Theories of Credit Rationing

Dilip Mookherjee

Boston University

Ec 721 Lecture 1
Distinctive Features/Imperfections of Credit Markets in LDCs

- **Credit Rationing**: Limits to borrowing at any given interest rate
- **Dispersion in Credit Limits and Interest Rates**: many cannot borrow at all (at any interest rate), others can borrow amounts and at interest rates depending on wealth, credit history
- **Segmentation between Formal and Informal Markets**
- **Collateral and Interlinkage**
- **Long-term relationships**
- **Reputation and Social Networks**
Example: 2010 Rural Credit Survey in West Bengal, India

Table 3
Credit market characteristics before experiment.

<table>
<thead>
<tr>
<th></th>
<th>All Loans</th>
<th>Agricultural Loans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Household had borrowed</td>
<td>0.67</td>
<td>0.59</td>
</tr>
<tr>
<td>Total Borrowing(^a)</td>
<td>6352 (10421)</td>
<td>5054 (8776)</td>
</tr>
<tr>
<td>Proportion of Loans by Source(^b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traders/Money Lenders</td>
<td>0.63</td>
<td>0.66</td>
</tr>
<tr>
<td>Family and Friends</td>
<td>0.05</td>
<td>0.02</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>0.24</td>
<td>0.25</td>
</tr>
<tr>
<td>Government Banks</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>MFI and Other Sources</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Annualized Interest Rate by Source (percent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traders/Money Lenders</td>
<td>24.93 (20.36)</td>
<td>25.19 (21.47)</td>
</tr>
<tr>
<td>Family and Friends</td>
<td>21.28 (14.12)</td>
<td>22.66 (16.50)</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>15.51 (3.83)</td>
<td>15.70 (2.97)</td>
</tr>
<tr>
<td>Government Banks</td>
<td>11.33 (4.63)</td>
<td>11.87 (4.57)</td>
</tr>
<tr>
<td>MFI and Other Sources</td>
<td>37.26 (21.64)</td>
<td>34.38 (25.79)</td>
</tr>
<tr>
<td>Duration by Source (days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traders/Money Lenders</td>
<td>125.08 (34.05)</td>
<td>122.80 (22.43)</td>
</tr>
<tr>
<td>Family and Friends</td>
<td>164.08 (97.40)</td>
<td>183.70 (104.25)</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>323.34 (90.97)</td>
<td>327.25 (87.74)</td>
</tr>
<tr>
<td>Government Banks</td>
<td>271.86 (121.04)</td>
<td>324.67 (91.49)</td>
</tr>
<tr>
<td>MFI and Other Sources</td>
<td>238.03 (144.12)</td>
<td>272.80 (128.48)</td>
</tr>
<tr>
<td>Proportion of Loans Collateralized by Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traders/Money Lenders</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Family and Friends</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>0.79</td>
<td>0.78</td>
</tr>
<tr>
<td>Government Banks</td>
<td>0.81</td>
<td>0.83</td>
</tr>
<tr>
<td>MFI and Other Sources</td>
<td>0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

\(^a\) Total borrowing as a proportion of total credit market.
\(^b\) Proportion of loans in terms of value of loans at the household level.
Potential Explanations?

- **Usury/Lender Monopoly**: cannot explain credit rationing; most informal markets appear to be competitive by usual IO standards

- **Heterogenous Default Risk**: need adverse selection to explain credit rationing (Stiglitz-Weiss (AER 1980)), and absence of collateral (Bester (AER 1986))

- **Endogenous Default Risk**: moral hazard, either ex ante (effort/involuntary default) or ex post (repayment/voluntary default)
Ex Ante Moral Hazard (Ghosh-Mookherjee-Ray Sec 2; Aghion-Bolton 1997)

- Ex ante identical borrowers seek to finance an indivisible project that costs $1
- Project returns \( Q \) with probability \( e \) (success state \( s \)), 0 with probability \( 1 - e \) (failure state \( f \)), where \( e \geq 0 \) is unobservable, costly effort of borrower
- Effort cost \( C(e) \) is smooth, strictly increasing and convex, \( C(0) = C'(0) = 0 \) (quadratic example: \( C = \frac{e^2}{2k} \))
- Borrower wealth \( w < 1 \), needs to borrow \( 1 - w \)
- Lender’s cost \( 1 + \rho \) per dollar lent
Assumptions

- **Moral Hazard (MH):** $e$ is unobservable/noncontractible, chosen selfishly by borrower

- **Limited Liability (LL):** borrower cannot repay ex post more than resources available; will repay if resources permit (involuntary defaults)

