Repayment and Exclusion in a Microfinance Experiment*

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Abstract

Microfinance groups often engage in a variety of collective activities not directly related to credit. We set up a three-stage repayment game to examine how the existence of these anciliary activities affects repayment behavior and group attrition. In the first stage, the group borrows under joint liability, each member undertakes a risky project and decides whether or not to contribute to loan repayment. In the second stage, contributing members can vote to expel others from the group. Those remaining engage in a public goods game in the last stage. We identify repayment equilibria with and without exclusion and show that exclusionary equilibria are most likely when loans are large and there is significant within-group heterogeneity in the gains from the public good. We design a laboratory experiment that embodies the main features of our model. Broadly consistent with our theoretical predictions, individual decisions to contribute to loan repayment depend on gains from the public good and groups with the largest debt burdens have the highest rates of default and attrition.

JEL Codes: C9, G21, O12.

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1 Introduction

Many microfinance groups engage in collective activities not explicitly related to credit. For example, the rules of Grameen membership specifically mention the obligation to help others in difficulty as well as to take part in all social activities collectively.[1] Members of Self-Help Groups, the dominant form of microfinance in India, often participate in village governance, school nutrition programs and a range of other productive and social activities. Ugandan microfinance members form associations called *Munno Mukabi*, that organize social functions such as weddings and burials (Sebstad and Cohen, 2001). In Kenya, about one fourth of the Roscas in Kibera invest in long term projects, health insurance or self-employment schemes (Anderson and Baland, 2002).[2]

The multi-faceted functions of these groups provide them with the capacity to sanction members who default on their loans by excluding them from valuable collective activities. Such informal enforcement mechanisms have been shown to be effective in a variety of historical and contemporary contexts where formal institutions are weak (Greif, 1993; Putnam, Leonardi, and Nanetti, 1994; Aoki, 2001; Platteau, 2006). In the group lending literature, Besley and Coate (1995) first modeled the relationship between social sanctions and repayment rates. Subsequent research has provided insights on the enforcement capacity of sanctions under alternative informational assumptions and contractual arrangements.[3] This literature typically assumes social sanctions to be costless and exogenously given. They are therefore always credible. In many real contexts however, sanctions which rely on social networks are costly to both sides. Our paper is an attempt to better understand these settings.

We explicitly model social sanctions as the exclusion from collective non-credit activities of the group. We construct a three-stage repayment game that relates these activities to group default and attrition. In the first stage, the group borrows under joint liability, each member undertakes a risky project, and those who succeed decide whether or not to contribute towards loan repayment. If there are enough contributors to reimburse the loan, the entire group proceeds to the next stage of the game. Contributing members are given the opportunity to vote against other members and all those receiving a unanimous vote against them must exit. Those remaining engage in a variant of a public good game. The value to each member from this final stage varies by member type and by the size and composition of the group. There are two types of members, a and b, with the former adding greater value to the public good and receiving a higher return from it.

[1] These are 2 of the 16 decisions that each member must commit to on joining the Grameen Bank.

[2] Microfinance groups studied by Rai and Ravi (2011) in India also provide health insurance in addition to credit.

[3] See for example, DeQuidt, Fetzer, and Ghatak (2014) and Baland, Somanathan, and Wahhaj (2013) and the references therein.

Exclusion in the second stage can potentially generate either expected benefits or costs for the sanctioning party, depending on beliefs on a member's type and contribution to the public good. We focus on characterizing repayment and exclusion in perfect Bayesian equilibria of this game in which strategies to exclude members cannot reduce the expected payoffs of those excluding them. We show that groups with small loans reimburse them with symmetric behavior across types and exclusion is unlikely. For large loans, there exist asymmetric equilibria in which those with low public good valuations default and are excluded. These results provide a mechanism through which default and attrition in microfinance groups are connected to the way in which they engage in collective action.

The second half of the paper reports results from a laboratory experiment that tests the broad predictions of our model. Experimental participants were randomly assigned in groups of 10 across 20 sessions. A session had 8 rounds and was in one of three treatments based on an pre-determined loan size. Each group had 5 individuals of each of the two types, a and b. The type of each individual remained private information throughout the session. Within a session, the per-member debt burden changed across rounds based on the number of successful projects. These differences in the required repayment, by round and treatment, allow us to examine whether loan repayment varied systematically with the expected benefits from the public good game.

Consistent with our theoretical results, groups with small repayment burdens always reimburse their loans and proceed to the public good game. Within these groups, almost all members contribute to repayment and there are no significant differences in behavior across the two types. By contrast, groups in the large debt treatment default in more than 40% of all rounds and the two types behave quite differently. Our results on voting in the second stage show that sanctions are actively used to provide repayment incentives. Three-quarters of all defaulters receive a vote against them and over half are excluded from the public good game. We also find members who gain most from the public good are twice as likely to contribute towards loan repayment in the first stage of the game.

Our groups of 10 are larger than those used in most microfinance experiments. This choice was motivated by our interest in understanding how the non-credit activities of Self-Help Groups (SHGs) help enforce credit contracts. These groups typically have at least 10 members. The heterogeneous returns from the public good in our experiment also have natural empirical counterparts in these groups. Baland, Somanathan, and Vandewalle (2008) study over 1,000 SHGs in India and find 80% collectively engage in activities such as providing school meals, visiting government officials and helping resolve family problems. The extent to which members benefit from such activities will naturally vary.

There is a large and expanding literature on group lending. Our main contribution to the theoretical work in this area is to provide a framework in which social sanctions are endogenously determined by the characteristics of members, the size of their loans, and the value of their collective activities. This allows us to explore the conditions under which social networks can be leveraged for greater access to credit. Since sanctions are credible only when they raise the value of group activities, our model can also explain why attrition from microfinance groups is likely to be selective rather than random.

There have been several microfinance experiments that compare loan repayment and monitoring decisions under joint and individual liability contracts. They provide a number of insights into repayment behavior, but since groups in these experiments engage primarily in credit and investment activities, sanctions can operate only through changes in the design of loan contracts.[4] Feigenberg, Field, and Pande (2013) do consider social interactions between group members and find that more frequent meetings improve credit-related outcomes. They do not however specifically address the question of whether this socialization can generate sanctioning capacity within groups. Banerjee (2013) summarizes the lessons learned from microfinance experiments and points to the inherent difficulties in using field experiments to test theoretical results in this area.

Our paper is also related to experimental research that explores mechanisms for improved cooperation in social dilemmas (Ostrom, Walker, and Gardner, 1992; Fehr and Gachter, 2000). In some of these games, sanctions are implemented by voting out uncooperative members (Cinyabuguma, Page, and Putterman, 2005). Experiments which allow for heterogeneity in benefits from the public good find that agents with higher marginal returns are both more willing to sanction uncooperative behavior and to contribute to the public good.[5] Our results are broadly consistent with these findings. By combining the group borrowing with a public good game, we link endogenously determined sanctions to repayment behavior and are able to provide an explanation for the varying rates of group survival and the selective attrition of members from microfinance groups.[6]

The remainder of this paper is organized as follows. The next section contains a description of the 3-stage repayment game and characterizes equilibria as a function of the debt burden and other parameters. Section 3 describes the design of our experiment and Section 4 presents experimental results. Section 5 concludes. Proofs of all theoretical results and experiment details are in the Appendix.

[4] Karlan and Zinman (2009) show that dynamic incentives in the form of lower interest rates on future loans in effect create sanctions that encourage repayment. Also see Gine, Jakiela, Karlan, and Morduch (2010), Abbink, Irlenbusch, and Renner (2006) and Cason, Gangadharan, and Maitra (2012).

