Entry of Profit-Motivated Microfinance Institutions and Borrower Welfare*

Ratul Lahkar† and Viswanath Pingali‡

September 19, 2011

Abstract

In this paper, we model welfare implications of entry of commercial microfinance institutions (MFIs). We initially characterize equilibrium with a sole fund-constrained benevolent credit institution followed by equilibrium with only profit-motivated MFIs. We show that entry of such MFIs can lead to an increase in interest and default and a decline in screening. However, it can still represent a Pareto improvement since: all agents previously denied credit can obtain loans, and existing clients have the option of seeking loans from MFIs. Finally, we model multiple group formation as an equilibrium mechanism, which allows more efficient risk diversification.

Keywords: Microfinance, Joint Liability, Risk Diversification .
JEL classification: D04; D86; G21.

*We thank TN Srinivasan, Bindu Ananth, and Lakshmi Kumar for comments and discussions.
†IFMR, 24, Kothari Road, Nungambakkam, Chennai, 600 034, India. email: r.lahkar@ifmr.ac.in.
‡IFMR, 24, Kothari Road, Nungambakkam, Chennai, 600 034, India. email: viswanath.pingali@ifmr.ac.in.

1 Introduction

Since the early 2000s, there has been rapid expansion of microfinance industry in the developing world, both in terms of number of borrowers as well as lending institutions, thereby making the industry competitive. Intensification of competition has led to concerns of excessive borrowing and higher default rates, and a consequent deterioration of borrower welfare and sustainability of this sector. In this paper, we seek to understand this issue from a theoretical perspective. Using a model of adverse selection, we show that entry of new firms in the industry can, indeed, raise interest rates and default rates. Nevertheless, we show that higher interest and default rates can conceal a Pareto improvement in borrower welfare. Aggregate welfare improves primarily due to the fact that higher competition increases the outreach in terms of number of loans. We also show that the presence of multiple firms enables a borrower to engage in more efficient "risk-diversification" by forming multiple groups. This has a further welfare enhancing effect on borrowers.

Microfinance refers to the idea of providing access to financial services to low-income households, who are typically defined "non-bankable" by the traditional banking system.[1] While there are some operational dissimilarities across countries, the fundamental idea - collateral free lending to a group jointly liable for the loan of each individual member - remains the core idea behind microfinance. The institution of joint liability is expected to trigger of monitoring of individual behaviour by other group members, thereby substituting for the role that collateral conventionally plays in combating adverse selection and moral hazard among borrowers (Ghatak, 2000).[2]

For example, in India, there are two types of players from the supply side that operate on the principle of joint liability: self help groups (SHG) and traditional microfinance institutions (MFIs). Self Help Groups (SHG) have been in existence since the early 1990s (Bansal, 2003). The SHGs, typically, operate on a not-for-profit basis with the objective of enhancing borrower welfare. But since they receive their funding primarily from donor agencies and/or microsavings of their clients, their scope to extend credit is limited. The SHGs also have stringent participation constraints like regular savings, and mandatory training programs. On the other hand, the traditional MFIs have been in operation since late 1990's, but only picked up momentum in early to mid 2000's.[3]. Unlike SHGs, several of these MFIs are commercial organizations motivated by profit, and typically tend to follow SHGs into a particular market.[4] Recent data suggests that MFIs have been growing at faster rate than SHGs both in terms of the amount of loans disbursed and the number of borrowers

[1]While all financial products like micro lending, micro savings, micro insurance, etc, fall under the canopy of microfinance we only consider micro credit for this study. For the rest of the paper, the term microfinance only refers to micro credit.

[2]Joint liability refers to the institution where potential borrowers organize themselves into groups (based on certain criteria) and obtain loans as a group. While loans are given to individual members, the group as a whole is responsible for repayment of all the loans.

[3]As of 2009, the total outstanding loan portfolio of Indian microfinance industry stands at \$ 4.3 billion with more than 25 million active borrowers across over 80 MFIs. (http://www.mixmarket.org/). It has also experienced phenomenal growth between 2004 and 2009 with the industry doubling itself on an average both in terms of amount and number of loans disbursed. ("Inverting the Pyramid", Intellicap, 3rd edition, 2010)

[4]Discussions with Madura Microfinance and Grameen Kootas, two leading MFIs based out of South India have confirmed that MFIs typically follow once SHGs have established their presence.

served (Chapters 2 and 3, Srinivasan, 2010). This suggests that MFIs are replacing SHGs as the major source of credit in the microfinance sector.

The Indian example is representative of the pattern of historical developments in microfinance industry that has been observed in other countries. Microfinance starts out as a benevolent industry, before seeing entry, and subsequent dominance, from commercially motivated MFIs. This change in orientation of industry from benevolent objectives to commercial motives has led to several concerns. For example, it has been found that increase in the number of microfinance lenders increases the default rate.[5] Another criticism is that with access to multiple sources of credit, there may be increase in indebtedness due to indiscriminate borrowing.[6].

In this paper, we attempt to understand these concerns from a theoretical perspective. To this end, we develop a model of adverse selection wherein there are two types of agents: high risk and low risk.[7] This categorization serves as a proxy for possible differences in the quality of borrowers. We envisage an initial situation with an SHG being the sole lender. The lending capacity of the SHG is constrained and it seeks to optimize the utilization of the limited number of loans it can make while breaking even. In this situation, we show that if the proportion of low risk borrowers is sufficiently low, the SHG imposes certain participation requirements on borrowers to screen out the high risk borrowers. Since lending is thereby limited to low risk borrowers, interest rates and default rates are low. Significantly, SHGs are able to serve only a limited number of potential borrowers due to their constrained lending capacity.

The unmet demand attracts MFIs guided by the profit motive, making the industry more competitive. We assume that these MFIs do not have any constraint on their lending capacity. Therefore, they lend to borrowers of either type as long as the marginal profit is positive. We characterize the equilibrium that emerges under Bertrand competition in the presence of multiple MFIs and the single SHG. In equilibrium, unless the proportion of low-risk borrowers is exceptionally low, MFIs adopt a non-discriminatory lending policy in which they lend to any borrower who approaches them. This interest rate needs to account for the possibility of a borrower being of either type. Hence, it is higher than the interest rate charged by the SHG when it lends to only low risk types. Furthermore, since MFIs lend to borrowers of both types, the default rate is also higher. Significantly, in this case, the MFIs do not impose any participation cost on borrowers.[8]

Our model, therefore, does predict that with entry of commercial MFIs, interest and default may go up.[9]. Despite this, the situation can still represent a Pareto improvement over the situation

[5]McIntosh et. al (2005) discuss the development of microfinance in Uganda. They also provide evidence about the increase in default rates following in the the number of firms.

[6]The popular press has reported several suicides among Indian farmers. This trend has been attributed to over indebtedness as a result of increase in competition in this sector. For example, see http://www.bbc.co.uk/news/world-south-asia-11997571. Also, see http://microfinanceafrica.net/news/a-case-of-multiple-borrowings/ and http://www.guardian.co.uk/katine/2008/jun/03/livelihoods.projectgoals1 for similar concerns expressed about microfinance sectors in Africa and Bangladesh respectively

[7]For expositional convenience, in the rest of the paper, SHG refers to a benevolent funds-constrained organization whereas MFI refers to the microfinance institution to a profit making entity.

[8]To this extent, our results are consistent with theoretical studies on banking industry. See See Marquez (2002).

[9]This implication is consistent with the empirical findings of McIntosh et. al (2002) (see footnote 5)

when the SHG is the sole lender. First, borrowers of both types, earlier left out of the SHG, can now access loans from the MFI. Second, clients of the SHG can choose to remain with the SHG under the pre-existing contract. They now have the additional choice to migrate to MFIs if the avoidance of the participation cost more than compensates for the higher interest charged by the MFIs. Therefore, several concerns expressed about competition in microfinance industry can be interpreted as reactions to bad random draw of an otherwise *ex ante* Pareto improving outcome.[10]

Our final set of results focus on the implications of borrowing from multiple sources on borrower welfare. The joint liability mechanism is necessitated by the informational asymmetry between borrower and lender. However, compared to individual lending in the first best case of no informational asymmetry, joint liability reduces the welfare of a risk-averse borrower by imposing the risk of her partners' default on her. With multiple MFIs, on the other hand, borrowers may be members of different groups with one group membership providing only a fraction of her total loan requirement. Provided defaults are independent across individuals, and her partners in different groups are not the same, this mechanism enables a borrower to diversify the additional risk incurred due to the chances of her partners defaulting. Hence, our analysis suggest that multiple group membership (and hence, multiple loans) is a mechanism for borrowers to achieve more efficient risk diversification, instead of it being a means to indulge in over-borrowing.

The existing theoretical literature on competition and microfinance models the borrowers based on their economic profile, i.e., the richer borrowers and the poorer ones. However, the literature is not clear on whether the increase in competition leads to wider access of loans from MFIs. [11] For example, McIntosh and Wydick (2005) show that the increase in competition causes poorer borrowers to be unambiguously worse-off. This is because with increased competition, MFIs lose their ability to cross-subsidize poorer borrowers by charging higher interest from richer clients. On the other hand, Guha and Roy Chowdhury (2010) show that increased competition coupled with multiple borrowing leads MFIs to reach out to poorer sections.

A common feature of the two studies is that the MFIs have complete knowledge of the income of individual clients. It is debatable as to what extent this assumption is valid. In contrast, we make a weaker informational assumption. MFIs are only aware of the overall distribution of the risk profile of their clients, and not individual characteristics. This assumption implies that MFIs offer a menu of contracts from which, the borrowers can self-select. On the other hand, the existing literature assumes that a contract is thrust upon the borrower based on her economic status. Another assumption commonly considered in the literature is that MFs are non-profit organization. However, we do not make any such restrictive assumption on MFIs objectives.

The roadmap for the rest of the paper is as follows. In the next Section, we characterize the equilibrium with only an SHG present. Section 3 characterizes a competitive equilibrium

[10] Pareto improvement of borrowers' welfare is unambiguously valid whenever SHG screens borrowers. Recent empirical evidence suggests that SHGs do screen borrowers (Bansal, 2002). If this condition does not hold, the implications on welfare are more qualified. See Section 4 for details.

[11] The empirical evidence so far seems to be mixed as well. For example, see Kai (2009), Olivares - Polanco (2005) and Rhyne and Christen (1999) for evidence of decreased, and Nagarajan (2001) for the evidence on increased outreach among the poor.

in an alternative situation where the microfinance sector consists of only commercial MFIs. In Section 4, we compare the equilibrium outcomes characterized in the previous two sections. While the preceding sections talk about individual liability, Section 5 incorporates the concept of joint liability and characterizes multiple group formation as an equilibrium outcome. Finally, Section 6 concludes the paper with the discussion of the results. An appendix outlining the proofs of some of the propositions is also attached.

