A Theory of Interactions Between MFIs and Informal Lenders*

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Abstract

We develop a theoretical framework to study the impact of microfinance on pre-existing rural credit markets, where local lenders have better information about risk types of local borrowers they have dealt with in the past. The microfinance institution's (MFI) comparative advantage lies in its lower opportunity cost of capital. Our simple model reconciles and explains a variety of well-documented facts: (i) MFI penetration might increase the interest rate in the rural credit markets, (ii) Informal lenders rarely offer joint liability loans and tend to have repeated interactions with their clientele, (iii) Very poor borrowers might pay relatively high interest rate in the informal market and are often beyond the reach of microfinance, and (iv) The MFI is more likely to attract risky borrowers. We also find that, irrespective of whether or not microfinance coverage increases the interest rate in the rural markets, its presence is always pareto improving for borrowers. Finally, we offer a number of testable implications.

Keywords: Microfinance, Informal Credit Market, Moneylender, Agent Based Lending, Group Based Lending, Selection, Takeup, Repayment
JEL: D82, O16

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1 Introduction

The economic literature has recently been questioning the ability of microfinance to deliver on its promises of fast and sustainable poverty alleviation. Aside from the limited impact on asset ownership and consumption[1], a criticism has been raised that microfinance might exert negative externalities on preexisting rural credit market.

Originally designed to reduce the dependence of poor households from moneylenders, microfinance was expected to drive local lenders out of business and to reduce the interest rate in rural credit markets. However, despite the rapid growth in outreach of microfinance institutions (MFIs), local moneylenders continue to coexist with formal institutions.

Recent empirical evidence from Bangladesh even suggests that the penetration of microfinance might have increased the equilibrium moneylender interest rate (Berg, Emran, and Shilpi [2012] and Mallick [2012]). Understanding the channels driving the increase in the informal interest rate is then important because it can help clarify whether microfinance programs are indeed imposing negative externalities and, if so, which policy intervention is advisable.

Empirical findings in Mallick (2012) suggest that this increase cannot be explained by theories that focus on negative externalities due to scale economies, competition or collusion among moneylenders.[2,3] Berg et al. [2012] confirm these results using a larger survey, which combines both cross section and panel data. However, taking advantage of the panel dimension, they also manage to rule out theories based on "crowding-in" (Jain and Mansuri [2003]) because they observe that being a MFI member reduces the probability of borrowing

[1]See Karlan and Mullainathan (2010); Banerjee, Duflo, Glennerster, and Kinnan, (2011); Karlan and Zinman, (2011) and Desai, Johnson, and Tarozzi, (2011).

[2]See for example, Hoff and Stiglitz (1998) on enforcement costs of lending where competition from MFIs can force a moneylender to increase the interest rate to cover screening-related fixed costs as the number of borrowers decline; Kahn and Mookherjee (1998) on moral hazard and non-exclusive credit contracts where competition from MFIs (or more generally an increase in public provision of credit) can result in increased interest rate, owing to a reduction in borrowers' effort; Floro and Ray (1997) on collusion where expansion of formal credit may strengthen the ability of informal lenders to collude with each other.

[3]Mallick's (2012) results hold after controlling for a rich set of variables including proxies for competition/collusion among moneylenders, cost of information collection about the borrowers, and village level fixed effects.

from moneylenders. Thus, MFI penetration does not seem to increase the moneylender interest rate by increasing the demand for informal loans.[4] Maitra, Mitra, Mookherjee, Motta and Visaria (2013) confirm this result by using data form a field experiment and further show that MFI members are likely to be risky borrowers, as indicated by the fact that they pay more-than-average interest rate in the informal market. These findings rule out "cream skimming" (Demont [2012]) a mechanism by which the MFI would attract safe borrowers away from informal lenders, exacerbating the asymmetric information problem in rural credit markets and potentially increasing the moneylender interest rate to the detriment of those safe borrowers that are excluded from the MFI loans.[5]

However thought provoking, the existing theories seem then unable to offer a unified approach that can explain the various facets of the recent empirical evidence. The contribution of this paper is to offer such an unified theory that reconciles this empirical evidence and explains other real-world observations such as (i) informal lenders rarely offer joint liability loans and tend to have repeated interactions with their clientele (Banerjee [2003] and Maitra et al. [2013]), and (ii) very poor borrowers might pay relatively high interest rate in the informal market and are often beyond the reach of microfinance (Khandker, [1998]). One important implication of our model is that the increase in moneylender interest rate need not be due to negative externalities imposed by microfinance programs. In fact, our model predicts that the increase is driven by selection of moneylender clients across wealth levels, and the presence of the MFI imposes no negative externalities. To rigorously test this hypothesis, household-level data on moneylender interest rate is required, something not available in Mallick [2012] and Berg et al. [2012]. Overcoming this limitation of the data, a point also discussed by the authors, seems crucial in light of our theoretical results.

Our theory builds on Ghatak's (2000) model and depart from it in two important ways.

[4] Jain and Mansuri (2003) propose that microfinance penetration might increase demand for informal loans and put upward pressure on moneylender interest rate. This is due to the fact that MFI members might need additional loans from informal sources because of the MFI's tight repayment schedule, or because investments are indivisible and certain economies of scale are required.

[5] Bose (1998) also points out that the subsidized credit might attract the better borrowers away from the moneylenders and worsen the borrower pool, forcing them charge a higher interest rate

First, we introduce an informal credit market alongside the formal one in which the MFIs operate. In practice, local lenders have extensive past experience in lending to their respective clienteles and have thereby accumulated substantial knowledge about their relative reliability in repaying loans. This is one of the comparative advantages of local lenders vis-a-vis external lenders, which explains why local lenders and MFIs can coexist (see Banerjee [2003] for a review). To accommodate this we allow local lenders to have better information about risk types of local borrowers they have dealt with in the past. This superior private information provides the local lenders with a measure of monopoly power, and it explains the emergence of segmentation in rural markets. On the other hand, the MFI's comparative advantage lies in its lower opportunity cost of capital, which in turn explains why group lending is notably not adopted by informal lenders: in equilibrium, the moneylender does not *need* to screen his own clientele using joint liability contracts, and *cannot* offer an attractive joint liability contract when competing with the MFI on the level field of borrowers outside his clientele.

The other direction we extend Ghatak's model is to introduce an additional observable characteristic, namely the borrowers' level of (non-collateralizable) wealth (i.e., land or other inputs of production). This is necessary to evaluate the success of microfinance with respect to targeting poor versus very poor borrowers.

In our analysis we assume that the MFI's objective is to maximize borrowers' welfare, but we remain agnostic regarding the possibility that the MFI might put more weight on the welfare of safe borrowers vis-a-vis risky ones. Competition between MFI and moneylenders takes place via an announcement game, where they all announce their credit contracts to the potential borrowers who then select only one contract among the available ones. We postulate that moneylenders can leverage their close relationship with borrowers (especially those within their clientele) by effectively renegotiating their announcement after the MFI makes its offer.