[5] See Tan (2008); Fellner, Lida, Kroger, and Seki (2010); Reuben and Riedl (2009); Nikiforakis (2008).

[6] See Baland, Somanathan, and Vandewalle (2008) for empirical evidence on patterns of group survival and the non-random attrition of members within Self-Help Groups.

2 The repayment game

We consider a group of n individuals, each of whom borrows to invest in an identical project. The project returns ρ with probability π and zero otherwise. Loans are given by an external lender to the entire group and members are jointly responsible for repayment. The per member loan plus interest is denoted by L. We follow the literature on group lending under joint liability in assuming that lenders have no enforcement capacity and internal sanctions within groups provide members with repayment incentives. However, instead of assuming sanctions to be fixed and costless, we explicitly model them as the exclusion from the benefits of collective activities undertaken by the group. Since exclusion changes the composition of the group engaged in collective action, it could be costly for both sanctioning and sanctioned members. We focus on equilibria in which sanctions are credible in that they yield expected benefits for sanctioning members, given their beliefs about the behavior and identity of those sanctioned.

Specifically, we model repayment, exclusion and collective action as a three-stage game. Each group has two types of members, a and b, their numbers n_a and n_b respectively. In the first stage, all members receive loans, project returns are realized and successful members make a binary decision of whether or not to contribute to loan repayment. If there are enough contributors, they share the debt burden equally. If not, the group is dissolved, members keep their project returns and the game ends. Any member who succeeds and defaults keeps the entire return from their project. Groups that reimburse their loans move on to the next stage of the game in which all contributing members can vote to expel others from the group.

Exclusion in the voting game is a simple and stylized way of capturing social ostracism in the absence of monetary punishments, which are rarely observed in the field. Each contributing member decides which of the other members should be excluded from the group. Those receiving votes against them from all voting members are forced to exit the group.[7] Modeling the voting decision in this way avoids problems of coordination when punishing defaulters within the group.

All members who survive the voting stage play the following variant of a public good game. Each player receives an endowment ω and decides on the amount to contribute to a group account. In a typical public good game, group contributions are multiplied by a constant and divided equally across members. Our variant differs in two respects. First, the multiplier on the group account depends on the fractions of the two types. Second, the private return from the public good varies by member type as captured by two parameters, α_a and α_b with $1 > \alpha_a > \alpha_b$. If the fractions of

[7] Imagine voters listing the names of all those they would like excluded from the group and members appearing on every list are excluded.

the two types of members playing the game are given by f_a and f_b, the value of the public good to type i is:

$$v_i = \alpha_i(f_a\alpha_a + f_b\alpha_b)\sum_{k=1}^{n_g} g_k. \tag{1}$$

We refer to the term $(f_a\alpha_a + f_b\alpha_b)$ as the *quality* (q) of the group of $n_g \leq n$ participating members. The total payoff to type i from this stage of the game is given by

$$I_i = (\omega - g_i) + v_i. \tag{2}$$

We make the standard assumption that contributions to the group account are privately costly and collectively beneficial when the entire group participates. The return for type b from an additional unit contribution by all n members is $\alpha_b n\bar{q}$, where $\bar{q}$ is the quality of the n-member group. We therefore assume $\alpha_b n\bar{q} > 1$.

The use of a single parameter α_i to capture the effect of type on quality and on the value received from the public good is not essential but simplifies our theoretical analysis and our experimental design. This is a reasonable representation for many of the collective activities of Self Help Groups, such as joint harvesting, government contracts for school services and shared child-care. Members rooted within a village community may gain more and also participate more actively. These are the a types in our framework.

We can now examine the conditions under which individuals and groups repay their loans. Since a member's type is private information, we have an extensive form game of imperfect information. We begin by characterizing the perfect Bayesian equilibrium of the 3-stage game.

Working backwards, we know that each player keeping the entire endowment ω and contributing nothing to the group account is a dominant strategy in the public good game. The threat of exclusion is always credible in this case since voting members can exclude defaulters without jeopardizing their return of ω. Player types are irrelevant to payoffs in the absence of positive contributions to the group account and both types, if threatened with exclusion, will contribute to loan repayment in Stage 1 if their debt burden is less than ω. With j successful projects within the group, the group loan is reimbursed if

$$\frac{nL}{j} \leq \omega. \tag{3}$$

We denote the left hand side of the above inequality by R_j and refer to it as the per-member debt burden. This takes us to our first result:

Proposition 1. *Consider a strategy profile in which no member contributes to the public good and all successful members contribute to the repayment of the group loan and vote to exclude successful members that do not. For a per member debt burden $R_j \leq \omega$, this is a perfect Bayesian equilibrium of the 3-stage game. When $R_j > \omega$, no such repayment equilibrium exists.*

In other words, when the debt burden is sufficiently small, there exists an equilibrium with group repayment, no individual default and no exclusion. As in most games with voting, there may be other equilibria with group repayment. For example, each player could vote against some set of members in Stage 2 and still receive the payoff ω in Stage 3. All such equilibria, when they exist, are Pareto inferior to the one described above. We do not discuss these further.

Proposition 1 provides a useful benchmark in that it establishes the conditions under which repayment is possible if individuals maximize monetary payoffs non-cooperatively. Evidence from both laboratory and field experiments however suggests that Nash behavior in the public good game may be unrealistic. Average contributions in most public good experiments are 40% to 60% of the optimal level. These could reflect altruism, myopia or implicit reciprocity.[8] In our own experiment, described in detail in the next section, only one-third of all contributions to the group account are zero. While we do find that the fraction not contributing to the public good is higher when $R_j \leq \omega$, it is desirable to have a theoretical framework that incorporates altruistic or norm-driven behavior in the public good game. We now modify our notion of equilibrium to allow for positive public good contributions and show when social sanctions can be leveraged to provide repayment incentives for an expanded set of loan sizes.

We assume that members of type a and b have positive public good contributions of g_a and g_b respectively. These might, for example, reflect social norms that operate once a player gets to this stage of the game. We treat them as parameters in our model and limit strategic behavior to the repayment and voting decisions in the previous stages. Income in the last stage is determined by (2) for these parameter values. We term a perfect Bayesian equilibrium of this 2-stage game as a *behavioral equilibrium*. The composition of the group now affects payoffs through both group quality as well as these public good contributions.

Repayment cannot occur in a behavioral equilibrium if the per member debt burden is greater than the expected return from the public good. If $R_j > \max\{I_a, I_b\}$, neither type has an incentive to

[8] See, for example Andreoni (1995); Fehr and Gachter (2000); Andreoni, Harbaugh, and Vesterlund (2008); Nikiforakis (2008); Fischbacher and Gachter (2010).

repay and the only equilibrium is one of group default. For smaller R_j, two types of repayment equilibria may be feasible; a pooling equilibrium in which both types contribute to repayment and one in which only a-types contribute and b-types are excluded. Both require that sanctions be credible.

The threat of exclusion is credible when it raises the expected payoff from the public good. It can be verified from (1) that an a-type would never be excluded since these members raise group quality and therefore add value even when they bring about no change in the group account. Moreover, even b types would not be excluded if they contributed as much as the a types. To see this, let $g_a = g_b = g$ and the total number of players of the two types in the public good game be n'_a and n'_b respectively, with $n'_a + n'_b = n_g$. Now (1) can be rewritten as

$$v_i = \alpha_i(n'_a\alpha_a + n'_b\alpha_b)g.$$

Since this is increasing in n'_b, each additional b type raises payoffs of all other members.

