Rural Financial Intermediaries

1. Limited Liability, Collateral and Its Substitutes

- A striking empirical fact about the operation of rural financial markets is how markedly the conditions of access can vary across households and how closely financing terms are tied to production activities.

- It is not uncommon to encounter situations where some farmers in a given region finance the bulk of their crop activities with commercial bank loans while smaller nearby farmers growing the same crops only finance with retained earnings or via more expensive informal moneylenders.

- It is also not uncommon to observe farmers who can obtain very generous financing from product traders or contract farming firms for certain crops, but almost no financing at all for other profitable crop activities grown in the same area but marketed through different channels.

- If markets where complete, all socially profitable investment projects would be financed regardless of the initial asset holdings of the borrower or the type of crop activity.
- In practice however the terms of loan access tend to be frequently tied to the borrower's existing asset position and production mix because agricultural lenders ask for land or chattel property mortgage pledges or other guarantees.
- Even when no such formal pledges are made, lenders may simply prefer to deal with farmers with proven assets and/or more diversified cash flows.
  - When this is the case the initial distribution of assets can have important effects on the structure and performance of the real economy and the number and types of financial contracts and intermediaries that can emerge.
- To build a theory of these issues one has to understand the role of limited liability and collateral.

1.1 The Model

- Consider a rural economy with a large number farmer-entrepreneurs.
- Entrepreneurs are identical in all respects except for their initial holding of collateral wealth or asset A.
  - These are by definition liquid assets such as land or equipment whose value is relatively easy to establish and transfer to an outside investor.
- Each entrepreneur has access to a crop production technology requiring lump sum investment I.
- The opportunity cost of funds (i.e., the rate of return to investing money elsewhere) is given by gross return γ.
- Entrepreneurs can invest funds in a farm production project that has two possible outcomes: success x_s or a failure $x_f < x_s$.

- The entrepreneur chooses between two possible levels of diligence that affect the expected return.
  - Diligence might refer to the quantity or quality of seed and/or fertilizer applied or to the farmer's level of effort and care.
- When a farmer is *diligent* the project succeeds with probability $\bar{\pi}$ and fails with probability $(1-\bar{\pi})$ to yield expected return $E(x \mid \bar{\pi}) = \bar{\pi}x_s + (1-\bar{\pi})x_f$.
- When he is *not diligent* the project succeeds with probability $\underline{\pi} < \bar{\pi}$, for a lower expected crop harvest of $E(x \mid \underline{\pi}) = \underline{\pi}x_s + (1-\underline{\pi})x_f$.
- Although non-diligence lowers the expected project returns, it also allows the entrepreneur to divert effort or funds away from the project to other projects or uses that generate private benefits.
- As is well understood, when all or part of the investment I is financed by an outside party a potential problem of moral hazard emerges when the borrower's level of diligence is not observable to the lender and wealth or legal constraints limit his liability following project failures (Stiglitz and Weiss, 1981).

1.2 Collateral-backed Loans with No Monitoring

- Assume that the private benefit to be captured via non-diligence under a non-monitored loan is $B(0) > 0$ while the private benefit to diligence has been normalized to zero.
- The contract terms are s_f and s_s, returns to the borrower in success and failure.
- The market for non-monitored loans is assumed perfectly competitive so lenders compete until they just break even on their investment and borrowers get their preferred feasible loan contract.
- **Borrower's Incentive Compatibility Constraint:** The contract must prevent the borrower from choosing non-diligence:

$$E\left(s \mid \bar{\pi}\right) \geq E\left(s \mid \underline{\pi}\right) + B(0). \tag{1}$$

- **Lender's Participation Constraint:**

$$E\left(x - s \mid \bar{\pi}\right) \geq \gamma I. \tag{2}$$

- **Borrower's Limited Liability Constraints:** The maximum the borrower can be made to pay is limited by project outcome x plus borrower's collateralized asset A:

$$\begin{aligned} x_s - s_s &\leq x_s + A, \\ x_f - s_f &\leq x_f + A. \end{aligned}$$

- The borrower's *incentive compatibility constraint* (1) can be rewritten to yield:

$$\begin{aligned} \bar{\pi} s_s + (1-\bar{\pi}) s_f &\geq \underline{\pi} s_s + (1-\underline{\pi}) s_f + B(0), \\ (\bar{\pi} - \underline{\pi})(s_s - s_f) &\geq B(0), \\ s_s &\geq s_f + \frac{B(0)}{\triangle \pi}, \end{aligned} \tag{3}$$

  where $\triangle \pi = (\bar{\pi} - \underline{\pi})$.

