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# Group Lending under Dynamic Incentives as a Borrower Discipline Device\*

*Bruce Wydick*

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**LRH:** Bruce Wydick

Abstract: In recent years group lending has become an increasingly utilized tool for providing credit access to the poor in developing countries. Using empirical results from first-hand field research on Guatemalan borrowing groups, this paper develops a simple game-theoretic model of group lending. Results from the model show that through peer monitoring, the threat of group expulsion, and the safety net of intra-group credit insurance, group lending mitigates some risky investment behavior that would otherwise occur under an individual borrowing contract. The credible threat of social sanctions against group members who misallocate borrowed capital further reduces instances of such behavior.

\*University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117-1080,

Tel: (415) 422-5863, Fax: (415) 422-5784, E-mail: [wydick@usfca.edu](mailto:wydick@usfca.edu). I would like to thank George Akerlof, Tim Besley, Marcel Fafchamps, Gabriel Fuentes, Alain de Janvry, Michael Kevane, Ethan Ligon, Carlos Perez, Betty Sadoulet, an anonymous referee, seminar participants at University of California, Williams College, and the directors of FUNDAP in Quetzaltenango, Guatemala for their helpful suggestions and encouragement. Financial support for research by the Mellon Foundation and the Pew Evangelical Scholars Program is gratefully acknowledged.

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**Contact Author:** See name and address above.

## 1. Introduction

A number of pioneering economic articles published in the 1970s such as Akerlof (1970), Alchian and Demsetz (1972), and Spence (1973) began to identify asymmetric information as a principal cause of market failure. At virtually the same time, however, anthropologists such as Scott (1976) were discovering that some of the adverse consequences of asymmetric information, such as moral hazard, are mitigated in the context of the tightly knit social structures of traditional societies.

The subsequent interplay between imperfect-information-based models and careful field research has given birth to a vast new literature, characterized by papers such as Udry (1994) and Townsend (1994, 1995), that has transformed the way economists understand economic behavior in developing countries. This research has demonstrated that the widespread nature of information in traditional societies allows for the use of informal, yet highly efficient, contingency-related credit contracts, risk sharing, and consumption smoothing. Interest among economists has now dramatically increased at the prospect of purposefully creating institutions that are similarly capable of mitigating asymmetric information problems in credit markets. This new literature investigates the information and incentive structures of credit cooperatives and village banks (e.g. Besley, Banerjee, and Guinnane, 1994; Barham, Boucher, and Carter, 1996), and even the use of village moneylenders as conduits of credit (Fuentes, 1996; Warning and Sadoulet, 1998). Yet the institution that has by far attracted the most attention of economists, and generated the greatest excitement among practitioners, is that of *group lending*.

Group lending schemes have enjoyed well-publicized success in recent years in a wide spectrum of developing countries.<sup>1</sup> Yet the specific characteristics of group lending that are responsible for this success remain an open question. Economists still do not clearly understand why group lending works. Nevertheless, researchers have put forth a number of hypotheses seeking to explain the impressive repayment performance of many well-known group lending institutions.

Ghatak (1999) and Van Tassel (1999) develop similar models, which show that the ability of borrowing groups to self-select membership mitigates adverse selection problems in credit markets, allowing lenders to offer a lower interest rate to a pool of potential borrowers. If borrowers within a pool have perfect information about one another's projects, borrowing groups (with joint liability for

a single loan) will self-select homogeneously with respect to investment risk. Because risky borrowers must bear the increased liability for the projects of their risky partners, they will reject a group loan contract acceptable to group of safe borrowers. This allows for a lower equilibrium interest rate and a Pareto superior outcome in credit markets vis-à-vis individual lending.

A second category of models focuses on the benefits of group lending *ex-post* to group formation. One subset of models in this literature focuses on the ability of social ties and social pressure between borrowing group members to internalize the moral hazard externality associated with limited liability credit contracts. Floro and Yotopolous (1991) and Impavido (1998) argue that in contexts where social ties are strong, group lending can, respectively, improve repayment performance and relax credit rationing. Besley and Coate (1995) show that group lending may reduce the incentive for moral hazard relative to individual lending if the credible threat of social penalties is sufficiently high in the case of borrower default.

Other models analyzing the benefits of group lending *ex-post* to group formation emphasize the potential benefits of peer monitoring and intra-group credit insurance. Stiglitz (1990), Conning (1999), and Armedáriz de Aghion (1999) create models that show how peer monitoring between borrowing group members reduces the incentive for risk-taking, fostering a reduction in competitive interest rates. Papers by Varian (1990) and Rashid and Townsend (1992) highlight the role of intra-group credit insurance, allowing borrowing group members to repay one another's loans in the case of negative stochastic shocks, if returns between members' projects are not highly correlated.

Performing econometric tests on Guatemalan group lending data, Wydick (1999) attempts to test the relative importance of hypotheses seeking to explain the strong performance of borrowing groups *ex post* to group formation. The tests fail to reveal any significant net effect of social ties on intra-group insurance, mitigation of moral hazard, or overall loan repayment. The results of this empirical research, however, do support current models that place an emphasis on the roles of peer monitoring and group pressure in borrowing group performance. Moreover, as will be shown in Section 2, the Guatemalan data yield additional insights into the relative advantages of group lending that are not captured in current models.

