Fragmented Credit Markets- Adverse Selection

Pranab Bardhan, Christopher Udry

March 17, 2011

Introduction

- Will be looking at the effects of specific information asymmetries and imperfect information on the structure of rural credit market.
- Artificial to treat separately the issues of adverse selection and moral hazard because most economic environments are characterized by a mixture of the two.
- model as if a clean distinction can be made between moral hazard and adverse selection, *for the sake of clarity.*

4 alternative market situations:

- 1. Benchmark case: competitive market for loans with complete information.
- 2. Competitive equilibrium with imperfect information- Villagers borrow from non-resident commercial lenders, banks, or government agencies which compete with one another for borrowers.Lenders cannot distinguish between borrowers with different characteristics, which might affect returns on loans (adverse selection).
- 3. Credit market dominated by a local monopolistic moneylender who has perfect information concerning the characteristics and activities of village borrowers.
- 4. Fragmented national market, villagers have the option of borrowing from one of a set of relatively uninformed, competitive non-resident lenders or from a local omniscient moneylender. Here, rents accrue to the local moneylender through his control of local information.

Model

- Assume that all borrowers and lenders are risk-neutral- eliminates an important motivation for borrowing: the desire to smooth consumption in the face of fluctutating income. This use of credit markets as a mechanism for coping with risk covered in the next chapter.
- Focus exclusively on credit as a source of working capital for productive activities that take time.
- Each individual in a village has access to the same amount of land, can farm his land for a certain fixed cost (normalized to 1).
- Farm yields 0 if there is a harvest failure, and $R > 1$ otherwise.
- Also suppose that farmers have no wealth of their own (there is no land market). If farmers are to engage in cultivation, they must borrow the necessary working capital.

- Heterogeneity among borrowers, lenders might have a good idea about the average characteristics of the pool of potential borrowers, they may not have complete information concerning the characteristics of any particular borrower. This leads to problems of adeverse selection.

- Farming requires no effort, but there are two types of potential borrowers indexed by $t \in \{1, 2\}$

- $\pi(t)$ is the probabilty of sucessful farming season; $t = 1, 2$

- Type 2 borrowers have access to land that is riskier but potentially more lucrative than that used by type 1 borrowers.
- This means: $\pi(1) > \pi(2)$, but $R(1) < R(2)$
- Suppose that the expected return to farming each type of land is identical: $(\pi(t)R(t) = R \quad \forall \quad t)$
- Lender offers an interest factor (which is 1 plus the rate of interest) of $i \leq R$
- Lenders have access to a risk-free capital market with a return of $\rho(R > \rho \geq 1)$
- If the borrower does not involve herself in farming, she can recieve a return of $W(R > W \geq 0)$ in alternative employment. This reservation utility of the different types of borrowers is constant $(W(t) = W \quad \forall \quad t)$

- Therefore, the expected utility of a borrower is

$$U(i,t) = \pi(t)[R(t) - i]$$

- Expected return of a lender from a loan at rate i is

$$\Pi(i,t) = \pi(t)i.$$

- Two extremely important assumptions:
- the loan contract has limited liability: if the borrower's harvest fails, she has no funds to repay the loan and the lender recieves nothing.
- there are no problems of contract enforcement: if the harvest is successful, the borrower has the resources to repay and the loan is repaid, i.e., borrower cannot renege on her commitment to repay the loan if the project is successful. (Possbible explanations: loss of future access to credit, general social sanctions)

(i) Competitive Equilibrium with Complete Information

- Perfectly informed lenders compete to makeloans within the village.
- Lenders can distinguish between the types of borrowers, so they can offer different interest rates to each type.
- Equilibrium with lending to borrower with type t will be an interest rate $(i_1(t))$ such that

- $(a) U(i_1, t) \geq W$;
- $(b) \Pi(i_1, t) \geq \rho$
- (c) There is no interest rate $i(t)$ that yields a return greater than or equal to ρ to a lender and which a type t borrower would prefer to $i_1(t)$.

