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Long-Term Relationships, Group lending and Peer Sanctioning in Microfinance: New Experimental Evidence

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Abstract

Microfinance is generally associated with high repayment rates. However, it is not clear whether the success of microfinance results only from the use of group lending or is also due to other mechanisms such as peer sanctioning or dynamic incentives induced by long-term relationships that are typically included in microfinance contracts. In this paper, we contribute to the existing literature by investigating the respective effects of each of these components of microfinance. This is done by running a laboratory experiment that allows us to isolate long-term relationships from the two other components (i.e. group lending and peer monitoring). Our experiment indicates that peer-lending dimension of microcredit in absence of peer-sanctioning mechanism is not sufficient to mitigate *ex ante* and *ex post* moral hazards. In sharp contrast, we find that individualized long-term credit relationships perform significantly better than group-lending mechanisms with or without peer sanctioning.

JEL Codes: C72, C91, G20, G21.

Keywords: Experimental Economics, Credit Market, Microfinance, Peer Lending.

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1. Introduction

Commercial banks have been traditionally reluctant to serve low-income borrowers because of various types of difficulties, such as deficient information, lack of collateral, irregular streams of income, and/or impossibility of loan contract enforcement. In contrast, contemporary microfinance,[1] which originated in Bangladesh in the mid-1970s with the Grameen Bank, has introduced a number of financial innovations making it possible to grant small loans to poor customers. Microfinance practitioners have designed mechanisms that have allowed Microfinance Institutions (henceforth MFIs) to attain very high repayment rates which often exceed 95% (Morduch, 1999). This achievement has resulted in institutional recognition with the 2005 United Nations International Year of Microcredit and the 2006 Nobel Peace Prize won by Muhammad Yunus. A concomitant flood of investments in developing countries – but also in transition or industrialized economies – now gives the opportunity to more than 150 millions borrowers to be served by MFIs around the world (Giné et al., 2010).

From the academic stance, the success of microfinance appears more ambiguous. Most theoretical works have focused on the key role played by group lending. Group lending relies on two distinctive dimensions. The first one, which has received most attention from academic researchers, is joint liability. Under the joint liability scheme, all group members are held accountable for each group member's loan repayment (i.e. each individual acts as a co-guarantor of the debt).[2] A number of models explain high repayment rates by the incentive mechanisms introduced by joint liability, such as peer monitoring and peer sanctioning. These incentive mechanisms, which effectively transfer screening, monitoring and enforcement costs from MFIs to borrowers, can help mitigate *i)* adverse selection (e.g. Ghatak, 1999; Armendariz de Aghion and Gollier, 2000), *ii)* moral hazard (e.g. Stigliz, 1990; Varian, 1990; Banerjee *et al*, 1994), or *iii)* strategic default (e.g. Besley and Coate, 1995; Armendariz de Aghion, 1999). However, joint liability schemes are not a panacea and may be vulnerable to free riding (Che, 2002) and collusion (Besley and Coate, 1995), thereby undermining the

[1] Popular forms of credit in 19th-century Europe already exhibited microfinance characteristics (Hollis and Sweetman, 1998).

[2] The bank can use different procedures for loan extension. It can make a loan to an individual who is a member of a group and the group is jointly liable for each member's repayment. It can alternatively make a loan to the group which then divides out the amount among its members.

bank's ability to harness "social collateral". Given the limits of joint liability, the success of group lending should be – at least partially – found elsewhere.[3]

This leads us to uncover the key role played by another essential dimension of group lending undernoted in the literature: the dynamic incentives, especially contingent renewal of loans, induced by repeated interactions between lenders and borrowers (Chowdhury, 2005). In the case of group lending, contingent renewal of loans concretely refers to the feature that default of repayment by the group as a whole implies that all its members become ineligible for future loans. As borrowers typically want to finance future projects, the promise of future loans enhances borrowers' loss from being cut off from credit. The dynamic incentives induced by long-term credit relationships may be a complement to and, even, a substitute for group liability (Armendariz de Aghion and Morduch, 2000). In this context, the relative neglect of the dynamic aspects of micro-lending is surprising given that in reality MFIs do not always enforce joint liability. MFIs have been even increasingly switching from group to individual liability, where each loan recipient is individually accountable for reimbursement of her loans. This trend is especially observable in industrialized countries and transition economies, but also in historical programs, such as Grameen Bank II and Bancosol that were the original pioneers of group lending (Armendariz de Aghion and Morduch, 2000; Armendariz de Aghion and Morduch, 2006). This change in the lending technology is often ascribed to the substantial costs incurred by group lending (Cull et al., 2007; Mersland and Ström, 2009) and to borrowers' dislike of the excessive peer-pressure (Giné and Karlan, 2009).[4]

In this paper, we examine lenders' contracting behavior as well as borrowers' investment, repayment and peer-sanctioning behavior in individual and group lending schemes within a controlled laboratory environment. The experimental implementation of various lending scenarios allows us to disentangle microfinance mechanisms in a methodical manner. The laboratory experiment approach has indeed the advantage of unpacking phenomena that prove

[3] Morduch (1999) explicitly expresses this idea: "*Group lending has taking most of the spotlight and the idea has had immediate appeal for economic theorists and for policy makers with a vision of building programs around households' "social" assets, even when physical assets are few. But its role has been exaggerated: group lending is not the only mechanism that differentiates microfinance from standard loan contracts. The programs […] also use dynamic incentives, regular repayment schedules, and collateral substitutes to help maintain high repayment rates*" Morduch, 1999, p. 1579).

[4] This tension is even less accepted in industrialized countries if one considers the failed replication of the Grameen Bank model in Canada by the *Calmeadow Foundation* (Churchill, 1999) or in France by *ADIE* (Servet, 2006).

to be complex to analyze with field data because of replicability, data accessibility and comparability (see for instance Bolnik, 1988; Hulme, 2000). This approach also has the advantage of measuring microeconomic causal relationships in a controlled environment and of avoiding any possible role for contextual effects. Furthermore, some relevant variables, such as the distinction between *ex ante* moral hazard (shirking) and *ex post* moral hazard (strategic default), can be easily quantified in the laboratory whereas they remain unobserved in the field. Of course, the laboratory approach has also some drawbacks, in particular the fact that laboratory experiments generally induce relatively low stakes and involve participants who are university students with fairly homogeneous characteristics.

Our experimental game consists of a finite repeated credit market experiment. This game involves trading between lenders and borrowers, in which neither the loan repayment nor the required choice of project are third-party enforceable. Each period consists of three stages. In the first stage, the lender decides whether to keep or transfer her endowment to the borrower she is matched with. In the second stage, the borrower chooses between an efficient low-risk project and a less efficient high-risk project. Finally, in the third stage, after observing the outcome of the project, the borrower decides how much to return to the lender. Importantly, two sources of moral hazard coexist in our credit market (Fehr et al., 2009). First, lenders cannot observe their borrowers' choice, and therefore, borrowers may choose the less efficient high-risk project (*ex ante* moral hazard). Second, the absence of legal enforcement of repayment implies that borrowers may withhold their repayment even if they successfully carry out their project (*ex post* moral hazard): lenders do not know whether a defaulting borrower is unable (because the project failed) or unwilling to repay the loan.

