Discussion paper

RELATIONAL CONTRACTING UNDER THE THREAT OF EXPROPRIATION – EXPERIMENTAL EVIDENCE

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Relational Contracting under the Threat of Expropriation - Experimental Evidence

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Abstract

We examine how relational contracting in credit and investment relationships is affected by the potential expropriation of funds. We implement credit relationships in which repayment is not third-party enforceable, i.e. borrowers can default on their loans. In our main treatment the borrower can expropriate the lender's funds: a defaulting borrower can reinvest the loaned funds in future periods. In a control treatment borrowers cannot expropriate borrowed funds, i.e. if they default they cannot reinvest these funds in future periods. We find that potential expropriation decreases the overall volume of credit as lenders offer smaller loans in initial periods. Borrowers are more likely to default in earlier periods of the relationship when expropriation is possible, especially when they receive large loans. Together these results suggest that relational contracts may be particularly difficult to establish in markets where the expropriation of funds is feasible. This finding is relevant to credit markets in which lenders' rights are weak, but also to sovereign lending, as well as to foreign direct investment in countries with weak investor protection.

Keywords: Relational contracts, Investor protection, Banking, Sovereign debt, Foreign direct investment.

JEL: C73, G21, O16, F21, F34.

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1. Introduction

When explicit contracts are costly to write and enforce relational contracts can mitigate opportunistic behavior in principal agent relationships. Existing theoretical research suggests that relational contracts may be particularly important in labor and credit markets, preventing workers from shirking (Bull, 1987) and borrowers from defaulting on their loans (Stiglitz and Weiss, 1983). Experimental evidence confirms that relational contracts do emerge in competitive labor and credit markets and reduce moral hazard by workers and borrowers (Brown et al., 2004; Brown and Zehnder, 2007; Fehr and Zehnder, 2009).

Existing experimental studies of relational contracting examine repeated principal-agent games which have one key feature in common: In each period the agent must trade with a principal in order to earn a surplus. This implies that the principal can discipline the agent by threatening to terminate the relationship should he or she behave opportunistically. This feature of existing experimental studies is unnatural in many environments. For example, in the context of bank-credit slow bankruptcy procedures and/or the inability of courts to immediately seize the assets of defaulting borrowers imply that a borrower may be able to expropriate borrowed funds from the lender and reinvest them. Likewise, if lenders and courts cannot prevent the tunneling of loaned funds to other investments (Johnson et al., 2000) the borrower may be able to expropriate borrowed funds. Thus, in countries with weak creditor protection and debt enforcement defaulting borrowers may continue their economic activity without the support of a lender. Cross-country data on debt enforcement and creditor protection suggests indeed that expropriation of funds by borrowers is perfectly feasible, particularly in emerging and developing economies.[1]

[1] The 2010 Doing Business Indicators of the World Bank (www.doingbusiness.org) show that the time required by a lender to recover a secured debt through a bankruptcy procedure ranges from 1.7 years on average in OECD countries to 3.4 years in Sub-Saharan Africa and 4.5 years in South Asia. The recovery rate (cents on the dollar) for the lender varies hereby from 68.6 in OECD countries to 17 in Sub-Saharan Africa and 20 in South Asia. Looking at a broader set of regulations and institutions which protect creditors, the Legal Rights Index elicited by Doing Business (on a scale of 0-10) varies from 6.8 in OECD countries to 4.6 in Sub-Saharan Africa and 5.3

Expropriation is also a major concern in sovereign lending and foreign direct investment (FDI). In the context of sovereign debt the borrower country can choose to default on the loan, and it may be impossible for the lender to recover any funds, due to the limitations of international law (Bulow and Rogoff, 1989). In the context of FDI, weak investor protection implies that the host-country partner may expropriate the investor's assets and continue production (e.g., Thomas and Worrall, 1994). [2]

In this paper we examine how potential expropriation of funds affects relational contracting. We concentrate on credit relationships and investigate how the credit volume, interest rate and loan repayment are affected by potential expropriation. We implement a credit market experiment in which a lender and a borrower interact for 7 periods. In each period the principal decides how much to lend to the borrower and which repayment to request. If the borrower receives a loan he earns a deterministic investment return. The borrower then decides whether to make the repayment requested by the principal. In our main treatment, a lender who defaults on a loan can expropriate these funds from the lender, i.e. he can use them to invest in future periods. We compare this main treatment to an otherwise identical control treatment in which, upon default, the agent cannot use the borrowed funds for future investment.