Important empirical facts from the 1994 Guatemalan data, along with data from a subsequent 1999 follow-up survey, which are summarized in Section 2, have informed the development of the

model presented in Section 3. This model portrays a borrowing group as a kind of evolving jury, or *dynamic peer review committee*. In an imperfect-information framework, the model illustrates how informational flows, dynamic repayment incentives, group pressure, intra-group insurance, and social relationships work together to mitigate asymmetric information problems in small-scale credit contracts. The intuition of the model is that when informational flows between group members are high, the potential for intra-group credit insurance, combined with the threat of being expelled from a borrowing group, deters some borrowers with a high rate of time preference from misallocating borrowed capital in a manner that increases risk to the lender. The credible threat of social sanctions further reduces instances of risky investment behavior. Moreover, in a perfect Bayesian equilibrium in which safe projects are undertaken, there is a trade-off between the credible threat of social sanctions and peer monitoring. Social sanctions can thus compensate for poor informational flows in contexts where direct peer monitoring is difficult.

## **2. Empirical Facts from the Guatemalan Group Lending Data**

The econometric results in Wydick (1999) come from data collected by a team led by this researcher in a 1994 survey of 137 borrowing groups in the western Guatemalan city of Quetzaltenango and surrounding rural areas. These borrowing groups, typically consisting of three to five members, were part of a group lending scheme administrated by FUNDAP<sup>2</sup>, an ACCION-affiliated institution that has operated a micro-credit program in the area since 1988. Data from the 1994 survey and a 1999 follow-up survey of 51 of these groups have revealed four important sets of empirical facts:

***Fact 1:** Peer monitoring and the need to maintain access to an affordable source of credit appear to play the leading roles in enticing timely group loan repayment.* In likelihood-ratio tests on a set of three variables intended to proxy for peer monitoring (knowledge of other members' weekly sales, distance between enterprises, and similarity of occupation) peer monitoring variables displayed a moderately significant effect on mitigating moral hazard problems, and a strongly significant effect in fostering intra-group insurance and overall loan repayment (Wydick, 1999: Table 5). Especially in rural areas, group pressure was also found to have a significant effect on

detering risky borrower behavior, but the origin of this pressure stemmed from the need to remain in the group to maintain access to credit, rather than the threat of social sanctions from other borrowers. Also significant from this empirical work is the neutralizing effect social ties between borrowers appear to play in borrowing group performance: Borrowers may invest borrowed capital more carefully to gratify friends in a borrowing group, but they may also be more reluctant to pressure these same friends to repay loans.

A revealing question in the 1994 survey was one that simply asked, "Why do you repay your share of a group loan?" In response to this question, 86.1% of the borrowers responded that a major reason for repaying their share of the group loan was to maintain access to future loans, while only 17.1% said that a major reason for repaying was to maintain a close relationship with the other group members.<sup>3</sup> While the threat of social sanctions may be important to enticing repayment for some borrowing groups, it appears to be secondary to the need to maintain access to affordable credit.

***Fact 2:** Much of the screening of borrowers occurs after group self-selection in the form of group expulsions.* An important assumption in recent papers such as Ghatak (1999) and Van Tassel (1999) is that perfect information between borrowers allows for homogeneously formed groups, which reduce the relative cost of capital for safe borrowers. There is good reason to believe that information between a pool of potential borrowers is stronger than that between the lending institution and the borrowing pool. But in order to access credit at low interest rates, borrowers are still often forced to self-select their jointly liable groups within a haze of imperfect information. Borrowers clearly have an incentive to choose the best partners available to them within their finite sphere of relationships, yet the data show that borrowers typically lack prior experience in financial matters with one another: Only 17.4% described borrowing partners before group formation as business associates, while 63.8% described them as "friends", 27.5% were "neighbors", and 14.5% were described as merely "casual acquaintances."<sup>4</sup>

As a result, expulsions from borrowing groups are quite common, especially in the initial stages of borrowing. In the 1994 survey, 22 of the 137 groups surveyed had expelled members for misusing borrowed capital, not including perhaps 20 other groups from which members had voluntarily resigned, usually because of failure to repay their share of a loan. (It was difficult from the data to ascertain how many of these borrowers would have been expelled from groups had they not left voluntarily.) Moreover, in the 1999 follow-up survey, member expulsions accounted for roughly one-third of the turnover in borrowing groups over the previous five years, and about two-thirds of the turnover for individuals who had not left the area. The required number of borrowing group members is three, so that when a borrower is ejected from a group of the minimum size, he or she is often quickly replaced by another whom the remaining two deem as the most responsible new candidate. This kind of adaptive, evolving behavior can be distinguished from the perfect information environment required for assortative matching.<sup>5</sup>

