Credit Rationing in Developing Countries: An Overview of the Theory

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Development Microeconomics Presentation

Motivation

- The setting: poor rural economy in a developing country.
- Importance of credit:
  - Financing of fixed and working capital.
  - Consumption smoothing.
  - Reduces reluctance to adopt technologies that raise both mean and volatility of income.
- A significant fraction of credit transactions still take place in the informal sector.
- Largely because poorer farmers lack sufficient assets to put up as collateral.
- There is *credit rationing*: borrowers are unable to borrow all they want, or some loan applicants are unable to borrow at all.

Features of Informal Credit Markets

- Often agreements are oral, with little or no collateral, making default an attractive option.
- Long term exclusive relationships, repeated lending.
- Interest rates higher on average than bank interest rates.
- Frequent inter-linkages with other markets: land, labor, crop.
- Significant credit rationing.

Existing Theory

- Several different theoretical approaches that attempt to explain some or all of these features.
- Common themes: missing markets. asymmetric information, and incentive problems.
- Three broad approaches: *adverse selection* (hidden information), *moral hazard* (hidden action) and *contract enforcement problems*.
- This paper covers *moral hazard* and *contract enforcement* and argues that these approaches are fundamentally similar in terms of their underlying logic and policy implications.

Moral Hazard and Credit Rationing: The Model

Assumptions:

- Indivisible project which requires funds of amount L to be viable.
- Output is binary: Q (good harvest) or 0 (crop failure).
- Probability of good harvest is $p(e)$, where e is the effort level of agent who oversees the project
- $p'(e) > 0$ and $p''(e) < 0$, representing usual diminishing returns.
- Effort cost is given by e and all agents are risk-neutral.

First Best

- Consider the problem of the **self-financed farmer**.
- If investment takes place at all, the effort level e is chosen so as to maximize:

$$p(e).Q - e - L \tag{1}$$

- The optimum choice e^* is given by the first order condition:

$$p'(e^*) = \frac{1}{Q} \tag{2}$$

- This is the benchmark against which all other results will be compared.

Moral Hazard

- Now consider a **debt financed farmer.**
- Let $R = (1 + i)L$ denote total debt, where i is the real interest rate.
- To introduce moral hazard, we assume that e is not verifiable, and hence not contractible.
- Furthermore, there is *limited liability*, the borrower faces no obligation in event of crop failure.
- Collateral w has to be put up by the borrower to get a loan, will be forfeited in case of crop failure.
- Assume $w < L$, since otherwise there would be no borrowing.

Moral Hazard...

- If investment takes place at all, the effort level e is chosen so as to maximize:

$$p(e).(Q - R) + (1 - p(e)).(-w) - e \tag{3}$$

- The optimum choice $\hat{e}(R, w)$ is given by the first order condition:

$$p'(\hat{e}) = \frac{1}{Q + w - R} \tag{4}$$

- $\hat{e}(R, w)$ is decreasing in R: A higher debt burden reduces the borrowers payoff in the good state, but not in the bad state, dampening incentive to apply effort.
- $\hat{e}(R, w)$ is increasing in w: A bigger collateral imposes a stiffer penalty in event of crop failure, stimulating the incentive to avoid such an outcome.

Moral Hazard...