2 Model and Equilibrium with SHG

Consider a rural community with $\mathcal{N}$ agents. Each agent has an investment opportunity that requires \$1 of financing. The investment yields a gross return of Y if it succeeds and zero if it fails. Agents, however, differ in the probability with which they succeed in their investment. Of the $\mathcal{N}$ agents, $\mathcal{N}_G$ are of the low-risk type (type G for "good") whose probability of success is p_G. The remaining $\mathcal{N}_B = \mathcal{N} - \mathcal{N}_G$ are of the high risk type (type B for "bad") who succeed with probability p_B, $p_G > p_B$. We denote by $\pi = \frac{\mathcal{N}_G}{\mathcal{N}}$ the proportion of agents of the good type in the population. We assume that $1 \leq \mathcal{N}_G \leq \mathcal{N} - 1$. The two inequalities imply that there exists at least one agent of each type in the village. To avoid trivial and tedious cases, we assume $\mathcal{N}$ to be a sufficiently large number.

Agents do not have any fund of their own for the investment. Therefore, they need to obtain a loan from a lending agency. Throughout the paper, we assume all lenders are risk neutral. In this section, we assume that there is only one such agency in the village which we call a "self-help group" (SHG). We also assume that the SHG does not have sufficient funds to lend to the entire community. To simplify our analysis, let the SHG have only \$1 to lend.[12] We further assume that the SHG is a benevolent institution in the sense that it seeks to maximize the social surplus that its loan can generate. In particular, the SHG charges the break even interest rate. In other words, if it faces a lending cost of $\rho > 1$ in providing the loan, it only seeks an expected return of ρ from the borrower.

All agents are risk-averse with a standard increasing and concave utility function on consumption $u(c)$. We assume $u(0)$ is defined and normalized to zero. Borrowers are protected by limited liability in the sense that they need to repay only when their investment is successful. The only source of consumption for a borrower is the successful realization of her investment. Hence, in both the events of an agent not obtaining a loan or her investment failing, her payoff is $u(0) = 0$.

The key operating principle of microfinance is the absence of collateral to secure a loan. Credit institutions need to rely entirely on the interest they expect to receive from borrowers to cover the cost of credit. This can create moral hazard in the form of wilful default by borrowers. Joint liability constitutes a mechanism to alleviate such moral hazard.[13] However, if we assume that

[12] For the rest of the analysis, this assumption is without loss of generality as long as the number of loans the SHG can give is less than $\mathcal{N}_G$.

[13] There is the additional type of moral hazard in the form or borrowers slackening effort, or taking excessive risk. The structure of our model rules out such possibilities.

firms face no such problem in securing repayment, then microfinance can operate even under the conventional individual liability mechanism. In this, and the next two sections, we indeed make such an assumption. This allows us confine ourselves to the individual liability setting which greatly simplifies our analysis without compromising the results on the impact of commercialization. In any case, these results can be easily extended to the joint liability setting. We elaborate on this further in Section 5, where we introduce joint liability to consider multiple group formation.

In a complete information scenario, the SHG is able to distinguish between the two types of borrower. Since the SHG cannot impose any collateral requirement, it charges gross interest rate $R_G = \frac{\rho}{p_G}$ if it lends to a low risk borrower and $R_B = \frac{\rho}{p_B}$ from a high risk borrower. The payoff of a type T borrower, $T \in \{G, B\}$, is then

$$U_T = p_T u(Y - R_T). \tag{1}$$

We assume that $U_B > 0$, i.e. $p_B Y > \rho$, so that both types have the incentive to participate in the market in this scenario. Since $U_G > U_B$, the SHG only lends to the good type. We call this the *first best solution.*

Our interest is in characterizing equilibrium under incomplete information; i.e. when the SHG is unable to distinguish between the two types but knows π. The first best solution is, therefore, not implementable. Suppose the SHG seeks to charge interest R_T from type T. Then, since $p_B u(Y - R_G) > U_B = p_B u(Y - R_B)$, the bad type has the incentive to to seek the loan claiming to be the good type. Implementation of the first-best solution, therefore, leads to a loss for the SHG and hence, is not feasible.

One option for the SHG, is, then to provide the loan to any individual without seeking information about its type. For such lending to be feasible, the SHG needs to charge the interest rate

$$\bar{R}(\pi) = \frac{\rho}{\pi p_G + (1 - \pi) p_B}. \tag{2}$$

With this interest rate, the expected benefit that the \$1 loan creates is

$$\bar{U}(\pi) = \pi \left(p_G u(Y - \bar{R}(\pi)) \right) + (1 - \pi) \left(p_B u(Y - \bar{R}(\pi)) \right). \tag{3}$$

Note that the objective of the SHG is to maximize the benefit that its loan yields. Equation (3) defines this benefit when the SHG charges $\bar{R}(\pi)$. It is possible, however, that at some values of π, it is more beneficial for the SHG to induce truthful type revelation, and lend to only a low-risk borrower.[14] This necessities the SHG to institute a screening mechanism, wherein it charges a cost of acquiring credit such that a high-risk agent loses the incentive to pretend to be a low-risk type.

[14] Once the SHG obtains information about type, it is never optimal to lend to a bad type. Once type is revealed, if the SHG lends to a bad type borrower, it charges interest R_B and the borrower obtains payoff U_B. But $\bar{U}(\pi) \geq U_B$ for all π with equality holding only at $\pi = 0$. Lending without seeking revelation of type is, therefore, better than lending to a bad type following type revelation. Further, if more than one agents approach the SHG, then the SHG randomizes uniformly between them.

Define

$$c_S = p_B u\,(Y - R_G)\,, \tag{4}$$

and

$$\hat{U}_G = U_G - c = (p_G - p_B)\,u(Y - R_G) > 0. \tag{5}$$

If c_S were the screening cost imposed by the SHG, only a low risk agent seeks the loan at interest rate R_G whereas high risk agents have no incentive to approach the SHG.[15] In that case, (5) represents the payoff of the low risk agent who obtains the loan. The following lemma establishes this result formally.

Lemma 2.1 *Suppose the SHG seeks to lend only to a low-risk type agent. It offers the contract* (R_G, c_S) *where* R_G *is the interest rate it charges and* c_S *is the cost it imposes on the borrower. Given this contract, only a low-risk type agent approaches the SHG for the loan. The payoff of the borrower is then* $\hat{U}_G$ *defined in (5).*

Proof. We need to verify that at cost c_S, a high-risk agent has no incentive to misreport type and approach the SHG for a loan. This follows since $p_B u\,(Y - R_G) - c_S = 0$.

We further need to check that that at any cost $c < c_S$, the high-risk agent does misreport her type. If she truthfully reveals herself as being high-risk, then she is denied the loan (see footnote 14) and her payoff is the outside option, zero. If she claims to be low-risk, her payoff is

$$p_B u\,(Y - R_G) - c > p_B u\,(Y - R_G) - c_S = 0.$$

Hence, c_S is the lowest cost that prevents a high-risk agent from approaching the SHG for a loan. We also need to confirm that a low-risk agent does not misreport type. This follows trivially by footnote 14. Further, the SHG makes zero profit. This follows from the interest rate R_G and the fact that the borrower is low-risk with certainty. ■

The value of c_S is determined by the fact that the SHG has only one loan to offer. Given its objective of maximizing the benefit that its loan yields, the purpose of its screening cost is to ensure that high-risk agents do not approach it for the loan. If, however, the the SHG does have sufficient funds at its disposal to satisfy the entire demand for credit, then it can screen borrowers with a lower cost. In that case, it would be able to offer two alternative contracts; cost

$$c_M = p_B u\,(Y - R_G) - U_B \tag{6}$$

[15] In defining (5), we use the assumption, standard in all screening models, that the net utility of the agent from consumption after paying any screening cost is additively separable in consumption and cost. Formally, define $v(p, x, y) = pu(x) - c$ for consumption x and cost c. Then, $\hat{U}_G = v\,(p_G, Y - R_G, c_S)$. Moreover, as is again common in screening models, we interpret the cost as not a monetary transfer from the agent to the principal but rather a wasteful expenditure of time and effort that the agent has to incur to convey her type. In the context of microfinance, this cost can take the form of mandatory group meetings, compulsory savings, or a training period before obtaining the loan etc.

along with interest rate R_G or interest rate of R_B with zero cost. Indeed, in Lemma 3.1 in Section 3, we show that commercial MFIs adopt these contracts while screening borrowers (hence the subscript M in the definition of c_M.) Borrowers then self-select with low-risk types adopting the former contract and high-risk types the latter. However, the SHG has only one loan which it is unwilling to offer to any agent who reveals herself as high-risk. Hence, if it imposes cost c_M or any cost less than c_S along with R_G, a high-risk agent opts for the contract since the alternative is to forego the loan and have zero payoff.

The SHG, therefore, has the choice of offering two contracts—the contract $\left(\bar{R}(\pi), 0\right)$ or the contract (R_G, c_S) where the first term denotes the interest rate charged and the second the screening cost imposed. For convenience, we refer to the former as the pooling contract, and the latter as the separating or screening equilibrium. Given π, the SHG offers the former contract if

$$\bar{U}(\pi) > \hat{U}_G \tag{7}$$

We now distinguish between two cases. First, for any π, the SHG offers the loan at $\bar{R}(\pi)$. Second, there exists a cutoff value π^* such that the SHG offers the former contract if $\pi > \pi^*$ and the latter contract if $\pi < \pi^*$. This distinction emerges from the parameter values Y, ρ, p_G and p_B. While formally, this may be established in several ways, intuitively, it is most convenient to first fix the values of Y, ρ and p_G and condition the distinction on the value of p_B. In the following lemma, we determine the range of values of π over which (7) holds as a function of the value of p_B.

Lemma 2.2 *Suppose Y, ρ and p_G are given. Then,*

1. *There exists $p_B = p_B^*$, $\frac{\rho}{Y} < p_B^* < p_G$, such that $\hat{U}_G(p_B) = U_B(p_B)$.*

2. *If $p_B > p_B^*$, then $\bar{U}(\pi) > \hat{U}_G$ for all π. If $p_B < p_B^*$, then there exists $\pi = \pi^*(p_B)$, $0 < \pi^*(p_B) < 1$, such that for $\pi < \pi^*(p_B)$, $\bar{U}(\pi) < \hat{U}_G$ and for $\pi > \pi^*(p_B)$, $\bar{U}(\pi) > \hat{U}_G$.*

Proof.

1. At $p_B = p_G$, $\hat{U}_G = 0 < U_B$. At $p_B = \frac{\rho}{Y}$, $U_B = 0 < \hat{U}_G$. The first part then follows by the continuity of the two functions in p_B and the intermediate value theorem.

2. For the second part, note that at $\pi = 0$, $\bar{U}(\pi) = U_B$. By the first part of this lemma, $\hat{U}_G = U_B$ at $p_B = p_B^*$. Therefore, at $\pi = 0$, $\bar{U}(\pi) = \hat{U}_G$ if $p_B = p_B^*$. But U_B and hence, $\bar{U}(\pi)$, is an increasing function of p_B whereas $\hat{U}_G$ is declining in p_B. So, for all $p_B > p_B^*$, $\bar{U}(0) > \hat{U}_G$ at. Furthermore, $\bar{U}(0)$ is increasing in π whereas $\hat{U}_G$ is not affected by π. Therefore, for all π, $\bar{U}(\pi) > \hat{U}_G$ if $p_B > p_B^*$.