The exclusion of k members of type b improves expected payoffs of remaining members only if

$$v_i(n_a, n_b - k, g_a, g_b) > v_i(n_a, n_b, g_a, g_b) \tag{4}$$

It turns out that this inequality holds when the ratio of contributions, $\phi = \frac{g_a}{g_b}$, is sufficiently large relative to the ratio of productivities, $\theta = \frac{\alpha_a}{\alpha_b}$. We show in the Appendix that the required condition is that ϕ be greater than

$$\hat{\phi}(k) = \frac{n(n-k)}{n_a^2(\theta - 1)} + 1 \tag{5}$$

We see from (5) that this threshold level of ϕ is decreasing in both θ and k. The latter implies that if the exclusion of a single b type member is profitable, so is the exclusion of more than one such member.

We now characterize the two kinds of repayment equilibria described above, with and without exclusion. Since the threat of exclusion is necessary to enforce repayment, both equilibria are supported by the belief that default, if it occurs, is by b-types.

All members prefer to contribute towards repayment rather than be excluded from the group if the debt burden is smaller than the expected return from the public good game for both types. This is true as long as

$$R_j \leq I_i(n_a, n_b), \quad i \in \{a, b\} \tag{6}$$

The exclusion of a single deviating member of type b raises payoffs if $\phi \geq \hat{\phi}(1)$. Our pooling equilibrium is summarized in the next result:

Proposition 2. *Suppose $\phi \geq \hat{\phi}(1)$. There exists a behavioral equilibrium such that, if j projects succeed and $R_j \leq \min\{I_a, I_b\}$, all successful members contribute to repayment of the group loan and no member is excluded from the public good game.*

The maximum per-member debt that can be supported in an equilibrium of this type is constrained by the smaller of the two incomes, I_a and I_b, whose ordering depends on our parameters, α_i and g_i. Although a-types have a higher return from the public good, if b-types contribute very little to the group account and the difference $(\alpha_a - \alpha_b)$ is small, they could earn higher incomes. The largest loan in an equilibrium of this type is obtained when the a-types place their entire endowment of ω in the group account and b-types contribute $\frac{\omega}{\hat{\phi}(1)}$, the largest value consistent with $\phi \geq \hat{\phi}(1)$.

When $R_j > \min\{I_a, I_b\}$, there is no pooling equilibrium when j projects succeed. However, with I_a sufficiently larger than I_b, a-types may be willing to bear the entire debt burden of the group while b types prefer default even when it results in exclusion. Our next result provides sufficient conditions for such an equilibrium:

Proposition 3. *Suppose $\phi \geq \hat{\phi}(1)$. There exists a behavioral equilibrium such that, when j projects succeed and (i) $\frac{nL}{j} > I_b(n_a, n_b)$ and (ii) $\frac{nL}{j-n_b} \leq I_a(n_a)$, successful a type members contribute to repaying the group loan while successful b types default and are excluded from the public good game.*

The above result provides a set of sufficient conditions. We favor these for their simplicity. They serve our purpose in illustrating why repayment behavior of the two types might diverge. Necessary conditions are more complicated than in the case of full repayment equilibria because, at the time that repayment decisions are made, the number of successful projects that belong to b-types is unknown. This number, say k, determines the debt burden per contributing member as well as their benefits of sanctioning defaulting members through exclusion. Necessary conditions therefore require using the probability distribution of k which, though straightforward given n_a and n_b, is cumbersome. For Proposition 2, a knowledge of k is unnecessary because all members contribute R_j when able to do so and credible exclusion only requires $\phi \geq \hat{\phi}(1)$. Since $\hat{\phi}(k)$ is decreasing in k, we impose $\phi \geq \hat{\phi}(1)$ as a sufficient condition. This ensures that excluding k members of type b is credible for all feasible k. A detailed proof of Proposition 3 is found in the Appendix.

We have, so far, considered only equilibria in which exclusion has expected benefits for voting members. If we relax this assumption and consider all Nash equilibria, repayment is feasible for much larger loan sizes and under weaker conditions on public good contributions. For example, a per-member debt burden of $\alpha_b(n_a\alpha_a + n_b\alpha_b)\omega$ can be supported if all voters follow the strategy of excluding all defaulters and both types contribute ω to the group account in the public good game. More generally, Nash behavior does not impose any conditions on ϕ and all threats of exclusion are permissible as long as they do not occur in equilibrium. Equilibria analogous to those outlined in Propositions 2 and 3 above exist under any values of g_a and g_b.

In this section, we have tried to characterize equilibria with credible sanctions as completely as possible within the framework of our model. These results have allowed us to link repayment incentives to the value derived from public goods. The existence of multiple non-Bayesian Nash equilibria as well the possibility of altruistic behavior that has been widely observed in public good experiments suggests that many subjects may deviate from the behavior we have outlined. Moreover, the conditions of Proposition 3 are stringent and unlikely to hold in most plays of the game. Finally, the game in the experiment, particularly the voting stage, is a simplified version of the one we model.

For all these reasons, we take broad rather than fine predictions of our theory to the experimental data. We have the following hypotheses:

1. If the debt burden per successful member is less than the endowment ω of the public good game, both types exhibit similar loan repayment behavior.
2. If the debt burden per successful member is larger than ω, it can be serviced only when there are positive contributions to the public good.
3. Default and exclusion, when it occurs is more likely to be observed for b-types and large debt burdens.

3 Experimental design

Our experiment consists of three activities, one corresponding to each of the three stages of the game. We run 20 non-computerized sessions. Each session has a group of 10 members, 5 each of type a and b, and 8 identical rounds. All subjects are assigned an identification number and a type, both are private information throughout a session. To examine the effects of loan size on repayment rates, we use three treatments, which we refer to as Low, Medium and High. The per-member loan in these is 20, 50 and 80 rupees respectively. We multiply this by 1.2 to account for interest and by 10 for group size, so groups are required to reimburse 240, 600 or 960 rupees, depending on the treatment they are in. This amount is fixed for all 8 rounds in a session and all sessions in the same treatment. We conducted 6 sessions of the Low treatment and 7 each of the Medium and High treatments. Our experimental dataset therefore has 1,600 observations on 200 individuals and 20 groups.

A round begins with all subjects receiving a loan that is invested in a risky project. This is the first activity. The project success probability is set equal to 0.75 and the project return to 300. Project returns are realized and observed privately by each member and by the experimenter who announces the total number of successful projects to the group. At this point, each member can compute their expected debt burden under alternative beliefs on the number of other contributors. For example, if there are 8 successes in the High treatment and all successful members decide to contribute to repayment, each member forgoes 120 rupees. Minimum contributions for each treatment vary by the number of successful projects as shown in Table 1. Fewer than 4 successes are not observed in any of our rounds so we omit those figures.

Table 1: Minimum contributions required for repayment

		Treatment	
Successes	Low	Medium	High
4	60	150	240
5	48	120	192
6	40	100	160
7	34	86	137
8	30	75	120
9	27	67	107
10	24	60	96

Once total successes are announced, each successful member decides whether or not to contribute towards repayment and records this decision on a strip of paper which is folded and slipped into an envelope. The experimenter announces and lists the outcome of each project and the decision to contribute by ID number on a blackboard, visible to the entire group. If there are enough contributors for the group to reimburse its loan, all contributors receive their project return of 300 minus an equal share of the reimbursed amount. A successful member who decides not to contribute keeps the entire return of 300. Failed projects generate no returns and these members have no decision to make at this stage. If a group defaults on the loan because there are not enough contributors, all successful members keep the entire return of 300, the group does not undertake any additional activity in this round, and a new round begins.

Groups that reimburse their loan move on to Activity 2. Each contributor can now cast a vote against any other member of the group. Defaulters and unsuccessful members do not have a vote. Voting is done privately on slips of paper in similar fashion to the decision to contribute towards repayment in Activity 1. To preserve anonymity, all members are given a slip and only those that are entitled to vote, and decide to do so, fill in the ID of the member they wish to exclude. The rest leave their slips blank. Members receiving two or more votes against them are excluded from the group for that round. The experimenter announces the ID numbers of excluded members. No further information is given on the pattern of voting.