- Risk-neutrality (less essential)
Feasible Contract

- Lender finances $1 - w$, borrower repays $R_i, i = s, f$, selects effort $e$

- LL: $Q \geq R_s, 0 \geq R_f$

- MH: $e$ maximizes $e(Q - R_s) + (1 - e)(-R_f) - C(e)$
Payoffs, Participation Constraints and Efficient Contracts

- Lender payoff: $i_L \equiv eR_s + (1 - e)R_f - (1 - w)(1 + \rho)$, outside option 0
- LPC: $eR_s + (1 - e)R_f - (1 - w)(1 + \rho) \geq 0$
- Borrower payoff: $i_B \equiv e(Q - R_s) + (1 - e)(-R_f) - C(e)$, outside option $w$
- BPC: $e(Q - R_s) + (1 - e)(-R_f) - C(e) \geq w$

(Constrained) efficient contract: for some welfare weight $\beta$, the contract maximizes $i_B + \beta i_L$, subject to LL, MH, LPC, BPC
- $\beta = 0$ corresponds to perfect (Bertrand) competition, $\beta = \infty$ to lender monopoly
Optimality of Pure Credit Market

**Lemma:** Every efficient contract is a pure credit contract ($R_f = 0$)

- Owes to risk neutrality assumption (no need for lender to provide insurance)
- Use $R$ to denote $R_s$

Simplify LL to $R \geq 0$, MH to $Q - R = C'(e)$ which determines $e = e(R)$ which is decreasing; in quadratic case $e(R) = k(Q - R)$
Introduction

Analysis

- **$R$** is an efficient contract for a borrower of wealth $w$ if for some $\beta$ it maximizes $e(R)[Q - R] - C(e(R)) + \beta[e(R)R - (1 - w)(1 + \rho)]$ s.t. $R \leq Q$, $e(R)R \geq (1 - w)(1 + \rho)$ and $e(R)[Q - R] - C(e(R)) \geq w$.

- **Debt Overhang:** Lender’s payoff $e(R)R$ may decrease in $R$, so repayment in an efficient contract could be bounded above.

- **Quadratic Case:** $e(R) = k(Q - R)$ so $i_L = kQR - kR^2 - (1 - w)(1 + \rho)$, rising in $R$ over $[0, \frac{Q}{2}]$, falling thereafter; efficient contract must have $R \leq Q/2$. 

Exclusion of Poor Borrowers

**Lemma:** *In the quadratic case, borrowers with* $w < w^* \equiv 1 - \frac{kQ^2}{4(1+\rho)}$ *can never borrow (at any interest rate)*

**Proof:** Maximum profit of a lender is achieved at $R = \frac{Q}{2}$, so it equals $k\frac{Q^2}{4} - (1 - w)(1 + \rho)$, which is nonnegative iff $w \geq w^*$.

Can interpret $w^*$ as minimum collateral/cofinancing requirement.
Social Surplus/Utilitarian Welfare

- Social surplus $W(w) \equiv i_L + i_B = eQ - C(e) - (1 + \rho)(1 - w)$ is independent of $R$
- First-best effort: $C'(e^*) = Q$, so MH causes too low effort $(e(R) < e^* \text{ whenever } R > 0)$
- Project is worthwhile without MH if $e^*Q - C(e^*) \geq (1 + \rho)(1 - w)$, which holds for all $w$ if $e^*Q - C(e^*) \geq (1 + \rho)$;

**Proposition** In the quadratic case if $e^*Q - C(e^*) \geq (1 + \rho)$, exclusion of poor borrowers is socially inefficient
Macro/Welfare Implications

Usury restrictions:

**Proposition** *For borrowers with \( w \in (w^*, 1) \), a decrease in lender bargaining power \( \beta \) raises effort, expected output and welfare*

Wealth Redistribution:

**Proposition** *Redistributing wealth to poor borrowers (from others) raises expected output and welfare*
Explaining Observed Credit Imperfections

- **Exclusion/Credit Rationing**: poor borrowers cannot borrow at all, at any interest rate; (model does not allow rationing on the intensive margin)

- **Dispersion**: For any given $\beta$, interest rate $i(w) \equiv \frac{R(w)}{1-w}$ varies with $w$

- **Collateral**: Extend the model to allow borrower to post collateral of $C$ which is transferred to lender in failure state: risk and incentive effects of relaxing LL (allows borrowers to commit to higher effort)

- **Long term relationships**: Extend to multi-period model: relax LL by carrying debt into the future
What About the Role of Reputation?