   Now, let $p_B < p_B^*$. By reversing the argument in the previous paragraph, $\bar{U}(\pi) < \hat{U}_G$ at $\pi = 0$. But at $\pi = 1$, $\bar{U}(\pi) = U_G > \hat{U}_G$. Continuity of $\bar{U}(\pi)$ and the intermediate value theorem then establishes the existence of π^*, $0 < \pi^* < 1$, as desired. ■

Lemma 2.2 implies that as $p_B \to p_B*$, $\pi^*(p_B) \to 0$. For $p_B > p_B*$, $\bar{U}(\pi) > \hat{U}_G$ for all $\pi \in [0,1]$; so π^* is not defined. Intuitively, if p_B is sufficiently high so that $p_B > p_B^*$, then there is lesser distinction between the productivity of the two types. Hence, $\bar{U}(\pi)$ is close to U_G at any π, whereas, $\hat{U}_G$ is close to zero. Therefore, (7) is satisfied for all π, which makes it optimal for the SHG to offer the pooling contract at any π. However, if $p_B < p_B^*$, then the decision to offer a contract depends on the value of π. If π is sufficiently high, then the chances of a reduced productive use of the loan are low; so low that the imposition of the cost c_S is not justified. The expected output from the loan is, therefore, best maximized by charging the common interest $\bar{R}(\pi)$. However, if π is low, then the random selection of a borrower is more likely to result in the less productive use of the loan. Therefore, the SHG finds it optimal to deliberately target the loan to the high productivity or the lower risk type even though this necessitates the imposition of the cost c_S. We formalize this intuition in the following proposition.

Proposition 2.3 *Given p_G, Y, and ρ, let p_B^* be as in (1) of Lemma 2.2. Then, we have the following two cases.*

1. *If $p_B > p_B^*$, then the SHG offers the pooling contract $\big(\bar{R}(\pi), 0\big)$. Given π, the rate of default is $1 - (\pi p_G + (1-\pi)p_B)$.*

2. *If $p_B < p_B^*$, then there exists a critical π^*, $0 < \pi^* < 1$, such that if $\pi > \pi^*$, the SHG offers the pooling contract $\big(\bar{R}(\pi), 0\big)$. However, if $\pi < \pi^*$, the SHG offers the screening contract (R_G, c_S). Given π, the rate of default is $1 - p_G$.*

Proof.

1. If $p_B > p_B^*$, then by Lemma 2.2, $\bar{U}(\pi) > \hat{U}_G$ for all π. Therefore, the pooling contract optimizes the SHGs objective function. Since a borrower of either type may receive the loan, the rate of success, and repayment, is $\pi p_G + (1-\pi)p_B$. Hence, the default rate.

2. If $p_B < p_B^*$, then Lemma 2.2 establishes the existence of π^*, $0 < \pi^* < 1$, such that $\bar{U}(\pi) > \hat{U}_G$ only if $\pi > \pi^*$. In this case, the SHG offers the pooling contract. But if $\pi < \pi^*$, $\bar{U}(\pi) < \hat{U}_G$. The separating contract optimizes the utilization of the loan. The default rate follows because only a low-risk borrower receives the loan. ■

In Figure 1, we illustrate Proposition 2.3 using a numerical example.

3 Credit Contracts in a Commercial MFI sector

Section 2 considers the lending behaviour of a credit-constrained SHG in equilibrium. In this section, we consider an alternative scenario where the microfinance sector consists of at least two profit-motivated microfinance institutions (MFIs) and no SHG. We assume that each MFI has access to an unlimited amount of funds for providing loans. Our objective is to identify the behaviour

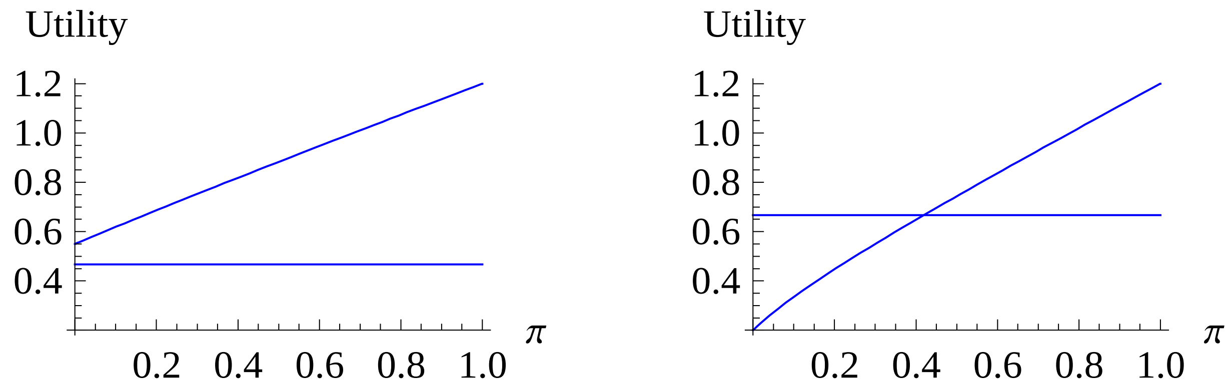

Figure 1: Let $u(c) = \sqrt{c}$ and $\{Y, \rho, p_G\} = \{3, 1.1, 0.9\}$. In both panels, the horizontal line is $\hat{U_G}(p_B)$ and the upward sloping line is $\bar{U}(p_B)$. Lemma 2.2, part 1 implies $p_B^* = 0.5252$. In the left panel, $p_B = 0.55 > p_B^*$. Hence, by Lemma 2.2 (1), $\bar{U}(\pi) > \hat{U}_G$ for all π and, therefore, π^* is not defined. Proposition 2.3 (1), then, implies that the SHG offers the pooling contract for all π. In the right panel, $p_B = 0.44 < p_B^*$. From Lemma 2.2(2), $\pi^* = 0.4193$, the point of intersection of the two lines. Proposition 2.3 (2), then, implies that for $\pi > \pi^*(p_B)$, the SHG offers the the pooling contract whereas if $\pi < \pi^*(p_B)$, the SHG offers the separating contract $(R_G, c_S) = (1.2222, 0.5333)$.

of the MFIs in a Bertrand equilibrium. As in the case with the SHG, we seek to characterize the conditions, which, decide whether MFIs offer a pooling contract to all borrowers or seek to induce self-selection among borrowers.

Like in Section 2. we first determine the screening cost that MFIs impose on a borrower, who seeks a loan at interest R_G. As usual, in equilibrium, the screening cost is the minimum cost that induces truthful revelation from high-risk borrowers. Alternatively, MFIs may offer loans to all borrowers at rate $\bar{R}(\pi)$. The different payoffs that a low-risk borrower obtains from the two policies determines a critical value, π^{**}, such that, only if $\pi < \pi^{**}$ do MFIs implement the screening equilibrium.

For the SHG, the change from the common interest rate mechanism to the screening mechanism is governed by the objective of optimizing the expected benefit from its loan. However, MFIs decide on which contract to offer, based on profit making opportunity. Under the common interest rate, the payoff of a type T, $T \in \{G, B\}$, is

$$\bar{U}_T(\pi) = p_T u(Y - \bar{R}). \tag{8}$$

It is obvious that $\bar{U}_B(\pi) > U_B$, whereas, $\bar{U}_G(\pi) < U_G$. The absence of information, therefore, benefits the high-risk type while working to the detriment of the low-risk type. It is also clear that the low-risk type's disadvantage is greater at lower π. Consequently, if π is sufficiently low, a profit opportunity may open up for MFIs, wherein they institute a screening mechanism that imposes a cost c on any borrower who claims to be low-risk, but which induces truthful revelation. Compared to paying interest $\bar{R}(\pi)$, the low-risk type benefits despite incurring the cost since the type specific interest rate declines to R_G. High-risk types do not incur any cost, but pays the higher interest R_B. As before, let us denote a contract by (R, c) where c is the cost the borrower needs to incur to obtain the loan at interest R. Then, under the screening mechanism, the MFI introduces two contracts—(R_G, c) and $(R_B, 0)$.

Our task is to determine the cost c that the MFI imposes on any low-risk type claimant. In equilibrium, c is the minimum cost that can induce truthful revelation of type. In our discussion following Lemma 2.1, we argued that if sufficient funds are available to meet the entire demand for credit, then a competitive financial sector imposes the cost $c = c_M$ defined in (6) as the screening cost. Since by assumption, MFIs can meet the entire credit demand, they imposes this cost in a screening equilibrium. We formalize this understanding in the following lemma.

Lemma 3.1 *Suppose that in a competitive equilibrium, MFIs seek to induce truthful revelation of type among agents. Then it introduces two contracts* (R_G, c_M) *and* $(R_B, 0)$ *where* $c_M = p_B u(Y - R_G) - U_B$. *Low-risk agents opt for the contract* (R_G, c_M) *and high risk ones for* $(R_B, 0)$.

Proof. We need to check that c_M is the minimum cost at which no agent of either type has the incentive to misreport their type. If a high risk agent reports truthfully, and therefore, opts for $(R_B, 0)$, then her utility is U_B. If she misreports and opt for (R_G, c_M), her utility is $p_B u(Y - R_G) - c_M = U_B$. Hence, she has no incentive to misreport her type. However, if $c < c_M$, then the high risk agent finds it optimal to claim to be low-risk.

For a low-risk agent, truthful reporting leads to utility $p_G u(Y - R_G) - c_M = \hat{U}_G + U_B$ where $\hat{U}_G$ is defined in 5. Misreporting leads to utility U_B. Therefore, truthful reporting is strictly better.

Therefore, c_M is the minimum cost that can induce truthful revelation from both types. We also need to verify that MFIs earn zero profit. This follows from the interest rate charged from the two types and the fact that the screening mechanism induces truthful revelation. ■

We therefore conclude that in equilibrium, MFIs either offer a common contract with interest rate $\bar{R}(\pi)$ to all agents or offer the menu of contracts $\{R_G, c_M), (R_B, 0)\}$. Guided by the profit motive, they adopt the former alternative if $\bar{U}_G(\pi) > U_G - c_M$. Clearly, the choice of contracts is determined by the value of π. In the following proposition, we establish the presence of a cut-off value of π, π^{**}, such that MFIs opt for the common interest contract if π exceeds this critical value.

Lemma 3.2 *Suppose the parameters* (Y, ρ, p_G, p_B) *are given. Consider* $\bar{U}_G(\pi)$ *and* $U_G - c_M$. *There exists* $\pi^{**} \in (0, 1)$ *such that for* $\pi > \pi^{**}$, $\bar{U}_G(\pi) > U_G - c_M$ *and for* $\pi < \pi^{**}$, $\bar{U}_G(\pi) < U_G - c_M$.