These voting rules in the experiment are a departure from our model. In the model, those contributing to loan repayment can vote against all the members that they would like excluded from the group. In our experiment, each contributor has only one vote and only those with at least two votes against them are excluded. This is simpler to execute in a non-computerized setting since it does not involve matching lists provided by the different subjects before the group can proceed to Stage 3. More importantly, the restriction on voting results in a sizable group of members proceeding to the public good game of Stage 3. This ensured that income from that stage was high enough to provide repayment incentives for a range of debt burdens.

Activity 3 is our public good game. Each member remaining in the group receives $\omega = 100$ rupees and allocates it across a private and a group account. Benefits from the group account are determined by (1), with $\alpha_a = 0.9$ and $\alpha_b = 0.3$. Total income from Activity 3 is the sum of the private account and the public good value as in (2). After members decide on their allocation, incomes for the two types from the public good are computed and announced, and a new round begins. Each member's type and contribution to the public good remains private information.

The experiment was conducted at the Delhi School of Economics. Subjects included both graduate and undergraduate students drawn from different academic disciplines, recruited from across the colleges in Delhi University using flyers and in-class announcements. Each session of the experiment lasted about 2 hours including reading of the instructions, a practice round and payment of money. Three sessions were usually conducted simultaneously and subjects were randomly assigned across these.[9] The average subject payment was around 600 Rupees (equivalent to approximately 15 US dollars at the prevailing exchange rate). This payment was computed by adding the earnings from

[9]As Table A1 in the Appendix shows, this assignment led to a balanced participant pool across treatments – the means of subject characteristics across the three treatments are almost identical.

Activities 1 and 3 over the eight rounds of the experiment. The instructions for the High treatment and a schematic structure of the experiment are in the Appendix (Figure A1).

4 Results

Repayment incentives

Table 2 reports the frequency distribution of successful projects for each treatment. The empirical distribution of successes in the experiment closely follows the theoretical binomial distribution. For example, with our parameters of $\pi = .75$ and $n = 160$, the probability of either 7 or 8 successes is 53%, and the observed frequency of this event in our data is 55%. With a project return of 300, repayment required at least one successful project for the Low treatment, 2 successful projects for the Medium treatment and 4 for the High treatment. The minimum number of successful projects in any session was 4 and repayment was therefore always feasible if enough members decided to contribute. Observed differences in behavior across rounds can therefore be attributed to repayment incentives rather than liquidity constraints.

Table 2: Project success frequencies across treatments

Successes	Low	Medium	High	All	Percentage of Sessions
4	0	1	1	2	1.2
5	2	3	2	7	4.4
6	5	7	2	14	8.8
7	12	15	14	41	25.6
8	9	17	21	47	29.4
9	10	10	12	32	20.0
10	10	3	4	17	10.6
Total	48	56	56	160	100

Table 3 shows individual repayment decisions and group default by treatment. Groups under the Low and Medium treatment always reimbursed their loans, while groups in the High treatment defaulted 43% of the time because there were not enough contributors. Group default rates for this loan size systematically increased with the per-member debt burden and all groups with fewer than 7 successes defaulted and did not advance to the public good game. Table 1 shows that the repayment required under the Low treatment was always lower than the endowment (ω) of 100 in the public good game. Recall from Propositions 1 and 2, that for low debt burdens, both types of members contribute to repayment. This is our first hypothesis at the end of Section 2. Our experimental results are in line with this prediction, and 96% of subjects contributed to repayment with no differences across types. In the Medium treatment, the average repayment rate is also above 90% and repayment rates are above 85% for both types. We do see a difference in repayment rates by type, although this is driven almost entirely by the rounds in which there are fewer than 6 successes and the required repayment is above 100. The differences across types are striking under the High debt treatment, with b-type members repaying only about half as often as the a-types.

Table 3: Repayment for individuals and groups (%)

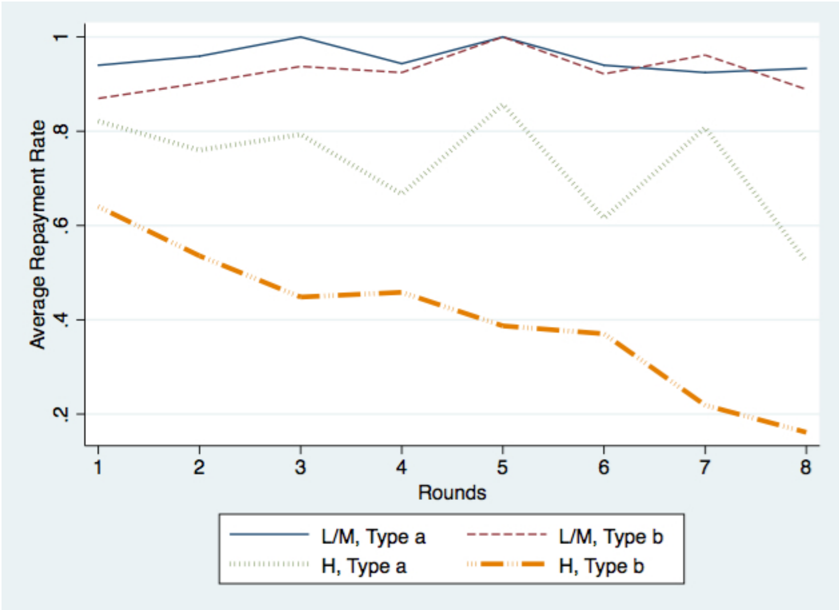
Successes	Type a	Type b	Difference by Type (p-value)	Group Default (%)
High treatment				
4	66.7	0.0	–	100.0
5	83.3	25.0	0.08	100.0
6	33.3	33.3	1.00	100.0
7	66.7	28.3	0.00	64.3
8	79.5	38.8	0.00	28.6
9	71.7	49.1	0.02	25.0
10	75.0	50.0	0.11	25.0
Average (High)	73.7	39.2	0.00	42.9
Average (Medium)	94.9	88.7	0.02	0.0
Average (Low)	96.3	96.9	0.74	0.0

The p-values reported are from t-tests for equality in means across types.

Figure 1 illustrates the changing pattern of individual repayment decisions by treatment and round. The high repayment rates for both types under the Low and Medium treatments are relatively constant across rounds while they are falling by round for the High treatment, most rapidly for b-types.

Table 4 pools observations across treatments for a more direct comparison of our theoretical and experimental results. Since we are aggregating data from multiple rounds with different numbers of successes, we denote the debt burden by just R, dropping the j subscript. Column (1) shows that when R is less than the endowment of ω in the public good game, 93% of successful members repay. In contrast, only 56% of successful members repay when $R > \omega$. In no round are all public good contributions zero, so we do not strictly observe the equilibrium of Proposition 1. However the fraction with zero contributions to the group account is higher when $R \leq \omega$. We also compute the average income, I, in the public good game, by session for both types and use this as a measure of expected income from the game. We classify the cases of $R > \omega$ into those for which $\omega < R \leq I$

Figure 1: Loan repayment rates by round and treatment



and $R > I$. We find repayment rates of 60% for the first case and 43% for the latter. Our second hypothesis is that for repayment burdens higher than ω, repayment is more likely when there are positive contributions to the public good. These positive contributions increase incomes in the public good game and allow for $R \leq I$. We therefore provide support for the second hypothesis that larger debt burdens are more likely to be reimbursed when collective group activities are more valuable.

