Exploiting Social Networks to Alleviate Credit Market Failures: On the Endogenous Selection of Peer Groups in Microfinance Programs[*]

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1   Introduction

A well-functioning credit market allows those who have surplus savings to lend it to those who have skills, talents and ideas. In addition it allows those who are born poor to acquire skills through education and move up the economic ladder. In the absence of any costs that prevents free flow of funds from those who have it to those who don't so long as they are willing to trade at a given rate of interest, borrowing and lending rates should roughly equal. They are not. There is typically a wide range of interest rates prevailing in the same area, with no apparent equalization due to arbitrage. For example, Siamwalla et al (1990), in their study of rural credit markets in the Nakhon Rachasima Province in Thailand, found the informal sector annual interest rate to be 90% whereas the formal sector rate ranged from 12-15%. In addition, there is evidence from all countries that borrowers are able to borrow only upto a limit for a given interest rate, and are not given a larger loan even if they are willing to offer a higher interest rate. The very poor are unable to borrow at any interest rate.

Economic theory identifies several kinds of transactions costs in the credit market that might generate frictions in this process and lead to such phenomena, namely, those arising from screening, monitoring and enforcement. The use of collateral might reduce these transactions costs, but those who need capital most are poor and unable to pledge collateral. This in turn prevents them from adopting efficient technologies or choose profitable occupations, and hence they remain poor. Moreover, even those who own assets, do not necessarily have formal

titles and even when they do, inefficient judicial systems make foreclosing on collateral costly, reducing their effectiveness as collateral.[1]

What are the policy implications? One possibility is to operate within the existing institutional environment and try to address credit market failures with policies such as offering subsidized credit, and redistributing wealth and income. The alternative is to try to change the institutional environment by titling land and other assets, rewriting bankruptcy codes, and reforming the legal system. These policies all involve significant costs. The policy of offering subsidized credit through conventional channels, such as government lending agencies, is widely considered to be a failure because the default rates were very high and wealthier farmers tended to capture most of the benefits.[2] A seemingly easier way out is promised by the success of microfinance programs such as the Grameen Bank of Bangladesh and Banco Sol of Bolivia that exploits social networks to generate "invisible" collateral. The main idea is simple - members of a community know more about one another than an outside institution such as a bank, and while a bank cannot apply financial or non-financial sanctions against poor people who default on a loan, their neighbors may be able to impose powerful non-financial sanctions at low cost. Institutions that give poor people the proper incentives to use information on their neighbors and to apply non-financial sanctions to delinquent borrowers can out-perform a conventional bank.

I will not attempt to provide a review of the vast literature on microfinance here and simply refer the reader to the papers by Morduch (1999), Ghatak and Guinnane (1999), Armendariz de Aghion and Morduch (2000), and Banerjee (2001). For those unfamiliar with this literature, I will briefly describe the most well known microfinance program, the Grameen Bank of Bangladesh drawing on these reviews. The Grameen Bank lends to about two million people, most of whom are rural, landless women, operates in 36,000 villages, or about half of all villages in the country. Small loans are given for self-employment projects (e.g., poultry, paddy husking, handloom weaving, grocery or tea shops, dairy farming). No collateral is charged, interest rates are high but are less than those charged by moneylenders. Borrowers organize themselves into self-selected groups of about five people from the same village. Loans are given to individuals, but the group is jointly liable for each other's loans. In particular, if any member of a group defaults, all members are ineligible for credit in the future. Joint liability is only one of the program features of the Grameen Bank, although the one that has received the most attention from economists. The Grameen Bank also: (a) engages in direct monitoring of clients; (b) has a regular repayment schedule where repayment starts immediately after the loan is disbursed and a fixed proportion of the loan has to be repaid in weekly or monthly intervals; and (c) relies on the promise of repeat loans for borrowers who perform well. It stands out compared to conventional lending approaches in terms of reaching target groups

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[1] See Hernando De Soto (2000).
[2] See Adams, Graham, and Von Pischke (1984).

and loan repayment. For example, the percentage of ineligible beneficiaries for the well known Integrated Rural Development Program (I.R.D.P.) in India was 15-26%, the highest reported being 50%. According to Jean Dreze, only 1 out of eight households in the poorest decile ever received any assistance from the I.R.D.P. In contrast, for the Grameen Bank, only 5% borrowers were outside the target group. The repayment rate for I.R.D.P. loans was 41% for India as a whole (Pulley, 1989). For the Grameen Bank, even according to conservative estimates (Morduch, 1999) the repayment rate is around 92% and the subsidy rate is about 11 cents per dollar of loan.

