Bogus Joint-Liability Groups in Microfinance – Theory and Evidence from China

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January 2016
Motivation

- survey data on clients of CFPAM, the leading microlender in China, indicates that a substantial fraction (69%) of microfinance joint-liability groups are what we call **bogus** (*Lei Da Hu*)

- **bogus group** = one person uses all loans given to the group members (cosigners) for one’s own *single* purpose

- **standard group** = each member uses their own separate loan for a *different* purpose (as modeled in the literature)

- the practice of *Lei Da Hu* is against CFPAM rules but hard (or unwilling?) to enforce compliance
What we do

- write a model in which bogus and standard joint liability groups arise endogenously and can coexist in equilibrium
  - selection — who and when forms bogus groups
  - repayment/default rate
  - efficiency — are bogus groups ‘bad’ or ‘good’?

- analyze the optimal loan contract (menu) when bogus groups cannot be detected or ruled out ex-ante

- empirical analysis; welfare and policy counterfactuals – in progress and future work
Model
Borrowers

- risk neutral; each has a single investment project with productivity (type), \( k_i \in \{k_L, k_H\} \) where \( k_H > k_L > 0 \)

- projects are fully loan-financed

- given loan (=investment) amount \( L \), the project return is:

\[
Y_i = \begin{cases} 
  k_i L & \text{with probability } p \in (0, 1) \quad \text{[success]} \\
  0 & \text{with probability } 1 - p \quad \text{[failure]}
\end{cases}
\]

- project returns are i.i.d. across borrowers
Lender(s)

- risk neutral

- zero profits; no cross-subsidization (free entry)

- opportunity cost of funds = 1

- only group loans are provided, with a joint liability clause
  - two-person borrower groups

- loan terms: each borrower receives
  - loan size $L$
  - gross repayment $R$
Credit market features

- **limited enforcement**
  - for example, unverifiable project return

- **limited liability**
  - the borrowers have no other assets or income to be seized in case of failure (or this is unenforceable)

- **joint liability**
  - each borrower can be held responsible for the full group obligation $2R$
Default or repayment I

- **involuntary default** – a borrower cannot repay the loan when her project fails

- **strategic default** – a borrower whose project succeeds may default strategically and keep $Y_i$

- in either case, the other group member could choose to repay $2R$ if her project succeeds
Default or repayment II

• if the lender does not receive $2R \implies \text{both borrowers are cut off from future access to credit}$

• if the lender receives $2R \implies \text{both borrowers obtain value of future access to credit } V > 0 \text{ each}$
Timing and information

1. two borrowers $i, j$ form a group

2. the project productivities $k_i, k_j$ are realized (observed by the borrowers but possibly not by the lender)

3. the lender offers contract(s) consisting of loan size and repayment $\{L, R\}$

4. the borrowers choose to operate as bogus or standard group – unobserved by the lender

5. the project outcomes are realized (non-verifiable)

6. each borrower decides to repay or default

7. payoffs are realized
Standard groups – repayment decision

• two-stage repayment game a la Besley-Coate

• **Stage 1**: each borrower asked to repay $R$; decide simultaneously, non-cooperatively*
  
  – if one’s project fails – default involuntarily
  – if both repay or both default – game ends, payoffs realized (see below);
  – if not, \(\Rightarrow\)

• **Stage 2**: if a borrower has repaid $R$ in stage 1 but her partner has not, the former is asked to pay extra $R$
Repayment decision – backward induction

• Stage 2: repay is optimal if $R \leq V$

• Stage 1: suppose $R \leq V$ (so either will repay in Stage 2), then the Stage 1 (row) payoffs, conditional on own project success, are as follows:

<table>
<thead>
<tr>
<th></th>
<th>repay</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>repay</td>
<td>$k_i L - R - (1 - p)R + V$</td>
<td>$k_i L - 2R + V$</td>
</tr>
<tr>
<td>default</td>
<td>$k_i L + pV$</td>
<td>$k_i L$</td>
</tr>
</tbody>
</table>

