Development Economics III

Lecture 1

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(IIES)

28th of March 2012

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The Lectures
Overview

1. Lecture: Micro-Credit - Theory
   - Micro-Credit: Introduction
   - Models of joint liability: Can it alleviate credit constraints?
2. Lecture: Micro-Credit - Empirics
   - Are the poor credit-constraint?
   - Which theories are empirically important in explaining credit-constraints?
   - What are the effects of expanding access to micro-credit?
   - Why do micro-credit contracts have the effects they have? Are the theories from lecture 1 powerful in explaining its effects?
3. Lecture: Property Rights - Theory & Empirics

- Ideally I'd like to provide an introduction to the economic literature on micro-finance, from the early works to the latest working papers. Effectively it will be an introduction to a sub-theme (but an important one) of this literature.

- Equally importantly, it would be great if you learned something methodologically. To this end I will
  - give an introduction to some key models, discuss the modeling techniques, think about the models' limitations.
  - discuss a wide range of empirical approaches.
  - give special emphasis to discussing how to combine the two!

One appeal: The notes almost certainly contain errors. Please let me know!

Disclaimer: Obviously most ideas in these lectures are not mine, and mostly without proper citation.

One thing: I hope I'll talk at most half the time. *Interrupt me at your convenience!*

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I'll forward the slides for lectures 2 and 3.

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What is micro-finance?

Many things, but a typical 'first generation' contract has the following components:

- Female borrowers.
- Borrowers form lending groups.
- Borrowers jointly liable for the repayment of group loan.
- Non-agricultural enterprise borrowing.
- In case the group fails to repay a loan, their are ineligible for future loans (dynamic incentives).
- Regular group meetings with the loan officer.
- Regular repayment schedules.

We focus on the effect of **joint liability** and **self-selection**!

Why might we need micro-credit loans?

In a **perfect** (efficient) credit market, borrowers would borrow up the where the marginal expected return equals the interest rate, and the interest rate equals the cost of funds of the lender.

Both things do not seem to be true in reality:

- The informal market interest rates are 40%-200%, or more. Banerjee reports: Chennai fruit vendors pay up to 5% *a day*!
- Aleem found in Pakistan that the average interest rate was 78.5% annually, and the average cost of capital was 32.5%.
- Most of the poor do not have access to any form of formal credit (excluding microcredit). The rich have larger loans, and pay lower rates.

The hope was (and is) that micro-lending might help to provide the poor with credit at lower rates, and do so profitably.

Indeed micro-finance institutions (MFI) have been lending to the poor, and often done so profitably. Their repayment rates have been very high.

Micro-lenders have expanded rapidly ($\rightarrow$ next slide) since the first scheme in the late 1970's (Grameen Bank).

In recent years the micro-finance industry has been changing: About 1/2 of micro-finance institutions are individual liability lenders, and about 1/4 are for-profits or cooperatives.

Table 1.1
Growth of microfinance coverage as reported to the Microcredit Summit Campaign, 1997–2007

End of year	Total number of institutions	Total number of clients reached (millions)	Number of "poorest" clients reported (millions)
1997	655	16.5	9.0
1998	705	18.7	10.7
1999	964	21.8	13.0
2000	1,477	38.2	21.6
2001	2,033	57.3	29.5
2002	2,334	67.8	41.6
2003	2,577	81.3	55.0
2004	2,814	99.7	72.7
2005	3,056	135.2	96.2
2006	3,244	138.7	96.2
2007	3,352	154.8	106.6

Source: Daley-Harris 2009.

However, our understanding of why credit markets fail in the first place, why micro-credit contracts helps to lend where other contract forms do not, and what are the effects of micro-credit on the poor is still limited/incomplete.

This course tries to sketch out these debates,
and what we know, if we know something.

Further General Reading:

- David Roodman. 2012. *"Due Diligence: An Impertinent Inquiry into Microfinance"*.
- Beatriz Armendriz and Jonathan Morduch. 2010. *"The Economics of Microfinance"*.

Interplay of empirics and theory in the literature:

- Abhijit Banerjee and Esther Duflo. 2010. *"Giving Credit Where it is Due"*.

Ok, so why might credit markets not function in the first place?

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There are two seminal papers, which describe how *asymmetric information* about the borrower's *types'* can lead to credit market inefficiencies:

Stiglitz and Weiss (1981) show that projects which would generate a social surplus might not obtain a credit.

De Meza and Webb (1987) show that projects which do not generate a social surplus might obtain funding.

First, let us understand these arguments in a simple model.

The borrower:

- Agents are endowed with 1 unit of labour, and an **uncertain** investment project.
- Agents can either sell their labour, and earn an outside option $\bar{u}$, or start the investment project, for which they require 1 unit of capital. They are risk-neutral.
- Projects have outcome x, which is 'success' or 'failure'.
- The return of the projects is uncertain, characterized by random variable y_i, which takes value R_i, when the outcome is 'success', which happens with probability p_i, and 0 otherwise.
- Agents have no wealth! (No collateral.)

