

# Development Economics (PhD) Credit

Yonas Alem

Department of Economics  
University of Gothenburg

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- \*Pranab Bardhan and Christopher Udry. Development Microeconomics. Oxford University Press, 1999, Ch. 7.
- \*Karlan, D. & J. Zinman (2009), Observing Unobservables: Identifying Information Asymmetries with a Consumer Credit Field Experiment, Econometrica, 77(6), 1993-2008.

- Access to credit helps agrarian communities to borrow and finance production and consume until harvest
- In the face of randomly fluctuating income, credit helps to smooth consumption
- When farmers are poorer, liquidity constraints are binding  $\implies$
- Seasonal credit transactions (mostly informal) are thus common
  - Moneylenders, informal loans among family members, loans tied to purchases, labour transactions or land rental arrangements, etc.
- Credit is an important input to production
- However informal financial transactions have often been exploitative and immoral,
  - Government action has been viewed necessary to raise access to credit and protect borrowers from monopolistic lenders

- However, policies such as interest rate ceilings lower the supply of credit and raise its demand  $\implies$  administrative rationing and associated rent-seeking behavior, while discouraging saving mobilization,
- This motivation was used to pursue liberalization of financial markets in developing countries over the past few years
- However, credit transaction involves risk (from both the borrower and lender side), requires knowledge of each other's activities
  - Information asymmetry, contract enforcement and government intervention play crucial role
- The standard assumptions of *smoothly functioning markets with complete information and perfect contract enforcement* on which the conventional argument for liberalization is based on would therefore not work

- This lecture:
  - Develops basic models of credit markets
  - Use these models to see the implications of asymmetric information and imperfect competition
- The key concept is “information”
  - What are the effects of adverse selection and moral hazard on credit transactions?
  - Can monopolists in a particular area extract rents using their superior information concerning local borrowers?
  - What would be the impact of competition from relatively less well-informed outside lenders?
- We derive contractual mechanisms that can mitigate the problems caused by information asymmetry

- Four alternative market situations we will focus on:
  - ① Competitive market for loans with complete information
  - ② A rural credit market in competitive equilibrium but with imperfect information
  - ③ A local monopolistic moneylender who has perfect information about the characteristics and activities of villagers
  - ④ Fragmented national market (residents of a village have the option of borrowing from one of the set of uninformed competitive non-resident lenders)
- We mainly consider a rural economy in our models
- However most of the fundamental results are applicable to:
  - Firms operating in urban areas of developing countries
  - Sovereign governments in the international credit market
  - Students borrowing to finance their education

# Credit Markets

## Basic Set-up

- Assume the following:
- All borrowers and lenders are risk-neutral
  - Thus, there is no desire for borrowing to smooth consumption
- Credit is a source of working capital for production activities that take time
- Each individual in the village has access to the same amount of land
- Cost of farming this land is normalized to 1
- Farm income,  $R = 0$  when there is a harvest failure,  $R > 1$  otherwise
- Probability of a successful farming season is  $\pi(a)$ , strictly increasing and concave
- Where  $a \in [0, 1]$  is an index of (say) the effort the farmer puts into her land

# Credit Markets

## Basic Set-up

- Let  $D(a)$  be an increasing and strictly convex dis-utility function from working
  - The marginal utility cost of effort is increasing in effort
- Farmers do not have wealth of their own (also no land market)
- If farmers want to cultivate, they must borrow capital
- If a lender offers an interest factor (which is 1 plus interest rate) of  $i \leq R$ , the returns to the farmer and the lender are as follows

	Borrower	Lender
Success	$R-i-D(a)$	$i$
Failure	$D(a)$	$0$



# Credit Markets

## Basic Set-up cont.

- Assume lenders have access to a risk-free capital market with a return of  $\rho$ , ( $R > \rho \geq 1$ )
- Borrower can choose to engage in an alternative livelihood activity which generates a return of  $W$ , ( $R > W \geq 0$ )
- The expected utility of the borrower and expected return of the lender:

$$U(i, a) = \pi(a)(R - i) - D(a) \quad (1)$$

$$\Pi(i, a) = \pi(a)i \quad (2)$$

- Two key assumptions have been made in crafting the above table
  - The loan contract has a *limited liability* (the borrower pays nothing if crops fail)
  - There are *no enforcement problems* (if harvest is successful, the borrower repays its loan)
- Of course, these two assumptions are far from the reality!
  - Harvests likely fail and borrowers often request that loans be rescheduled, or make partial payments
  - There are imperfect formal legal enforcement mechanisms in rural areas of developing countries
- Thus, most likely borrowers will not repay