*Fact 3: Especially in impoverished areas, the moral hazard associated with borrowing does not lie in risky projects as such, but in the risk of credit diverted from investment toward consumption.* Many models of credit markets associate risky borrower behavior with an incentive to undertake risky *projects*, where such projects are taken to represent a mean-preserving spread over those of a safe project. This, of course, is a notion that is inconsistent with the well-known aversion to risk among the poor in developing countries. It is not surprising, therefore, that in practice risky borrower behavior from the lender's perspective is very rarely associated with risky *projects*. The much greater risk to the lender lies in granting loans to borrowers with a high rate of time preference, who may try to divert all or a part of borrowed capital to an immediate consumption need, thus reducing the probability that a given project will yield a return sufficient for repayment.<sup>6</sup>

*Fact 4: Intra-group insurance is prevalent and important.* Of the 137 groups interviewed in the 1994 survey, 119 reported that since the foundation of their group, at least one of the group members had been the victim of some type of unavoidable shock that made it difficult for that

borrower to repay. Among those groups having experienced some type of negative shock, 89.9% indicated at least some degree of mutual aid occurred, with 59.6% of groups describing the frequency of intra-group insurance as either "occasional" (42.0%) or "frequent" (17.6%). The typical form of intra-group credit insurance is a kind of shock-contingent loan granted to the unfortunate member by one or more of the other borrowing partners. The 1999 survey revealed intra-group insurance to be a far more frequently used buffer against unforeseen shocks (80.1%) than family (8.9%) or moneylenders (2.2%) for repaying group loans. Moreover, the frequency of intra-group insurance was strongly correlated with the repayment performance of borrowing groups who had experienced some type of negative shock: The average number of days in arrears (on a three-to-four month loan) for groups providing intra-group insurance on a "frequent" basis was 0.22 days, an "occasional" basis 0.39 days, a "seldom" basis 0.37 days, and among groups that "never" provided intra-group insurance mean arrears were 11.72 days.

### 3. A Model of Group Lending

In light of these empirical facts from the Guatemalan data, consider a large pool of borrowers  $P = \{1, 2, 3 \dots n\}$ , indexed by  $i$  with rates of time preference uniformly distributed along a continuum such that  $\rho_i \in (0, \bar{\rho}]$ . To begin with, we assume each borrower has a utility function that is strictly a linear function of income. Borrowers have access to one unit of capital per period through two sources: 1) a credit institution with whom interest and principal due at the end of the lending period are equal to  $r$ ; 2) a moneylender who charges a higher interest rate such that interest and principal due on the loan are equal to  $m > r$ .<sup>7</sup> Over an infinite time horizon, the lower interest rate of the credit institution therefore yields a surplus to the  $i^{th}$  borrower equal to  $\Delta_i = (m - r)/\rho_i$ .

Let us also assume that because of information asymmetries and economies of scale in lending, credit from the lending institution is only available via group borrowing. Borrowing groups are made up of two members.<sup>8</sup> The set of players in the game,  $\{M_1, M_2\}$  represent the two roles

played in the game by each group member, that of *investor* and potential *insurer* of a partner's failed project. Reflecting commonly established practices of group lending institutions, we will assume that 1) groups are free to self-select membership; however, because borrowers routinely lack experience in financial matters with one another, we will assume that initially there is asymmetric information over  $\rho_i$ ;<sup>9</sup> 2) loans are small and of short duration; 3) each group member is individually liable for the repayment of the entire amount due on the group loan (=  $2r$  in our simplified case); 4) any member who internally defaults to the group may be expelled from the group by the other member(s) and costlessly replaced; 5) members expelled from lending groups are disqualified from receiving future loans; 6) *all* members of a group externally defaulting on its group loan are disqualified from receiving future loans.

The extensive-form game in Figure 1 considers the player  $M_1$  in the role of investor and  $M_2$  in the role of potential insurer, a useful simplification since it will be seen that a member's strategy in one role is independent of her strategy in another role. The game begins after groups obtain a loan of one unit of capital for each member. A borrower either safely allocates the full one-unit of borrowed capital into her specified project, or diverts some portion  $G$  of her loan toward present consumption, increasing the risk of project failure. A borrower's project either succeeds, yielding a net return of  $R - r > 0$ , or fails in which case it yields  $R' - r < 0$ .

The probability of project success (failure) is a monotonically decreasing (increasing) function of  $G$ . The relative probabilities of these outcomes are  $p(G)$  and  $1 - p(G)$  respectively, where  $p(0) = 1 - \varepsilon$ ,  $p(1) = 0$ ,  $p_G(\cdot) < 0$ ,  $p_G(1) = \infty$ , and  $p_{GG}(\cdot) < 0$ , with  $\varepsilon > 0$ .

**LEMMA 1:** Under an individual, limited-liability (one-shot) loan contract, a borrower will optimally divert some portion  $G^* \in (0, 1)$  of the loan toward consumption.