We expect potential expropriation to have two main effects on lender-borrower relationships in our experiment: First, we expect to see less relational contracts in which borrowers are motivated to repay loans and more relationships in which borrowers default, and thus are screened out, in initial periods. Second, when relational contracts emerge under expropriation we expect them to display lower credit volumes in initial periods. Only by

in South Asia. Evidence by Djankov et al. (2007, 2008) shows that these indicators of debt enforcement and creditor protection are correlated with access to credit and economic performance across countries.

[2] Expropriation is not only a characteristic of credit and investment relationships. In many labor relationships, such as in consultancy or law firms, expropriation of know-how or clients by employees is parallel to expropriation of funds by borrowers. A solution used in this context is the non-compete clause (Kräkel and Sliwka, 2006).

"starting small" and increasing loan sizes over time can a lender motivate a borrower to repay when expropriation is feasible.

Our experimental results confirm these predictions: Aggregate lending is lower when expropriation is feasible than when it is not, leading to lower investment and efficiency. In particular, loans offered in the initial period of a relationship are substantially lower with expropriation than without. When borrowers can expropriate the lender's funds, they default more often in early periods of a relationship, especially when they receive a large loan.

Our study contributes to the theoretical literature studying the increase in stakes over time in credit and investment relationships. Expropriation provides a rationale for the observation of the gradual building up of credit relationships in microfinance (Morduch, 1999, Armendariz and Morduch, 2006), in small-business lending, (Ioannidou and Ongena, 2009) and in FDI relationships (Rauch and Watson, 2003). Several reasons have been suggested for the progressive increase in stakes within principal-agent games. Some are based on the existence of asymmetric information about players' types, i.e. whether they are myopic or patient (Ghosh and Ray, 1996 and 2001), high or low ability (Rauch and Watson, 2003) or have a preference for cooperation or not (Sobel, 1985)[3]. Others are based on the optimality for the principal to increase stakes towards the end of the relationship, such that he can extract a greater surplus in the beginning (e.g. Thomas and Worrall, 1994, and Ray, 2002).

Our paper also contributes to the extensive literature on relational contracting in labor (e.g. Bull, 1987, MacLeod and Malcolmson, 1998) and credit relationships (e.g. Boot and Thakor, 1994, Boot, 2000). Experimental evidence both in labor and credit environments has shown that relationships can be sustained and lead to more efficient outcomes than one-shot interactions (see e.g. Fehr et al., 2009 for an overview). To our knowledge, all existing experimental investigations of relational contracting ignore potential expropriation by the

[3] This has also been studied in prisoner's dilemmas (see Watson, 1999 and 2002, Andreoni and Samuelson, 2006).

agent: If the agent defaults or shirks in one period, the funds he earns from doing so cannot be stored for future periods, but must be immediately consumed. This implies that if the agent wants to earn income in future periods he has to trade with a principal. This of course increases the prospects for successful relational contracts as principals have a strong disciplining device: the threat of discontinuation of a relationship.

Our lending game is closely related to the trust game introduced by Berg et al. (1995). One-shot and repeated trust games have been studied intensively in the experimental literature (for a review see, e.g., Camerer 2003). They have also been adapted to lending relationships, for the study of experimental credit markets (Brown and Zehnder, 2007). Experiments on repeated trust games have followed two different approaches. Some studies (starting with Camerer and Weigelt, 1988, many experiments have followed this tradition[4]) examine dichotomous decisions by the first-mover (trust or not trust) and second mover (honor or not honor). Other studies allow the first-mover to choose how much to send to the second-mover from an initial endowment, while the second-mover decides how much to send back (Cochard et al., 2004, King-Casas et al., 2005 and Bornhorst et al., 2009). As in Brown and Zehnder (2007) we combine these approaches: Lenders can choose how much to lend to the borrower, while the borrower chooses whether to repay or not.

The rest of the paper is organized as follows. Section 2 describes the experimental design. In Section 3, we outline the predictions, and report the experimental results in Section 4. Section 5 concludes.

[4] See Neral and Ochs (1992), Anderhub et al (2002), Brandts and Figueras (2003), Engle-Warnick and Slonim (2004, 2006a, 2006b), Rigdon et al (2007) and Duffy et al (2009).

2. Experimental design

Table 1 provides an overview of our three experimental treatments.

