Credit and Microfinance: Adverse Selection

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Lecture 2

Borrower’s Project & Type

- Borrower’s project

\[ x_i \quad \text{with probability } p_i \]
\[ 0 \quad \ldots \quad (1 - p_i) \]

- Borrower type \( i = \{s, f\} \)

\[
\begin{cases} 
  p_s & \text{(Safe type)} \\
  p_r & \text{(Risky type)} \\
  \ldots & p_r < p_s
\end{cases}
\]

- Borrower’s type unobservable to lender

Environment

- Impoverished borrower \( i \)
  - Risk neutral
  - No wealth
  - Reservation utility is \( \bar{u} \)
  - proportion of type \( r \rightarrow \theta \)
  - \( \ldots \text{ type } s \rightarrow 1 - \theta \)

- Lender
  - Risk neutral
  - opportunity cost of capital \( \rho \)
  - Lends in a competitive loan market

First Best: Perfect Information Benchmark

- If the lender knows borrower’s type (perfect information environment) then the lender’s profit condition would be:

\[ r_i = \frac{\rho}{p_i} \quad i = r, s \]  

(L-ZPC)

\[ \ldots \text{lender charges } r \text{ and } s \text{ different rate} \]
\[ \ldots \text{ risky type pays a higher interest rate} \]

- Borrower \( i \)'s expected payoff

\[ U_i(r) = p_i(x_i - r_i) \]

Recall that the borrower is risk neutral and thus only cares about her expected payoff.
Socially Viable Project

A project is social viable if the expected output is greater than the social cost, in this case, the opportunity cost of capital and reservation wage in this case.

\[ p_i x_i \geq \rho + \bar{u} \]

- Under perfect information, all socially viable projects are feasible.
  - The lender would offer the borrowers contracts contingent on their type and all borrowers’ projects would be funded.

Second Best: Hidden Information Problem

If the lender is ignorant of the borrower’s type, he has the following two options.

- **either** lend to both type - **Pooling Equilibrium**
  - both type pay the same pooling interest rate
  \[ \bar{p} = \theta p_r + (1 - \theta)p_s \] (loan repayment probability)
  \[ \bar{r} = \frac{\rho}{\bar{p}} \] (pooling interest rate)

- **or** lend to only one type - **Separating Equilibrium**
  - interest rate for the type left in the market
  - Which type do you think this will be?
  \[ p_r \text{ or } p_s \] (loan repayment probability)
  \[ r_r = \frac{\rho}{p_r} \text{ and } r_s = \frac{\rho}{p_s} \] (resp. interest rates)

Imperfect Information: Adverse Selection

- **Stiglitz & Wiess (1981)**
  \[ p_s x_s = p_r x_r = \hat{x} \]
  - the expected project outputs (mean) are identical
  - the risky project has a greater spread around mean

- may lead to a problem of **Under-investment**
  - safe type with socially viable projects (i.e., \( \hat{x} = p_s x_s \geq \bar{u} + \rho \))
  - driven out of the loan market
**Participation Constraint: Stiglitz & Wiess**

![Graph showing pooling and separating equilibria](image)

**Borrower’s Participation Constraint**

\[ U_i(r) = \hat{x} - p_i r \geq \bar{u} \]

\[ i = r, s \]

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**Under-Investment: Stiglitz & Wiess**

Safe type borrower’s participation constraint:

\[ U_s(\bar{r}) = \hat{x} - p_s \bar{r} \geq u \]

By substituting for the value of \( \bar{r} = \frac{\rho}{p} \) this condition becomes

\[ \hat{x} \geq \frac{p_s}{p} \rho + u. \]

**Note:** that the lower-bound on \( \hat{x} \) is greater than \( \rho + \bar{u} \), the threshold for socially viable projects.

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**Under-Investment: Exclusion of the Safe type**

![Graph showing socially viable projects and under-investment](image)

**Under-investment:** Some safe agents with socially viable projects (i.e., \( \bar{u} + \rho < \hat{x} < \bar{u} + \frac{\rho}{p} \rho \)) unable to borrow.
Imperfect Information: Adverse Selection

- De Meza & Webb (1987)
  \[ p_r x > p_r x \]
  ... projects have different mean
  ... risky project has a lower mean

- may lead to a problem of **Over-investment**
  risky type with projects which are **not** social viable \((p_r x < \bar{u} + \rho)\)
  may participate in the market at the pooling interest rate.

Participation Constraint: De Meza & Webb

Borrower’s Participation Constraint

\[ U_i(r) = p_i(x_i - r) \geq \bar{u} \quad i = r, s \]

Over-Investment: De Mezza & Webb

Risky type borrower’s participation constraint:

\[ U_r(\bar{r}) = p_r(x - \bar{r}) \geq u \]

By substituting for the value of \( \bar{r} \) this condition becomes

\[ p_r x \geq \frac{p_r}{\bar{p}} \rho + u. \]

**Note:** that the lower-bound on \( p_r x \) is **lower** than \( \rho + \bar{u} \), the threshold for socially viable projects.
Under-Investment: De Meza & Webb

\[ \left( \frac{\rho}{\bar{r}} \right) \rho + u < \rho + u < \rho \]

Figure: Risky type’s over-investment project range

Over-investment: Risky type agents with projects that are not socially viable \((\bar{u} + \rho > \bar{p}_r x > \bar{u} + \frac{\rho}{\bar{p}} \rho)\) are able to borrow (because they are cross-subsidised by the safe type borrowers).

