Pay, peek, punish? Repayment, information acquisition and punishment in a microcredit lab-in-the-field experiment

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Abstract

While remarkable repayment rates have been achieved in microcredit group lending, anecdotal evidence from the field suggests that there is excessive peer punishment among group members. To measure excessive peer monitoring and punishment and to study their effect on repayment, I conduct a lab-in-the-field experiment with actual microcredit borrowers in rural India. I design a repayment coordination game with strategic default and the possibility of acquiring information about a peer's investment return (peer peeking) or of sanctioning a peer (peer punishment). I observe loan repayment of over 90 percent and excessive peeking and punishment of around 85 percent. The experimental results give rigid support to the anecdotal evidence and they inform the debate on whether microcredit institutions should move away from joint-liability group lending. While non-cooperative game theory can explain the high repayment under consideration of risk-averse preferences, it fails to predict the use of peer peeking and punishment. The most promising alternative explanation is that borrowers have internalized the mission indoctrination of the microlender of what constitutes a good borrower, namely repaying loans and disciplining peers.

Keywords: Microcredit, lab-in-the-field experiment, joint-liability group lending, peer punishment
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1 Introduction

Microcredit has been praised for offering access to credit for poor people using innovative lending techniques that circumvent problems of information asymmetries in credit markets in the absence of physical collateral. The best known innovation in microcredit is joint liability of borrowers within group lending structures. In this concept, borrowers in a lending group are jointly liable for each other's loan repayments. The lender exploits existing social capital and local information advantages among the group members to address adverse selection and moral hazard. High repayment rates above 95 percent have been recorded for microcredit institutions and have been attributed to innovative lending techniques, in particular to joint liability (Morduch (1999), Ghatak and Guinnane (1999)).

While the benefits of microlending have attracted much attention over the past two decades, the costs of group lending in the form of extensive monitoring and peer punishment are increasingly being recognized. Social anthropological case studies, such as Montgomery (1996), Rahman (1999) and Karim (2008), argue that Bangladeshi microcredit institutions instrumentalize patriarchal structures and honor and shame codes in rural societies in order to enforce loan repayment. They report cases of drastic social pressure on defaulting borrowers, such as verbal harassment, shaming in public, raiding of houses to confiscate assets for sale to cover the loan installments and even stripping down the defaulter's house completely.[1] During the 2010 microfinance crisis in the Indian state of Andhra Pradesh the criticism of group lending has culminated in newspaper reports of harsh enforcement mechanisms for loan repayment, excessive peer punishment in borrowing groups and even borrower suicides (Gokhale (2009), Biswas (2010), Buncombe (2010) and Klas (2011)).

Despite this criticism microcredit still substantially relies on joint-liability lending.[2] In reaction to observed pressure in village societies, many microcredit institutions have started to move away from joint-liability contracts in favor of individual-liability contracts. First and foremost among the institutions making this move was the flagship of joint-liability lending, the Grameen Bank in Bangladesh, which introduced individual liability in 2002 with the *Grameen Generalised System*, also known as Grameen Bank II (Yunus (2002)). As reported in Rutherford *et al.* (2004), with this move the Grameen Bank strengthened its emphasis on 'tension-free microcredit' practices that do not involve any form of joint liability or resulting pressure among borrowers.

So far, however, there is only anecdotal evidence on the costs of joint-liability group lending because peer monitoring and peer punishment are difficult to observe rigidly. To measure peer monitoring and punishment and to analyze their effect on repayment, I conduct a microcredit lab-

[1] Taking possession of a defaulting member's house has a long history in rural Bangladeshi society as reported by Karim (2008) p.19: "It is known as *ghar bhanga* (house-breaking) and is considered as the ultimate shame of dishonor in rural society."

[2] Using data from MixMarket, Hermes *et al.* (2011) show in their sample of 464 microfinance institutions that more than 60 percent employ some form of group structure and solidarity for lending to the poor.

in-the-field experiment with actual microcredit clients in northern India.[3] In particular, I study joint-liability group lending with strategic default and the possibilities of acquiring information by observing a peer's investment return (peer peeking) and of punishing a defaulting peer (peer punishment).[4] I analyze group repayment coordination and the excessive use of the two social-capital based enforcement techniques in a game-theoretic and in an empirical analysis.

The experimental design builds upon the literature on microcredit mechanisms for strategic default. Theoretical models have assigned the success of group lending to joint liability. They have shown that joint liability in group lending exploits existing social capital and increases the lending group's repayment performance by addressing adverse selection, ex-ante moral hazard related to project and effort choice, and ex-post moral hazard related to strategic default.[5]

Besley and Coate (1995) address the trade-off between mutual insurance against shocks and free riding on joint-liability repayment obligations and analyze the role of social sanctions in repayment enforcement and reduction of strategic default. In their model with continuous investment returns and bank punishment for group default, strategic default is reduced if the social sanctions borrowers can impose on their joint-liability group members are severe enough. The credible threat of social sanctions is sufficient to induce higher repayment in joint-liability group lending than in individual lending.

Empirical studies have found mixed evidence on the theoretical predictions regarding repayment. In a conventional lab experiment with college students, Abbink *et al.* (2006) study the trade-off between mutual insurance for involuntary default and the incentive to free-ride on fellow borrowers' loan repayments in group lending. They find that, compared to individual liability, joint liability with dynamic incentives overcomes ex-post moral hazard and strategic default although game theory suggests free riding. In lab-in-the-field experiments Giné *et al.* (2010) confirm higher repayment in group lending due to increased risk pooling, although they simultaneously observe increased risk taking. In contrast to lab experiments, randomized evaluations by Attanasio *et al.* (2011) and Giné and Karlan (2014) do not find any significant difference in repayment rates when comparing joint and individual liability for loan repayment.[6]

Lab-in-the-field experiments looked at social capital as a channel for repayment performance

[3] This type of experiment would be categorized as a *framed field experiment* in the classification by Harrison and List (2004) commonly used in the behavioral economics literature.

[4] The terminology for observing the investment returns of peers without any sanction possibilities is not clear in the literature. Most studies (e.g. Stiglitz (1990), Madajewicz (2011), Giné *et al.* (2010), and Fischer (2013)) refer to *peer monitoring* for monitoring actions or perfect information regarding the project or effort choice of borrowers that potentially eliminate ex-ante moral hazard. Armendáriz de Aghion (1999) labels information acquisition with sanction possibilities for strategic default as *peer monitoring*. I refrain from using this term here, and instead refer to information acquisition in the form of pure observation of the peer's investment return without any sanction possibilities as *peer peeking*.

[5] See Ghatak and Guinnane (1999) for a comprehensive overview; Ghatak (1999), Armendáriz de Aghion and Gollier (2000) and Ghatak (2000) for adverse selection; Stiglitz (1990), Varian (1990) and Madajewicz (2011) for ex-ante moral hazard related to project and effort choice; and Besley and Coate (1995) and Armendáriz de Aghion (1999) for ex-post moral hazard related to strategic default.

[6] While Attanasio *et al.* (2011) compare individual lending with joint-liability group lending, Giné and Karlan (2014) compare joint-liability with individual-liability group lending.

and have found mixed evidence. Karlan (2005) correlates social capital measures of microcredit clients in Peru with repayment data. He finds a positive effect of trustworthiness, no effect of cooperative behavior, and even a negative effect of trust on repayment performance. Cassar *et al.* (2007) combine Karlan's (2005) measure of social capital with Abbink *et al.*'s (2006) lab experiment on strategic default and conduct lab-in-the-field experiments with typical microcredit clients in South Africa and Armenia. They are able to confirm the theoretical importance of social capital as measured by trust between group members for repayment.

Recent work has concentrated on analyzing the effects of peer monitoring as a concrete enforcement mechanism. Carpenter and Williams (2010) elicit the propensity to monitor among new microcredit clients in artefactual field experiments in Paraguay. Six months after the experiments, they correlate the propensity to monitor peers with the actual repayment performance of the borrowing groups and find a strong relationship between the average monitoring propensity of a group and its loan repayments. In lab-in-the-field experiments, Giné *et al.* (2010) and Fischer (2013) study the effects of perfect information, which they name peer monitoring, on ex-ante moral hazard and project choice. While Giné *et al.* (2010) find no difference on investment choice and repayment with and without peer monitoring, Fischer (2013) finds a stark reduction of ex-ante moral hazard even when the risky investment alternative is efficient.

While existing studies on group lending have focussed on exogenously assigned information structures and peer monitoring and their effect on ex-ante moral hazard, I conduct a lab-in-the-field experiment to measure the use of information acquisition and peer punishment and their effect on repayment and ex-post moral hazard. The design of the microcredit game is based on Abbink *et al.*'s (2006) microfinance investment game on strategic default. To study the excessive use of peer monitoring and peer punishment, I augment the game by three different treatments: first, the possibility of observing a peer's investment return at a cost (peer peeking), second, the possibility of reducing a defaulting peer's payoff at a cost (peer punishment), and third, the possibilities of observing a peer's investment return and of reducing a defaulting peer's payoff at a cost (peer peeking-cum-punishment).

Since there is no theoretically determined benchmark for an optimal level of peer peeking or peer punishment, I design both techniques as non-credible. For this I relate to the behavioral economics literature on punishment in cooperation (e.g. Fehr and Gächter (2000, 2002)). In this literature, punishment is mostly studied in Public Good Games for cooperation, where people within one group decide how much to contribute to a public good. Even though punishment is costly and pecuniarily non-beneficial, and hence non-credible, excessive levels of punishment and increased levels of cooperation are observed in these studies. Fehr and Gächter (2000, 2002), and Carpenter (2007) argue that punishment of free riders can be explained by people's aversion to being taken advantage of when being cooperative.

Following Fehr and Gächter (2000, 2002) I design the three treatments with enforcement techniques that are costly and pecuniarily non-beneficial due to a static setting in a one-shot experiment. Hence, they should not be exercised by expected utility maximizers. This constitutes a theoretical benchmark and it allows me to test whether peer peeking and peer punishment are applied excessively.

To explore repayment coordination, the use of non-credible enforcement techniques, and their influence on repayment behavior of actual decision makers the experiment is conducted with 105 actual microcredit clients from a microlender in Bihar, Northern India. This controlled experimental environment allows me to study real microcredit borrowers' decisions in situations similar to their actual financial decision-making scenarios.

While non-cooperative game theory suggests little repayment and no punishment for risk-neutral expected utility maximizers, I find that cooperation in the form of loan repayment is extremely high. Analysis of the use of non-credible enforcement techniques reveals that the subjects excessively peek on their peers and punish defaulters. Unwilling and strategic defaulters are punished alike, indicating that borrowing peers dislike mutually insuring each other and consequently penalize defaulters in any case. The experimental findings replicate anecdotal evidence from the field with regard to both high repayment performance and extensive peer punishment giving rigid support to the anecdotal evidence.

Compared to real-life repayment and suggestive evidence on real-life peer peeking from household surveys, I conclude that borrowers replicated their real-life behavior in the experiment. Although the experiment successfully measures difficult to observe behavior, the explanations are less clear. Risk-averse or inequity-averse preferences can partially explain the high repayment levels, but the results for peer peeking and peer punishment are robust to different preferences. Intrinsic motivation to punish defaulters, either driven by negative emotions or fairness concerns, may explain the punishment behavior, but not the repayment behavior. Since the experiment elicits real-life behavior, participants may have internalized the identity of good microcredit borrowers as shaped by the microlender. The lender uses group trainings and repeated affirmations to inculcate the message of what constitutes a good borrower, as for example by a pledge that clients take at every weekly meeting. This is the most plausible explanation for simultaneously observed high repayment, and excessive information acquisition and punishment.

I contribute to the literature in three ways. First, I provide a measure of the costs of group lending in the form of excessive information acquisition and peer punishment that much of the criticism of group lending is based on (e.g. Montgomery (1996), Rahman (1999) and Karim (2008)). This informs the debate on whether microcredit institutions should move away from joint-liability group lending (compare Attanasio *et al.* (2011) and Giné and Karlan (2014)). Second, I add the choice of non-credible enforcement techniques to experimental studies of strategic default in group lending. While few studies have analyzed the effect of peer monitoring on ex-ante moral hazard (Giné *et al.* (2010), Cason *et al.* (2012) and Fischer (2013)), the actual choice of peer monitoring and punishment as well as their effect on strategic default in group lending has been neglected so far. Third, I contribute to the small but growing literature conducting experiments on microcredit mechanisms with actual microcredit borrowers (e.g. Karlan (2005), Cassar *et al.* (2007), Giné *et al.* (2010), Carpenter and Williams (2010), and Fischer (2013)). This is important because microcredit borrowers differ substantially in their socioeconomic characteristics and social connectedness from the typical subject pool in lab experiments, namely college students.

The remainder of the paper is organized as follows. Section 2 gives an overview of the experimental design and Section 3 sets out the game-theoretic foundations. The results are presented in Section 4. Section 5 discusses potential shortcomings of the experimental design and alternative explanations for results, and Section 6 concludes.

2 Experimental design

2.1 Subject pool

The framed field experiment was carried out with borrowers of Gramyasheel in the northern Indian state of Bihar. The choice of the subject pool allows me to directly study the decision making of relevant stakeholders in microcredit. This has several advantages. First, compared to university students, microcredit clients have substantially different socioeconomic characteristics: they are less educated and literate, which influences their decisions and risk assessment, and they usually have less income at their disposal and place a higher value on monetary returns. Second, microcredit clients typically run their own micro-enterprise or household business so that they are familiar with making investment decisions and handling money even though they are likely to be illiterate. As actual borrowers, they have experience with taking and repaying a loan in a borrowing group, which they can draw upon in the experiment. Third, microcredit borrowers live in societies with different social structures, including social networks and institutions for informal risk sharing and contract enforcement. This feature is crucial to group lending and quite distinct from more individual-oriented western societies.

Gramyasheel is an NGO-based microcredit institution in the Supaul district in Bihar, a remote area with limited access to finance. It employs a group-lending methodology for female clients where five women form a joint-liability group (JLG) securing loan repayment through joint liability among the group members. Each group is part of a center that consists of up to four joint-liability groups. Before an applicant group is approved, it has to complete compulsory group training on the rules and procedures of microcredit and pass a group test on lending and joint liability. Joint liability is officially defined at the group level, but there is also a responsibility defined for the center, which leads to de facto joint liability at the center level.

Gramyasheel offers loans of 5,000 Indian Rupees (Rs.) in the first, Rs. 10,000 in the second and Rs. 15,000 in the third loan cycle, which are repaid in 52 equal weekly installments with 15 percent annual flat interest.[7] The loans are subsequently disbursed to each client of a joint-

[7] The loan amounts corresponded to \$ 111, \$ 222, and \$ 333 at the time of study in April 2011, with an

liability group at one week intervals. While credit disbursement takes place at the Gramyasheel office, loan repayments are collected by a loan officer at weekly center meetings in the neighborhood of its members. At the beginning of the meeting, the clients recite a pledge to always support their group and repay their loan, which further induces solidarity among the group members and towards Gramyasheel.

[Table 1 about here]

For the experiment, 105 clients from 12 randomly selected centers were invited to participate in six sessions, with around 20 participants from up to two centers in each session. The characteristics of the microcredit clients participating are set out in Table 1. The average age of the women participating is 33 years. On average, the subjects went to school for 2.5 years, but only 27 percent of them state that they are literate. Literacy refers to being able to read and write and most clients stated they were literate when they could read and write their names, so literacy is over-reported here. Although the majority of subjects are illiterate, they know how to handle money and run a business. In fact, 65 percent listed petty trade and business as their main occupation. Moreover, the subjects are actual borrowers of Gramyasheel. They are responsible for their microloan, and hence they are familiar with working with money and the concept of credit.