Our experimental design consists of four different treatments. The first treatment mimics the game described above under a stranger-matching protocol, in which there is no opportunity to establish repeated interactions. This means that each lender is randomly assigned to a different borrower in each period. Our second treatment is identical to the first one, except that we now implement a partner-matching protocol, allowing for repeated interactions with the same partner. Our third treatment is analogous to the second one except that each lender can decide to offer a contract to a group of four borrowers without the possibility to

individualize her offer.[5] The fourth and last treatment is similar to the third one except that another stage is added. In this additional stage, each group member has the opportunity to discipline the other members of her group by assigning them costly points of sanction. These different treatments allow us to capture the main components of microfinance by establishing the following comparisons: (1) *long-term* versus *short-term* relationships, (2) *individualized* versus *group* lending schemes, and finally (3) *peer sanctioning* allowed or not.[6]

This paper contributes to the topical debate on joint versus individual liability in microfinance. Our work is a new piece of evidence that complements the few lab or field experiments that actually compare individual responsibility with joint liability. The existing evidence is not clear-cut. Cason et al. (2012) report the results from a lab experiment of group lending with (costly) peer monitoring. In comparing peer-monitoring treatments and individual lending with lender monitoring, the authors conclude that peer monitoring schemes result in higher loan frequencies and safer investment decisions (leading to higher repayment rates) with respect to lender monitoring. Exploring the impact of lending technologies on borrowers' strategic default, Abbink et al. (2006) document that group lending outperforms individual lending in a lab setting. Field experiments tend to show quite the opposite: group lending does not perform better than individual lending even when group members can monitor and sanction each other. This is typically the cases of Kono (2006) in Vietnam and Giné and Karlan (2009) in the Philippines. Giné et al. (2010), in a series of microfinance games involving real borrowers in Peru, find that dynamic incentives strongly reduce risk-taking even without group-based mechanisms. Group lending, especially when the group is not endogenously formed, increases risk-taking.

Strikingly, the aforementioned experiments systematically focus on one sole dimension of moral hazard. Giné et al. (2010) and Cason et al. (2012) examine *ex ante* moral hazard, i.e. the possibility for borrowers to shirk in their project choice. In these studies, the repayment is mechanical since the borrower's project output is automatically collected by the lender. In contrast, Abbink et al. (2006), Kono (2006) and Giné and Karlan (2009) only pay attention to

[5] Like Cason et al. (2012), we restrict our attention on exogenously formed group and leave the issue of endogenous group formation for further research.

[6] We choose to focus our analysis on these mechanisms of microfinance that we consider to be of main importance. We acknowledge that microfinance programs also use several other mechanisms such as peer selection, regular repayment schedules or collateral substitutes (see Morduch, 1999). We choose deliberately not do not address these mechanisms in this paper.

ex post moral hazard (strategic default).[7] In this context, our work proceeds further with the analysis by providing a more unified approach to analyze lenders' contracting behavior as well as borrowers' conduct. The originality of our experimental design definitely lies in the fact that we combine both sources of moral hazard (i.e. *ex ante* and *ex post*). This fruitful combination enables us to distinguish between two borrowers' potential misbehaviors since we capture both shirking (i.e. borrowers do not select the project stipulated in the lender's offer) and strategic default (i.e. borrowers voluntarily withhold their repayment to the lender even if their project succeeds).

To anticipate our results, we find that the success of microcredit mainly rests on the existence of individualized long-term lending relationships. We observe that group-lending contracts, in absence of sanctioning mechanisms, exacerbate both *ex ante* and *ex post* moral hazards as the tendency toward free-riding emerges. The introduction of peer sanctioning tends however to alleviate this free-riding problem. In contrast with peer-group lending, the opportunity to engage in individualized bilateral long-term relationships notably improves market performance compared to short-term contracts in which participants cannot build up reputations. Individualized bilateral long-term relationships partially mitigate the repayment problem and thus enhance cooperation between borrowers and lenders. This highlights the prominence of reputation as a discipline device that constraints selfish borrowers to behave reciprocally.

The remainder of the paper is organized as follows. Section 2 presents our experimental design. Section 3 presents the theoretical predictions of the model. The results are detailed in Section 4. Finally, Section 5 discusses the results and concludes.

2. Experimental design and procedures

2.1. The microfinance game

The basic structure of our microfinance game is inspired from Fehr and Zehnder (2009).[8] This game has the advantage of allowing for the coexistence of two sources of moral hazard: *ex*

[7] In Kono's (2006) experimental design, borrowers can actually choice between various risky projects. Nonetheless, the author's econometric analysis solely focuses on strategic default.

[8] Fehr and Zehnder (2009) show how reputation can endogenously emerge in a credit-market experiment. They conduct a series of experiments with three different treatments. The benchmark treatment corresponds to a

ante and *ex post*. In every period, two projects are available to each borrower: project *A* and project *B*. As depicted in Table 1, project *A* is an efficient low-risk project with a high expected return, and project *B* is a less efficient high-risk project with a low expected return.[9] Both projects require 32 capital units to be launched. Due to capacity constraints, borrowers can solely carry out one of the two projects. Importantly, borrowers are dependent on external funding from lenders since they do not have any equity and they are not able to carry excess returns into future periods.

[Table 1: about here]

Let us now describe the completion of one period. The basic game consists of three stages. In stage one, each lender is endowed with 32 Experimental Monetary Units (henceforth, EMUs) has to decide how to allocate her endowment ($\overline{k}$). She can either invest her whole endowment in an outside option S that yields a safe payoff of 32 EMUs or grant a loan of 32 EMUs to the borrower with whom she is matched. In the latter case, the lender has to stipulate a desired project ($p^d \in \{A, B\}$) and a desired repayment (r^d). Lenders can at most contract a loan per period since their endowment equals the external financing required by borrowers to carry out one of the two investment projects. In the second stage of the game, borrowers observe whether they have received a loan offer from their incumbent lender. If so, borrowers then decide whether to accept the offer. In case of rejection, borrowers cash an outside option, *Q*, which yields a small safe payoff of 10 EMUs. In case of acceptance, they choose between the two investment projects, i.e. *A* or *B*. A borrower is not forced to invest in the project stipulated in the lender's contract (p^d). Borrowers' investment choices are unobservable by lenders, thereby giving rise to *ex ante* moral hazard. After each borrower has made her investment decision, a random device determines whether the chosen project succeeds or not. The third stage deals with borrowers' repayment. In the case of project failure, the repayment to the lender is automatically set to zero ($r = 0$). If the project is successful, borrowers decide freely how much they are willing to repay to the lender by choosing an amount ($r \in [0, R_p]$). This

competitive credit market where debt repayments are not third-party enforceable and participants are anonymous, which prevents participants from engaging in repeated interactions. In a second treatment, participants can endogenously engage in repeated interactions, by holding fixed the ID numbers of the participants. Finally the third treatment introduces third-party enforcement. The authors find that borrowers' repayments are significantly higher when bilateral relationships are feasible than in a one-shot interaction setup.

