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

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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 $2R \Longrightarrow both$ borrowers are **cut off** from future access to credit

- if the lender receives $2R \Longrightarrow both$ borrowers obtain **value of future access** to credit $V > 0$ 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, $\Longrightarrow$
- 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:

	$repay$	$default$
$repay$	$k_i L - R - (1-p)R + V$	$k_i L - 2R + V$
$default$	$k_i L + pV$	$k_i L$

- ($repay$, $repay$) 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:

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

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

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

Standard groups only

- assume

$$k_L \geq \frac{2}{p(2-p)} \quad \text{[Assumption A1]}$$

(ensures feasibility for any i, j; also implies $pk_i > 1$ – all projects are socially efficient)

- **Proposition 1**: *The optimal standard group contract* $\mathcal{S} \equiv \{L_S, R_S\}$ *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**

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

  – *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:

$$L_B = pV/2, \;\; R_B = V/2$$

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?

- 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)

- 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* $\mathcal{S} = (L_S, R_S)$, *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:

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

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

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

$$R = \tau\tfrac{L}{p(2-p)} + (1-\tau)\tfrac{L}{p} \quad \text{(zero profits)}$$

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*

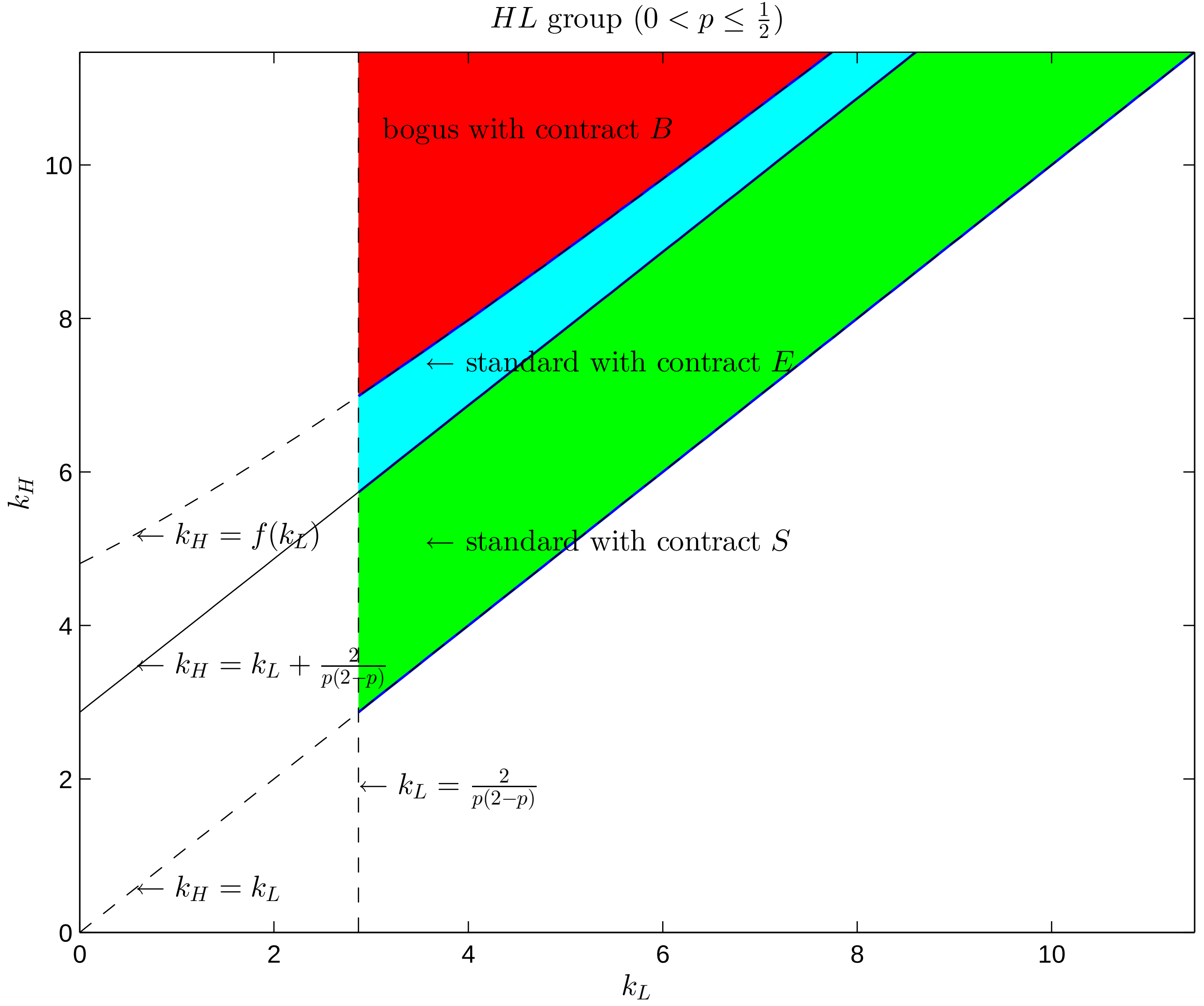
- *if* $p(2p-1)k_i > 1$ *(large* k_i *or* p*), then* $L^* = pV/2 \equiv L_B$, $R^* = V/2 \equiv R_B$ *and the group is bogus* $(\tau^* = 0)$
- *if* $p(2p-1)k_i \leq 1$ *(small* k_i *or* p), *then* $L^* = p(1-p)V = L_S$, $R^* = \frac{(1-p)V}{2-p} = R_S$ *and the group is standard*