  – Intuitively, the return to the borrower following a successful outcome s_s must be made sufficiently greater than the return received following failure s_f so as to provide an incentive for the borrower to want to raise the probability of success by choosing to be diligent.

- It follows that the effective *borrower's limited liability constraint* is:

$$s_f \geq -A, \tag{4}$$

since the limited liability constraint under success is met automatically if (4) holds as long as (3) is also met and $B(0) > 0$.

- The contract design problem can then be seen as choosing contract terms s_f and s_s (return to the borrower in each state) to solve the following program:

$$\left.\begin{array}{l} \underset{\{s_f,\, s_s\}}{\text{Maximize}} \; E\left(s \mid \bar{\pi}\right) \\ \\ \text{subject to} \\ \\ E\left(x - s \mid \bar{\pi}\right) \geq \gamma I, \\ \\ E\left(s \mid \bar{\pi}\right) \geq E\left(s \mid \underline{\pi}\right) + B(0), \\ \\ s_f \geq -A. \end{array}\right\}$$

- Since the objective is to maximize $E(s \mid \bar{\pi})$, whereas the lender's participation constraint (2) requires $E(s \mid \bar{\pi}) \leq E(x \mid \bar{\pi}) - \gamma I$, it follows that the lender's participation constraint will hold with equality, that is,

$$\begin{aligned} E(s \mid \bar{\pi}) &= E(x \mid \bar{\pi}) - \gamma I, \\ \bar{\pi} s_s + (1 - \bar{\pi}) s_f &= E(x \mid \bar{\pi}) - \gamma I. \end{aligned}$$

- Using $s_s \geq s_f + \dfrac{B(0)}{\triangle \pi}$, it follows that

$$E(x \mid \bar{\pi}) - \gamma I \geq s_f + \bar{\pi} \frac{B(0)}{\triangle \pi}.$$

- Finally, using $s_f \geq -A$, we derive

$$A \geq \bar{\pi} \frac{B(0)}{\triangle \pi} - [E(x \mid \bar{\pi}) - \gamma I] \equiv \underline{A}(0). \tag{5}$$

  – $\underline{A}(0)$ defines the *minimum collateral requirement*, that is, no lender would willingly lend to a borrower who cannot post collateral A in excess of $\underline{A}(0)$.

- The minimum collateral requirement will be larger
  - the larger is the potential private benefit $B(0)$,
  - the larger is the loan I,
  - the higher the cost of funds γ.
- The minimum collateral requirement will be smaller
  - the larger is the size of expected returns $E\left(x \mid \bar{\pi}\right),$
  - the 'safer' is the diligent project compared to the non-diligent one (as measured by an increase in $\bar{\pi}$ holding $\underline{\pi}$ constant).
    - This result follows from the fact that $\dfrac{\bar{\pi}}{\triangle\pi}$ is decreasing with $\bar{\pi}$ for all $\bar{\pi} \geq \underline{\pi}$.
    - This result suggests reasons why lenders may want to steer collateral-poor borrowers toward safer, but possibly lower return projects.

- Borrowers who cannot post the minimum collateral requirement cannot credibly commit to being diligent.

  – So all entrepreneurs with assets $A < \underline{A}(0)$ will be refused non-monitored loan.

- Borrowers with assets $A \geq \underline{A}(0)$ get un-monitored loans of size I and earn expected return $E(x \mid \bar{\pi}) - \gamma I$.

- The practical problem with this method to obtain a borrower's commitment to diligence is that it may exclude a large number of borrowers with good projects but insufficient collateral.

- A good part of the vast literature on financial contracting and financial intermediation since Stiglitz and Weiss (1981) can be understood as efforts to find new mechanisms to create collateral substitutes or ways to relax incentive constraints so as to reduce the size of the limited liability rents that limit the range of feasible contracting.

