Joint Liability, Asset Collateralization, and Credit Access

William Jack, Michael Kremer, Joost de Laat and Tavneet Suri

October 30, 2015
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. mortgages, 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
Outline

1. Introduction
2. Background
3. Model
4. Experimental Design
5. Loan Types
6. Impact on Loan Take Up
7. Repayment
8. Real Outcomes
9. Early Payment
10. Conclusion
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
Sketch of Model

- Farmers have distribution of tank valuation, $\theta$
  - If $\theta_i > \theta^*$, farmer borrows to pay tank, repays loan
  - If $\theta_i = \theta^*$, farmer will borrow; repay in good state, allow repossession in bad state
  - If $\theta_i < \theta^*$, farmer does not borrow

- If 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 this, note that borrowers who contemplate default will particularly dislike deposit requirements so raising deposit requirements and lowering interest rates attract better borrowers
- Formal model has monopolist with institutionally determined interest rate
  - Intuition: reducing borrowing requirements from profit-maximizing level creates second-order change in profits, first-order welfare gain for inframarginal borrowers
- Model nests case of prospect theoretic preferences
- Key result: profit-maximizing deposit requirement generically exceeds welfare-maximizing deposit requirement
- FOC for deposit requirement equates number of marginal bad borrowers times cost of bad borrower, number of marginal good borrowers times profits from good borrowers
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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 paid interest on deposit
- 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

<table>
<thead>
<tr>
<th>Loan Type</th>
<th>Deposit Amount</th>
<th>Guarantor Amount</th>
<th>Asset Collateralized</th>
<th>Offers</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 100% Cash collateralized</td>
<td>8,000 KSh</td>
<td>16,000 KSh</td>
<td>0 KSh</td>
<td>419</td>
</tr>
<tr>
<td>(2) 25% Deposit</td>
<td>6,000 KSh</td>
<td>0 KSh</td>
<td>18,000 Ksh</td>
<td>450</td>
</tr>
<tr>
<td>(3) 21% Guarantor, 4% Deposit</td>
<td>1,000 KSh</td>
<td>5,000 KSh</td>
<td>18,000 Ksh</td>
<td>425</td>
</tr>
<tr>
<td>(4) 4 % Deposit</td>
<td>1,000 KSh</td>
<td>0 KSh</td>
<td>23,000 Ksh</td>
<td>510</td>
</tr>
</tbody>
</table>
### Experimental Design

<table>
<thead>
<tr>
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<td>419</td>
</tr>
<tr>
<td>(2a) 25% Deposit (maintained)</td>
<td>6,000 KSh</td>
<td>0</td>
<td>18,000 Ksh</td>
<td>225</td>
</tr>
<tr>
<td>(2b) 25% Deposit (waived)</td>
<td>1,000 KSh</td>
<td>0</td>
<td>18,000 Ksh</td>
<td>225</td>
</tr>
<tr>
<td>(3a) 21% Guarantor, 4% Deposit (maintained)</td>
<td>1,000 KSh</td>
<td>5,000 KSh</td>
<td>18,000 Ksh</td>
<td>225</td>
</tr>
<tr>
<td>(3b) 21% Guarantor, 4% Deposit (waived)</td>
<td>1,000 KSh</td>
<td>0 KSh</td>
<td>18,000 Ksh</td>
<td>200</td>
</tr>
<tr>
<td>(4) 4% Deposit</td>
<td>1,000 KSh</td>
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<td>23,000 Ksh</td>
<td>510</td>
</tr>
</tbody>
</table>