[9] Diamond's (1989) model of reputation acquisition in debt markets rests on the same assumption with type G and type B borrowers; type B borrowers carrying out a risky and low-expected-return project.

absence of any exogenous enforcement mechanisms of repayment is a source of *ex post* moral hazard.

At the end of the period each participant is informed about her final payoff given as:

$(\pi_{Lender, IS}) = r$ if the lender grants a loan of 32 EMUs to the borrower (1)

$= S$ (= 32) if the lender chooses the outside option

$(\pi_{Borrower, IS}) = R_p - r$ if the borrower accepts the lender's credit offer (2)

$= Q$ (= 10) if borrower rejects the lender's credit offer

2.2. Experimental treatments

We conducted four different treatments, summarized in Table 2, which mimic the microfinance game described above. All treatments lasted 15 identical periods. Moreover, in all scenarios, each player was randomly assigned the role of borrower or lender at the beginning of the experiment and kept this role for the whole duration of the session.

As shown in Table 2, two individual lending treatments were conducted: the IS treatment (*Individualized relationship in stranger matching*), which is our baseline treatment, and the IP treatment (*Individualized relationship in partner matching* treatment). The sole difference between these two treatments lies in the matching protocol. In the IS treatment, lenders are randomly re-matched with a different borrower at each period (stranger matching), whereas, in the IP treatment, each lender-borrower pair is held fixed for the whole session (partner matching). The comparison between these two treatments allows us to investigate the extent to which repeated interactions with the same partner can mitigate both *ex ante* and *ex post* moral hazards. This comparison may also shed light on the negative externalities associated to long-term credit relationships such as the hold-up effect.

[Table 2: about here]

Table 2 also displays two group lending conditions: the GP treatment (*Group lending without sanctions*) and the GPS treatment (*Group lending with sanctions*). The GP treatment is constructed analogously to the IP treatment, except that each lender offers a contract to a group of four borrowers (b_1, b_2, b_3, b_4) without the possibility to individualize her offer. As in

the IP treatment, the lender trades with the same group for the whole duration of the game.[10] To facilitate comparisons across treatments and to rule out any possible income effects, lenders' payoff function is slightly modified: a lender receives 32 EMUs if she chooses the outside option and the average repayment of the group if she grants a loan to the group. Comparing the GP condition and the IP condition allows us to check whether group-lending contracts in absence of peer sanctioning entail free-riding behaviors among borrowers.

Lastly, the GPS treatment introduces the opportunity for a borrower to sanction her group-lending peers. The GPS condition differs from that of GP in the following respect: after being informed about each other group member's repayment level, borrowers can assign between 0 and 10 punishment points to any of the other three group members.[11] Punishment is costly for the punisher as every point reduces her income by 1 EMU. Each point the punished player receives reduces her earnings by 5 EMUs (Nikiforakis and Normann, 2008; Egas and Riedl, 2008). Comparing the GP and the GPS treatments enables us to disentangle the effect of group lending from that of peer sanctioning.

2.3. Procedure and parameters

The experiment was computerized and the scripts were programmed using the z-tree platform (Fischbacher, 2007). Our overall design consists of 23 sessions. We recruited 252 subjects.[12] No subject participated in more than one session. Some of the subjects had previously participated in experiments, but all of them were inexperienced in this particular type of experiment. All of the sessions were conducted at the LABEX of the University of Rennes

[10] In contrast to the original microfinance mechanism, borrowers are not automatically barred from borrowing in the future in case of shirking. Instead, in all partner treatments (both individual and group treatments) the introduction of a long-term relationship allows the lender to condition her future loans on past repayments from the borrower(s). Introducing such automatic rules in all our treatments would change theoretical predictions while undoubtedly leaving unchanged the observed differences across treatments. The investigation of such automatic rules that might also explain a part of the success of microcredit is left for future research.

[11] Precisely, at the beginning of this stage, players are informed about i) the projects chosen by their counterparts, ii) the issue of these projects (i.e. success or failure), and iii) the size of the return transfer of their counterparts.

[12] Among our participants who were assigned the role of "lender", there were real bankers: 21 commercial bankers and 10 social bankers. The remaining subjects were students, who constituted our benchmark population in the experiment. The students were recruited from undergraduate courses in business, literature, and economics at the University of Rennes (France). Commercial bankers were recruited from well-known French banks: *Banques Populaires*, *Crédit Agricole*, *Crédit Mutuel*, *CIC-CIO*, and *BNP Paribas*. Social bankers were recruited from the following social banking institutions: *Société Financière de la Nef*, *Fédération des Cigales de Bretagne*, *PRESOL*, *ADIE*, and *Bretagne Capital Solidaire*. We control for these characteristics in the estimates. However, in the present paper, the potential differences between students, commercial bankers and social bankers are not investigated in detail. We did so in a previous companion paper (refer to Cornée et al. 2012).

(France). Subjects only participated in one treatment, except in sessions 22-23 where participants were required to play two successive treatments.

A session lasted between one hour and one hour and a half, including instruction reading and payment. The exchange rate was set at 47 EMUs for € 1 and the average monetary gain amounted to € 17.67 in total for the credit game and the lottery explained below. A set of instructions (available upon request) was given to each participant and read aloud by the experimenter. Subjects were then administered a test with control questions. At the end of each session, subjects were asked to fill out an individual questionnaire. We also asked them to play a simple lottery choice experiment to determine their degree of risk aversion. This simple game replicates Holt and Laury's (2002) design.[13] Table 3 contains some summary information about each of the sessions.

[Table 3: about here]

3. Theoretical Predictions and behavioral assumptions

3.1. Theoretical predictions for rational and selfish subjects

We derive the predictions from our four treatments assuming common knowledge of rationality, risk-neutrality and selfishness. Under these assumptions, the theoretical prediction of the IS treatment is clear-cut. By reasoning backward, one can easily see that, in the third stage of the game, borrowers should never repay their debts because of the absence of legal institutions enforcing debt contracts. Anticipating this, lenders would not grant any loan to borrowers in the first stage of the game. Introducing the opportunity to build up partner relationships in the IP treatment should not affect the theoretical predictions of the game, since it is only finitely repeated. Analogous backward induction arguments show that there is a unique subgame perfect equilibrium in the group lending treatments with or without sanction. Because punishment is costly to the sanctioner, it does not affect decisions at later nodes: borrowers would never repay their debt. Lenders offer no credit anticipating no repayment at any time. This is stated below in H0.

[13] Subjects were confronted with ten choices between two lotteries, one "risky" (with payoffs of €3.85 and €0.1) and one "safe" (with payoffs of €2 and €1.6), with probabilities ranging from 10% to 100%. In both options, the probabilities for the first of the ten sequential decisions are 10% for the high payoff and 90% for the low payoff. The difference in the expected payoffs between the two lotteries is such that only an extreme risk-seeker would systematically choose the "risky" option.

