Midterm Exam (25 March 2017)

• There is one question, with several parts; you have to answer all of them. You have 3 hours to write this exam.

1. [20 points] The Set-up

• All borrowers live in a village with a large population normalized to unity. Each borrower is endowed with a risky investment project. The project requires one unit of capital. Borrowers lack sufficient personal wealth and need to borrow to launch the project. The project can yield either a high or a low return, referred to as success or failure. The project returns are observable and verifiable. The borrowers are characterized by probability of success p_r and p_s , with $0 < p_r < p_s < 1$, and are referred to as *risky* and *safe* borrowers respectively.

Risky and safe types exist in proportions θ and $(1 - \theta)$ in the population. The outcomes of the project are independently distributed across borrowers. The return of a project of a borrower of type *i* is a random variable which takes two possible values: $Q_i > 0$ if successful, and 0 if not. To simplify the exposition we assume $p_sQ_s = p_rQ_r \equiv \overline{Q}$. Borrowers are risk-neutral and maximize expected returns. Note that each borrower is endowed with only one project, i.e., borrows either from the micro finance institution (MFI) or the informal lender. Hence borrowing from the MFI will crowd out borrowing from the informal lender.

Loan contracts offered by informal lenders or the MFI are not collateralized and can involve either individual liability or joint liability. The individual liability contract is a standard debt contract between a borrower and any lender with a fixed repayment Rin case of success, and zero otherwise. The joint liability contract involves asking the borrowers to form groups of two, and offering an individual liability component R and a joint liability component C. Owing to limited liability and the fact that lenders do not use collateral, a borrower does not repay if the project fails. But if a borrower's project is successful then he is liable for his own repayment R in addition to C if his partner's project failed.

The cost of capital for the MFI is $\rho > 1$ which is lower than ρ^I , the capital cost for informal lenders. Each lender can offer as many loans as it likes in the village, as long as they break-even on average. All projects are socially productive in the sense that

$$p_i Q_i > \rho^I + \underline{u}, \ i = r, s,$$
 (Assumption 1)

where \underline{u} represents a borrower's outside option. Informal lenders seek to maximize expected profit, while the MFI maximizes the welfare of borrowers. We also assume the following tie-breaking rule: lenders offer individual liability loans if they earn the same expected profit with joint liability loans.

The MFI cannot identify a borrower's risk type, while informal lenders know the risk type of borrowers in their own segment. Borrowers repay whenever they have the means to do so, i.e., consistent with limited liability. Given the loan size is fixed, it is impossible for the MFI to screen different types using individual liability contracts. The only instrument controlled by the MFI would then be the interest rate, and both types would opt for the loan with the lowest interest rate. The same applies to the informal lenders when they deal with borrowers outside their own segment for whom they have no information.

As Ghatak (2000) showed, it is possible for a lender to screen different types using joint liability loans and asking borrowers to form groups. Assuming that borrowers know each other's types, there is assortative matching: safe (resp. risky) borrowers pair up with safe (resp. risky) borrowers. The lender can induce self-selection between safe and risky groups.

• Without loss of generality, each lender can offer a pair of contracts (R_r, C_r) and (R_s, C_s) designed for risky and safe groups of borrowers.

(a) [4 points]

Explain that expected payoff for a borrower of risk-type i is

$$U_i(R,C) = p_i Q_i - [p_i R_i + p_i (1 - p_i) C_i].$$

• The MFI maximizes a weighted average of the expected utilities of a representative borrower of each of the two possible types:

$$V = \lambda U_r + (1 - \lambda) U_s, \ \lambda \in (0, 1).$$

- Consider first the constraints faced by the MFI in offering the pair of contracts (R_r, C_r) and (R_s, C_s) .
- (b) [5 points]
 - (i) Explain that the **zero-profit constraints** for the MFI for separating contracts (R_r, C_r) and (R_s, C_s) are given by

$$p_r R_r + p_r \left(1 - p_r\right) C_r \ge \rho,$$

and

$$p_s R_s + p_s \left(1 - p_s\right) C_s \ge \rho.$$

- Let ZPC_i denote the set of joint liability contracts that satisfy the zero-profit constraint for a borrower of type i (i = r, s) with equality.
- (ii) Explain that for a *pooling contract* (R, C) the **zero-profit constraint** requires

$$\theta \left[R_r + (1 - p_r) C_r \right] p_r + (1 - \theta) \left[R_s + (1 - p_s) C_s \right] p_s \ge \rho.$$

- Let $ZPC_{r,s}$ denote the set of pooled joint liability contracts that satisfy the zero-profit constraint with equality.

(c) [3 points]

Express the **participation constraint** for a borrower of type i.

- Let PC_i denote the set of joint liability contracts that satisfy the participation constraint for a borrower of type i (i = r, s) with equality.