- Two mechanisms have been suggested by theorists:
  - Self-enforcing contract: borrowers repay because they will not get any loan in the future if they don't repay
  - Existence of social sanctions: the community as a whole penalizes defaulters
- These mechanisms indeed play important roles in rural credit markets in developing countries

### Competitive Equilibrium With Complete Information

- Assume:
- Large number of competitive lenders
- Lenders can observe the borrowers' choice of  $a \implies$ 
  - They can write a contract specifying both  $i$  &  $a$
- Equilibrium would be a pair  $(i_1, a_1)$ :

$$U(i_1, a_1) \geq W; \quad (3)$$

$$\Pi(i_1, a_1) \geq \rho \quad (4)$$

- And there is no other pair  $(i, a)$  that yields a return greater than or equal to  $\rho$  to a lender and which a borrower would prefer to  $(i_1, a_1)$

Competitive Equilibrium With Complete Information cont.

- The equilibrium with lending would be characterized by the solution to:

$$\text{Max}_{i,a} \quad \pi(a)(R - i) - D(a) \quad (5)$$

$$\text{S.t} \quad \pi(a)i \geq \rho \quad (6)$$

$$\text{and} \quad \pi(a)(R - i) - D(a) \geq W \quad (7)$$

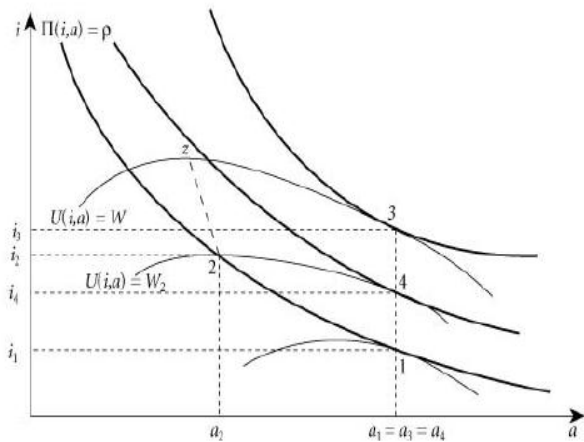
- There is no lending equilibrium if there is no  $(i, a)$  such that both constraints are satisfied
- For any fixed  $\rho$ , there is a  $W$  low enough so that both constraints may be satisfied (see Fig. 7.1)

### Competitive Equilibrium With Complete Information cont.

- Equilibrium point is denoted by point (1) with the optimal values of  $(a_1, i_1)$  pair
- The allocation of effort is efficient!
  - $\pi'(a_1)R = D'(a_1)$
  - $\pi(a_1)i_1 = \rho$
  - Borrowers achieve an expected utility
$$U(i_1, a_1) = \pi(a_1)R - D(a_1) - \rho > W$$

# Credit Markets

## Moral Hazard



### Competitive Equilibrium and Moral Hazard

- Assume now the lender cannot observe  $a$
- The borrower will choose  $a$  that maximizes her utility given the credit contract offered to her
- A lender's return from a loan still depends on the choice of  $a$  by the borrower  $\implies$  **Moral Hazard**
- As before, an equilibrium pair  $(i_2, a_2)$  must satisfy:

$$U(i_2, a_2) \geq W; \quad (8)$$

$$\Pi(i_2, a_2) \geq \rho \quad (9)$$

- And there is no other pair  $(i, a)$  that yields a return greater than or equal to  $\rho$  to a lender and which a borrower would prefer to  $(i_2, a_2)$



### Competitive Equilibrium and Moral Hazard cont.

- The equilibrium loan contract will be characterized by the solution to:

$$\text{Max}_{i,a} \quad \pi(a)(R - i) - D(a) \quad (10)$$

$$\text{S.t} \quad \pi(a)i \geq \rho \quad (11)$$

$$\text{and} \quad \pi(a)(R - i) - D(a) \geq W \quad (12)$$

and

$$\pi(a)(R - i) - D(a) \geq \pi(a')(R - i) - D(a') \forall a' \in [0, 1] \quad (13)$$

- Compare this maximization problem with the case of perfect information!