Table 4: Behavior when $R \leq \omega$ and $R > \omega$

	$R \leq \omega$ (1)	$R > \omega$ (2)	Difference (p-value) (3)
Repayment Rate	0.93	0.56	0.00
	[829]	[419]	
No Contribution to the Public Good	0.38	0.29	0.00
	[961]	[297]	

The p-values are from t-tests for equality in means across the two populations. Square brackets contain the number of observations in each case. For repayment rates the row sum is the number of successful projects and for public good contributions, it is the number proceeding to the third stage of the game.

Table 5 analyzes the repayment decision in a regression framework. The dependent variable is 1 if the group member chose to contribute towards repayment and 0 otherwise. The 1,248 observations correspond to all the successful projects in the experiment. With three treatments and two types, there are six categories of borrowers. Model (1) estimates the propensity to contribute using a Probit specification with the omitted borrower category being b-type members in the Low treatment. This model uses only information on treatment and type. In Model (2), instead of using a member's type and treatment, we directly use the repayment burden and the expected benefit in terms of the average income a member of that type earns from the public good game. This corresponds more closely to our theoretical formulation in Section 2. In both these columns, marginal effects are reported. The last column presents estimates from a linear probability model which includes member fixed-effects and thereby exploits the variation in required repayments for each individual within a session. This variation arises from the differences in project success rates across rounds.

In the model in Section 2, a member defaults when the debt burden exceeds expected benefits from the public good game. The probability of contributing therefore jumps down to zero at the point that this incentive compatibility condition is violated. The models we estimate here are a continuous approximation of this propensity to contribute and the estimates in Table 5 cannot therefore be interpreted literally. These empirical formulations are useful because they allow us to control for unobservable fixed-effects which could influence the decision to contribute towards repayment. For example, we see in Figure 1 that subjects tend to contribute at higher rates in earlier rounds. Also, some individuals may be more altruistic. The estimates reported in the Table show that, even after controlling for these factors, the debt burden systematically influences the repayment decision and that this effect is greater for b-types.

The estimates in Column (1) exhibit the same pattern as the means by type and treatment given in Table 3. More interesting are the estimates in Columns (2) and (3) which relate the probability of contributing to the required repayment and show that individuals are less likely to contribute when the debt burden is higher. These effects are sizable. For example, when a group under the High treatment moves from 6 to 9 successful projects, the minimum required repayment decreases by a little over 50 Rupees (see Table 1). We can therefore halve the coefficients in the fixed-effects model in Column (3) to get estimates of the resulting change in repayment behavior. These imply a 19 percentage point decline in probability of contributing for b-types and a 6 percentage point decline for a-types. This supports our third hypothesis, namely that higher debt burdens result in differential rates of default across the two types.

We now turn to a description of behavior in the voting and public good games. In the voting game, we focus on whether default is punished, since these punishments are critical in turning potential sanctions into actual ones. For the public good game, we have no theoretical results to test and simply describe the pattern of contributions by type and treatment. We do look to differences in contributions by type and ask whether the a-types who gain more from the game, also contribute

Table 5: Contributing to repayment

	Probit ME (1)	Probit ME (2)	FE (3)
Type a	-0.02		
	(0.05)		
Medium Debt	-0.23***		
	(0.07)		
High Debt	-0.57***		
	(0.05)		
Medium Debt $\times$ Type a	0.09**		
	(0.04)		
High Debt $\times$ Type a	0.14***		
	(0.03)		
Total Number of Successes	0.03***		
	(0.01)		
Required repayment/100		-0.40***	-0.38***
		(0.04)	(0.12)
Expected Benefit		0.61**	
		(0.20)	
Required repayment/100 $\times$ Type a			0.26*
			(0.150)
Constant			1.05***
			(0.069)
Sample Size	1,248	1,248	1,248

Robust standard errors in parentheses. The Probit specifications control for session, round, day and experimenter fixed-effects. Required repayment has been rescaled for ease of interpretation. The expected benefit is computed as the average income from Activity 3 (by session and type) multiplied by the overall probability of being excluded if choosing to default since not all defaulters are excluded. This average exclusion rate is 52 percent.

more.

Exclusion

As described above, all those contributing to loan repayment are eligible to vote but only those receiving at least two votes are excluded from the group. We divide all members into 3 categories, contributors, failures and defaulters. The top panel of Table 6 reports the fractions of each of these categories receiving at least one vote against them and the bottom panel reports the corresponding exclusion rates. Not surprisingly, contributors receive a negligible fraction of votes and are almost never excluded. By contrast, about three-quarters of all defaulters receive at least one vote against them and about half are excluded. One-quarter of those with failed projects also receive a vote against them even though their failure is randomly determined. Voting against these members is akin to discriminating against those with bad luck. This phenomenon of responding to luck has been observed by others in both experimental and observational data (De Oliveira, Smith, and Spraggon, 2014; Cappelen, Konow, Sorensen, and Tungodden, 2013; Bertrand and Mullainathan, 2001). While we do not have an explanation for this behavior in our model, it is also clear that votes against failures are qualitatively different and of a much lower magnitude than those against defaulters. Only 9% of this group gets excluded.

Table 6: Exclusion rates

	(1) All	(2) Contributors	(3) Failures	(4) Defaulters	(5) Difference ($p-value$) (4 – 3)
Panel A: Received at least One Vote					
All	0.17 (0.01) [1360]	0.07 (0.01) [949]	0.23 (0.03) [286]	0.74 (0.04) [125]	0.00
Low and Medium	0.16 (0.01) [1040]	0.08 (0.01) [760]	0.27 (0.03) [232]	0.83 (0.05) [48]	0.00
High	0.19 (0.02) [320]	0.02 (0.01) [189]	0.09 (0.04) [54]	0.69 (0.05) [77]	0.00
Difference: Low and Medium – High ($p-value$)	0.13	0.00	0.01	0.07	
Panel B: Excluded					
All	0.08 (0.01) [1360]	0.01 (0.01) [949]	0.09 (0.02) [286]	0.52 (0.05) [125]	0.00
Low and Medium	0.06 (0.01) [1040]	0.01 (0.00) [760]	0.11 (0.02) [232]	0.60 (0.07) [48]	0.00
High	0.12 (0.02) [320]	0.00 (-) [189]	0.02 (0.02) [54]	0.47 (0.06) [77]	0.00
Difference: Low and Medium – High ($p-value$)	0.00	0.11	0.03	0.13	

Standard errors in parentheses. Reported p-values are from t-tests for equality in means. Square brackets contain the number of observations in each case.

Table 7 shows the fraction of eligible voters who actually vote, by type and treatment. The sample here is restricted to contributors in rounds where there is some default. We do this to test the propensity of members to sanction default. The fraction voting is much higher for the High treatment, relative to the Low and Medium treatments. One possible explanation for this greater use of sanctions is that enforcement is more critical in ensuring the repayment of the group loan than in the other two treatments and one or two defaulters can more easily trigger group default. We find b-types more likely to vote in the Low and Medium treatment but there are no systematic differences across the two types within the High treatment. Our theoretical model does not predict any differences in voting behavior by type. In any equilibria in which both a and b types contribute to repayment, their incentives to exclude defaulters are aligned.

Table 7: Voting behavior by type and treatment

	All (1)	Type a (2)	Type b (3)	Difference (p-value) (4)
Low and Medium Debt	0.75 (0.06) [190]	0.68 (0.05) [101]	0.82 (0.04) [89]	0.03
High Debt	0.85 (0.03) [189]	0.87 (0.03) [119]	0.80 (0.05) [70]	0.17
Difference: Low and Medium – High (p-value)	0.01	0.00	0.75	

Standard errors in parentheses and sample sizes in square brackets. The sample consists of all contributors in rounds where there is some default. p-values are based on a t-test for equality in means.