(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* $L_E \equiv \frac{p(1-p)V}{\frac{1-p}{2-p}+\frac{p}{2}(k_H-k_L)} < L_S$*)*

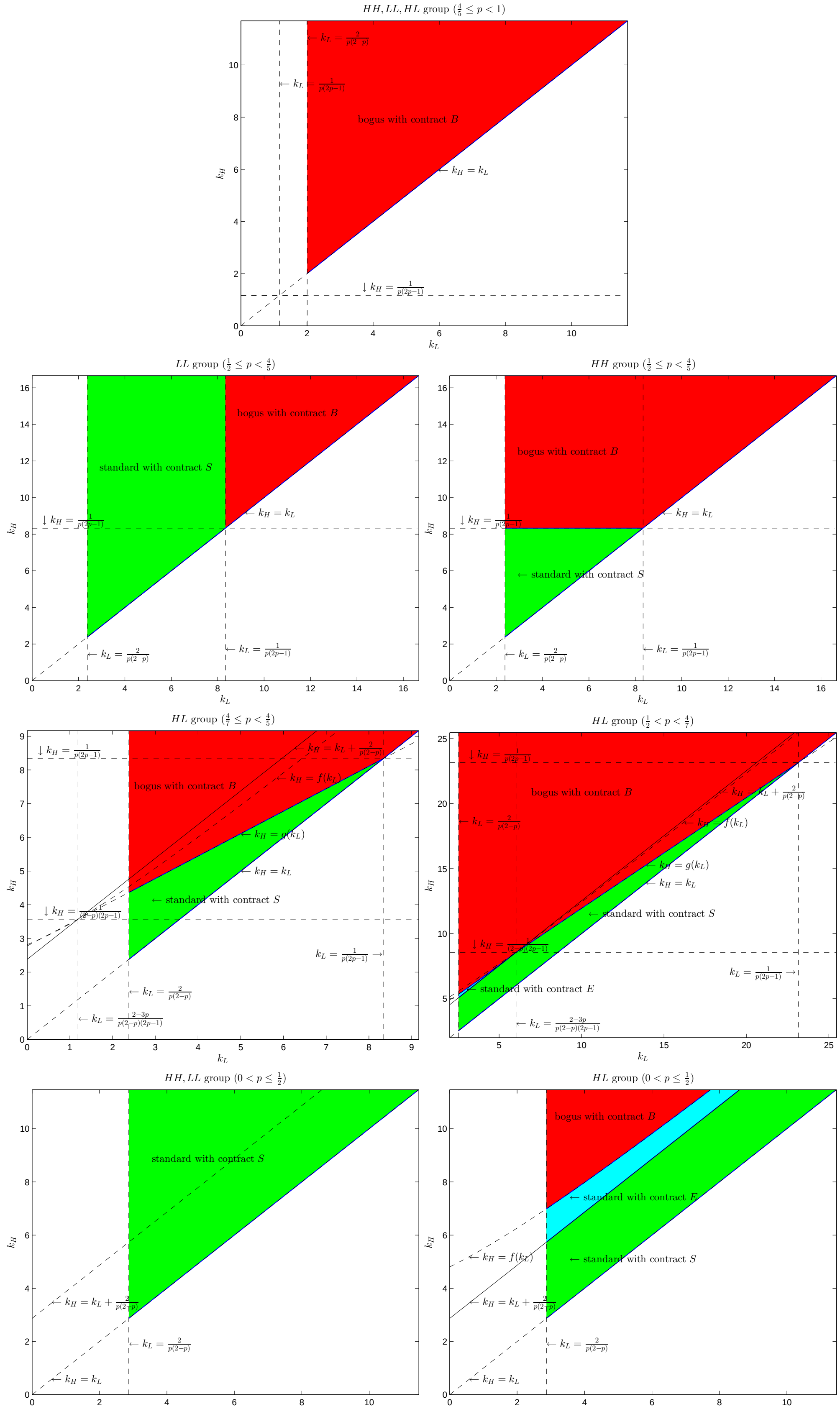
Optimal lending with endogenous bogus groups – summary