Depending on the opportunity cost of capital, the borrowers' wealth, and the concentration of risky borrowers, we have a variety of possible equilibrium outcomes in the credit market. In all equilibria, the risky borrowers are served by the MFI. On the other hand, safe borrowers could be served by the informal lenders and be completely expropriated. This is likely to occur when the safe borrowers are poor. In a world with no asymmetric information, the MFI would offer a fair interest rate to the safe borrowers and attract all of them. With the intensifying of the asymmetric information problem, the MFI tries to mitigate the adverse selection by offering joint liability loans. The latter involve a joint liability tax that could be unaffordable to the poor farmers. Moreover, as the intensity of the adverse selection problem increases, so does the value of the informal lenders' private information, rendering the MFI relatively less competitive. The combination of these two effects implies that poor borrowers are more likely to be served by the informal lenders. Nonetheless, the presence of the MFI can in some cases provide an outside option to the poor borrowers that effectively reduces the level of exploitation (something that was also previously noted by Besley, Burchardi and Ghatak [2012]).

Given that the MFIs attract mostly risky borrowers, their presence might help reduce the average interest rate in the informal market. But the MFIs are also likely to leave the very poor safe borrowers in the clutches of the moneylenders, and, as it turns out, poor borrowers might pay a relatively high interest rate in the informal market if projects returns are at (least initially) increasing in wealth (an assumption consistent with the findings in Maitra et al. [2013]). Hence, our model predicts that microfinance program coverage could increase the observed average interest rate in the informal market. But our explanation does not hinge"cream skimming". Quite the opposite, our result stems from the combination of segmentation in the informal market and the MFI's adoption of joint liability contracts to reduce its informational disadvantage. Crucially, our explanation differs from cream skimming in that microfinance programs unequivocally increase welfare and its penetration is always pareto improving for borrowers.[6]

[6]In a concurrent but independent paper Demont (2012) also builds on Ghatak's (2000) model but, unlike us, assumes that the informal lenders have no privileged information regarding the borrowers' risk type. Therefore, his model cannot explain the emergence of segmentation in the informal credit market. Demont (2012) also posits that the MFIs and the informal lenders have the same opportunity cost of capital, but,

In the next section we introduce the model. Sections 2.1 and 2.2 present the equilibrium when the only lenders operating in the market are respectively the MFIs and the informal lenders. Section 3 study the competitive equilibrium between MFIs and informal lenders, and Section 3 concludes.

2 The Model

All borrowers live in a village with a large population normalized to unity and are endowed with a risky investment project. The project requires one unit of land and 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; we refer to these outcomes as success (S) or failure (F). The outcome of a farmer's project will be denoted by the binary random variable $\bar{x} \in \{S, F\}$, which is observable and verifiable. The borrowers are characterized by (i) their unobservable probabilities of success p_i with $i \in \{r, s\}$ and $0 < p_r < p_s < 1$ (ii) their (non-collateralizable) wealth $a \geq 0$, which also represents their outside option (autarky) from the investment project. Wealth can take the form of land or other inputs of production. If $a < 1$ the borrowers need to lease in the remaining amount of inputs $(1 - a)$ required by the project.[7] Borrowers characterized by probability of success p_r and p_s are refereed to as risky and safe farmers respectively. Risky and safe borrowers exist in proportions θ and $(1 - \theta)$ in the population, where $\overline{p} \equiv \theta p_r + (1 - \theta) p_s$. The outcomes of the project are assumed to be independently distributed for the same types and across the different types. The return of a project of a borrower of type i is a random variable $\tilde{y}_i$, which takes two values: $R_i(a)$ if successful and 0 if not where $R_i(a) > 0$; $i = r, s$. Project returns will be assumed to be increasing in a. If a is interpreted as landholding the

for reasons not explicitly modelled, only the MFIs can offer joint liability loans. In Demont's model (2012) the MFIs have a limited amount of credit to offer whereas informal lenders have no capacity constraints, a situation that prevents MFIs from driving the informal lenders completely out of business. Demont also assumes away that the limited liability condition is always satisfied, effectively side stepping the possibility that the joint liability tax (implicit in any group loan) could be unaffordable to the poor farmers.

[7]If a is land, leasing is on a sharecropping contract, where the borrowers retains α fraction of the output, the remaining going to the landlord, with $\alpha \in (0, 1)$.

returns are increasing owing to the reduction in distortions associated with tenancy, ranging from inferior quality of leased in land to Marshallian undersupply of effort. For the sake of exposition, we assume $p_s R_s(a) = p_r R_r(a) \equiv \bar{R}$. Borrowers are risk-neutral and maximize expected returns. Note that each borrower is endowed with only one project, and so she borrower either from the MFI or the informal lender. Exclusive lending is consistent with empirical evidence in Maitra et al. (2013) that suggests that providing borrowers with new loans does change the total amount borrowered but just the composition of the portfolio.

2.1 Microfinance Institution.

To begin with, we assume there are no informal lenders and the Microfinance Institution (MFI) is the only provider of credit. Informal lenders will be introduced in the next section. In what follows we assume that the MFI can offer two types of credit contracts: individual liability contracts and joint liability contracts. The former is a standard debt contract between a borrower and the MFI with a fixed repayment r in state $\bar{x} = S$, and zero otherwise. The latter involves asking the borrowers to form groups of two, and offering an individual liability component r and a joint liability component c.[8] Owing to the limited-liability constraint, if the project of a borrower fails she pays nothing to the bank. If a borrower's project is successful then apart from repaying her own debt r to the bank she has to pay c per member of her group whose projects have failed. Irrespective of which type of contract the MFI offers, there are no capacity constraints.[9]

If the MFI cannot identify a borrower's type then using individual liability contracts with separate interest rates would not work. A borrower would have an incentive to accept the lowest interest rate, irrespective of her type. If the lenders charge all borrowers the same interest rate r, and both types of borrowers participates in equilibrium, the lenders need to charge at least $r = \rho/\overline{p}$ to breakeven, where $\rho > 1$ denotes the opportunity cost of capital.

[8]See Ahlin (2012) and Maitra et al. (2013) for an analysis of group lending under adverse selection with group size greater than 2.

[9]Our main results would not change if we were to assume that the MFI has a limited amount of loans to disburse.

To keep the model simple we postulate that all projects are socially productive, $p_i R_i > \rho + a$ for $i = \{r, s\}$.

Let us turn now to a more general class of contracts that allow for joint liability. The contracting problem is the following sequential game: first, the bank offers a finite set of contracts $\{(r_1(a), c_1(a)), ...\}$; second, borrowers who wish to accept any one of these contracts select a partner and do so; finally, projects are carried out and outcome-contingent transfers as specified in the contract are met. Note that this class of contracts include individual liability loans as a special case when $c(a) = 0$. Borrowers who choose not to borrow enjoy their reservation payoff a.

