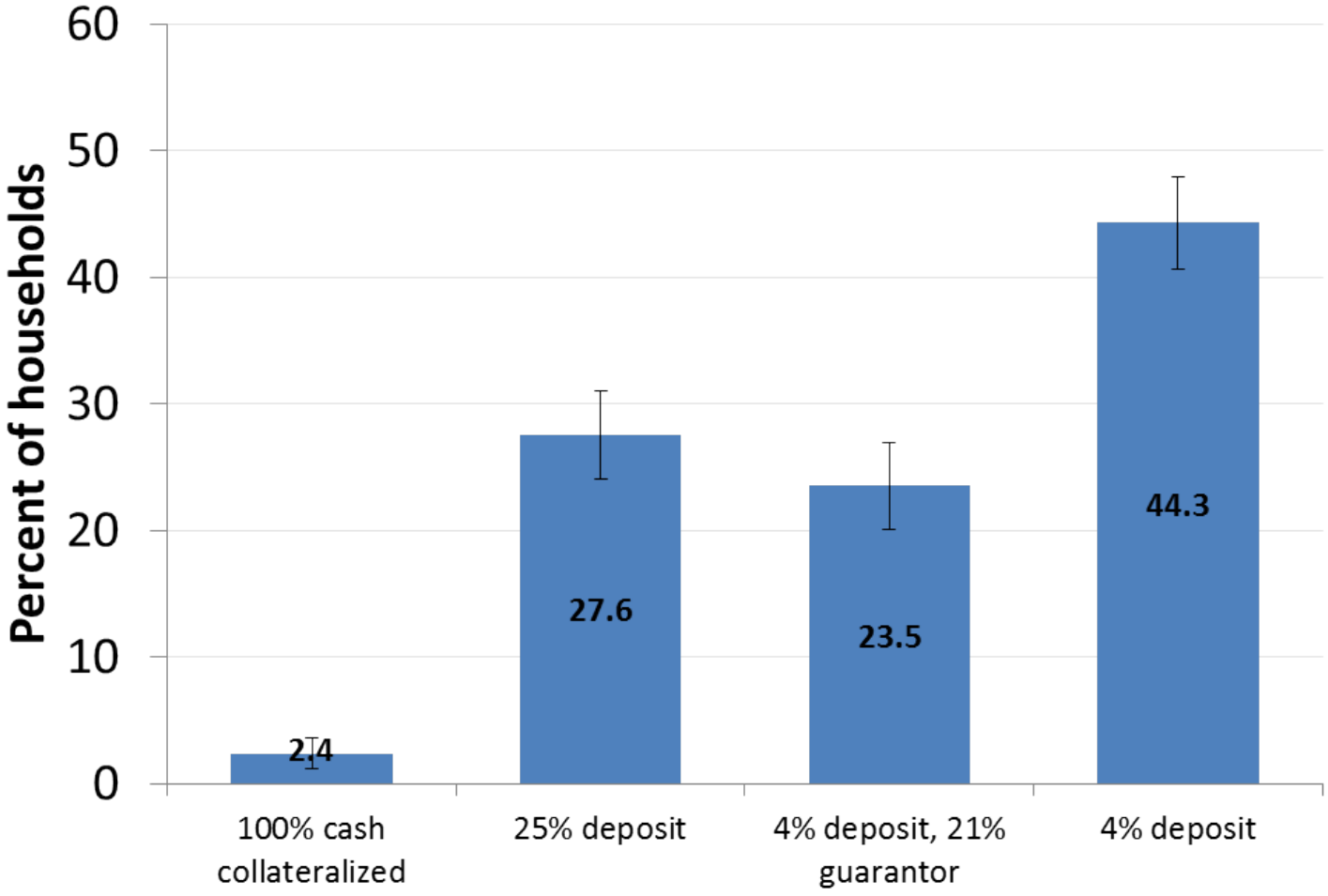
(3a) 21% Guarantor, 4% Deposit (maintained)	1,000 KSh	5,000 KSh	18,000 Ksh	225
(3b) 21% Guarantor, 4% Deposit (waived)	1,000 KSh	0 KSh	18,000 Ksh	200
(4) 4 % Deposit	1,000 KSh	0	23,000 Ksh	510

- Ex-post variation in groups (2) and (3) 1-2 months after loans made
- Additional 2,616 offers in 2012, in out of sample group
- In asset collateralized arms, in event of repossession, lender could recover up to KSh 4,000 repossession fee
- Late fees and repossession fee less than administrative costs to SACCO

Identifying Selection and Treatment Effects of Borrowing Requirements

- Selection Effects: compare 4% deposit to:
  - 25% deposit, 21% waived
  - 4% deposit, 21% guarantor waived
- Treatment Effects
  - 25% deposit (compare maintained and waived)
  - 4% deposit, 21% guarantor (compare maintained and waived)

Take Up, Initial Experiment



Note: Error bars represent 90% confidence intervals.