- 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

<table>
<thead>
<tr>
<th>Loan Type</th>
<th>Original sample</th>
<th>Out of sample loans</th>
<th>Combined data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loans taken up/offers</td>
<td>Rate (percent)</td>
<td>Loans taken up/offers</td>
</tr>
<tr>
<td>100% cash collateralized loan (C)</td>
<td>10/419</td>
<td>2.39</td>
<td>233/1042</td>
</tr>
<tr>
<td>25% deposit loan (D)</td>
<td>124/450</td>
<td>27.55</td>
<td>261/1036</td>
</tr>
<tr>
<td>21% guarantor, 4% deposit loan (G)</td>
<td>100/425</td>
<td>23.53</td>
<td>261/1036</td>
</tr>
<tr>
<td>4% deposit (A)</td>
<td>226/510</td>
<td>44.31</td>
<td>205/519</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>(1) Log household assets</th>
<th>(2) 100% collateralized borrowers</th>
<th>(3) 25% deposit borrowers</th>
<th>(4) 4% deposit 21% guarantor borrowers</th>
<th>(5) 4% deposit borrowers</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Full sample incl. non-borrowers</td>
<td>12.28 [0.02]</td>
<td>12.30 [0.25]</td>
<td>12.60 [0.10]</td>
<td>12.68 [0.10]</td>
</tr>
<tr>
<td>(2)</td>
<td>Log per capita expenditure</td>
<td>10.37 [0.02]</td>
<td>10.36 [0.10]</td>
<td>10.56 [0.07]</td>
<td>10.64 [0.07]</td>
</tr>
<tr>
<td>(3)</td>
<td>Avg cows producing milk</td>
<td>1.67 [0.03]</td>
<td>1.80 [0.18]</td>
<td>1.94 [0.17]</td>
<td>2.04 [0.17]</td>
</tr>
<tr>
<td>(4)</td>
<td>Milk per cow (liters)</td>
<td>142.7 [2.27]</td>
<td>142.7 [23.57]</td>
<td>163.9 [10.34]</td>
<td>143.6 [10.34]</td>
</tr>
<tr>
<td>(6)</td>
<td>Education (years) of HH head</td>
<td>8.46 [0.11]</td>
<td>10.30 [1.54]</td>
<td>9.78 [0.36]</td>
<td>9.08 [0.36]</td>
</tr>
<tr>
<td>(7)</td>
<td>Female HH head</td>
<td>0.20 [0.01]</td>
<td>0.20 [0.13]</td>
<td>0.18 [0.03]</td>
<td>0.24 [0.03]</td>
</tr>
<tr>
<td>(8)</td>
<td>Girls as % of HH</td>
<td>0.13 [0.00]</td>
<td>0.05 [0.04]</td>
<td>0.13 [0.01]</td>
<td>0.11 [0.01]</td>
</tr>
<tr>
<td>(9)</td>
<td>Piped water access</td>
<td>0.32 [0.01]</td>
<td>0.40 [0.16]</td>
<td>0.27 [0.04]</td>
<td>0.30 [0.04]</td>
</tr>
<tr>
<td>(10)</td>
<td>Own tank</td>
<td>0.43 [0.01]</td>
<td>0.80 [0.13]</td>
<td>0.49 [0.05]</td>
<td>0.46 [0.05]</td>
</tr>
<tr>
<td>(11)</td>
<td>Own big tank (&gt; 2500 L)</td>
<td>0.24 [0.01]</td>
<td>0.40 [0.16]</td>
<td>0.30 [0.04]</td>
<td>0.33 [0.04]</td>
</tr>
<tr>
<td>(12)</td>
<td>Number of big tanks</td>
<td>0.32 [0.02]</td>
<td>0.40 [0.16]</td>
<td>0.41 [0.07]</td>
<td>0.43 [0.07]</td>
</tr>
<tr>
<td>(13)</td>
<td>Practice zero grazing</td>
<td>0.18 [0.01]</td>
<td>0.20 [0.13]</td>
<td>0.18 [0.03]</td>
<td>0.19 [0.03]</td>
</tr>
<tr>
<td>(14)</td>
<td>Practice zero/semi zero grazing</td>
<td>0.75 [0.01]</td>
<td>1.00 [0.00]</td>
<td>0.81 [0.04]</td>
<td>0.77 [0.04]</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Group</th>
<th>Tank repossession</th>
<th>Loan non-recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Rate (percent)</td>
</tr>
<tr>
<td>4% deposit (A)</td>
<td>3/431</td>
<td>0.7 (0.14, 2.02)</td>
</tr>
<tr>
<td>25% deposit (D)</td>
<td>0/357</td>
<td>0 (0, 0.83)</td>
</tr>
<tr>
<td>21% guarantor, 4% deposit (G)</td>
<td>0/361</td>
<td>0 (0, 0.83)</td>
</tr>
<tr>
<td>100% cash collateralized (C)</td>
<td>0/10</td>
<td>0 (0, 25.89)</td>
</tr>
<tr>
<td>25% deposit or guarantor</td>
<td>0/718</td>
<td>0 (0, 0.42)</td>
</tr>
</tbody>
</table>
Tank Repossession and Loan Non-Recovery (Combined Sample)

- Principal and interest fully recovered in all of the loans
- No tank repossessions 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

- 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

<table>
<thead>
<tr>
<th>Loan Type</th>
<th>Late ever</th>
<th>Rec'd pending default letter</th>
<th>Security deposit reclaimed</th>
</tr>
</thead>
<tbody>
<tr>
<td>4% deposit loan</td>
<td>0.57***</td>
<td>0.29***</td>
<td>0.09***</td>
</tr>
<tr>
<td>25% deposit loan, maintained</td>
<td>0.50***</td>
<td>0.33***</td>
<td>0.16***</td>
</tr>
<tr>
<td>25% deposit loan, waived</td>
<td>0.46***</td>
<td>0.28***</td>
<td>0.08**</td>
</tr>
<tr>
<td>21% guarantor loan, 4% deposit, maintained</td>
<td>0.51***</td>
<td>0.18***</td>
<td>0.10**</td>
</tr>
<tr>
<td>21% guarantor loan, 4% deposit, waived</td>
<td>0.43***</td>
<td>0.32***</td>
<td>0.14***</td>
</tr>
<tr>
<td>Constant(100% secured joint-liability loan)</td>
<td>0.11</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Deposit Selection Effect P-value
- 25% dep loan waived = 4% dep loan