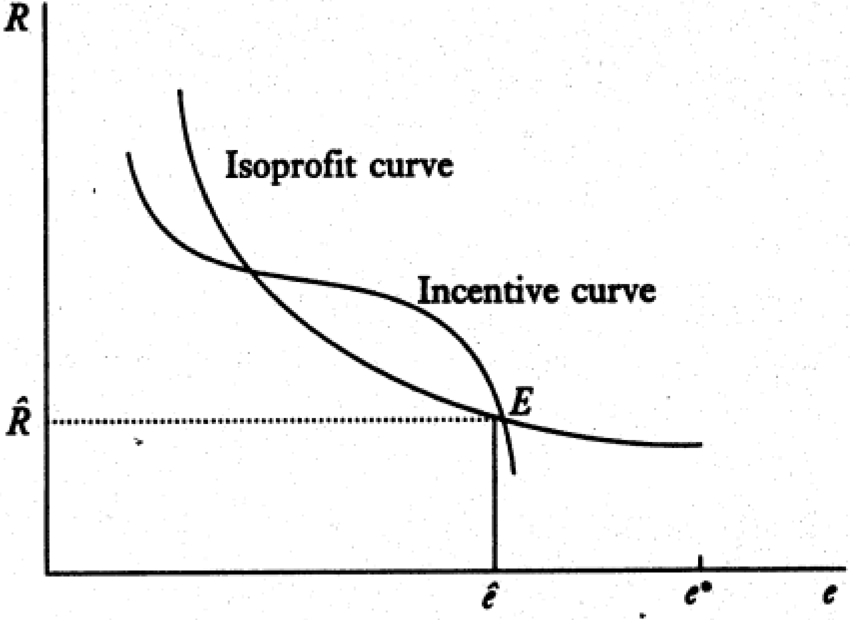
- Notice that $w < L \implies w < R$
- Since the $p(e)$ function is concave, we have $\hat{e} < e^*$.
- **Proposition 1** As long as the borrower does not have enough wealth to guarantee the full value of the loan, the effort choice will be less than first best.
- This is the *debt overhang* problem. An indebted borrower will always work less hard on his project than one who is self-financed.

Equilibrium effort and rate of interest

- The lender's profit is given by

$$\pi = p(e)R + [1 - p(e)]w - L \tag{5}$$

- To start with, assume that lenders are competitive and there is free entry.
- Therefore, we can fix $\pi = 0$.
- The locus of (e, R) tuples that yield a particular level of profit (in this case, zero profit) is the isoprofit curve.
- The locus of (e, R) tuples such that e is the incentive compatible choice of effort given R, is the incentive curve.
- Clear that both will be downward sloping.
- The intersection of these curves gives us equilibrium (e, R).



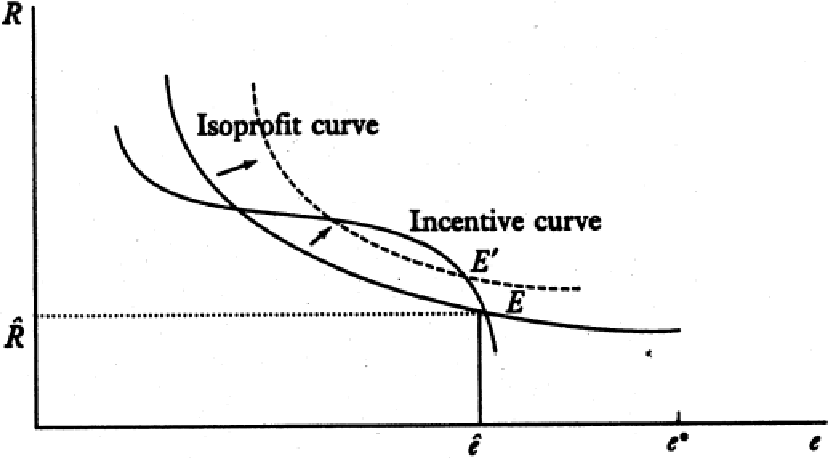
R
Isoprofit curve
Incentive curve
E
R̂
ê
e*
e

Pareto efficiency

- Not all points of equilibrium are Pareto efficient.
- Lower debt (R) increases borrower payoff for any given choice of effort.
- By envelope theorem, lower debt (R) increases borrower payoff also after adjusting for optimal choice.
- Thus, as we move downward along the incentive curve, the borrower's payoff is increasing.
- If there are multiple intersections, only the lowest among these is Pareto efficient. Borrower friendly equilibria are more efficient.

Comparative Statics

- What happens to equilibrium (e, R) when lender profit π or collateral w change.
- When π increases, the isoprofit curve shifts up and in the new resultant Pareto efficient equilibrium, the debt burden (R) increases, and so does the interest rate (since the loan size L is fixed), while the effort level falls.
- **Proposition 2** (Pareto efficient) equilibrium in which lenders obtain higher profits involve higher debt and interest rates, but lower levels of effort. Hence, this equilibrium produces lower social surplus.



R
Isoprofit curve
Incentive curve
E′
E
R̂
ê
e*
e

Market Power or Agency Costs?