### Competitive Equilibrium and Moral Hazard cont.

- Inclusion of the Moral Hazard therefore may result in no equilibrium loan!
- The borrowers utility function is differentiable and strictly concave  $\forall i \leq R$ , thus:
  - The condition  $\pi'(a)(R - i) - D'(a) = 0$  is necessary and sufficient for the third set of constraints in the maximization problem above
- If a solution  $(i_2, a_2)$  exists, then it satisfies:

$$D'(a_2) = \pi'(a_2)(R - i_2) < \pi'(a_2)R \implies a_2 < a_1 \quad (14)$$

- Obviously, in the case of moral hazard, the effort by farmers would be less than in the case of complete information

### Competitive Equilibrium and Moral Hazard cont.

- Hence,  $i_2 > i_1$
- The equilibrium is point (2) in figure 7.1
- The dashed line from  $z$  to  $a_2$  is the set of contracts that satisfy all three constraints

### Competitive Equilibrium and Moral Hazard - Collateral

- How can one address the problem of moral hazard in credit markets?
- Assume the borrower owns some asset with value greater than  $R$
- If the project fails, the borrower transfers the collateral pledged for the loan ( $C$ ) to the lender
- The equilibrium is now described by the solution to:

$$\text{Max}_{i,a,C} \quad \pi(a)(R - i) - (1 - \pi(a))C - D(a) \quad (15)$$

$$\text{S.t.} \quad \pi(a)i + (1 - \pi(a))C \geq \rho \quad (16)$$

$$\pi(a)(R - i) - (1 - \pi(a))C - D(a) \geq W \quad (17)$$

### Competitive Equilibrium and Moral Hazard - Collateral

- and

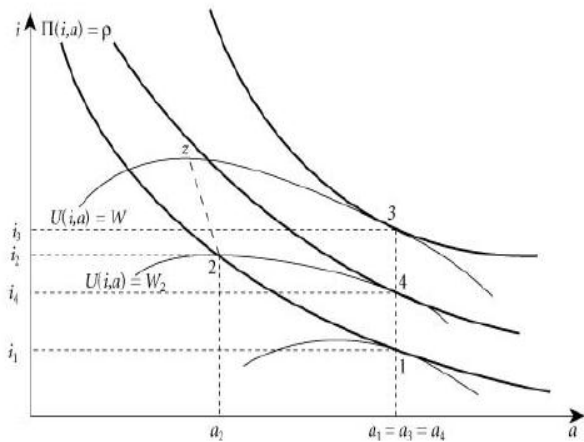
$$\pi(a)(R - i) - (1 - \pi(a))C - D(a) \geq \pi(a')(R - i) - (1 - \pi(a'))C - D(a') \forall a' \in [0, 1] \quad (18)$$

- In equilibrium:

- $C^* = i^* = \rho$  and  $a^* = a_1$
- The borrower absorbs the entire risk of the transaction
- The return to the lender no longer depends on the choice of  $a$  by the borrower
- The loan is now riskless to the lender so interest rate is lowered from equilibrium (2) to the riskless rate
- Borrowers are induced to put the optimal level of effort into the project
- Lenders make zero economic profit and borrowers achieve the same utility as they achieve in the complete-information equilibrium

# Credit Markets

## Moral Hazard



### Competitive Equilibrium and Moral Hazard - Collateral cont.

- Note that the above result hinges on the assumption of *risk-neutrality* by both parties
- If for e.g., the borrower was risk averse, the use of collateral could not entirely alleviate the difficulties induced by moral hazard.
- Jewellery, land (in areas with more developed land markets), livestock, crops, farm equipments or other hh assets are commonly used as collateral
- But note that some of these collateral by themselves might be subject to moral hazard
  - A farmer may treat a tractor pledged as collateral with less care than otherwise
- If there is unobserved (to the lender) difference in quality of these assets, adverse selection may arise