H0. *Assuming common knowledge of rationality and selfishness, lenders will never offer loans. Neither the opportunity to build up partner relationships nor the introduction of group lending (with or without peer sanctioning) should affect the theoretical predictions of the game.*

3.2. Behavioral assumptions

We can relax the above assumption and assume that a significant fraction of borrowers may be trustworthy and exhibit a reciprocal behavior. A number of papers have shown that at least some people are reciprocally-motivated and react to (un)fair intentions by sacrificing part of their payoff in order to punish bad intentions or reward kind actions (this reciprocity is modeled in Rabin, 1993; Fehr and Schmidt, 1999; Charness and Rabin, 2002; Falk and Fischbacher, 2006; and Dufwenberg and Kirchsteiger, 2004).[14] In our credit-market game, reciprocal borrowers are those who would honor the credit terms proposed by the lender, were the proposal to be seen as fair (for example if the lender asked for the efficient project to be carried out and for fair repayment in the case of project success). Consequently, one would expect non-null levels of loan offers by lenders to borrowers in the IS treatment if the former anticipate that the latter will reciprocate by repaying their debt.

In addition to reciprocity, repeated interactions in the partner treatments may also give rise to reputation effects. Reputation mechanisms can be characterized as follows: albeit selfish, a lender may have an incentive to enter the credit market if she anticipates the presence of a sufficient fraction of reciprocal borrowers, because she can earn more by entering the market than by choosing the outside option. Similarly, selfish borrowers may have an incentive to imitate reciprocal borrowers because they can benefit from repaying their debt. The intuition is that borrowers have an incentive to be reputed as reciprocal because they anticipate that lenders will condition the renewal of the contract on past repayments. This in turn makes it profitable for lenders to enter the credit market. As a result, both the number of loans and market performance should be greater under the partner-matching treatments than under the stranger-matching treatment. In our credit market, we would therefore expect that the possibility of reputation-building should enhance cooperation between lenders and borrowers.

[14] Reciprocal behavior has been observed in a variety of experimental games. For example, Berg et al. (1995) find reciprocal decisions in the context of the investment game; Gächter and Falk, (2002) in a gift-exchange game; Clark and Sefton (2001) in a sequential prisoner's dilemma; and Abbink et al. (2000) in the "moonlighting game". Fehr and Gächter (2000), Keser and van Winden (2000), and Croson (2007) note that a non-negligible fraction of subjects reciprocate others' contributions to a public good.

Experimental works (e.g. Andreoni and Miller, 1993; Gächter and Falk, 2002) show that levels of cooperation are significantly higher under a partner-matching protocol than under a stranger-matching protocol via greater reciprocity and reputation. These works also highlight a strong endgame effect when no more reputation building is possible. Brown and Zehnder (2007) and Fehr and Zehnder (2009) draw the same conclusions in a competitive credit market, and remark that lenders' offers in *t* depend on repayment of the previous loan in *t*-1. The analysis of survey data also reveals a positive correlation between long-term relationships and credit availability (e.g. Petersen and Rajan, 1994; Berger and Udell, 1995; Cole, 1998). These alternative conjectures assuming reciprocity and reputation building are stated in H1.

H1*: a) Lenders may be incited to grant loans even under the IS treatment if they anticipate that borrowers will reciprocate by repaying their debt. b) The opportunity to engage in repeated interactions (IP treatment) should improve cooperation between lenders and borrowers, leading to a higher number of loan proposals and higher repayments in the IP than in the IS treatment.*

One possible objection to this putative positive correlation between long-term relationships and fair credit offers is that reciprocity and reputation may be nullified by lenders taking advantage of their bargaining power to raise the interest rate, as long-term relationships imply captive markets (Sharpe, 1990; Von Thadden, 1998; Boot, 2000). This suggests that lenders may ask for higher repayment rates in the IP treatment. This hold-up effect has been noted in Sharpe (1990) and Rajan (1992). We can easily see from the discussion above that the hold-up and reciprocity/reputation effects work in opposite directions, leading to a multiplicity of equilibria and making the theoretical prediction of the game indeterminate. We thus turn to empirical analysis to identify the links between long-term relationships and credit cost. This is summarized in assumption H2.

H2*: Under the assumption of a hold-up effect, the cost of credit (i.e. the repayment rate stipulated by the lender in the credit contract) should be higher under a partner-matching protocol (i.e. IP treatment) than under a stranger-matching protocol (i.e. IS treatment).*

Our third conjecture concerns the incidence of introducing a group dimension in the contract. Based on previous findings, we argue that group-lending contracts in absence of sanctioning mechanisms should induce the emergence of a free-riding problem that leads to an exacerbation of moral hazard (Giné et al., 2010). The underlying reason to this phenomenon is that peer-group lending would incite borrowers to adopt opportunistic behaviors by exhibiting

low levels of repayment while benefiting from the collective contract offered to the whole group. Anticipating these opportunistic strategies, lenders would restraint the credit flow (number of loan offers) as compared to other treatments wherein personalized contracts are possible. This is summarized in assumption H3.

H3*: In absence of sanctioning mechanisms, free-riding should emerge with groups, leading to lower reimbursement rates than in the individualized contracts. Consequently, anticipating this situation, bankers would make fewer loan offers.*

The introduction of peer sanctioning should alleviate such free-riding problem. We indeed know from previous laboratory experiments that in several contexts such as voluntary contribution to public good, the use of costly sanctions in groups has been frequently observed in laboratory settings, leading to higher contribution levels (Fehr and Gächter, 2000 and 2002; Gintis, 2000; Masclet et al., 2003; Carpenter et al., 2004; Gächter and Hermann, 2005; Carpenter, 2006). In the same vein, Carpenter and Williams (2010) run a field experiment inspired by Masclet et al. (2003) and Carpenter and Seki (2011), in which non-monetary sanctions are used to control free-riding with women about to enter a group-lending program in Paraguay. The authors find a very strong causal relationship between the average monitoring propensity of one's lending group and repayment. Our conjecture concerning the effect of peer sanctioning is stated more precisely in H4.

H4*: The introduction of peer-sanctioning mechanisms should alleviate free-riding problem, leading to higher reimbursement levels in the GPS than in the GP treatment.*

4. Results

4.1. Lenders' contracting behavior

Consistent with our assumption H1, Table 4 indicates that, in all treatments, lenders do not hesitate to grant loans. There is however an important heterogeneity across treatments. In particular, Table 4 shows that more loans are granted in the IP treatment.