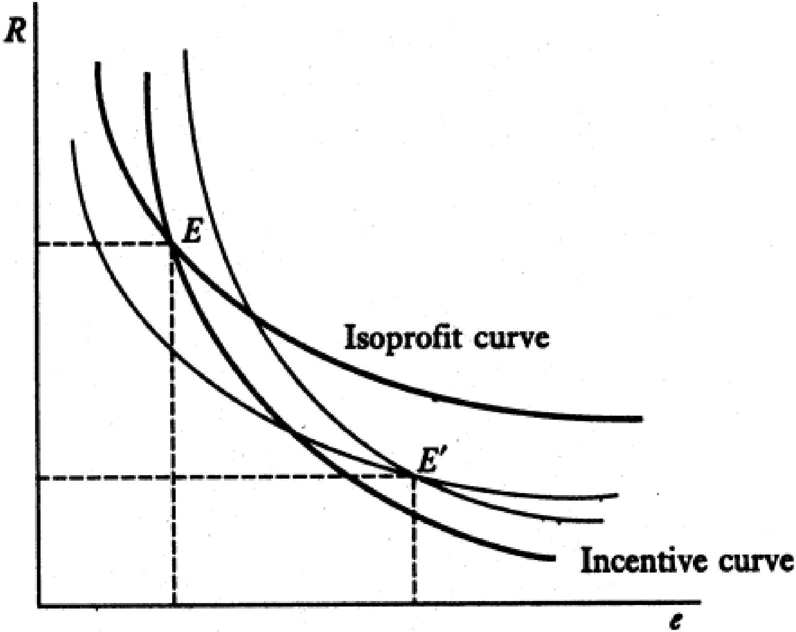
- What is the source of this inefficiency?
- Consider two extreme cases:
- The case of $\pi = 0$ represents perfect competition, and this situation generates the highest level of effort among all.
- However, since the debt burden R still exceeds w, effort will nonetheless be less than first best.
- This tells us that the source of the inefficiency is not so much monopolistic distortion caused be the lenders' market power (although it exacerbates the problem), but the agency problem itself, and the distortion in incentives created by limited liability.
- While the borrower shares in capital gains, he bears no part of the capital losses (beyond the collateral)
- Working with other people's money is not the same as working with one's own.

The case of monopoly

- The value of π is maximized from among all feasible and incentive compatible alternatives.
- That is, the monopolistic lender will choose the point on the incentive curve that attains the highest isoprofit curve (standard condition of tangency)
- This provides a ceiling on the interest rate, or debt level (say $\bar{R}$), and the lender will not find it profitable to raise it above this level.
- Since at such high level of interest rates, the borrower will always have an incentive to shirk.
- Thus, even in a competitive credit market, if there is excess demand for funds at $\bar{R}$, the interest rate will not rise to clear the market.
- Hence, there is credit rationing due to moral hazard.

The role of collateral

- Suppose there is an increase in w.
- The incentive curve shifts to the right.
- The isoprofit curve shifts down.
- Equilibrium interest rate falls, and equilibrium effort level increases.
- **Proposition 3** An increase in the size of collateral, w, leads to a fall in the equilibrium interest rate and debt, and an increase in the effort level.
- Intuition: A bigger collateral increases the incentive to put in effort, since failure is now more costly. Since there is lower default risk, interest rates must fall to keep the lender's profit the same.
- Also, higher effort levels increase the social surplus. And since lender's profits are held constant, borrowers are better off.


R
E
Isoprofit curve
E′
Incentive curve
e

Effect on inequality

- Functioning of the credit market may exacerbate already existing inequalities.
- Those with lower wealth are double cursed:
  - Lower consumption potential from asset liquidation.
  - Lower earning potential, owing to costlier or restricted access to credit.
- The reason is that the poor cannot credibly commit to refrain from morally hazardous behavior as effectively as the rich, since they cannot put up as much collateral.
- Long term exclusive relationships and social networks can be useful in mitigating these inefficiencies to some extent.

Repeated Borrowing and Contract Enforcement

- Results similar to those in the previous section can also arise from costly contract enforcement.
- The principal problem faced be lenders is in preventing *ex-post wilful default* by borrowers who do in fact possess the means to repay their loans, i.e. voluntary default.
- Most credit contracts in the developing world are not enforced by courts, but instead by social norms and third party sanctions.
- Contracts have to self-enforcing, where repayment of loans rely on self-interest of borrowers.