The treatments are assigned randomly across sessions. Comparing the subject characteristics across the different treatment groups in the experiment shows that they differ significantly in the number of household members, and the binary literacy variable (Table 1, column 5). On the one hand, the sample size is small so that the law of large numbers equalizing characteristics on average across randomly assigned groups may not be at work yet. On the other hand, differences in social characteristics may be more pronounced since the groups in the different treatments are real borrowing groups that the clients formed themselves, possibly on the basis of social characteristics. Table 6 shows, however, that none of these variables have a significant correlation with repayment behavior. Additionally, most of the analyses do not rely on the distinction of groups by treatment. However, I will discuss in more detail in section 5 whether the difference in literacy affects decision making.

2.2 Microcredit game - experimental setup

2.2.1 Standard microcredit game with joint liability and risky investment returns

The standard microcredit game is a one-shot game with loan disbursement, automatic investment in an individual risky project, repayment decisions on individual loan repayments and realization of investment returns and repayments. The timing of the model is illustrated in Figure 1.

[Figure 1 about here]

exchange rate of 44.94 INR/USD.

Each borrower receives a loan of Rs. 100, which is automatically invested in an individual risky project. Following Abbink *et al.* (2006), there is no choice regarding investment projects or effort levels in order to focus exclusively on ex-post moral hazard problems regarding strategic default. With a probability of $p_h = \frac{5}{6}$, the investment yields a high return $y_h =$ Rs. 250; with a probability $p_l = \frac{1}{6}$ it yields a low return $y_l =$ Rs. 10.[8] The interest rate is 20 percent, so that each borrower has to repay Rs. 120. The total debt of the joint-liability group is Rs. 240. Borrowers can only repay their loan when they have a high investment return.

Before the realization of investment returns, a borrower has to decide whether to repay or to default. The repayment is conditional on having a high investment return and the decision can be regarded as a commitment-to-repay decision. The timing follows Abbink *et al.* (2006), it resembles elements of the strategy method, and it allows me to collect repayment decision even if subjects have low investment returns.[9]

The repayment of the group loan depends on both group members' investment returns and on their repayment decisions. If only one borrower repays the loan, then joint liability is automatically enforced and she has to repay for her defaulting peer. This follows Abbink *et al.* (2006) to simplify repayment decisions, which are independent of investment returns. Also, it resembles a revelation of investment returns: when a borrower repays her loan she signals to the bank that her project is successful.

If both borrowers default, they face a severe bank punishment. This means, that each borrower has an incentive to free-ride on the repayment of her peer. However, free-riding is not a dominant strategy since both borrowers are worse off with group default. In practice, it is common to deny future loans to all group members in the case of group default, and it has been modeled theoretically by Rai and Sjöström (2004). In this static experimental setting these dynamic consequences are not possible. Stories from the field report other more coercive techniques to punish group default and recover repayments. Arunachalam (2010), for example, states that various strategies are applied by microcredit institutions to prevent group default and recover repayments, such as obstruction of work, threats, verbal abuse, repossession of property, and physical intimidation. Therefore, I follow the common assumption that the bank has a punishment technique that punishes all borrowers in the case of group default, as for example is assumed in Besley and Coate (1995), Armendáriz de Aghion (1999), and Rai and Sjöström (2004).

The individual repayment obligation is equal to the group's total loan repayment obligation of Rs. 240 divided by the number of repaying borrowers. This is deducted from the individual investment return and subjects keep whatever is left as a payoff. If a borrower repays, she gets

[8] The terminology applied in this paper follows Besley and Coate (1995) and Armendáriz de Aghion (1999) and refers to the gross investment return as the *investment return*. The term *payoff* is used to describe the earnings in the experimental sessions after the repayment obligation has been deducted from the investment return.

[9] The strategy method was first introduced by Selten (1967). It is used to elicit the complete strategies of players of the game, and it allows information to be collected on subject's behavior in different hypothetical decision-making scenarios, and hence provides the individual's complete strategy.

Rs. 130 when her partner repays, and Rs. 10 when her partner defaults. If a borrower defaults she gets to keep her investment return of Rs. 250, or Rs. 10 if the total group loan is repaid by her partner. If both borrowers default, I assume a bank punishment of each borrower to the highest possible extent so that the payoff for both is zero. The expected payoffs considering the borrowers' risky investments are illustrated in Figure 2.

[Figure 2 about here]

The design of the microcredit game is based on Abbink *et al.*'s (2006) microfinance investment game on strategic default with three main modifications. First, I only look at two-person borrowing groups to facilitate game theoretic analyses. Second, I conduct the microcredit game in a static instead of a dynamic setup to exclude various explanations for cooperation and punishment in repeated interactions. Third, instead of dynamic incentives as punishment for group default, I assume that the lender has access to a punishment technology that allows him to punish each borrower to the highest possible extent in the case of group default.

2.2.2 Peer peeking, peer punishment, and peer peeking-cum-punishment treatments

I introduce three different non-credible enforcement technologies to the standard game as treatments, namely the possibility of observing the peer's investment return at a cost (peer peeking), the possibility of reducing a defaulting peer's payoff (peer punishment), and the possibilities of observing the peer's investment return and of reducing a defaulting peer's payoff (peer peeking-cum-punishment). The timing of the extended model with peer peeking-cum-punishment is illustrated in Figure 3. The timing for peer peeking is without the peer punishment elements, and vice versa.

[Figure 3 about here]

Since anecdotal evidence from the field suggests that there is excessive peer punishment in borrowing groups (e.g. Gokhale (2009), Biswas (2010), Buncombe (2010) and Klas (2011)), the level of punishment may be driven by aspects other than self interest for cooperation enforcement. To facilitate analysis, all the treatments of acquiring information and penalizing peers in this experiment are designed as non-credible threats that a self-interested expected utility maximizer with standard preferences would not apply.

In the *peer peeking* treatment, participants can observe their peer's investment return at a cost. Before their repayment decision and investment return realization, they can pay Rs. 10 from their show-up fee of Rs. 40 to learn about their peer's investment return after return realization. This only reveals investment returns, but due to the timing of repayment decisions made before returns are realized, peer peeking does not influence any other decision.

In the *peer punishment* treatment, participants can punish a defaulting peer at a cost. After their repayment decision, they can pay Rs. 10 from their show-up fee of Rs. 40 to punish the defaulting partner by reducing her show-up fee by Rs. 20. This decision is made without knowing the peer's investment return and consequently without knowing the reason for default, e.g. involuntary default due to bad investment or strategic default. Since there is no repeated interaction, punishment will not influence future behavior, as will be shown subsequently, and since the punishment is small compared to the monetary gains from strategic default, punishment will not change the current behavior of the expected utility maximizer. Hence, punishment is pecuniarily non-beneficial.

In the *peer peeking-cum-punishment*, participants can choose both to observe their peer's investment return after loan repayment and to punish a defaulting peer after the repayment decision at a cost. With peer peeking, subjects can distinguish between involuntary and strategic defaulters in their punishment decision. Without peer peeking, subjects make the punishment decision without knowing the reason for default. Although it is mostly argued that there exists an information advantage among peers due to private local information, this design explicitly accounts for some costs associated with acquiring local information. The same reasonings as provided above make this combined enforcement technology non-credible.

In addition to the non-credible design of the enforcement techniques, I rely on a one-shot game. As a consequence, confounding effects such as reputation building through punishment or strategic reasons for punishing to increase cooperation in repeated interactions, as shown by Gächter *et al.* (2004) and Gächter and Herrmann (2009), can be excluded.

2.3 Procedural details

In each experimental session the participants conducted the standard microcredit game and one of the three treatments. The treatment played in the second round was randomly assigned to the experimental session. The participants did not know in advance that two different games would be played during a session, so any anticipation effects were excluded from their decisions.

All the experimental sessions took place in the big meeting room at Gramyasheel, but the participants were assured that their decisions could not be identified by Gramyasheel due to anonymous participant codes. The clients were seated in rows on the ground with sufficient space between each participant.

First, the instructions for the standard game were read aloud, followed by a role play showing the possible decisions. After each step was explained, the instructor checked the participants' understanding with questions.[10] Questions by the participants were answered immediately. In addition, the determination of the investment returns by individually rolling a dice to determine

[10] Questions included "The first person got a loan of Rs. 100, the second got a loan of Rs. 100, both have to pay Rs. 20 interest, how much do they have to repay?", "What are they doing? Did she decide to repay? Did the other one decide to repay? What will happen now to the payoff?".

the personal loosing number, collectively rolling a dice to determine the game's loosing number, and matching both loosing numbers to determine a low investment return was illustrated.

Next, the questions on decision making were read aloud by the instructor and the participants stated their decisions on their decision sheet. Because most of the participants were illiterate, they only had to answer questions with *yes* or *no* and circle the respective answer. The instructors helped them to find the right question where to place the respective answer. After the standard game, the participants were informed that they would play another game in which they had to make decisions. The actual payout that they would receive after the session would be calculated based on the decisions made in one of the two games, selected with the same probability. Then the randomly assigned treatment game was explained and illustrated in a role play.

In both games, all the decisions were elicited using a variant of the strategy method. This method, based on Selten (1967), is used to elicit the player's complete strategy for a game. It allows information to be collected on subjects' decisions in different hypothetical scenarios, and hence provides the individual's complete strategy. Without the strategy method, information would only be collected on one decision in a particular situation.[11] Using the strategy method, both unconditional decisions when the repayment decision of the peer is unknown, as well as conditional repayment decisions when it is known that the peer repays or defaults, were elicited.

To calculate the payoffs after the experimental decisions were taken, players were matched in two-person borrowing groups by randomly assigning them as player A and B based on the list of participants. It was randomly determined whether the payoffs would be calculated based on the standard or the treatment game.

In the standard game, a two-stage mover approach with random assignment of the sequence of moves was applied to incentivize all the decisions. The unconditional repayment decision of the first mover was matched with the corresponding conditional repayment decision of the second mover. In the treatment game, the payoffs were calculated based on the unconditional repayment decisions of both players since no conditional repayment decisions were elicited. This procedure monetarily incentivized all the decisions.

After the session finished, the participants were individually called into a separate room where they handed in the piece of paper with their participant code and were paid according to the payoff determined. They were shown the decision sheets, which included the peer's investment return if the participant had chosen to observe it in treatments with the peer peeking option.[12]

In total, 105 clients participated in six sessions with an average of 17.5 participants per session, and an average session lasted 2.5 hours. The payoffs to the participants, including a

[11] Brandts and Charness (2011) provide a meta-study comparing experiments with the strategy method versus a direct-response method. The majority of the studies considered do not find any difference between these two methods. However, it appears that punishment levels are substantially lower with the strategy method since emotions are curbed in hypothetical decisions.

[12] The clients were so distracted by the money that they did not concentrate on the payoffs and decisions of their peers. If they were interested, the decisions and the calculation of payoff were explained to them in detail.

show-up fee of Rs. 40, ranged from Rs. 20 to Rs. 290, with an average payoff of Rs. 131. To put this into context, the daily wage of an agricultural laborer is around Rs. 100 in the area of study and this is similar to the daily income of most clients, according to Gramyasheel.

3 Game-theoretic analysis

The standard microcredit game with a two-person joint-liability group and expected returns from risky individual investments is formally described by the game tree in Figure 4. Each player i chooses from her strategy set $s_i \in$ *{repay, default}*. After the repayment decisions, the investment returns are realized and the payoffs are calculated.[13]

[Figure 4 about here]

There are two variations of the repayment coordination game resulting from the experimental setup, namely a sequential and a simultaneous move game. In the standard game, two repayment decisions are elicited: *unconditional repayment decisions* that elicit repayment decisions without knowing the peer's action, and *conditional repayment decisions* that elicit repayment decisions conditional on the peer's action, e.g. for the case that the peer has repaid or defaulted. Each conditional repayment decision, which can be considered the second mover's decision, is matched with the peer's unconditional repayment decision, which can be considered the first mover's decision. The repayment decisions in the standard game are therefore best described as a sequential move game. In the treatment games, only one type of repayment decision is elicited, namely unconditional repayment decisions elicited without knowing the peer's action. The unconditional repayment decisions of both peers are matched, so the repayment coordination game in the treatment game is better described as a simultaneous move game.

The analysis assumes that an individual i behaves as an expected utility maximizer with standard preferences and an increasing utility function $u(x)$ such that $u'(x) \geq 0$. The most simple utility function is the linear utility function $u(x) = x$, representing risk-neutral preferences. However, this does not reflect findings that many individuals in developing countries are risk-averse (Binswanger (1980, 1981)), which influences investment decisions (e.g. Rosenzweig and Binswanger (1993)) and technology adoption (e.g. Liu (2013)). Therefore, a constant relative risk aversion (CRRA) utility function $u(x) = \frac{x^{1-\beta}}{1-\beta}$ with $u(x) = \ln x$ for $\beta = 1$ and β as the coefficient of relative risk aversion, is used as a functional form. Risk-neutral preferences are nested in this utility function with $\beta = 0$. Risk-averse preferences are described by $\beta > 0$. The following analysis considers the two cases separately. The expected utilities in the repayment coordination are set out in Figure 5.

[Figure 5 about here]

[13] Appendix Figure C.3 presents the different states of nature explicitly.

3.1 Standard game

The repayment coordination game in the standard game is best represented as a sequential move game. Here, the second mover has to react to the repayment decision of the first mover by finding her best response to every decision the first mover can make. The first mover can anticipate the second mover's best response to her own first mover decision and she can use her first mover advantage to choose her own utility maximizing strategy. Solving the sequential repayment coordination game with expected utility as in Figure (5) for its Nash equilibria establishes Proposition 1. All the proofs are delegated to the appendix.

Proposition 1 *In a sequential analysis of the standard repayment coordination game for players with a CRRA utility function* $u(x) = \frac{x^{1-\beta}}{1-\beta}$ *with* $u(x) = \ln x$ *for* $\beta = 1$ *and* β *as the coefficient of relative risk aversion, the Nash equilibrium* $(s_i; s_j)$ *of players* i *and* j *with the action space* {repay, default} *is characterized*
a) for risk-neutral actors with $\beta_1 = 0,\ \beta_2 = 0$ *as* (default; (default, repay))

b) for risk-averse actors with $\beta_1 > 0,\ \beta_2 > 0$ *as in a) if actors are not sufficiently risk-averse. However, if actors are sufficiently risk-averse, the best response structure switches to* (repay, repay) *for the second mover and* (repay) *for the first mover.*

Proposition 1 implies that there is a threshold in the level of risk aversion, above which predicted repayment behavior switches so that the players will always choose to repay. This holds for unconditional repayment decisions if the player knows her peer is sufficiently risk-averse or if she does not know her peer's exact risk aversion, and for conditional repayment decisions in the case that the peer repays. In terms of repayment behavior, in a comparative static setting this implies that a player is more likely to repay the higher her level of risk aversion.

3.2 Treatment games

In the treatment games, matching both peers' unconditional decisions leads to a simultaneous decision-making problem. So the repayment coordination game here is best represented in a simultaneous move game. Additionally, peer peeking and peer punishment technologies are available in each of the treatment games. As a point of reference, the repayment decision is first analyzed separately for a simultaneous repayment coordination game, and only then peer peeking and peer punishment decisions are integrated in the repayment analysis. Solving the simultaneous repayment coordination game with expected utility as in Figure (5) for its Nash equilibria establishes Proposition 2.