The public good game

The average contribution to the group account is 26 rupees, one quarter of the endowment. Type a players contribute on average 76% more than type b. Based on a Mann-Whitney Wilcoxon rank sum test, the distribution of contributions by a-types first-order stochastically dominates that of b-types for all treatments. The sum of contributions is largest in the High treatment, implying that, conditional on these groups reaching Activity 3, the income earned from this stage is larger. In support of our second hypothesis in Section 2, generous public good contributions allow a larger debt burden to be supported in equilibrium.

As discussed at the end of Section 2, we restrict ourselves to examining whether the general pattern of repayment behavior fits our theoretical model rather than attempt a fine test for our theoretical propositions. The range of data values that emerge from our experimental data do not allow us to do much more. For example, credible sanctions in Propositions 2 and 3 require that the ratio of contributions in the public good game, $\phi = \frac{g_a}{g_b}$, lies between 2 and 2.8. Although there are 9 out of 20 sessions in which the average level of ϕ is above 2, and 5 in which it is above 2.8, we are unable

Table 8: Average contributions to the public good

	All (1)	Type a (2)	Type b (3)	$F_b > F_a$ (p-value)†
All	25.92	32.85	18.70	0.00
	(0.91)	(1.39)	(1.09)	
	[1258]	[642]	[616]	
Low and Medium Loan	24.31	31.39	17.19	0.00
	(1.00)	(1.59)	(1.14)	
	[975]	[489]	[486]	
High Loan	31.47	37.52	24.35	0.00
	(2.07)	(2.90)	(2.85)	
	[283]	[153]	[130]	

Standard errors in parentheses and sample sizes in square brackets. Reported p-values are from a rank sum test of first order stochastic dominance of the distribution of the a-types.

to satisfactorily test Proposition 3 because the other conditions required are not simultaneously satisfied. Whenever expected benefits from the public good game are lower than the repayment burden for a b-type member, they also fall short of the repayment burden for an a-type if all b -types default. As a result, the conditions under which a separating equilibrium occurs are never strictly satisfied in our experiment and this result is derived mainly for theoretical completeness. However using the experimental data we show in this paper that repayment incentives matter and do so in ways that have not been carefully explored in the microfinance literature.

5 Conclusion

The expanding body of research in microfinance, both theoretical and empirical, has focussed on how the structure of contracts influences repayment behavior. Experimental studies have often emerged out of collaborations of researchers and microfinance institutions in which borrowers are assigned to different treatments to estimate the impact of contractual features on repayment rates. In the field, the interactions of members in microfinance groups extend well beyond credit. Many of these groups engage in a range of social and production activities, yet little is known about how these activities influence their financial performance.

Our paper investigates the relationship between loan size and the value of ancillary group activities to highlight their importance in encouraging compliance in credit contracts. We use a three-stage repayment game in which groups can vote to expel members who default on their loans and exclude them from group activities. We identify repayment equilibria with and without exclusion and show that exclusionary equilibria are most likely when debt burdens are large and there is significant heterogeneity across members in the benefits from group activities. We design an experiment to test the main predictions of the model and our experimental findings are broadly consistent with the theory. Within groups, those with the largest gains from group activities contribute more often to loan repayment and exclusion is used as an effective disciplinary device.

These results suggest that the collective activities undertaken by microfinance groups are not incidental and can be directly linked to their performance. From a policy perspective, one could argue that the development of alternative activities by microfinance groups should be encouraged as a way to increase their ability to sanction defecting members. In doing so however, it is critical that the returns from such activities be sizable. This is particularly true of the ultra-poor households who operate in precarious environments and may be more susceptible to default.

A common criticism of laboratory experiments is that decisions made by student subjects are unlikely to adequately capture the decision-making environments of members of microfinance groups. While the levels of repayment rates, contributions to the public good and the frequency of sanctions may differ across subject pools, we believe our results provide evidence on the importance of incentives in explaining differences in behavior. Our purpose in this paper is to examine the relevance of incentives faced by groups in a controlled environment. A natural next step would be to take an experiment of this type to the field.

Appendix

Proofs of theoretical results

Proof of Proposition 1. With zero contributions to the public good by both types, the income of all those continuing to Stage 3 is ω and exclusion is always credible because, in this case, Stage 3 income is fixed and does not depend on the size or composition of the group. Therefore repayment will occur only if $\frac{nL}{j} \leq \omega$ and not otherwise. $\square$

Condition for the profitable exclusion of k members of type b: With n_a and n_b as the numbers of the two types in the group, the threat of excluding k defaulting members of type b is credible if it increases the value of the public good for voting members. This requires the inequality in (4) to hold. This condition can be re-written as:

$$\frac{(n_a\alpha_a + n_b\alpha_b - k\alpha_b)\,(n_a g_a + n_b g_b - k g_b)}{n_a + n_b - k} \geq \frac{(n_a\alpha_a + n_b\alpha_b)\,(n_a g_a + n_b g_b)}{n_a + n_b}$$

Multiplying both sides by $\frac{(n_a+n_b-k)(n_a+n_b)}{\alpha_b g_b}$ and using ϕ and θ to denote $\frac{g_a}{g_b}$ and $\frac{\alpha_a}{\alpha_b}$ respectively, we obtain:

$$\phi \geq \frac{(n_a + n_b)\,(n_a + n_b - k)}{n_a^2(\theta - 1)} + 1$$

or

$$\phi \geq \frac{n\,(n-k)}{n_a^2(\theta - 1)} + 1 = \hat{\phi}(k).$$

Since $\hat{\phi}(k)$ is clearly decreasing in k, the necessary condition for excluding k members is weaker than that for excluding any number less than k. Therefore, if the threat to exclude k members of type b is credible, so is the threat to exclude any larger number of members of type b. $\square$

Proof of Proposition 2. All members are willing to repay the loan rather than face exclusion if $\frac{nL}{j} \leq \min\{I_a, I_b\}$ where I_a and I_b are both computed using all n members with contributions of the two types given by g_a and g_b respectively. Exclusion is however only credible if the exclusion of a single b type member does not decrease the expected return from Stage 3 of the game. This is true only when the ratio $\phi \geq \hat{\phi}(1)$. $\square$

Proof of Proposition 3. Our proof proceeds in 3 steps. We first point out that the condition on ϕ implies that exclusion of any defaulting members of type b is always credible. The second step is to show that when there are j successes, the condition $\frac{nL}{j} > I_b(n_a, n_b)$ implies that successful b types always prefer default and exclusion to repayment. Our third and final step is to show that the condition $\frac{nL}{j-n_b} < I_a(n_a)$ is sufficient to ensure that successful a type members contribute to repaying the group loan, even though they do not know the distribution of the j successful projects across the 2 types when making this repayment decision.

Step 1: Consider a group with j successful projects and values of g_a and g_b such that their ratio $\phi \geq \hat{\phi}(1)$. We see from (5) that $\hat{\phi}(k)$ is decreasing in k. Therefore, the condition $\phi \geq \hat{\phi}(1)$ ensures that, for any feasible value of k, the exclusion of k members of type b raises expected payoffs in Stage 3 for the remaining members. Feasible values of k are integers in the interval $[\max(0, j - n_a), \min(n_b, j)]$.