PROOF: The borrower will choose  $\arg\max_G G + p(G)(R - r)$  for which the first-order condition

$$\frac{\partial(\cdot)}{\partial G} = -p_G(\cdot) = 1/(R - r) \text{ is solved by } G^* = p_G^{-1}\left[\frac{-1}{R - r}\right] > 0. \quad \square$$

In order to focus on the central insights yielded by the model, we will assume for simplicity that the probability of being caught is dependent on the choice to misallocate borrowed capital rather than on the level of  $G$ . This will therefore leave the borrower choosing from the discrete strategy set  $\Sigma_1 = \{Risky, Safe\}$ . We can accordingly define  $P_s \equiv p(0)$  and  $P_R \equiv p(G^*)$ .

If and only if  $M_1$  chooses risky behavior and the project fails, Nature determines with probability  $\alpha \in (0, 1]$  whether  $M_2$  receives information revealing of risky behavior by  $M_1$ . This is denoted by  $\omega \in \{0, 1\}$  where  $\omega = 1$  constitutes revealed information of risky behavior and  $\omega = 0$  constitutes the absence of such information. In this way  $\alpha$  functions as an exogenous parameter reflecting the flow of information between borrowers.

The contingent action of  $M_2$ ,  $a_2 \in \{Expel, Insure\}$ , constitutes a response to a failed project by  $M_1$ , given  $\omega \in \{0, 1\}$ . Through this contingent action,  $M_2$  seeks to deter  $M_1$  from misallocating his borrowed capital, since such behavior increases her expected financial liability. Thus in the case that  $M_1$ 's project fails,  $M_2$  will either *Expel* him from the group after the current loan cycle, or *Insure* his failed project by retaining his membership in the group and repaying his portion of the group loan.

The model associates loan repayment with the solvency generated by successful projects; we will assume that dynamic incentives are strong enough to set aside issues of strategic default. Furthermore, we assume the success of one project yields the liquidity necessary to insure a partner's failed project, or  $R > 2r - R'$ , and that dynamic incentives are sufficiently strong that  $\rho_i$  satisfies  $\rho_i < \frac{m-r}{2r-R'}$  for all  $\rho_i \in (0, \bar{\rho}]$ .<sup>10</sup>

### *Equilibrium*

A perfect Bayesian equilibrium is a strategy profile for which  $\sigma_1 \in \Sigma_1 = \{Risky, Safe\}$  and  $\sigma_2 \in \Sigma_2 = (a_2 | \omega=0, a_2 | \omega=1 : \delta)$  constitute strategies that are a mutual best response, given  $M_2$ 's belief  $\delta$  that a failed project originated from Risky behavior. The complete set of pure-strategy profiles is given by the Cartesian product  $\Sigma = \Sigma_1 \times \Sigma_2$  and the payoffs to each player  $M_1$  and  $M_2$  are determined by the mapping  $h: \Sigma \rightarrow \mathfrak{R}^2$  via their effect on the income of both group members.

The *prior* belief of  $M_2$  about the probability of risky behavior by a borrowing partner  $i$  is derived from the proportion of borrowers whose rate of time preference lies above the critical level

necessary for  $M_1$  to play Safe. Obtaining an expression for this critical level is the first step in solving for an equilibrium. To find this expression we examine the best investment strategy of  $M_1$  given different levels of the information parameter  $\alpha$  and different contingent responses by  $M_2$ . Let us first assume that  $M_2$  plays the strategy  $\sigma_2 = (\text{Expel} \mid \omega = 0, \text{Expel} \mid \omega = 1: \delta)$ . Given this strategy by  $M_2$ , (1) gives the condition under which a borrower  $i$  ( $M_1$ ) will play Safe:

$$\begin{aligned} E(U_i)_{\text{risky}} &= P_R(G^* + R - r) + \alpha(1 - P_R)(G^* - \Delta_i) + (1 - \alpha)(1 - P_R)(G^* - \Delta_i) \\ &< E(u)_{\text{safe}} &= P_S(R - r) + (1 - P_S)(-\Delta_i) \end{aligned} \quad (1)$$

Algebraic manipulation of (1) yields the critical value of  $\rho_i$  necessary for  $M_1$  to play Safe.

$$\rho_i < \frac{(P_S - P_R)(m - r)}{G^* + (P_R - P_S)(R - r)} \quad (2)$$

Denote the critical value of  $\rho_i$  for which a borrower is indifferent to playing Risky or Safe when uninsured by  $M_2$  as  $\rho^*$ . For borrowers with  $\rho_i \in (\rho^*, \bar{\rho}]$ , the potential short-term gains from diverting  $G^*$  of borrowed capital toward consumption outweigh the increased probability of being expelled from the group. Note in Figure 2 that the “switching line”, which describes  $M_1$ ’s indifference between playing Safe and playing Risky, is horizontal in  $\alpha$ - $\rho$  space. Borrowers with  $\rho_i$  above the switching line play Risky, while borrowers with  $\rho_i$  below the line play Safe.