- **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



HL group $(0 < p \leq \frac{1}{2})$
bogus with contract B
$\leftarrow$ standard with contract E
$\leftarrow$ standard with contract S
$\leftarrow k_H = f(k_L)$
$\leftarrow k_H = k_L + \frac{2}{p(2-p)}$
$\leftarrow k_L = \frac{2}{p(2-p)}$
$\leftarrow k_H = k_L$
k_H
k_L
0
2
4
6
8
10

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 $\mathcal{B} = (\frac{pV}{2}, \frac{V}{2})$ independent of k_i, k_j

- the contract for a standard group may differ from $\mathcal{S}$ 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 $not\ a\ loss\text{-}causing\ nuisance$ 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 $\mathcal{S}'$ with $L_{S'} = p(2-p)V$ and $R_{S'} = V$
  - larger loan size, same interest rate as $\mathcal{S}$

- allowing bogus groups:
  - the no-default condition is now $R \leq V$ for both bogus and standard groups (no strategic interaction)
  - at $\mathcal{S}'$ 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.*

	optimal contract and group form		
	LL groups	*HH groups*	*HL groups*
1. k_H close to k_L	$\mathcal{S}'$, standard	$\mathcal{S}'$, standard	$\mathcal{E}$, standard
2. k_H large relative to k_L	$\mathcal{S}'$, standard	$\mathcal{S}'$, standard	$\mathcal{B}$, bogus

- 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

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

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

- *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

  $\Longrightarrow$ 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 ($\mathcal{N}$ or $\mathcal{M}$)

Optimal contract menu – unobserved productivities

$$\max_{L_N,R_N,L_M,R_M} \sum_{ij} q_{ij} W_{ij}(L_N, R_N, L_M, R_M) \text{ subject to:}$$

$$R_M \leq \tfrac{V}{2} \quad \text{(no default, bogus)}$$

$$R_M = \tfrac{L_M}{p} \quad \text{(zero profits, bogus}$$

$$R_N \leq \tfrac{1-p}{2-p} V \quad \text{(no default, standard)}$$

$$R_N = \tfrac{L_N}{p(2-p)} \quad \text{(zero profits, standard)}$$

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

$\forall ij \in \{HH, HL, LL\}$, 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* $L_F \equiv \frac{pk_H - 1}{pk_H - \frac{1}{2-p}} \frac{pV}{2}$ *and* $R_F \equiv \frac{L_F}{p(2-p)}$.