(d) [4 points]

Express the **limited liability constraint** for a borrower of type i.

- Let LLC_i denote the set of joint liability contracts that satisfy the limited liability constraint for a borrower of type i (i = r, s) with equality.
- (e) [4 points]

Express the **incentive compatibility constraint** for each type of borrower.

- Let ICC_i denote the set of joint liability contracts that satisfy the incentive compatibility constraint for a borrower of type i (i = r, s) with equality. • The ex-post incentive-compatibility constraint for each type requires that it is in the self interest of the group to report that a project failed when it actually did¹:

$$R_i \ge C_i, \ i = r, s.$$

- Let ICC_{ep} denote the set of joint liability contracts that satisfy the ex-post incentive-compatibility constraint for a borrower of type i (i = r, s) with equality.
- In dealing with borrowers outside their own segments, the informal lenders maximize their own profit subject to the same constraints the MFI faces, provided that ρ is substituted by ρ^{I} .

2. [35 points] Before the MFI Enters: Informal Lenders in Isolation

• Here we consider the case where MFIs are absent as corresponding to the baseline situation before an MFI enters. The market is divided into a number of segments, either spatially or on the basis of social relations, wherein residents of each segment know a lot about each other and/or engage in a thick web of social and economic transactions. Each segment has one lender and many borrowers. Owing to the thick interactions and exchange of information within any given segment in the past, the lender knows perfectly the risk types of borrowers in his own segment.

In the absence of the MFI the timing of the game is as follows: At stage 1, the informal lenders offer contracts to other-segment borrowers. At stage 2, informal lenders announce the contract for their own-segment borrowers. At stage 3, each borrower accepts at most one offer. At stage 4, contingent on the project being successful, the loan is repaid. The timing captures the additional advantage of dealing with own-segment borrowers, namely the ability to renegotiate the terms of their contracts following an offer from an external lender. We think it is plausible that lenders can communicate more frequently with members of their own segment, so they can react to offers made by lenders in other segments. Finally, we assume that borrowers prefer to be served by their own-segment lender whenever they are indifferent and the latter makes positive profit.

¹If this constraint is violated, the member of the group who succeeded may prefer to announce that both members succeeded even when her partner actually failed. This would entail paying the interest rate for both rather than paying back her own loan and paying joint liability for her partner.

(a) [10 points]

Explain carefully that there cannot be an equilibrium in which a lender in some segment (j, say) lends to a safe borrower in a different segment (i, say).

[Hints: Can the segment j lender make a positive expected profit on this loan? What is the implication on the lender's expected profit from a risky borrower in segment i?]

(b) [3 points]

It follows that lenders in any given segment i will have monopoly power over lending to safe types in i, and will thus be able to charge them a repayment amount R_s^I which extracts a certain amount of their surplus.

- What kind of contract, individual or joint liability, will a safe type borrower receive? Explain clearly.
- (c) [10 points: 2+3+3+2]

Note that all lenders compete for risky type borrowers across different segments.

- (i) What is the expected profit of a lender from lending a risky type?
- (ii) What kind of contract, individual or joint liability, will a risky type borrower receive? Explain clearly.
- (iii) Derive the expression for the repayment amount R_r^I that a risky type will receive.
- (iv) Given the tie-breaking rule, which segment lender will a risky type borrow from own or different?
- (d) [5 points]

Explain that safe borrowers pay the repayment amount

$$R_s^I = \min \left\{ Q_s - \frac{\underline{u}}{p_s}, \frac{\rho^I}{p_r} \right\}.$$

- (e) [7 points: 3 + 4]
 - (i) Is a risky borrower better-off compared with autarky? Explain clearly.
 - (ii) Is a safe borrower better-off compared with autarky? Explain clearly.

3. [45 points] When MFI and Informal Lenders Co-exist

- Finally we consider the scenario when the MFI enters and competes with informal lenders. To this end, we add an additional stage to the timing presented in the last section, namely, at stage 0 we allow the MFI to make loan offers.
- Suppose the parameter values are such that 4 different scenarios arise as depicted in panels A, B, C and D in the following figure. Carefully analyze the scenarios and answer, with a clear explanation, the following questions for each panel.
 - (i) Outreach:
 - From which type of lender will a risky type borrower borrow MFI, informal lender in own segment, or informal lender in different segment?
 - From which type of lender will a safe type borrower borrow MFI, informal lender in own segment, or informal lender in different segment?
 - (ii) Contract Choice:
 - What kind of contract, individual or joint liability, will a risky type borrower receive?
 - What kind of contract, individual or joint liability, will a safe type borrower receive?
 - (iii) Welfare:
 - Is a risky borrower better-off compared with the equilibrium of the informal market without an MFI?
 - Is a safe borrower better-off compared with the equilibrium of the informal market without an MFI?