4.1.1. Average loan offers

Figure 1 presents the time series of the average number of loan offers per period, averaged across treatments. It shows that, in all treatments, the number of loan offers declines over time. Figure 1 also shows that more loans are offered in the IP than in the IS, GPS and GP

treatments. On average, 79% of loans are proposed in the IP treatment, as compared to only 51% in the IS and GPS treatments and 39% in the GP treatment. A Mann-Whitney rank-sum test indicates that there are significantly more loans offered in the IP than in the IS treatment (p=0.0003). Similar tests show that the differences both between the IP and GP treatments and between the IP and GPS treatments are also significant (p=0.0002 and p=0.0039, respectively).[15] When a loan is granted, in a vast majority of cases (two thirds of cases), the lender stipulates project *A* as the desired project. Mann-Whitney rank-sum tests indicate that there is no significant difference in the stipulated contract across treatments. These findings are summarized in Result 1.

[Table 4 and Figure 1: about here]

Result 1: *a) The average number of loan offers is significantly higher when long-term individualized relationships are possible compared to situations with short-term or non-individualized (i.e. group lending) relationships. b) The lender conditions the renewal of her offer in* t *on repayment in* t-1.

Support for result 1: To provide a more formal proof of these findings, we estimated probit models on the probability of making a loan offer. Since each subject is observed up to 15 times, we use panel data methods with random effects.[16] These estimates are shown in Table 5. The dependent variable Y_{it} corresponds to the lender's decision of making a loan offer in period *t*. This takes the value 1 if subject *i* makes a proposal and 0 otherwise.

$$Y_{i,t} = \alpha + \beta_1 IP + \beta_2 GP + \beta_3 GPS + \beta_4 Repayment_{t-1} + \beta_5 Period + \beta_6 FinalPeriod + \beta_5 X_i + \varepsilon_{i,t} \quad (3)$$

The estimates include dummy variables for each treatment. The omitted variable is the IS treatment. In so doing, we are able to take in isolation three essential features of microfinance: long-term relationship, group lending and peer sanctioning. The $Repayment_{t-1}$ variable measures the share of the previous loan reimbursed by the borrower in *t*-1. We also control for time effects by including a trend variable and for order effects by introducing a dummy that

[15] Each group is considered as an independent observation in the IP, GPS and GP treatments, whereas each session is considered as an independent observation in the IS treatment.

[16] To check the robustness of our experimental results, we also considered a number of alternative specifications: random effect tobit models and two-step estimates procedure that corrects for any selection bias due to the exclusion of observations corresponding to rejected contracts. These additional specifications provide very similar results.

takes 1 when participants took part in two treatments. X_i is a vector of personal characteristics, including gender, a measure of risk aversion,[17] and a binary variable indicating whether the participant is an economics student.[18] The results are shown in Table 5. Column (1) shows that the fact of being in the IP treatment significantly increases the probability of offering a contract. In contrast, the coefficients on *GP* and *GPS* are insignificant, thereby indicating that peer-group lending dimension – even with the opportunity of peer sanctioning – has no significant effect on the number of contracts offered. The positive and significant coefficient on $Repayment_{t-1}$ indicates that lenders are more willing to make an offer in period *t* when borrowers did not default in the previous period. This shows that lenders condition a new loan offer in *t* on good past repayment behavior. The negative coefficient on the *Period* variable indicates that loan offers fall over time. This shows that lenders are more reluctant to grant money as reputation building becomes infeasible. Estimate (2) controls for demographics. It provides very similar findings.[19]

[Table 5: about here]

4.1.2. Cost of credit (average repayment desired) and hold-up effect

The results presented above emphasized the influence of long-term relationships in increasing the number of credit offers. In this subsection, we show that entering a long-term relationship may also produce negative externalities. Our data indicate that the cost of credit (i.e. the repayment desired by the banker / project outcome in the case of success) is significantly higher in the IP treatment compared to the IS treatment. In the IS treatment, the cost of credit is 0.40 whereas it amounts to 0.46 in the IP treatment. A Mann-Whitney rank-sum test confirms the significance of the difference between the IS and IP treatments (p=0.0450). One interpretation is that long-term bilateral relationships may hold up borrowers due to lenders taking advantage of their bargaining power. The costs of credit are 0.40 and 0.40 in the GP and GPS treatments, respectively. Mann-Whitney rank-sum tests indicate that the differences

[17] This score corresponds to the number of safe choices made by the subject out of the ten choices in Holt and Laury's (2002) lottery (see footnote 13). A score of 1 corresponds to "highly risk-loving", whereas a score of 8 or more corresponds to "highly risk-averse".

[18] We also control for the fact of being real banker by including two dummy variables for real bankers (one for commercial bankers and another for social bankers). These findings are not discussed here but in a companion paper (see Cornée et al. 2012).

[19] Most of the variables corresponding to socio-demographic characteristics remain insignificant to the notable exception of *Social Bankers*. In Cornée et al. (2012), we provided an in-depth examination of the differences between real bankers (commercial bankers and social bankers) and students. We found that these differences were essentially explained by the social bankers' behavior which was driven by social and ethical considerations. No such differences appeared between commercial bankers and students.

between the IS condition and the GP/GPS conditions are not significant (p=0.9433 between IS and GP and p=0.3838 between IS and GPS). These observations are summarized in Result 2.

Result 2: *a) The repayment desired by the banker is significantly higher under the IP than in the IS treatment. b) The repayment desired in the group-lending treatments (GP and GPS) does not differ from the IS treatment.*

Support for Result 2: A more formal proof of Result 2 is given in the right panel of Table 5 that shows estimates on desired repayment levels.

$$DesiredRepayment_{i,t} = \alpha + \beta_1 IP + \beta_2 GP + \beta_3 GPS + \beta_4 Repayment_{t-1} + \beta_5 Period + \beta_6 FinalPeriod + \beta_5 X_i + \quad (4)$$

$DesiredRepayment_{i,t}$ corresponds to the repayment desired by the banker separately for contracts which demand project *A* or project *B*. Our independent variables include dummy variables for each treatment as well as the lag variable $Repayment_{t-1}$. All specifications include period dummies. We also include dummy variables to control for real bankers and the usual demographics.

The first two specifications display the results of regressions in which the dependent variable is the desired repayment level for contracts which demand project *A*. The last two specifications display similar results for contracts which demand project *B*. The positive and significant coefficients associated to the *IP* variable in columns (3) to (6) confirm that individual long-term relationships incite lenders to take advantage of their bargaining power. This finding tends to give support to assumption H2.

4.2. Borrowers' investment, repayment and sanctioning behavior

4.2.1. The effects of contractual design on ex ante *moral hazard (shirking) and* ex post *moral hazard (strategic default)*

In this section, we investigate the effects of long-term relationship, group lending and peer sanctioning on the *ex ante* and *ex post* moral hazards: shirking (not choosing the project stipulated in the credit contract) and strategic default (null or partial reimbursement), respectively.

Let us consider first *ex post* moral hazard. Figure 2 illustrates the time path of borrowers' repayment rates per period, averaged across groups, in the four treatments. In the IS treatment, repayment rates are 0.33 after project success. In the IP treatment, this rate is 0.70.