(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

	menu	**selected contract and group form**		
		LL groups	*HH groups*	*HL groups*
1. k_H close to k_L	$\mathcal{E}$,$\mathcal{B}$	$\mathcal{E}$, standard	$\mathcal{E}$, standard	$\mathcal{E}$, standard
2. k_H large relative to k_L	$\mathcal{F}$,$\mathcal{B}$	$\mathcal{F}$, standard	$\mathcal{F}$, standard	$\mathcal{B}$, bogus

- standard groups receive smaller loans than in contract $\mathcal{S}$ – 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 $\mathcal{S} = (L_S, R_S)$*

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

  - $\mathcal{S} = (L_S, R_S)$ *if* $k_H - k_L \leq \frac{2}{p(2-p)}$
  - $\mathcal{E} = (L_E, R_E)$ *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 2: Summary Statistics

Variable	Variable Definition	Obs	Mean	Std. Dev.	Min	Max
bogus	group type dummy	366	0.69	0.21	0	1
mpayment	monthly payment (in RMB)	366	828.6	192.3	50.7	908
loansize	loan amount (in RMB)	366	7194	1774	500	8000
duration	number of payments in total	366	9.93	0.62	4	10
ir	interest rate	366	13.5%	0.32%	12%	16%
age	age	366	43.8	9.68	21	64
married	marital status dummy	366	0.94	0.24	0	1
AFAF	industry dummy	366	0.80	0.40	0	1
manufacture	industry dummy	366	0.06	0.23	0	1
service	industry dummy	366	0.02	0.15	0	1
wholesale	industry dummy	366	0.08	0.27	0	1
transport	industry dummy	366	0.02	0.14	0	1
housing	industry dummy	366	0.02	0.15	0	1
below	education dummy	366	0.01	0.10	0	1
primary	education dummy	366	0.27	0.44	0	1
junior	education dummy	366	0.69	0.46	0	1
highschool	education dummy	366	0.03	0.17	0	1
college	education dummy	366	0.01	0.09	0	1
beizhen	county dummy	366	0.54	0.50	0	1
xiuyan	county dummy	366	0.22	0.41	0	1
xingcheng	county dummy	366	0.25	0.43	0	1
Han	the majority of Chinese	366	0.29	0.46	0	1
Manchu	one of the minorities of Chinese	366	0.70	0.46	0	1
Mongols	one of the minorities of Chinese	366	0.01	0.07	0	1

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 $\mathcal{S}$ or $\mathcal{B}$ contract is optimal for all?
  - **cannot be** since we observe 70:30 split in group form
- the lender ignoring or unaware of bogus groups? $\Longrightarrow$ 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

	(1) bogus	(2) bogus	(3) bogus	(4) bogus	(5) bogus	(6) bogus	(7) bogus	(8) bogus
lmpayment	-4.78**				-4.75**	-4.85**	-4.44**	-4.60**
	(2.14)				(2.10)	(2.12)	(2.00)	(2.06)
lloansize	5.41**				5.38**	5.53**	5.12**	5.28**
	(2.18)				(2.13)	(2.16)	(2.04)	(2.10)
lage				-0.47	-0.53	-0.60	-0.60	-0.66
				(0.48)	(0.50)	(0.52)	(0.54)	(0.54)
married				-0.22	-0.077	0.04	0.08	0.15
				(0.49)	(0.50)	(0.51)	(0.51)	(0.51)
AFAF		-1.16				-0.98	-0.97	-0.99
		(1.08)				(1.08)	(1.09)	(1.09)
manufacture		-1.54				-1.56	-1.41	-1.39
		(1.16)				(1.17)	(1.18)	(1.18)
service		0.00				-0.10	-0.09	-0.13
		(1.51)				(1.52)	(1.52)	(1.52)
wholesale		-0.76				-0.82	-0.65	-0.62
		(1.15)				(1.16)	(1.17)	(1.17)
transportation		-3.74**				-3.82**	-3.82**	-3.78**
		(1.52)				(1.52)	(1.52)	(1.52)
below			13.80				15.16	15.89
			(574.1)				(716.9)	(894.2)
primary			14.47				15.00	15.68
			(574.1)				(716.9)	(894.2)
junior			14.68				14.97	15.62
			(574.1)				(716.9)	(894.2)
highschool			14.78				14.98	15.58
			(574.1)				(716.9)	(894.2)
manchu								-0.26
								(0.28)
mongols								-1.30
								(1.45)
Constant	-15.10***	1.95*	-13.80	2.76	-12.97**	-12.42**	-26.64	-27.25
	(5.41)	(1.07)	(574.1)	(1.87)	(5.68)	(5.82)	(716.9)	(894.3)
Observations	366	366	366	366	366	366	366	366

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1