The lender:

- The lender has cost of funds ρ and is risk-neutral.

First-Best: It would be socially optimal that any borrower i undertakes his project if and only if

$$p_i Y_i \geq \overline{u} + \rho.$$

1. Why?

[1] We will focus on debt contracts throughout, so contracts which are conditional on outcomes, but not on returns. This can be rationalized with a costly state-verification argument à la Townsend (1979).

Adverse Selection Problem
First-Best contracts

First-Best: It would be socially optimal that any borrower i undertakes his project if and only if

$$p_i Y_i \geq \overline{u} + \rho.$$

1. Why?
2. This would be achieved by offering a debt contract[1] in which the borrower pays interest $r_i = \rho / p_i$ in case of success. He would then take the loan if and only if it is socially optimal to do so and the bank would make zero-profit. (Show it.)

$\rightarrow$ Problem: p_i might not be observable by the borrower!

[1] We will focus on debt contracts throughout, so contracts which are conditional on outcomes, but not on returns. This can be rationalized with a costly state-verification argument à la Townsend (1979).

Adverse Selection Problem

Types of borrowers

Assume that p_i is **not observable** to the lender. This implies that the lender must make the same offer (which might be a menu of contracts) to all clients.

For simplicity assume two types of borrowers, $i \in \{r, s\}$: 'risky' ones (with share $1-\theta$) and 'safe' ones (with share θ), where

$$0 < p_r < p_s < 1.$$

There are (at least) two ways to think about 'riskiness', which both lead to inefficiencies, but very different ones.

Adverse Selection Problem

Notion of 'riskiness'

A. Stiglitz and Weiss, 1981

Assume $p_s Y_s = p_r Y_r = \overline{Y}$:
all projects yield the same expected return.

Assume that $\overline{Y} > \rho + \overline{u}$:
all projects are socially desirable.

(Safe projects are second-order-stochastically-dominanting risky projects.)

B. De Meza and Webb, 1987

Assume $Y_s = Y_r = Y$:
all projects yield the same when successful, risky projects are just less likely to succeed.

Assume $p_s Y > \rho + \overline{u} > p_r Y$:
only safe projects are socially desirable.

(Safe projects are first-order-stochastically-dominanting risky projects.)

A. Stiglitz and Weiss, 1981

Given that the lender needs to offer the same interest rate to all borrowers, is it still necessarily true that all borrowers do obtain a loan (as should be in the Stiglitz and Weiss set-up)?

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Given that the lender needs to offer the same interest rate to all borrowers, is it still necessarily true that all borrowers do obtain a loan (as should be in the Stiglitz and Weiss set-up)?

Suppose it was true that both types borrow at some common interest rate r. Then r needs to satisfy

$$[\theta p_s + (1-\theta)p_r]r \geq \rho \tag{1}$$

for the lender to make non-negative profits.

Adverse Selection Problem 1

Stiglitz and Weiss, 1981

The borrower borrows at any interest rate iff

$$p_i(Y_i - r) > \overline{u}.$$

Suppose that r was the lowest possible, satisfying (1) with equality. Even then it is possible that

$$p_s[Y_s - \rho/(\theta p_s + (1-\theta)p_r)] < \overline{u}$$

$$p_r[Y_r - \rho/(\theta p_s + (1-\theta)p_r)] > \overline{u},$$

so the **safe borrowers do not realize their project!**

Do you see the math? (Remember: $\overline{Y} - \rho > \overline{u}$ holds for both.)

Adverse Selection Problem 1
Stiglitz and Weiss, 1981

Intuition: The presence of risky borrowers drives the break-even interest rate of the bank up. It might be so high, that safe borrowers do not make a profit even when successful. Only the risky ones, who in this case have a very high return, would make a profit in case of success at this interest rate.

Consequence

The only equilibrium is in this case that only the risky types borrow, at interest rate $r = \rho/p_r$. **Some socially desirable projects might not take place!** We observe high interest, low repayment rates.

[Obviously: The parameter value might as well be such that both types borrow at $r = \rho/(\theta p_s + (1-\theta)p_r)$.]

B. De Meza and Webb (1987)

Again the bank would offer a common interest rate, which needs to satisfy (1). With competition in the credit market, it satisfies it with equality.

Is it still true that only the safe investors would obtain a credit, as is socially optimal?

Adverse Selection Problem 2

De Meza and Webb, 1987

Suppose it was true. Then the equilibrium interest rate is $r = \rho/p_s$. For this to be an equilibrium, it needs to be true that the risky types would not want to borrow this interest rate. They will not borrow iff

$$p_r(Y - r) = p_r(Y - \frac{\rho}{p_s}) = p_r Y - \rho \frac{p_r}{p_s} > \overline{u}.$$

This might be true, despite the assumption that $p_r Y - \rho < \overline{u}$.

Adverse Selection Problem 2

De Meza and Webb, 1987

Intuition: At low interest rates, the risky investors do not pay for the expected cost of their project (which often fails), and hence might undertake it.