- One prominent strategy is for the lender to use *intermediaries* or *delegated monitors* who can help reduce information asymmetries or engage in 'monitoring' and 'control' activities aimed at directly lowering the agent's return from moral hazard.

2. Rural Financial Intermediaries

- Rural households and farm enterprises in developing countries obtain credit and insurance from a wide array of financial service providers including product traders, banks, cooperatives and mutuals, contract farming firms, and input suppliers.
  - They might also borrow informally from relatives, friends, landlords, shopkeepers or moneylenders.
- A defining characteristic of many of these financial transactions is that they involve ‘active monitoring’ (Tirole, 2006).
  - The aim is to keep agents focused on their efforts to improve the chances that their financed projects do not fail and/or to reduce the possibility that project cash flows may be diverted to other purposes rather than meeting promised repayments.
  - Monitoring is used both as a substitute for, and in addition to, collateral guarantees and legal enforcement strategies.

- With the exception of some moneylenders and other informal sources who may lend entirely out of their own funds, each of these financial service providers is typically an *intermediary*, financing loan advances using both their own capital as well as funds leveraged from other outside sources.
  - They are in this sense also acting as *delegate monitors* for other outside investors.
    - For example, a trader or input supplier may tap into credit advances from their own buyers or suppliers, from bank loans and overdrafts or via the discounting of bills.
- Financial intermediation therefore can involve a long chain of monitored financial relationships
  - with an investor at any given node in the chain only willing to lend if they can be convinced that financial intermediaries further down the chain face the right incentives to carefully select and monitor borrowers and projects in ways that will uphold the value of the original investors' stakes.

- Active monitoring takes many forms.
  - Product traders and contract farming firms often release credit in installments timed to match the farmer's likely needs at different tasks over the crop season.
    - An installment may be held up or sized down in response to farmer's actions to that date as perceived by the trader or company extension agent.
    - Traders also typically make it their business to visit the farmer's fields at the time of harvest or during important input applications.
  - Input suppliers in virtually all industries supply most of their trade credit to borrowers via in-kind loans rather than as cash advances – seed, fertilizer, or a voucher for transport services will be delivered to the farmer rather than cash.
    - These practices clearly aim at making it more difficult for borrowers to divert credit or other resources to other private uses or, more generally, to raise the borrower's expected return to being diligent rather than nondiligent.

2.1 Monitored Loan Contracts

- Consider again the model of moral hazard and limited liability.
- Since this problem of moral hazard is driven by the high opportunity cost of diligence $B(0)$, it seems logical that lenders might want to engage in 'active monitoring' in an effort to directly lower the borrowers' scope for, and benefit from diverting effort and other resources to private projects.
- A straightforward way to capture this is to assume that by expending resources c on monitoring and control activities an intermediary can lower the benefits of non-diligence from $B(0)$ to $B(c)$.
  - For example a lender's frequent visits to the farmer's field, or the delivery of loans in kind in the form of fertilizer or seed, lowers the borrower's scope for diverting funds and resources to other uses.
- As in Holmstrom and Tirole (1997) the costly monitoring activity will itself be subject to moral hazard on the part of any delegate monitor or intermediary acting on behalf of an uninformed outside lender.

- The function $B(c)$ indicates how the borrower's opportunity cost of being diligent can be modified by the lender's monitoring activities.
  - It is reasonable to assume that there are diminishing returns to the monitoring activity:

$$B'(c) < 0, \text{ and } B''(c) > 0. \qquad \text{(Assumption 1)}$$

- There are two types of lender on the market:
  - *uninformed lenders* such as banks who rely primarily on collateral based enforcement of their loans, and
  - *monitoring lenders* who lend against less collateral per amount borrowed than do banks, but who must actively monitor their borrowers during the project operation.
    - The analysis will later distinguish between two types of monitoring lenders:
      - *intermediary lenders*, who lend to farmers out of their own equity and from funds leveraged from outside lenders, and
      - *pure moneylenders* who lend entirely out of their own equity.