Proposition 2 *In a simultaneous analysis of the treatment repayment coordination game for players with a CRRA utility function* $u(x) = \frac{x^{1-\beta}}{1-\beta}$ *with* $u(x) = \ln x$ *for* $\beta = 1$ *and* β *as the coefficient of relative risk aversion, the Nash equilibria* $(s_i; s_j)$ *of players* i *and* j *with the action*

space {repay, default} *are characterized*
a) for risk-neutral actors with $\beta_1 = 0$, $\beta_2 = 0$ *as* (repay, default) *and* (default, repay) *in pure strategies and* ($\frac{6}{65}$ repay, $\frac{59}{65}$ default) *in mixed strategies for both players*
b) for risk-averse actors with $\beta_1 > 0$, $\beta_2 > 0$ *as in a) if actors are not sufficiently risk-averse. However, if actors are sufficiently risk-averse, the best response structure switches to* (repay) *for both players.*

The comparative-static interpretation of Proposition 2 is that with increasing levels of risk aversion a player is more likely to repay in the unconditional repayment decision elicited in the treatment games.

In the peer peeking treatment, the decision to peek on the peer's investment return is taken before the repayment decision. However, the peer's investment return is only observed after the repayment decision and there is no next round in this one-shot game. Due to the timing of decision making, the investment return actually observed cannot influence the peer's repayment decision if only monetary payoffs are considered and if any possible disutility from being peeked upon is neglected. Anticipating this, a borrower will not peek on her partner in the first place since it is costly. The availability of peer peeking will therefore not influence the Nash equilibria of the repayment decision. This is manifested in a lower expected utility from peeking than from not peeking and is summarized in Proposition 3.

Proposition 3 *For an expected utility maximizers with a concave utility function* $u(x)$ *with* $u'(x) \geq 0$ *and* $u''(x) \leq 0$, *it holds that* $EU(peeking) < EU(not\ peeking)$, *consequently, she will not peek on her peer. The repayment decision in the treatment game will remain unaltered. This holds for risk-neutral and risk-averse expected utility maximizers alike.*

In the peer punishment treatment, the repayment decision with punishment is represented by two stages, with the repayment decision in the first stage and the punishment decision in the second stage. Looking at this problem recursively, in the second stage punishment is costly and the penalty inflicted upon a defaulter is very small compared to the advantages of free riding on the peer's group loan repayment. Hence, the possibility of peer punishment will not change the best response structure of the repayment coordination and punishment will not be chosen in the second stage. Consequently, the availability of costly and non-pecuniary beneficial punishment possibilities does not influence the Nash equilibria of the repayment decision. This lower expected utility of punishing compared to not punishing is summarized in Proposition 4.

Proposition 4 *For an expected utility maximizers with a concave utility function* $u(x)$ *with* $u'(x) \geq 0$ *and* $u''(x) \leq 0$, *it holds that* $EU(punish) \leq EU(not\ punish)$ *independently of whether the peer punishes or not. Consequently, a player will not punish her peer and the repayment decision in the treatment game will remain unaltered. This holds for risk-neutral and risk-averse expected utility maximizers alike.*

This underlines that the costly punishment is pecuniarily non-beneficial. In the peeking-cum-punishment treatment, both enforcement technologies are available at the same time. Since the timing of the decisions in the experimental game does not change, the theoretical predictions from both treatments remain valid even when they are combined. Since peer peeking and punishment should not influence repayment, the latter can be described as in the simultaneous move repayment coordination game.

The game theory predictions for an expected utility maximizer suggest limited unconditional repayment and conditional repayment in the case that the peer repays and no peer peeking or punishment for risk-neutral players, and high repayment and no peer peeking or punishment for risk-averse players.

4 Microcredit investment game - experimental results

4.1 Repayment results

In the standard microcredit game, an average of 93 percent of the subjects repay when they do not know their peer's repayment decision (Table 2). The result for the unconditional repayment decision in the standard game does not differ significantly across the three different treatment groups (Table 2, column 5).

In the conditional repayment decisions, on average 81 percent of subjects repay their loan when their peer repays, and 74 percent repay when their peer defaults. The drop in repayment rates is driven by a lower repayment level of the peer peeking-cum-punishment treatment group. This leaves a marginally significant difference across the treatments in the conditional repayment decisions in situations where the peer repays (Table 2, column 5). When the peer defaults, conditional repayment drops in all three treatments.

[Table 2 about here]

The overall high repayment rates in the standard game contradict Proposition 1 a) for a risk-neutral decision maker. A substantially higher share of subjects repay in the unconditional repayment decision than is predicted by game theory for a risk-neutral expected utility maximizer, since under risk-neutral preferences it is optimal to exploit the first-mover advantage and default, forcing the second mover to repay. In the conditional repayment decisions, under risk-neutral preferences an asymmetric strategy is optimal, implying that it is best to repay if the peer defaults and to default if the peer repays. The results show, however, that a high share of subjects repay in both conditional repayment decisions with a lower repayment when the peer defaults. On the one hand, this high level of repayment when the peer repays cannot be explained with risk-neutral preferences of an expected utility maximizer. On the other hand, the lower level of repayment when the peer defaults even points to non-monetary motives for punishing defaulters with default. Possible explanations involving inequity aversion and conditional cooperation are discussed in section 5.

For a sufficiently risk-averse second mover, it is theoretically optimal to repay in both cases. For a sufficiently risk-averse first mover, it is theoretically optimal to repay if she either knows that the second mover is sufficiently risk-averse or if she does not know whether the second mover is sufficiently risk-averse or not. Under these restrictions, the repayments observed match the theoretical predictions for risk-averse preferences much better than for risk-neutral ones, so that Proposition 1 b) seems to hold for a substantial share of players.

Proposition 1 b) implies that more risk-averse borrowers are more likely to repay. Unfortunately, data on risk aversion is only available for a subset of 39 participants who participated in both the experimental game and a household survey by Czura and Hebous (2012). Risk aversion was elicited in a Binswanger (1981)-type experiment with a monetarily incentivized choice between six lotteries with different levels of risk. Higher risk in the lotteries is compensated by a higher return. Partial risk aversion can be deduced from the lottery choice by specifying parameter ranges from indifference between two neighboring lotteries. Absolute and relative risk aversion can be deducted from partial risk aversion using the transformations set out in Binswanger (1981).

[Table 3 about here]

Table 3 sets out the risk aversion measures for the subset of 39 participants. While around 50 percent display extreme, severe or intermediate risk aversion, 36 percent range from only slightly risk-averse to risk-neutral, and of these half are even considered to be risk-neutral to risk-preferred. The coefficient of partial risk aversion is calculated from the lottery choices, using indifference between two neighboring lotteries and the partial risk aversion function $u(x) = (1-\delta)M^{1-\delta}$ with M as the certainty equivalent of a risky prospect. Using the partial risk aversion coefficient, the coefficient of absolute risk aversion α is calculated as $\alpha = \frac{\delta}{M}$, with M as the geometric mean of a risky prospect. The coefficient of relative risk aversion β is defined as the coefficient of absolute risk aversion multiplied by the wealth level W, such that $\beta = \alpha * W$. Since the level of wealth was not elicited in this study, I calculate the level of relative risk aversion as a lower bound for the wealth level of Rs. 100, which is the equivalent of a wage laborer's daily wage. Using this value, an intermediate level of relative risk aversion corresponds to β between 1.21 and 2.52.

[Table 4 about here]

Table 4 sets out the correlations between repayment decisions and risk aversion for the subset of participants. The correlations are displayed for both conditional repayment decisions in the standard game and the unconditional repayment decisions in the treatment game. The unconditional repayment decision in the standard game is excluded from the analysis since all the 39 participants with risk aversion data available repay, so there is no variation in risk aversion that can be exploited to explain variation in repayment behavior.

The correlations indicate that there is indeed a positive but insignificant correlation between the binary variable classifying an individual as risk-averse and the conditional repayment decision when the peer repays, on the one hand, and the unconditional repayment decision in the treatment game, on the other hand (Table 4).

Splitting up the binary indicator for risk aversion into binary variables for each level of risk aversion reveals that the positive relation with the conditional repayment decision given that the peer repays is significantly positive for moderate and intermediate levels of risk aversion (Table 4, column 2). For the other levels, the correlation remains insignificant with a positive sign, except for the insignificant negative correlation for extreme levels of risk aversion. The pattern observed of the signs of the correlation coefficients is similar for the unconditional repayment decision in the treatment game, but the magnitude of the correlations is smaller than before (Table 4, columns 8).

Accounting for a non-linear relation between risk aversion and repayment shows that there is a substantial positive effect of risk aversion on the conditional repayment decision if the peer repays that is statistically significant (Table 4, columns 3).

If the lack of significance can be partly attributed to the small sample size, there is overall some support for an increase in the repayment probability with an increase in risk aversion which supports the comparative static implications of Proposition 1 b). However, the correlation between risk aversion and repayment in the standard game's conditional repayment decision when the peer defaults does not support Proposition 1 b). For the binary risk aversion and most of the binary risk aversion level measures there is a negative but insignificant correlation with the repayment decision, which is not consistent with the theoretically optimal behavior under risk aversion. While risk aversion seem to explain the repayment behavior to some extent, it is not sufficient to explain it completely.

Result 1 *The share of subjects repaying the loan based on the unconditional (93 percent) and the conditional repayment decisions (81 percent repay when the peer repays, 74 percent repay when the peer defaults) cannot be explained by risk-neutral preferences. Risk-averse preferences of an expected utility maximizer can only partially explain the repayment behavior.*

The negative correlation between risk aversion and repayment in the conditional repayment decision when the peer defaults remains unexplained in the game theoretical analysis. This finding is similar to conditional cooperators observed in Public Good Games, who cooperate if the partner cooperates and default if the partner defaults. Also, it is similar to internalized behavior patterns of *good borrowers* who always repay their loan. Section 5 discusses both points further.

4.2 Peer peeking and peer punishment results

In the treatment games, on average, 83 percent of subjects choose to repay their loan with a significant F-test between the treatments (Table 2, column 5). Before analyzing differences in repayment in detail, I will describe the use of peer peeking and peer punishment in the treatment game.

On average across the peer peeking and the peer peeking-cum-punishment treatments, 86 percent of subjects observe the investment return of their peers at a cost after loan repayments have been made with no difference between the level of peeking in the peer peeking treatment (86 percent) and that in the peer peeking-cum-punishment treatment (86 percent) (Table 2, column 5 and Wilcoxon rank sum test, $z = -0.035$, Prob $> |z| = 0.9724$). A similarly high share believe that their peer observes their investment return at a cost (82 percent), with no difference between these two treatments (Table 2, column 5 and Wilcoxon rank sum test, $z = 1.238$, Prob $> |z| = 0.2158$).

The observed level of peer punishment is on average 87 percent, with 85 percent of subjects punishing a defaulting peer in the peer punishment treatment and 88 percent in the peer peeking-cum-punishment one. There is no significant difference in this unconditional punishment decision across the treatment groups (Table 2, column 5 and Wilcoxon rank sum test, $z = -0.348$, Prob $> |z| = 0.7276$). On average, 80 percent believe that their peer will punish them in the case of default, with no difference in beliefs between these treatments (Table 2, column 5 and Wilcoxon rank sum test, $z = 0.156$, Prob $> |z| = 0.8763$).

In the peer peeking-cum-punishment treatment, subjects can distinguish between unwilling or strategic default, but both types of default are punished alike. 88 percent of participants punish a defaulting peer when they do not know the reason for default, either because they lack the possibility of observing the peer's investment return or due to a decision not to observe it. This share reduces marginally to 82 percent who punish unwilling default due to bad investment with no statistically significant difference from the unconditional punishment decision (Table 2, column 2 and Wilcoxon signed-rank test, $z = 0.832$, Prob $> |z| = 0.4054$). Strategic default is punished by 78 percent of participants and this is not statistically different from punishment of unwilling default. The high level of punishment observed implies that borrowers do not distinguish the reasons for default, but punish unlucky investors forced to rely on mutual insurance via joint liability to the same extent as strategic defaulters who take advantage of the joint liability and free-ride on the repayment of their peers. The result can be summarized as:

Result 2 *A substantial share of participants engage in costly peer peeking (86 percent) and peer punishment (87 percent). Participants do not distinguish between unwilling and strategic default and punish defaulters in both cases alike.*

These results strongly reject the game theoretical suggestions that subjects with risk-neutral or risk-averse standard preferences would not engage in costly peer peeking or peer punishment that is pecuniarily non-beneficial. While risk-averse preferences could partially explain repayment behavior, the results for peer peeking and peer punishment are robust to alterations in the curvature of the utility function.

Since the subjects punished unwilling and strategic defaulters alike, it seems that borrowing peers do not happily provide mutual insurance for an unlucky investor who unwillingly defaults. Instead, they punish her in the same way as a strategic defaulter. This result contradicts the assumption made in the theoretical models of Besley and Coate (1995) and Armendáriz de Aghion (1999), who state that borrowers within a group use their local information advantage to only punish strategic defaulters. Necessary extensions of the theoretical models may be to consider punishment of unwilling default and to determine an optimal level of punishment considering possible positive punishment effects on repayment.

[Table 5 about here]

Table 5 compares repayment in the treatment games across the treatments and in comparison to the standard game. Comparing repayment only across treatments while controlling for repayment in the standard game indicates a higher repayment in the punishment treatment than in the peeking-cum-punishment treatment (Table 5, column 1). There is no significant difference between repayment in the peeking and punishment treatment and in the peeking and peeking-cum-punishment treatment.

Using the unconditional repayment decision from the standard game, I apply a differences-in-differences estimation across the three treatments while simultaneously controlling for differences across treatments in the standard game. Since there are two repayment decisions per participant, the most conservative estimation includes participant fixed effects to control for unobserved heterogeneity across the participants. In this specification, there is no significant difference in repayment across treatments (Table 5, column 3). Although peer peeking and peer punishment are applied excessively, they do not have any effect on repayment.

5 Discussion of experimental design and results

5.1 Possible concerns about the experimental design

The clients' low literacy level and the limited infrastructure in the field were major challenges that influenced the design of the experiment and may have influenced the results. A first concern is that the participants may not have understood the game properly. Due to the lack of literacy of the subject pool, no formal questions to test understanding to be answered individually with pen and paper were asked. Instead, during the illustrations the instructor asked questions, and the explanations were repeated until the instructors felt comfortable with the participants' understanding. If lack of understanding is a credible concern for why participants did not behave according to game theoretic predictions of a risk neutral expected utility maximizer with standard preferences, we would expect that better-educated participants, who understood the game better, had chosen the second mover's expected utility maximization strategy more often, and would be more likely to repay when the peer defaults and less likely to repay when the peer repays.

Table 6 shows that the participants' levels of education or literacy do not have any significant correlation with the repayment decisions, with just one exception. Years of education shows a positive marginally significant effect on the client's conditional repayment decision when the partner defaults (Table 6 column 3). Given the high level of repayment, it seems that it would be more important for better educated participants to be less likely to repay when the peer repays if lack of understanding is a concern. Since this is not supported by the data, and since the microcredit game was designed to be very similar to the participants' real-life microcredit experience, I am confident that the participants understood the game properly.

[Table 6 about here]

A second concern regards the comparability of the unconditional repayment decision in the standard and the treatment games. Because the standard game was always played before the treatment game, learning effects from the standard game on the treatment game are possible. Since the present design lacks an extension game without treatment, learning effects cannot be identified. Nevertheless, there were no payoff realizations after any decision, so the scope for learning is in any case very much limited.