I will focus on two specific (and somewhat narrow) issues in this paper, both related to the *self selection* of borrowers into microfinance programs that use joint liability. The first is a theoretical issue: can the instrument of joint liability be viewed as an incentive device for borrowers to self-select groups on the basis of local information available in social networks? That is, could joint liability be successful because it affects the behavior of borrowers (such as encouraging either *peer-monitoring*, which alleviates moral hazard problems, or *peer-pressure* which ensures better enforcement) or does it simply attract better risks? If this is the case, what are the welfare effects of such programs if one also considers their effect on individuals who do not necessarily have access to such social networks? I will discuss models of peer selection drawing on and extending recent work by Armendariz de Aghion and Gollier (2000), Ghatak (1999, 2000), and Van Tassel (1999) to throw some light on this issue. The second issue is an empirical one: in the presence of endogenous peer selection how does one solve the fundamental endogeneity problems when analyzing the effect of social networks on lending outcomes such as repayment rates? There are studies that have shown that variables that proxy for social cohesion and better information flow among group members imply improved repayment rates in microfinance programs using joint liability. But since group composition is endogenous and borrowers can choose whether to join a joint liability program these results are subject to endogeneity problems.[3] I will discuss various aspects of this problem and how empirical researchers have attempted to address it.

2   The Welfare Effects of Endogenous Peer Selection

Adverse selection arises when borrowers have characteristics that are unobservable to the lender but affect the probability of being able to repay the loan. A lender can try to deal with this information problem directly, by trying to assess these characteristics, or indirectly by offering loan terms that only good risks will accept. The typical method for separating good risks from bad risks is to ask the borrower to pledge collateral. Risky borrowers are likely to fail more often and lose their collateral. If the bank offers two different contracts, one with

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[3]See Morduch (1999) for a review of the empirical literature on evaluation of microfinance programs that addresses this and other econometric issues such as non-random program placement.

high interest rates and low collateral and the other with the opposite, risky borrowers will select the former and safe borrowers the latter. But poor people by definition to do not have assets that make useful collateral, meaning that lenders have no effective way to separate good risks from bad. But borrowers in a certain area are likely to know the characteristics of each other's projects better than the bank. From now on, we will refer to these characteristics as a borrower's 'type,' risky or safe. Economists have argued that one way to explain how group lending programs are successful in ensuring high repayment rates even though they lend to poor borrowers who have no collateral to offer is that the instrument of joint liability is used to induce self-selection of groups based on information contained in social networks, thereby mitigating the problem of adverse selection.[4] While all borrowers prefer to have safe partners (because of lower expected joint liability payments) safe borrowers value safe partners more than risky borrowers because they repay more often, and as a result more likely to realize the gain of having a safe partner. This implies that in equilibrium borrowers end up with partners of the same type. As a consequence the bank can screen borrowers by varying the degree of joint liability. This is because risky borrowers have risky partners, and hence will prefer a contract with less joint liability than will a safe borrower. We illustrate this idea using a simple model. We also examine the issue what happens to welfare when all borrowers have do not have equal access to social networks.

There are two types of borrowers, safe and risky. Each project requires one unit of capital and the labor input of the borrower. The opportunity cost of capital is $\rho > 1$ and the reservation payoff of a borrower is u which is the opportunity cost of their labor input. There is a risk neutral lender whom we will call a bank that can provide investment financing to each borrower. A standard loan contract specifies an interest rate r (this is a *gross* interest rate, namely, principal plus the *net* interest rate) which is the amount the borrower must repay to the bank. This can be interpreted as the *individual liability* of the borrower. There is a limited liability constraint. So in case their projects fail, borrowers are liable up to the amount of collateralizable wealth they posses, w which we take to be zero for simplicity. We model joint liability in the following way : if a borrower is willing and able to repay her own loan but her partner is unwilling or unable to repay her loan, then the former must pay an additional amount c to the bank. The form of joint liability for defaults in actual group-lending programs often takes the form of denying future credit to all group-members in case of default by a group-member until the loan is repaid. In most cases, intra-group loans are used to ensure timely repayment (Huppi and Feder, 1990).