• (repay, repay) is the unique* SPNE if

$$R \leq \frac{1-p}{2-p}V$$
Standard groups only

- the optimal loan terms for standard group $ij$ maximize the group expected payoff

$$W_{ij}(L, R|S) \equiv p(k_i + k_j)L - 2p(2 - p)R + 2p(2 - p)V$$

subject to:

$$2R \leq k_mL \text{ for } m = i, j \text{ (feasibility)}$$

$$R \leq \frac{1-p}{2-p}V \text{ (no strategic default)}$$

$$p(2-p)R = L \text{ (lender zero profits)}$$
Standard groups only

- assume
  \[ k_L \geq \frac{2}{p(2-p)} \]  [Assumption A1]
  (ensures feasibility for any \( i, j \); also implies \( pk_i > 1 \) – all projects are socially efficient)

- **Proposition 1:** The optimal standard group contract \( S = \{L_S, R_S\} \) is
  \[ L_S = p(1-p)V \text{ and } R_S = \frac{1-p}{2-p}V \]

- note: the contract is the same whether or not the lender observes \( k_i, k_j \)
Allowing for bogus groups

- suppose now
  - **bogus groups may form** and
  - **group form choice is unobserved** by the lender

- the group form choice is *endogenous*, based on maximizing the *group’s joint payoff*

- in a bogus group, all funds are invested into the more productive project (w.l.o.g., $k_i \geq k_j$)
  - it resembles an individual loan of size $2L$
  - the joint liability clause has no bite since the ‘ghost’ member has no income (limited liability)
Bogus groups

- same repayment game but, since the cosigner has no project, the lender comes back to the Stage 1 repaying member with certainty

- upon project success, the cosigner is compensated with some transfer $T$ independent of the repay/default decision

- given $(L, R)$, optimal to repay if

$$2k_iL - 2R + V - T \geq 2k_iL - T \iff R \leq V/2$$

- weaker than the standard group no-default condition, $R \leq \frac{(1-p)V}{2-p}$

- using the lender’s zero profit condition, $2pR = 2L$, the best contract for a bogus group is:

$$L_B = pV/2, \quad R_B = V/2$$
Bogus vs. standard groups – comparison

1. **risk-sharing** – standard group members cover for their partners (larger expected continuation value but also larger expected repayment); favors standard groups if $R \leq V$
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5. **loan size** – larger loans can be supported in a bogus group ($L \leq pV/2$ vs. $L \leq p(1-p)V$); implied by 3.
Who forms bogus groups?

bullet for given \((L, R)\), optimal to form a bogus group instead of a standard group if,

\[
(k_i - k_j)L > 2(1 - p)(V - R) \quad \text{[form bogus]}
\]

* the RHS is the net risk-sharing benefit in a standard group (item 1)
* the LHS is the expected output gain in a bogus group (item 2)

bullet for given \((L, R)\) a bogus group is more likely

- the larger are \(k_i - k_j\) and \(p\)
- the lower is \(V\)
Bogus groups – a problem?

• Proposition 2: At the standard group contract $S = (L_S, R_S)$, if

$$k_H - k_L > \frac{2}{p(2-p)} \quad (**).$$

then:

(a) all $(k_H, k_L)$ borrower pairs optimally form bogus groups
(b) all $(k_H, k_L)$ groups cause losses to the lender

• Intuition:

(a) output gains
(b) loss of diversification – all funds put into a single project instead of split between two i.i.d. projects.
Bogus groups – a problem?