Without loss of generality Ghatak (2000) restricts attention to the set of contracts which have non negative individual and joint liability payments, $\mathcal{F}^{JL} = \{(r_i, c_i) : r_i(a) \geq 0, c_i(a) \geq 0\}$. Ghatak (2000) also proves that any joint liability contract $(r, c) \in \mathcal{F}^{JL}$ induces assortative matching in the formation of groups, and that assortative matching maximizes aggregate expected payoff of all borrowers over different possible matches. It is straightforward to see that these results extends to our framework: the farmers that self-selecte in a group are of the same type (i, a). Given that there are two types of borrowers and any contract $(r, c) \in \mathcal{F}^{JL}$ induces assortative matching in the formation of groups, we follow Ghatak (2000) and restrict the bank's choice of optimal contracts to a pair (r_r, c_r) and (r_s, c_s) designed for groups consisting of risky and safe borrowers respectively. The expected payoff for a borrower of type i under a contract (r, c) is

$$U_{ii}(r, c) = p_i R_i(a) - \{p_i r + p_i(1 - p_i)c\} . \tag{1}$$

The bank's objective is to choose (r_r, c_r) and (r_s, c_s) to maximize

$$V = \lambda U_{rr}(r_r, c_r) + (1 - \lambda)U_{ss}(r_s, c_s), \tag{2}$$

where $\lambda \in (0, 1)$ is the welfare weight that the MFI attributes to risky borrowers, and subject to the following constraints: (i) The *zero profit constraint* of the bank requires that the average expected repayment is at least as large as the opportunity cost of capital, ρ. We require the MFI to break even on the average loan: $\theta[r_r + c_r(1-p_r)]p_r + (1-\theta)[r_s + c_s(1-p_s)]p_s \geq \rho$. Let $ZPC_{r,s}$ denote the set of joint liability contracts that satisfy the zero-profit constraint with equality. 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) The *participation constraint* of each borrower requires that the expected payoff of a borrower from the contract is at least as large as the value of her outside option a: $U_{ii}(r_i, c_i) \geq a$, where $i = r, s$. Let PC_i denote the set of joint liability contracts that satisfy the participation constraint of a borrower of type i with equality. (iii) The *limited liability constraint* requires that a borrower cannot make any transfer to the lender when her project fails, and that the sum of individual and joint liability payments cannot exceed the realized revenue from the project when it succeeds: $r_i + c_i \leq R_i(a)$, where $i = r, s$. Let LLC_i denote the set of joint liability contracts that satisfy the limited liability constraint of a borrower of type i with equality. (iv) The *incentive-compatibility constraint* for each type of borrower requires that it is in the self-interest of a borrower to choose a contract that is designed for her type since that is private information: $U_{ii}(r_i, c_i) \geq U_{ii}(r_j, c_j)$, where $i, j = r, s$ and $i \neq j$. For a pooling contract the same contract (r, c) is offered to all borrowers who wish to borrow and hence these constraints are not relevant. Let ICC_i denote the set of joint liability contracts that satisfy the incentive-compatibility constraint of a borrower of type i with equality. (v) The *ex-post incentive-compatibility constrain* for each type requires that it is in the self interest of the group to report that a project failed when it actually did (see Gangopadhyay, Ghatak and Lensink, 2005): $r_i \geq c_i$ for $i = r, s$. Let ICC_{ep} denote the set of joint liability contracts that satisfy the ex-post incentive-compatibility constraint with equality. We abstract from moral hazard and assume that there is no voluntary default, i.e., borrowers always repay when the project is successful. Albeit assuming moral hazard would be plausible, here we consider a parsimonious model with pure adverse selection and show that it can effectively explain the empirical evidence we are interested in, without the need of further complications.

The following assumption ensures that there exists a joint lability contract:

$$p_s R_s(a) \geq \max\left\{\frac{p_s(2-p_s)}{\theta p_r(2-p_r)+(1-\theta)p_s(2-p_s)}\rho + a, \rho\frac{p_s}{\overline{p}} + \beta a\right\}, \tag{3}$$

where $\beta \equiv \frac{\theta p_r^2 + (1-\theta)p_s^2}{p_s \overline{p}}$. The two terms on the right hand side represent the relevant thresholds on the safe borrowers' project expected return. The first one ensures that there exists a contract the satisfies the participation constraint and the ex-post incentive compatibility constraint, whereas the second term guarantees that the participation constraint and limited liability constraints are satisfied.

Proposition 1 *Suppose that (3) holds and there are no informal lenders. Then in equilibrium the MFI serves both risky and safe borrowers using either pooling or separating contracts. If (3) is violated the MFI serves only the risky borrowers.*

Proof. We first consider a pooling joint liability contract (r, c). Note that this set of contracts includes individual liability as a special case, i.e., $c = 0$. Take the (r, c) plane and note that the absolute value of slope of the iso-cost curves[10] for the risky borrower, the average, and the safe one are respectively $1/(1-p_r) < -1/\left\{1 - [\theta p_r^2 + (1-\theta)p_s^2]/\overline{p}\right\} < 1/(1-p_s)$. The iso-cost curves also represent the iso-profit curves of the MFI for the corresponding type of borrowers. Hence, $ZPC_{r,s}$ is steeper than ZPC_r but flatter than ZPC_s as shown in Figure 1. Since $p_s > p_r$ it is sufficient to check the limited liability constraint of the safe borrowers, LLC_s. Given that LLC_s is flatter than both ZPC_r and ZPC_s, it is also flatter than $ZPC_{r,s}$. Thus, the contract (r, c) that lies on both the $ZPC_{r,s}$ and the LLC_s and satisfies the ICC_{ep}, must also satisfy $r > \hat{r}$ and $c < \hat{c}$, where $(\hat{r}, \hat{c})$ represent the point in the (r, c) plane where ZPC_s, ZPC_r, and $ZPC_{r,s}$ intersects as shown in Figure 1. It is easy to check that for such a contract $U_{rr}(r, c) > U_{ss}(r, c)$. Thus, of the two participation constraints, we only need to check that of safe borrowers. The condition under which this

[10]The iso-cost curve for a generic type i and level k is $p_i r + p_i(1-p_i)c = k$.

contract satisfies PC_s and the ICC_{ep} turns out to be (3): it effectively ensures that there exists a segment AB on the $ZPC_{r,s}$ as depicted in Figure 1. If condition (3) were violated the MFI would be unable to offer a pooling contract that attracts both the risky and the safe borrowers and that ensures non-negative profit at the same time. Condition (3) also applies to separating joint liability contracts. To see this, note that in this model the key problem facing the MFI is how to discourage risky borrowers trying to imitate safe borrowers. If the optimal individual lending contracts under full information were offered in the presence of adverse selection, it will be the risky borrowers who will try to mimic the safe borrowers. This is due to the fact that $U_r(r) > U_s(r)$ for any r, where $U_i(r) = p_i R_i - p_i r$ represents the borrower's i utility from an individual liability contract. Thus, any contract that attracts the safe borrowers also attracts the risky borrowers but not necessarily the other way around. As a result, the MFI finds it optimal to raise the extent of joint liability faced by safe borrowers up to a point where the incentive compatibility constraint of risky borrowers will bind, as in Ghatak (2000). The binding incentive compatibility for the risky type requires that $p_r r_r + p_r(1-p_r)c_r = p_r r_s + p_r(1-p_r)c_s$. Substitute this into the $ZPC_{r,s}$ to obtain $\theta[r_s + c_s(1-p_r)]p_r + (1-\theta)[r_s + c_s(1-p_s)]p_s \geq \rho$. All the other constraints for the safe borrowers are unchanged, so the proof for the pooling joint liability contract extends to the separating one.