Voluntary Default: The Model

- In the absence of usual enforcement mechanisms (courts, collateral etc.) compliance must be achieved through the use of dynamic incentives, i.e. from the threat of losing access to credit in the future.
- A infinite horizon repeated lending-borrowing game is used to illustrate such a mechanism.
- Since involuntary default is not the focus here, we assume away any production uncertainty.
- Each period the borrower has access to a production technology which produces output $F(L)$, where L is the value of inputs purchased and applied. $F' > 0$ and $F'' < 0$.

Voluntary Default: The Model...

- Let r be the bank rate of interest (opportunity cost of funds).
- Consider a **self financed** farmer
- The optimum investment L^* is chosen to maximize

$$F(L) - (1 + r)L \tag{6}$$

- Which yields the first order condition

$$F'(L^*) = 1 + r \tag{7}$$

- This characterizes the first best

Partial equilibrium: Single lender

- Now turn to **debt-financed** farmers.
- Assume that farmers do not accumulate any savings and have to rely on credit market to finance investment needs every period.
- Live for infinitely many periods and use the one period discount factor δ
- First consider a partial equilibrium exercise: single borrower and a single lender.
- Focus on stationary subgame perfect equilibrium, where the lender offers a loan contract $[L, R = (1 + i)L]$ every period and follows the trigger strategy of never again offering a loan in case of default.
- The defaulting borrower has an outside option that yields a payoff v every period.

- As is the case with repeated games, there can be multiple stationary equilibria.
- All of them must satisfy the incentive constraint for the borrower:

$$(1-\delta)F(L)+\delta.v \leq F(L)-R \tag{8}$$

- i.e. in any stationary equilibrium (same contract is offered every period) the borrower should not benefit from defaulting on the loan.
- The left hand side is the lifetime payoff from defaulting in the current period, and the right hand side is the payoff from not defaulting in any period.

- Fix the lender's profit at z (z may be zero due to threat of entry)
- We must maximize the borrower's per period net income (over all possible contracts), while satisfying the incentive constraint.
- Maximize with respect to (L, R)

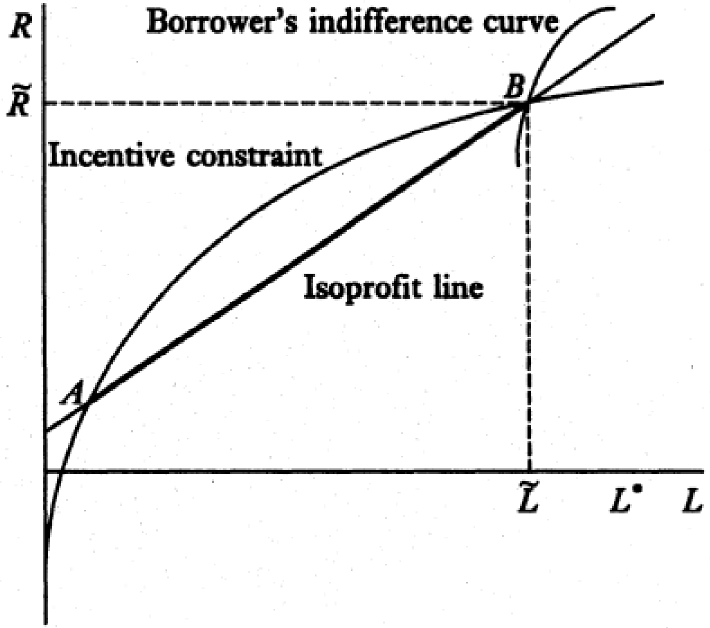
$$F(L) - R \tag{9}$$

subject to the constraints

$$R \leq \delta[F(L) - v] \tag{10}$$

$$z = R - (1 + r)L \tag{11}$$

- The nature of the solution is illustrated in the following diagram



R
Borrower's indifference curve
B
$\tilde{R}$
Incentive constraint
Isoprofit line
A
$\tilde{L}$
L^*
L