Now assume a strategy by  $M_2$  of  $\sigma_2 = (\text{Insure} \mid \omega = 0, \text{Expel} \mid \omega = 1: \delta)$ . Such a strategy provides intra-group credit insurance for a failed project when there is no evidence of risky investment behavior. Borrower  $i$  in the role of  $M_1$  will then play Safe if (3) is satisfied.<sup>11</sup>

$$\begin{aligned} E(U_i)_{\text{risky}} &= P_R(G^* + R - r) + \alpha(1 - P_R)(G^* - \Delta_i) + (1 - \alpha)(1 - P_R)(G^*) \\ &< E(u)_{\text{safe}} &= P_S(R - r) + (1 - P_S)(0) \end{aligned} \quad (3)$$

The critical rate of time preference value necessary for  $M_1$  to play Safe is now

$$\rho_i < \frac{\alpha(1 - P_R)(m - r)}{G^* + (P_R - P_S)(R - r)}. \quad (4)$$

Denote the critical value of  $\rho$  for which a borrower is indifferent to playing Risky or Safe in (3) and (4) as  $\rho^{**}$ . For borrowers with  $\rho_i \in (\rho^{**}, \bar{\rho}]$ , the potential short-term gains from risky behavior outweigh the risk of being expelled from the group in the case that the risky behavior is discovered by  $M_2$ . As seen in Figure 2 that this second switching line is positively sloped in  $\alpha$ - $\rho$  space. For all

combinations of  $\alpha$  and  $\rho$  lying northwest (southeast) of the switching line, borrower  $i$ , in the role of  $M_I$ , plays Risky (Safe). Note that as the dynamic incentives become stronger (the amount borrowed declines relative to  $m - r$ ) the proportion of borrowers playing Risky declines.

LEMMA 2: *The contingent strategy of  $M_2$  depends on the informational environment,  $\alpha$ .*

PROOF: See Figure 2

Figure 2 reveals that in a low- $\alpha$  environment, below the critical point  $\alpha^* = (P_s - P_R)/(1 - P_R)$ ,  $M_2$ 's optimal strategy to induce  $M_I$  to play Safe is (*Expel* |  $\omega = 0$ ; *Expel* |  $\omega = 1$ :  $\delta$ ). In a high-information environment with  $\alpha \in (\alpha^*, 1]$  (such as in a crowded market where borrowing groups are often made up of vendors with stalls located near to one another), Figure 2 shows that the strategy (*Insure* |  $\omega = 0$ ; *Expel* |  $\omega = 1$ :  $\delta$ ) is optimal.

Strategies that form part of a perfect Bayesian equilibrium must be subgame-perfect, or credible. Therefore it must be just below this critical point  $\alpha^*$  that replacing a member with a failed project (given  $\omega = 0$ ) for a new random borrower is optimal for  $M_2$ . To see that this is true let  $\hat{p}_r$  and  $\hat{\hat{p}}_r$  be  $M_2$ 's prior beliefs about the probability of a random borrower  $i$  undertaking a Risky investment strategy given  $\sigma_2 = (\text{Expel} | \omega = 0, \text{Expel} | \omega = 1: \delta)$  and  $(\text{Insure} | \omega = 0, \text{Expel} | \omega = 1: \delta)$  respectively. Under a uniform distribution,  $\hat{p}_r = \frac{\rho^*}{\bar{\rho}}$  and  $\hat{\hat{p}}_r = \frac{\rho^{**}}{\bar{\rho}}$ . Given her priors  $p_r \in \{\hat{p}_r, \hat{\hat{p}}_r\}$ ,  $\omega = 0$ , and  $\alpha$ ,  $M_2$  calculates  $\delta$ , the probability that a failed project by  $M_I$  originated from Risky behavior, using Bayes' Rule:

$$\delta = p(\text{Risky} | \sigma_2, \alpha, \omega = 0) = \frac{p_r(1 - P_R)(1 - \alpha)}{p_r(1 - P_R)(1 - \alpha) + (1 - p_r)(1 - P_S)}. \quad (5)$$

It is optimal for  $M_2$  to expel  $M_I$  from the group if the expected future financial liability from a new random group is greater than that for the current member or,

$$p_r < \frac{p_r(1 - P_R)(1 - \alpha)}{p_r(1 - P_R)(1 - \alpha) + (1 - p_r)(1 - P_S)}, \text{ which reduces to } \alpha < \alpha^* = (P_s - P_R)/(1 - P_R). \quad (6)$$

The intuition is that with  $\omega = 0$  and  $\alpha \in (0, \alpha^*]$ ,  $M_2$  replaces  $M_I$  in the borrowing group because he is more likely to be a borrower who plays Risky in the current informational environment than his random replacement. With  $\alpha \in (\alpha^*, 1]$  and  $\omega = 0$ , a failed project is likely to have been an unavoidable mishap in the context of Safe behavior; if it was the result of Risky behavior, it would likely have been discovered as such. In this case,  $M_I$  is less likely to be a borrower who plays Risky than his random replacement. This credible threat of expulsion and the reward of intra-group

insurance where  $\alpha > \alpha^*$  lay the foundation for a perfect Bayesian equilibrium in which some high- $\rho$  borrowers are dissuaded from risky behavior.