Guarantor Selection Effect P-value
- 25% guar loan waived = 4% dep loan

Deposit Treatment Effect P-value
- 25% dep loan maintained = 25% dep loan waived

Guarantor Treatment Effect P-value
- 25% guar loan maintained = 25% guar loan waived

Mean of dependent variable | 0.64 | 0.28 | 0.11 |
Observations | 456 | 456 | 456 |
## Late Balance at End of Loan Term

<table>
<thead>
<tr>
<th>Loan Type</th>
<th>Repaid late</th>
<th>Late balance (KSh)</th>
<th>Months late</th>
</tr>
</thead>
<tbody>
<tr>
<td>4% deposit loan</td>
<td>0.12***</td>
<td>221.79***</td>
<td>0.13***</td>
</tr>
<tr>
<td>(0.02)</td>
<td>(50.02)</td>
<td>(0.03)</td>
<td></td>
</tr>
<tr>
<td>25% deposit loan, maintained</td>
<td>0.02</td>
<td>45.67</td>
<td>0.02</td>
</tr>
<tr>
<td>(0.02)</td>
<td>(33.04)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>25% deposit loan, waived</td>
<td>0.12***</td>
<td>161.90**</td>
<td>0.13***</td>
</tr>
<tr>
<td>(0.04)</td>
<td>(66.76)</td>
<td>(0.05)</td>
<td></td>
</tr>
<tr>
<td>21% guarantor loan, 4% deposit, maintained</td>
<td>0.06*</td>
<td>101.91</td>
<td>0.08*</td>
</tr>
<tr>
<td>(0.03)</td>
<td>(63.43)</td>
<td>(0.05)</td>
<td></td>
</tr>
<tr>
<td>21% guarantor loan, 4% deposit, waived</td>
<td>0.14***</td>
<td>297.52***</td>
<td>0.22**</td>
</tr>
<tr>
<td>(0.05)</td>
<td>(111.67)</td>
<td>(0.09)</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Mean of dependent variable</td>
<td>0.10</td>
<td>180.36</td>
<td>0.12</td>
</tr>
<tr>
<td>Observations</td>
<td>456</td>
<td>456</td>
<td>456</td>
</tr>
</tbody>
</table>

- 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 repossessed.
- 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%.
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

<table>
<thead>
<tr>
<th>Loan Types</th>
<th>Repaid early</th>
<th>Months early</th>
<th>Months of principal in deposit</th>
<th>Foregone months of low interest loan</th>
<th>Months of repayment freed by waiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% cash collateralized loan (C)</td>
<td>0.900</td>
<td>15.000***</td>
<td>8</td>
<td>7.000***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.100]</td>
<td>[2.431]</td>
<td></td>
<td>[2.431]</td>
<td></td>
</tr>
<tr>
<td>25% deposit loan, maintained (D&lt;sup&gt;M&lt;/sup&gt;)</td>
<td>0.594</td>
<td>5.500***</td>
<td>6</td>
<td>-0.500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.063]</td>
<td>[0.835]</td>
<td></td>
<td>[0.835]</td>
<td></td>
</tr>
<tr>
<td>25% deposit loan, waived (D&lt;sup&gt;W&lt;/sup&gt;)</td>
<td>0.383</td>
<td>4.957***</td>
<td>1</td>
<td>3.957***</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>[0.063]</td>
<td>[1.113]</td>
<td></td>
<td>[1.113]</td>
<td></td>
</tr>
<tr>
<td>4% deposit, 21% guarantor loan, maintained (G&lt;sup&gt;M&lt;/sup&gt;)</td>
<td>0.560</td>
<td>3.804***</td>
<td>1</td>
<td>2.804***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.071]</td>
<td>[0.810]</td>
<td></td>
<td>[0.810]</td>
<td></td>
</tr>
<tr>
<td>4% deposit, 21% guarantor loan, waived (G&lt;sup&gt;W&lt;/sup&gt;)</td>
<td>0.320</td>
<td>5.214***</td>
<td>1</td>
<td>4.214***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.067]</td>
<td>[1.281]</td>
<td></td>
<td>[1.281]</td>
<td></td>
</tr>
<tr>
<td>4% deposit loan (A)</td>
<td>0.239</td>
<td>1.875***</td>
<td>1</td>
<td>0.875***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.028]</td>
<td>[0.322]</td>
<td></td>
<td>[0.322]</td>
<td></td>
</tr>
</tbody>
</table>

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 repossession? 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!