A third concern is the lack of privacy in decision making and the presence of the real-life borrowing group in the experimental session. Due to logistical challenges, clients were seated in rows in one big room with their real-life borrowing group members, instead of being seated in separate booths. The location chosen was already the most suitable one in the field. The illiterate clients needed the instructors' assistance to show where to circle the answers *yes* or *no*. This assistance could be provided more easily with the seating configuration chosen. The participants were seated in three rows with approximately one meter space between the rows. They were asked to turn their decision sheets over once they had made a decision. Clients followed this instruction eagerly and secured the turned pages with their hands. The instructors made sure that participants were not talking to each other or peeking at their neighbor's decision sheet. In addition to these precautions, participants were only matched after the decision making with somebody from their group using a stranger matching protocol. They did not know the exact identity of their peer and they could not observe her decisions directly which makes a signaling motive less likely.

Also, a possible signaling motive only yields a plausible explanation for the high repayment rate, but not necessarily for the high peeking and punishment level. Regarding the high repayment levels, the presence of the real-life borrowing group members could induce subjects to cooperate and repay as a signal to the other group members that they are good cooperating borrowers. However, with punishment the effect is less clear. On the one hand, subjects may have wanted the other group members to see that they are norm enforcers, willing to punish any default. On the other hand, subjects may not have wanted to openly punish other people whom they have social relationships with because this may induce mistrust or other negative emotions. If the presence of the group induces behavior that is beneficial to the group, it is a priori not clear whether this includes high or low levels of punishment.

A last concern is that the experiment uses the same institutional setting in the experiment as clients actually experience in their real-life borrowing. This similarity might have induced the clients to behave in the experiment as they were trained to behave by the microcredit institution. This concern can be marginally alleviated by two considerations. First, in the experiment it was ensured that the microcredit institution's staff were not present at the sessions. Second, in practice, loan repayments are not collected at the location of Gramyasheel but at the decentralized center meetings, so that the repayment location is different in the experiment and in reality. If the similar institutional setting was influencing participants' decisions in the experiment, two explanations of the behavior observed seem plausible, namely that the participants either behaved to impress their lender or that they just repeated trained behavior from their microlending experience. Both explanations will be discussed below.

5.2 Alternative explanations for the behavior observed

5.2.1 Conditional cooperation and inequity-averse preferences

The participants' repayment behavior reveals that they are less likely to cooperate and repay when their peer defaults, despite this being the expected utility-maximizing strategy. It resembles the behavior of conditional cooperators studied in public good problems in which non-cooperation is considered as a form of punishment for defaulters (compare Fischbacher *et al.* (2001)). Rustagi *et al.* (2010) study forest commons management in Ethiopia and find that forest user groups with a larger conditional cooperator share are more successful in solving the public good problem. They also identify that conditional cooperators use costly monitoring as a key instrument to enforce cooperation.

From the conditional repayment decisions in this experiment I can derive four repayment types similar to cooperation types: (1) the *always repay*-type, who cooperates unconditionally, (2) the *never repay*-type, who never cooperates, (3) the *reciprocal repay*-type, who conditionally cooperates and repays when the peer repays and defaults when the peer defaults, and (4) the *repay conversely*-type, who repays when the peer defaults, and defaults when the peer repays. A simple model of inequity aversion à la Fehr and Schmidt (1999), outlined in Appendix B, can explain the cooperative outcomes in the repayment coordination game. The model includes disutility from disadvantageous inequality in an envy parameter and from advantageous inequality in an altruism parameter.

[Figure 6 about here]

Figure 6 illustrates the share of the four repayment types among the participants. The share of conditional cooperators is around 18 percent, so it seems less likely that this group is driving the repayment results. The share of participants who always repay dominates at nearly 63 percent. Both repayment types can be explained by inequity-averse preferences with different levels of envy and altruism. However, to explain the most common always repay-type, the altruism parameter has to be nearly ten times higher than the envy parameter, which seems unreasonable. In fact, although some studies on inequality aversion in cooperation problems incorporate the possibility of higher altruism than envy parameters (Neugebauer *et al.* (2008)), Fehr and Schmidt (1999) explicitly exclude this case since they argue that individuals will always suffer more from disadvantageous than from advantageous inequality. Therefore, conditional cooperation and inequality-averse preferences cannot properly explain the repayment behavior in this experiment.

5.2.2 Preferences for punishment

The more puzzling behavior observed is, however, the high level of peer punishment in the experiment. Many motives for punishing have been studied, such as inequity aversion, emotions, reciprocity, confusion, spite, and social norms (Casari (2005)). Costly punishment is even observed if it is materially non-beneficial. Fehr and Gächter (2000, 2002) and Falk *et al.* (2005) argue that punishment of free riders can be explained by people's aversion to being taken advantage of when being cooperative. They identify negative emotions, such as anger, and fairness concerns, in particular retaliation, as the main motives for punishment. Studying altruistic punishment in artefactual field experiments in 15 diverse populations, Henrich *et al.* (2006) argue that costly punishment of norm deviators is part of human psychology.

In this experiment, only non-cooperators who default can be punished, so that any antisocial or spite-related punishment motives can be excluded. On average, 87 percent of participants punish a defaulting peer. In comparison, Fehr and Gächter (2002) find a high frequency of punishment and Falk *et al.* (2005) find that around 60 percent of cooperators punish defaulters. Since the punishment level observed in this experiment is substantially higher than in other studies, it may also be that punishment was stimulated by the low cost of sanctioning. However, Carpenter (2007) shows that punishment demand is only slightly responsive to changes in the cost of punishment. In sum, it seems plausible that the participants punished their defaulting peers due to negative emotions or fairness concerns. Unfortunately, without data on punishment preferences and abstract punishment behavior in public good problems, for example, this point cannot be backed by data.

5.2.3 Behavioral influences of the microlender

The concern that the same institutional setting in the experiment and real-life borrowing may have induced the clients to behave in the experiment as they were trained to behave by the microcredit institution was raised above. The aim of this study is to observe participants' decisions in their real-life environment experimentally. Given that the microlender transmits its picture of a good borrower in the pre-admission group training and in the weekly pledge borrowers have to make at the center meeting, the lender's presence in the experiment may have induced participants to behave in the experiment as they think the lender expects them to, namely to repay and to support and discipline their borrowing peers.

[Figure 7 about here]

In the experimental setting, the *impress-the-lender* explanation cannot be disentangled from the other explanation that clients just displayed the natural behavior they had acquired as a result of the lender's *mission indoctrination* in the group training and the weekly pledges. However, information available from an accompanying client survey with 200 Gramyasheel borrowers (Czura and Hebous (2012)) shows some evidence of mutual insurance and actual peeking behavior. Around 24 percent of the clients are engaged in mutual insurance by either having paid an installment for a peer or having a peer pay an installment for them. Clients stated that they made some effort to observe their peers' business and private situations. Over 58 percent stated that they go to the business or home of a fellow client in order to check the situation, which is similar to peer peeking in the present experiment (see Figure 7). The majority of participants reported that they know about their peers' problems (62 percent) and vice versa (69 percent).

This gives some confidence that the behavior observed in the microcredit game replicates the subjects' real behavior in their everyday microcredit-related activities and does not just imitate the behavior expected by the microlender. Hence, a possible explanation for the experimental results is that the clients have internalized the mission indoctrination of the microlender about being good borrowers who repay their loans and discipline their peers.

6 Conclusion

In this study I provide a first measure of the costs of group lending in the form of excessive peer peeking and punishment that much of the criticism of group lending is based on. In a lab-in-the-field experiment, I analyze strategic default as well as the use of peer peeking and peer punishment and their effect on repayment. I find high repayment of over 90 percent and excessive peer peeking and punishment of around 85 percent, and it seems that borrowers replicated their real-life behavior in the experiment.

The results confirm that excessive peer pressure in microlending is a serious concern. These findings are not consistent with theoretical models on group lending stating that the credible threat of social sanctions is sufficient and no punishment should be observed in equilibrium. An extension of existing theoretical models by a welfare analysis weighing the benefits and costs of punishment is needed to determine an efficient level of punishment. This becomes even more important since joint liability does not seem to be the sole source of peer pressure. For example, Giné and Karlan (2014) argue that relaxing joint liability while still maintaining the group lending structure may still induce sufficient peer pressure such as reputation and shame to achieve high repayment. This again raises the question of what constitutes an efficient level of punishment and if there is excessive punishment even without joint liability.

Observed punishment in this experiment is always high and does not differ for strategic or unwilling default. Although high non-credible punishment is broadly in line with the experimental literature on punishment and may be assigned to general preferences for punishment, it is striking that the intentions for default are not taken into consideration. Future research could look at exact motives for punishment in microlending and control whether they align with motives for punishment in cooperation.

While there exist explanations for individually observed repayment and punishment, the high information acquisition is less obvious. This is especially so since peer peeking does not yield information about the repayment intentions of a peer with a low investment return. Future research could look at motives for information acquisition, such as valuation of imperfect information or curiosity.

Since the experiment elicits real-life behavior, participants may have internalized the identity of good microcredit borrowers as shaped by the microlender. The lender uses group trainings and repeated affirmations to inculcate the message of what constitutes a good borrower, as for example by a pledge that clients take at every weekly meeting. This is the most plausible explanation for simultaneously observed high repayment, and excessive information acquisition and punishment. It could explain 1) high repayment even in the absence of enforcement techniques, 2) high information acquisition even though acquired information is imperfect and non-beneficial, and 3) high punishment even when punishment is non-credible and when the peer defaulted unwillingly but with good repayment intentions. Future research could compare microcredit clients to non-clients to analyze whether cooperation, peeking and punishment behavior of microcredit borrowers is driven by identity internalization, but this is possibly prone to self-selection into microlending. Experimental research could use identity enforcing treatments to analyze the effects of the indoctrinated microcredit borrower identity on repayment, peeking and punishment. It could also differentiate whether punishment is part of the shaped identity or whether it is used for violations of the prescribed identity.

Although this research raised many detailed questions for motives and drivers of behavior in microlending, the results give rigid support to anecdotal evidence on excessive punishment in group lending. In particular, they manifest the concern of excessive peer pressure that fuels the debate on whether microcredit institutions should move away from joint-liability group lending.

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7 Figures and Tables

FIGURE 1: Timing of the standard microcredit game

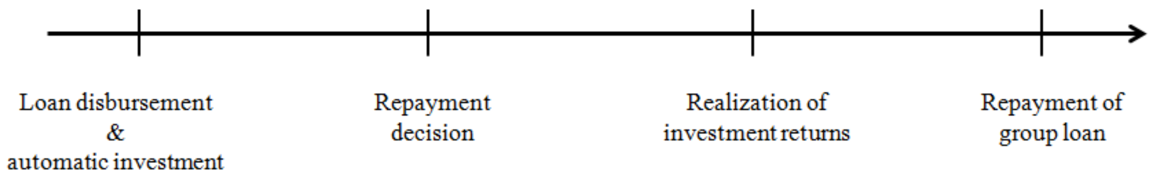


FIGURE 2: Expected payoffs in the standard repayment coordination game

		Player 2	
		Repay	Default
Player 1	Repay	$\left(93\frac{1}{18}, 93\frac{1}{18}\right)$	$\left(8\frac{1}{3}, 175\right)$
	Default	$\left(175, 8\frac{1}{3}\right)$	$(0, 0)$

FIGURE 3: Timing of the treatment microcredit game

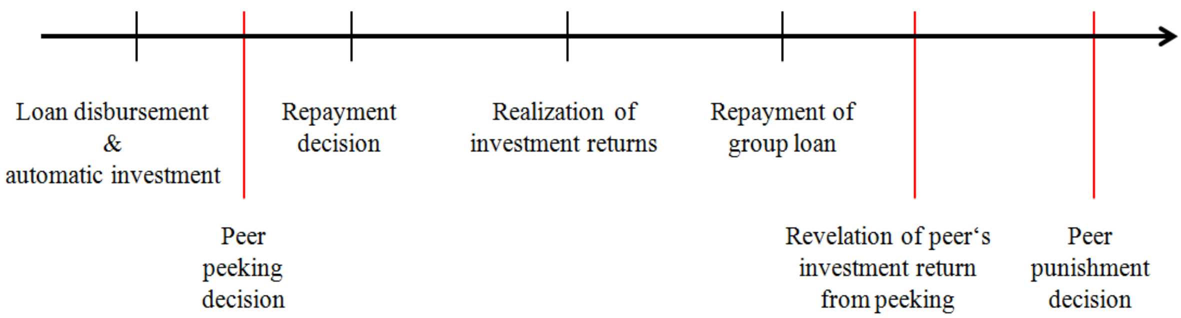


Figure 4: Reduced form representation of the standard repayment coordination game with expected payoffs

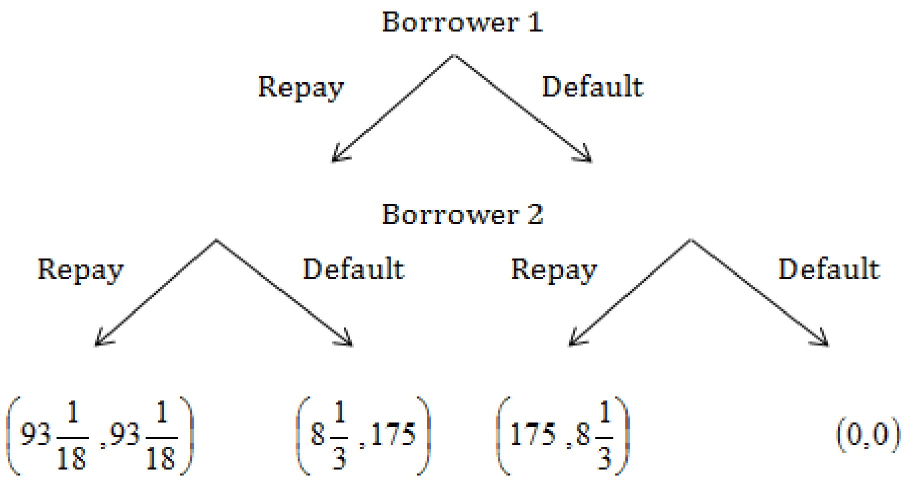


Figure 5: Expected utilities in the standard repayment coordination game

		Player 2: Repay	Player 2: Default
Player 1	Repay	$\left(\frac{10}{36}u(10)+\frac{25}{36}u(130)\,;\ \frac{10}{36}u(10)+\frac{25}{36}u(130)\right)$	$\left(\frac{6}{36}u(0)+\frac{30}{36}u(10);\ \frac{5}{36}u(10)+\frac{25}{36}u(250)\right)$
	Default	$\left(\frac{5}{36}u(10)+\frac{25}{36}u(250)\,;\ \frac{6}{36}u(0)+\frac{30}{36}u(10)\right)$	$\left(u(0);\ u(0)\right)$

FIGURE 6: Repayment types based on conditional repayment decisions in the standard game