A Mann-Whitney test confirms that reimbursement is significantly higher in the IP than in the IS treatment (p=0.0001). Turning next to the GPS and GP treatments, repayment rates are respectively 0.59 and 0.38. Repayment rates are significantly higher in the GPS than in the IS condition (p=0.0339) while no significant difference is found between the GP and IS treatment (p=0.2595). Finally, repayment rates are significantly higher in the IP than in the GP condition (p=0.0030). No significant difference is found between the IP and GPS treatments (p=0.2446). These findings are summarized in Result 3a.

[Figure 2: about here]

Result 3a: *a) Borrowers' repayment levels are significantly higher in the IP than in the IS treatment. b) In absence of peer-sanctioning mechanisms, the introduction of peer-group dimension fails to increase borrowers' repayment levels. c) Introducing peer sanctioning leads to higher repayment.*

Support for Result 3a: A more formal proof of Result 3a is given in the left panel of Table 6, which presents the determinants of repayment levels. The regressions are estimated via Generalized Least Squares. The independent variables include most of the variables introduced in the previous table. This parametric analysis confirms our previous results based on nonparametric tests. The positive and significant coefficient on *IP* highlights the incentives associated with long-term relationships. In specifications (1) and (2), the coefficient on the *GP* variable is not significant, confirming the fact that, in absence of peer-sanctioning mechanisms, peer-group contracts fail to reduce *ex post* moral hazard. In contrast, the introduction of peer sanctioning partially alleviates the free-riding problem as shown by the positive and significant coefficient on *GPS*. Finally, the negative and significant coefficients on *Period* and *Final period* highlight a strong endgame effect. Since it is common knowledge that the experiment is finitely repeated, we contend that part of the borrowers (the opportunistic ones) decide to default strategically and discontinue their cooperation with their incumbent lenders in the last periods of the game.

We now turn to the effects of the different contracts on the problem of shirking (*ex ante* moral hazard). Our main findings are summarized in Result 3b.

[Table 6: about here]

Result 3b: a) *The probability of shirking is driven by the level of repayment desired by the lender. b) In absence of peer-sanctioning mechanisms, the introduction of peer-group dimension increases free-riding. c) Introducing peer sanctioning limits the opportunity to shirk for borrowers in group.*

Support for Result 3b: The right panel of Table 6 exhibits a similar pattern regarding the *ex ante* moral hazard (shirking). Specifications (3) and (4) are probit models that estimate the probability of shirking, i.e. not choosing the project stipulated in the credit contract. The positive and significant coefficients on *Desired repayment* indicate that the probability of shirking is impacted by the level of repayment desired by the lender in the credit contract. The positive and significant coefficient on the *GP* variable confirms that group lending without peer sanctioning is plagued by shirking problems. Once again, the peer-sanctioning dimension (*GPS* variable) has a counterbalancing effect by lessening the *ex ante* moral hazard. Finally, in a similar manner to strategic defaulting in the case of repayment, borrowers tend to have a higher propensity to shirk in the last periods of the game if one refers to the positive coefficients on *Period* and *Final period* – to a lesser extent though since not all the coefficients are significant. Altogether Results 3a and 3b give support to assumptions H3 and H4.

4.2.2. A focus on the effects of peer-sanctioning mechanism on ex ante *and* ex post *moral hazards*

The results presented above showed that in absence of peer-sanctioning mechanism, peer-group lending systems have a negative influence on borrowers' repayment rates. The possible reason is that peer-group lending may incite borrowers to adopt free-rider's behaviors by repaying low levels while benefiting from the collective contract offered to the whole group. Subsequently, borrowers may benefit from this situation and may hide behind the group to adopt opportunistic behaviors, such as shirking and strategic default. We now investigate in greater details the effects induced by the introduction of peer sanctioning. The findings are summarized in Result 4.

Result 4: *a) In the GPS treatment, the borrowers who contribute (i.e. repay) less than the average or shirk receive punishment points. b) The disciplining effect of the sanction points is observable for repayment but not for shirking.*

Support for Result 4: In the GPS treatment, after the completion of the microfinance game, borrowers can observe the repayment decisions of the other individuals of the group as well as the project they choose. Thus, they can condition their sanctioning behavior on these pieces of information. In the left panel of Table 7, we examine the determinants of the sanctions by the other members of the group. The dependent variable is *Received punishment points* of a participant. The independent variables include *Others' average repayment* that corresponds to the repayment level of the other members of the group. The variable *Negative deviation from average* is the absolute value of the actual negative deviation of a subject's repayment level from the others' average, in the case that her own repayment level is below the average group repayment. It takes zero if her own repayment level is equal or above the average. The variable *Positive deviation from average* is constructed analogously. We also include a dummy variable *Shirking* which indicates whether the borrower shirked by not choosing the project stipulated in the lender's contract. Column (1) shows that the greater is a group member's negative deviation from the average, the more punishment points she receives. Column (1) also indicates that subjects are also punished for shirking by not choosing the stipulated project, as shown by the positive and significant coefficient associated to the *Shirking* variable.

[Table 7: about here]

To test the impact of the received punishment points in period *t* on subsequent repayment decisions, additional specifications are run in the right panel of Table 7. In the GLS estimation of Column (2), the dependent variable *Change in repayment* is defined as the change in repayment level between period *t*-1 and period *t*. The estimate indicates that those who received punishment points in *t*-1 increase their repayment in *t*. Altogether these findings show the disciplining effect of sanctioning mechanisms in promoting cooperation within groups and reducing opportunism that lead to higher repayment rates in the GPS treatment compared to the GP treatment. No such an effect is observed for shirking. The probit model (available upon request) run to check this possibility does not yield any significant result.

5. Discussion

The success of microfinance has most often been explained by its recourse to peer lending. However, several previous studies have shown the key role played by individual long-term based contracts in microfinance systems, in particular when they are implemented in developed countries in absence of peer-lending systems (Armendariz de Aghion and Morduch, 2000; Vigenia and Kritikos, 2004). Our experimental study confirms this idea. We indeed suggest that the key dimension for successful microcredit schemes is dynamic incentives induced by repeated interactions, which means that lenders make future loan accessibility contingent on good repayment conduct for the current loan in order to deter borrowers from defaulting strategically. First, consistent with previous findings, in absence of peer-monitoring and peer-sanctioning mechanisms, microcredit contracts tend to accentuate moral hazard by inciting borrowers to adopt opportunistic behaviors (Giné et al., 2010). The introduction of peer sanctioning only partially mitigates *ex ante* and *ex post* moral hazards. As observed in several previous studies, both laboratory and field experiments, peer sanctioning leads to higher cooperation levels (e.g. Fehr and Gächter, 2000 and 2002; Gintis, 2000; Masclet et al., 2003; Carpenter and Williams, 2010; Carpenter and Seki, 2011).