- Let $I^m \geq 0$ be the finance provided to a borrower out of the monitoring lender's own equity, and $I^u \geq 0$ the remaining contribution from the un-informed bank lender.
  - For a project to be fully financed we must have

$$I^m + I^u = I.$$

- The contract design problem is to choose how to optimally divide the available property claims generated by each outcome x_i ($i = s, f$) between
  - a return to the borrower s_i,
  - a return to the monitoring intermediary w_i, and
  - a return to an uninformed lender $R_i = x_i - s_i - w_i$.
- This division must be chosen in such a way that
  - both the borrower and the intermediary monitor have incentives to take their unobserved action choices, and
  - that all parties are willing to participate.

- The sequence of events is as follows.
  - First the parties agree to the terms of a contract and the lenders deliver their loan amounts (I^m and/or I^u) to the borrower. At the start of the production cycle the monitor commits to a monitoring strategy c.
  - In response to these conditions the farm borrower chooses his unobserved production diligence level $\bar{\pi}$ or $\underline{\pi}$.
  - Production uncertainty is resolved at harvest and property claims over the realized project outcome are divided according to the terms of the contract.
- We assume a competitive lending market with free entry into both the uninformed and monitored lending activities.
- Then an optimal contract $\{s_i,\ w_i,\ R_i\}$ for a borrower with collateral assets A is found by solving the following program:

- $$\underset{\{s_i,\, w_i,\, c\}}{\text{Maximize}} \;\; E\left(s_i \mid \bar{\pi}\right)$$

subject to

$$E\left(R_i \mid \bar{\pi}\right) \geq \gamma I^u, \tag{6}$$

$$E\left(w_i \mid \bar{\pi}\right) - c \geq \gamma I^m, \tag{7}$$

$$E\left(s_i \mid \bar{\pi}\right) \geq E\left(s_i \mid \underline{\pi}\right) + B(c), \tag{8}$$

$$E\left(w_i \mid \bar{\pi}\right) - c \geq E\left(w_i \mid \underline{\pi}\right), \tag{9}$$

$$s_i \geq -A,\, i = s, f, \tag{10}$$

$$w_i \geq 0,\, i = s, f. \tag{11}$$

- Constraint (6) is the bank *lender's participation constraint*.
  - It requires that she earn at least as much from expected repayments as she could earn from leaving the same investment funds I^u in the competitive interest rate on competitive bank deposits summarized in the gross return γ.
- (7) is the *intermediary's participation constraint* which requires that the expected value of repayments w_i to an intermediary who lends amount I^u and monitors at cost c be at least as large as she could have earned from a similar bank deposit.
- The *borrower's incentive compatibility constraint* (8) requires that the borrower earn at least as much from choosing the high action than from the inefficient low action.
  - Using $E(s_i \mid \pi) = \pi s_s + (1-\pi)s_f$ and rearranging, this can be written in more compact form as

$$s_s \geq s_f + \frac{B(c)}{\triangle\pi}, \tag{12}$$

where $\triangle\pi = (\bar{\pi} - \underline{\pi})$.

- (9) is the *intermediary's monitoring incentive compatibility constraint* which can be rewritten as

$$w_s \geq w_f + \frac{c}{\triangle \pi}. \tag{13}$$

- (10) is the *borrower's limited liability constraint* that we have already encountered in the last section.

- Finally, (11) is the *intermediary's limited liability constraint* requiring that the intermediary's liability in the borrower's project is limited to the amount of intermediary capital put at risk, nothing more than that.

- Now we proceed to solve this optimal contracting problem.

- Consider first the contract offered by an uninformed lender, such as a bank, without the presence of an additional intermediary lender.
  - Since there is no intermediary involved we can drop constraints (7), (9) and (11) and set $w_f = w_s = c = 0$.
- From the borrower's incentive compatibility constraint (12) it is clear that if collateral is to be required at all, it will be in the failure state.
- It is also evident that when collateral use is at a minimum the borrower's incentive compatibility constraint (8) must bind because this makes the failure repayment level $R_f = x_f - s_f$ as low as feasible (and when s_f is as large as feasible collateral is at a minimum).
  - The binding incentive compatibility constraint gives us the relation

$$s_s = s_f + \frac{B(0)}{\triangle\pi}, \text{ implying } E\left(s_i \mid \bar{\pi}\right) = s_f + \bar{\pi}\frac{B(0)}{\triangle\pi}.$$

    - This last expression is the minimum expected return – or the *enforcement rent* – that must be left to the borrower if the incentive compatibility constraint is to bind.