Table 1 here

2.1. Main treatment

In a single round of our main treatment, the **Expropriation treatment (E treatment),** one lender and one borrower are paired for 7 periods. We choose a finite horizon instead of an infinite horizon for several reasons. Theoretically, under both horizons, the effect of expropriation on credit volume and repayment behavior is expected to be qualitatively similar. It leads to a decrease in credit volume and makes repayment less likely. Experimentally, the fixed number of periods implies that all sessions are of the same length. Therefore, differences in learning are ruled out. Also, the finite number of periods implies that we can observe individual variation in reputation concerns. While these concerns are constant in an infinite horizon, they are strong at the beginning and very weak at the end with a finite horizon.[5]

In each period $t = \{1,..,7\}$ the borrower has an investment opportunity: he can invest the amount $I_t \in \{0, 1, 2, 3, ..., 10\}$, which yields a gross return of $3I_t$. with certainty.[6] We hold the investment opportunity of the borrower constant over time in order to examine credit rationing over the course of a relationship.[7]

[5] We choose 7 periods rather than 2 or 3, to be able to clearly separate the initial 'starting small' in loan sizes from the potential end-game effect, i.e. a reduction of loan sizes in the last periods of the game due to the fact that the game is close to an end.

[6] For an experimental analysis of credit relationships with stochastic investment returns see Fehr and Zehnder (2009).

[7] If, for example, we observe that a lenders offers a small loan in period 1 and she increases it over time, we know that the borrower was credit constrained in period 1. By contrast, when field studies observe rising loan schedules over time (e.g. Ioannidou and Ongena, 2010) they typically cannot distinguish whether this is due to increasing investment opportunities of the borrower over time or a relaxation of credit constraints. Kirschenmann (2010) examines credit constraints over the course of microfinance relationships by contrasting the desired loan

The investment amount of the borrower in each period $I_t = C_t + S_t$ is equal to his capital C_t and the loan size S_t he receives from the lender. In period 1 the borrower starts off with zero capital C_1=0. The loan available to the borrower in each period t={1,..,7} and the capital of the borrower in periods t={2,..,7} are determined by the subsequent decisions of the lender and borrower. The decision structure in each period is as follows:

- **Loan offer:** The lender receives an endowment of 10 units at the beginning of each period. As the borrower can invest at most 10 units per period, the lender can offer a loan size of $S_t \in [0, 10\text{-}C_t]$ to the borrower. The lender also chooses her requested repayment R_t. The requested repayment cannot exceed the income generated by the loan: $R_t \in [0, 3S_t]$. When the lender has determined her offer (S_t, R_t), the offer is shown to the borrower.
- **Loan acceptance:** If the lender chooses an offer with a strictly positive loan S_t >0, the borrower must decide whether to accept (A_t=1) or reject the offer (A_t=0).
- **Repayment decision:** If the borrower accepts a loan offer (S_t, R_t), he then decides whether to make the repayment requested by the lender (D_t=0) or default (D_t=1). Partial repayments are not possible.[8]

As mentioned above, the borrower starts off with zero capital. However, if the borrower receives a loan he can expropriate the lender's funds and keep these funds for future investment. We assume that borrowers who default in period t automatically have the loan principal S_t added to their capital for all subsequent periods. We further assume that

size and granted loan size as reported in credit file data of a Bulgarian bank. However, her identification of credit constraints is based on the assumption that borrowers report their true financing needs.

[8] In reality some borrowers obviously become delinquent without fully defaulting. However, due to the deterministic nature of investment earnings in our design we exclude partial repayments, as in Brown and Zehnder (2007).

borrowers cannot liquidate their capital (and consume the proceeds) before the final period.[9] The capital of a borrower in periods $t = 2,\ldots,7$ thus equals the sum of the loaned funds which he did not repay: $C_t = \sum_{k=1}^{t-1} D_k S_k$.

We implement a symmetric "reservation" income of 10 points per period for the lender and the borrower. This design choice was made so that asymmetric reservation payoffs would not affect the decisions of lenders to offer credit.

The income of the lender in each period is equal to her reservation payoff plus her net income from lending (R_t - S_t) if she lends.

$$\pi_t = \begin{cases} 10 & \text{if no loan } (S_t = 0, A_t = 0) \\ 10 - S_t + R_t & \text{if loan repaid } (S_t > 0, A_t = 1, D_t = 0) \\ 10 - S_t & \text{if loan default } (S_t > 0, A_t = 1, D_t = 1) \end{cases}$$

The income of the borrower is equal to his reservation payoff plus his gross investment income $3(C_t + S_t)$ minus any repayment he makes to the lender (R_t) and minus the capital which he is forced to keep for the following period $C_{t+1} = C_t + D_t S_t$. As mentioned above, borrowers cannot liquidate their capital before the final period. In periods t=1,…, 6 this amount is thus deducted from their gross income and transferred as capital to the following period.

$$u_{t=1,\ldots 6} = \begin{cases} 10 + 3C_t - C_t & \text{if no loan } (S_t = 0, A_t = 0) \\ 10 + 3(S_t + C_t) - R_t - C_t & \text{if loan repaid } (S_t > 0, A_t = 1, D_t = 0) \\ 10 + 3(S_t + C_t) - (C_t + S_t) & \text{if loan default } (S_t > 0, A_t = 1, D_t = 1) \end{cases}$$

[9] The fact that we force borrowers to reinvest funds that they expropriate, rather than allowing them to decide whether to consume or reinvest them seems restrictive. We made this design choice for two reasons. First, we wanted to simplify the game as much as possible by abstracting from consumption / saving decisions. Second, reinvestment of loaned funds is the optimal strategy of a borrower who has defaulted: in a reputation equilibrium, any borrower who defaults on a loan will not receive future loans and so it is in his best interest to reinvest the funds he has available.