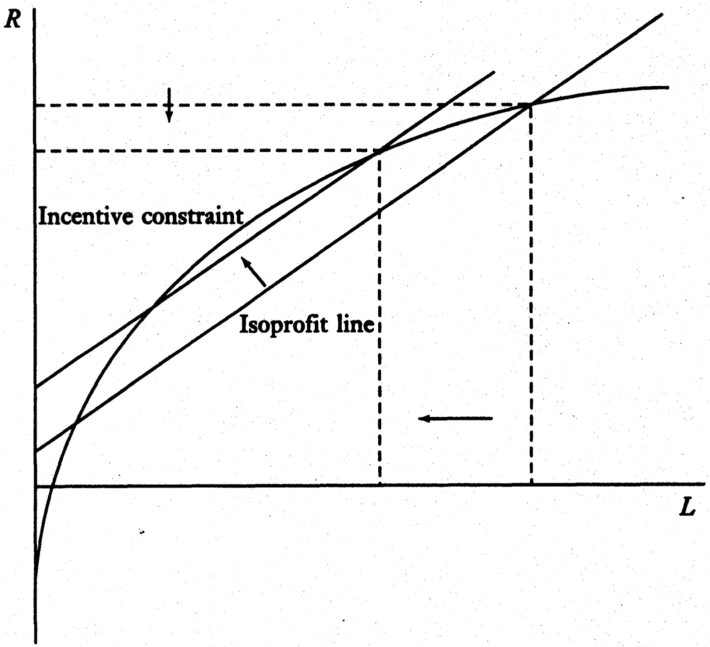
- The points of intersection A and B are where both constraints bind.
- Clearly the line segment AB represents the feasible set.
- Borrower's indifference curves are rising, concave curves with slope $F'(L)$, lower indifference curves representing higher payoff.
- If these indifference curves attain tangency at some point on AB, it is the solution to the problem and has the property: $L = L^*$ and $R = (1 + r)L^* + z$.
- If not, then the solution must be at the corner B. Let $\hat{L}(v, z)$ be the value of L at B.
- If $\tilde{L}(v, z)$ denotes the solution of the above program, then

$$\tilde{L}(v, z) = min[L^*, \hat{L}(v, z)] \quad (12)$$

- The corner solution at B denotes a situation where there is credit rationing.

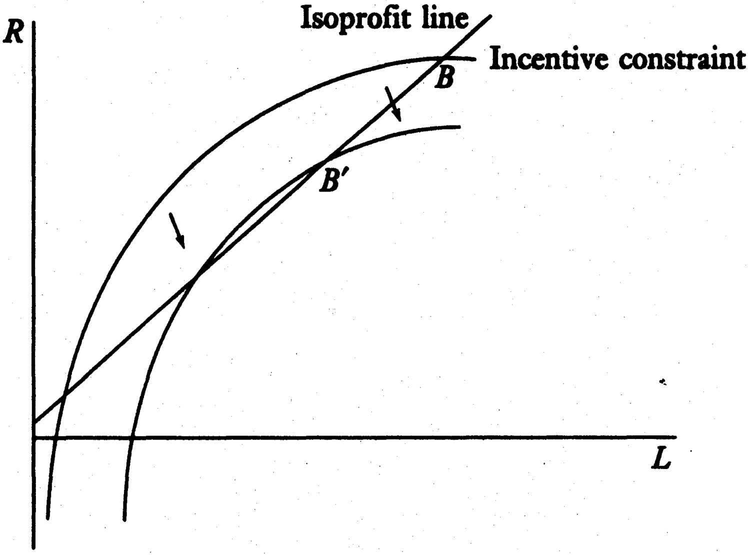
Comparative Statics

- If z increases, the isoprofit line shifts up, and point B moves to the left, i.e. $\hat{L}(z, v)$ is decreasing in z.
- If there's a corner solution, interest rates rise and rationing becomes more acute. If not, then interest rates rise but the loan size remains unaffected.


R
Incentive constraint
Isoprofit line
L

Comparative Statics

- Suppose the borrower's outside option v increases.
- The boundary of the incentive constraint undergoes a paralled downward shift, moving the corner point B to the left.
- Effects are similar to earlier case.
- If there's a corner solution, interest rates rise and rationing becomes more acute. If not, then nothing happens.



Isoprofit line
Incentive constraint
R
B
B′
L

Can Credit Rationing Arise in Equilibrium?

- **YES**. To see why consider the following argument:
- If the value of z or v is too high, the problem does not have a solution.
- The borderline case is one where the two constraints are tangent.
- Then, solution is a singleton characterized by $\delta . F'(\tilde{L}) = 1 + r$, implying $\tilde{L} < L^*$ since $\delta < 1$ and F is concave.