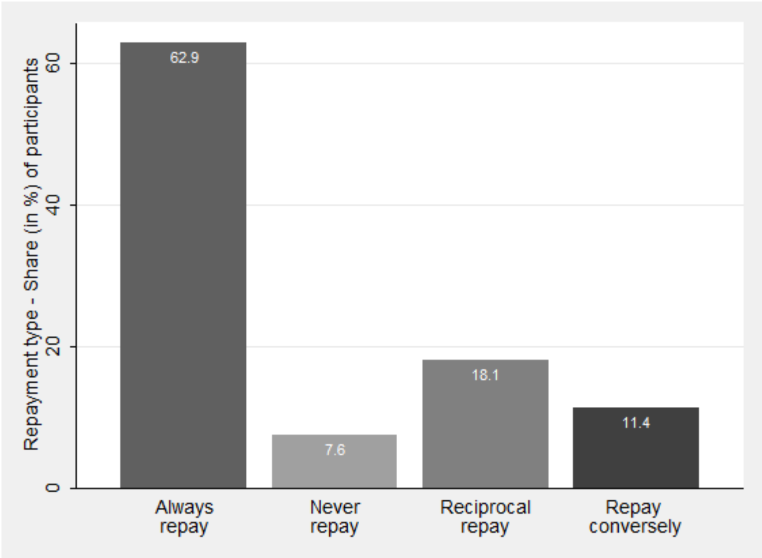


FIGURE 7: Real-life information on mutual insurance and peer peeking

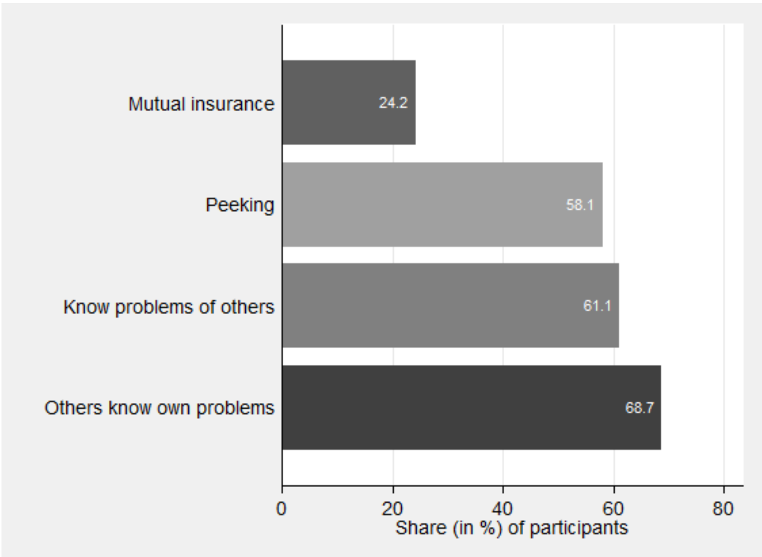


Table 1: Socio-economic characteristics of participants

	All treatment groups (1)	Peer peeking-cum-punishment (2)	Peer peeking (3)	Peer punishment (4)	F-stat p-value (5)
Age (years)	33.07	33.46	32.18	33.26	0.332
	(7.99)	(7.61)	(9.14)	(7.65)	
Household size	6.36	5.84	5.96	7.70	0.009
	(2.25)	(2.02)	(2.05)	(2.37)	
Education (years)	2.51	3.20	2.29	1.48	0.372
	(4.01)	(4.28)	(3.80)	(3.57)	
Literate	0.27	0.36	0.25	0.11	0.050
	(0.44)	(0.48)	(0.44)	(0.32)	
Annual household income	35.716	40.684	34.464	27.815	0.280
(in Rs.)(self-reported)	(26.551)	(29.748)	(18.099)	(26.420)	
Membership (in months)	15.70	18.61	14.24	11.82	0.047
	(6.04)	(5.39)	(4.58)	(5.93)	
Number of observations	105	50	28	27	
Clients' occupation (in %)					
Animal husbandry	0.95	0.00	3.57	0.00	
Petty trade/business	64.76	68.00	67.86	55.56	
Salaried employment-government	1.90	4.00	0.00	0.00	
Salaried employment-private	0.95	2.00	0.00	0.00	
Wage labor-casual	4.76	0.00	7.14	11.11	
Housework	26.67	26.00	21.43	33.33	

Notes: Table includes means of subject characteristics in total (column 1) and by treatment groups (column 2 - 4) . Standard deviations are in parentheses. Standard errors in parentheses and clustered at the joint-liability group (JLG) level for the F-test regressions of characteristics on treatment dummies. F-test compares (3) and (4) to (2).

Table 2: Decisions on repayment, peer peeking, and peer punishment in standard and treatment games

	All groups (1)	Peer peeking-cum-punishment (2)	Peer peeking (3)	Peer punishment (4)	F-stat p-value (5)
Standard Game (without treatment)					
Repayment - unconditional	0.93	0.90	0.96	0.96	0.473
	(0.25)	(0.30)	(0.19)	(0.19)	
Repayment - peer repays	0.81	0.70	0.89	0.93	0.084
	(0.39)	(0.46)	(0.31)	(0.27)	
Repayment - peer defaults	0.74	0.70	0.79	0.78	0.633
	(0.44)	(0.46)	(0.42)	(0.42)	
Belief that peer repays	0.90	0.90	0.86	0.96	0.284
	(0.29)	(0.30)	(0.36)	(0.19)	
Treatment Games (with treatment)					
Repayment - unconditional	0.83	0.76	0.82	0.96	0.007
	(0.38)	(0.43)	(0.39)	(0.19)	
Belief that peer repays	0.89	0.84	0.93	0.93	0.378
	(0.32)	(0.37)	(0.26)	(0.27)	
Peer peeking	0.86	0.86	0.86		0.979
	(0.35)	(0.35)	(0.36)		
Belief that peer peeks	0.82	0.78	0.89		0.203
	(0.39)	(0.42)	(0.31)		
Peer punishment	0.87	0.88		0.85	0.725
- unconditional	(0.34)	(0.33)		(0.36)	
Belief that peer punishes	0.81	0.80		0.81	0.897
	(0.40)	(0.40)		(0.40)	
Peer punishment	0.82	0.82			
- unwilling default by peer	(0.39)	(0.39)			
Peer punishment	0.78	0.78			
- strategic default by peer	(0.42)	(0.42)			
Belief that peer punishes	0.88	0.88			
- unwilling default	(0.33)	(0.33)			
Belief that peer punishes	0.76	0.76			
- strategic default	(0.43)	(0.43)			
Sign rank tests of peer punishment decisions in peeking-cum-punishment treatment: p-value of z-score					
Unconditional punishment vs. punishment for					
unwilling default by peer		0.405			
strategic default by peer		0.096			
Punishment for unwilling vs. strategic default		0.564			
Number of Observations	105	50	28	27	

Notes: All variables are binary variables equal to 1 if the participant decides to take the respective action, 0 otherwise. Table includes means and standard deviations. Standard deviations are in parentheses below the means. F-test compares (3) and (4) to (2).

TABLE 3: Experimental risk aversion measures

Lottery	Bad luck	Good luck	Share (in %)	Partial risk aversion		Relative risk aversion		Risk aversion categories
			(of 39 Participants)	lower bound	upper bound	lower bound	upper bound	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A	50	50	10.26	7.51		11.48		extreme
B	45	95	15.38	1.74	7.51	2.52	11.48	severe
C	40	120	25.64	0.81	1.74	1.21	2.52	intermediate
D	30	150	12.82	0.32	0.81	0.72	1.21	moderate
E	10	190	17.95	0.00	0.32	0.00	0.72	slight-to-neutral
F	0	200	17.95		0.00		0.00	neutral-to-preferred

Notes: Brackets of partial risk aversion are assigned to the six different lotteries by looking at indifference between two neighboring lotteries, e.g. by equating the expected utility with the partial relative risk aversion utility function $u(x) = (1-\delta)M^{1-\delta}$ for each two neighboring lotteries with the certainty equivalent M of the lottery and solving numerically for the coefficient of partial risk aversion δ. Following Binswanger (1981) in the calculation of risk aversion coefficients, partial risk aversion is used to determine absolute risk aversion by dividing the coefficient of partial risk aversion by the value of the gamble. Here the geometric mean of each lottery was used, except for lottery F where the arithmetic mean was used since this lottery involves a 0 payoff. For the sake of space, the absolute risk aversion coefficient is not displayed in this table. The coefficient of relative risk aversion is the level of wealth times the coefficient of absolute risk aversion. For level of wealth, the minium wage of Rs. 100 per day is used as a lower bound of the wealth level since the actual wealth level is not measured properly for the survey participants. Risk aversion data was collected for a subset of participants in a household survey by Czura and Hebous (2012).

TABLE 4: Repayment decisions and decision makers' level of risk aversion

	Repayment standard game - peer repays			Repayment standard game - peer defaults			Repayment treatment game - unconditional		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A) Risk aversion - dummy variable									
Risk averse	0.241			-0.027			0.018		
	(0.144)			(0.144)			(0.139)		
B) Risk aversion (RA) - dummy variable for each level of risk aversion									
Slight-to-neutral RA		0.143			0.143			0.000	
		(0.232)			(0.191)			(0.194)	
Moderate RA		0.429***			-0.314			0.143	
		(0.135)			(0.224)			(0.127)	
Intermediate RA		0.429***			-0.014			0.043	
		(0.135)			(0.191)			(0.164)	
Severe RA		0.262			0.119			0.143	
		(0.196)			(0.195)			(0.127)	
Extreme RA		-0.321			-0.214			-0.357	
		(0.274)			(0.302)			(0.304)	
C) Risk aversion - discrete variable									
Risk averse			0.441***			-0.013			0.167
			(0.100)			(0.139)			(0.115)
Risk averse squared			-0.094***			-0.002			-0.041
			(0.022)			(0.030)			(0.025)
Constant	0.571***	0.571***	0.497***	0.714***	0.714***	0.734***	0.857***	0.857***	0.809***
	(0.127)	(0.135)	(0.128)	(0.116)	(0.123)	(0.123)	(0.120)	(0.127)	(0.119)
Mean risk aversion	0.821	2.333	2.333	0.821	2.333	2.333	0.821	2.333	2.333
R-squared	0.048	0.317	0.283	0.000	0.107	0.005	0.000	0.171	0.096
Observations	39	39	39	39	39	39	39	39	39

Notes: Dependent variable: Repayment decision in the standard game - binary variable equal to 1 if participant repays, 0 if participant defaults. (1)-(3) Conditional repayment decision given that the peer repays. (4)-(6) Conditional repayment decision given that the peer defaults. (7)-(9) Unconditional repayment decision - treatment game. Risk aversion dummy: 1 if individual is risk-averse, 0 otherwise. Risk aversion is measured by a lottery choice game following Binswanger (1981). Mean of risk aversion for the different levels of risk aversion on a scale from 0 (= risk-neutral participant choosing lottery F) to 5 (=extreme risk-averse participant choosing lottery A). Data on risk aversion only for a subset of participants in the experimental games who also participated in a household survey by Czura and Hebous (2012). Standard errors in parentheses and clustered at the joint-liability-group (JLG) level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 5: Differences in repayment in standard and treatment games across treatment groups

	Repayment decision (0-1) - only treatment game (1)	Repayment decision (0-1) - standard and treatment game (2)	Repayment decision (0-1) - standard and treatment game (3)
Treatment game: Peeking	0.036	-0.003	-0.003
(with treatment)	(0.109)	(0.093)	(0.132)
Treatment game: Punishment	0.178**	0.140*	0.140
(with treatment)	(0.069)	(0.084)	(0.118)
Treatment game: Peeking-cum-punishment		-0.140**	-0.140
(with treatment)		(0.064)	(0.091)
Standard game: Peeking		0.064	
(without treatment)		(0.056)	
Standard game: Punishment		0.063	
(without treatment)		(0.057)	
Standard game: Repayment (base level)	0.402**		
(without treatment)	(0.162)		
Constant (Reference: Peer peeking-cum-punishment)	0.398**	0.900***	1.071***
(for (1) treatment game, for (2) and (3) standard game)	(0.157)	(0.043)	(0.048)
R-squared	0.118	0.064	0.649
Observations	105	210	210
P-value F-test comparing coefficients:			
Standard game: Peeking-Punishment	0.184	0.980	
Treatment game: Peeking-Punishment		0.099	0.242
Treatment game: Peeking-cum-Punishment-Punishment		0.047	0.158
Treatment game: Peeking-cum-Punishment-Peeking		0.347	0.506
Participant fixed effects	no	no	yes
Standard errors clustered at level of	group (JLG)	individual	individual

Notes: Dependent variable: Repayment - binary variable equal to 1 if participant repays, 0 if participant defaults. Peer peeking-cum-punishment is the reference category, it is indicated in table whether the references decision is in the standard or in the treatment game. Standard errors in parentheses and clustered at the joint-liability-group (JLG) level for the cross-sectional analysis across treatments (1) and at the individual level for the differences-in-differences analysis in (2) and (3). P-value of F-test reported for coefficients of peer punishment and peer peeking-cum-punishment. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Determinants of repayment in standard and treatment games

		Standard game	
	Repayment - unconditional	Repayment - peer repays	Repayment - peer defaults
	(1)	(2)	(3)
Age	-0.002	0.004	0.001
	(0.004)	(0.005)	(0.006)
Relation to household head	0.013	0.046	0.021
	(0.015)	(0.036)	(0.036)
Household size	0.018	-0.011	0.015
	(0.011)	(0.022)	(0.019)
Education (years)	0.003	0.008	0.036*
	(0.009)	(0.023)	(0.020)
Literate	0.009	-0.113	-0.279
	(0.051)	(0.146)	(0.205)
Membership (in months)	-0.004	-0.001	-0.005
	(0.004)	(0.008)	(0.009)
Constant	0.912***	0.673***	0.636**
	(0.130)	(0.228)	(0.240)
R-squared	0.057	0.027	0.045
Observations	104	104	104

Notes: Dependent variable: Repayment - binary variable equal to 1 if participant repays, 0 if participant defaults. (1) Unconditional repayment without knowledge of partner's repayment decision in the standard game. (2) Conditional repayment given that the partner repays in the standard game. (3) Conditional repayment given that the partner defaults in the standard game. (4) Unconditional repayment decision in the treatment game. Standard errors in parentheses and clustered at the joint-liability-group (JLG) level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix A Proofs

A.1 Proposition 1 - Repayment in standard game

The sequential move repayment game for expected utility maximizers is solved by backward induction, starting with analyzing the second mover's decision followed by the first mover's decision. The first mover anticipates the actions of the second mover and incorporates this into her decision making. The utility function $u(x)$ is increasing ($u'(x) \geq 0$) with diminishing increments ($u''(x) \leq 0$). In particular, the constant relative risk aversion (CRRA) utility function $u(x) = \frac{x^{1-\beta}}{1-\beta}$, with $u(x) = \ln x$ for $\beta = 1$ is used as a functional form of the utility function, with β as the coefficient of relative risk aversion. Actors with risk-neutral preferences for $\beta = 0$ and risk-averse preferences for $\beta > 0$ will be considered separately.