PROPOSITION 1: *Through peer monitoring, the possibility of intra-group insurance, and the threat of expulsion from a borrowing group, a Perfect Bayesian equilibrium exists in which group lending reduces the risk of moral hazard in credit contracts.*

PROOF: See Appendix and Figure 2.

The intuition to the proof is captured clearly in Figure 2. If under individual lending all insolvent borrowers with failed projects are denied future loans, borrowers for whom  $\rho_i \in (\rho^*, \bar{\rho}]$  play Risky, and all borrowers for whom  $\rho_i \in (0, \rho^*]$  play Safe. However, under group lending, the borrowers located in  $\alpha$ - $\rho$  space between the switching lines in the northeastern section of the diagram choose Safe instead of Risky. For these borrowers with  $\rho_i \in (0, \rho^*]$ , the benefits of intra-group insurance and the threat of group expulsion outweigh the gain from playing Risky for all  $\alpha \in (\alpha^*, 1]$ .<sup>12</sup>

### *Social Sanctions*

Certain papers in the literature such as Besley and Coate (1995) have identified the potential for social sanctions between borrowing group members as key to the success of group lending. We now extend the current model to analyze the effect of social sanctions on borrowing group performance.

Let borrower utility to be a function of both income and social standing,  $U_i(Y, S)$ , where utility is concave and twice differentiable in both arguments. Define  $u(y, s) \equiv U(Y + \Delta Y, S + \Delta S) - U(Y, S)$ , and let  $s_{\omega=0}$  and  $s_{\omega=1}$  represent the largest credible threat of social sanctions resulting from an unsuccessful project with  $\omega = 0$  and  $\omega = 1$ , respectively. We would anticipate the loss in social standing to be greater when risky behavior is detected. Therefore, all else equal, we would expect that  $s_{\omega=1} > s_{\omega=0}$ . Consider the case in which  $\sigma_2 = (\text{Expel} \mid \omega = 0, \text{Expel} \mid \omega = 1: \delta)$ . The switching line in (1) for playing Safe is now

$$\begin{aligned} E(u)_{\text{risky}} &= P_R u(G^* + R - r, 0) + \alpha(1 - P_R) u(G^* - \Delta_i, -s_{\omega=1}) + (1 - \alpha)(1 - P_R) u(G^* - \Delta_i, -s_{\omega=0}) \\ &< E(u)_{\text{safe}} &= P_S u(R - r, 0) + (1 - P_S) u(-\Delta_i, -s_{\omega=0}). \end{aligned} \quad (7)$$

Similarly, when  $\sigma_2 = (\text{Insure} \mid \omega = 0, \text{Expel} \mid \omega = 1: \delta)$ , the switching line given in (3) becomes

$$\begin{aligned}
E(u)_{risky} &= P_R u(G^* + R - r, 0) + \alpha(1 - P_R) u(G^* - \Delta_i, -s_{\omega=1}) + (1 - \alpha)(1 - P_R) u(G^*, -s_{\omega=0}) \\
&< E(u)_{safe} &= P_S u(R - r, 0) + (1 - P_S) u(0, -s_{\omega=0}).
\end{aligned} \tag{8}$$

The effect of credible social penalties on borrower behavior in equilibrium can be seen in Figure 3: The “Expel |  $\omega = 0$ ” switching line shifts upwards while the “Insure |  $\omega = 0$ ” switching line rotates up and to the left. This enlarges the area within  $\alpha$ - $\rho$  space in which the safe project is optimal for  $M_1$ , increasing the level of intra-group insurance and the expected repayment rate. If  $s_{\omega=1}$  is very large, moral hazard is eliminated altogether:

PROPOSITION 2: *If  $s_{\omega=1}$  is sufficiently large, there exists a perfect Bayesian equilibrium in which risky borrower behavior is deterred for all  $\rho_i \in (0, \bar{\rho}]$ , and all  $\alpha \in (0, 1]$ .*

PROOF: See Appendix.

The intuition to Proposition 2 is that given any level of  $\rho_i$  and  $\alpha$ , there exists a social penalty sufficiently strong (if risky borrower behavior is discovered) that it induces even the most short-sighted and informationally isolated borrower to play Safe.<sup>13</sup> Proposition 3 argues that a sufficiently strong threat of social sanctions can compensate for poor monitoring between borrowers:

PROPOSITION 3: *There is a trade-off between peer monitoring and social sanctions such that the severity of social sanctions needed to induce safe investment behavior in equilibrium is a monotonically decreasing and convex function of the level of  $\alpha \in (0, 1]$ .*

PROOF: See Appendix.