Following existing models of adverse selection in the credit market we focus only on debt contracts. Assume that borrowers are risk-neutral and of two types, safe (s) and risky (r). The proportions of safe and risky borrowers in the population are θ and $1 - \theta$ respectively. With a project of type i output takes two values, R_i and 0, and the probability of high output

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[4]See, for example, Armendariz de Aghion and Gollier (2000), Ghatak (1999, 2000), and Van Tassel (1999).

is $p_i, i = s, r$. We assume $p_s > p_r$. The type of a borrower is private information. Following Stiglitz and Weiss (1981) we assume both types of borrowers have the same mean return, i.e, $p_s R_s = p_r R_r = \bar{R}$. If there was perfect information the borrowers would be charged different interest rates such that the bank broke even, namely, $r_s^* = \frac{\rho}{p_s}$ and $r_r^* = \frac{\rho}{p_r}$. We assume it is economically efficient to pursue all investment projects, i.e., $\bar{R} > \rho + u$.

If the bank does not know a borrower's type, and if standard screening instruments such as collateral are not available, then it has to offer loans to all borrowers at the same nominal interest rate. Let $\bar{p} \equiv \theta p_r + (1 - \theta) p_s$ be the probability of repayment of a borrower picked up at random. To break even the bank will have to charge an interest rate $\bar{r} = \frac{\rho}{\bar{p}}$ to all borrowers. Under such a contract safe borrowers have an expected cost of $p_s \bar{r}$ which is greater than that of risky borrowers, namely, $p_r \bar{r}$, i.e., they have to cross-subsidize the risky borrowers. The risky borrowers are better off than they would be under full information, and the safe borrowers are worse off. More dramatically, the presence of enough risky borrowers can push the equilibrium interest rate high enough to drive the safe borrowers away from the market. The formal condition for this to happen is $\rho \frac{p_s}{\bar{p}} + u > R$. Notice that this is consistent with the projects being efficient under the full information outcome. In other words, the lemons problem, apart from making safe borrowers worse off, can lead to a net loss of surplus.

Under a joint-liability credit contract a borrower must repay her loan r whenever her project yields high returns, and in addition, if her partner's project yields low returns, she must pay an extra amount $c > 0$. The expected payoff of a borrower of type i when her partner is type j from a joint-liability contract is :

$$EU_{ij}(r, c) = p_i p_j (R_i - r) + p_i (1 - p_j)(R_i - r - c)$$

The net expected gain of a risky borrower from having a safe partner is $EU_{rs}(r, c) - EU_{rr}(r, c) = p_r(p_s - p_r)c$. Similarly, the net expected loss for a safe borrower of having a risky partner is $EU_{ss}(r, c) - EU_{sr}(r, c) = p_s(p_s - p_r)c$. If $c > 0$ the latter expression is larger than the former since $p_s > p_r$. Hence, a risky borrower will not find it profitable to have a safe partner. A borrower of any type prefers a safer partner, but the safer is the borrower herself, the more she values a safe partner. A risky borrower in theory could pay the safe borrower to accept her as a partner, but the expressions above imply that such payments would have to be so large that the risky borrower would not want to make them.[5] Therefore, we can state:

Result 1: *Group formation will display positive assortative matching under a joint-liability contract. This assortative matching property potentially allows the bank to screen borrowers 'by the company they keep' because risky borrowers are less willing than safe borrowers to accept an increase in the extent of joint liability.*

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[5]Since we are assuming that borrowers have no assets, such transfers are implausible if interpreted in purely financial terms. What we have in mind is that borrowers within a group might make transfers to each other in forms which are not feasible with an outsider (e.g., free labor services).

Consider a pair of contracts $(r_r, 0)$ and (r_s, r_s) targeted for risky and safe borrowers. That is, risky borrowers are offered an individual liability contract that specifies an interest rate r_r to be paid by the borrower if her project is successful and 0 otherwise. In contrast safe borrowers are offered a joint liability contract that specifies the group as a whole must pay $2r_s$ so long as at least one of the two borrowers succeed, and 0 otherwise. Since all types of borrowers have the same expected revenue, we can use expected costs as the payoff measure. The incentive compatibility constraint of risky borrowers bind in equilibrium, which implies that the expected cost of a risky borrower from borrowing under the individual liability contract $(r_r, 0)$ must be equal to the expected cost of forming a group with another risky borrower and borrowing under the joint liability contract (r_s, r_s):

$$p_r r_r = p_r^2 r_s + p_r(1 - p_r)2r_s.$$

Also, r_r can be solved from the zero-profit condition of the bank:

$$p_r r_r = \rho.$$

These two equations pin down r_r and r_s : $r_r = \frac{\rho}{p_r}$ and $r_s = \frac{\rho}{p_r(2-p_r)}$. Note that as $2 - p_r > 1$, $r_r > r_s$, i.e., risky borrowers are offered a higher interest than safe borrowers, but incentive compatibility is maintained as a safe borrower pledges to repay her partner's loan if she succeeds and the partner fails. The expected cost of a safe borrower under this contract is

$$p_s r_s + p_s(1 - p_s)2r_s = \rho \frac{p_s(2 - p_s)}{p_r(2 - p_r)}.$$

Since the expression $x(2-x)$ is increasing in x for $x \in [0,1]$, therefore $p_s(2-p_s) > p_r(2-p_r)$ and so the expected cost facing the safe borrowers is higher than the opportunity cost of capital. Under a pooling individual liability contract their expected costs would have been $\rho \frac{p_s}{\bar{p}}$ and it is easy to see that so long as θ is high enough, safe borrowers are better off under the joint liability lending contract. This brings us to:

Result 2: *If the bank offers two contracts, one with high joint liability and low interest rates and the other with low joint liability and high interest rate, safe borrowers will select the former contract and risky borrowers the latter. Starting with an initial situation where safe borrowers were not borrowing under a individual liability contract, a joint liability contract has the ability to improve welfare in a Pareto sense, since risky borrowers are no worse off and safe borrowers are strictly better off.*

What happens if all borrowers do not necessarily belong to dense social networks? Will joint liability lending still improve welfare? Think of two villages, one where everyone knows everyone else's type and another where people are individualistic and know their own types but not that of others. Suppose the a fraction q of the population belongs to the first village

and a fraction $1 - q$ belongs to the second. For simplicity assume that the distribution of project types is the same within both villages and so there are four types of borrowers with their proportion in the population indicated within parenthesis : informed risky ($q\theta$), informed safe ($q(1 - \theta)$), uniformed risky ($(1 - q)\theta$) and uninformed safe ($(1 - q)(1 - \theta)$).

Suppose initially everyone was borrowing under the standard debt contract with $r = \frac{\rho}{\tilde{p}}$. Suppose the bank introduces the joint liability contract (r_s, r_s). This will attract all informed safe borrowers. Informed risky borrowers will not borrow under this contract. By construction they are indifferent between this contract and $(0, \frac{\rho}{p_r})$ but so long as some uninformed safe borrowers remain in the pool they will strictly prefer to borrow under the standard debt contract. Uninformed borrowers have two options : to borrow under the debt contract, or to form a group by randomly choosing a partner and borrow under the contract (r_s, r_s). Type contingent side payments are not feasible among uninformed borrowers. For example, a risky borrower knows her type, but cannot offer a bribe to attract a safe partner, because she does not know anybody else's type, and if she naively offers a bribe for a safe partner, risky borrowers could take advantage of it.

Let us consider a safe uninformed borrower. She has two options, to borrow under the standard debt contract or to take a random partner and borrower under (r_s, r_s). In the former case, assuming other safe uninformed borrowers do the same her expected cost is $\rho \frac{p_s}{\tilde{p}(q)}$ where $\tilde{p}(q) \equiv \theta p_r + (1 - \theta)(1 - q)p_s$ is the average probability of repayment in the population excluding informed safe borrowers. In contrast if she chooses a partner randomly and borrows under (r_s, r_s) her expect cost is $p_s r_s + p_s(1 - \tilde{p}(q))2r_s = \rho p_s \frac{(2 - \tilde{p}(q))}{p_r(2 - p_r)}$. Since $\tilde{p}(q)(2 - \tilde{p}(q)) > p_r(2 - p_r)$, the second option is more costly. The intuition for this is as follows. Under both contracts, an uninformed safe borrower has to cross-subsidize risky borrowers. But under a joint liability contract, in addition, the interest rate r_s is fixed at a level that is higher than what is needed to satisfy the bank's zero profit condition in order to satisfy the incentive compatibility constraints of informed risky borrowers.