• if condition (**) is not satisfied, it does not mean that offering \((L_S, R_S)\) is necessarily optimal

• the lender would not lose money but a superior contract may exist, utilizing the additional advantages of bogus groups (items 3 and 5)
The optimal loan contract allowing for bogus groups

- assume $k_i, k_j$ observed* by the lender. For given $k_i, k_j, p$, the optimal loan contract solves:

$$\max_{L, R, \tau \in \{0,1\}} \tau W(L, R|S) + (1 - \tau)W(L, R|B) \quad \text{subject to}$$

$$\tau W(L, R|S) + (1 - \tau)W(L, R|B) \geq \tau W(L, R|B) + (1 - \tau)W(L, R|S) \quad \text{(IC)}$$

$$R \leq \tau \frac{(1-p)V}{2-p} + (1 - \tau)\frac{V}{2} \quad \text{(no default)}$$

$$R = \tau \frac{L}{p(2-p)} + (1 - \tau)\frac{L}{p} \quad \text{(zero profits)}$$
The optimal contract – observable productivity

Proposition 3: The optimal loan contract \((L^*, R^*)\) for a \(k_i, k_j\) group is:

(a) for homogeneous, \(ii\) (HH or LL) groups

- if \(p(2p - 1)k_i > 1\) (large \(k_i\) or \(p\)), then \(L^* = pV/2 \equiv L_B\), \(R^* = V/2 \equiv R_B\) and the group is bogus \((\tau^* = 0)\)
- if \(p(2p - 1)k_i \leq 1\) (small \(k_i\) or \(p\)), then \(L^* = p(1 - p)V = L_S\), \(R^* = \frac{(1-p)V}{2-p} = R_S\) and the group is standard

(b) for heterogeneous (HL) groups, depending on parameter values*

- either \(L^* = L_B, R^* = R_B\) and the group is bogus (for large \(k_i\), or \(p\), or \(k_H - k_L\))
- or \(L^* = \min\{L_S, L_E\}, R^* = \frac{L^*}{p(2-p)}\) and the group is standard
  (where \(L_E \equiv \frac{p(1-p)V}{2-p + \frac{p}{2}(k_H - k_L)} < L_S\))
Optimal lending with endogenous bogus groups –
summary

• **bogus homogeneous groups** if

  – large $p$
  – medium $p$ + large $k_i$

• **bogus heterogeneous groups** if

  – large $p$
  – medium $p$ + large $k_L$
  – small/medium $p$ + large $k_H$ relative to $k_L$

• **standard heterogeneous groups** with contract $\mathcal{E} \equiv (L_E, R_E)$ for
  small/medium $p$ + medium $k_H$ relative to $k_L$
\[ k_H = k_L + \frac{2}{p(2-p)} \]

\[ k_H = k_L \]

\[ k_H = f(k_L) \]

\[ HL \text{ group } (0 < p \leq \frac{1}{2}) \]

- Bogus with contract \( B \)
- Standard with contract \( E \)
- Standard with contract \( S \)
Figure 1: The equilibrium contracts and group forms under different parameter values when productivity is observable.
Discussion

• **interest rate**: \( \frac{R_B}{L_B} > \frac{R_S}{L_S} = \frac{R_E}{L_E} \) – bogus groups face higher interest rate

• **repayment amount**: \( R_B > R_S \) – bogus groups owe more

• **loan size**: \( L_B > L_S > L_E \) – bogus groups receive larger loans (if \( p > 1/2 \))

• **project type**: larger productivities \( k_H, k_L \) and/or larger differential, \( k_H - k_L \) make bogus groups optimal

• **composition**: heterogeneous groups have stronger incentive to be bogus
Discussion

• bogus groups always receive their optimal loan \( B = \left( \frac{pV}{2}, \frac{V}{2} \right) \) independent of \( k_i, k_j \)

• the contract for a standard group may differ from \( S \) and depend on the productivities (case \( \mathcal{E} \))
  - IC only binds in case \( \mathcal{E} \)

• taking into account bogus groups maximizes total surplus (constrained-efficient)

• bogus groups are not a loss-causing nuisance but arise endogenously to exploit higher-productivity investments