Proof. Note that $U_G - c_M = (p_G - p_B)u(Y - R_G) + p_B u(Y - R_B)$. At $\pi = 0$, $\bar{U}_G(\pi) = p_G u(Y - R_B)$. Since $(p_G - p_B)u(Y - R_B) < (p_G - p_B)u(Y - R_G)$, $\bar{U}_G(\pi) < U_G - c_M$ at $\pi = 0$.

At $\pi = 1$, $\bar{U}_G(\pi) = p_G u(Y - R_G) = U_G > U_G - c_M$ since $c_M > 0$. Hence, at $\pi = 1$, $\bar{U}_G(\pi) > U_G - c_M$. The existence of π^{**} follows from the intermediate value theorem. ■

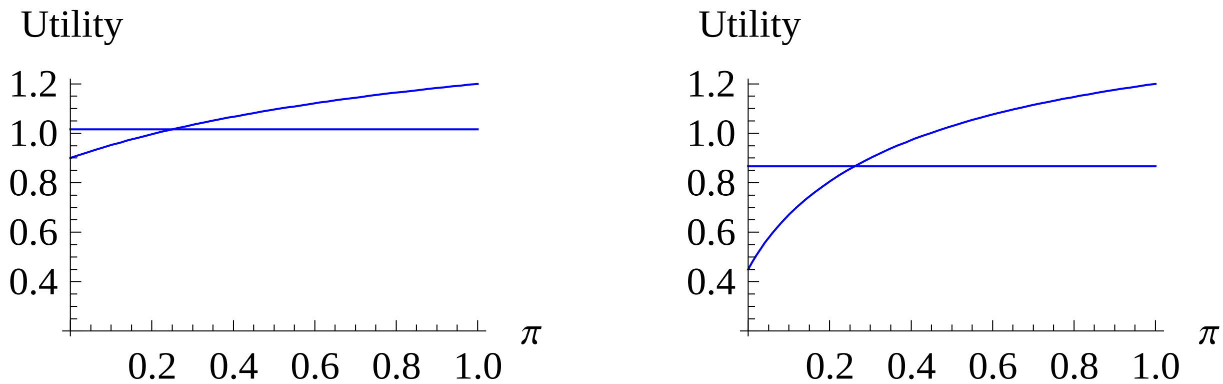

Figure 2: Consider the numerical example in Figure 1 with $u(c) = \sqrt{c}$ and $\{Y, \rho, p_G\} = \{3, 1.1, 0.9\}$. Here, in both panels, the horizontal line is $U_G(p_B) - c_M(p_B)$ and the upward sloping line is $\bar{U}_G(p_B)$. In the left panel, $p_B = 0.55$ and $\pi^{**} = 0.2516$ given by the intersection of the two lines. In the right panel, $p_B = 0.4$ and $\pi^{**} = 0.2614$. In either case, by Proposition 3.3, MFIs implement the pooling contract if $\pi > \pi^{**}$ and the separating contract if $\pi < \pi^{**}$.

Clearly, if $\pi > \pi^{**}$, MFIs offer the same contract to all borrowers whereas if $\pi > \pi^{**}$, it implements the screening equilibrium. We formalize this equilibrium behaviour of MFIs in the following proposition.

Proposition 3.3 *Let π^{**} be as characterized in Lemma 3.2. For $\pi > \pi^{**}$, MFIs offer the contract $\left(\bar{R}(\pi), 0\right)$ to all borrowers. For $\pi < \pi^{**}$, MFIs offer the menu of contracts $\{(R_G, c_M), (R_B, 0)\}$. Borrowers self-select with low risk borrowers opting for the contract (R_G, c_M) and high-risk borrowers opting for $(R_B, 0)$. In either case, the aggregate default rate is $1 - (\pi p_G + (1 - \pi)p_B)$.*

Proof. The choice of contract follows readily from Lemma 3.2. The default rate follows from the fact that under either contract arrangement, all agents, irrespective of type, do receive a loan. ■

As in Section 2, we refer to $\left(\bar{R}(\pi), 0\right)$ as the pooling contract and the menu $\{(R_G, c_M), (R_B, 0)\}$ as the separating or screening contract. We note that the screening contract that the SHG offers differs from the one that MFIs offer. Also, analogous to Figure 1, we illustrate Proposition 3.3 in Figure 2.

We may reinterpret Lemma 3.2 along the lines of Lemma 2.2 by varying p_B while keeping $\{Y, \rho, p_G\}$ fixed. This reinterpretation facilitates comparison of the two lemmas. We note that, unlike SHG behaviour in equilibrium, where $\pi^*(p_B)$ does not exist if $p_B > p_B^*$, $\pi^{**}(p_B)$ always exists. However, given Lemma 3.2, it is easy to verify that as $p_B \to p_G$, $\pi^{**}(p_B) \to 0$. Intuitively, in this case, $\bar{U}_G(\pi)$ is sufficiently close to U_G, and therefore, higher than $U_G - c_M$. This is true if π is not exceptionally low, in which case, the inflationary impact on $\bar{R}(\pi)$ makes acceptance of c_M

the preferable option of low-risk types. We may, therefore, conclude that closer is p_B to p_G, the larger is the range of π over which MFIs offer the non-discriminatory contract.

4 Welfare, Credit Contract and Default: Changes following MFI entry

Our larger objective is not just to characterize equilibrium behaviour in the two alternative scenarios we have considered in Sections 2 and 3. Instead, we aim to evaluate the impact of the transition of the microfinance sector from a benevolent to a commercial orientation on the overall welfare of borrowers. As a corollary, we also assess the changes in interest and default rates, as well as on the intensity of screening, during this transition. In this section, we adopt this historical perspective by assuming a temporal sequence where initially, a benevolent SHG is the sole source of loans. Retaining our assumption that the SHG can provide only one loan, we assess how borrowers' welfare, terms of credit(interest and screening), and default rates change as a profit-oriented competitive MFI sector emerges.

In order to understand the impact of this transition, it is critical to appreciate that the SHG, by itself, is able to satisfy a limited part of the demand for loans in the village. Therefore, even with benevolent intentions, the SHG has a minimal impact on enhancing aggregate welfare in the community, in which it operates. However, the MFI sector has unlimited funds at its disposal; or at least sufficient funds to meet the entire loan demand in the community. Hence, the MFI sector has a direct impact on aggregate welfare. Therefore, the welfare of all agents who were deprived from credit from the SHG must improve. Furthermore, if the SHG were indulging in screening the borrowers —-lending only to the good types—then welfare of all the concerned parties necessarily improves. By Proposition 2.3, the SHG necessarily screens if π^* exists and, $\pi < \pi^*$. In other words, if π is sufficiently low and p_G sufficiently different from p_B so that π^* exists (by Lemma 2.2), then entry of commercial MFIs must necessarily lead to Pareto improvement situation. This argument is formalized in the proposition below.

Proposition 4.1 *Suppose the parameters (Y, ρ, p_G, p_B) be such that π^* exists and determined as in Lemma 2.2. Let π^{**} be as determined in Lemma 3.2. If the fraction of safe borrowers is sufficiently low, i.e. if $\pi < \pi^*$, then entry of commercial MFI sector always leads to a strict Pareto improvement in welfare. The default rate increases and the level of screening declines. The SHG shuts down following MFI entry.*

Proof. For $\pi < \pi^*$, we distinguish the following two cases.

1. $\pi < \pi^{**}$. Irrespective of the relationship between π^* and π^{**}, the SHG imposes the screening cost c_S and lends only to a low-risk borrower who obtains payoff $\hat{U}_G$. Upon entry, MFIs impose the lower screening cost c_M. The pre-existing client of the SHG shifts to a MFI increasing her payoff to $U_G - c_M$. The payoff of every other agent improves as they access credit from MFIs.

Note that the SHG loses its client and therefore shuts down. The default rate increases from $1 - p_G$ to $1 - (\pi p_G + (1-\pi)p_B)$. The intensity of screening declines from c_S to c_M. Instead of one interest rate R_G, multiple rates become prevalent following MFI entry; R_G and the higher rate R_B.

2. $\pi > \pi^{**}$. In this case, the SHG, as the sole lender, imposes the screening cost c_S and lends only to a low-risk borrower. The borrower obtains utility $U_G - c_S$. However, when MFIs enter, they offer the pooling contract at interest $\bar{R}(\pi)$. Since $\pi > \pi^{**}$, Lemma 3.2 implies $\bar{U}_G(\pi) > U_G - c_M$, and since $c_S > c_M$, $U_G - c_M > U_G - c_S$. The existing client of the SHG therefore obtains a higher payoff from MFIs and shifts. Every other agent improves welfare by accessing credit from MFIs.

   The SHG,therefore, shuts down. Further, interest rate increases to $\bar{R}(\pi)$ from R_G and default rate to $1 - (\pi p_G + (1-\pi)p_B)$ from $1 - p_G$. The final consequence is that screening is entirely eliminated as a lending policy instrument with the exit of the SHG.

We note that in Case 1, instead of one interest rate R_G, multiple rates become prevalent following MFI entry; R_G and the higher rate R_B. In Case 2, the prevailing interest rate increases from R_G to $\bar{R}(\pi)$.[16] It is, therefore, interesting to note that Pareto improvement is happening despite the fact that interest rates and default rates increase with the entry of commercial MFI sector. The intuition behind this result is as follows: the risky ones, who were left out of the market under the SHG regimen, participate in the market under competitive regime. The safer ones participate in the market under both regimes, but pay lesser screening cost under the competitive regime. Since the competition enables risky borrowers to participate in the market, the interest rates, and the default rates increase. Therefore, an increase in interest rates and defaults can be artifacts of an *ex ante* Pareto improved situation.[17]

The key factor that explains the changes following the entry of MFIs is not the differing objective functions of the benevolent SHG and the profit motivated MFIs but that MFIs can disburse a much higher number of loans. Bertrand competition erodes any conflict between seeking profit and maximizing welfare through marginal cost pricing. Therefore, if the SHG also had unlimited funds at its disposal, then even with its benevolent objective, it would have behaved exactly like the

[16] Strictly speaking, the fact that the population size N is finite requires MFIs to follow a more nuanced policy when they follow a SHG to a market. Define

$$\tilde{R}_{\mathcal{N}} = \frac{\rho}{p_G \frac{\mathcal{N}_G - 1}{\mathcal{N} - 1} + p_B \frac{\mathcal{N}_B}{\mathcal{N} - 1}}.$$

This is the common break-even interest rate for MFIs if they know with certainty among their potential borrowers, only $(\mathcal{N}_G - 1)$ are low-risk type. It is easy to verify that $\tilde{R}_N > \bar{R}(\pi)$ but $\tilde{R}_{\mathcal{N}} \to \bar{R}(\pi)$ as $n \to \infty$. Suppose $U_G - c_S > p_G u(Y - \tilde{R}_{\mathcal{N}})$. In this case, the low-risk SHG client continues borrowing from the SHG. Therefore, MFIs know after entry that of the remaining borrowers, only $(N_G - 1)$ are of low-type and hence charge $\tilde{R}_{\mathcal{N}}$. In this case, the SHG remains in business with its existing client. However, we assume that $\mathcal{N}$ is large enough such that if $U_G - c_S < p_G u(Y - \bar{R}(\pi))$, then so is $U_G - c_S < p_G u(Y - \tilde{R}_{\mathcal{N}})$. Indeed, our assumption of $\mathcal{N}$ is large enough is meant precisely to rule out such tedious borderline cases.