Consequence

Then the only equilibrium is that all projects are financed at interest rate $r = \rho/(\theta p_s + (1-\theta)p_r)$. **Some socially undesirable projects are undertaken.**

Key assumptions for both results:

Limited Liability: Individuals cannot be held responsible for losses. In particular, we assumed that they had no (limited) wealth, or that their wealth can not be pledged as collateral. Otherwise...

Key assumptions for both results:

Limited Liability: Individuals cannot be held responsible for losses. In particular, we assumed that they had no (limited) wealth, or that their wealth can not be pledged as collateral. Otherwise... agents, and in particular risky types, could be made pay the cost of failure. Then the interest rate could be ρ both in case of success and failure, and the agents participation constraint would be the same as the social optimum condition.

Key assumptions for both results:

Limited Liability: [...]

Asymmetric Information: Contracts can not be conditioned on the type, so in particular risky types can not be forced to pay more in case of success (or failure, but that is ruled out by limited liability anyway). Otherwise...

Key assumptions for both results:

Limited Liability: [...]

Asymmetric Information: Contracts can not be conditioned on the type, so in particular risky types can not be forced to pay more in case of success (or failure, but that is ruled out by limited liability anyway). Otherwise... effectively different interest rates could be charged, making borrowing attractive for safe types in (A) and unattractive for risky types in (B).

Joint Liability Lending and the Peer Selection Effect

Ghatak (2000)

Ghatak (2000) shows, that with **joint liability contracts** and **endogenous group formation** the latter can be achieved:

Risky types can be made to pay more in case of success, reducing the expected effective interest rate for save types.

[“Lenders can use degree of joint liability to screen borrowers with different (unobservable) probability of repayment.”]

Joint Liability Lending and the Peer Selection Effect

Ghatak (2000)

Assume (a) that borrowers can observe each others' types,

(b) form groups of two,

(c) in case of own success and other member's failure need to pay additionally c, and

(d) the timing is: first (a menu of) contracts are announced, then groups are formed which choose a contract, then projects, returns and payments are realized.

Focus on the *underinvestment problem*.

Joint Liability Lending and the Peer Selection Effect
Ghatak (2000)

Plan: We show that there is a menu of contracts (r_s, c_s) and (r_r, c_r) such that risky types match with risky types, and safe with safe (**Positive Assortative Matching**) and these contracts satisfy:

1. Risky (safe) groups prefer the contracts designated to them. (Incentive Compatibility)
2. Borrowers want to take a loan. (PC of Borrower)
3. The amount $r + c$ can be paid by borrowers when successful. (Limited Liability)
4. Lenders make zero-profit. (PC of Lender)

$\rightarrow$ Hence there is a menu of contracts which is feasible, and leads to all borrowers taking a loan, which is socially optimal.

The argument proceeds in 5 steps.

Step 1 (Proposition 1): *Joint Liability contracts lead to positive assortative matching in the formation of groups.*

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The expected payoff of i with partner j is

$$U_{ij}(r, c) := p_i Y_i - [p_i r + p_i(1 - p_j)c].$$

The net gain for risky borrower of being with safe partner is $U_{rs}(r, c) - U_{rr}(r, c)$, the net expected loss of a safe borrower from being with a risky partner is $U_{ss}(r, c) - U_{sr}(r, c)$. If $c > 0$, the latter is larger than the former. Therefore...? Role of side-payments? (Becker, 1993)

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Intuition? Both gain the same from having a safe partner when succeeding, but...

The previous result shows that if there is *one* contract for all, there will be assortative matching. Now let us show

Step 2 (Lemma 1): *If* (r_r, c_r) *and* (r_s, c_s) *satisfy the incentive compatibility constraints then they will induce assortative matching in the group formation stage.*

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The incentive compatibility constraints are:

$$U_{rr}(r_r, c_r) \geq U_{rr}(r_s, c_s)$$

$$U_{ss}(r_s, c_s) \geq U_{ss}(r_r, c_r).$$

Proof: Suppose not. Then a risky type must prefer having a safe partner and borrowing under[2] (r_s, c_s) rather than having risky partner and borrowing under (r_r, c_r) even after compensating the safe borrower for having a risky partner, i.e.

$$U_{rs}(r_s, c_s) + U_{sr}(r_s, c_s) > U_{rr}(r_r, c_r) + U_{ss}(r_s, c_s).$$

[2] I believe the proof in the paper is incomplete. It should go: "and borrowing under either (r_s, c_s) or (r_r, c_r)..." and check both possibilities. Both times a contradiction is derived.

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$$U_{rs}(r_s, c_s) + U_{sr}(r_s, c_s) > U_{rr}(r_r, c_r) + U_{ss}(r_s, c_s).$$

We know from Proposition 1, if the lender had offered (r_s, c_s) only, there would have been assortative matching since

$$U_{rr}(r_s, c_s) + U_{ss}(r_s, c_s) > U_{rs}(r_s, c_s) + U_{sr}(r_s, c_s).$$

These inequalities can only be satisfied if $U_{rr}(r_s, c_s) > U_{rr}(r_r, c_r)$, which violates incentive compatibility.