• bogus groups could mitigate the strategic default problem making larger loans possible (if \( p > 1/2 \))
Extension – joint repayment decision

• borrowers decide jointly to default or repay $2R$ (verifiable $Y_i$ within the group or social capital)

• standard groups only:
  – optimal contract is $S'$ with $L_{S'} = p(2 - p)V$ and $R_{S'} = V$
  – larger loan size, same interest rate as $S$

• allowing bogus groups:
  – the no-default condition is now $R \leq V$ for both bogus and standard groups (no strategic interaction)
  – at $S'$ any $HL$ group is bogus and causes loss to the lender
  – intuition: only effect 2 (expected output) operates; effect 1 (risk sharing) is zero at $R_{S'} = V$
Extension – joint repayment decision

Proposition D3: Suppose the borrowers make the repayment decision jointly and $k_i$ and $k_j$ are observed by the lender.

<table>
<thead>
<tr>
<th></th>
<th>optimal contract and group form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$LL$ groups</td>
</tr>
<tr>
<td>1. $k_H$ close to $k_L$</td>
<td>$S'$, standard</td>
</tr>
<tr>
<td>2. $k_H$ large relative to $k_L$</td>
<td>$S'$, standard</td>
</tr>
</tbody>
</table>

• intuition:
  – homogeneous pairs (HH or LL) – no benefit from forming bogus group (no extra output, no risk-sharing, same $R$)
  – heterogeneous pairs (HL) – bogus groups optimal for $k_H$ sufficiently large relative to $k_L$
Conclusions

- bogus groups are efficient – larger loan size can be supported and larger output created

- bogus groups are more likely to be used by “better” borrowers (with higher $k_i$ and $p$)

- bogus groups have a lower repayment rate ($p$ vs. $1 - (1 - p)^2$) and hence require higher interest rate

- MFIs using group lending must take into account that bogus groups can form and address this by offering appropriate loan terms or menus
Thank you
Endogenous bogus groups – payoffs

- the expected total payoffs of a standard and bogus group are respectively

\[
W(L, R|S) = \begin{cases} 
p(k_i + k_j)L - 2p(2 - p)R + 2p(2 - p)V & \text{if } R \leq \frac{1-p}{2-p}V \text{ (repay,repay)} 
p(k_i + k_j)L - 2pR + 2pV & \text{if } R \in \left(\frac{1-p}{2-p}V, \frac{V}{2}\right] \text{ (repay,default)} 
p(k_i + k_j)L & \text{if } R > \frac{V}{2} \text{ (default,default)}
\end{cases}
\]

\[
W(L, R|B) = \begin{cases} 
2pk_iL - 2pR + 2pV & \text{if } R \leq \frac{V}{2} \text{ (repay)} 
2pk_iL & \text{if } R > \frac{V}{2} \text{ (default)}
\end{cases}
\]

- *remark: the standard group (repay, default) equilibrium is payoff-dominated by the (repay) bogus group outcome
Unobserved productivities

• due to free entry the lender cannot screen the group composition (HH, LL or HL) using different interest rates

⇒ at most a two-contract menu can be offered, \((L_N, R_N)\) and \((L_M, R_M)\) designed for standard and bogus groups respectively

• IC has to ensure that each group
  
  – chooses its intended form (bogus vs. standard)
  – self-selects into intended contract \((\mathcal{N} \text{ or } \mathcal{M})\)
Optimal contract menu – unobserved productivities

\[
\max_{L_N, R_N, L_M, R_M} \sum_{i,j} q_{ij} W_{ij}(L_N, R_N, L_M, R_M) \quad \text{subject to:}
\]

\[
R_M \leq \frac{V}{2} \quad \text{(no default, bogus)}
\]

\[
R_M = \frac{L_M}{p} \quad \text{(zero profits, bogus)}
\]

\[
R_N \leq \frac{1-p}{2-p} V \quad \text{(no default, standard)}
\]