If there is an equilibrium with lending, it is characterized by solving, for each t,

$$\max_{i(t)} \pi(t)(R(t) - i(t))$$

subject to

$$i(t)\pi(t) \geq \rho$$

$$\pi(t)(R(t) - i(t)) \geq W$$

For transactions to occur, the borrower's constraint has to be satisfied to begin with,
form the Lagrangean,

$$L = \pi(t)(R(t) - i(t)) + \lambda(i(t)\pi(t) - \rho)$$

first order condition:

$$\{\lambda\}: \quad \lambda(i(t)\pi(t) - \rho) = 0; \quad \lambda \geq 0; \quad (i(t)\pi(t) - \rho) \geq 0$$

$$\{i(t)\}: -\pi(t) + \lambda\pi(t) = 0$$

$$\implies -1 + \lambda = 0$$
$$\implies \lambda = 1 \ldots (i)$$

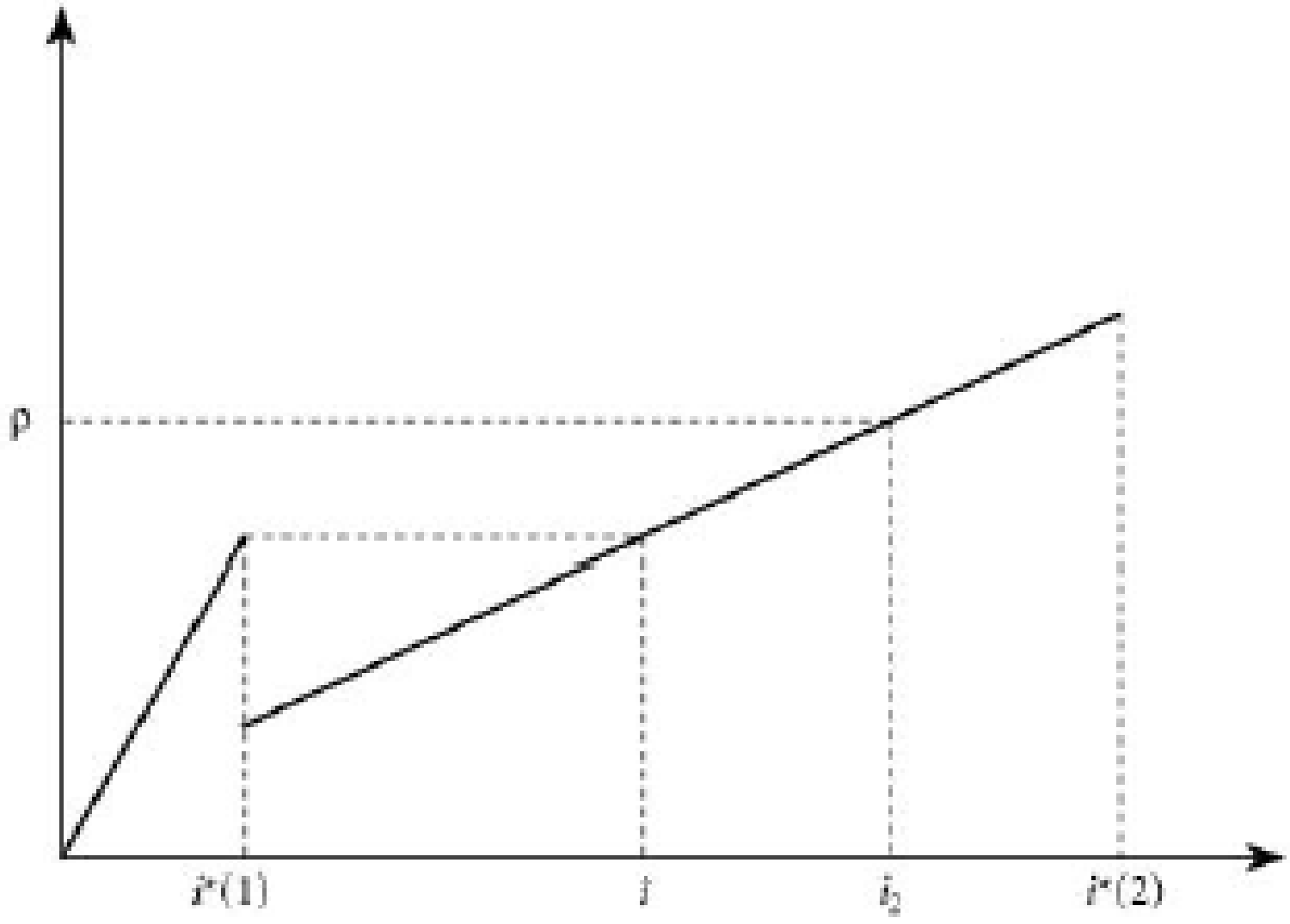
- $\lambda = 1$, therefore first constraint (lender's participation) binds,
- $i_1(t) = \rho/\pi(t) \quad \forall t \ldots$ (ii)
- Lender makes 0 expected profits.
- Borrower's utility $U(i_1(t), t) = R - \rho$
- substituting the lender's participation constraint into the borrower's, we get $R - \rho \geq W \forall t$ which is therefore the condition for lending to occur ... (iii)
- if there is lending, both types of farmers will borrow, and $i_1(1) < i_1(2)$ (from (ii), recall $\pi(1) > \pi(2)$)