Step 2: We now show that a b type who prefers exclusion to repayment of a j^{th} share of the loan would also prefer exclusion to repayment if some of the other b types defaulted and were excluded from the group:

$$\frac{nL}{j-k} - I_b(n_a, n_b - k) > \frac{nL}{j} - I_b(n_a, n_b) \tag{7}$$

for feasible values of k. Substituting the expression for I_b from (2), the above inequality can be written as

$$\frac{nL}{j-k} - \frac{nL}{j} > \alpha_i \left(\frac{(A - k\alpha_b)(G - kg_b)}{n-k} - \frac{AG}{n} \right)$$

$A = n_a\alpha_a + n_b\alpha_b$ is the sum of the α coefficients in the initial group and $G = n_a g_a + n_b g_b$ is the total contribution to the public good when the group is intact. Replacing $(A - k\alpha_b)(G - kg_b)$ by AG, it is enough to show that

$$\frac{nL}{j-k} - \frac{nL}{j} \geq \alpha_b \left(\frac{AG}{n-k} - \frac{AG}{n} \right)$$

which can be re-written as

$$\frac{\frac{nL}{j}}{\frac{\alpha_b AG}{n}} \geq \frac{j-k}{n-k}$$

This inequality always holds since we started with the assumption that $\frac{nL}{j} > I_b(n_a, n_b)$ and $\frac{\alpha_b AG}{n}$ is just one component of $I_b(n_a, n_b)$ so the LHS is greater than 1 and the RHS cannot be greater since $j \leq n$.

Step 3: We now show that, given the condition on ϕ in the proposition, a types who are willing to reimburse the loan when all n_b members of type b default and are excluded from the public good game are also willing to do so when $k < n_b$ default. This implies that a type members contribute to repayment irrespective of the number of successful projects owned by defaulting b types.

An a type member prefers to reimburse the loan even if all b-types succeed, default and are excluded under condition (ii) in the proposition, i.e. $\frac{nL}{j-n_b} < I_a(n_a, 0)$. We now need to show that $\frac{nL}{j-k} < I_a(n_a, n_b - k)$ for all $k < n_b$. A sufficient condition for this is

$$\frac{I_a(n_a, n_b - k)}{\frac{nL}{j-k}} > \frac{I_a(n_a, 0)}{\frac{nL}{j-n_b}} \text{ for all } k < n_b$$

The above inequality can be re-written as

$$\frac{j-k}{j-n_b} > \frac{I_a(n_a, 0)}{I_a(n_a, n_b - k)}$$

or, expanding the expressions for income on the RHS, we have

$$\frac{j-k}{j-n_b} > \frac{w - g_a + v_a(n_a, 0)}{w - g_a + v_a(n_a, n_b - k)}$$

The condition on ϕ in Step 1 implies $v_a(n_a, 0) > v_a(n_a, n_b - k)$, so the ratio on the RHS is greater than 1 and adding a constant to both the numerator and denominator reduces it. It is therefore enough to show that

$$\frac{j-k}{j-n_b} > \frac{v_a(n_a, 0)}{v_a(n_a, n_b - k)}$$

or, using the expression for v_i from (1)

$$\frac{j-k}{j-n_b} > \frac{\alpha_a(A - n_b\alpha_b)(G - n_b g_b)/(n - n_b)}{\alpha_a(A - k\alpha_b)(G - kg_b)/(n - k)} \tag{8}$$

Now, since $k < n_b$, replacing k by n_b in the term $(A - k\alpha_b)(G - kg_b)$ increases the RHS in (8). It is therefore enough to show that

$$\frac{j-k}{j-n_b} \geq \frac{n-k}{n-n_b}$$

which clearly holds since $j \leq n_b$. □

Figure A1: Structure of the experiment

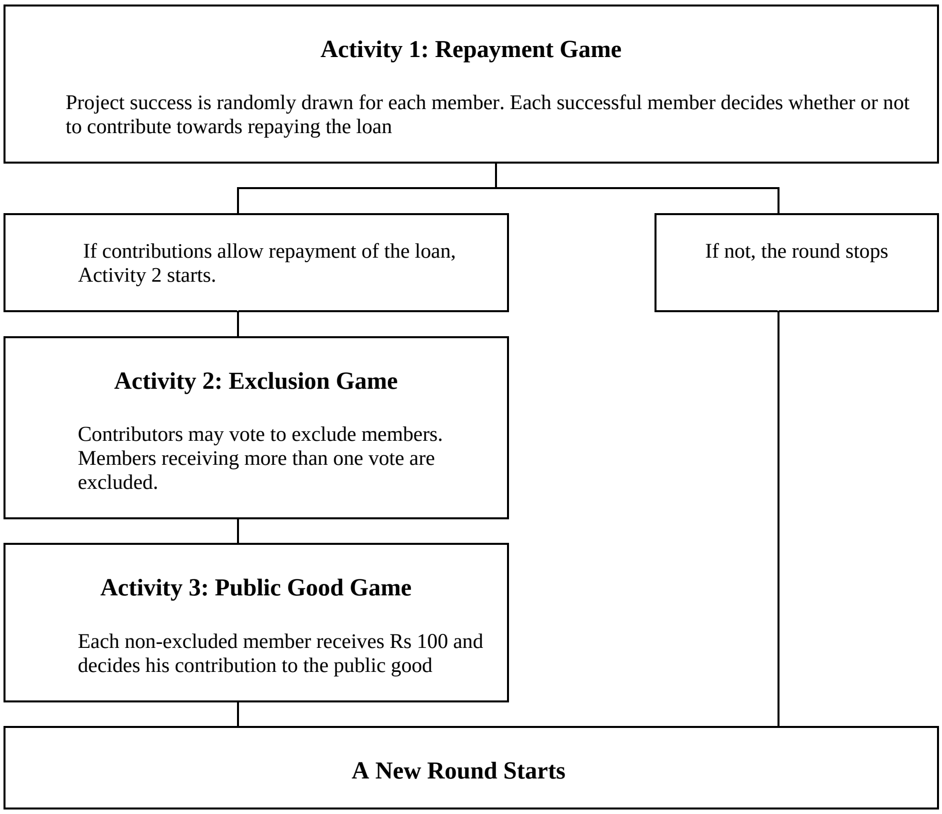


Table A1: Baseline balance

	All (1)	Low (2)	Medium (3)	High (4)
Age	21.00	20.80	21.13	21.04
	(0.12)	(0.24)	(0.21)	(0.18)
Male	0.56	0.57	0.56	0.54
	(0.04)	(0.07)	(0.06)	(0.06)
Course Economics	0.62	0.62	0.61	0.63
	(0.03)	(0.06)	(0.06)	(0.06)
Post Graduate	0.55	0.47	0.61	0.54
	(0.04)	(0.07)	(0.06)	(0.06)
Born: Delhi	0.41	0.28	0.46	0.47
	(0.04)	(0.06)	(0.06)	(0.06)
Born: Other North	0.25	0.25	0.23	0.27
	(0.03)	(0.06)	(0.05)	(0.05)
Lived in Delhi Long	0.49	0.38	0.46	0.60
	(0.04)	(0.06)	(0.06)	(0.06)
Eldest	0.34	0.30	0.40	0.30
	(0.03)	(0.06)	(0.06)	(0.06)
Youngest	0.41	0.40	0.36	0.47
	(0.04)	(0.06)	(0.06)	(0.06)
Sample Size	200	60	70	70

Standard errors in parentheses.

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Instructions:

ID:
Type:

This is an experiment in the economics of decision-making. The instructions are simple and if you follow them carefully and make good decisions you will earn money that will be paid to you privately in cash at the end of the experimental session. Your earnings will be in experimental rupees (ERs), which will be converted into real rupees (Rs) at the following exchange rate: ___ Experimental rupees = Rs 1.