We assume that at the end of period 7 the borrower can liquidate all of his capital and consume it. We make this assumption to ensure that repayment behavior in the final period of our main treatment has the same payoff implications as in our control treatments (described below) where loan defaults are feasible but the expropriation of loan principal is not.

$$u_{t=7} = \begin{cases} 10 + 3C_t & \text{if no loan } (S_t = 0, A_t = 0) \\ 10 + 3(S_t + C_t) - R_t & \text{if loan repaid } (S_t > 0, A_t = 1, D_t = 0) \\ 10 + 3(S_t + C_t) & \text{if loan default } (S_t > 0, A_t = 1, D_t = 1) \end{cases}$$

At the end of each period the lender is informed about the borrower's repayment decision. Each player gets to know his own and his partner's payoffs for this period and both players are informed about the borrower's capital for the following period.

2.2. Control Treatments

We contrast our main treatment with a control treatment in which expropriation is not feasible, the **No Expropriation treatment (NE treatment)**. In this treatment the decision structure, information conditions and parameters are identical to the E treatment. The only difference between the two treatments is the determination of the borrower's capital. In the NE treatment we impose that the borrower cannot expropriate loaned funds and reinvest them. Thus, C_t =0 in each period.

Note that in both the E treatment and the NE treatment borrowers can default on their loans. The difference between the two treatments lies in what a borrower can do with the funds when he defaults. In the NE treatment the borrower must "consume" all of these funds and cannot reinvest any part of them. This treatment represents a legal environment in which loan default is possible, but the borrower can only evade repaying a loan if he liquidates his

investment and consumes all the proceeds. In the E treatment, by contrast, the borrower is not forced to liquidate his investment if he defaults on a loan. The borrower continues using the loaned funds for investment purposes without having to surrender either his assets or his future profits from these assets to the creditor. The E treatment thus represents a legal environment in which creditor protection and debt enforcement are weaker than in the NE treatment.

In both treatments, we abstract from the possibility of saving from net investment earnings. We concentrate on the problem of weak investor protection and, thus, do not allow borrowers to 'legally' save money for investment, from the profits earned in each period.

Our second control treatment is the **One Shot Treatment (1S Treatment)**. Here the lending game lasts for 1 period only and borrowers have zero capital. This treatment serves as a benchmark for lending activity, when multi-period relationships are not feasible.

2.3. Procedures

At the beginning of each session participants are randomly assigned to the role of either a borrower or a lender. These roles are fixed for the whole session. Each player forms part of a matching group, composed of 3 lenders and 3 borrowers. Each player plays three rounds of our lending game: each lender (borrower) repeats the lending game with three different borrowers (lenders) in her/his matching group. As a consequence we observe 9 lender-borrower relationships for each matching group.

In the E and NE treatments, the lender and the borrower have an overview of the history of play in previous periods for the current round. As mentioned above, each round lasts 7 periods. For each past period in the current round they can see the loan size and requested repayment of the lender, whether it was accepted by the borrower and whether the borrower

repaid. As a new round started lenders and borrowers were newly matched, and the history of play was erased.

In total 126 students participated in our experiment. In the E treatment there were 7 matching groups of 6 players each, in the NE treatment 8 matching groups, and in the 1S treatment 6 matching groups. As displayed by Table 1 this implies that we observe 63 lender-borrower relationships in the E treatment, 72 relationships in the NE treatment and 54 relationships in the 1S treatment.

Each participant could only participate in one session, so that each subject experienced only one of the treatments. All participants were students at Tilburg University. The experiment was programmed and conducted with the experimental software z-Tree (Fischbacher, 2007).

Behavior in our lending game might be affected by individual characteristics. First, as shown by Schaechter (2007), individual risk preferences do affect decisions in trust-games. Second, the level of strategic reasoning, i.e. the anticipation of what other subjects in the matching group might do, can affect behavior significantly (Nagel, 1995). Third, social preferences, i.e. reciprocal motives and fairness preferences of the borrower, as well as the anticipation of these preferences, i.e. trust by the lender, should affect behavior in our experiment (see Camerer, 2003 for a detailed discussion).[10] