Queuing for Credit:

**Increasing the Reach of Microfinance Through Sequential Group Lending**

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Queuing for Credit: Increasing the Reach of Microfinance Through Sequential Group Lending

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Labortaory Experiment on Sequential Group Lending

Kumar Aniket & Donna Harris
Microfinance

*Recurrent theme:* individuals with negligible wealth that are too poor to borrow become *credit-worthy* if they *borrow collectively* under *joint-liability contract*

**Group Lending:** *borrow in groups*

**Joint-liability:** *inter-linked contracts*

- Collateral aligns borrower’s incentive with lender’s
- Poor with no collateralisable wealth left out of credit market
- *Joint-liability* aligns borrowers’ incentive with lender’s
FIRST WAVE

Compares joint liability with individual lending in terms of lending efficiency

Strands of the literature

Adverse Selection

Moral Hazard
- Ghatak (1999), Stiglitz (1990), Conning (2000)

Auditing and Enforcement
CRITICISM OF THE FIRST WAVE

  • Results from *impact evaluation* exercise gloomy
  • Group lending does not do always do better than individual lending
  • Theory literature under estimates the *practical problems* associated with group lending
  • *Various mechanisms*, other than group lending, used in microfinance
SECOND WAVE

Look beyond joint liability at the internal mechanism of group lending

Sjostrom and Rai (2005): cross-reporting
Jain and Mansuri (2003): periodicity of loans
Aniket (2007): Role of Savings, negative assortative matching in wealth
Moral Hazard Strand

Recurrent Theme: it is more efficient to incentivize effort collectively for the group rather than individually

Ghatak (1999): incentivizing effort less expensive

Varian (1990): collective project choices more prudent

Conning (2000): incentivizing complementary tasks leads to multiple equilibria
**Environment**

- opportunity cost of capital $\rho$

- Impoverished Agent $k$
  - Risk neutral
  - Cash wealth 0
  - Reservation income 0

Lender

Risk neutral
No access to monitoring technology
Faces a competitive loan market $\Rightarrow$ zero profit condition

Project that succeeds with probability $\pi^i$

$$\rho = \pi^i r$$
**BORROWER’S PROJECT & EFFORT LEVEL**

- **Borrower’s project**

  1 unit of capital $\rightarrow \begin{cases} 
  x_s = \bar{x} & \text{with probability } \pi^i \\
  x_f = 0 & \text{with probability } (1 - \pi^i) 
  \end{cases}$

- **Borrower chooses effort level** $i = \{H, L\}$

  \[ \pi^i = \begin{cases} 
  \pi^h & \text{(High effort level)} \\
  \pi^l & \text{(Low effort level)} 
  \end{cases} \]

- **Borrower’s effort unobservable**

- **Agent’s reservation income is 0**

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# Effort Level & Private Benefits

<table>
<thead>
<tr>
<th>Effort</th>
<th>Cost of action</th>
<th>Private Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>$B(c)$</td>
</tr>
</tbody>
</table>

- Monitoring with intensity $c$ curtails private benefits $B$
  - cost of monitoring with intensity $c$ is $c$
  - monitoring is unobservable
- Private benefits are non transferable amongst agents
Assumption (Monitoring function)

i. \( B(0) > 0 \)

ii. \( B(c) \geq B(c + \varepsilon) \geq 0 \) for all \( c, \varepsilon \geq 0 \)
**ENVIRONMENT**

- opportunity cost of capital $\rho$

- Impoverished Agent $k$
  - Risk neutral
  - Cash wealth 0
  - Reservation income 0

- Lender
  - Risk neutral
  - No access to monitoring technology
  - Cost of capital $\rho$
  - Zero profit condition
INDIVIDUAL LENDING: CONSTRAINTS

Contract with outcome contingent payoffs \((b_s, b_f)\)

\[
E[b_i | H] \geq 0 \quad \text{(PC)}
\]

\[
E[b_i | H] \geq E[b_i | L] + B(0) \quad \text{(ICC}_e\text{)}
\]

\[
b_i \geq 0; \ i = \{s,f\} \quad \text{(LL)}
\]

Optimal Contract:

\[
b_s = \frac{B(0)}{\Delta \pi}, \ b_f = 0
\]

Using Lender’s zero profit condition

\[
E[x_i | H] \geq \rho + E[b_i | H] \quad \text{(L-ZPC)}
\]

\[
\bar{x} \geq \left[ \frac{\rho}{\pi^h} + \frac{B(0)}{\Delta \pi} \right] = \bar{x}_{\text{ind}}
\]

threshold project financed under simultaneous group lending
**Simultaneous Lending: Timings**

\[ t = 0 \quad (b_{ss}, b_{sf}, b_{fs}, b_{ff}) \quad \text{Group loan contract offered} \]

\[ t = 1 \quad (c_1, c_2) \quad \text{Project initiated} \]

\[ t = 2 \quad (e_1, e_2) \quad \text{Borrowers choose effort level} \]

\[ t = 3 \quad \text{Project outcome realised} \]

\[ \text{Borrowers obtain payoffs} \]
SIMULTANEOUS LENDING: CONSTRAINTS

- Each borrower’s individual ICC $e$ for subgame $\xi(c,c)$

$$\pi^h b_{ss} \geq \pi^l b_{ss} + B(c)$$

$$b_{ss} \geq \frac{B(c)}{\pi^h \Delta \pi} \quad \text{(Condition 1)}$$

Cost of inducing high effort is decreasing in monitoring intensity

- Group’s Collective ICC $e,c$:

$$\pi^h b_{ss} - c \geq \pi^l b_{ss} + B(0)$$

$$b_{ss} \geq \frac{B(0) + c}{\pi^h \pi^l - \pi^l} \quad \text{(Condition 2)}$$

“good” versus “bad” equilibrium

Cost of satisfying both tasks simultaneously increasing in monitoring intensity

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Figure: Monitoring Intensities in Group lending
\( c_{sim} \) & \( \bar{x}_{sim} \)

**Condition 1 & 2**

\[
\begin{align*}
  b_{ss} &= \frac{B(c_{sim})}{\pi^h \Delta \pi} = \frac{B(0) + c_{sim}}{\pi^h^2 - \pi^l^2} \\
  B(c_{sim}) &= \alpha (B(0) + c_{sim}); \quad \alpha = \frac{\pi^h}{\pi^h + \pi^l}
\end{align*}
\]

\( c_{sim} \) is the monitoring intensity that minimises \( b_{ss} \)

**Using the lender’s zero profit condition**

\[
E[x_i | HH] \geq \rho + E[b_{ij} | HH] \quad (L-ZPC)
\]

\[
\bar{x} \geq \left[ \frac{\rho}{\pi^h} + \frac{B(c_{sim})}{\Delta \pi} \right] = \bar{x}_{sim}
\]

threshold project financed under simultaneous group lending
**Sequential Lending: Timings**

$t = 0$  
Group loan contract $(b_{ss}, b_{sf}, b_{ff})$ offered

*Project initiated by Borrower 1*

$t = 1$  
$c_2$  
Borrower 2 choose monitoring intensity

$t = 2$  
$e_1$  
Borrower 1 choose effort level

$t = 3$  
*Project outcome realised*

*If project fails, game terminates, borrowers get $b_f$*

*If project succeeds, the game continues*

*Project initiated by Borrower 2*

$t = 4$  
$c_1$  
Borrower 1 choose monitoring intensity

$t = 5$  
$e_2$  
Borrower 2 choose effort level

$t = 6$  
*Project outcome realised*

Borrowers obtain payoffs
SEQUENTIAL LENDING: CONSTRAINTS

Each borrower’s individual ICC\(_{e,c}\)

\[ b_{ss} \geq \frac{1}{\pi^h \Delta \pi} \max [B(c), c] \]  \hspace{1cm} (Condition 3)

each task incentivized individually
group’s collective incentive compatibility condition slack
\( c_{\text{seq}} \) & \( \bar{x}_{\text{seq}} \)