(ii) Competitive Equilibrium with Adverse Selection

- Now suppose that the lenders cannnot differentiate between borrowers of different types, though they know the relative proportions of type 1 and type 2 farmers in the village.
- at any given interest rate i,
  - $U(i,1) = \pi(1)[R(1) - i] < \pi(2)[R(2) - i] = U(i,2)$,
  - but $\Pi(i,1) = \pi(1)i > \pi(2)i = \Pi(i,2)$
- i.e., safer borrowers achieve a lower expected utility from a given interest rate, but provide higher expected income to the lender. This follows from the limited liabilty nature of the credit contract, limits the loss faced by a borrower when her crop fails.
- participation constraint: $\pi(t)(R(t) - i) \geq W$; and $\partial U(i,t)/\partial i < 0$

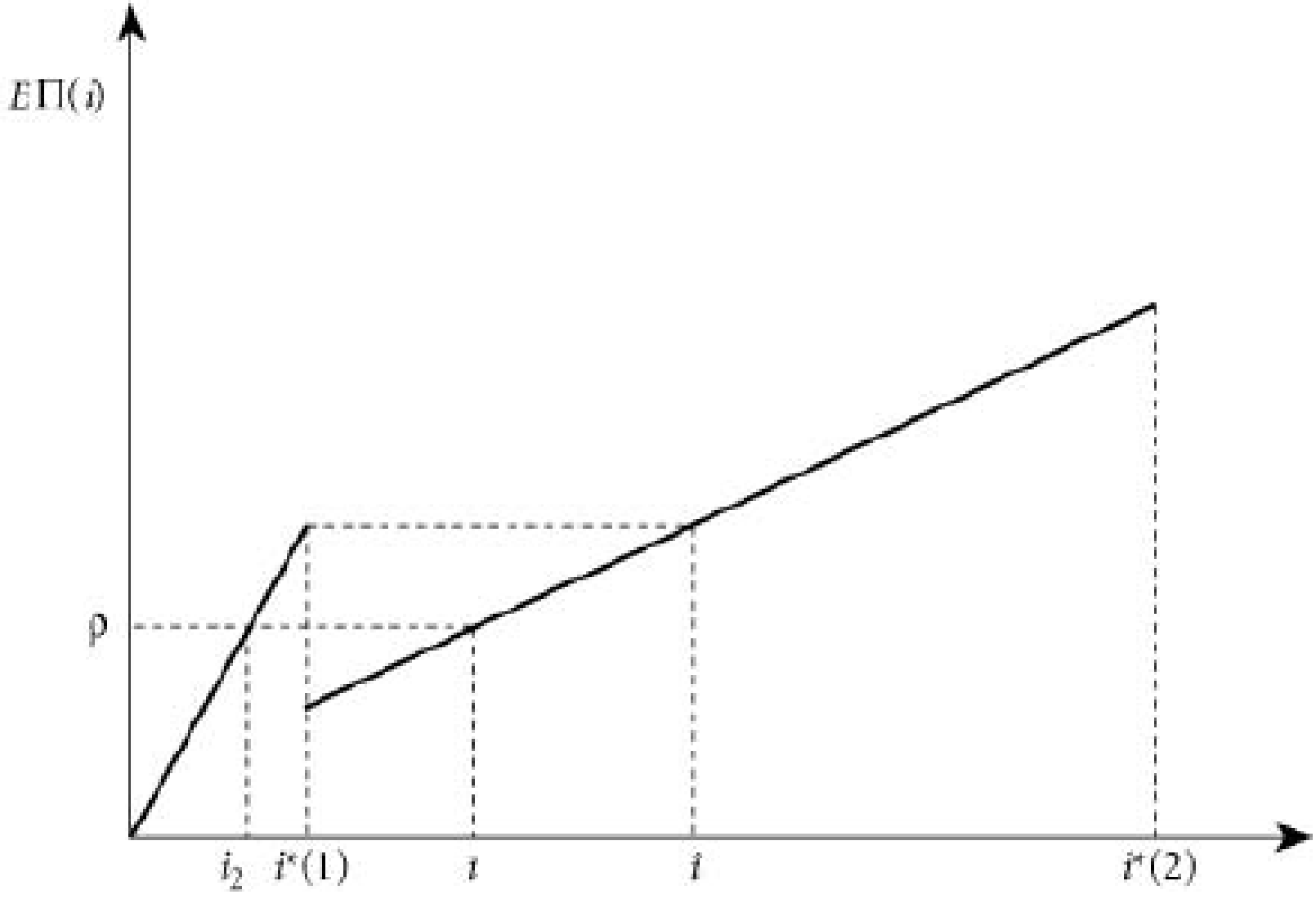
- Define $i^*(1)$ as the highest interest rate at which type 1 borrowers are willing to borrow.
- $i^*(1)$ is implicitly defined by the equation R - $\pi(1)i^*(1) = W$
- define $i^*(2)$ similarly. Also, $i^*(1) < i^*(2)$
- As interest rate increases, households with safer projects drop out of the pool of borrowers first.
- For interest rates less than $i^*(1)$, all the potential borrowers demand credit.
- If the interest rate increases past $i^*(1)$, the relatively safe type 1 borrowers stop demanding credit, type 2 borrowers continue to demand loans.
  - As safer borrowers drop out of the market, lender income falls discontinuously.