- Substituting this into the investor's break-even condition yields:

$$E\left(R_i \mid \bar{\pi}\right) = E\left(x_i \mid \bar{\pi}\right) - s_f - \bar{\pi}\frac{B(0)}{\triangle\pi} \geq \gamma I.$$

- The lowest repayment $R_f = x_f - s_f$ such that the above constraint holds exactly and the investor just breaks even defines a minimum cutoff $\underline{A}\left(0\right) = -s_f$ given by

$$\underline{A}\left(0\right) = \bar{\pi}\frac{B(0)}{\triangle\pi} - E\left(x_i \mid \bar{\pi}\right) + \gamma I. \tag{5}$$

  - This is the minimum collateral requirement we have derived in the last section.
    - No bank would be willing to lend to a borrower who could not post at least $\underline{A}\left(0\right)$ collateral, because the bank could not trust such a borrower to have a sufficient incentive to not pursue private benefits that harm the value of expected repayments.

- Borrowers with assets $A \geq \underline{A}(0)$ will have access to loans that require minimum collateral requirements of exactly $\underline{A}(0)$ and, in expected value, will earn

$$E(s_i \mid \bar{\pi}) = -\underline{A}(0) + \bar{\pi}\frac{B(0)}{\triangle\pi} = E(x_i \mid \bar{\pi}) - \gamma I.$$

  - This is the expected project outcome net of the minimum expected repayments required for the investor to participate.
    - The cost of funds to the borrower who borrows from a bank is therefore exactly the bank's opportunity cost of funds, or the lowest market rate.

- Borrowers with insufficient assets A to meet these requirements will be excluded from pure-collateral based loans but may still be able to obtain finance through more expensive *monitored loans*.

- Under the free entry assumption intermediary profits are driven to zero so the intermediary's participation constraint should hold as an equality:

$$E\left(w_i \mid \bar{\pi}\right) - c = \gamma I^m.$$

- Using $w_s \geq w_f + \dfrac{c}{\triangle\pi}$, it follows that

$$E\left(w_i \mid \bar{\pi}\right) \geq w_f + \bar{\pi}\frac{c}{\triangle\pi}.$$

- Combining the two we get

$$\gamma I^m = E\left(w_i \mid \bar{\pi}\right) - c \geq w_f + \bar{\pi}\frac{c}{\triangle\pi} - c \geq \bar{\pi}\frac{c}{\triangle\pi} - c,$$

since $w_f \geq 0$, the intermediary's limited liability constraint.

- Thus we get the expression for the *minimum required intermediary loan* for any level of monitoring intensity c:

$$\gamma I^m = \bar{\pi}\frac{c}{\triangle\pi} - c. \tag{14}$$

- By lending I^m the intermediary establishes a stake in the borrower's project that provides her with the incentive to monitor making the uninformed lender willing to step in and make the remaining investment $I^u = I - I^m$.
  - This is the sense in which the monitoring lender is also an intermediary:
    - she facilitates or intermediates funding from other less informed sources.
- Now we solve for the minimum collateral requirement when there is a monitoring intermediary.
- Under the free entry assumption uninformed bank lender's profit is driven to zero so the bank lender's participation constraint (6) should hold as an equality:

$$E\left(R_i \mid \bar{\pi}\right) = E\left(x_i - s_i - w_i \mid \bar{\pi}\right) = \gamma I^u.$$

It follows that

$$\begin{aligned} E\left(x_i \mid \bar{\pi}\right) &= E\left(s_i \mid \bar{\pi}\right) + E\left(w_i \mid \bar{\pi}\right) + \gamma I^u, \\ &= E\left(s_i \mid \bar{\pi}\right) + c + \gamma I^m + \gamma I^u, \text{ [since } E\left(w_i \mid \bar{\pi}\right) - c = \gamma I^m\text{.]} \\ &= E\left(s_i \mid \bar{\pi}\right) + c + \gamma I. \end{aligned}$$