- If L^* is to the right of B, then there is credit rationing to begin with.
- Suppose L^* is less than B.
- Suppose we start at L^*, and keep increasing one of z or v, keeping the other constant.
- Point B keeps moving to the left, and we will reach a stage where it hits L^*.
- From onwards, there will be credit rationing if we increase z or v.
- And since $\tilde{L} < L^*$, there is still scope for increasing z or v.
- Hence, there can be credit rationing in equilibrium, if z or v are high enough.

Can Credit Rationing Arise in Equilibrium?

- **Propostion 4** There is credit rationing if z, the lenders' profit (given v), or v, the borrower's outside option (given z), is above some threshold value. If rationing is present, a further increase in the lender's profit, or the borrower's outside option, leads to further rationing as well as a rise in the interest rate.
- Equilibria which give more profit to the lender involve lower overall efficiency, because credit rationing is more severe in such equilibria.
- Increased bargaining power of lenders thus reduces efficiency.

General equilibrium:

Multiple lenders

Assumptions

- Assumption so far: exogenous outside option "v"

  Which means in a competitive setting with multiple lenders, a defaulting borrower can switch to another lender.

  But if there is a good deal of information flow within the community then the defaulting borrower could face social or market sanctions, thus restores the discipline

  But the strength of such networks could vary form one context to another therefore strength of network is modeled as a parameter in the model.

Endogenous v

- Suppose following a default, the existing relationship is terminated. Then borrower goes to another lender who checks his past credit history.

- Probability of uncovering the default : p (iid across periods)

- If caught then loan is rejected. Similarly for other lenders.

- If not uncovered then offered the similar contract (L,R) with the payoff w (same payoff as with the previous employer because we are looking for the symmetric and stationary equilibrium).

Endogenous v (contd.)

- Outside option "v" is given by:

$$v = p\delta v + (1-p)w = \frac{1-p}{1-\delta p}w$$

Then we can write $v = (1-\rho)w$, where

$$\rho \equiv \frac{p(1-\delta)}{1-\delta p}$$

can be viewed as scarring factor.

As $p \rightarrow 1$, $\rho \rightarrow 1$ and
as $\delta \rightarrow 1$ or $p \rightarrow 0$ then $\rho \rightarrow 0$

Determination of v

- We borrow from the partial equilibrium model
- Construct a function ϕ(v,z) whose fixed point denotes in this setting
- Consider a given z and any arbitrary value of v for which partial equilibrium problem has a solution. The borrower per-period pay off in partial equilibrium is given by

$$w(v,z) = (1-\delta)F(\tilde{L}(v,z)) + \delta v$$

If he defaults his expected per payoff is (1- ρ)w(v,z).

The original v is rationalized if (1- ρ)w(v,z) coincides with v.

Determination of v (contd.)

- Focus: stationary symmetric equilibrium

  Hence each lender offer the same package (L,R) to borrowers in good standing.

  Hence we define the following function:

  $$\phi(v,z) = (1-\rho)w(v,z)$$

  and note that, given z, any fixed point of ϕ (with respect to v) denotes an equilibrium.

Determination of v (contd.)

