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.

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

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)), which seems unrealistic in a close-knit society. Also the theory is not robust to presence 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: $\pi_L \equiv eR_s + (1-e)R_f - (1-w)(1+\rho)$, outside option 0
- LPC: $eR_s + (1-e)R_f - (1-w)(1+\rho) \geq 0$
- Borrower payoff: $\pi_B \equiv e(Q - R_s) + (1-e)(-R_f) - C(e)$, outside option w
- BPC: $e(Q - R_s) + (1-e)(-R_f) - C(e) \geq w$
- (Constrained) efficient contract: for some welfare weight β, the contract maximizes $\pi_B + \beta\pi_L$, subject to LL, MH, LPC, BPC
- $\beta = 0$ corresponds to perfect (Bertrand) competition, $\beta = \infty$ to lender monopoly

Key Implication of Moral Hazard

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 $e = e(R)$
- Observe that $e(R)$ is decreasing (in quadratic case $e(R) = k(Q - R)$) — **higher debt payment due lowers borrower effort, and raises the likelihood of default**
- The main implication of moral hazard: "if you owe the bank a thousand dollars, its your problem; of you owe them a billion dollars, its their problem"

Analysis

- R is an efficient contract for a borrower of wealth w if for some β 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 $\pi_L = kQR - kR^2 - (1-w)(1+\rho)$, achieving a maximum at $R = \frac{Q}{2}$; efficient contract must have $R \leq \frac{Q}{2}$

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 $W(w) \equiv \pi_L + \pi_B = eQ - C(e) - (1+\rho)(1-w)$ is independent of R
- First-best effort: $C'(e^*) = Q$, so MH causes too low effort ($e(R) < e^*$ 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 (in a first-best setting)*

Macro/Welfare Implications

Usury restrictions:

Proposition *For borrowers with* $w \in (w^*, 1)$*, a decrease in lender bargaining power* β *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 β, 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 ('hardworking'), high-return ('productive') borrowers
- Borrowers would develop reputations based on past credit/project history — the value of social networks and/or credit bureaus in allowing lenders to screen borrower 'type'
- Reputation could also be a borrower discipline device: controlling ex post moral hazard (where default is voluntary and is the main source of 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
- Now there is no production uncertainty: output $F(L)$ appears with probability one, so *there is no possibility of involuntary default*
- Lender has unlimited wealth and incurs cost $1 + \rho$ per dollar lent
- **Timeline:** Infinite horizon $t = 1, 2, ..$; 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: $R \leq F(L)$
- Loan contract specifies pair $(L, R = R(L))$ where $R(L) \leq F(L)$ is the borrowers repayment obligation
- MH problem: borrower would be tempted to pay back less (select $R < R(L)$) despite having the means to repay — *voluntary default*
- 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:

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

- (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 satisfies MH ($R \leq \delta[F(L) - v]$), 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 $F(L^*) - v \geq R \geq L^*(1+\rho)$, assuming v is small enough that there exists a feasible allocation ($v < F(L^*) - L^*(1+\rho)$)
- Where R is set depends on β, or equivalently a desired profit level $\underline{\pi}_L \leq F(L^*) - (1+\rho)L^*$ for lender

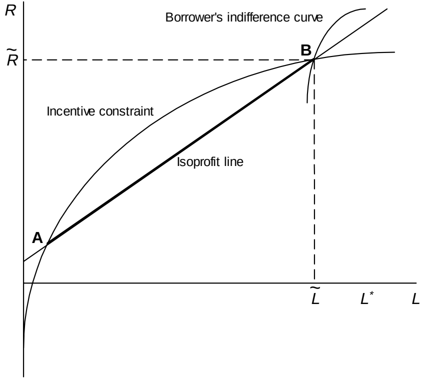
When is the First-best Achievable with MH?

- If $R^* \equiv L^*(1+\rho) + \underline{\pi}_L \leq \delta[F(L^*) - v]$
- Restate this condition as:

$$\delta \geq \delta^*(v; \underline{\pi}_L) \equiv \frac{L^*(1+\rho) + \underline{\pi}_L}{F(L^*) - v}$$

Second-Best Contract

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


R
R̃
Borrower's indifference curve
B
Incentive constraint
Isoprofit line
A
L̃
L*
L

Properties of Second-Best Contracts

- **Credit Rationing** Consider the case of perfect competition ($\beta = 0$): 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 (δ, v) affecting severity of MH problem (eg, 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)