In order to complete the proof, we need to show that it is never optimal for the MFI to offer a contract where all or some borrowers are excluded. We break this proof in three parts. We show that (i) It is never optimal for the MFI to serve no one. Suppose not, then the MFI can increase its payoff V by offering a contract along the ZPC_r that attracts the risky borrowers, leaves them with strictly higher utility than their outside option a (PC_r lies above and to the right of the ZPC_r because the project is assumed to be socially productive), and satisfies the break even constraint (irrespective of whether this contract attracts also the safe borrowers or not); (ii) It is never optimal to serve only the risky borrowers when there exists a contract that can also attract the safe ones. This is due to the fact that if

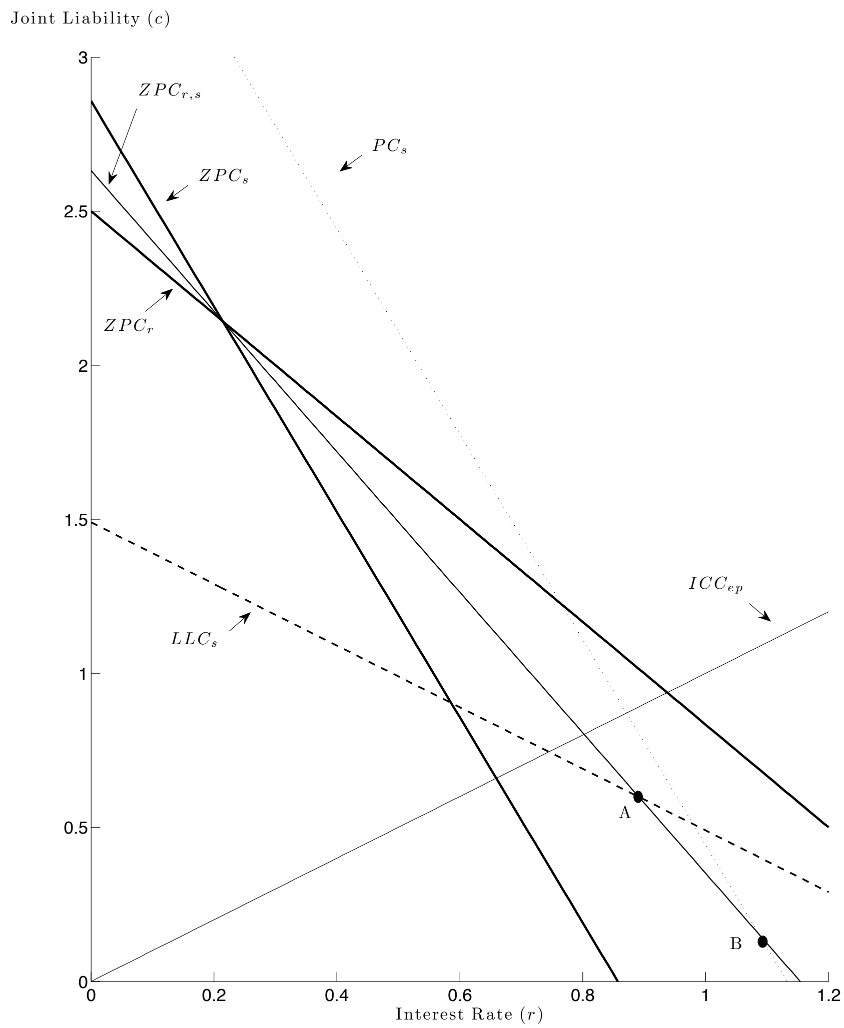

Figure 1: *The credit market when the MFI is the only lender.*

such a contract exists then it satisfies the safe borrowers' participation constraint and so it must be (weakly) welfare improving for these type of borrowers. The risky borrowers are strictly better off because they are cross-subsidized by the safe ones; (iii) It is never possible to serve only the safe borrowers. As we showed above, in the contractual space that satisfies the ICC_{ep} we have $U_{rr}(r, c) > U_{ss}(r, c)$. ■

Proposition 1 clarifies the condition such that the MFI can serve both safe and risky borrowers. A quick inspection of Figure 1 reveals that any contract on the $ZPC_{r,s}$ that satisfies the relevant constraints (i.e., the segment AB in Figure 1) is a candidate for the optimal pooling contract. Within this set, contract A maximizes the utility of the safe borrowers and any movement along the segment AB away from A strictly reduces their utility. The opposite applies to the risky borrowers, whose preferred contract is B. Thus, the solution to the optimal pooling contract can be pinned down using the MFI's utility weight λ.

The optimal separating contract will not be unique in general: as we show in the proof of Proposition 1, any contract on AB is also a candidate for the safe borrower's optimal separating contract (choosing a contract to the right and above would reduce both the safe and risky borrowers' utility; choosing a contract below and to the left would violate the zero profit condition). However, for any given safe borrower's contract C on AB there is an infinite number of contracts along the risky borrower's indifference curve that crosses C, which satisfy the incentive compatibility constraint and yield the same level of utility to the risky borrowers.

2.2 Informal Lenders

We assume that there is a large number of identical risk-neutral informal lenders. The cost of capital per loan is equal to $\rho^I > \rho$ and there are no capacity constraints. It is plausible to assume that informal lenders are endowed with some privileged information regarding their clientele. To capture this aspect, we consider the case where the informal credit market consists of a large number of segments. There is one lender in each segment and all segments contain the same number of independently distributed borrowers. Each lender observes the type of the borrowers in his own segment, but not in other lenders' segments. Lenders are otherwise identical. Each lender can commit to a set of contracts, consisting in a triple

$$\Gamma = \left\{(r_s^I(a), c_s^I(a)), (r_r^I(a), c_r^I(a)), (\tilde{r}_i^I(a), \tilde{c}_i^I(a))\right\},$$

where $i \in \{r, s\}$. These contracts define the interest rates and joint liabilities respectively for own-segment safe farmers, own-segment risky farmers, and other-segment farmers, for a given autarky option a. Let us denote by $ZPC^I_{r,s}$, ZPC^I_r, and ZPC^I_s the corresponding zero profit constraint lines for the informal lenders. For the sake of exposition, we assume that both safe and risky borrowers have socially productive projects

$$p_i R_i(a) - a \geq \rho^I \qquad i = r, s. \tag{4}$$

As a tie-breaker assumption we impose that, if payoff-equivalent, the informal lenders prefer individual liability contracts to joint liability ones, a rationale being that joint liability comes with additional administrative costs due to group meetings.

Timing. In the absence of the MFI the timing of the game is as follows: At date 1, the informal lenders announce the contract for the other-segment borrowers. At date 2 informal lenders announce the contract for the own-segment borrowers. At date 3, each borrower accepts at most one offer.[11] At date 4, contingent on the project being successful, the loan is repaid. The announcements 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.[12] We think that this is a plausible assumption: it is tantamount to impose that lenders have a better communication technology with borrowers in their clientele and that this superior technology allows them to send an additional message after the external lenders have depleted their communication opportunities. Finally, we assume that borrowers prefer to be served by own-segment lenders whenever they are indifferent and the latter makes positive profit. This assumption in not substantive, it merely simplifies the exposition.