- Suppose $p(1)$ is the proportion of the population of potential borrowers who are type 1.
- Expected income from a loan at interest $i \leq i^*(1)$ is $E\Pi(i) = p(1)\pi(1)i + [1 - p(1)]\pi(2)i$
- As i increases past $i^*(1)$, type 1 borrowers drop out of the market and lender income falls.
- As the interest rate continues to increase, lender income once again increases until $i^*(2)$, at which point type 2 borrowers also stop demanding credit.


p
$i^*(1)$
i
i_2
$i^*(2)$

- For $i^*(1) < i \leq i^*(2)$, $E\Pi(i) = \pi(2)i$.
- For $i > i^*(2)$, $E\Pi(i) = 0$
- since lenders cannot distinguish between type 1 and type 2 borrowers, competitive equilibrium with adverse selection is defined as an interest rate i_2 such that

- (a) $E\Pi(i_2) \geq \rho$;
- (b) there is no interest rate i for which $E\Pi(i) \geq \rho$ and both $U(i,t) \geq U(i_2,t)$ and $U(i,t) > W$ for any type of t.
- i.e., interest rate i is an equilibrium if lenders do not lose money on average at i, and if there is no other interest rate which any type of borrower would prefer at which lenders would avoid losing money.

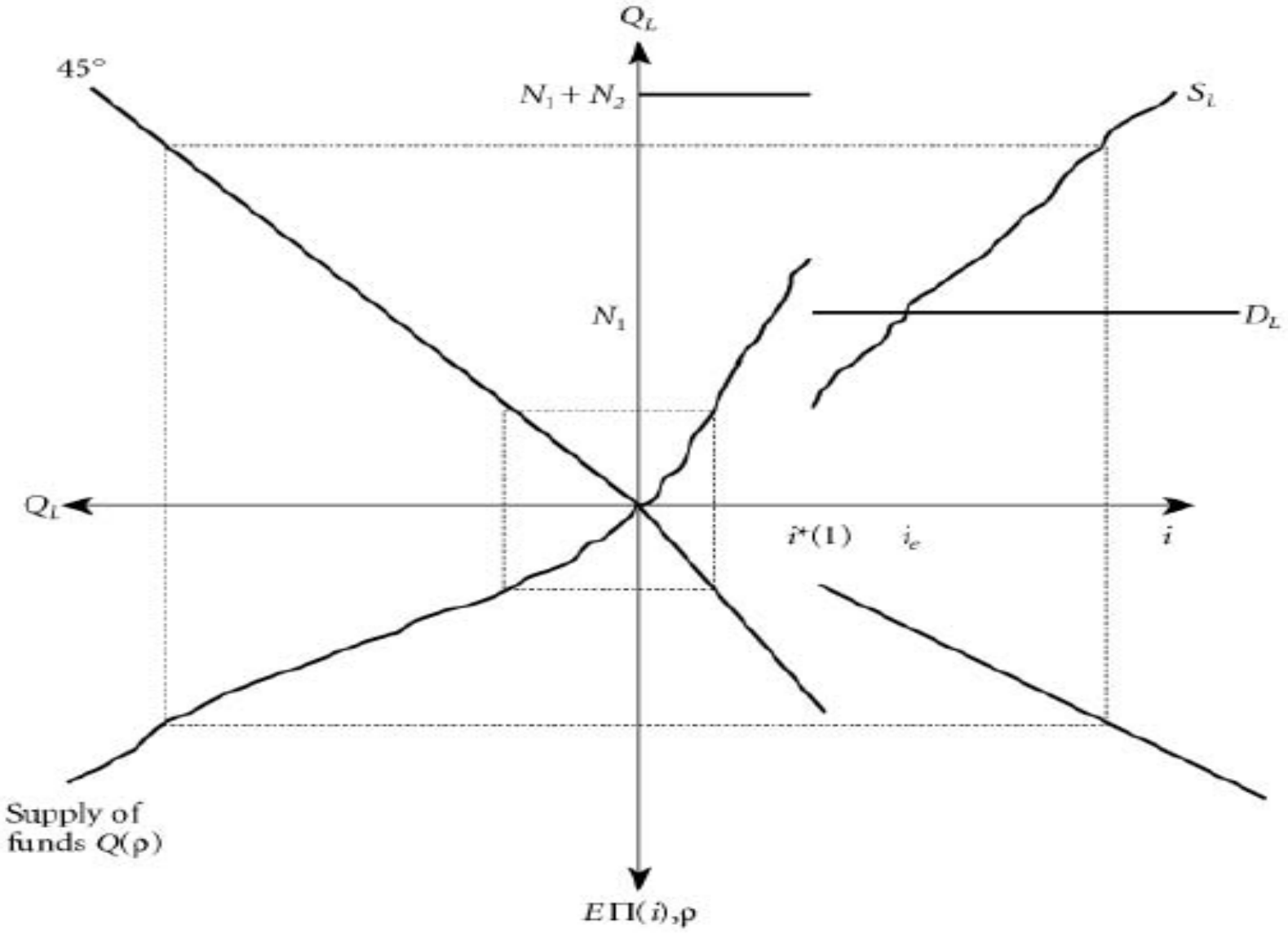

$E\Pi(i)$
ρ
i_2
$i^*(1)$
i
$\hat{i}$
$i^*(2)$

- $R - \rho > W$, (condition for lending in the case of complete information) there will be lending in the equilibrium with adverse selection.
- If $\rho > E\Pi(i^*(1)) \equiv p_1\pi(1)i^*(1) + (1 - p_1)\pi(2)i^*(1)$, equilibrium rate of interest will be $i_2 = \rho/\pi(2) > \hat{i}$, only risky type 2 borrowers will demand loans.
- If $\rho < E\Pi(i^*(1))$, then the interest rate will be $i_2 = \rho/\left\{p(1)\pi(1) + [1 - p(1)]\,\pi(2)\right\} < i^*(1)$, and all potential borrowers will demand loans.