[17] The recent happenings in the Indian microfinance sector can be explained using this result. As pointed out earlier, the Reserve Bank of India (RBI) is blaming competition among MFIs as a reason for increase in defaults, and hence suicides. Therefore, this result has important regulatory significance.

competitive MFI sector in equilibrium. In that case, entry of profit motivated MFIs would have made no difference either to borrower welfare, or to the terms of the credit contract and default rates.

Proposition 4.1 is relevant when π^* exists and $\pi < \pi^*$. However, these condition may not be satisfied. In such cases, the SHG offers only pooling contracts which subsidizes a high risk borrower. Then, if MFIs, upon entry, screen borrowers, the welfare of the SHG client declines if she is of high risk as she cannot be cross-subsidized any longer. Alternatively, there is another case where the entry of SHG weakly improves welfare in that the existing SHG client retains her level of welfare, while every other agent benefits from increased access to credit. We discuss these two cases now.

1. *Weak Pareto Improvement* ($\pi > \pi^{**}$). This includes two subcases:

   (a) Let π^* exist. Then, irrespective of the relationship between π^* and π^{**}, both the SHG and MFIs offer the pooling contract. Hence, the existing client of the SHG is indifferent between remaining with the SHG or shifting to MFIs. Every other agent benefits from access to MFI credit.

   When the SHG is the sole lender, the interest rate and default rate are, respectively, $\bar{R}(\pi)$ and $1-(\pi p_G + (1-\pi)p_B)$. Once MFIs enter, all remaining potential borrowers receive loan on these same terms. Neither sector imposes any screening cost and therefore, there is no change in this aspect of the credit contract as well. Therefore, neither the credit contract nor the default rate changes following MFI entry. The SHG, given its objective function of maximizing welfare with its one loan, is indifferent between continuing with its solitary client or shutting down with its client obtaining the loan from a MFI on exactly similar terms.

   (b) Let π^* not exist. In this case, both the SHG and MFIs offer the pooling contract. This case is, therefore, identical to Case 1a discussed above.

2. *Decline in Welfare of existing high-risk SHG client* ($\pi < \pi^{**}$). This also has two subcases:

   (a) Let π^* exist. The SHG offers the pooling contract and depending upon type T, its borrower obtains payoff $\bar{U}_T(\pi)$ defined in (8). MFIs implement the screening equilibrium in which low-risk borrowers obtain payoff $U_G - c_M > \bar{U}_G(\pi)$. Hence, if the existing SHG client is low-risk, she shifts to MFIs. Therefore, any client that the SHG retains after MFI entry must be high-risk with probability 1. The interest rate she needs to pay increases from R_B to $\bar{R}(\pi)$ and her welfare declined to U_B from $\bar{U}_B(\pi)$. Every other agent benefits through increased access to credit.

   Default rate remains unchanged and interest changes from the uniform rate $\bar{R}(\pi)$ to R_G and R_B. Screening which was earlier absent from the SHG is now introduced following MFI entry. The fate of the SHG is more difficult to pin down. Since $U_G - c_M > \bar{U}_G(\pi)$, the SHG cannot retain a low-risk borrower. Therefore, if its pre-existing client is a low-risk type, it loses the client and shuts down. Hence, if, following MFI entry, the SHG retains its client, it updates its belief of that client being high-risk from $(1-\pi)$ to 1 and charges interest R_B. Given its objective function, the SHG is then indifferent between continuing with its high-risk borrower or shutting down in which case, the borrower shifts to MFIs.

(b) Let π^* not exist. In this case, the SHG offers the pooling contract whereas MFIs follow the policy of screening. This case is therefore identical to Case 2a above.

It is interesting to note that in Case 2 above, where the welfare of the existing SHG client declines if she is of high-risk, is also the only case, in which, the level of screening unambiguously rises following entry of MFIs. It is, of course, an empirical question as to whether such screening actually increases or falls following intensification of commercialization. If, however, it does decline, then we may argue with reasonable confidence that there is a Pareto improvement in social welfare following entry of MFIs.

Furthermore, Lemmas 2.2 and 3.2 imply that if p_B is close to p_G, π^* and π^{**} are likely to be low and indeed, π^* may not even exist. In this situation, the likelihood of π being higher than both π^* and π^{**} is high. Therefore, as discussed in Case 1 above, the chances that MFI entry leads to changes in default, interest or screening are low. In other words, if agents are less heterogeneous, entry of profit motivated MFIs is unlikely to change any of these variables significantly. On the other hand, suppose p_B differs significantly from p_G. Then, this implies both π^* and π^{**} are high as in Case 1 of Proposition 4.1. In that case, increased competition is more likely to increase default and interest rates and reduce screening intensity. Irrespective of whichever case occurs, entry of MFIs always represent a Pareto improvement over the situation when the SHG is the sole lender.

5 Group Lending and Multiple Group Membership

Sections 2—4 analyze the microfinance sector in the setting of individual lending without collateral. Microfinance of course, in reality, operates on the principle of joint liability, which is expected to act as a mechanism to control adverse selection and moral hazard. Nevertheless, it is sufficient to consider the individual liability setting to convey the main implications of commercialization of microfinance without introducing the complications of joint liability into the analysis. However, the structure of joint liability is necessary to address the phenomenon of multiple group membership, another widely reported consequence of the increase in the number of microfinance firms operating in a certain area. Instead of obtaining her entire loan requirement through membership of a single group, an agent may split up her total credit requirements among different groups. Each group is then liable for only that portion of the total loan that is obtained through that group. Informal conversations with MFIs in India reveal that multiple group membership is a common phenomenon. Macintosh et. al (2005) also present evidence suggesting that this is indeed the case in the Ugandan microfinance market.

The practice of multiple group membership has been criticized on the grounds that this may lead to indiscriminate borrowing as borrowers form new groups to shift to newer MFIs, thereby escaping their liabilities with an existing MFI.[18] If, indeed, MFIs are not aware of the identity of individuals who adopt this practice of multiple borrowing, this may be a problem that threatens the sustainability of the microfinance sector. Yet, the same conversations with MFIs reveal that they are well aware of this practice, and do not seem inclined to impose any restrictions on it, since overall repayment rates remain high. This suggests that borrowers are not indiscriminately borrowing, but are making optimal use of the loan they obtain. It is simply that, instead of obtaining that loan through one group, they might be obtaining parts of it through membership in different groups.

We, therefore, view the incidence of multiple borrowing as a rational response of borrowers to an increase in the number of MFIs. Our analysis reveals that this response, in turn, is motivated by the possibility of more improved risk diversification. Joint liability involves an agent bearing the risk of failure of her group partners. For an risk averse agent, this has a detrimental effect of welfare. With multiple membership, the aggregate liability in monetary terms remain unchanged. However, since the liability is spread out over different groups and therefore different partners, there is a better distribution of risk. An agent needs to honour a substantial proportion of her liability of covering for her partners' failure only if most of her partners' fail simultaneously. As the number of groups increases, this event becomes increasingly rare.

We consider a competitive microfinance sector consisting of a number of profit-motivated MFIs. We assume there exists some factor, for example, the possibility of wilful default, that makes individual liability lending without collateral impossible. Therefore, MFIs only lend on the principle of joint liability, in which all group members are liable for each other's loan. Borrowers are protected by limited liability so that they only need to repay, whether for themselves or their partner, only when their investment is successful.

For simplicity, we consider a scenario where a group consists of *two members*. Individuals are allowed to be members of multiple groups. If an agent is a member of n groups, she sources a loan of $\frac{1}{n}$ through membership of each group, thereby obtaining her total loan requirement of \$1. We retain the parameter specification $\{Y, \rho, p_G, p_B\}$ established in Section 2 to define the credit scenario. We make the additional assumption that success rates of the investment project financed by a loan are independent across individuals. This implies having two groups with the same partner does not lead to any better risk sharing than having one group with that partner and obtaining a loan of $\frac{2}{n}$ through that group. The purpose of risk spreading is best served when the agent does not have any partner in common in any two groups she may be a member of. We, therefore, assume that if an agent is a member of n two-member groups, then all her n group partners are different from each other. All groups that we refer to in this paper follow this structure that we have outlined here.

We first show that in an environment of complete information, as an individual of either type forms more and more groups with other agents of the same type, her payoff increases and converges to the payoff under individual lending defined in (1). Under the weaker assumption that only agents know each others' type but not MFIs, we extend the previous result to show that irrespective of

[18]For example, see http://microfinanceafrica.net/news/a-case-of-multiple-borrowings/ cited earlier in footnote 6.

whether MFIs offer a separating contract or a pooling contract, welfare is improving with the number of groups. Finally, we characterize equilibrium in which borrowers form as many groups as possible, while MFIs offer either the separating or the pooling contract depending on which contract maximizes the payoff of low-risk agents. In the spirit of Section 4, we close the analysis by making a comparison of this equilibrium with the equilibrium that prevails when a funds constrained SHG is the sole borrower.