### Competitive Equilibrium and Moral Hazard - Collateral cont.

- A form of collateral substitute which grew over the past two decades is *joint liability*
- E.g., the experience of the Grameen Bank in Bangladesh
- Group members may be able to impose penalties on each other which are otherwise difficult for the lender
  - Thus, group loans will be less likely to be defaulted than individual loans



### Equilibrium With Fully Informed Monopolist

- Suppose in the village there is a single person rich enough to act like a moneylender
- The money lender can observe the activities of anyone who borrows from him
- He has the option of depositing his wealth at a risk-free rate of  $\rho$
- The moneylender will set  $(i, a)$  to solve:

$$\text{Max}_{a,i} \quad i\pi(a) \quad (19)$$

$$\text{S.t} \quad \pi(a)(R - i) - D(a) \geq W \quad (20)$$

$$\text{and} \quad i\pi(a) \geq \rho \quad (21)$$

### Equilibrium With Fully Informed Monopolist cont.

- You can see that the constraint set is identical to that of the case of perfect competition with complete information
  - As in the case of competitive credit market with complete information, this equilibrium is pareto-efficient
- Effort is set so that:

$$\pi'(a_3)R = D'(a_3) \implies (a_3 = a_1) \quad (22)$$

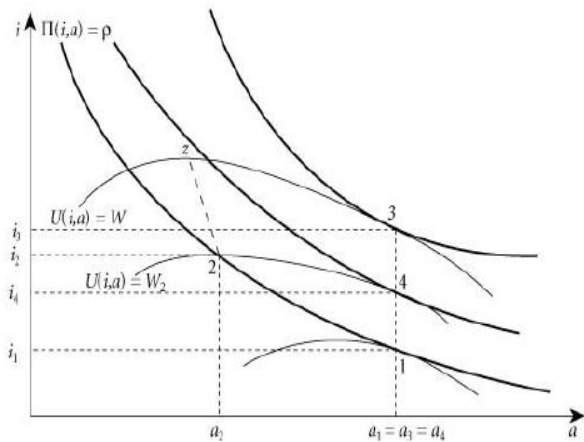
- Interest rate is set so that the borrower achieves his reservation utility:

$$\pi'(a_3)(R - i_3) - D(a_3) = W \quad (23)$$

- The only difference is that the farmers are now pushed down to their reservation utility

# Credit Markets

## Moral Hazard



### Informed Local Moneylender and Uninformed Outside Lenders

- Assume a competitive credit market from lenders not resident in the village
  - Could be private urban lenders, moneylenders from other villages, or formal sector (bank or government) lenders
- These lenders face the same opportunity cost of funds  $\rho$ , and prohibitive costs of monitoring the actions of borrowings in the village
- There is a resident lender facing the same  $\rho$  but can monitor the actions of borrowers costlessly
- The local moneylender can extract rents using its informational advantage

### Informed Local Moneylender and Uninformed Outside Lenders

- Availability of the outside lenders rises  $W$  to  $W_2$
- The local moneylender now implements the contract outlined in the previous section replacing  $W$  by  $W_2$
- He will be able to make positive profits  
( $i_4\pi(a_4) > i_1\pi(a_1) = i_2\Pi(a_2) = 0$ )

- **Adverse Selection:** another key problem of information asymmetry in credit markets of developing countries
- Enormous heterogeneity among farmers (borrowers)
- Lenders may have good information about the average characteristics of the pool of potential borrowers
  - But not complete information about the characteristics of any particular borrower
- This will lead to the problem of *adverse selection*

- Suppose that farming requires no effort, but that there are two types of potential borrowers indexed by  $t \in \{1, 2\}$
- Type 2 borrowers have access to land that is riskier but potentially more lucrative than that used by type 1 borrowers, i.e.,
  - $\pi(1) > \pi(2)$ , but  $R(1) < R(2)$
- We assume that the expected return to farming each type of land is identical
  - $(\pi(t)R(t) = \bar{R} \forall t)$
- $W$  is the same for both types:  $W(t) = W \forall t$
- The model is identical to the previous case
- Expected utility of  $i$  is  $U(i, t) = \pi(t)[R(t) - i]$  and expected return from a loan at rate  $i$  to a type  $t$  borrower is  $\Pi(i, t) = \pi(t)i$