[11] In our model there are no capacity constraints. Thus, assuming instead that each borrower could accept more than one offer—possibly from the same lender—would not change our results.

[12] Assuming instead that the announcements are simultaneous would not alter out main results substantially but it would complicate the analysis of the equilibrium in the informal market, namely the equilibrium would not exist whenever the informal lender is able to offer a set of contracts that satisfy the zero profit condition and also attracts both risky and safe borrowers from other segments.

Proposition 2 *In the absence of the MFI, the informal lenders offer individual liability contracts. The informal lender serves his own-segment safe borrowers at interest rate* $r_s^I(a) = \min\{R_s(a) - \frac{a}{p_s}, \frac{\rho^I}{p_r}\}$ *and makes positive profit. The risky borrowers are served by any lender at fare interest rate* $r^I = \frac{\rho^I}{p_r}$.

Proof. We proceed by backward induction. At date 2, if a contract exists that attracts own-segment borrowers and makes positive profit, the informal lenders announce it. At date 1, informal lenders announce the contract for the other-segment borrowers. Let us start with pooling contracts. In order to break-even, a pooling joint liability contract must be on the $ZPC_{r,s}^I$ or above and to the right of it. But the informal lenders can make a profit by announcing at date 2 a better contract for the own-segment safe borrowers (i.e., a contract below and to the left of the $ZPC_{r,s}^I$), leaving only risky borrowers in the market. Thus, informal lender cannot attract safe borrowers from other-segments using a pooling joint liability contract. The same applies to separating joint liability contracts. To see this note that whenever the ICC_{ep} is satisfied it is the risky borrowers that have a stake in mimicking the safe borrowers, not the other way around. Thus, the binding incentive compatibility constraint for the risky type requires that $p_r\tilde{r}_r^I(a) + p_r(1-p_r)\tilde{c}_r^I(a) = p_r\tilde{r}_s^I(a) + p_r(1-p_r)\tilde{c}_s^I(a)$. Substitute this into the $ZPC_{r,s}$ to obtain $\theta[\tilde{r}_s^I(a) + \tilde{c}_s^I(a)(1-p_r)]p_r + (1-\theta)[\tilde{r}_s^I(a) + \tilde{c}_s^I(a)(1-p_s)]p_s \geq \rho$, which is equivalent to the zero profit condition for a pooling contract. Hence, in equilibrium informal lenders cannot attract other-segment safe borrowers using separating joint liability contracts. Still, they can try to attract other-segment risky borrowers. Clearly, any contract below and to the left of the ZPC_r^I does not break-even if only the risky borrowers are left in the market. The contract cannot be above and to the right of the ZPC_r^I either. Suppose it is, then one lender could offer a contract with slightly better conditions, attract all the risky borrowers from other-segments and make positive profit. Thus, the equilibrium contract must be on the ZPC_r^I. Given that we assumed that informal lenders prefer individual liability contracts when indifferent, the equilibrium contract is $\tilde{c}_s^I(a) = \tilde{c}_r^I(a) = 0$ and $\tilde{r}_s^I(a) = \tilde{r}_r^I(a) = \frac{\rho^I}{p_r}$. At date 2, the informal lenders cannot announce a more favourable contract for the own-segment risky borrowers that also makes positive profit, so our tie-breaking assumption implies that risky borrowers are served by the informal lenders from other segments. On the other hand, informal lenders serve their own-segment safe borrowers and make strictly positive profit by offering $c_s^I(a) = 0$, and $r_s^I(a) = \min\{R_s(a) - \frac{a}{p_s}, \frac{\rho^I}{p_r}\}$, i.e., a contract that is incentive compatible and also satisfies PC_s. Offering a contract with positive joint liability would not increase profit, so under our tie-breaking assumption assumption there is no stake in deviating from individual liability contracts. Whenever $r_s^I(a) = \min\{R_s(a) - \frac{a}{p_s}, \frac{\rho^I}{p_r}\} = \frac{\rho^I}{p_r}$ our tie-breaking assumption entails that safe borrowers prefer to be served by the informal lender in their segment because they are indifferent and the latter makes positive profit. ■

The reason why informal lenders do not offer joint liability contracts is that, although group loans can help alleviate the adverse selection problem, they still suffer from the inefficiencies associated with the use of the joint liability tax. Hence, the own-segment lender can leverage his privileged information and outcompete any group loan offered by other-segment lenders. It is also worth noting that the equilibrium interest rate for the risky borrowers is higher than the one for the safe borrowers. Moreover, the former does not depend on the level of landholding. On the other hand, the interest rate for the safe borrowers depends on the level of landholding. The nature of this relationship hinges on the shape of the return function $R_s(a)$: it is rising or falling in a depending on whether $R_s'(a)$ exceeds or falls below $\frac{1}{p_s}$. If $R_s(a)$ is at least initially convex in a, the interest rate is likely to exhibit a u-shape.

2.3 Market Equilibrium

We now study the interaction between informal and formal credit market. To this purpose, we add an additional stage to the timing presented in the Section 2.2, namely at date 0 we allow the MFI to make its announcement. Loans are exclusive in that each borrower can accept at most one offer.[13] Let us define

$$\delta \equiv \frac{\beta - 1}{\beta}\left(\frac{\rho^I}{p_s} - \rho\frac{p_s}{[\theta p_r p_r + (1-\theta)p_s p_s]}\right) \tag{5}$$

and

$$\delta_I \equiv \frac{p_s(2-p_s)}{\theta p_r(2-p_r) + (1-\theta)p_s(2-p_s)}\rho. \tag{6}$$

Finally,

$$\gamma(a) \equiv \frac{p_r}{p_s^2}a + \frac{\rho}{p_r}. \tag{7}$$

Then we show:

Proposition 3 *For a given landholding a, every equilibrium has the following properties:*

1. *If $R_s(a) \geq \delta$ and $\rho_I \geq \delta_I$ the MFI serves both the risky and safe borrowers. The informal lenders do not serve any borrower.*

2. *If $R_s(a) < \delta$ or $\rho_I < \delta_I$ the MFI serves only the risky borrowers, and the informal lenders serve the own-segment safe borrowers. However, if $R_s(a) \geq \gamma(a)$ the presence of the MFI can increase the bargaining power of the safe borrowers, which in turn raises their equilibrium payoff. If $R_s(a) < \gamma(a)$ the presence of the MFI cannot affect the safe borrowers' payoff.*

Proof. See Appendix ■

Figure 2 depicts a number of numerical examples to clarify the channels that drive the results in Proposition 3 (for details regarding the simulations see Appendix B). The Figure presents the relevant constraints for both the MFI and the informal lenders in the (r, c) plane, and highlights the effect of competition on the set of feasible contracts. Without loss of generality we focus here on the optimal MFI pooling contracts, the same discussion

[13] The assumption on exclusivity is consistent with the empirical findings in Maitra et al. [2013] and Berg at al. [2012], which suggest that MFI and moneylender loans are substitutes for each other.