Investment Problem in a Adverse Selection Framework

○ Stiglitz & Webb
  Under-investment: Safe type unable to borrow for a range of socially viable projects because at high interest rates, only the risky types willing to borrow.

○ De Meza & Webb
  Over-investment: Risky type are able to borrow for a range of non socially viable projects because they are cross-subsidised by the safe type borrowers in a pooling equilibrium.

Group Lending with Joint Liability

Definition (Joint-Liability Group-Lending)
Lender lends to a group with the proviso that each borrower’s payoffs contingent on peer’s outcome.

○ Joint-Liability Group-Contract: \((r,c)\)

Definition (Joint Liability Payment: c)
Payment due if the borrower succeeds but her peer fails

Definition (Positive Assortative Matching)
Groups homogenous in the types of borrowers
Positive Assortative Matching

Proposition (Positive Assortative Matching)
Joint Liability contracts lead to positive assortative matching.

\[ U_{ij}(r, c) = p_i (x_i - r) + p_i (1 - p_j) (x_i - r - c) = p_i (x_i - r) - p_j (1 - p_j) c \]

\[ U_{rs}(r, c) - U_{ir}(r, c) = p_r (p_s - p_r) c \quad (1) \]
\[ U_{ss}(r, c) - U_{sr}(r, c) = p_s (p_s - p_r) c \quad (2) \]

\[ (2) > (1) \]

Indifference Curves

Indifference Curve of borrower type \( i \)

\[ U_{ij}(r, c) = p_i (x_i - r) - p_i (1 - p_j) c = \bar{k} \]

\[ \left[ \frac{dc}{dr} \right]_{U_{ii}=\text{constant}} = -\frac{1}{1 - p_i} \]

\( s \) type’s indifference curve steeper

\[ \left| -\frac{1}{1 - p_s} \right| > \left| -\frac{1}{1 - p_r} \right| \]

Positive Assortative Matching and Social Optimum

Paper (Ghatak, 1999, 2000)

Joint Liability Group Lending leads to positive assortative matching solves the problems of under and over-investment.

Assumption (Socially Optimal Matching)

Positive assortative matching maximises the aggregate expected payoffs of borrowers over all possible matches

\[ U_{ss}(r, c) - U_{sr}(r, c) > U_{rs}(r, c) - U_{rr}(r, c) \quad ((2) > (1)) \]
\[ U_{ss}(r, c) - U_{sr}(r, c) > U_{rs}(r, c) - U_{rs}(r, c) \quad \text{(rearranging)} \]

Indifference Curves of the two types

Figure: Risky and Safe Types’ Indifference Curves
Lender’s Problem

- Lender offers group contracts \((r_r, c_r)\) and \((r_s, c_s)\) which maximise the borrower’s payoff subject to the following constraint’s:

\[
\begin{align*}
r_r p_r + c_r (1 - p_r) p_r &\geq \rho \\
r_s p_s + c_s (1 - p_s) p_s &\geq \rho
\end{align*}
\]

\[
\frac{dc}{dr} = -\frac{1}{1 - p_r} \quad (L-ZPC_r)
\]

\[
\frac{dc}{dr} = -\frac{1}{1 - p_s} \quad (L-ZPC_s)
\]

\[
\begin{align*}
U_{ii}(r_i, c_i) &\geq \bar{u}, \\
x_i &\geq r_i + c_i
\end{align*}
\]

\[
\begin{align*}
U_{rr}(r_r, c_r) &\geq U_{rr}(r_s, c_s) \\
U_{ss}(r_s, c_s) &\geq U_{ss}(r_r, c_r)
\end{align*}
\]

(L-ZPC\(_i\) Lender’s Zero Profit Condition for type \(i\))

(PC\(_i\) Participation Constraint for type \(i\))

(LLC\(_i\) Limited Liability Constraint for type \(i\))

(ICC\(_{ii}\) Incentive Compatibility Constraint for group \(i, i\))

Separating Equilibrium in Group Lending

(\(L-ZPC_s\)) and (\(L-ZPC_r\)) cross at \((\hat{r}, \hat{c})\)

Proposition (Separating Equilibrium)

For any joint liability contract \((r, c)\)

i. if \(r_s < \hat{r}, c_s > \hat{c}\), then \(U_{ss}(r_s, c_s) > U_{rr}(r_r, c_r)\)

ii. if \(r_r > \hat{r}, c_r < \hat{c}\), then \(U_{rr}(r_r, c_r) > U_{ss}(r_s, c_s)\)

- Safe groups prefer high joint liability payment low interest rates
- Risky groups prefer low joint liability payments high interest rate
- Different interest rates for different types – back to the perfect information environment

Separating Equilibrium in \(r-c\) space

- Safe borrower’s steeper IC
- Risky borrower’s flatter IC

Figure: Separating Joint Liability Contract

Abbreviations

\(L-ZPC_i\) Lender’s Zero Profit Condition for type \(i\)

\(PC_i\) Participation Constraint for type \(i\)

\(LLC_i\) Limited Liability Constraint for type \(i\)

\(ICC_{ii}\) Incentive Compatibility Constraint for group \(i, i\)
Contracts

Separating Contract  Pooling Contract
- Safe: Segment BA  - (\(\hat{c}, \hat{r}\)) at A
- Risky: Segment AC

Conditions: Projects sufficiently productive to satisfy the Limited Liability Condition (LLC) along respective contract segments.

Under-investment:
Bring back the safe borrowers with socially productive investment.

Over-investment:
Risky borrowers with socially productive investment drop out.