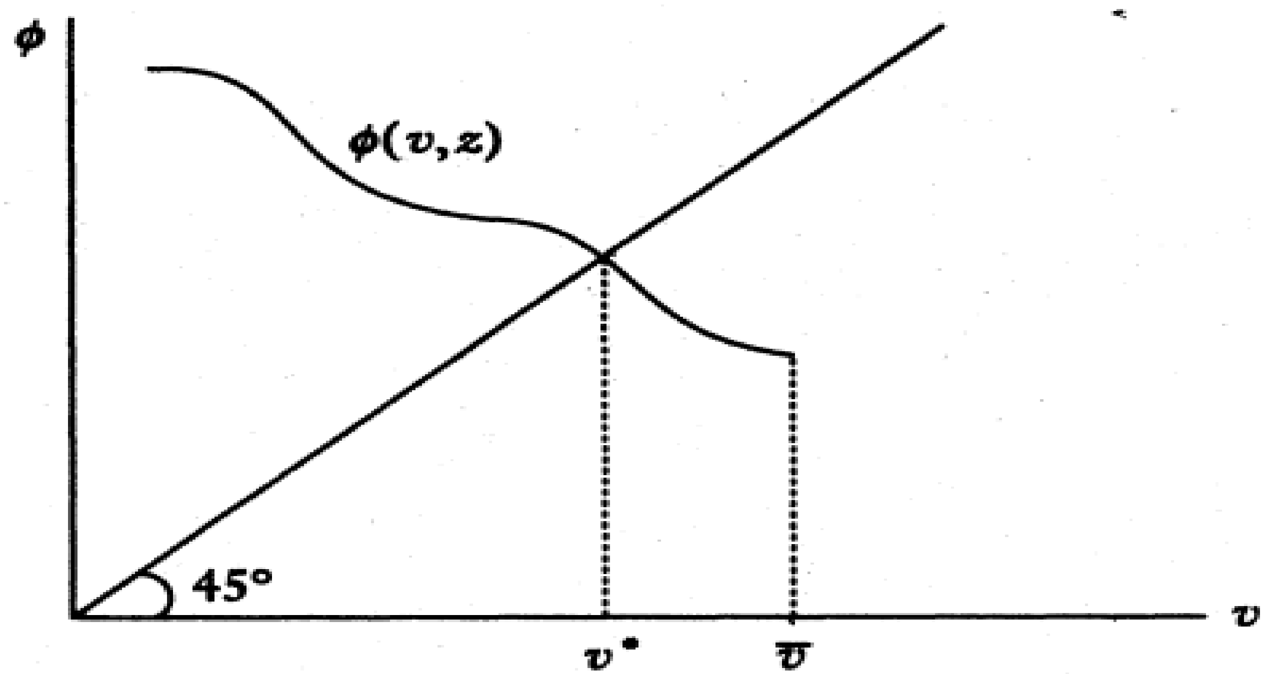
- Proposition 4 tell us that an exogenous increase in v or z leads to smaller loan and high rate of interest , which adversely affect the borrowers payoffs.

  hence the ϕ(v,z) is decreasing in both its arguments.

- If v is higher than some threshold $\bar{v}(z)$, the problem has no solution, and the value of ϕ(v,z) can be taken to be 0.

- Take z as given.

Determination of v (contd.)



The function $\phi(v, z)$

Since Φ(v,z) = v at v* then v* is the unique fixed point.

Observation 1:

- **If ρ is sufficiently high then equilibrium usually exists.**
- The "v" has a lower bound 0, so there will be a maximal value of z (say $\bar{z}$) consistent with the solution defined in (9) through (11).
- Z is fixed below this threshold
- $\rho\uparrow \rightarrow$ ϕ shifts downward, the point of discontinuity remains the same (w(v,z) is independent of ρ).
- The discontinuity disappears as $\rho \rightarrow 1$

  it means there is a threshold value ρ^* such that an equilibrium exists if and only if $\rho \geq \rho^*$.

Proposition 5

- Suppose $z \leq \bar{z}$. There is a unique equilibrium in the credit market provided ρ is greater than threshold value ρ*, i.e. provided that borrowers are sufficiently patient, or the probability of detection is high.

Intuition

- A high discount factor implies the perceived cost of (probabilistic)lack of credit in the future is more costly.
- A rise in probability of detection has a similar effect which brings attention to the disciplining role of dissemination of information regarding borrower credit histories.

Observation 2:

- **Equilibrium that provide higher profits to the lender create more credit rationing and reduce efficiency.**
- Z↑ → ϕ shifts downward → v* must fall. Since in equilibrium ϕ(v,z) = v and using that we can write