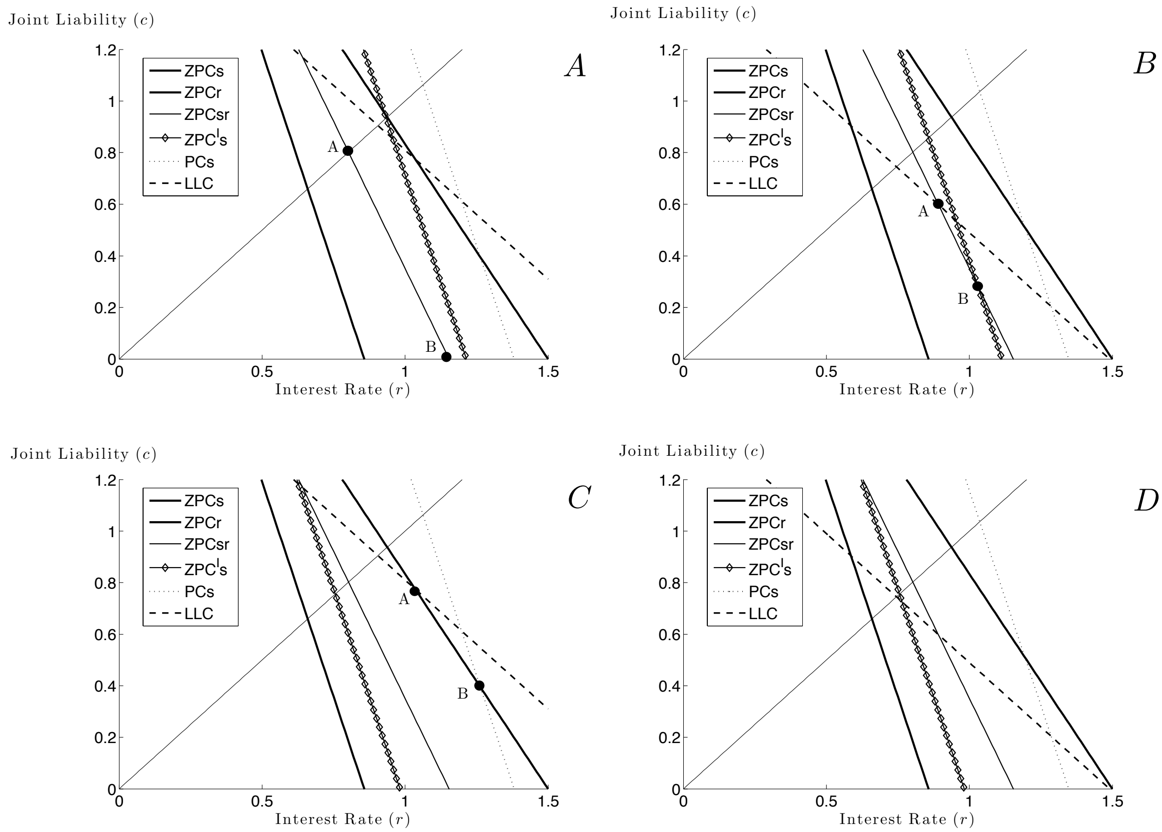

Figure 2: *Interactions between MFI and Informal Lenders.*

applies to MFI separating contracts. Panel A shows a case where the borrower's level of landholding poses no restrictions—LLC_s never binds—and the MFI can easily outcompete the informal lenders—ρ^I is relatively high compared to ρ. Thus the MFI can offer any contract along the portion of the $ZPC_{r,s}$ that satisfies the ICC_{ep}, the segment AB in Panel A. In the absence of the MFI the safe borrowers would have received a contract with zero joint liability on the PC_s (see Proposition 2), which is clearly less favourable. The risky borrower would have been offered a contract on the ZPC_r^I, which is by construction to the left of the ZPC_r. Hence, both risky and safe borrowers are better off for the presence of the MFI. As borrowers become poorer (a decreases) and the informal lender more competitive (ρ^I decreases) the LLC_s and ZPC_s^I start to bind, effectively reducing the set of contracts available to the new segment AB depicted in Panel B. Further increases in competitiveness to the point where $\rho_I < \delta_I$ prevents the MFI from serving the safe borrowers (see Panel C). Proposition 3 implies that the MFI serves only risky borrowers by offering a contract along the ZPC_r. However, note that any contract on segment AB in Panel C appeals to the safe borrowers—it meets both PC_s and LLC_s. Hence, the informal lender must leave the own-segment safe borrowers with at least the same utility they would derive from accepting the MFI's offer. Panel C clearly shows that such level of utility is higher than the one achievable in the absence of the MFI, i.e., in this case a contract along the PC_s that fully expropriate the safe borrower. Interestingly then the MFI might have an incentive to offer a joint liability contract along the ZPC_r that does not add to the utility of the risky borrower but rather increases the bargaining power of the safe one. This might explain the real-world observation that a variety of joint liability contracts announced by the MFI are regularly neglected by borrowers and remain underused. Finally, Panel D illustrates the case where a further decrease in the level of landholding shifts the LLC_s to the left in a way that negates the possibility of affecting the payoff of the safe borrowers—$R_s(a) < \gamma(a)$ and therefore there is no contract along the ZPC_r that satisfies both PC_s and LLC_s.

Figure 2 gets our point across by showing that the MFI does not "cream skim", quite to the contrary the informal lenders do so by using their privileged information. This is particularly clear in Panels C and D where the MFI could offer a welfare improving contract along the $ZPC_{r,s}$ but the informal lenders prevent it to do so by leveraging the asymmetric informal to their advantage. In summary:

Remark 4 *The presence of the MFI unambiguously increases borrowers welfare and reduces the interest rate they pay (at least for a fraction of them). Informal lenders use their private information to engage in "cream skimming", which decreases borrowers' welfare.*

The discussion preceeding Remark 4 seems to imply that the average interest rate in the informal market should decrease following the appearance of the MFI. However, this need not be the case and the opposite might still occur. Such an increase would not be due to "cream skimming" but rather to selection across landholding levels. Figure 3 represents the