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Step 3: Since in the end the two contracts attract different borrowers, both must individually satisfy the zero-profit condition (otherwise the lender would not want to offer one of them). We construct a contract $(\hat{r}, \hat{c})$ such that both of these are satisfied simultaneously.

Step 4 (Lemma 2): Then we show, deviating from $(\hat{r}, \hat{c})$, which contracts satisfy incentive compatibility (and by Lemma 1 assortative matching applies).

Step 5 (Proposition 2): Lastly we show that there are such contracts and that all other constraints can be satisfied, too.

Step 3: For the two contracts (r_s, c_s) and (r_r, c_r) the non-negative-profit constraints are:

$$r_r p_r + c_r(1 - p_r)p_r \geq \rho$$

$$r_s p_s + c_s(1 - p_s)p_s \geq \rho.$$

We consider the case where they hold with equality. (This makes getting save borrowers credit not unnecessarily hard.)

The contract which solves both with equality is:

$$\hat{r} = \rho(p_r + p_s - 1)/(p_r p_s)$$

$$\hat{c} = \rho/(p_r p_s).$$

Step 4 (Lemma 2): *For any joint liability contract* (r, c)

if $r < \hat{r}$ *and* $c > \hat{c}$ *then* $U_{ss}(r, c) > U_{rr}(r, c)$, *and*

if $r > \hat{r}$ *and* $c < \hat{c}$ *then* $U_{ss}(r, c) < U_{rr}(r, c)$.

Intuition?

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Intuition?

Proof: $U_{ss}(r, c) - U_{rr}(r, c) = (p_s - p_r)[r - c(p_r + p_s - 1)]$.
This is positive if $r/c > (p_r + p_s - 1)$ and negative if $r/c < (p_r + p_s - 1)$. Note that $\hat{r}/\hat{c} = (p_r + p_s - 1)$.

Step 5 ($\approx$ Proposition 2): "Consider a pair of joint liability contracts (r_r, c_r) and (r_s, c_s) which lie on the zero-profit equations of the bank for the risky and safe borrowers, respectively. Suppose in addition, $r_s < \hat{r}$, $c_s > \hat{c}$ and $r_r > \hat{r}$, $c_r < \hat{c}$."

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$\rightarrow$ By assumption these contracts satisfy the zero-profit conditions (Tick).

$\rightarrow$ By step 4 the contracts are incentive compatible (Tick), and hence by step 2 they induce assortative matching at the group formation stage (Tick).

$\rightarrow$ Since both contracts satisfy the respective zero-profit equation, the expected payoff to each type of borrower is $(\overline{Y} - \rho)$, and $\overline{Y} - \rho > \overline{u}$ by the Stiglitz-Weiss assumption. So both types of borrowers participate (Tick).

→ What we are left to show is that the contracts satisfy the limited liability constraint. In fact this is not necessarily true for all thinkable contracts. We need to ensure that $r_s + c_s \leq Y_s$ $r_r + c_r \leq Y_r$. Note that (r_s, c_s) and (r_r, c_r) can each be chosen very close to $(\hat{r}, \hat{c})$. Further $\hat{r} + \hat{c} \leq Y_s$ (and hence $< Y_r$) is satisfied iff $\rho(p_r + p_s)/(p_r p_s) \leq Y_s$ which is satisfied if

$$\rho(1 + \frac{p_s}{p_r}) < \overline{Y}.$$

This is guaranteed by assumption 4 in the paper (Tick).

Joint Liability Lending and the Peer Selection Effect

Ghatak (2000)

Result

With joint liability contracts it is possible to device screening contracts, such that positive assortative matching of types happens, and both groups obtain a loan.

Note:

- The above result only holds under assumption 4. Otherwise joint liability does not help.
- The above result crucially depends on groups self-selecting!
- When the zero-profit constraints hold with equality, the risky type pays (in expectation) ρ/p_r when successful, and the safe type pays ρ/p_s. That is just what they would pay in the first-best! So JL contracts effectively achieve that riskier types pay a higher interest rate.

Further results of Ghatak (2000):

- With JL a pooling contract exists (so all types borrow, too) under even more general conditions (a relaxed version of assumption 4). But the main effect is the same, namely that risky types effectively pay more in case of success, despite the nominal terms being the same.
  (It vanished with competitive markets.)
- JL can as well help to solve the over-investment problem in De Meza and Webb: [...]

Further results of Ghatak (2000):

- With JL a pooling contract exists [...]
- JL can as well help to solve the over-investment problem in De Meza and Webb: Since $\rho > p_r Y - \overline{u}$ (by assumption), any contract (r, c) that lies on the zero-profit line when lending to risky borrowers (where $rp_r + cp_r(1 - p_r) = \rho$) does not satisfy the participation constraint of risky borrowers. Therefore, as long as $(\hat{r}, \hat{c})$ satisfies the limited liability, it does the job: "Saddled with risky partner and high expected joint liability payments, risky borrows decide not to borrow. This raises the repayment rate and aggregate social surplus, but not necessarily welfare, as risky borrowers are worse off."