**Condition 3**

\[
 b_{ss} = \frac{B(c_{\text{seq}})}{\pi^h \Delta \pi} = \frac{c_{\text{seq}}}{\pi^h \Delta \pi}
\]

\( c_{\text{seq}} \) is the monitoring intensity that minimises \( b_{ss} \)

Using the lender’s zero profit condition

\[
 E[x_i \mid HH] \geq \rho + E[b_{ij} \mid HH] \quad \text{(L-ZPC)}
\]

\[
 \pi^h (1 + \pi^h) \bar{x} \geq (1 + \pi^h) \rho + \pi^h \Delta \pi \cdot 2b_{ss}
\]

\[
 \bar{x} \geq \left[ \frac{\rho}{\pi^h} + \frac{2}{1 + \pi^h} \cdot \frac{B(c_{\text{seq}})}{\Delta \pi} \right] = \bar{x}_{\text{seq}}
\]

threshold project financed under sequential group lending
Figure: Monitoring Intensities in Group lending
**Collusion**

- Sequential Lending temporally separates the decisions on task

Interpret **Condition 2** in terms of collusion

- Condition 2 *binds* in simultaneous lending

  collusion rents without side-contracting abilities

- Condition 2 is *slack* in sequential Lending

  collusion rents require explicit side-contracting abilities

  inability to side-contract exploited to lower borrower’s rents
Figure: $c_{sim}$ and $c_{seq}$ as Monitoring Efficiency Increases
VARYING MONITORING TECHNOLOGY

- As *monitoring becomes more efficient*, both $\bar{x}_{sim}$ and $\bar{x}_{seq}$ decrease
- *Threshold project* lower under sequential lending if monitoring is *sufficiently efficient*
- With *extremely efficient monitoring technology*,
  simultaneous lending: some socially viable project not feasible
  sequential lending: all socially viable projects feasible

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LAB EXPERIMENT

Question: Does lending sequentially reduce the collateral (wealth) requirement?

Can a given repayment rate be sustained with lower collateral requirement under sequentially lending?

Does sequential lending induce greater peer-monitoring than sequential lending?
**DESIGN**

**Project:** Invest 50 token and obtain 140 tokens if successful.

**Endowment:** Players endowed with $w$ tokens and borrow $(50 - w)$ from lender, where $w = \{10, 20, 30, 40\}$

**Monitoring Choice:** Choose $c$, the *proportion of ex post payoff committed to monitoring cost*

**Effort Choice:** $(H, L)$ such that $p^h = 0.75, \ p^l = 0.25$

With low effort, borrower obtains private benefit

\[
\begin{align*}
50 \text{ tokens} & \quad \text{with probability } 1 - c \\
0 & \quad \text{with probability } c
\end{align*}
\]
**DESIGN**

**Borrower’s payoff:** The final expect payoff of borrower 1 with peer borrower 2

\[
E[\Pi_1 \mid e_1, e_2, c_1, c_2, w_1] = (1 - c_1) \left( p_1^{e_1} p_2^{e_2} [\bar{x} - (1 - w_1)] + (1 - c_2)B \cdot I \right)
\]

\[\bar{x} = 140\]
\[B = 50\]

\[c_1, c_2\] are the monitoring choices of borrower 1 and 2
\[e_1, e_2\] are the effort choices of borrower 1 and 2
\[w_1\] is borrower 1’s wealth endowment
\[I = 1\] if \(e_1 = H\) and \(i = 0\) if \(e_1 = L\)
**Very Preliminary Results**

We ran experiments for simultaneous lending \((w = 10 \text{ and } w = 20)\) and sequential lending \((w = 10)\) where each player played 10 rounds.

- For endowment \(w = 10\), sequential lending induces *higher* monitoring intensity than simultaneous lending.
- In simultaneous lending, *higher* monitoring intensity is induced as endowment increases from \(w = 10\) to \(w = 20\).