- $\tilde{i}$ is not an equilibrium, since at that rate only risky borrowers would demand credit and lenders make zero profits. All borrowers prefer i_2 to $\tilde{i}$, lenders also avoid losing money at i_2.

Credit Rationing

- In this simple model, credit rationing does not occur since it presumes that lenders have access to an infinitely elastic supply of funds at a cost of ρ.
- Stiglitz-Weiss Result: when the relationship between the expected return to lenders and the interest rate charged is a non-monotonic function with an interior local maximum (as in the previous figures), then there exists a supply of fund schedules that lead to a competitive equilibrium with rationing.
- lower left quadrant, supply of funds to lenders as a function of the cost of those funds, ρ. (other supply schedules also possible.)
- loan supply schedule in the first quadrant derived by tracing the effect of the interest rate i on th expected return on loans, and hence the supply of funds to lenders.


Q_L
45°
$N_1 + N_2$
S_L
N_1
D_L
Q_L
$i^*(1)$
i_e
i
Supply of
funds $Q(\rho)$
$E\Pi(i),\rho$

- N_i is the number of i^{th} type of borrower. Demand for loans is:
  - $N_1 + N_2$ when $i \leq i^*(1)$
  - N_2 when $i^*(1) < i \leq i^*(2)$
  - 0 for larger i
- Competitive equilibrium:
  - Lenders charge $i^*(1)$, earn an expected return of $E\Pi(i^*(1))$.
  - Demand for loans at $i^*(1)$ exceeds the supply of loanable funds- *rationing of credit*.
  - Increase in interest rate would cause type 1 borrowers to drop out of the market, leaving lenders with a riskier portfolio of loans and reducing expected returns to lending.
  - At i_c, loan supply equals loand demand, only type 2 borrowers in the market, lenders earn a lower expected return than at $i^*(1)$, a lender charging $i^*(1)$ could attract borrowers of all types, and would earn a higher expected return.