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Effect of Joint Liability 2: Ex-Ante Moral Hazard

Sitglitz (1990)

Again, let us first recap how moral hazard can cause credit market failure, and then understand how joint liability might help.

We consider the model of Stiglitz (1990), which highlights the effect of **moral hazard in project choice** (as opposed to effort choice).

Set-Up:

- Individuals can, after obtaining the credit, choose one of two projects: a **safe project**, and a **risky project**. They are successful with probability $p_S > p_R$, respectively.
- A credit contract is characterized by the loan size L and the interest rate r.
- In case of success the projects yield $Y_i(L)$.

$\rightarrow$ Note that we introduced the loan amount, so potentially we can derive implications on the size of loans (which in the previous model we did not).

Set-Up (cont.):

- Assume that $p_S Y_S(L) > p_R Y_R(L)$ and $Y_S(L) < Y_R(L)\ \forall L$.
  - $\rightarrow$ So the safe project is always socially preferable, but not necessarily privately. Do you see the latter?

- Individuals have a concave instantaneous utility function U, and greater scale projects require greater effort. The utility cost of effort $v(e)$ is convex. Expected utility from project i is:

$$V_i(L, r) = U(Y_i(L) - rL)p_i - v(e(L)), \;\; i \in \{S, R\}.$$

If the borrowers were always choosing the save project, i.e. the socially preferable one, the bank could provide the efficient amount of capital. The "if" is not true.

Hence: **When does the borrower choose which project?**

Borrowers are indifferent when $V_S(L, r) = V_R(L, r)$. This defines a *switch line* in the (L, r) space.

Under some assumptions we can characterize the slope of the *switch line* in the (L, r) space:

- Take the total differential: $\frac{dr}{dL} = -\frac{\frac{\partial V_R}{\partial L} - \frac{\partial V_S}{\partial L}}{-L(p_R U_R' - p_S U_S')}$.

Under some assumptions we can characterize the slope of the *switch line* in the (L, r) space:

- Take the total differential: $\frac{dr}{dL} = -\frac{\frac{\partial V_R}{\partial L} - \frac{\partial V_S}{\partial L}}{-L(p_R U_R^{'} - p_S U_S^{'})}$.
- We know $p_R < p_S$ and that $U_R^{'} < U_S^{'}$, since U is concave and $Y_R(L) > Y_S(L)$. Hence $-L(p_R U_r^{'} - p_S U_S^{'}) > 0$.
- Assume $\frac{\partial V_R}{\partial L} = p_R U_R^{'} \times (Y_R^{\prime} - r) > p_S U_S^{'} \times (Y_S^{\prime} - r) = \frac{\partial V_R}{\partial L}$. This is really an assumption that $Y_R^{\prime} >> Y_S^{\prime}$.

$\rightarrow$ Then $\frac{dr}{dL} < 0$.

Intuitively:

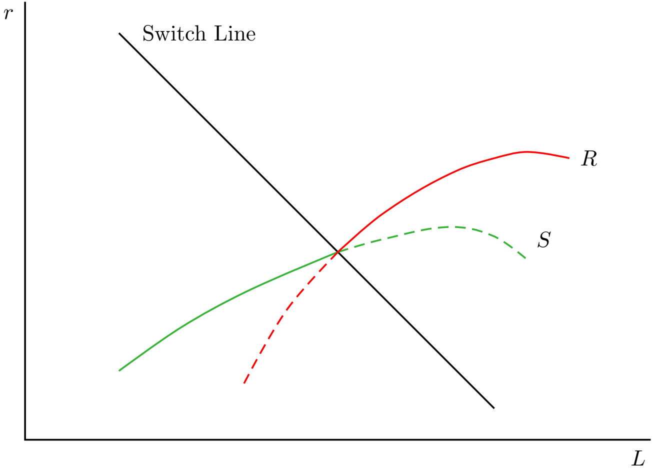
An increase in r makes the risky project more attractive: You pay it less often, and the utility loss is smaller (concave U).

We assumed an increase in L makes the risky project relatively more attractive.

Hence for the borrower to be indifferent between both, an increase in r needs to be accompanied by a decrease in L!

Graphically: ...

Moral Hazard Problem
Project Choice



Ok, so we (and the lender) know what the borrower will do given any contract (L, r) he is offered.

What will the lender do?

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What will the lender do?

[An aside: Like in *any* moral hazard model we are just solving for the subgame-perfect equilibrium of a sequential game.]