5.1 Group Lending and Screening

In this sub-section, we seek to characterize a separating contract that MFIs offer in equilibrium. We establish this momentarily under the assumption that all agents are members of n two member group. Moreover, while all the n group partners of an agent are different individuals, they are of the same type as the agent. This assumption of uniformity of type of an agent and her partners require further elaboration. First, underlying this assumption here is the more fundamental assumption that agents are perfectly informed about the type of all other agents. Therefore, as long as there are other low-risk agents to form a group, a low-risk agent never forms a group with a high-risk agent. In a population of finite size, it is possible that low-risk agents may wish to form a group with high-risk agents particularly if p_B is not too different from p_G. However, Assumption 5.7 below restricts the number of groups that a low-risk agent can form to below that of the population size of low-risk agents. Hence, when we characterize equilibrium in Proposition 5.8 using Assumption 5.7, the opportunity to form a group with a high-risk agent never arises for a low-risk agent. This also implies that high risk agents can only form groups with other agents of the same type. Therefore, since uniformity of types among group partners emerges as a equilibrium phenomenon, we are justified in using this feature as an assumption provisionally in our assumption.[19]

Formally, we refer to a group in which both members are of type T, $T \in \{G, B\}$, as a type T group. In a separating contract, there is truthful revelation of type. Hence, the break-even interest charged by MFIs to lend amount m to each member of a type T group is $R_{D,T}$ given by

$$\begin{aligned} \left(1-(1-p_T)^2\right)(2R_{D,T}m) &= 2\rho m \\ \Rightarrow R_{D,T} &= \frac{\rho}{(1-(1-p_T)^2)}. \end{aligned} \tag{9}$$

Joint liability implies that the MFI fails to receive repayment only if both members of the group fail in their investment. This happens with probability $\left(1-(1-p)^2\right)$. Note that $R_{D,T} < R_T$, the break-even interest rate under individual lending defined as part of (1). This is the most obvious benefit from group lending. Since her partner is also liable for repayment, an individual agent is able to obtain the loan at a lower interest rate than under individual lending. However, on the other hand, for a risk-averse agent, the assumption of risk for her partner can have a negative impact on

[19]See Ghatak (2000) for further details of assortative matching in microfinance.

welfare. To see this, define for $n \in \mathbb{Z}_{++}$

$$U^{n,T} = \sum_{k=0}^{n} \binom{n}{k} p_T^{n+1-k}(1-p_T)^k u\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right)$$
$$= p_T \sum_{k=0}^{n} \binom{n}{k} p_T^{n-k}(1-p_T)^k u\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right). \quad (10)$$

Excluding any screening cost that she might have to pay in a separating contract, Eq. 10 defines the payoff that a type T agent obtains in such a contract under the assumptions stated; she obtains an amount $\frac{1}{n}$ through each of her n groups and all her n group partners are of the same type as her. From the total of 1 unit of loan she obtains, she generates an income Y with probability p_T. If she is successful, she needs to cover her own liability of $R_{D,T}$ on her loan of 1. Additionally, if any of her partners' fails in their investments, she also need to cover the liability of that part of their loan that was obtained in partnership with her.[20] Thus, if k of her partners fail, she needs to repay an additional $\frac{kR_{D,T}}{n}$. By independence of failure rates, the probability of this event is $\binom{n}{k} p_T^{n+1-k}(1-p_T)^k$ and in that event, the agent's consumption is $\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right)$. This accounts for (10).

How does individual welfare depend on n in (10)? In Proposition 5.1 that follows, we show that an increase in n leaves the agent's expected consumption unchanged. However, as n increases, the variability in consumption that arises from bearing additional risk declines. Intuitively, the agent needs to bear the risk of repaying an entire additional loan only if all her n partners fail simultaneously, an event of vanishing significance as n increases. Individual welfare therefore increases with n for a risk-averse agent. Indeed, we show that as n becomes increasingly large, individual welfare approaches the payoff obtainable under individual liability lending. The proof, which follows from the convergence of the binomial distribution to the normal distribution, is in Appendix A.1.

Proposition 5.1 *Consider $U^{n,T}$ defined in (10) and $U_T = p_T u(Y - R_T)$ defined in (1) for $T \in \{G, B\}$. $U^{n,T}$ increases as n increases and further, $U^{n,T} \to U_T$ as $n \to \infty$.*

An obvious corollary of Proposition 5.1 is that if all agents are of the same type, then they would seek to form as many groups as possible. However, in the particular situation we consider here, a separating contract with two types, a low-risk agent cannot obtain payoff $U^{n,G}$ by forming n groups. In order to induce truthful revelation of type, MFIs need to impose a screening cost on any group that seeks credit at interest rate $R_{D,G}$. To characterize the screening cost, define

$$U_B^{n,G} = p_B \sum_{k=0}^{n} \binom{n}{k} p_B^{n-k}(1-p_B)^k u\left(Y - R_{D,G} - \frac{kR_{D,G}}{n}\right). \quad (11)$$

This is the payoff that a high-risk agent obtains when she along with her n partners, all of them high-

[20] If the agent's investment fails, she is freed of all liability, whether for herself or her partners. Once again, we are assuming that lenders cannot use coercive tactics to secure repayment. Note also the implicit assumption that Y is large enough to meet the additional liabilities if all her partners fail, i.e. $Y > 2R_{D,B}$.

risk, claim to be low-risk and obtain credit at rate $R_{D,G}$. In the following corollary to Proposition 5.1, we derive the asymptotic value of $U_B^{n,G}$. The proof is in Appendix A.1.

Corollary 5.2 *Consider $U_B^{n,G}$ defined in (11). $U_B^{n,G}$ increases as n increases and further, $U_B^{n,G} \to p_B u\left(Y - (2 - p_B)R_{D,G}\right)$ as $n \to \infty$.*

We are now in a position to characterize the separating contract that MFIs offer when all agents are members of n groups. The argument in Lemma 3.1 makes it clear that an aggregate screening cost of

$$c_{MG}^n = U_B^{n,G} - U^{n,B} \tag{12}$$

is sufficient to deter a type B group from claiming to be a type G group. One way to implement the cost is to charge a cost $\frac{c_{MG}^n}{n}$ on each loan of $\frac{1}{n}$ that an agent obtains.

Lemma 5.3 *Suppose all agents are members of n groups. Hence, through each loan contract, agents obtain an amount $\frac{1}{n}$. If MFIs seek to induce truthful revelation of type, they offer two contracts; $\left(R_{D,G}, \frac{c_{MG}^n}{n}\right)$ and $(R_{D,B}, 0)$. Low-risk agents select the former contract, and high-risk agents, the latter.*

Proof. If agents need to incur $\frac{c_{MG}^n}{n}$ on a loan of $\frac{1}{n}$ at interest $R_{D,G}$, aggregate cost is c_{MG}^n. Therefore, given the definition of c_{MG}^n, a high-risk agent's payoff from misreporting type is $U^{B,n}$. Truthful revelation and paying interest $R_{D,B}$ at zero cost yields the same payoff. For low-risk agents, truthful revelation leads to payoff $U^{n,G} - c_{MG}^n = U^{n,B} + \left(U^{n,G} - U_B^{n,G}\right) > U^{n,B}$, the payoff from misreporting. Therefore, neither type has an incentive to misreport. ■

We may therefore conclude that given the number of groups n, in a separating contract, a low-risk agent obtains payoff $U^{n,G} - c_{MG}^n$ while high-risk agents obtain payoff $U^{n,B}$. Proposition5.1 implies that both $U^{n,G}$ and $U^{n,B}$ increase with n. Hence, a higher n clearly benefits a high-risk agent in a sequence of separating contracts. Low risk agents also unambiguously benefit if c_{MG}^n declines with n. The following lemma establishes this point. The proof is in Appendix A.1.

Lemma 5.4 *Consider the cost c_{MG}^n. As $n \to \infty$, $c_{MG}^n \to c_{MG}^\infty = p_B u\left(Y - (2 - p_B)R_{D,G}\right) - U_B$. Furthermore, c_{MG}^n declines as n increases.*

We now combine Proposition 5.1 and Lemma 5.3 to conclude that in a separating contract, as n rises, the payoffs of both types increase.

Proposition 5.5 *Suppose an agent is a member of n two-member groups with all her n group partners being different. Suppose MFIs implement the separating contract $\left(R_{D,G}, \frac{c_{MG}^n}{n}\right)$ and $(R_{D,B}, 0)$ characterized in Lemma 5.3. If the agent is low risk, her payoff increases to $U_G - (u\left(Y - (2 - p_B)R_{D,G}\right) - U_B)$ as $n \to \infty$. If the agent is high risk, her payoff increases to U_B as $n \to \infty$.*

Proof. By Lemma 5.3, low risk agents opt for the contract $\left(R_{D,G}, \frac{c^n_{MG}}{n}\right)$ and high-risk agents for $(R_{D,B}, 0)$. Therefore, given n, the payoff of a low-risk agent is $U^{n,G} - c^n_{MG}$. By Proposition 5.1, $U^{n,G}$ increases to U_G whereas by Lemma 5.4, c^n_{MG} declines to $(u\,(Y - (2-p_B)R_{D,G}) - U_B)$ as $n \to \infty$. Therefore, the low-risk agent's payoff rises to $U_G - (u\,(Y - (2-p_B)R_{D,G}) - U_B)$ as $n \to \infty$ if MFIs implement the screening equilibrium at all n. The high-risk agents's payoff is $U^{n,B}$ given n which, again by Proposition 5.1, rises to U_B as $n \to \infty$. ■

5.2 Pooling Contract

As an alternative to implementing a separating contract, MFIs may implement a pooling contract by charging the same interest from all groups. In this case, the break even interest rate $\bar{R}_D(\pi)$ that a MFI charges for lending amount m to each member of a group is

$$\begin{aligned}
&\left[\left(1-(1-p_G)^2\right)\pi + \left(1-(1-p_B)^2\right)(1-\pi)\right]\left(2\bar{R}_D(\pi)m\right) = 2\rho m \\
&\Rightarrow \bar{R}_D(\pi) = \frac{\rho}{\left[\left(1-(1-p_G)^2\right)\pi + \left(1-(1-p_B)^2\right)(1-\pi)\right]}. \qquad (13)
\end{aligned}$$

Suppose an agent of type T, $T \in \{G, B\}$, is a member of n two-member groups. As in Section 5.2, we continue to operate under the assumption that all her n group partners are of the same type till we invoke Assumption 5.7 below to obtain this characteristic of groups in equilibrium. Under such a borrowing mechanism with MFIs charging interest $\bar{R}_D(\pi)$, the payoff of a type T individual is

$$\begin{aligned}
\bar{U}^{n,T}(\pi) &= \sum_{k=0}^{n} \beta(n,k) p_T^{n+1-k}(1-p_T)^k u\left(Y - \bar{R}_D(\pi) - \frac{k\bar{R}_D(\pi)}{n}\right) \\
&= p_T \sum_{k=0}^{n} \beta(n,k) p_T^{n-k}(1-p_T)^k u\left(Y - \bar{R}_D(\pi) - \frac{k\bar{R}_D(\pi)}{n}\right), \qquad (14)
\end{aligned}$$

The intuition behind (14) is exactly the same that of (10). The only difference is that (14) depends upon the proportion π of good types in the population. We then obtain the following corollary to Proposition 5.1. The proof is in Appendix A.1. First, define

$$\bar{U}^{\infty,T}(\pi) = p_T u\left(Y - (2-p_T)\,\bar{R}_D(\pi)\right). \qquad (15)$$

Corollary 5.6 *Consider $\bar{U}^{n,T}(\pi)$ defined in (14) for $T \in \{G, B\}$. For every $\pi \in [0,1]$, $\bar{U}^{n,T}(\pi)$ increases as n increases and $\bar{U}^{n,T}(\pi) \to \bar{U}^{\infty,T}(\pi)$ as $n \to \infty$.*

5.3 Equilibrium: Multiple Group Formation

We are now in a position to characterize equilibrium in the microfinance sector under group lending. Section 3 shows that the choice of contract by profit motivated MFIs is determined by the payoff of low-risk agents under the alternative contracting scenarios of a separating or a pooling equilibrium.