A.1.1 Second mover

If the first mover repays, the second mover compares her expected utility when she repays and when she defaults. When the first mover repays, the second mover's expected utility of repaying is $\frac{1}{36}u(0)+\frac{10}{36}u(10)+\frac{25}{36}u(130)$ and the expected utility of defaulting is $\frac{6}{36}u(0)+\frac{5}{36}u(10)+\frac{25}{36}u(250)$. Comparing both expected utilities for the CRRA utility function $u(x) = \frac{x^{1-\beta}}{1-\beta}$ yields that the second mover will repay if *EU(repay| 1.mover repays)* $\geq$*EU(default| 1.mover repays)*, that is if

$$\frac{u(250) - u(130)}{u(10) - u(0)} = \frac{\frac{250^{1-\beta}}{1-\beta} - \frac{130^{1-\beta}}{1-\beta}}{\frac{10^{1-\beta}}{1-\beta} - \frac{0^{1-\beta}}{1-\beta}} \leq \frac{1}{5}. \tag{1}$$

If the first mover defaults, the second mover compares her expected utility when she repays and when she defaults. When the first mover defaults, the second mover's expected utility of repaying is $\frac{6}{36}u(0) + \frac{30}{36}u(10)$ and the expected utility of defaulting is $u(0)$. Comparing both expected utilities yields that the second mover will repay if *EU(repay| 1.mover defaults)* $\geq$*EU(default| 1.mover defaults)*, that is if

$$u(10) - u(0) = \frac{10^{1-\beta}}{1-\beta} - \frac{0^{1-\beta}}{1-\beta} \geq 0. \tag{2}$$

Risk neutrality ($\beta_2 = 0$): With risk-neutral preferences with $\beta = 0$, the utility function simplifies to the linear utility function $u(x) = x$. When the first mover repays, the second mover will repay if the condition in equation (1) is met. However, $\frac{250-130}{10-0} = 12 > \frac{1}{5}$, so that a risk-neutral second mover will not repay. This can already be seen by comparing the expected payoffs *EU(repay| 1.mover repays)* $= 93\frac{1}{18}$ and *EU(default/ 1.mover repays)* $= 175$ directly. Hence, the second mover defaults when the first mover repays. When the first mover defaults, the second mover will repay if the condition in equation (2) is met. Since $10 > 0$, the second mover repays. For $\beta = 0$, the best response of the second mover is presented by *(default, repay)*.

Risk aversion ($\beta_2 > 0$): Risk-averse preferences are incorporated in the CRRA utility function with $\beta > 0$. Since $u(0)$ is not properly defined for $\beta > 1$ the analysis distinguishes between the cases $\beta < 1$, $\beta > 1$, and $\beta = 1$.

First, a risk-averse second mover's best response is determined in the case that the first mover repays. For $\beta < 1$, equation (1) can be rearranged and solved numerically for the coefficient of relative risk aversion β yielding $\beta \geq 0.818933$. For $\beta \geq 0.82 \wedge \beta < 1$, it is optimal for a risk-averse second mover to repay. For $\beta > 1$, $u(x)$ is not defined for $x = 0$, so I consider the repayment condition in equation (1) from its limit. With $\lim\limits_{x \longrightarrow 0} \frac{x^{1-\beta}}{1-\beta} = -\infty$ and an otherwise continuous function, rearranging yields $5(\frac{250^{1-\beta}}{1-\beta} - \frac{130^{1-\beta}}{1-\beta}) - \frac{10^{1-\beta}}{1-\beta} \leq \infty$. With a concave utility function that is bounded from above at zero for $\beta > 1$, this holds true for all $\beta > 1$ so it is always optimal to repay. For $\beta = 1$, the utility function is defined as $u(x) = \ln x$. Again $u(x)$ is not defined for $x = 0$, so that the limit of equation (1) has to be considered. With $\lim\limits_{x \longrightarrow 0} \ln x = -\infty$ and an otherwise continuous function, taking the limit and rearranging equation (1) yields $0.967047 \leq \infty$ which holds for $\beta = 1$ so the repayment condition is met. Combined with the previous results, it is optimal for a risk-averse second mover to repay when the first mover repaid if $\beta \geq 0.82$.

Second, a risk-averse second mover's best response is determined in the case that the first mover defaults. For $\beta < 1$, equation (2) becomes $\frac{10^{1-\beta}}{1-\beta} \geq \frac{0^{1-\beta}}{1-\beta} = 0$, which holds true for $\forall \beta \in [0; 1[$. For $\beta > 1$, the limit of the condition is considered, which resolves to $\frac{10^{1-\beta}}{1-\beta} \geq -\infty$, with $\lim\limits_{x \longrightarrow 0} \frac{x^{1-\beta}}{1-\beta} = -\infty$ and this holds true for all $\forall \beta \in \;]1; \infty]$. For $\beta = 1$, the limit of the condition is considered since $u(x)$ is not defined for $x = 0$. The condition in equation (2) is met since $\ln 10 \geq -\infty$, with $\lim\limits_{x \longrightarrow 0} \ln x = -\infty$. So for $\forall \beta \in [0; \infty]$, the second mover will repay if the first mover defaults.

The best response of the second mover is presented by *(default, repay)* if her coefficient of relative risk aversion $\beta_2 < 0.82$, and *(repay, repay)* if $\beta_2 \geq 0.82$, with the subscript referring to the second mover.

A.1.2 First mover

The first mover anticipates the best response of the second mover, namely that the second mover repays when she defaults, and defaults when she repays if the second mover is not sufficiently risk-averse, and that the second mover, if she is sufficiently risk-averse, repays independently of her first action. The first mover may or may not know the second mover's exact relative risk aversion coefficient and the implied best response. Both cases are considered in the following.

Complete information - second mover's risk aversion known: If the first mover knows the second mover's level of risk aversion, she can anticipate that for $\beta_2 < 0.82$ the second mover defaults when she repays and repays when she defaults, and that for $\beta_2 \geq 0.82$ the second mover will repay in any case.

Second mover insufficiently risk-averse ($\beta_2 < 0.82$): For $\beta_2 < 0.82$, the first mover compares the expected utility of repaying, if the second mover defaults in this case, of $\frac{6}{36}u(0) + \frac{30}{36}u(10)$ and the expected utility of defaulting, if the second mover repays in this case, of $\frac{6}{36}u(0) + \frac{5}{36}u(10) + \frac{25}{36}u(250)$, so that the first mover will repay if *EU(repay| 2.mover defaults)* $\geq$ *EU(default| 2.mover repays)*, which is satisfied for

$$\frac{25}{36}(u(10) - u(250)) \geq 0. \tag{3}$$

Equation (3) will not be satisfied with inequality for any increasing utility function with $u'(x) \geq 0$, since $u(10)$ will never exceed $u(250)$ for an increasing utility function. For risk-neutral preferences with $\beta_1 = 0$, the utility function simplifies to the linear utility function $u(x) = x$. The repayment condition in equation (3) is not met since $\frac{25}{36} \cdot (10 - 250) < 0$. This can already be seen by comparing the expected payoffs *EU(repay| 2.mover defaults)*$= 8\frac{1}{3}$ and *EU(default| 2.mover repays)*$= 175$ directly. The best response of the first mover is to choose *(default)*. For risk-averse preferences with $\beta_1 > 0$, the repayment condition in equation (3) is not met since $\frac{25}{36} \cdot (\frac{10^{1-\beta}}{1-\beta} - \frac{250^{1-\beta}}{1-\beta}) \leq 0$ for all $\beta \in [0, \infty]$, with equality only for $\beta = 1$. The best response of the first mover is to choose *(default)*.

Second mover sufficiently risk-averse ($\beta_2 \geq 0.82$): For $\beta_2 \geq 0.82$ the second mover will repay for any first mover's action. The first mover now compares her expected utility when she repays and the second mover repays of $\frac{1}{36}u(0) + \frac{10}{36}u(10) + \frac{25}{36}u(130)$ to the expected utility when she defaults and the second mover repays $\frac{6}{36}u(0) + \frac{5}{36}u(10) + \frac{25}{36}u(250)$. She will repay if *EU(repay| 2.mover repays)* $\geq$ *EU(default| 2.mover repays)*, which is satisfied for

$$\frac{u(250) - u(130)}{u(10) - u(0)} \leq \frac{1}{5}, \tag{4}$$

which, due to the symmetry of the decision problem, is the same as the repayment condition for the second mover if the first mover repays in equation (1) and is met for risk-averse actors with $\beta \geq 0.82$ as above. The best response of the first mover is to choose *(default)* if $\beta_1 < 0.82$ and *(repay)* if $\beta_1 \geq 0.82$ if she knows that the second mover is sufficiently risk-averse.

Incomplete information - second mover's risk aversion not known: Now the first mover does not know whether the second mover is sufficiently risk-averse or not. I assume that the first mover places an equal probability on both cases, such that $p(\beta_2 < 0.82) = 0.5$ and $p(\beta_2 \geq 0.82) = 0.5$. Taking both possible reactions of the second mover into consideration with equal probability, the first mover's expected utility from repaying is $0.5\left[\frac{7}{36}u(0) + \frac{40}{36}u(10) + \frac{25}{36}u(130)\right]$. When she defaults, the second mover will always repay independently of her level of risk aversion so that the first mover's expected utility is $\frac{6}{36}u(0) + \frac{5}{36}u(10) + \frac{25}{36}u(250)$. The first mover will repay, if *EU(repay)* $\geq$*EU(default)*, that is if

$$\frac{2u(250) - u(130)}{6u(10) - u(0)} \leq \frac{1}{5}. \tag{5}$$

The same argument as above applies, and given $u'(x) \geq 0$ and $u''(x) \leq 0$ the repayment condition in equation (5) will be met if the first mover's utility function is concave enough.

For risk-neutral preferences with $\beta = 0$, the utility function simplifies to the linear utility function $u(x) = x$. The repayment condition in equation (5) is not met since $6\frac{1}{6} \geq \frac{1}{5}$. Hence, the first mover defaults given the best response of the second mover. The best response of the first mover is to choose *(default)*.

For risk-averse preferences with $\beta_1 > 0$, $u(0)$ is not properly defined for $\beta > 1$ so the analysis distinguishes between the cases $\beta < 1$, $\beta > 1$, and $\beta = 1$. For $\beta < 1$ the condition in equation (5) holds true for $\beta \geq 0.952683$ so that for $\beta \geq 0.95 \wedge \ \beta < 1$ it is optimal for the first mover to repay. For $\beta > 1$ we again consider the limit of equation (5) since $u(x)$ is not defined for $x = 0$. For the otherwise continuous function, rearranging (5) yields $10\frac{250^{1-\beta}}{1-\beta} - 5\frac{130^{1-\beta}}{1-\beta} - 6\frac{10^{1-\beta}}{1-\beta} \leq \infty$, with $\lim\limits_{x \longrightarrow 0} \frac{x^{1-\beta}}{1-\beta} = -\infty$, which holds true for all $\forall \beta \in]1; \infty]$ since $u(x)$ is increasing at diminishing rates with $u'(x) \geq 0$ and $u''(x) \leq 0$, so that $u(x)$ will be bounded from above in β for $\beta > 1$ (with 0 being the upper bound for $u(C, \beta)$, with C a constant level of consumption and β the varying coefficient of relative risk aversion) and hence the left-hand side cannot exceed ∞. For $\beta = 1$, the limit of the condition is considered since $u(x)$ is not defined for $x = 0$ so that rearranging (5) yields $17.0614 \leq \infty$, with $\lim\limits_{x \longrightarrow 0} \ln x = -\infty$, which is always satisfied.

The best response for the first mover taking into consideration the second mover's best response function is to choose *(default)* if $\beta_1 < 0.95$ and *(repay)* if $\beta_1 \geq 0.95$, with the subscript referring to the first mover.

Nash equilibria: The preceding analysis has shown that for two risk-neutral players ($\beta_1 = 0, \beta_2 = 0$), the Nash equilibrium in the sequential move game is the combination of both best response functions, namely *(default; (default, repay))*. This proves part a) of Proposition 1. However, if the second mover is sufficiently risk-averse ($\beta_2 \geq 0.82$) or if the first mover does not know whether the second mover is sufficiently risk-averse, it becomes a best response function for the first mover to repay if she is sufficiently risk-averse, e.g. $\beta_1 \geq 0.82$ or $\beta_1 \geq 0.95$ respectively. For each player there exists a level of risk aversion at which the best response changes and *(repay, repay)* becomes a best response for the second mover and *(repay)* becomes a best response for the first mover. This proves part b) of Proposition 1.

A.2 Proposition 2 - Repayment in treatment games

In the treatment games, a simultaneous move game best represents the setup of the repayment coordination. If player 1 *repays* with probability p, the expected utility for player 2 is

$\left[\frac{1}{36}u(0) + \frac{10}{36}u(10) + \frac{25}{36}u(130)\right]\cdot p + \left[\frac{6}{36}u(0) + \frac{30}{36}u(10)\right]\cdot(1-p)$ if she *repays* and $\left[\frac{6}{36}u(0) + \frac{5}{36}u(10) + \frac{25}{36}u(250)\right] \cdot p + u(0)\cdot(1-p)$ if she *defaults*. Hence, player 2's best response is to *repay* if *EU(repay)* $\geq$*EU(default)*, that is if

$$p \leq \frac{30}{25}\frac{u(10) - u(0)}{u(250) - u(130) + u(10) - u(0)}. \tag{6}$$

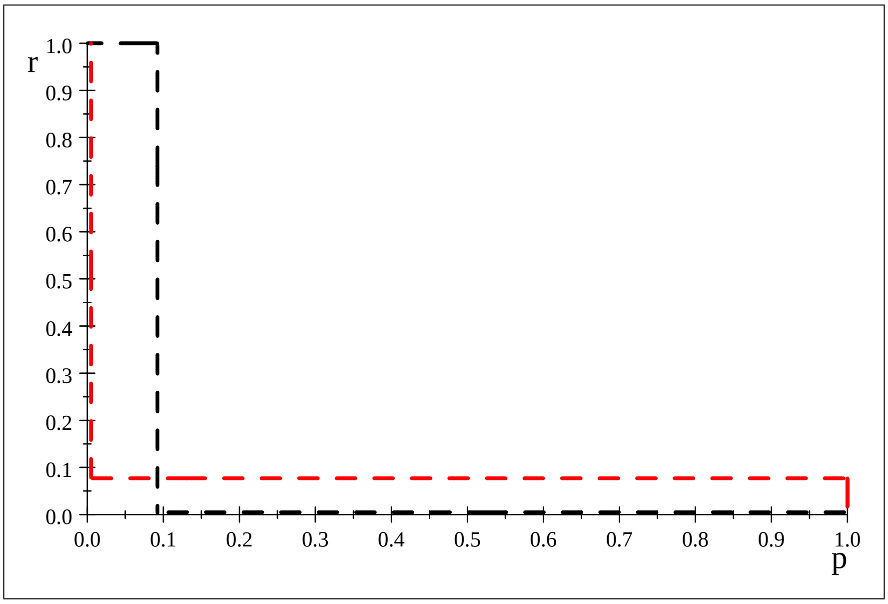
Risk neutrality ($\beta_i = 0,\ i = 1, 2$): For risk-neutral preferences with $\beta = 0$, the utility function simplifies to the linear utility function $u(x) = x$. If player 1 *repays* with probability p, the expected payoff for player 2 is $93\frac{1}{18} \cdot p + 8\frac{1}{3} \cdot (1-p)$ if she *repays* and $175 \cdot p + 0$ if if she *defaults*. Hence, player 2's best response is to *repay* if $93\frac{1}{18} \cdot p + 8\frac{1}{3} \cdot (1-p) > 175 \cdot p$, that is if $p < \frac{6}{65}$. Likewise, player 2's best response is *default* if $p > \frac{6}{65}$. For $p = \frac{6}{65}$ player 2 is indifferent between *repay* and *default*. Let $b(p)$ denote the probability of *repaying* in the best response of player 2 to player 1's probability to *repay* p, then the best response correspondence of player 2 is given by

$$b(p) = \begin{cases} 1 & \text{if } \ p < \frac{6}{65} \\ (0,1) & \text{if } \ p = \frac{6}{65} \\ 0 & \text{if } \ p > \frac{6}{65} \end{cases}. \tag{7}$$

Let q denote the probability that player 2 *repays*. Player 1's best response correspondence is symmetric to player 2's best response correspondence and is given by

$$b(q) = \begin{cases} 1 & \text{if } \ q < \frac{6}{65} \\ (0,1) & \text{if } \ q = \frac{6}{65} \\ 0 & \text{if } \ q > \frac{6}{65} \end{cases}. \tag{8}$$

FIGURE A.1: Best response correspondences for players 1 and 2



A Nash equilibrium is a pair of probabilities (p, q) such that $p \in b(q)$ and $q \in b(p)$. It is easily seen that the only three equilibria are $(1, 0), (0, 1)$ and $(\frac{6}{65}, \frac{6}{65})$. This corresponds to two equilibria in pure strategies *(repay, default)* and *(default, repay)* and one symmetric equilibrium in mixed strategies, where player i plays $(\frac{6}{65} repay,\ \frac{59}{65} default)$. This is graphically illustrated in Figure A.1 and proves part a) of Proposition 2.