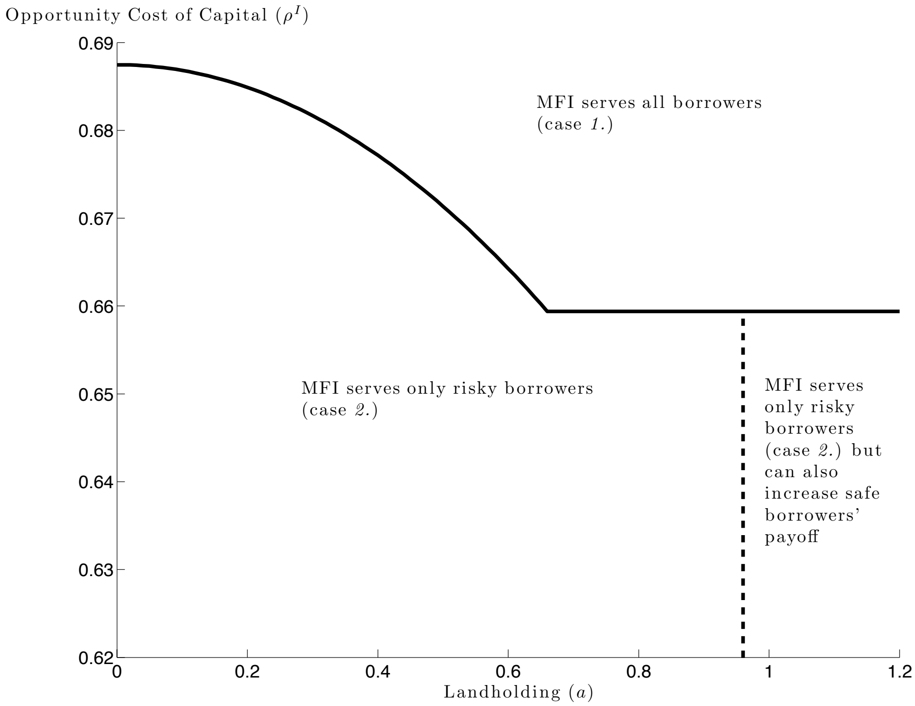

Figure 3: *Borrowers' selection function of landholding and cost of capital.*

selection process in the (a, ρ^I) plane, and further clarifies how borrowers are sorted between the MFI and the informal lenders.

In equilibrium the informal lenders are more likely to be left with poor safe borrowers who are unable to afford the joint liability tax. But these borrowers could be paying a relative high interest rate in the informal market absent the MFI. Figure 4 shows that in our numerical examples (see Appendix B) this turns out to be the case. Recall from Proposition 2 that the interest rate for the safe borrowers depends on the level of landholding. In our numerical example $R_s(a)$ is initially convex in a, an assumption that have empirical support (see, for example, Maitra et al. [2013]). The model thus is consistent with the u-shaped interest rate curve in Figure 4. This shape has an intuitive interpretation: It can be seen as the surplus that the lender extracts from his safe clients.[14] Take now the numerical example depicted in

[14]Initially the surplus is large because the lender is in a strong bargaining position owing to the client's outside option, a, which is low. An increase in a boosts the value of the project, and consequently the surplus that the lender can extract. But it also increases the client's outside option, weakening the bargaining position of the lender. If $R_i(a)$ is convex, the second effect could dominate for low values of a, while it would be

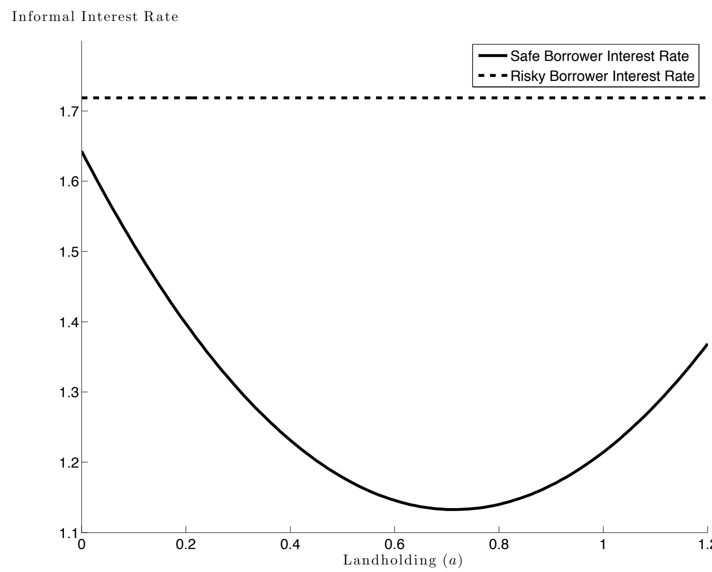

Figure 4: *Interest rate by level of landholding in the absence of the MFI.*

Figures 3 and 4, and consider a village with $\rho^I = 0.68$ and a population of borrowers with landholding uniformly distributed in the interval $[0, 1.2]$. The entrance of the MFI leaves the informal lenders with safe borrowers with small landholding (approximately less than 0.4 as represented in Figure 3). If one were to compute the interest rate in the informal market before and after the entrance of the MFI, the result would indicate an increase of 5% in the interest rate. But this is entirely due to selection and to the high interest rate paid by the poor borrowers in the informal market; it does not indicate a deterioration of borrowers' welfare. We summarise this result below:

Remark 5 *Following the entrance of the MFI, the average interest rate in the informal market could increase. This is due to selection across landholding and it is not detrimental to borrowers. The MFI's presence does not cause any negative eternality on those excluded form its dealings.*

dominated for high values of a.

3 Conclusion

We study the impact of Microfinance on pre-existing rural credit markets. We assume that the informal lenders have better information regarding the riskiness of their clients, but they also have higher cost of capital. We show that, in the absence of the MFI, informal lenders offer individual liability loans to their clients. The risky borrowers pay the fair interest rate, and the safe ones get expropriated. The market is segmented in that informal lenders entertains long-run and repeated dealings with their safe clients. Once the MFI has penetrated a market, it serves all the risky borrowers. However, safe borrowers could end up being served by the informal lenders and be completely expropriated. This is likely to occur when the safe borrowers are poor. In a world with no asymmetric information, the MFI would offer a fair interest rate to the safe borrowers and attract all of them. With the intensifying of the asymmetric information problem, the MFI tries to mitigate the adverse selection by offering joint liability loans. The latter involve a joint liability tax that could be unaffordable to the poor farmer. Moreover, as the intensity of the adverse selection problem increases, so does the value of the informal lenders' private information, rendering the MFI relatively less competitive. The combination of these two effects implies that poor borrowers are more likely to be served by the informal lenders. Nonetheless, the presence of the MFI can in some cases provide an outside option to the poor borrowers that effectively reduces the level of exploitation.

We present a numerical example to show that the average interest rate in the informal market could increase following the entrance of the MFI. This not due to the fact that the MFI engages in "cream skimming" of safe borrowers but rather it is due to selection: high-interest-rate poor safe borrowers are the ones who remain with the informal lenders. Thus, such an increase is not an indication that the MFI is detrimental to certain borrowers. In our model, the presence of the MFI does not generate any negative externality on those that are beyond its reach.

Our results are then consistent with the real-world observation that (i) informal lenders never offer joint liability loans and tend to have repeated interactions with their clientele (i.e., the informal market is segmented), (ii) poor borrowers might pay relatively high interest rate in the informal market and are often beyond the reach of Microfinance, (iii) the MFI are more likely to attract risky borrowers and rich safe borrowers and this selection might end up increasing the average interest rate in the informal market. This last result in particular serves as cautionary tale against evaluating the impact of Microfinance based on village-level data: in order to investigate the possibility of negative externalities due to MFI penetration, one needs to disentangle the selection process using household-level data on the interest rate paid in the informal market.

Finally, our theory provides some testable implications. First, controlling for landholding, interest rates in the informal market should fall with MFI penetration. Second, higher landholding and riskier borrowers are more likely to switch to microfinance. Third, moneylender interest rates should be higher in villages where higher percentage of household borrows from MFIs (i.e., there is a cumulative effect).