\[
R_N = \frac{L_N}{p(2-p)} \quad \text{(zero profits, standard)}
\]

\[
W_{ij}(L_N, R_N, L_M, R_M) \geq \max\{W_{ij}(L_N, R_N|B), W_{ij}(L_M, R_M|S)\} \quad \text{(IC2)}
\]

\[\forall ij \in \{HH, HL, LL\}, \text{ where}\]

\[
W_{ij}(L_N, R_N, L_M, R_M) \equiv \max\{W_{ij}(L_N, R_N|S), W_{ij}(L_M, R_M|B)\}
\]
Optimal contract menu – unobserved productivities

- **Proposition 4**: Suppose $k_i$ and $k_j$ are unobservable to the lender. The optimal loan menu consists of two contracts, $\mathcal{N}$ and $\mathcal{M}$ such that:

(i) contract $\mathcal{M}$ has terms $L^*_M = L_B$ and $R^*_M = R_B$ for any $k_H, k_L, p$.

(ii) contract $\mathcal{N}$ has terms $L^*_N = L_S$, or $L^*_N = L_E < L_S$, or $L^*_N = L_F < L_S$, and $R^*_M = \frac{L^*_N}{p(2-p)}$, depending on parameters, where $L_F = \frac{pk_H - \frac{1}{2}}{pk_H - \frac{1}{2-p}} \frac{pV}{2}$ and $R_F = \frac{L_F}{p(2-p)}$.

(iii) borrowers who select contract $\mathcal{N}$ optimally form standard group; borrowers who select $\mathcal{M}$ form a bogus group.
Joint repay/default decision – unobservable k’s

<table>
<thead>
<tr>
<th>menu</th>
<th>selected contract and group form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>LL groups</strong></td>
</tr>
<tr>
<td>1. (k_H) close to (k_L)</td>
<td>(\mathcal{E}, \mathcal{B})</td>
</tr>
<tr>
<td>2. (k_H) large relative to (k_L)</td>
<td>(\mathcal{F}, \mathcal{B})</td>
</tr>
</tbody>
</table>

- standard groups receive smaller loans than in contract \(S\) – agency costs
Excluding bogus groups?

- choose \((L, R)\) to maximize the group payoff subject to: no default, zero profits, and

\[(k_i - k_j)L \leq 2(1 - p)(V - R) \quad \text{[no bogus]}\]

- **Proposition 5:** Suppose the lender wants to exclude bogus groups and \(k_i, k_j\) are observed.

(i) the payoff-maximizing excluding contract for \(HH\) and \(LL\) groups is \(S = (L_S, R_S)\)

(ii) the payoff-maximizing excluding contract for \(HL\) groups is:

- \(S = (L_S, R_S)\) if \(k_H - k_L \leq \frac{2}{p(2-p)}\)
- \(E = (L_E, R_E)\) with \(L_E < L_S\) if \(k_H - k_L > \frac{2}{p(2-p)}\) (***)
Data

- 2011 phone survey with 366 borrowers belonging to 80 joint liability groups
  - clients of CFPAM – China’s largest microlender (175,000 clients, 1.87RMB in loans in 2013)

- data on
  - group form (*Lei Da Hu* or not)
  - knowledge of joint liability and other members
  - loan use, size, repayment, interest
  - others – see Table 2
<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Definition</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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<tbody>
<tr>
<td>bogus group type dummy</td>
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What is going on?

- the data indicate that the interest rate and number of repayments are basically identical across all borrower groups

- are parameters such that the $S$ or $B$ contract is optimal for all?
  - cannot be since we observe 70:30 split in group form

- the lender ignoring or unaware of bogus groups? $\implies$ losses or sub-optimality
  - consistent with the 2005 *Planet Rating* report
Bogus groups – determinants

- Table 4 – bogus groups are statistically significantly associated with:
  - smaller monthly repayment
  - larger loan size
Table 4: Determinants of bogus vs. standard group form

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Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1