Set-up (cont.):

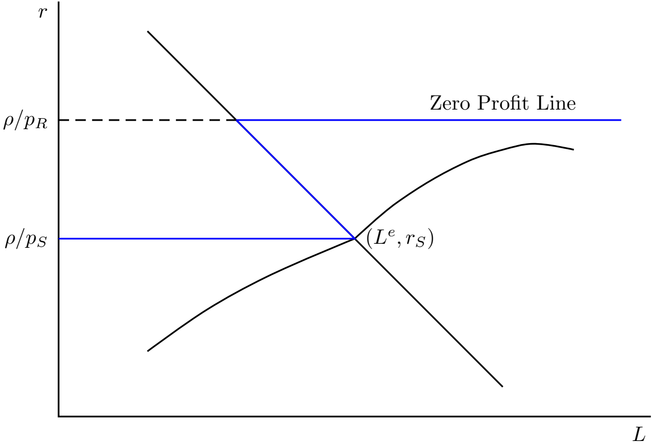
- Banks maximise profits.
- Credit markets are perfectly competitive.
- But: Borrowers can borrow from at most one bank!

→ Then the banks will - in equilibrium - make zero profits and offer the contract which gives the highest utility to the borrower. Why?

Which are the zero profit contracts? Contracts with $r_S = \rho/p_S$ where the safe project is chosen, and all contracts with $r_R = \rho/p_R$ when the risky project is chosen.

Graphically: ...

Moral Hazard Problem
Equilibrium



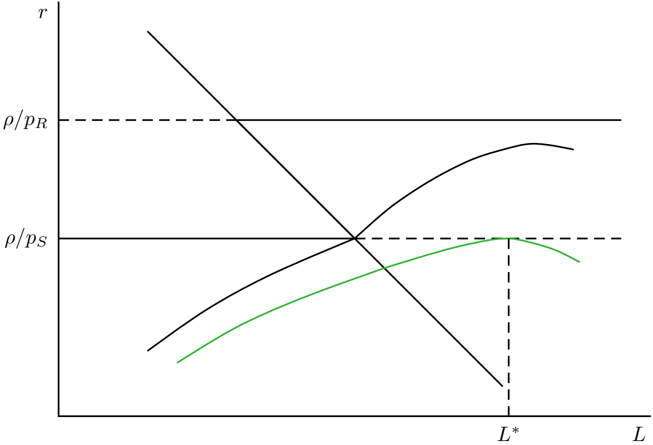
Hence a contract (L^e, r_S) will be offered[3] which, even thought at r_S the borrower would prefer a loan size bigger than L^e. He is not offered this loan, since the bank knows he would choose the risky project, in which case charging the low interest rate is not an equilibrium.

Result

Borrowers get a loan which is **smaller than socially optimal**.

[3] That is, if the indifference curves are not such that the high-risk contract is preferred, in which case there is no probem.

Moral Hazard Problem
Equilibrium



"[I]f the bank could directly control the actions of the borrower, it would specify that the borrower undertake the safe project. It cannot, and this is the basic problem with incentives in credit markets. By controlling the terms of the loan contract, the bank can induce the borrower to undertake the safe project."

(Stiglitz, 1990, p.356)

Stiglitz (1990) shows, that with joint liability contracts the equilibrium loan size might be bigger than L^e.

The key idea is that joint liability **changes the probability distribution of pay-offs**.[4]

[4] I personally feel the 'monitoring' aspect is well hidden in the paper (footnote 12). But read it yourself.

Set-Up (cont.):

- Borrowers are in groups of two, returns are independent.
- When borrower B fails to be successful, while A is successful, A needs to pay an additional amount qL.

→ The own expected payoff depends on partner's project.

- Assume that individuals in a group take their decision which project to choose jointly, and take the same.[5]

→ The project is now 'more risky': the interest rate is lower, but with some probability amount qL needs to be paid.

[5] This can be justified with a game where 'monitoring' amongst group members is important.

The **strategy of the proof**: Starting from $q = 0$, if q is increased by a little (and the bank held at zero profit):

1. By how much *needs* L to be increased, in order to compensate the borrower for the additional risk?
2. By how much *can* L be increased, without having the borrower choose the risky project?

- If there is a range where the latter is bigger than the former, we can increase L by more than necessary to compensate for risk without the borrower switching projects, hence making the borrower better off.

Ad 1:

i) The bank's zero profit condition, given everybody chooses the safe project, is $p_S r + p_S(1 - p_S)q = \rho$. The change in r induced by changing q is $dr/dq = -(1 - p_S)$.

[6] Remember, we want to consider that r changes when q changes.

Ad 1:

i) The bank's zero profit condition, given everybody chooses the safe project, is $p_S r + p_S(1-p_S)q = \rho$. The change in r induced by changing q is $dr/dq = -(1-p_S)$.

ii) The borrower's utility is

$$V_i = p_i^2 \cdot U[Y_i(L) - rL] + p_i(1-p_i) \cdot U[Y_i(L) - rL - qL].$$

We are interested in $\frac{dL}{dq}|_{V \text{ and } q=0}$. First notice, $\frac{dL}{dq}|_V = -(\frac{\partial V_S}{\partial q} + \frac{\partial V_S}{\partial r}\frac{dr}{dq})/(\frac{\partial V_S}{\partial L})$. We know $\frac{\partial V_S}{\partial L} > 0$. We can show[6]:

$$(\frac{\partial V_S}{\partial q} + \frac{\partial V_S}{\partial r}\frac{dr}{dq})|_{q=0} = \cdots = 0.$$

[6] Remember, we want to consider that r changes when q changes.