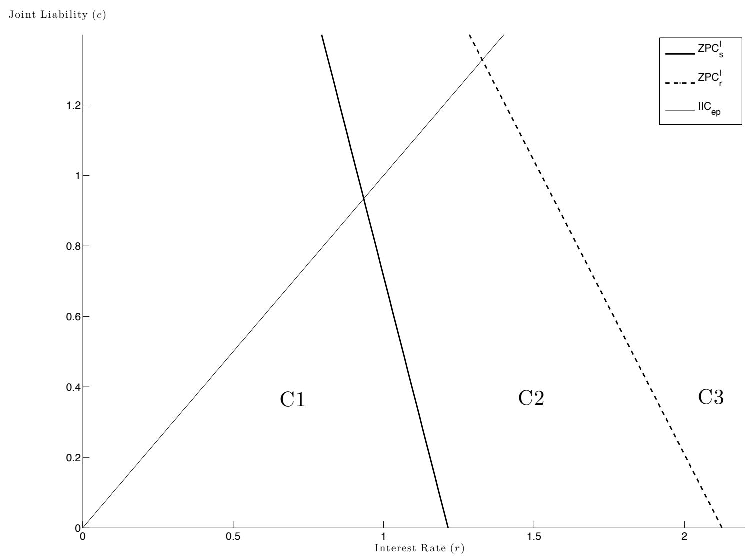

Figure 5: *Three contractual areas.*

4 Appendix

4.1 Proof of Propositon 3

Consider the three areas in the (r,c) plane delimited by the 45° line, and the ZPC_i^I for both types. Denote them respectively by $C1$, $C2$, and $C3$ as depicted in Figure 5, where $C1$ ($C2$) also includes the ZPC_s^I line (ZPC_r^I).

Remark 6 *If the MFI offers at least one contract $M1$ in $C1$, then in the continuation equilibrium it serves all the borrowers. Informal lenders are out of business.*

Irrespective of what type of borrower accepts it, any contract that it is preferable to the one offered by the MFI (i.e., a contract below and to the left of $M1$) leaves the informal lender with strictly negative profit.

Remark 7 *If the MFI only offers a set of contracts $M2$ in $C2$, then in the continuation equilibrium it attracts the risky borrowers whereas safe borrowers go to the own-segment lender and obtain at least a payoff equivalent to accepting $M2$.*

At date 2, the informal lender can announce a contract for the own-segment safe borrower, which is payoff-equivalent to $M2$ and makes positive profit. As showed in Proposition 2, the informal lender can always outcompete the contract announced by other-segment lenders. Then, in equilibrium the informal lender serves the own-segment safe borrowers. At date 1 the informal lender could still try to announce a contract that attracts risky borrowers (from his or others segment). However, any contract that attracts the risky borrower (i.e., a contract below and to the left of $M2$) also leaves the informal lender with negative profit.

Remark 8 *If the MFI offers contracts in $C3$, then in the continuation equilibrium all borrowers go to the informal lender.*

In this case the presence of the MFI has no impact. The market equilibrium is the one presented in Proposition 2.

From the perspective of the MFI, having a borrower accepting a contract in $C1$ always dominates one in $C2$, which in turns dominates one in $C3$. This is due to the fact that borrowers' utility increases moving downward and to left. Having determined this, a close inspection reveals that the MFI can offer a contract in $M1$ when case *1.* applies: such a joint liability contract (i) satisfies the limited liability constraint of the safe borrowers LLC_s — and so trivially also the risky borrowers' one (ii) satisfies the zero profit constraint $ZPC_{r,s}$ and (iii) cannot be matched by the informal lenders without violating the zero-profit constraint. Because point (iii) implies that the contract offered by the MFI must lie below and to the left of the ZPC_s^I, our assumption (4) ensures that the MFI's contract trivially satisfies the safe borrower's participation constraint PC_s. As we pointed out in the Proof of Proposition 1, for a contract (r, c) that lies on both the $ZPC_{r,s}$ and satisfies the ICC_{ep} it must be that $U_{rr}(r, c) > U_{ss}(r, c)$. Thus, of the two participation constraints, we only need to check that of safe borrowers. When case *1.* applies, Remark 6 implies that the MFI serves both the risky and safe borrowers in equilibrium. The contract that maximizes the borrowers' payoff is on the portion of the $ZPC_{s,r}$ that satisfies both LLC_s and ZPC_s. (Alternatively, the MFI could also offer a separating limited liability contract, where the risky borrowers is offered a payoff-equivalent contract). Panel A and B of Figure 2 depict alternative scenarios for case *1.* In both panels the contracts on the segment AB are candidates for optimality: the optimal contract is pinned downed by the MFI's utility weights λ. On the other hand, in case *2.* the MFI cannot offer any contract in $C1$, but it can still offer a contract in $C2$. From Remark 7 follows that the MFI serves only the risky borrowers. Any contract on the ZPC_r in $C2$ maximizes the risky borrowers' payoff. However, the MFI can also increase the safe borrowers equilibrium payoff by offering a contract along the ZPC_r that increases their bargaining power. Such contract exists if $R_s(a) \geq \gamma(a)$ is satisfied. This condition ensures that the MFI can offer a joint liability contract that lies on the ZPC_r and also satisfies (i) the safe borrower's participation constraint PC_s, (ii) the safe borrower's limited liability constraint, LLC_s. If $R_s(a) \geq \gamma(a)$ the optimal contract for the risky borrower has a joint liability component and lies on the segment AB as in Panel C of Figure 2. By offering this contract to the risky borrowers, the MFI forces the informal lenders to offer a contract to the left and below the PC_s, effectively preventing the safe borrower from being fully expropriated. If $R_s(a) < \gamma(a)$ there is no contract along the ZPC_r that satisfies both LLC_s and PC_s. In this case the presence of the MFI does not affect the safe borrowers' welfare (see Panel D of Figure 2). The MFI serves only the risky borrower via a fair individual liability contract.

4.2 Appendix B

The graphs and numerical examples presented in the paper are compiled with Matlab. We assume that $R_i(a) = 1+\sqrt{a}$, and the outside option is normalised to $a-\pi$. In all simulations we set $p_s = 0.7$ and $p_r = 0.4$, and we discretize the interest rate r and the joint liability c (and also landholding a in Figure 3 and 4) using more than 100 grid points for each variable. In Figure 1 $a = 0.7$; $\pi = 0.45$; $\rho = 0.6$; $\theta = 0.6$. In Figure 2 Panel A $a = 0.9$; $\pi = 0.6$; $\rho = 0.6$; $\rho^I = 0.85$; $\theta = 0.6$. In Figure 2 Panel B $a = 0.7$; $\pi = 0.6$; $\rho = 0.6$; $\rho^I = 0.78$;

$\theta = 0.6$. In Figure 2 Panel C $a = 0.9$; $\pi = 0.6$; $\rho = 0.6$; $\rho^I = 0.6874$; $\theta = 0.6$. In Figure 2 Panel D: $a = 0.7$; $\pi = 0.6$; $\rho = 0.6$; $\rho^I = 0.6874$; $\theta = 0.6$. In Figure 3 $\pi = 0.45$; $\rho = 0.6$; $\theta = 0.3$, and in Figure we additionally set 4 $\rho^I = 0.6874$.

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