The same argument applies to the group lending scenario. Microfinance institutions implement a contract such that low-risk agents obtain payoff $\max\{\bar{U}^{n,G}(\pi), U^{n,G} - c^n_{MG}\}$ given number of groups n. However, since both these payoff variables are increasing in n, it is clearly optimal for all low-risk agents to form as may groups as possible. It is possible that high-risk types prefer a lower number of groups if a higher number of groups imply a shift from a pooling to a separating equilibrium and and a consequent loss of the benefits of cross-subsidization. However, since low-risk agents form the highest possible number of groups, failure to form additional groups by high-risk agents simply signals their type leading to payoff $U^{n,B}$. Since both $\bar{U}^{n+1,B}(\pi)$ and $U^{n+1,B}$ are higher than $U^{n,B}$, high-risk agents too opt for increasing the number of groups.[21].

How do we characterize the number of groups in equilibrium? For this purpose, we now make a crucial assumption. Let the number of microfinance institutions be $\mathcal{M} < \mathcal{N}_G$. Since our results are most relevant when the population size N is large, the number of low-risk and high-risk agents are also likely to considerable for reasonable values of π. It is therefore realistic to assume this upper bound on the number of MFIs. We now make the following assumption.

Assumption 5.7 *Let the number of microfinance institutions be $\mathcal{M} < \mathcal{N}_G$. Each MFI provides one and only one loan to an agent irrespective of the size of the loan the agent seeks or the number of groups that the agent is a member of.*

We can provide a superficial justification to this assumption by citing the institutional practice of MFIs. It is well-known that microfinance borrowers cannot obtain more than one loan from a MFI by acquire membership in multiple groups. However, it is a deeper question as to why MFIs follow this practice. One reason may that MFIs are actually risk averse instead of being risk neutral as we have assumed. If, indeed, that is the case, then this may be due to MFIs trying to diversify their risk involved in securing repayment. Splitting up \$1 into several smaller loans among different individuals allows better risk diversification than offering those smaller loans to the same individual in different groups. MFIs can then break-even in terms of their risk-averse utility functions at a lower interest rate. We do not pursue this question further in this paper but it provides an interesting hypothesis to explore in future research.

In any case, taking Assumption 5.7 for granted, we can now characterize equilibrium behaviour by MFIs and borrowers in the setting of group lending and the possibility of forming multiple groups. Earlier, we have argued that an agent of either type acquires membership of the maximum possible number of groups. Given the lending policy of MFIs that we have assumed in Assumption 5.7, this maximum number is clearly $\mathcal{M}$. Low-risk borrowers prefer to partner with low-risk types. It is, however, possible that having exhausted all possible partners of their type, they may also benefit from forming groups with high-risk agents, particularly if p_B is not very different from p_G. However, given the upper bound on the number of MFIs, there exist sufficient number of low-risk agents such that all low-risk agents can form the maximum possible number of groups without

[21] This follows because $\bar{U}^{n+1,B}(\pi) \geq U^{n+1,B}$ with equality holding only at $\pi = 0$ and $U^{n+1,B} > U^{n,B}$ by Proposition 5.1

having to team up with any high-risk agent. Groups are therefore homogeneous in type. We formally state the equilibrium characterization in the following proposition.

Proposition 5.8 *Let Assumption 5.7 be valid. An agent, irrespective of type, becomes a member of $\mathcal{M}$ groups. Given π, MFIs offer the pooling contract with interest $\bar{R}_D(\pi)$ if $\bar{U}^{\mathcal{M},G}(\pi) > U^{\mathcal{M},G} - c^{\mathcal{M}}_{MG}$ and the separating contract characterized in Proposition if otherwise.*

Proof. If all low-risk agents are members of n groups, Bertrand competition ensures that MFIs choose the pooling contract if $\bar{U}^{\mathcal{M},G}(\pi) > U^{\mathcal{M},G} - c^{\mathcal{M}}_{MG}$ and the separating contract otherwise. Given π, low-risk agents therefore obtain payoff $\max \bar{U}^{n,G}(\pi), U^{n,G} - c^{n}_{MG}$. Since this is increasing in n, all low-risk agents acquire membership of $\mathcal{M}$ groups. Since a low-risk agent prefers to form a group with another low-risk agent, instead of a high-risk agent, and $\mathcal{M} < \mathcal{N}_G$, all low-risk types have a sufficient number of other low-risk types to form $\mathcal{M}$ groups of homogeneous type.

Since low-risk types form $\mathcal{M}$ groups, high-risk types signal their type by forming $n < \mathcal{M}$ groups. They then obtain payoff $U^{n,B} < U^{\mathcal{M},B} \leq \bar{U}^{\mathcal{M},B}(\pi)$ with equality holding only at $\pi = 0$. Therefore, high-risk types gain by forming $\mathcal{M}$ groups irrespective of whether MFIs offer the separating or pooling contract when all agents form $\mathcal{M}$ groups. Therefore, high-risk agents also form $\mathcal{M}$ groups. ■

Under group lending, it is, therefore, natural to expect the emergence of multiple group membership as borrowers seek more efficient ways to distribute the risk they incur in taking up the liability of repayment for their group partners. In Section 3, we have determined a cut-off value π^{**} that determines whether under individual lending, MFIs offer a separating or a pooling contract. Here, we provide a heuristic derivation of a similar cut-off level in the case of group lending and remark upon some of its properties. We forego a more rigorous analysis because some of it is a repetition of the arguments in Section 3, whereas in other parts, it is difficult to to establish precise results since we need to work with approximations of limiting values.

For moderately large $\mathcal{M}$, it is reasonable to expect that

$$\max\{\bar{U}^{\mathcal{M},G}(\pi), U^{\mathcal{M},G} - c^{\mathcal{M}}_{MG}\} \approx \max\{\bar{U}^{\infty,G}(\pi), U_G - c^{\infty}_{MG}\},$$

where c^{∞}_{MG} is defined in Lemma 5.4. We define π^{∞}_{MG} as the particular π where $U^{\infty,G} = U_G - c^{\infty}_{MG}\}$. Further, if we define $\pi^{\mathcal{M}}_{MG}$ as π where $\bar{U}^{\mathcal{M},G}(\pi) = U^{\mathcal{M},G} - c^{\mathcal{M}}_{MG}$, we may expect $\pi^{\mathcal{M}}_{MG}$ to approximate $\pi^{\mathcal{M}}_{MG}$ reasonably well. Therefore, heuristically, MFIs offer the pooling contract if $\pi > \pi^{\infty}_{MG}$ (more precisely, if $\pi > \pi^{\mathcal{M}}_{MG}$) and the separating contract if the inequality is reversed.

How does π^{∞}_{MG} compare with π^{**} characterized in Lemma 3.2? First, we note that group lending has the effect of reducing interest rates that borrowers need to pay, whether in a separating contract or a pooling contract. In particular, the inflation in the pooling interest rate due to the presence of high-risk agents is much more moderate under group lending. Therefore, it is optimal for low-risk agents to pay the pooling interest rate for a larger range of π as compared to individual lending. In

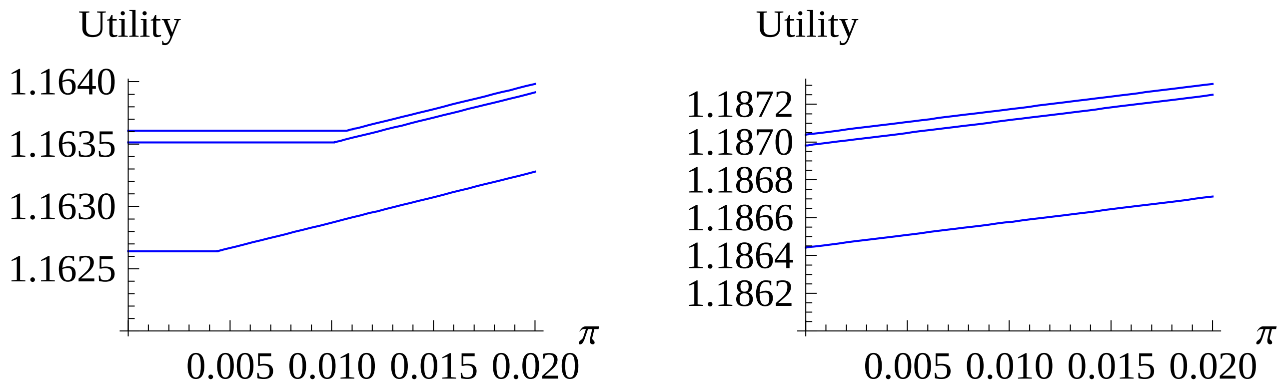

Figure 3: Let $u(c) = \sqrt{c}$ and $\{Y, \rho, p_G\} = \{3, 1.1, 0.9\}$. In both panels, we show the change in π^n_{MG} as n increases. Each line depicts $\max\{\bar{U}^{\mathcal{M},G}(\pi), U^{\mathcal{M},G} - c^{\mathcal{M}}_{MG}\}$. The lowest line corresponds to $n = 10$, the middle line to $n = 100$ and the topmost line is the limiting value as $n \to \infty$. The kink in each line determines π^n_{MG}. In the left panel, $p_B = 0.7$. Here, π^n_{MG} increases as n increases. In the right panel, $p_B = 0.8$. Here, $\pi_M G^\infty$ does not exist. Hence, for any finite n, π^n_{MG} does not exist.

particular, $\pi^\infty_{MG} < \pi^{**}$. Introduction of group lending leads to screening free lending for a greater range of π. Moreover, unlike π^{**}, π^∞_{MG} may even fail to exist particularly if p_B is close to p_G.[22]

We may also argue that multiple group formation also alleviates the problem of adverse selection in that it reduces distortions of equilibrium payoffs from those that would obtain under complete information. Under complete information, high risk types obtain payoff U_B in equilibrium. In Section 3, under individual lending with incomplete information, high risk types obtain payoff $\bar{U}_B(\pi)$ under a pooling equilibrium. With group lending, the corresponding payoff is approximately $\bar{U}^{\infty,B}(\pi)$. It is easy to verify that $\bar{U}_B(\pi) \geq \bar{U}^{\infty,B}(\pi) \geq U_B$ with the equalities holding only at $\pi = 0$. Therefore, for any π, the payoff under a pooling equilibrium is closer to that under complete information in a regime of multiple group formation. The same applies for low-risk types since $\bar{U}_G(\pi) \leq \bar{U}^{\infty,G}(\pi) \leq U_G$ with the equalities holding only at $\pi = 0$. For the low-risk types, the distortion in payoff under a screening equilibrium is also less since $c^\infty_{MG} < c_M$, the screening cost charged by MFIs under individual lending.