In today's experiment you will take part in 3 different activities (we will call them Activity 1, Activity 2 and Activity 3). Your ID number and your type are provided on the top left hand corner of this page. You can be type A or type B. Each type has a number associated with it: A = 0.9 and B = 0.3. This number will determine your income in Activity 3. There are equal number of types in each group (i.e., there are 5 type A's and 5 type B's). Attached to the instructions you will also find a record sheet. **Please do not reveal your type or show your record sheet to any other member of your group.**

You will participate in Activity 1 10 times. The number of times you continue on to Activity 2 and Activity 3 will depend on the outcome of Activity 1 in a manner to be explained below.

<u>**Activity 1:**</u>

For this activity you are in a group of ten individuals each of whom has received a business improvement loan. Each member of your group has received a loan of ERs 80 to operate a business. If your business is successful you will earn ERs 300, if your business is not successful you will earn nothing. There are 10 members in your group, **the group as a whole** must pay back ERs 960 (in that case we will say that the debt has been repaid). If the debt is fully repaid, we will continue on to Activity 2 and Activity 3. If not we stop and go to the next round.

<u>Earnings</u>

In this activity you have to draw a ball from the bag in front of you, to determine if your business is successful or not (i.e., whether you earn money or not). There are a total of three green balls and one red ball in the bag.

- If you draw a green ball your business is successful and you earn ERs 300.
- If you draw a red ball your business fails and you earn zero.

This means that each of you has a one in four chance of earning zero. It is possible that more than one of you will draw a red ball. It is also possible that none of you will draw a red ball. Depending on the colour of the ball drawn, please circle R (red) or G (green) in column 2 of the attached record sheet. After you have drawn the ball and noted the colour (and written it in column 2), please return the ball to the bag. The colour of the ball chosen will be recorded by the experimenter. Once all 10 individuals have drawn a ball, the total number of members who have drawn a green ball will be announced. Write this in column (3) of your record sheet.

<u>Loan Repayment</u>

If you have drawn a green ball you must decide whether you want to contribute towards group repayment. If you choose to contribute, please circle Y in column (4) of the attached record sheet; if you choose not to contribute, please circle N in the same column. Also record this decision on the strip of paper provided for this round and this Activity (look at the experimenter to see a sample). The experimenter will collect this from you. If a person draws a red ball from the bag she has earned zero and therefore cannot repay in this round.

The actual amount you will be asked to contribute will depend on the number of group members who draw a green ball **and** choose to contribute. Since the total amount that needs to be repaid is ERs 960, the more people in the group who contribute to loan repayment, the less each person will have to pay.

Your income from Activity 1 will be calculated in the following way:

Number of group members choosing to contribute	**Contribution amount of each member choosing to contribute**	**Income of each member choosing to contribute**	**Income of each member choosing not to contribute**	**Income of each member unable to contribute**	**Loan repaid?**	**Go on to activity 2 and 3**
0	0	300	300	0	No	No
1	0	300	300	0	No	No
2	0	300	300	0	No	No
3	0	300	300	0	No	No
4	240	60	300	0	Yes	Yes
5	192	108	300	0	Yes	Yes
6	160	140	300	0	Yes	Yes
7	137	163	300	0	Yes	Yes
8	120	180	300	0	Yes	Yes
9	107	193	300	0	Yes	Yes
10	96	204	NA	NA	Yes	Yes

Notice that for the group to move on to Activities 2 and 3, at least 4 group members should choose to contribute.

After every group member has made his/her decision, the experimenter will display on the whiteboard the contribution amount of each member who chose to contribute and whether this member drew a red ball or a green ball. Write down **your** contribution amount in column (5) of the record sheet if you drew a green ball. If you chose not to contribute your contribution amount is always 0. Calculate your income from activity 1 as ERs 300 minus your actual contribution amount (number in column (5)). Write this in column (6) of the attached record sheet. Remember if you drew a red ball, you cannot contribute and your income for this round is 0.

At the end of each round the experimenter will announce whether the loan has been repaid or not and whether you move on, as a group, to Activity 2 and 3 or not.

If the loan is not repaid, then you forego the chance to earn income from Activity 3 (below). The round ends here and your income from this round is simply your income from Activity 1.

Write this number in column (13) of the attached record sheet. We now go to round 2 where we start with Activity 1 all over again.

Activity 2

Suppose you are eligible to participate in Activity 2 and Activity 3. Each member of the group who drew a green ball **and** chose to make a positive contribution towards debt repayment will be allowed to vote out one person from participating in Activity 3. Please write down the ID number of the person you want to vote out in column (7) of your record sheet. Remember you can vote out **any** member of the group. You can of course choose not to vote out any member of your group. Also record this decision on the strip of paper provided for this round and this Activity. The experimenter will collect this from you.

We will add up the votes and any member of the group who receives **more than one vote** will be voted out and will not be eligible to participate in Activity 3. If no one receives a vote, no member is voted out. Also you need to receive more than one vote to be excluded from Activity 3. So the number of members of the group who go on to Activity 3 can vary (depending on the number of members voted out).

After everyone has made their decision we will announce the number and ID of individuals voted out. Write down the total number of individuals voted out in column (8) of the attached record sheet. Remember the total number remaining is 10 minus total number voted out.

Activity 3

Those group members, who have not been voted out, now participate in Activity 3. It does not matter if you drew a red or a green ball in Activity 1 or you chose to contribute in Activity 1. You can participate in Activity 3 as long as you have not been voted out in Activity 2.

For this activity you are given an endowment of ERs 100, which you can choose to keep with you in a private account or place in a group account. Each ERs kept in the private account gives you ERs 1.

The return on the money you place in the group account will depend on
 (1) your type;
 (2) the number of individuals of each type (type A or type B) remaining.

The earnings from the group account will be calculated in the following manner.

Income from Activity 3:

If you are of type A:

$$\left[\frac{(\text{Number of type A remaining} \times 0.9) + (\text{Number of type B remaining} \times 0.3)}{\text{Total number of members remaining}}\right] \times G \times 0.9$$

If you are of type B:

$$\left[\frac{(\text{Number of type A remaining} \times 0.9) + (\text{Number of type B remaining} \times 0.3)}{\text{Total number of members remaining}}\right] \times G \times 0.3$$

G is the **total** amount placed in the group account by all the members participating in Activity 3.

Remember you know your type but you do not know the type of the others.

Please write down the amount you wish to keep with you in your private account in column (9) of the record sheet. The amount you then place in the group account is given by ERs 100 minus what you keep in the private account. Write this number in column (10) of the record sheet. Record the amount you want to place in the group account on the strip of paper provided for this round and this Activity. The experimenter will collect this from you.

Once all of you have decided on your contribution to the group account, we will calculate your income from the group account. We will write this on the whiteboard. Write this in column (11) of the record sheet. Your income from Activity 3 will then be the sum of the amount you kept in the private account (column (9)) plus your income from the group account (column (11)). Write this in column (12).

Let us consider an example. Suppose 9 members are eligible to participate in Activity 3. Of these 9 members, suppose 4 are of type A and 5 are of type B. The information on how many of each type are remaining will not be provided to you, this is just an example. Also suppose that the total contribution to the group account is ERs 400 (by all members of the group who participate in Activity 3). Then the income of a type A individual is $\left[\frac{(4\times 0.9)+(5\times 0.3)}{9}\right]\times 400\times 0.9=\text{ERs } 204$ and the income of a type B individual is $\left[\frac{(4\times 0.9)+(5\times 0.3)}{9}\right]\times 400\times 0.3=\text{ERs } 68$. Your total income from activity 3 is then the sum of your income from the group account plus the amount you had placed in the private account.

Your total income from this round is the sum of your income in Activity 1 (column (6)) and Activity 3 (column (12)). Please write this in column (13) of the record sheet.

Please write your cumulative income (total income from all rounds in the experiment this far) in column (14) of the record sheet.

We then move on to Round 2, which works exactly in the same manner.

Are there any questions before we begin?