Risk aversion ($\beta_i > 0,\ i = 1, 2$): Risk-averse preferences are incorporated in the CRRA utility function with $\beta > 0$. From the risk-neutral case with a linear utility function $u(x)$ we know that if player 1 repays with a probability $p < \frac{6}{65}$ then it is optimal for player 2 to repay. Now, we have three unknowns, namely the coefficient of risk aversion β in our utility function and the probabilities p and q with which the players repay, which cannot be identified with only one equation. Instead, I look for a level of risk aversion above which it is a best response for a player 2 to repay independently of the probability with which her partner player 1 will repay, e.g. β such that player 2 repays for player 1 repaying with a probability $p \leq 1$. This yields an upper bound and an equilibrium in pure strategies, while ignoring possible equilibria in mixed strategies that cannot be identified. This implies that the right-hand side of equation (6) is equal to or greater than 1, so that player 2 repays if:

$$\begin{aligned} p &\leq \frac{30}{25} \frac{u(10) - u(0)}{u(250) - u(130) + u(10) - u(0)} \ \wedge\ p \leq 1 \\ \frac{u(250) - u(130)}{u(10) - u(0)} &\leq \frac{1}{5}\ ,\ \forall\, p \leq 1, \end{aligned} \tag{9}$$

where $u(250) - u(130) + u(10) - u(0)$ is always positive because $u'(x) \geq 0$. Since the utility function $u(x)$ is increasing with $u'(x) \geq 0$ but with diminishing marginal utility $u''(x) \leq 0$, the condition in equation (9) will be fulfilled if the utility function $u(x)$ is concave enough.

For risk-averse individuals with a CRRA utility function of the form $u(x) = \frac{x^{1-\beta}}{1-\beta}$ with $u(x) = \ln x$ for $\beta = 1$, $u(0)$ is not properly defined for $\beta > 1$, so that the analysis looks at the cases $\beta < 1$, $\beta > 1$, and $\beta = 1$.

For $\beta < 1$, rearranging equation (9) and solving numerically yields $\beta \geq 0.818933$ so that for $\beta \geq 0.82 \wedge \beta < 1$, it is optimal for a risk-averse player to repay in a simultaneous move repayment game.

For $\beta > 1$, I consider the limit of equation (9) since $u(x)$ is not defined for $x = 0$. For the otherwise continuous function, rearranging yields $5(\frac{250^{1-\beta}}{1-\beta} - \frac{130^{1-\beta}}{1-\beta}) - \frac{10^{1-\beta}}{1-\beta} \leq \infty$, with $\lim\limits_{x \longrightarrow 0} \frac{x^{1-\beta}}{1-\beta} = -\infty$, which holds true for all $\forall \beta \in]1; \infty]$ since $u(x)$ is increasing at diminishing rates with $u'(x) \geq 0$ and $u''(x) \leq 0$, so that $u(x)$ will be bounded from above in β for $\beta > 1$ (with 0 being the upper bound for $u(C, \beta)$, with C a constant level of consumption and β the varying coefficient of relative risk aversion) and hence the left hand side cannot exceed ∞.

For $\beta = 1$ the limit of the condition is again considered since $u(x)$ is not defined for $x = 0$. Rearranging equation (9) for $u(x) = \ln x$ yields $0.967047 \leq \infty$, with $\lim\limits_{x \longrightarrow 0} \ln x = -\infty$, which is always true. It is player 2's best response to *repay* for $\forall\ p \in [0,1]$ of player 1 if her level of risk aversion is $\beta_2 \geq 0.82$.

Let $b(p|\beta)$ denote the probability of *repay* in the best response of player 2 to player 1's probability to *repay* p. Then the best response correspondence of player 2 is given by

$$b(p|\beta_2) = \begin{cases} 1 & \text{if} \quad p \leq 1|\beta_2 \geq 0.82 \\ 0 & \text{if} \quad p \leq 1|\beta_2 < 0.82 \end{cases} . \tag{10}$$

Let q denote the probability that player 2 *repays*. Player 1's best response correspondence is symmetric to player 2's best response correspondence and is given by

$$b(q|\beta_1) = \begin{cases} 1 & \text{if} \quad q \leq 1|\beta_1 \geq 0.82 \\ 0 & \text{if} \quad q \leq 1|\beta_1 < 0.82 \end{cases} . \tag{11}$$

A Nash equilibrium is a pair of probabilities (p, q) such that $p \in b(q)$ and $q \in b(p)$. There are four equilibria in pure strategies depending on the risk aversion coefficients of both players: *(repay, repay)* for $(\beta_1 \geq 0.82, \beta_2 \geq 0.82)$, *(repay, default)* for $(\beta_1 \geq 0.82, \beta_2 < 0.82)$, *(default, repay)* for $(\beta_1 < 0.82, \beta_2 \geq 0.82)$, and *(default, default)* for $(\beta_1 < 0.82, \beta_2 < 0.82)$. For given coefficients of risk aversion other equilibria in pure and mixed strategies may arise, but they are impossible to determine with the three unknowns, the probabilities p and q, and the risk aversion coefficient β, in only one equation. However, this shows that for a given level of risk aversion $\beta \geq 0.82$ it becomes a best response for each player i to repay independently of the other player's probability of repaying. This proves part b) of Proposition 2.

A.3 Proposition 3 - Peer peeking

A player will peek on her peer if the expected utility of peeking exceeds the expected utility of not peeking. In the timing of the decision making, the peeking decision takes place before investment returns are realized. Information from peer peeking is only revealed after investment returns are realized. Since the game is set up as a one-shot game, the information from peer peeking cannot influence any future repayment decision if only monetary payoffs are considered and if any possible disutility from being peeked upon is neglected.

In the experiment, each player earns a show-up fee of Rs. 40 from which the costs for peeking are paid. Given that player 1 repays with probability p and player 2 repays with probability q, the expected utility of peer peeking for any player i is $pq \cdot u(123\frac{1}{18}) + p(1-q) \cdot u(38\frac{1}{3}) + (1-p)q \cdot u(205) + (1-p)(1-q) \cdot u(30)$ and the expected utility of not peeking is $pq \cdot u(133\frac{1}{18}) + p(1-q) \cdot u(48\frac{1}{3}) + (1-p)q \cdot u(215) + (1-p)(1-q) \cdot u(40)$. Comparing both, a player i will peek on her peer if *EU(peeking)* $\geq$*EU(not peeking)* or if

$$pq[u(133\frac{1}{18}) - u(123\frac{1}{18})] + p(1-q)[u(48\frac{1}{3}) - u(38\frac{1}{3})]$$

$$+ (1-p)q[u(215) - u(205)] + (1-p)(1-q)[u(40) - u(30)] \geq 0. \tag{12}$$

For any increasing utility function $u(x)$ with $u'(x) \geq 0$, it holds that the each pair on the left-hand side of equation (12) exhibits a positive expression and hence *EU(not peeking)* $\geq$*EU(peeking)* so that a player will choose not to peek.

For a risk-neutral expected utility maximizer with $\beta = 0$, the CRRA utility function becomes a linear utility function $u(x) = x$ so that the condition on peer peeking in equation (12) reduces to $40 > 30$ which implies that *EU(not peeking)* $>$*EU(peeking).* This lower expected utility from peeking than from not peeking implies that player i prefers not to peek.

For a risk-averse expected utility maximizer with $\beta > 0$, equation (12) has too many unknowns (p, q, and β) to solve it explicitly. However, it can be already seen that the left-hand side of equation (12) is positive since $u'(x) = x^{-\beta} > 0$, and $u(x) = \frac{x^{1-\beta}}{1-\beta}$ is a monotone increasing function for $\forall x > 0$ so that *EU(not peeking)* $\geq$*EU(peeking).* This lower expected utility from peeking than from not peeking implies that player i prefers not to peek and proves Proposition 3.

A.4 Proposition 4 - Peer punishment

Peer punishment is analyzed in a two-stage game with the peer punishment decision in the second stage and the repayment decision in the first stage. The game is solved recursively for one player at a time under consideration of the punishment decisions of her peer. The show-up fee of Rs. 40 that each participant receives is used to pay for the cost of punishment, Rs. 10 for punishing, and to deduct the penalty payment from being punished, Rs. 20 as a penalty. Player 1 repays with probability p and player 2 repays with probability q, but the problem is treated in general for player i due to the symmetry of the decision-making problem.

A.4.1 If the peer punishes

Given that the peer punishes default, player i chooses to punish if the expected utility from punishing is higher than from not punishing a defaulting peer who herself punishes, e.g. *EU(punish$|$ peer punishes)* $\geq$*EU(not punish$|$peer punishes).* Now the expected utility if a player punishes is given by $pq \cdot u(133\frac{1}{18}) + p(1-q) \cdot u(38\frac{1}{3}) + (1-p)q \cdot u(195) + (1-p)(1-q) \cdot u(10)$ and the expected utility if a player does not punish is given by $pq \cdot u(133\frac{1}{18}) + p(1-q) \cdot u(48\frac{1}{3}) + (1-p)q \cdot u(195) + (1-p)(1-q) \cdot u(20)$. Player i will not punish if *EU(punish$|$peer punishes)* $\leq$*EU(not punish$|$peer punishes)* so that

$$p(1-q)[u(38\frac{1}{3}) - u(48\frac{1}{3})] + (1-p)(1-q)[u(10) - u(20)] \leq 0. \tag{13}$$

Since $u'(x) > 0$, all pairs in the left hand side of expression (13) exhibit a negative difference and the expression is a sum of negative numbers that is negative so that player i will not punish a defaulting peer who is herself punishing .

For a risk-neutral expected utility maximizer with $\beta = 0$ and a linear utility function $u(x) = x$, equation (13) becomes $10 - 10q \geq 0 \ \ \forall\, q \in [0,1]$, implying that *EU(not punish|peer punishes)* $\geq$*EU(punish|peer punishes)* so that player i does not punish if her peer punishes.

For a risk-averse expected utility maximizer with $\beta > 0$, the equation (13) has too many unknowns (p, q, and β) to solve it explicitly. However, it can be already seen that the left-hand side of equation (13) is negative since $u'(x) = x^{-\beta} > 0$, and $u(x) = \frac{x^{1-\beta}}{1-\beta}$ is a monotone increasing function for $\forall x > 0$. This lower expected utility from punishment implies that player i does not punish if her peer punishes.

A.4.2 If the peer does not punish

Given that the peer does not punish default, player i chooses to punish if the expected utility from punishing is higher than from not punishing a defaulting peer who does not herself punishes, e.g. *EU(punish|peer does not punish)* $\geq$*EU(not punish|peer does not punish).* Now the expected utility if a player punishes is given by $pq \cdot u(133\frac{1}{18}) + p(1-q) \cdot u(38\frac{1}{3}) + (1-p)q \cdot u(215) + (1-p)(1-q) \cdot u(30)$ and the expected utility if a player does not punish is given by $pq \cdot u(133\frac{1}{18}) + p(1-q) \cdot u(48\frac{1}{3}) + (1-p)q \cdot u(215) + (1-p)(1-q) \cdot u(40)$. Player i will not punish if *EU(punish|peer does not punish)* $\leq$*EU(not punish|peer does not punish)* so that

$$p(1-q)[u(38\frac{1}{3}) - u(48\frac{1}{3})] + (1-p)(1-q)[u(30) - u(40)] \leq 0. \tag{14}$$

Since $u'(x) > 0$, all pairs in the left hand side of expression (14) exhibit a negative difference and the expression is a sum of negative numbers, which is negative so that player i will not punish a defaulting peer who is not herself punishing.

For a risk-neutral expected utility maximizer with $\beta = 0$ and a linear utility function $u(x) = x$, equation (14) becomes $10 - 10q \geq 0 \ \ \forall\, q \in [0,1]$, implying that *EU(not punish|peer does not punish)* $\geq$*EU(punish|peer does not punish)* so that player i does not punish if her peer does not punish.

For a risk-averse expected utility maximizer with $\beta > 0$, the equation has too many unknowns (p, q, and β) to solve it explicitly. However, it can be already seen that the left-hand side of equation (14) is negative since $u'(x) = x^{-\beta} > 0$, and $u(x) = \frac{x^{1-\beta}}{1-\beta}$ is a monotone increasing function for $\forall x > 0$. This lower expected utility from punishment implies that player i prefers not to punish if her peer does not punish. From equation (13) and (14) it is clear that for any player with an increasing utility function with $u'(x) \geq 0$ it is not optimal to punish a defaulting peer, independently of whether the peer punishes or not. This proves Proposition 4.

Appendix B Inequity-averse preferences

A simple model of inequity aversion à la Fehr and Schmidt (1999) can explain the cooperative outcomes in the repayment coordination game. A utility function for inequity-averse players augments a linear utility from the monetary payoff x_i of player i by disutility from inequity. Both disadvantageous inequality and advantageous inequality are considered separately in the utility function

$$U_i(x_i; x_j) = x_i - \alpha_i \max[x_j - x_i; 0] - \beta_i \max[x_i - x_j; 0]. \tag{15}$$

Disutility from disadvantageous inequality is captured by the envy parameter α_i. Disutility from advantageous inequality is captured by the altruism parameter β_i.[14] With social preferences and a linear utility function, the reduced form matrix of the expected payoffs can be transformed to a matrix with the utility of expected payoffs which includes inequity-averse preferences as in Figure B.2. Since the game is symmetric for both players i and j, $\alpha_i = \alpha_j = \alpha$ and $\beta_i = \beta_j = \beta$.

FIGURE B.2: Expected payoffs in the standard microcredit game with social preferences

		Player 2	
		Repay	Default
Player 1	Repay	$\left(93\frac{1}{18}, 93\frac{1}{18}\right)$	$\left(8\frac{1}{3} - 166\frac{2}{3}\alpha_1, 175 - 166\frac{2}{3}\beta_2\right)$
	Default	$\left(175 - 166\frac{2}{3}\beta_1, 8\frac{1}{3} - 166\frac{2}{3}\alpha_2\right)$	$(0, 0)$

Four different repayment types can be distinguished that can all be explained with inequity-averse preferences and different parameter restrictions for the envy parameter α and the altruism parameter β. The four different types are individuals who (1) always repay their loan, (2) never repay their loan, (3) repay their loan reciprocally with respect to their peer, e.g. repay when the peer repays, and default when the peer defaults, and (4) repay their loan conversely to their peer, e.g. repay when the peer defaults, and default when the peer repays. All repayment types can be explained by different parameter specifications as summarized in Table B.1.