As peer monitoring increases, differentiation of (7) reveals that the level of informed sanctions needed to keep  $M_1$  playing Safe declines, making it more likely that (7) is satisfied. The convexity of this function means that at low levels of  $\alpha$ , the value peer monitoring is very high. Yet as  $\alpha$  increases, the value of additional informational flow between group members declines. The implication of Proposition 4 is that in high-information environments, borrowers are likely to be able to deter moral hazard strictly through threats of group expulsion. In areas where borrowing group members are dispersed, safe projects may be undertaken with a strong threat of social sanctions, especially where sensitivity to those sanctions,  $u_s(\cdot)$ , is high.<sup>14</sup>

#### 4. Conclusion

A large number of models have been developed in recent years that have sought to account for the strong repayment rates of many well-known group lending schemes. While some of these models have argued that the ability of groups to self-select membership mitigates adverse selection problems in credit markets, the empirical component of this research suggests that much of the screening of borrowers actually occurs *ex post* to group formation, in the form of group expulsions. The model presented here suggests that a borrowing group functions more as a kind of dynamic peer review committee: Members self-select under imperfect information, come to the aid of their own who appear victims of unavoidable shocks, and render the harsh judgement of expulsion upon those likely to have misallocated their borrowed capital.

Three short policy remarks follow: First, by exploiting informational advantages, group lending clearly represents a Pareto improvement (for borrower *and* lender) over a lack of credit access. Yet group lending imposes significant costs to borrowers over individual lending. Aside from the added administrative costs imposed on borrowers, some of these costs are reflective of borrowers' own imperfect information, *i.e.* borrowers are held financially responsible for their screening mistakes. This may be an important reason that when surveyed, 80.6% of borrowers indicated a preference for individual loans, 13.6% preferred group loans, and 6.0% were indifferent.

Secondly, it is important to understand that the credible threat by the lending institution to deny credit to expelled group members and defaulting groups provides the backbone for a borrowing group's internal discipline. Therefore, there may be substantial advantages for a well-managed non-profit institution to retain a local lending monopoly. With the proliferation of microenterprise lending, it is critical defaulting borrowers not be able to access credit from alternative institutions.

Finally, the results here also support the importance that microenterprise lending institutions place on group training sessions, in which group members are admonished to visit one another regularly, pressure one another to make timely payments, support one another in the event of

unavoidable mishap, and eject members who misuse borrowed capital. Through such training sessions, and through the repeated experience of repaying group loans, social cohesion can actually be created in borrowing groups, even when it is weak or non-existent *ex-ante* to group formation.

## Appendix

*Proof of Proposition 1:* Under individual lending the fraction of borrowers choosing Risky is given by  $\int_0^1 (\bar{\rho} - \rho^*) d\alpha$ , where  $\rho^* = \frac{(P_S - P_R)(m - r)}{G^* + (P_R - P_S)(R - r)}$ . Under group lending the fraction of borrowers playing Risky is  $\int_0^{\alpha^*} (\bar{\rho} - \rho^*) d\alpha + \int_{\alpha^*}^1 (\bar{\rho} - \rho^{**}(\alpha)) d\alpha$ , where  $\rho^{**}(\alpha) = \frac{\alpha(1 - P_R)(m - r)}{G^* + (P_R - P_S)(R - r)}$ . Since  $\int_{\alpha^*}^1 (\bar{\rho} - \rho^{**}(\alpha)) d\alpha < \int_{\alpha^*}^1 (\bar{\rho} - \rho^*) d\alpha$  because  $\rho^{**}(\alpha) = \rho^*$  at  $\alpha^*$  and  $\frac{\partial \rho^{**}(\alpha)}{\partial \alpha} > 0$  for  $\forall \alpha \in [\alpha^*, 1]$ , the fraction of borrowers choosing Risky is smaller under group lending.  $\square$

*Proof of Proposition 2:* Consider first the case of  $\sigma_2 = (Expel | \omega = 0, Expel | \omega = 1)$ . Assuming that  $s_{\omega=0}$  is zero for simplicity, we can write a linear approximation of (7) as  $P_S \cdot u_y(R - r) - (1 - P_S)u_y \bar{\Delta} > P_R \cdot u_y(G^* + R_R - r) - \alpha(1 - P_R)[u_y(\bar{\Delta} - G^*) + u_s \cdot s_{\omega=1}] - (1 - \alpha)(1 - P_R)[u_y(\bar{\Delta} - G^*)]$ , where  $\bar{\Delta} \equiv \Delta(\bar{\rho})$ . Solving for  $s_{\omega=1}$ , we see that for  $M_I$  to play Safe,  $s_{\omega=1}$  must always be greater than  $\hat{s}_{\omega=1}|Expel = \frac{u_y[G^* + (P_R - P_S)(R - r + \bar{\Delta})]}{\alpha(1 - P_R)u_s}$  for all  $\rho_i \in (0, \bar{\rho}]$ . Similarly, we use (8) with  $\sigma_2 = (Insure | \omega = 0, Expel | \omega = 1)$  to obtain  $\hat{s}_{\omega=1}|Insure = \frac{u_y[G^* + (P_R - P_S)(R - r) - \alpha(1 - P_R)\bar{\Delta}]}{\alpha(1 - P_R)u_s}$ . With  $\alpha < \alpha^*$ , the strategy profile  $(\sigma_1 = Safe; \sigma_2 = Expel | \omega = 0, Expel | \omega = 1; \delta)$  is a perfect Bayesian equilibrium (PBE) for all  $\rho_i \in (0, \bar{\rho}]$  if  $s_{\omega=1} > \hat{s}_{\omega=1}|Expel$ . In the case of  $\alpha \geq \alpha^*$ , the strategy profile  $(\sigma_1 = Safe; \sigma_2 = Insure | \omega = 0, Expel | \omega = 1; \delta)$  is a PBE for all  $\rho_i \in (0, \bar{\rho}]$  if  $s_{\omega=1} > \hat{s}_{\omega=1}|Insure$ .  $\square$