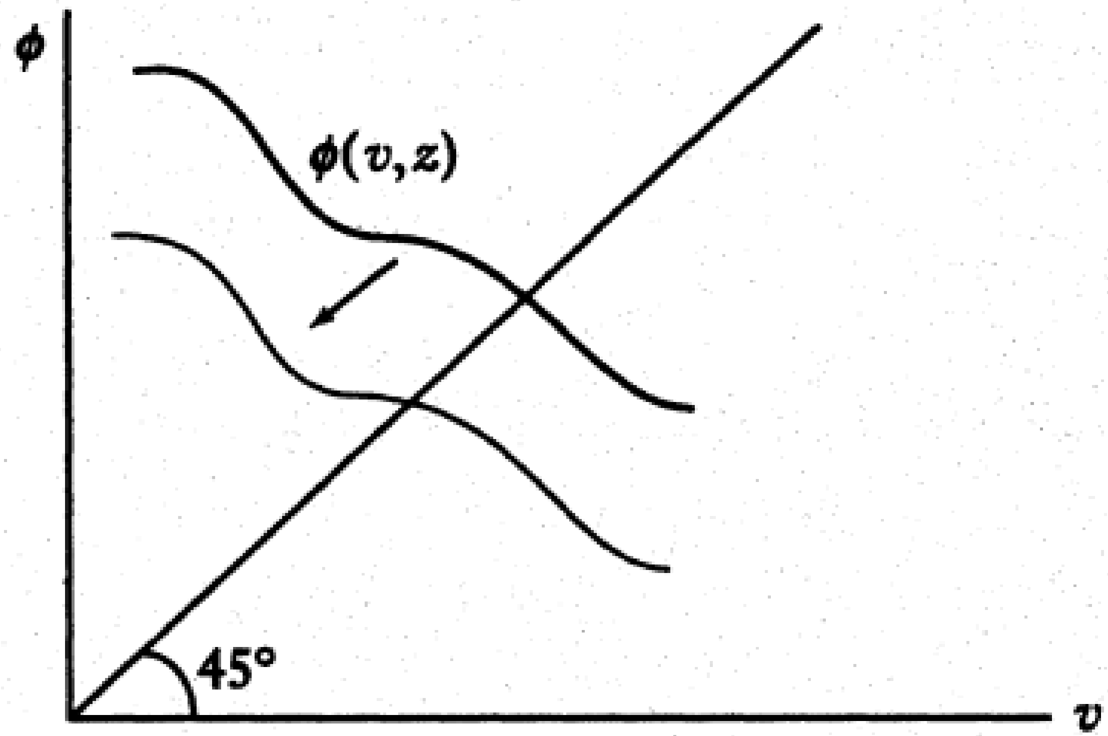
$$v = (1-\rho)[(1-\delta)F(\tilde{L}) + \delta v]$$

which, on rearrangement, yields:

$$v = \frac{(1-\rho)(1-\delta)F(\tilde{L})}{1-\delta(1-\rho)}$$

where $\tilde{L}$ denotes the equilibrium loan.

- In equilibrium v and $\tilde{L}$ are positively related.



Effect of an increase in lender's profit

- Hence more credit rationing and lower efficiency.

Macro Credit rationing

Targeted Exclusion: Incidence of past defaults are discovered by a new lender(with prob. p), and he is refused a loan.

Anonymous Exclusion: Whether or not a potential borrower has actually defaulted in the past but he is facing difficulty in getting a loan. This is **macro rationing of credit**.

Observation 3:

- **Anonymous exclusion may be an equilibrium-restoring device.**
- Probability of anonymous exclusion : q>0

- First we will see why the market may not clear?

Neither individual lender can not attempt to lend these borrowers at above market interest rates nor he can lend on stiffer term .

So lender is making zero profit therefore there will be a mix between giving credit and not giving credit to a new borrower.

Observation 3 (contd.):

- The effective scarring factor, when there is both targeted and anonymous exclusion is given by

$$\rho \equiv \frac{\pi(1-\delta)}{1-\delta\pi} \tag{17}$$

where π, now, is the overall probability of being excluded at any date. It is easy to see that

$$\pi = 1-(1-p)(1-q) \tag{18}$$

- Notice irrespective of the value of p, q can always adjust to guarantee that an equilibrium exists.

Conclusion

- Despite difference in detail, the two theories of credit rationing described above are similar in number of broad aspects.
- Both are driven by positive relation between high repayment burden and default risk.
- Limiting default risk necessitate restrictions on repayment burdens.
- This is achieved by limiting loan size below that borrowers desire - the micro credit rationing.
- Micro credit rationing + prevent interest rate form rising + scarce loan funds $\rightarrow$ Macro credit rationing.

Policy implication:

- Role of interest rate in Macroeconomics stabilization policy
- Structural reforms through credit subsidies

- The government or other non profit institutions play a important role in altering the environment within which lenders and borrowers interact on the informal market. For example: increase in bargaining power of borrowers, reduce asset inequality and improve credit information networks.

Thank you