Loan Take Up Overall

	Original sample		Out of sample loans		Combined data	
	Loans taken up/offers	Rate (percent)	Loans taken up/offers	Rate (percent)	Total loans taken up/offers	Overall Rate (percent)
100% cash collateralized loan (C)	10/419	2.39			10/419	2.39
		[0.75]				[0.75]
25% deposit loan (D)	124/450	27.55	233/1042	22.36	357/1492	23.93
		[2.11]		[1.29]		[1.10]
21% guarantor, 4% deposit loan (G)	100/425	23.53	261/1036	25.19	361/1461	24.71
		[2.06]		[1.35]		[1.13]
4% deposit (A)	226/510	44.31	205/519	39.50	431/1029	41.89
		[2.20]		[2.15]		[1.54]

Take Up

- High elasticity of loan take up
  - 40% of population would like to borrow at the interest rate, but cannot because of borrowing requirements
  - 95% of farmers willing to borrow with 4% deposit will not borrow with 100% deposit
- Joint liability does not increase credit access relative to individual liability
- Under the model, this implies borrower, guarantor requirements costly

Borrower Characteristics by Arm

- Borrower characteristics
  - Borrowers had more assets, income, cows than non-borrowers; differences are small
  - Little evidence of selection across treatment groups
- The main difference across arms:
  - 80% of borrowers in the 100% cash collateralized loan arm already owned tanks
  - Only 43%-49% of borrowers in the other arms already owned tanks.

Impact on Borrower Characteristics by Arm

	(1) Full sample incl. non-borrowers	(2) 100% collateralized borrowers	(3) 25% deposit borrowers	(4) 4% deposit 21% guarantor borrowers	(5) 4% deposit borrowers
(1) Log household assets	12.28	12.30	12.60	12.68	12.44
	[0.02]	[0.25]	[0.10]	[0.10]	[0.06]
(2) Log per capita expenditure	10.37	10.36	10.56	10.64	10.41
	[0.02]	[0.10]	[0.07]	[0.07]	[0.04]
(3) Avg cows producing milk	1.67	1.80	1.94	2.04	1.93
	[0.03]	[0.18]	[0.17]	[0.17]	[0.08]
(4) Milk per cow (liters)	142.7	142.7	163.9	143.6	148.4
	[2.27]	[23.57]	[10.34]	[10.34]	[5.91]
(5) Monthly sales to dairy (liters)	78.2	86.3	106.1	89.3	115.1
	[4.14]	[32.96]	[13.44]	[13.44]	[22.99]
(6) Education (years) of HH head	8.46	10.30	9.78	9.08	9.14
	[0.11]	[1.54]	[0.36]	[0.36]	[0.30]
(7) Female HH head	0.20	0.20	0.18	0.24	0.15
	[0.01]	[0.13]	[0.03]	[0.03]	[0.02]
(8) Girls as % of HH	0.13	0.05	0.13	0.11	0.10
	[0.00]	[0.04]	[0.01]	[0.01]	[0.01]
(9) Piped water access	0.32	0.40	0.27	0.30	0.34
	[0.01]	[0.16]	[0.04]	[0.04]	[0.03]
(10) Own tank	0.43	0.80	0.49	0.46	0.49
	[0.01]	[0.13]	[0.05]	[0.05]	[0.03]
(11) Own big tank (> 2500 L)	0.24	0.40	0.30	0.33	0.24
	[0.01]	[0.16]	[0.04]	[0.04]	[0.03]
(12) Number of big tanks	0.32	0.40	0.41	0.43	0.30
	[0.02]	[0.16]	[0.07]	[0.07]	[0.04]
(13) Practice zero grazing	0.18	0.20	0.18	0.19	0.23
	[0.01]	[0.13]	[0.03]	[0.03]	[0.03]
(14) Practice zero/semi zerograzing	0.75	1.00	0.81	0.77	0.80
	[0.01]	[0.00]	[0.04]	[0.04]	[0.03]

Note: Standard errors in brackets.
All data is pre-treatment. Log per capita expenditure is measured in log Kenya shillings per year.
There are significant differences between borrowers and non-borrowers at the 5% level in the first three rows, columns (3)-(5); row 5, columns (4) and (5); row 6, column (5); row 10, column (2); row 11, column (4); and row 14, column (3).