- As in the last section, using $s_s \geq s_f + \dfrac{B(c)}{\triangle\pi}$ and $s_f \geq -A$, we get

$$E\left(s_i \mid \bar{\pi}\right) \geq -A + \bar{\pi}\frac{B(c)}{\triangle\pi}.$$

- So we have

$$E\left(x_i \mid \bar{\pi}\right) = E\left(s_i \mid \bar{\pi}\right) + c + \gamma I \geq -A + \bar{\pi}\frac{B(c)}{\triangle\pi} + c + \gamma I.$$

- It follows that *the minimum collateral requirement* is

$$A \geq \bar{\pi}\frac{B(c)}{\triangle\pi} - E\left(x_i \mid \bar{\pi}\right) + c + \gamma I \equiv \underline{A}\left(c\right). \tag{15}$$

  – Observe that the minimum collateral requirement on an uninformed loan in (5) is just a special case of this more general collateral hurdle with monitoring intensity, c, set at zero.

- Whether or not monitoring actually lowers the minimum collateral requirement on a loan depends on the nature the monitoring technology.

- From (15) we observe that

$$\frac{d}{dc}\left(\underline{A}\left(c\right)\right) = \bar{\pi}\frac{B'(c)}{\triangle\pi} + 1,$$

and

$$\frac{d^2}{dc^2}\left(\underline{A}\left(c\right)\right) = \bar{\pi}\frac{B''(c)}{\triangle\pi} > 0.$$

- There are two effects at work.
  - On the one hand, monitoring lowers the borrower's private benefits from side activities. This relaxes the borrower's incentive compatibility constraint and hence lowers the collateral requirement.
  - On the other hand, monitoring is a costly activity and every extra rupee's worth of monitoring reduces the expected total project surplus from which repayments can be made by one rupee. This raises the collateral requirement.

- If $\bar{\pi}\frac{B'(0)}{\triangle\pi} < -1$ (so that $\frac{d}{dc}\left(\underline{A}\left(c\right)\right) < 0$), then then the first rupee spent on monitoring will have the net effect of lowering the collateral hurdle.
- Because of the assumption of diminishing returns to monitoring ($B''(c) > 0$), however, there is some monitoring intensity level $\bar{c}$ at which $\bar{\pi}\frac{B'(\bar{c})}{\triangle\pi} = -1$, that is, $\frac{d}{dc}\left(\underline{A}\left(\bar{c}\right)\right) = 0.$
  - Beyond $\bar{c}$ no further monitoring is worthwhile as the marginal benefit of an extra dollar of monitoring always exceeds its marginal cost.

- Next we will establish that the collateral poor borrowers pay a higher (implicit) interest rate.

- Since monitoring uses up real resources, monitored lending is always more expensive than uninformed lending.

  – It follows that only collateral-poor borrowers with assets below the bank collateral requirement $\underline{A}(0)$ would turn to monitored finance.

- To economize on the cost of borrowing, borrowers will choose loans that involve only as much monitoring as is minimally required to satisfy incentives and lower the collateral requirement to their available asset level A.

  – The optimal level of monitoring is therefore that level at which $\underline{A}(c) = A$, that is,

$$c(A) = \underline{A}^{-1}(A).$$

    ◦ Since $\dfrac{\bar{\pi}}{\triangle\pi} > 1$ and $B'(c) < 0$, it follows from (15) that $c(A)$ is a decreasing function of A.

- We have derived earlier that

$$E\left(x_i \mid \bar{\pi}\right) = E\left(s_i \mid \bar{\pi}\right) + c + \gamma I,$$

It follows that the expected return to a monitored borrower is

$$E\left(s_i \mid \bar{\pi}\right) = E\left(x_i \mid \bar{\pi}\right) - \left[c\left(A\right) + \gamma I\right],$$

where $c\left(A\right)$ is the optimum monitoring intensity.

- Since the borrower repays $c\left(A\right) + \gamma I$ on amount borrowed I, the implicit interest rate per dollar borrowed on a loan of size I is $\dfrac{c\left(A\right)}{I} + \gamma$ which is decreasing in the borrower's collateral wealth A.

- We show next that collateral poor borrowers obtain a larger proportion of their finance via monitored lending arrangements.