In sharp contrast, the opportunity to engage in bilateral long-term relationships markedly improves market performance by facilitating borrowers' access to credit and mitigating the repayment problem (*ex post* moral hazard) through higher repayment rates. These findings are consistent with those in previous experiments showing that long-term relationships have a powerful disciplinary effect in a number of different contexts, including public-good games, gift-exchange games and trust games (e.g. Andreoni and Miller, 1993; Fehr and Gächter, 2000; Gächter and Falk, 2002; Bohnet and Huck, 2004). Long-term relationships also have some have detrimental side effects. In particular, we tend to give support to the hold-up effect hypothesis in showing that lenders tend to take advantage of long-term relationships by increasing their interest rates. One of the main drawbacks induced by the hold-up effect is the exacerbation of *ex ante* moral hazard. Higher interest rates may indeed incite borrowers to select riskier investment projects (Cornée et al., 2012).

To summarize, our findings indicate that the success of microcredit mainly rests on the existence of long-term lending relationships and, to a lesser extent, on the use of group lending conditioned on the presence of peer-sanctioning mechanisms.

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Figure 1: Average number of loans offered per period

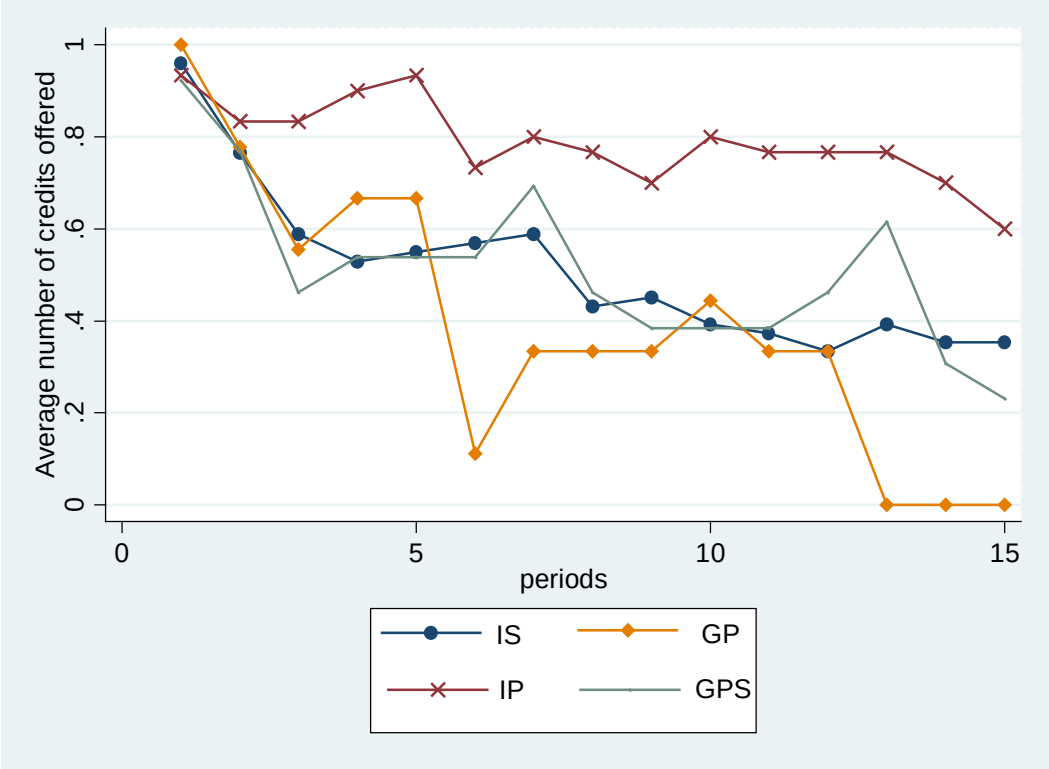
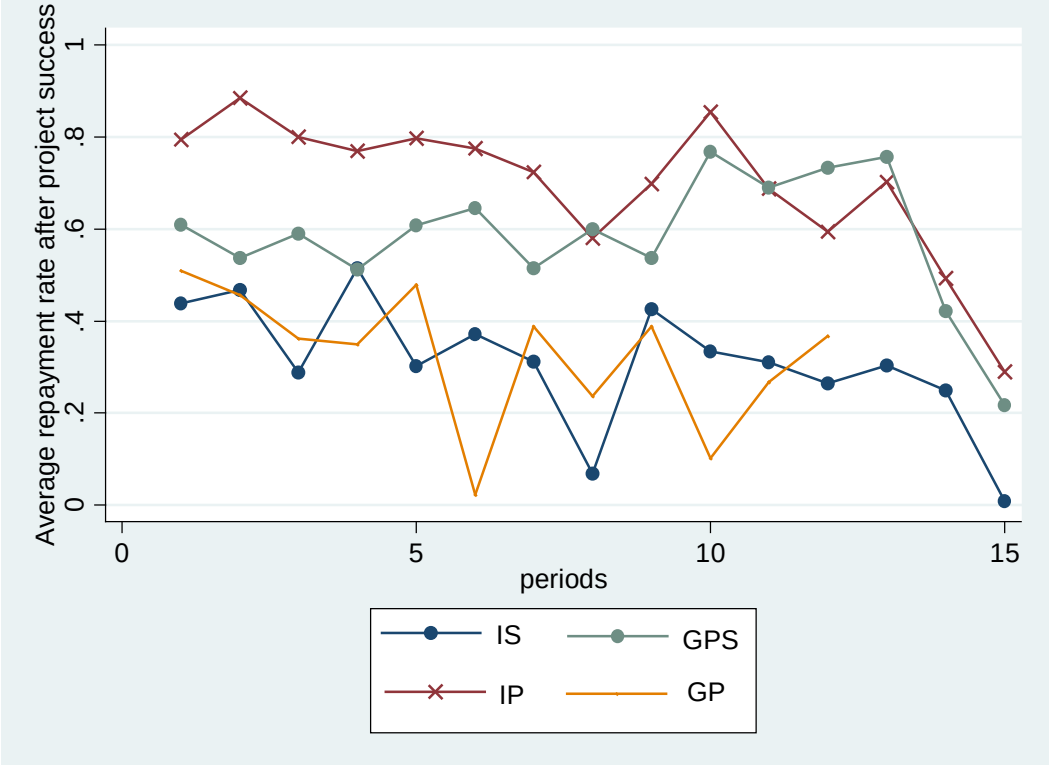


Figure 2: Average repayment rates after project success per period



Note: In periods 13, 14, and 15, there is no observation for the GP treatment because lenders make no offer in these periods.