A small α indicates that the aversion against being taken advantage of is limited, whereas a large β indicates a high aversion against advantageous inequity or altruism. For this combination, cooperation becomes a dominant strategy and the cooperative outcome with both borrowers repaying can become a Nash equilibrium. Repayment types based on the conditional repayment decision are used here as a short cut to model social preferences as in Neugebauer *et al.* (2008). In the unconditional repayment decision, assumptions on the distribution of social preferences

[14] Fehr and Schmidt (1999) only consider the case where individuals get more disutility from disadvantageous than from advantageous inequality with $\alpha \geq \beta$). Neugebauer *et al.* (2008) extend the Fehr and Schmidt (1999) social preference model and also consider the case of altruism with $\beta \geq \alpha$.

in the population are necessary but are avoided here for simplification.

TABLE B.1: Repayment types and social preferences parameters

	Always repay	Never repay	Reciprocal repay	Repay conversely
	(1)	(2)	(3)	(4)
Envy parameter α	$< \frac{1}{20}$	$> \frac{1}{20}$	$> \frac{1}{20}$	$< \frac{1}{20}$
Altruism parameter β	$> \frac{59}{120}$	$< \frac{59}{120}$	$> \frac{59}{120}$	$< \frac{59}{120}$
Equilibrium concept	Dominant Strategies		Nash	

Each of the four repayment types can become a best response for different parameter combinations, e.g.

- *Always repay* becomes a best response for player i if

$$93\frac{1}{18} > 175 - 166\frac{2}{3}\beta \quad \text{and} \quad 8\frac{1}{3} - 166\frac{2}{3}\alpha > 0 \quad \Longleftrightarrow \alpha < \frac{1}{20} \quad \text{and} \quad \beta > \frac{59}{120}.$$

- *Never repay* becomes a best response for player i if

$$93\frac{1}{18} < 175 - 166\frac{2}{3}\beta \quad \text{and} \quad 8\frac{1}{3} - 166\frac{2}{3}\alpha < 0 \quad \Longleftrightarrow \alpha > \frac{1}{20} \quad \text{and} \quad \beta < \frac{59}{120}.$$

- *Reciprocal repay*, e.g. repay when the other player repays, and default when the other player defaults, becomes a best response for player i if

$$93\frac{1}{18} > 175 - 166\frac{2}{3}\beta \quad \text{and} \quad 8\frac{1}{3} - 166\frac{2}{3}\alpha < 0 \quad \Longleftrightarrow \alpha > \frac{1}{20} \quad \text{and} \quad \beta > \frac{59}{120}.$$

- *Repay conversely*, e.g. repay when the other player defaults, and default when the other player repays, becomes a best response for player i if

$$93\frac{1}{18} < 175 - 166\frac{2}{3}\beta \quad \text{and} \quad 8\frac{1}{3} - 166\frac{2}{3}\alpha > 0 \quad \Longleftrightarrow \alpha < \frac{1}{20} \quad \text{and} \quad \beta < \frac{59}{120}.$$

If a player's best response structure is to always repay or reciprocal repay, cooperative outcomes occur in the repayment coordination game. Table B.1 summarizes the results and sets out the parameter restrictions for different best responses of player i.

For example, *reciprocal repay*, is a best response for a high envy and a high altruism parameter. The the most common repayment type *always repay* (see Figure 6), however, can only be explained by a level of altruism that is at least ten times the level of the envy parameter, which seems infeasible, especially since Fehr and Schmidt (1999) explicitly exclude this case as individuals will always suffer more from disadvantageous than from advantageous inequality.

Appendix C Figures

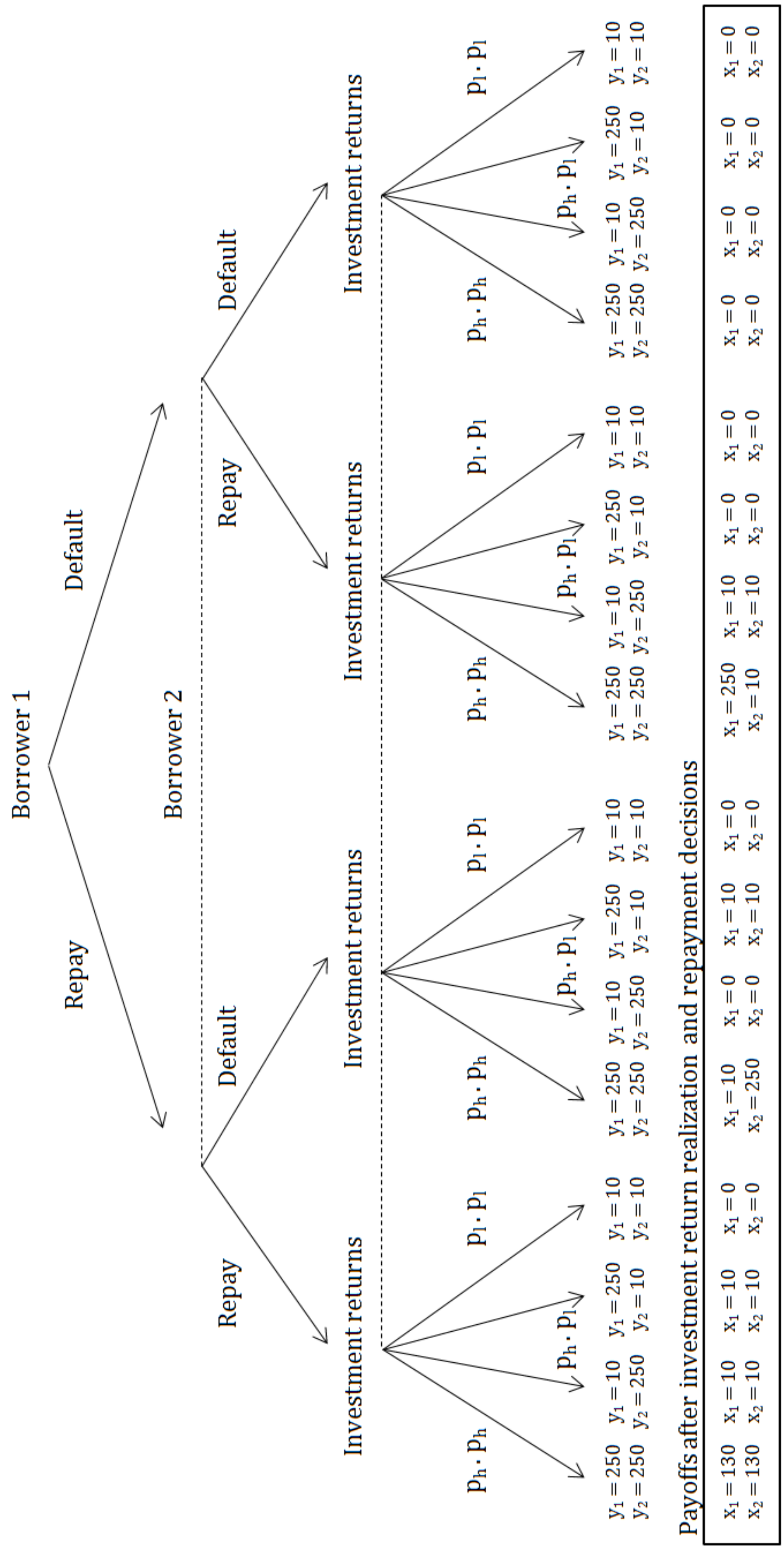
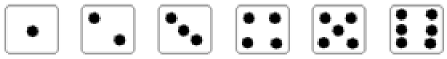


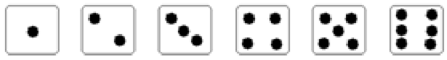
Figure C.3: Extensive form representation of standard microfinance investment game

Appendix D Experimental material - decision sheets

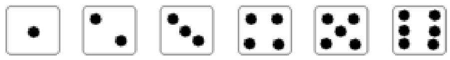
Decision Sheet – Standard Microfinance Game

1) Investment Return		
Roll a die before the game starts and circle the outcome. Your investment return will be calculated based on a “losing number”. A die will be rolled in each round to determine the “losing number”. If you picked the “losing number” in that round, you will receive Rs. 10 from your investment. If you did not pick the “losing number” in that round, you will receive Rs. 250 from your investment.		
		
2) Repayment Choice		
a) Suppose you do not know what your partner will be doing, will you repay if you can repay?	YES	NO
Now suppose you know what your partner is doing.		
b) If you can repay, will you repay if your partner repays?	YES	NO
c) If you can repay, will you repay if your partner does NOT repay?	YES	NO
3) Belief		
Do you expect your partner to repay if he is able to repay his loan?	YES	NO
4) Individual Return		
After you stated your repayment choice, the decision sheet will be collected by the instructors. By rolling a die the investment return “losing number” will be generated for the round. Your individual return from your investment will be stated here at the end of the whole session.		
5) Individual Payoff		
Your individual payout after subtracting your repayment will be stated here. Your repayment depends on your decision to repay, on your partners decision to repay, and on both your returns from investment. However, you only know your investment return. Your individual payoff will be stated here at the end of the whole session.		

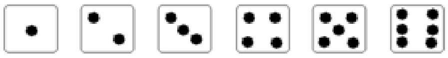
Decision Sheet – Standard Microfinance Game + Peeking

1) Investment Return		
Roll a die before the game starts and circle the outcome. Your investment return will be calculated based on a “losing number”. A die will be rolled in each round to determine the “losing number”. If you picked the “losing number” in that round, you will receive return Rs. 10 from your investment. If you did not pick the “losing number” in that round, you will receive return Rs. 250 from your investment.		
		
2) Peeking		
You have the possibility to pay Rs. 10 from your investment return to get to know the investment return of your partner at the end of the game. Do you want to pay Rs. 10 to get to know the payoff of your partner at the end of the game?	YES	NO
3) Belief of Peeking of Partner		
Do you believe your partner will choose to pay Rs. 10 to get to know your payoff?	YES	NO
4) Repayment Choice		
Suppose you do not know what your partner will be doing, will you repay if you can repay?	YES	NO
5) Belief of Repayment of Partner		
Do you expect your partner to repay if he is able to repay his loan?	YES	NO
6) Individual Return		
After you stated your repayment choice, the decision sheet will be collected by the instructors. By rolling a die the investment return “losing number” will be generated for the round. Your individual return from your investment will be stated here.		
7) Individual Payoff		
Your individual payout after subtracting your repayment will be stated here. Your repayment depends on your decision to repay, on your partners decision to repay, and on both your returns from investment. If you choose to monitor, you will know your partner’s investment return as well. However, if you do not choose to monitor, you only know your investment return.		
8) Partner’s Return		
Your partner’s return from his investment will be stated here. She has the same investment realization possibilities as you have.		

Decision Sheet – Standard Microfinance Game + Punishment

1) Investment Return		
Roll a die before the game starts and circle the outcome. Your investment return will be calculated based on a "losing number". A die will be rolled in each round to determine the "losing number". If you picked the "losing number" in that round, you will receive return Rs. 10 from your investment. If you did not pick the "losing number" in that round, you will receive return Rs. 250 from your investment.		
		
2) Repayment Choice		
Suppose you do not know what your partner will be doing, will you repay if you can repay?	YES	NO
3) Belief of Repayment of Partner		
Do you expect your partner to repay if he is able to repay his loan?	YES	NO
4) Individual Return		
After you stated your repayment choice, the decision sheet will be collected by the instructors. By rolling a die the investment return "losing number" will be generated for the round. Your individual return from your investment will be stated here.		
5) Individual Payoff		
Your individual payout after subtracting your repayment will be stated here. Your repayment depends on your decision to repay, on your partners decision to repay, and on both your returns from investment. However, you only know your investment return. Your individual payoff will be stated here at the end of the whole session.		
6) Punishment		
After getting to know your individual payoff, you know if you made a repayment for your partner or not, however, you do not know your partner's investments return. You have the possibility to pay Rs. 10 from your initial endowment of Rs. 40 to reduce your partner's endowment by Rs. 20. Do you want to pay Rs. 10 from your initial endowment of Rs. 40 to reduce your partner's endowment by Rs. 20 if your partner did not repay?	YES	NO
7) Beliefs about Punishment by Partner		
a) Suppose your partner does NOT know what you did. Do you expect your partner to pay Rs. 10 from his endowment to reduce your endowment by Rs. 20?	YES	NO
Suppose your partner knows what you did:		
b) Do you expect your partner to pay Rs. 10 from his endowment to reduce your endowment by Rs. 20 if you have contributed to the repayment?	YES	NO
c) Do you expect your partner to pay Rs. 10 from his endowment to reduce your endowment by Rs. 20 if you have NOT contributed to the repayment?	YES	NO

Decision Sheet – Standard Microfinance Game + Peeking + Punishment

1) Investment Return		
Roll a die before the game starts and circle the outcome. Your investment return will be calculated based on a "losing number". A die will be rolled in each round to determine the "losing number". If you picked the "losing number" in that round, you will receive return Rs. 10 from your investment. If you did not pick the "losing number" in that round, you will receive return Rs. 250 from your investment.		
		
2)Peeking		
You have the possibility to pay Rs. 10 from your investment return to get to know the investment return of your partner at the end of the game. Do you want to pay Rs. 10 to get to know the payoff of your partner at the end of the game?	YES	NO
3) Belief of Peeking of Partner		
Do you believe your partner will choose to pay Rs. 10 to get to know your payoff?	YES	NO
4) Repayment Choice		
Suppose you do not know what your partner will be doing, will you repay if you can repay?	YES	NO
5) Belief of Repayment of Partner		
Do you expect your partner to repay if he is able to repay his loan?	YES	NO
6) Individual Return		
After you stated your repayment choice, the decision sheet will be collected by the instructors. By rolling a die the investment return "losing number" will be generated for the round. Your individual return from your investment will be stated here.		
7) Individual Payoff		
Your individual payout after subtracting your repayment will be stated here. Your repayment depends on your decision to repay, on your partners decision to repay, and on both your returns from investment. If you choose to monitor, you will know your partner's investment return as well. However, if you do not choose to monitor, you only know your investment return.		
8) Partner's Return		
Your partner's return from his investment will be stated here. She has the same investment realization possibilities as you have.		

9) Punishment		
After getting to know your individual payoff you know if you made a repayment for your partner or not, however, you only know your partner's true investment return when you decided to pay Rs. 10. You have the possibility to pay Rs.10 from your initial endowment of Rs. 40 to reduce your partner's endowment by Rs. 20.		
Suppose you do not know the return of your partner:		
a) Do you want to pay Rs. 10 from your initial endowment of Rs. 40 to reduce your partner's endowment by Rs. 20 if your partner did not repay?	YES	NO
Suppose you know the return of your partner:		
b) Do you want to pay Rs. 10 from your initial endowment of Rs. 40 to reduce your partner's endowment by Rs. 20 if your partner did not repay because she could not repay due to low return?	YES	NO
c) Do you want to pay Rs. 10 from your initial endowment of Rs. 40 to reduce your partner's endowment by Rs. 20 if your partner did not repay because she did not want to repay although she had a high return?	YES	NO
10) Beliefs about Punishment by Partner		
a) Suppose your partner does NOT know what you did. Do you expect your partner to pay Rs. 10 from his endowment to reduce your endowment by Rs. 20?	YES	NO
Suppose your partner knows what you did:		
b) Do you expect your partner to pay Rs. 10 from his endowment to reduce your endowment by Rs. 20 if you have contributed to the repayment?	YES	NO
c) Do you expect your partner to pay Rs. 10 from his endowment to reduce your endowment by Rs. 20 if you have NOT contributed to the repayment?	YES	NO