Ad 2: We can use a very similar argument to show $\frac{dL}{dq}\big|_{\text{switch line and } q=0} > 0$.[7]

[7] Use the condition defining the switch line, take the total differential, and evaluate at $q = 0$.

Result

With joint liability contracts bigger loans are given in market equilibrium, making the borrower better off. (And the borrower still chooses the safe project.)

Note:

- We had to assume that borrowers can only borrow from one lender.

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Ex-post Moral Hazard Problem

Besley and Coate, 1995

Lastly, let us focus on the **ex-post moral hazard problem**, i.e. the question whether individuals are *willing* to repay when they are *able* to repay.

We will look at a model of the ex-post repayment decision of an individual (obvious), then see how introducing *joint liability* changes the **repayment probability**, and then look at the effect of *social sanctions* within jointly liable borrowing groups.

Ex-post Moral Hazard Problem

Set-Up

Set-Up:

- Borrowers can undertake a risky project, which requires one unit of capital ($L = 1$).
- The project yields a payoff Y, distributed with c.d.f $F(Y)$ on $[\underline{Y}, \overline{Y}]$, and $F(\underline{Y}) = 0$.
- Borrowers are risk neutral.
- Assume that repayment is all or nothing: Either the borrower repays r or nothing.

→ If there is no cost to not repaying, nobody would repay, and nobody would lend. So assume:

- The bank can impose sanction s on the borrower, when he does not repay. Assume that these are increasing in Y, $s'(Y) > 0$. We can think of these as...?

An individual will repay whenever $r \leq s(Y)$. Denote the critical project return above which the expected sanctions are so high that the borrower prefers to pay r, as $\phi(r)$.

$\phi(\cdot)$ is nothing but the inverse of the penalty function, i.e. $\phi(\cdot) = s^{-1}(\cdot)$. For any r it gives you the Y above which the borrower repays.

Given any r the loan repayment rate will then be[8]

$$R_I(r) = 1 - F(\phi(r)). \tag{2}$$

[8] To make the problem interesting, assume $\phi(1) > \underline{Y}$, so even at $r = 1$ the bank cannot enforce full repayment.

Next analyze what happens when joint liability is introduced.

Set-Up (cont.):

- Individual returns independent; observable within group.
- The group jointly needs to repay $2r$.
- If the group defaults, individual penalties $s(Y_1)$ and $s(Y_2)$ are imposed.

$\rightarrow$ Now my repayment decision depends on the other's repayment decision! Does this improve repayment rates?

$\rightarrow$ To answer this question, we need to model the 'bargaining' between the borrowers in a repayment game.

Ex-post Moral Hazard Problem

Probability of Repayment: Joint Liability

Besley and Coate (1995) assume a **sequential game**:

1. One borrower decides whether to repay r or not.
2. The other borrower decides whether to repay r or not.
3. In case one borrower decided to repay, but the other decided not to, the one who had decided to repay can decide to bail out the other borrower, and hence pay $2r$.

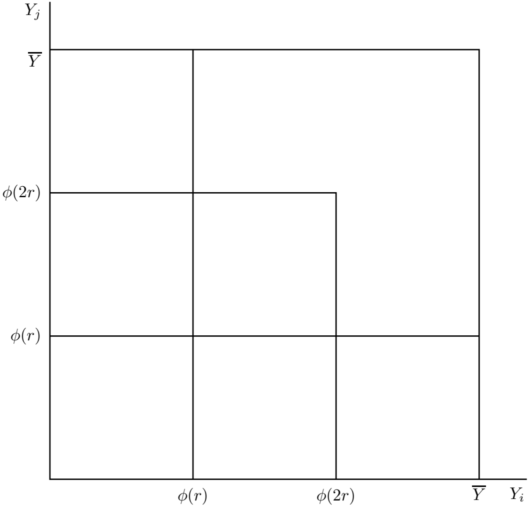
Write the pay-off function; find the sub-game perfect equilibria.

The SGPE depends on the size of the pay-offs. There are three situations (Proposition 1):

- *Loan will always be repaid if at least one borrower has a payoff $Y > \phi(2r)$.*
- *Loan* ***may*** *be repaid if both borrowers have returns between $\phi(r)$ and $\phi(2r)$.*
- *Loan will not be repaid otherwise.*

Ex-post Moral Hazard Problem

Probability of Repayment: Joint Liability

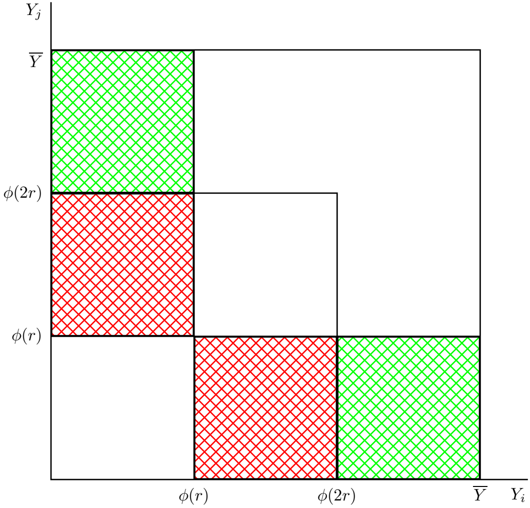


Joint liability has **two effects** in this model: one increases, one decreases repayment!