Tank Repossession and Loan Non-Recovery (Combined Sample)

	Tank repossession		Loan non-recovery	
Group	Count	Rate (percent)	Count	Rate (percent)
4% deposit (A)	3/431	0.7	0/431	0
		(0.14, 2.02)		(0, 0.85)
25% deposit (D)	0/357	0	0/357	0
		(0, 0.83)		(0, 0.83)
21% guarantor, 4% deposit (G)	0/361	0	0/361	0
		(0, 0.83)		(0, 0.83)
100% cash collateralized (C)	0/10	0	0/10	0
		(0, 25.89)		(0, 25.89)
25% deposit or guarantor	0/718	0	0/718	0
		(0, 0.42)		(0, 0.42)

Tank Repossession and Loan Non-Recovery (Combined Sample)

- Principal and interest fully recovered in all of the loans
- No tank repossesssions with 25% deposit or with 21% guarantor and 4% deposit
- Since no tank repossessions when borrowing requirements waived, no estimated treatment effect of borrowing requirement
- Three tank repossessions (0.7%) in 4% deposit group, combined
- Can reject null hypothesis that repossession rate is the same in 4%, 25% cash collateralization groups at 5.3% level, using Fisher's exact test
- Estimated Selection Effect: 1 in 62 marginal loans will lead to repossession
    - Implies that profit-maximizing deposit requirement exceeds welfare-maximizing deposit requirement

Late Payment

	During loan cycle		
	(1)	(2)	(3)
	Late ever	Rec'd pending default letter	Security deposit reclaimed
4% deposit loan	0.57***	0.29***	0.09***
	[0.11]	[0.03]	[0.02]
25% deposit loan, maintained	0.59***	0.33***	0.16***
	[0.12]	[0.06]	[0.05]
25% deposit loan, waived	0.46***	0.28***	0.08**
	[0.12]	[0.06]	[0.04]
21% guarantor loan, 4% deposit, maintained	0.51***	0.18***	0.10**
	[0.13]	[0.05]	[0.04]
21% guarantor loan, 4% deposit, waived	0.43***	0.32***	0.14***
	[0.13]	[0.07]	[0.05]
Constant(100% secured joint-liability loan)	0.11	0.00	0.00
	[0.11]	[0.00]	[.]
Deposit Selection Effect P-value	0.10	0.97	0.80
25% dep loan waived = 4% dep loan			
Guarantor Selection Effect P-value	0.07	0.64	0.38
25% guar loan waived = 4% dep loan			
Deposit Treatment Effect P-value	0.13	0.55	0.2
25% dep loan maintained = 25% dep loan waived			
Guarantor Treatment Effect P-value	0.42	0.10	0.54
25% guar loan maintained = 25% guar loan waived			
Mean of dependent variable	0.64	0.28	0.11
Observations	456	456	456

- 64% of farmers late at least once (milk production varies over year)
- Deposit and guarantor requirements select borrowers who are 11-14 p.p. less likely to be "ever late" (10% significance)
- No significant treatment effect of either deposit or guarantor requirements

Late Balance at End of Loan Term

	Late at end loan		
	(4)	(5)	(6)
	Repaid late	Late balance (KSh)	Months late
4% deposit loan	0.12***	221.79***	0.13***
	[0.02]	[50.02]	[0.03]
25% deposit loan, maintained	0.02	45.67	0.02
	[0.02]	[33.04]	[0.02]
25% deposit loan, waived	0.12***	161.90**	0.13***
	[0.04]	[66.76]	[0.05]
21% guarantor loan, 4% deposit, maintained	0.06*	101.91	0.08*
	[0.03]	[63.43]	[0.05]
21% guarantor loan, 4% deposit, waived	0.14***	297.52***	0.22**
	[0.05]	[111.67]	[0.09]
Constant(100% secured joint-liability loan)	0.00	0.00	0.00
	[.]	[0.00]	[.]
Mean of dependent variable	0.10	180.36	0.12
Observations	456	456	456

- Cannot reject hypothesis that no selection effect
- Cannot reject hypothesis that no incentive effect

Calibration

- From the model's FOC, the lender's decision about deposit depends on repossession rate (no borrowers had negative equity)
- In the data, the repossession rate is 1.63% for marginal borrowers:
  - 42.9% of lenders who borrow with a 4% deposit would not do so with 25% deposit
  - The average repossession rate for 4% loan is 0.7%
  - $\frac{0.007}{0.42} \approx 0.0163 = \frac{1}{62}$ of marginal borrowers have tank repossesed
- Profit-maximizing lender likely prefers 25% deposit to 4% deposit
  - Additional profit from serving marginal borrowers is negligibly small
  - Loss per additional marginal borrower is 1/62nd repossession costs (KSh 4,500)
  - Administrative costs associated with late payment also higher with 4% deposit requirement
- After the experiment, the SACCO lowered deposit requirement to 25%, but not to 4%

Calibration - continued.