*Proof of Proposition 3:* For simplicity, consider the case of the switching line in (7). First, we show that for  $\alpha \in (0, 1]$ ,  $\hat{s}_{\omega=1}$  is monotonically decreasing in  $\alpha$ . Assume  $M_I$  is indifferent to playing Safe or Risky. Totally differentiating (7) gives  $d\alpha[(1 - P_R)(u(G^* - \Delta_i, -s_{\omega=1}) - u(G^* - \Delta_i, -s_{\omega=0}))] = ds_{\omega=1} \cdot \alpha(1 - P_R)u_s(\cdot)$ . Solving for  $\frac{\partial s_{\omega=1}}{\partial \alpha}$ , yields  $\frac{\partial s_{\omega=1}}{\partial \alpha} = \frac{(1 - P_R)[u(G^* - \Delta_i, -s_{\omega=1}) - u(G^* - \Delta_i, -s_{\omega=0})]}{\alpha(1 - P_R)u_s(\cdot)}$ . The numerator is negative since  $s_{\omega=1} > s_{\omega=0}$ , and the denominator is positive since  $u_s(\cdot) > 0$ , making  $\frac{\partial s_{\omega=1}}{\partial \alpha} < 0$ . Further differentiation yields  $\frac{\partial^2 s_{\omega=1}}{\partial \alpha^2} = \frac{-(1 - P_R)^2 u_s(\cdot)[u(G^* - \Delta_i, -s_{\omega=1}) - u(G^* - \Delta_i, -s_{\omega=0})]}{[\alpha(1 - P_R)u_s(\cdot)]^2} > 0$ , which shows convexity.  $\square$

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## Notes

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<sup>1</sup> These include the well-known examples of the *Grameen Bank* in Bangladesh and *BancoSol* in Bolivia, as well other programs in countries as diverse as Burkina Faso, Guatemala, Indonesia, Nepal, Nigeria, Thailand, and Zimbabwe.

<sup>2</sup> *Fundación para el Desarrollo Integral de Programas Socioeconómicos* (FUNDAP), an affiliate of ACCION International, an umbrella organization covering a network of 18 group lending institutions in Latin America.

<sup>3</sup> More than one answer was permitted to the question.

<sup>4</sup> When asked what were the reasons they chose the members they had chosen to be in their borrowing group, 67.1% chose members “*por que son responsables*” (because they are responsible), 10.0% because they could communicate during the day, 18.6% were chosen because they were commercial associates, and 37.7% included other reasons.

<sup>5</sup> Furthermore, group expulsions represent merely the *upper bound* of group heterogeneity. Field interviews revealed a wide range of heterogeneity among borrowing groups, usually tolerated as a cost of group credit access.

<sup>6</sup> There was only one clear anecdote of a borrower intentionally diverting funds to a risky project to increase expected profits: a sidewalk vendor who habitually overstocked umbrellas, apparently betting that rainy weather would result in a deluge of profitable sales, but of course risking high inventory carrying costs in the event of dry weather.

<sup>7</sup> Monthly interest rates of moneylenders were up to ten times higher than the 3% monthly interest rate of FUNDAP.

<sup>8</sup> Typically borrowing groups contained either three to five members; two are used for analytical tractability.

<sup>9</sup> Assuming screening advantages of borrowers over lenders adds realism but also unnecessary complexity to the model.

<sup>10</sup> We thus assume that borrowers are not subject to limited liability in the case of successful projects in order to avoid confusion between the issue of enforcing repayment and that of moral hazard related to investment risk.

<sup>11</sup> We implicitly assume that  $M_I$ 's play of Risky insignificantly increases the probability that both projects fail.

<sup>12</sup> The notion that instances of group expulsion are negatively related to monitoring ability is supported by the Guatemalan data. Of the 22 groups who had expelled borrowers, there was only one clear case in which a member was expelled when borrowers were both located closely together and claimed to be aware of one another's weekly sales, the most important data in the 1994 survey collected to measure peer monitoring.

<sup>13</sup> In practice the relationship between social ties and the threat of social sanctions is often complicated. Social ties may sharpen the bite of sanctions to group members, but they also may render the threat of expulsion non-credible. An example is a story that circulated in a rural Guatemalan village about a midwife who failed to repay her share of a loan. Expelling her was impractical for the other women because they risked losing her help during times of childbearing.

<sup>14</sup> Moreover, it should be noted, if the problem of *enforcing* repayment (regardless of project outcome) is a central issue, the relative importance of social sanctions may increase substantially.