Since uninformed safe borrowers prefer to borrow under the individual liability contract, if at all, their expected costs are higher since the informed safe borrowers all shift to the joint liability contract. Therefore, we have:

Result 3: *Because joint liability contracts will attract away the informed safe borrowers by a process of cream-skimming the uninformed safe borrowers will be worse off because the pool of borrowers who continue to borrow under individual liability lending is worse than before. The net welfare effect from introducing joint liability lending is ambiguous, and in the extreme case, net surplus can go down if uninformed safe borrowers stop borrowing.*

The significance of Result 3 is that welfare evaluations are inherently difficult when we talk about exploiting local information to alleviate credit market failures. Those who have access to local information networks are going to benefit, but those without such access could lose

and the net effect is ambiguous.[6]

3 Program Evaluation in the Presence of Endogenous Peer Selection

Theory tells us that microfinance programs have the potential to exploit social networks and alleviate credit market failures, even though, as we noted above the welfare effects are not always unambiguously positive. Does empirical evidence confirm the presence of such mechanisms at work that can explain the success of microfinance programs? Some empirical studies have compared the performance of microfinance programs that use individual liability with those that use joint liability and found that the latter in general have better repayment rates. Others have focused on group lending programs that use joint liability and found that variables that proxy for social cohesion and better information flows among group members imply improved repayment rates (see Wenner (1995), Wydick (1997), Ahlin and Townsend (2000)). Since group formation is endogenous, these studies are obviously subject to endogeneity problems. There are several issues relating to the self selection of borrowers into groups, and groups into different kinds of lending programs that need to be separated out.

First, as the model presented in the previous section indicates, if borrowers can choose whether to join a joint liability program and a standard loan program, better risks will join the former. So comparing the repayment rates of the two programs is subject to a selection bias. McKernan (1998) in her evaluation of the Grameen Bank based on a large scale survey conducted in 87 villages in Bangladesh finds a positive correlation between unobservable borrower characteristics (such as entrepreneurial ability) that affect both profits and participation in such programs. This positive correlation provides evidence that the Grameen Bank may successfully screen bad credit risks (either because low profit households are turned away or because high profit households choose to join). She concludes that not controlling for selection bias can lead to an overestimation of the effect of participation on profits by as much as 100%. But the issue is slightly different compared to other program evaluations. In this case, inducing this selection bias might exactly be the socially useful service that the program is performing. But then as our theoretical discussion suggests, one must also look at general equilibrium effects because the pools were these good borrowers were participating before and worsened by their exit, and this will have a negative effect on those who continue to remain there.

Second, given the opportunity of selecting one's own partners, if a person still ends up in a group where members are not very connected socially, the group members (including this person) must be relatively unreliable and unattractive. That could be positively correlated

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[6]If we abandon the partial equilbrium setting then, naturally, there are other effects which make welfare jusdgements even harder. See Arnott and Stigltiz (1990) and Banerjee and Newman (1997).

with how productive their projects are.

Third, if groups are formed by villages or neighborhoods, then areas that have greater social capital may have better repayment, but they may also have better economic opportunities (e.g., less crime).

Given that good instruments are hard to find, researchers have tried several alternative methodologies to address these problems. Some use a cross-sectional methodology that compares veterans to new participants. This is subject to the problem that the timing of the decision to join the program could be endogenous, with households that are the most productive and/or with belonging to the better connected social networks being the first to join (or be selected).[7] Another alternative is to exploit variation over time by collecting information about participants before and after program participation. This approach too is not entirely free from potential biases due to time-varying unobservables.[8]

The ideal is of course to study a randomized experiment to estimate the effect of social networks on loan repayments. These are unfortunately rare to come across. One recent and interesting example of this approach is provided by the study by Karlan (2002). His study is based on about 1700 individuals participating in FINCA, Peru, a microfinance program. It uses a process of assigning individuals to groups that allows a clean empirical strategy to identify the effect of social networks. When lending groups are formed, borrowers are not asked to self select their group members, nor are they assigned by the lender, as in typical microfinance programs. Individuals come from different parts of the city to the office of the lender located at the city centre and sign up for loans. Groups of size 30 are formed on a first come first served basis and so their composition is random. Also, the FINCA office being in the city center, not in any particular neighborhood means that people come from a variety of different neighborhoods. Individuals are not observed to come in groups. Sometimes, they are invited by a friend or relative. These individuals have been excluded from the sample by Karlan. This provides an exogenous variation in the how connected the individuals are in terms of social networks. The measure he uses is based on how connected they are in terms of geographic distance and cultural distance (which in turn is based on language, dress and hairstyle). These are correlated with indices such as if these borrowers have traded with one another, know each other's homes, borrowed from each other and sit next to each other in group meetings. Karlan finds that groups who belong to the same social network are significantly more likely to repay their loans.

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[7]See Karlan (2001).

[8]See Morduch (1999) for a discussion of this approach.

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