- existence of collateral can eliminate the problem of adeverse selection, a pledge of collateral places some risk of the transaction on the borrower, and the return to the lender no longer depends on the unknown type of the borrower only. (depends crucially on the assumption of risk neutrality.)

(iii) Equilibrium with a fully informed monopolist

- Single lender, knows which villagers have access to which type of land.
- Lender's Problem:

$$\max_{i(t)} \pi(t) i(t)$$

- subject to

$$\pi(t)(R(t) - i(t)) \geq W$$

$$\pi(t) i(t) \geq \rho$$

For transactions to occur, the lender's constraint has to be satisfied to begin with, Form the Lagrangean,

$$L = \pi(t) i(t) + \lambda[\pi(t)(R(t) - i(t)) - W]$$

first order condition

$$\{\lambda\} : \lambda[\pi(t)(R(t)-i(t))-W] = 0; \quad \lambda \geq 0; \quad \pi(t)(R(t)-i(t))-W \geq 0$$

$$\{i(t)\} : \pi(t) - \lambda\pi(t) = 0$$

$$\implies 1 - \lambda = 0$$
$$\implies \lambda = 1 \ldots (iv)$$

- $\lambda = 1$, therefore borrower's participation binds,
  - $\pi(t)R(t) - \pi(t)i(t) = W$
  - R - $W = \pi(t)i(t)$
  - $i_3(t) = [R - W]/\pi(t)$
- Also, subsituting the first constraint into the second gives us $R - W \geq \rho \ldots$ (v)

Hence,

- As long a s $R - \rho \geq W$, equilbrium will involve lending to each type of borrower at interest rates $i_3(t) = (R - W)/\pi(t) = i^*(t)$
- Each type of borrower achieves an expected utility of W
- Lender earns an expected return of $R - \rho \geq W$

(iv) Competition Between an Informed Local Moneylender and Uniformed Outside Lenders

- all lenders face an opportunity cost of funds equal to ρ
- the resident moneylender will be able to use his informational advantage to collect rents even in the face of competitive pressure from uninformed lenders.
- Case 1:

- $E\Pi(i^*(1)) < \rho \leq R - W$ (as in the first figure)
- equilibrium involves lending only to type 2 borrowers, with $i_2 = \rho/\pi(2)$
- local moneylender can charge different interest rates to different types of borrowers, denote it to be $i_4(t)$
- availability of outside loans to type 2 borrowers implies that the local moneylender cannot charge more than i_2 from type 2 borrowers, so $i_4(2) = \rho/\pi(2)$

- type 1 borrowers have no access to credit from outside lenders, so the local moneylender can revert to Case 3 behavior and set $i_4(1) = (R - W)/\pi(1) = \pi^*(1)$
- local lender earns rent on his loans to typen 1 borrowers, his return from these loans is $R - W > \rho$

Case 2:

- $\rho \leq E\Pi(i^*(1))$ (as in the second figure)
- in equilibrium, competitive uninformed lenders would ser $i_2 \leq i^*(1)$, and lend to both types.
- local moneylender can lend to type 1 farmers at any interest rate less than or equal to i_2, suppose he sets $i_4 = i_2$ (or just a bit below)

- then some (or all) of the type 1 borrowers would not borrow from the outside lenders who would then be faced with a riskier pool of borrowers ar $i = i_2$, hence their expected returns from loans at i_2 would fall below ρ.
- therefore, outside lenders cannot offer i_2.
- all type 1 borrowers will borrow from the local moneylender at $i_4(1) = i_2$
- outside lenders will lend to type 2 borrowers at $\widetilde{i}$, therefore the local moneylender also sets $i_2(2) = \widetilde{i}$
- the local moneylender again earns rents on his loans to type 1:

$$\pi(1)i_4(1) = \frac{\pi(1)\rho}{p(1)\pi(1) + (1 - p(1))\pi(2)} \geq \rho$$

Conclusion

- static consequences of information asymmentries, lead to inefficient allocation of credit, monopoly profits for lenders woth relatively more information.
- implications more dramatic when credit marekt imperfections considered in a dynamic context.
  - Banerjee Newman(1993), Galor Zeira (1993), dynamics of income distribution when credit markets have asymmetric information or impefect contract enforcement.
- can have a dramatic impact on the labour market, e.g, labour supplied by individuals who can't self finance or borrow to become entrepreneurs, while those who can become entrepreneurs determine labour demand- could worsen income inequalities.