Section 4 contrasts equilibria under MFIs and a SHG in the setting of individual lending. That is of course, sufficient to understand the impact that the entry of commercial MFIs can have on borrower welfare. However, for the sake of completeness, we now briefly contrast Proposition 5.8 with the equilibrium that would obtain with a sole SHG that would operate through joint lending. As in Section 2, we make the stark assumption that the SHG can only lend to one group; i.e. it has only \$2 to lend. With this assumption, the analysis of the contract choice problem largely remains

[22] We may also be prove that for any finite n, $\pi^n_{MG} < \pi^\infty_{MG}$. This follows because the screening cost c^n_{MG} falls as n rises due to which the rate of growth of $U^{n,G} - c^n_{MG}$ with respect to n is faster than that of $U^{n,G}$. Moreover, since $\bar{R}_D(\pi) > R_{D,G}$, the rate of growth of $U^{n,G}$ is higher than that of $\bar{U}^{n,G}(\pi)$. Consequently, as both $\bar{U}^{n,G}(\pi)$ and $U^{n,G} - c^n_{MG}$ rises with n, the latter rises faster due to which the point of intersection, if any, between the two shifts rightward.

unchanged from Section 2. Given π, the SHG offers a pooling contract at interest $\bar{R}(\pi)$ if

$$\pi \bar{U}^{1,G}(\pi) + (1-\pi)U^{1,B}(\pi) > U^{1,G} - c^1_{MG}. \tag{16}$$

If this equation is not satisfied, the SHG offers the separating contract $\{(R_{D,G}, c^1_{MG}), (R_{D,B}, 0)\}$. Then, following entry by MFIs and depending the contract choice of the SHG and that of MFIs in Proposition 5.8, we would be faced with a variety of cases as in Section 4. However, the main conclusion of that section remains valid. All agents who could not access credit from the SHG definitely benefit. Existing SHG clients are at least as well off except possibly in the situation when the SHG does not screen whereas MFIs implement screening. It that case, the SHG loses its ability to cross-subsidize due to which high-risk borrowers need to settle for the payoff $U^{\mathcal{M},B} \approx U_B$.

6 Discussion and Conclusion

In this paper, we analyze the welfare implications of entry of commercial MFIs in an industry where a benevolent, albeit fund-constrained SHG is in operation. We show that the entry of commercial MFIs can lead to Pareto superior situation despite the fact that interest and default rates may increase. This is because this entry enables access to microfinance loans to greater sections of people. Unlike the previous literature, which classifies borrowers based on their economic profile, we classify the borrowers on their riskiness. With the entry of commercial MFIs, our model shows that the access to microfinance, even to high risk borrowers, always increases. Therefore, since the inherent risk increases, interest as well as default rates go up. We also show that, as commercial MFIs enter, screening cost imposed by MFIs - to break information problem - weakly decreases.

In the context of joint liability, we show that competition can diversify the risk a borrower is exposed to. An artifact of increased competition is the ability for the borrowers to obtain credit from multiple sources. We show that, by obtaining loan from different MFIs through being a part of different groups, a borrower can efficiently diversify the inherent risk she carries. In other words, multiple borrowing, by being a part of different groups, leads to Pareto efficient risk diversification. Therefore, our model suggests that multiple loans should be looked upon in the light of risk mitigating activities, and not myopic behavior that leads to over indebtedness.

We start out by assuming that the SHG is a fund-constrained entity, whereas MFIs have unlimited access to funds. Even if this assumption were violated - that is, MFIs also have limited funds - the equilibrium characterization will not change substantially in the long run. In the short run, however, Bertrand competition with capacity constraints implies that the interest rates are close to monopoly levels. In the long run, new entry erases the capacity constraint, thereby restoring the equilibrium we have characterized in Section 4. The results pertaining to Pareto improvement are still valid, even in short run because of increase in outreach.

The equilibrium outcomes characterized in Section 4 and Section 5 provide a few hypotheses that can be tested using data. First, since competition enables the risky borrowers to obtain loans, we must observe that defaults increase with the number of MFIs in the market. Moreover, we should also observe that the borrowers with previous loans with SHGs should default less than the ones whose first loan is from a commercial MFI.[23] Second, screening costs decrease with entry of commercial MFIs. If the screening costs are interpreted as mechanisms through which the microfinance industry ensures group cohesiveness, increase in competition should weakly decrease group cohesiveness. This can take several forms. For example, time spent on each group meeting and waiting time to obtain a loan can reduce.

In Section 5, we have made an assumption that an MFI provides at most one loan to an individual, thereby limiting the number of groups a person can be a part of to the number of MFIs in the market. We have justified this assumption by suggesting that MFIs could be risk averse. We also justified the risk aversion on the grounds that MFIs impose ceiling on maximum loan that can be disbursed to a borrower. If this assertion of risk aversion were indeed true, we must observe that, as the number of MFIs in a market increases, the maximum amount of loan that a given MFI provides to an individual must decrease. Another implication of multiple group formation to diversify risk is that as the number of MFIs increase, the number of individuals an agent associates with to form groups increases.

Our paper has a few regulatory implications. We have shown that, despite increase in interest rates and default rates social welfare can improve. Therefore, evidence of defaults should not lead to arbitrary market regulations. We also show that multiple group formation is welfare enhancing, and not necessarily a path to over indebtedness. Hence, the regulator ought to be more circumspect in imposing restrictions both on number of groups borrowers can form, as well as on the number of MFIs in the market.

A Appendix

A.1 Proofs of Section 5

Proof of Proposition 5.1. Given n, let C_k be the random variable $\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right)$. This is the consumption level obtained by an agent when k of her partners fail to repay their loans. The variable factor in C_k is k which, by (10) is binomially distributed with parameters n and $(1 - p_T)$, i.e. $k \sim B(n, 1 - p_T)$. Hence, for any n, the expected consumption of the agent is

$$\begin{aligned} EC_k &= p_T E\left(\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right)\right) \\ &= p_T\left(Y - R_{D,T}\left(1 + \frac{1}{n}Ek\right)\right) \\ &= p_T\left(Y - \frac{\rho}{p_T(2-p_T)}\left(1 + \frac{1}{n}n(1-p_T)\right)\right) \\ &= p_T\left(Y - \frac{\rho}{p_T}\right), \end{aligned}$$

[23] While most MFIs report very high repayment rate (more than 95%), they only report their results at a group level, and not at individual level.

which is the expected consumption under individual lending.

To determine the declining variation in consumption, note that as $n \to \infty$, $B(n,(1-p_T)) \to_d N(n(1-p_T), np_T(1-p_T))$, i.e. the binomial distribution $B(n,(1-p_T))$ converges to normal distribution with mean $n(1-p_T)$ and variance $np_T(1-p_T)$. It is also easy to verify that $N(n(1-p_T), np_T(1-p_T)) \to_d \delta_{n(1-p_T)}$ as $n \to \infty$, where $\delta_{n(1-p_T)}$ is the Dirac distribution on $n(1-p_T)$. Hence, the variance in consumption approaches zero as $n \to \infty$. To see the convergence in utility, denote by $\Phi(k)$ the distribution function of $N(n(1-p_T), np_T(1-p_T))$. The convergence in distribution then implies

$$\lim_{n\to\infty} U^{n,T} = \lim_{n\to\infty} p_T \int u\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right) d\Phi(k) = p_T u\left(Y - R_T\right) = U_T,$$

where the convergence of expected value follows from the boundedness of $u\left(Y - R_{D,T} - \frac{kR_{D,T}}{n}\right)$ by $u(Y)$. ■

Proof of Corollary 5.2. Note that $k \sim B(n, 1-p_B) \to_d N(n(1-p_B), np_B(1-p_B)) \to_d \delta_{n(1-p_B)}$. Hence, applying the logic of the proof of Proposition 5.1, we obtain

$$\begin{aligned}
\lim_{n\to\infty} U_B^{n,G} &= \lim_{n\to\infty} E_k u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,G}\right) \\
&= u\left(Y - \left(1 + \frac{n(1-p_B)}{n}\right) R_{D,G}\right) \\
&= u\left(Y - (2-p_B)R_{D,G}\right). \ ■
\end{aligned}$$

Proof of Lemma 5.4. Proof. By Proposition 5.1, $U_B^{n,G} \to p_B u(Y - (2-p_B)R_{D,G})$ and $U^{n,B} \to U_B$. The first part of the result therefore follows.

Take n to be a continuous variable. Both $U_B^{n,G}$ and $U^{n,B}$ are increasing in n. To show that c_{MG}^n declines in n, we need to show that $U_B^{n,G} - U^{n,B}$ declines which is equivalent to showing that $\log U_B^{n,G} - \log U^{n,B}$ falls in n. To show this, we need to show that the rate of increase in $\log U_B^{n,G}$ in n is slower than that of $\log U^{n,B}$. Note that the difference in the rate of increase between the two magnitudes is determined by the difference in rate of increase of $\log u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,G}\right)$ and $\log u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,B}\right)$ respectively at n, $k \in \{0, 1, \cdots, n\}$. Denoting the derivative of a function f with respect to n by f_n, we have

$$\begin{aligned}
\left(\log u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,G}\right)\right)_n &= \frac{u'(\cdot)}{u(\cdot)}\left(\frac{kR_{D,G}}{n^2}\right) \\
\left(\log u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,B}\right)\right)_n &= \frac{u'(\cdot)}{u(\cdot)}\left(\frac{kR_{D,B}}{n^2}\right)
\end{aligned}$$

Since $R_{D,G} < R_{D,B}$, $u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,G}\right) > u\left(Y - \left(1 + \frac{k}{n}\right) R_{D,B}\right)$. Further, risk aversion implies that $u'\left(Y-\left(1+\frac{k}{n}\right)R_{D,G}\right) < u'\left(Y-\left(1+\frac{k}{n}\right)R_{D,B}\right)$. Hence,

$$u_n\left(Y-\left(1+\frac{k}{n}\right)R_{D,G}\right) < u_n\left(Y-\left(1+\frac{k}{n}\right)R_{D,B}\right). \blacksquare$$

Proof of Corollary 5.6 Note that $k \sim B(n, 1-p_T) \rightarrow_d N(n(1-p_T), np_T(1-p_T)) \rightarrow_d \delta_{n(1-p_T)}$ and apply the argument in the proof of corollary 5.2. $\blacksquare$

References

[1] H. Bansal, SHG-Bank Linkage Program in India, Journal of Microfiance, 5 (2003), 21-49.

[2] M. Ghatak, Screening by the Company You Keep: Joint Liability Lending and the Peer Selection Effect, The Economic Journal, 110 (2000), 601-631.

[3] B. Guha, P. Roy Chowdhury, Microfiance Competition with Motivated MFIs, ISI-Delhi Working Paper Series, 2010.

[4] H. Kai, Competition and Wide Outreach of Microfiance Institutions, MPRA Paper 17143, 2009.

[5] R. Marquez, Competition, Adverse Selection, and Information Dispersion in the Banking Industry, Review of Financial Studies, 15 (2002), 901-26.

[6] C. McIntosh, A. de Janvry, E. Sadoulet, How Rising Competition among Microfinance Institutions affects Incumbent Lenders, The Economic Journal, 115 (2005) 987-1004.

[7] C. McIntosh, B. Wydick, Competition and Microfinance, Journal of Development Economics, 78 (2005) 271-98.

[8] F Olivares-Polanco, Commercializing Microfiance and Deepening Outreach: Empirical Evidence from Latin America, Journal of Microfiance, 7 (2006), 47-69.

[9] E. Rhyne, R. Christen, Microfiance Enters the Market Place, USAID, Washington DC, 1999.

[10] N. Srinivasan, Microfinance India: State of Sector Report, Sage Publications, 2010.