- To economize on the cost of borrowing, collateral poor borrowers (borrowers with $A < \underline{A}(0)$) use the *minimum required intermediary loan*, I^m, in their total financing package.

  – From (14) we have

$$\gamma I^m = \bar{\pi}\frac{c(A)}{\triangle\pi} - c(A).$$

    ◦ Since $\dfrac{\bar{\pi}}{\triangle\pi} > 1$ and $c(A)$ is a decreasing function of A, it follows that I^m is decreasing in A.

- Finally, we establish how the difference between two types of monitored lending, *intermediary lenders* and *pure moneylenders*, emerges.

- Note that

$$\gamma I^m(A) = \bar{\pi}\frac{c(A)}{\triangle\pi} - c(A).$$

  – $I^m(A) = 0$ for $A > \underline{A}(0)$, since $c(A) = 0$ for $A > \underline{A}(0)$.

  – Also, $I^m(A)$ is decreasing in A.

- As we move to borrowers with fewer and fewer collateral assets, monitoring intensity will rise until it has reached a point $\hat{c}$ defined by

$$\gamma I = \bar{\pi}\frac{\hat{c}}{\triangle\pi} - \hat{c} = \left(\frac{\underline{\pi}}{\triangle\pi}\right)\hat{c}.$$

  – At this point so much monitoring is required that the intermediary's stake in the borrower's project I^m equals the full investment I.

- As A is further decreased, monitoring intensity eventually reaches level $\bar{c}$, beyond which further monitoring simply becomes unprofitable.
  - This defines an absolute minimum collateral requirement $\underline{A}(\bar{c})$, below which borrowers will be excluded entirely from the loan market.
  - The monitoring lender will be lending I entirely out of her own equity for borrowers with assets between $\underline{A}(\hat{c})$ and $\underline{A}(\bar{c})$.
- Studies of rural credit markets have characterized informal moneylenders precisely in the terms predicted by the model:
  - moneylenders lend primarily out of own equity, they monitor and screen borrowers intensely, and they charge high interest rates (Aleem, 1994; Bell, 1994).

- The discussion so far can be summarized in the following proposition.

- **Proposition:**

Define the Minimum Collateral Requirement function $\underline{A}(c)$ *as*

$$\underline{A}(c) = \bar{\pi}\frac{B(c)}{\triangle\pi} - E(x_i \mid \bar{\pi}) + c + \gamma I,$$

and define the cutoff levels $\bar{c}$ *and* $\hat{c}$ *from the relations* $\bar{\pi}\dfrac{B'(\bar{c})}{\triangle\pi} = -1$, *and* $\hat{c} = \left(\dfrac{\triangle\pi}{\underline{\pi}}\right)\gamma I$. *The Optimum Monitoring Intensity* $c(A)$ *for a borrower with assets* A *is defined implicitly by* $\underline{A}(c) = A$ *over the domain* $(0, \bar{c})$. *The loan required from the monitoring intermediary,* I^m, *is given by* $\gamma I^m(A) = \bar{\pi}\dfrac{c(A)}{\triangle\pi} - c(A)$ *over the asset range* $A \in [\underline{A}(\bar{c}), \underline{A}(0)]$ *and zero otherwise. Borrowers will be matched to different loan types according to their initial level of collateral assets as follows*:

Collateral Assets	Loan Amounts	Loan Type
$A \geq \underline{A}(0)$	$(I^u = I,\ I^m = 0)$	Non-monitored Loans
$\underline{A}(0) > A \geq \underline{A}(\hat{c})$	$(I^u > 0,\ I^m > 0)$	Intermediated Monitored Loans
$\underline{A}(\hat{c}) > A \geq \underline{A}(\bar{c})$	$(I^u = 0,\ I^m = I)$	Directly Monitored Loans
$\underline{A}(\bar{c}) > A$	$(I^u = 0,\ I^m = 0)$	Excluded from loan market

3. References

- This note is based on

1. Conning, Jonathan and Christopher Udry (2007), “Rural Financial Markets in Developing Countries”, in *Handbook of Agricultural Economics*, vol. 3, edited by R. E. Evenson, P. Pingali and T. P. Schultz, Elsevier, 2857–2908.

– The references mentioned in this note can be traced in this survey.