- Credit history also matters: could extend preceding model to incorporate unobserved heterogeneity in effort costs ($k$) or project returns ($Q$)

- Lenders would prefer to lend to low-cost, high-return borrowers

- Borrowers would develop reputations based on past credit/project history

- Reputation could also be a borrower discipline device: controlling ex post moral hazard

- Next model incorporates voluntary default and credit rationing on the intensive margin
Ex Post Moral Hazard Model

- Representative borrowers (all identical), has no wealth and seeks to borrow $L \geq 0$ to finance a project at scale $L$, which will generate output $F(L)$, where $F$ is smooth, strictly increasing and strictly concave, satisfying Inada conditions.

- Lender has unlimited wealth and incurs cost $1 + \rho$ per dollar lent.

- **Timeline**: Infinite horizon $t = 1, 2, \ldots$; at beginning of $t$, lender lends $L$; at the end of $t$ borrower earns $F(L)$ and decides on repayment $R$, consumes the rest $F(L) - R$ (i.e., not able to save).
Ex Post Moral Hazard Model, contd.

- LL constraint: \( R \leq F(L) \)
- MH problem: If loan contract stipulates repayment of \( R(L) \leq F(L) \), borrower could select any \( R \leq R(L) \)
- Outside option payoffs \( v \) for borrower and 0 for lender; everyone has discount factor \( \delta \in (0, 1) \) applying to future continuation payoffs
Default Penalties

- Punishment for voluntary default: denial of credit by the lender (and all other lenders) at every date $t + k, k = 1, 2, \ldots$

- This is the worst credible (subgame perfect) punishment

- Focus on stationary loan contracts $(R, L)$ that are incentive compatible, i.e., induce borrower to repay:

  $$\frac{F(L) - R}{1 - \delta} \geq F(L) + \frac{\delta v}{1 - \delta}$$

  (MH)

- (MH) reduces to an upper bound on loan repayment (a form of debt overhang):

  $$R \leq \delta [F(L) - v]$$
Efficient Contracts

- A contract \((R, L)\) is **feasible** if it satisfiesMH \((R \leq \delta[F(L) - v])\), LL \((R \leq F(L))\), LPC \((R - L(1 + \rho) \geq 0)\), and BPC \((F(L) - R \geq v)\)

- A contract \((R, L)\) is **efficient** if for some \(\beta > 0\) it maximizes \([F(L) - R] + \beta[R - L(1 + \rho)]\) over the set of feasible contracts
First-best Contracts

- In the absence of a MH problem, what is an efficient contract?
- Social surplus $F(L) - (1 + \rho)L$, maximized at $L^*$ where $F'(L^*) = 1 + \rho$
- $R$ must satisfy PCs $F(L^*) - \nu \geq R \geq L^*(1 + \rho)$, assuming $\nu$ is small enough that there exists a feasible allocation ($\nu < F(L^*) - L^*(1 + \rho)$)
- Where $R$ is set depends on $\beta$, or equivalently a desired profit level $i \leq F(L^*) - (1 + \rho)L^*$ for lender
When is the First-best Achievable with MH?

If \( R^* \equiv L^*(1 + \rho) + i \leq \delta [F(L^*) - v] \)

Restate this condition as:

\[
\delta \geq \delta^*(v; i) \equiv \frac{L^*(1 + \rho) + i}{F(L^*) - v}
\]
Second-Best Contract

**Proposition**  The first-best cannot be attained iff $\delta < \delta^*(v; i)$, in which case the second best contract involves a loan of size $\hat{L}(v, i) < L^*$ which is the highest $L$ satisfying MH and LPC ($L(1 + \rho) + i \leq \delta[F(I) - v]$).
Ex Post Moral Hazard

Borrower's indifference curve
Incentive constraint
Isoprofit line

$R$

$\tilde{R}$

$\tilde{L}$

$L^*$

$L$
Properties of Second-Best Contracts

- **Credit Rationing**: Consider the case of perfect competition ($i = 0$): borrower would like to borrow more at the prevailing interest rate but faces a credit limit owing to the MH problem.

- **Dispersion**: Credit limits depend on borrower characteristics ($\delta, \nu$) affecting severity of MH problem (e.g., possible gender differences, as found by Karlan and Zinman (2009) in an RCT).

- **Collateral**: Helps relax MH, as well as LPC.

- **Role of reputation and social networks**: Discipline device for defaulting borrowers; problem of possible switching to third-party lenders who are not aware of the default or do not cooperate with original lender in punishing the deviator.

- **Ambiguous role of competition**: Kranton and Swamy (JDE, 1999).