You see why?

Ex-post Moral Hazard Problem

Probability of Repayment: Joint Liability



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Group vs. Indiviudal Lending

Upside: When one borrower has payoff $Y \geq \phi(2r)$ which the other has payoff $Y < \phi(r)$, with group lending the full loan is repaid, while with individual liability only half would be repaid.

Downside: When one borrower has return $\phi(r) \leq Y < \phi(2r)$, while the other has return $Y < \phi(r)$, no repayment happens with group liability, while with individual liability half would be repaid.

To calculate the predicted repayment rate under joint liability, we need to make an assumption about what happens in the case with multiple equilibria:

Assume that the borrowers coordinate on the repayment equilibrium.[9]

[9] Hence any repayment rate we calculate is an upper-bound!

Ex-post Moral Hazard Problem

Probability of Repayment: Joint Liability

The repayment rate under group lending is then:

$$
\begin{aligned}
R_G(r) &= [1 - F(\phi(2r))]^2 + 2 \times [1 - F(\phi(2r))] \cdot [F(\phi(2r))] \\
&\quad + [F(\phi(2r)) - F(\phi(r))]^2
\end{aligned}
$$

Ex-post Moral Hazard Problem

Probability of Repayment: Joint Liability

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Subtract R_I from equation (2) to get:

$$R_G(r) - R_I(r) = \underbrace{F(\phi(r))[1 - F(\phi(2r))]}_{\text{Prob. of higher repay. case}} - \underbrace{[F(\phi(2r)) - F(\phi(r))]F(\phi(r))}_{\text{Prob. of lower repay. case}}$$

Once more: the trade-off between individual and group lending.

Ex-post Moral Hazard Problem

Probability of Repayment: Joint Liability

Group vs. Indiviudal Lending

Upside: When one borrower has a high return, he might bail out a partner who would otherwise not repay.

Downside: When one borrower has a low return, the other borrower might not pay for both, even though under individual liability he would have repaid.

The effect of group lending on repayment rates is **ambiguous**.

Note:

- We assumed that borrowers decide on whether to repay or not *non-cooperatively*. What happens if they cooperate?

Equally importantly: **Besley and Coate (1995)** discuss how group liability can harness *social sanctions*.

Suppose individual i has returns $\phi(r) \geq Y_i < \phi(2r)$, while individual j has returns $Y_j < \phi(r)$. We can imagine that individual i imposes social sanctions m on j for not contributing his share. (He might be *able* to repay, he just does not want to!)

Ex-post Moral Hazard Problem

Probability of Repayment: Social Sanctions

Equally importantly: **Besley and Coate (1995)** discuss how group liability can harness *social sanctions*.

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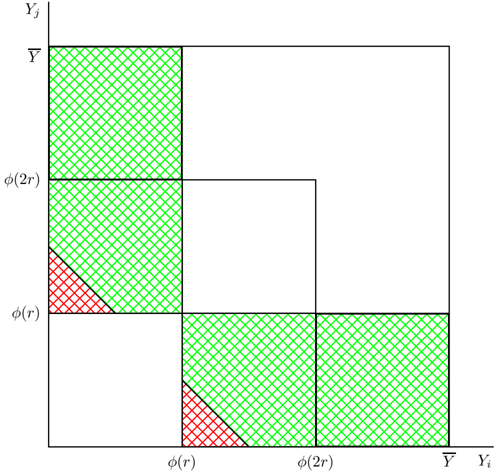
Then individual j contributes his part of the loan when $m + \phi(Y_j) > r$. Obviously this gives more repayment. Besley and Coate show, under some reasonable assumptions on the social sanction function, that with strong enough social sanctions the repayment rate under joint liability is higher than under individual liability.

Ex-post Moral Hazard Problem

Probability of Repayment: Social Sanctions



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Summary

Today, we have seen three models of why credit markets might not work, and corresponding theories why the joint liability (and self-selection) of groups - in theory - might help to alleviate these problems.

Note:

- We focussed mostly on implications for repayment. However, a higher repayment rate does not necessarily correspond to higher welfare. It may just reflect the use of penalties to enforce repayment when it is not optimal.
- We as well assumed perfect competition of for-profit lenders (through a zero-profit constraint). What would the models imply for a different competitive environment?

Tomorrow

Tomorrow we will look at evidence:

- that borrowers are indeed credit constraint,
- which theories are empirically successful at explaining credit market failures,
- survey evidence on the effects of access to micro-credit on borrowers,
- look at empirical tests of why micro-credit has the effects it has (i.e. can the models seen today explain its effects),
- and look at evidence on other aspects of micro-finance.