- Social planner might plausibly prefer 4% deposit to 25% deposit
  - 1.33 inframarginal borrowers per each marginal borrower
  - Suppose alternative investment had 25% annual return, while deposit pays 3% per quarter or 24% over the two year life of the loan
  - (50% - 24%)*(KSh 6,000 - KSh 1,000) = KSh 1,300 lost earnings per inframarginal borrower
  - 1.33*KSh 1,300 $>>$ 1.63%*KSh 4,500

Real Impacts

- Wide standard errors on milk production
  - Point estimate: 0.047 point increase in log production
  - Not significant
- Some evidence of increased sales to dairy (admin data)
  - 4% group farmers were more likely to sell milk to the dairy ($p < 0.10$)
  - Stronger evidence outside of top 5% of observations
- Time savings
  - Treatment girls spent 3.17 fewer minutes per day fetching water ($p < 0.01$)
  - Treatment boys spent 9.66 fewer minutes per day tending livestock ($p < 0.10$)
- Increased schooling for girls
  - 4 percentage points (4.3%) higher enrollment in Difference-in-Difference specification

Early Payment

	(1) Repaid early	(2) Months early	(3) Months of principal in deposit	(4) Foregone months of low interest loan	(5) Months of repayment freed by waiver
100% cash collateralized loan (C)	0.900	15.000***	8	7.000***	–
	[0.100]	[2.431]		[2.431]	
25% deposit loan, maintained (D^M)	0.594	5.500***	6	−0.500	–
	[0.062]	[0.835]		[0.835]	
25% deposit loan, waived (D^W)	0.383	4.957***	1	3.957***	5
	[0.063]	[1.113]		[1.113]	
4% deposit, 21% guarantor loan, maintained (G^M)	0.560	3.804***	1	2.804***	–
	[0.071]	[0.810]		[0.810]	
4% deposit, 21% guarantor loan, waived (G^W)	0.320	5.214***	1	4.214***	–
	[0.067]	[1.281]		[1.281]	
4% deposit loan (A)	0.239	1.875***	1	0.875***	–
	[0.028]	[0.322]		[0.322]	

Note: * p < 0.1, ** p < 0.05, *** p < 0.01

- Lots of early repayment, especially in 100% cash collateralized group
- Borrowers turning down zero interest loans
  - Odd from credit constraint perspective
- When deposit requirements waived, many pay down principal

Key Results

- Reducing deposit, guarantor requirements increases take up of credit from 2% to 44%
- High borrowing requirements select owners of tanks, but not particularly rich borrowers
- Substituting joint liability for deposit requirements does not expand access
- All principal and interest repaid; no evidence that 25% borrowing requirement increases tank repossession
- Moving from 25% to 4% deposit requirement selects borrowers with 1 in 62 tank repossession rate
- Early repayment widespread; when deposit waived, many stay with status quo
- Savings and credit cooperative loosened borrowing requirements, following study

Policy Implications

- Model suggest that profit-maximizing borrowing requirement > socially optimal borrowing requirement
- Data suggest investment, technology adoption very sensitive to borrowing requirements
- High repayment in this context, this period
- Subsidies?

Role of Asset Collateralized Loans

- Laws and institutions
  - Property rights
  - Financial repression
- Technology
  - Reducing cost of late payment notification, repayment collection (cell phones)
  - Facilitating reposession? Identification technology, remote deactivation
- Contract design:
  - Suspend repayment (but with interest accumulating) in periods of negative weather, aggregate yield or price shocks?
  - Role for larger scale lender/insurer to lend to saving and credit cooperatives
  - Agriculture equipment suppliers?
- Learning about asset-collateralized loans as a public good
  - Role for additional trials

Loss Aversion and Loan Take Up

- Loss averse farmers averse to risking existing assets, relationships to obtain new tank
- Consistent with low take-up of standard contract, limited effect of joint liability on take up
- 80% of borrowers in the 100% cash collateralized loan arm already owned tanks
  - Surprising from diminishing returns perspective
  - Consistent with loss aversion if fear losing existing tank to cracking or rust
- Loss aversion also consistent with reluctance of lender to weaken borrowing requirements

Loss Aversion and Repayment, Early Payment

- Once tank purchased, reference point shifts, endowment effect creates strong desire to retain possession
  - Very low tank repossession
  - Repay early to avoid risk of loss

Thanks!