Table 1: Characteristics of investment projects

Characteristics	Project A	Project B
Probability of success (φ_p)	80%	30%
Return in the case of success (R_p)	100	200
Return in the case of failure	0	0

Table 2: Characteristics of experimental treatments

	Treatments	**Contractual design**	**Partner**	**Group lending**	**Peer sanctioning**
Individual lending	Individualized relationship in stranger matching **(IS)**	1 lender => 1 borrower			
	Individualized relationship in partner matching **(IP)**	1 lender => 1 borrower	**X**		
Group lending	Peer-group lending without sanctions **(GP)**	1 lender => 1 group of 4 borrowers	**X**	**X**	
	Peer-group lending with sanctions **(GPS)**	1 lender => 1 group of 4 borrowers	**X**	**X**	**X**

Table 3: Characteristics of the Experimental Sessions

Session number	Number of subjects	Treatments	Matching protocol
1	8	IS	Stranger
2	8	IS	Stranger
3	8	IS	Stranger
4	8	IS	Stranger
5	8	IS	Stranger
6	8	IS	Stranger
7	9	IS	Stranger
8	9	IS	Stranger
9	8	IS	Stranger
10	8	IS	Stranger
11	20	IP	Partner
12	10	IP	Partner
13	10	IP	Partner
14	10	IP	Partner
15	10	IP	Partner
16	15	GP	Partner
17	15	GP	Partner
18	15	GP	Partner
19	15	GPS	Partner
20	15	GPS	Partner
21	15	GPS	Partner
22	10	IS+GPS	Stranger/Partner
23	10	IS+GPS	Stranger/Partner
Total	**252 subjects**		

Table 4: Characteristics of contracts proposed by lenders and borrowers' behavior

Subjects pools Treatments	Microcredit contracts	Borrowers' behavior
IS	0.51[a] [0.68][b] *0.41*[c]	0.33[d] [0.68][e] *0.31*[f]
IP	0.79 [0.67] *0.46*	0.70 [0.71] *0.33*
GP	0.39 [0.65] *0.40*	0.38 [0.72] *0.40*
GPS	0.51 [0.65] *0.40*	0.39 [0.68] *0.34*

Notes: [a] Percentage of offers per period; [b] Percentage of projects *A* selected by lenders when loan offer; [c] Average credit cost (i.e. repayment desired by the banker / project outcome in case of success); [d] Average repayment rate (borrowers' repayment / repayment desired by lenders in the case of project success); [e] Average number of project *A* selected by borrowers when loan offers accepted; [f] Average shirking: percentage of borrowers that do not choose the project stipulated in the loan offer.

Table 5: Determinants of contracts (probability that a banker proposes a loan and determinants of desired repayment level)

Dependent variable	Loan offer		Desired repayment Contracts stipulating project A		Contracts stipulating project B	
Model	RE Probit [a]		RE GLS[b]			
Treatments	All treatments		All treatments		All treatments	
	(1)	(2)	(3)	(4)	(5)	(6)
IP	0.92***	0.79***	6.35***	7.70***	25.34**	18.53*
	(0.22)	(0.231)	(2.467)	(2.516)	(11.823)	(11.231)
GP	-0.27	-0.05	-0.44	0.73	1.105	-3.84
	(0.286)	(0.286)	(4.175)	(4.173)	(7.750)	(9.440)
GPS	0.02	0.15	0.148	-1.42	-1.79	0.33
	(0.244)	(0.237)	(3.897)	(3.638)	(11.260)	(9.626)
Period	-0.08***	-0.08***	0.07	0.08	1.19*	1.23*
	(0.011)	(0.011)	(0.151)	(0.153)	(0.671)	(0.684)
Final period	-0.05	-0.05	-1.39	-1.19	-10.28	-11.37
	(0.169)	(0.169)	(2.423)	(2.429)	(7.147)	(7.124)
Repay. level t-1	1.04***	1.03***	1.21	1.26	-9.12	-8.08
	(0.161)	(0.161)	(1.120)	(1.112)	(5.687)	(5.793)
Treatment order	-0.02	-0.166	-1.60	0.92	2.50	2.49
	(0.251)	(0.260)	(3.254)	(3.0755)	(11.345)	(9.088)
Demographics	No	Yes	No	Yes	No	Yes
Constant	0.48***	0.30	44.15***	43.48***	62.69***	70.19***
	(0.144)	(0.371)	(1.59)	(4.060)	(6.362)	(15.305)
Observations	1,442	1,442	520	520	279	279
Log likelihood	-766.65	-757.76	.	.	.	.
R-squared	.	.	0.05	0.12	0.14	0.22

Notes: [a] RE Probit = Random Effect Probit; [b] RE GLS = Random Effects Generalized Least Squares *** Significant at the 0.01 level; ** at the 0.05 level; * at the 0.1 level; Standard errors in parentheses. *Period* corresponds to the time periods (1-15) of the game. *Treatment order* takes 1 when participants were involved in a second treatment (periods 16-30) and 0 otherwise.

Table 6: Determinants of repayment and shirking

Dependent variable	Repayment		Shirking	
Model	RE GLS[a]		RE Probit[b]	
	(1)	(2)	(3)	(4)
IP	15.01***	15.12***	0.02	0.05
	(2.108)	(2.136)	(0.114)	(0.117)
GP	2.31	2.61	0.27**	0.32**
	(2.056)	(2.084)	(0.120)	(0.123)
GPS	8.85***	8.92***	0.07	0.08
	(2.184)	(2.100)	(0.108)	(0.109)
Period	-0.29**	-0.29**	0.003	0.00
	(0.146)	(0.146)	(0.009)	(0.009)
Final period	-7.47***	-7.19***	0.39*	0.42**
	(2.111)	(2.106)	(0.203)	(0.203)
Desired repayment	-0.04	-0.04	0.005***	0.00***
	(0.024)	(0.025)	(0.001)	(0.001)
Treatment order	-3.524	-3.48	0.06	0.063
	(2.570)	(2.504)	(0.112)	(0.112)
Demographics	No	Yes	No	Yes
Constant	13.57***	-1.88	-0.80***	-0.64
	(2.126)	(7.770)	(0.119)	(0.454)
Observations	1,323	1,323	1,323	1,323
Number of individual	.	.	-834.69	-832.50
R-squared	0.08	0.10	.	.

Notes: [a] RE GLS = Random Effects Generalized Least Squares; [b] RE Probit = Random Effect Probit;*** Significant at the 0.01 level; ** at the 0.05 level; * at the 0.1 level; Standard errors in parentheses. *Period* corresponds to the time periods (1-15) of the game. *Treatment order* takes 1 when participants were involved in a second treatment (periods 16-30) and 0 otherwise.

Table 7: Determinants of peer sanctioning and its effects on repayment

Dep. Var	Received punishment points	Net change in repayment
Model	RE Tobit [a]	RE GLS [b]
Treatment	GPS	GPS
	(1)	(2)
Neg. dev. from average	0.27***	
	(0.058)	
Pos. dev. from average	0.01	
	(0.033)	
Others' average contribution	0.05	
	(0.045)	
Shirking	1.58*	
	(0.819)	
Period	0.10	-0.11
	(0.087)	(0.483)
Received punishment points		6.03*
		(3.367)
Treatment order	-1.37	10.03
	(1.854)	(6.136)
Demographics	Yes	Yes
Constant	-14.69	33.16
	(9.360)	(23.804)
Observations	267	117
Left-censored observations	154	.
Log likelihood	-420.14	.
R^2	.	0.08

Notes: [a] RE Tobit = Random Effect Tobit; [b] RE GLS = Random Effects Generalized Least Squares;*** Significant at the 0.01 level; ** at the 0.05 level; * at the 0.1 level; Standard errors in parentheses. *Period* corresponds to the time periods (1-15) of the game.