### Competitive Equilibrium With Complete Information

- Lenders can offer different interest rates for different borrowers ( $i_s$ )
- An equilibrium with lending to borrower type  $t$  will be an interest rate ( $i_1(t)$ ) such that:
  - 1  $U(i_1(t), t) \geq W$ ;
  - 2  $\Pi(i_1(t), t) \geq \rho$ ;
  - 3 There is no  $i(t)$  that yields a return  $\geq \rho$  to a lender and which a type  $t$  borrower would prefer to  $i_1(t)$ .
- Solving the following for each  $t$  would give the equilibrium

$$\text{Max}_{i(t)} \quad \pi(t)(R(t) - i(t)) \quad (24)$$

$$\text{S.t.} \quad i(t)\pi(t) \geq \rho \quad (25)$$



### Competitive Equilibrium With Complete Information

$$\text{and } \pi(t)R(t) - i(t) \geq W. \quad (26)$$

- There would be lending equilibrium to both types if  $\bar{R} - \rho > W$ , otherwise neither type will receive loans
- If there is lending:  $i_1(t) = \rho / \pi(t) \forall t$ , and the lender makes zero expected profits
- $U(i_1(t), t) = \bar{R} - \rho \forall t$
- Both types will borrow and  $i_1(1) < i_1(2)$

### Competitive Equilibrium With Adverse Selection

- Competitive lenders cannot differentiate borrowers of different types
- In this case, at any given interest rate:

$$U(i,1) = \pi(1)[R(1) - i] < \pi(2)[R(2) - i] = U(i,2),$$

$$\text{but } \Pi(i,1) = \pi(1)i > \pi(2)i = \Pi(i,2). \implies \quad (27)$$

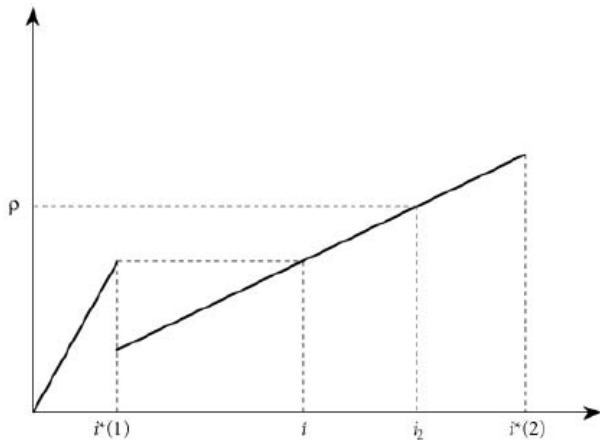
- Safer borrowers achieve a lower expected utility from a given interest rate but provide higher expected income to the lender
  - This follows from the limited liability nature of the credit contract
- Recall the participation constraint:  $\pi(t)(R(t) - i) \geq W$  and we know that,  $\partial U(i,t)/\partial i < 0$

### Competitive Equilibrium With Adverse Selection Cont.

- Define  $i^*(1)$  as the highest interest rate at which type 1 borrowers are willing to borrow
- So,  $i^*(1)$  is implicitly defined by the equation
$$\bar{R} - \pi(1)i^*(1) = W$$
- $i^*(2)$  can be defined in a similar fashion
- $i^*(1) < i^*(2) \implies$  as the interest rate increases, borrowers with safer projects drop out of the pool of borrowers first
  - Income of the lender then falls discontinuously
- See fig. 7 for the relationship between the interest rate charged by lenders and the expected income from lending
- Thus, adverse selection leads to credit rationing
- A collateral could eliminate the problem of adverse selection

# Credit Markets

## Moral Hazard



- Adverse Selection: to read
  - Equilibrium with a Fully Informed Monopolist
  - Competition b/n an Informed Local Moneylender and Uninformed Outside Lenders

### Implications

- Documented consequences of information asymmetries
  - Inefficient allocation of credit
  - Excessive loan default
  - Monopoly profits in the hands of lenders with relatively good information
  - Even collapse of the credit market
- Collateral can mitigate some of these consequences
  - Asset rich borrowers can have better access to credit and become richer
- Those who can't access credit will work for the rich  $\implies$
- Wage goes down and the poor remains poor
- Credit market imperfections have huge general equilibrium effect on the labor market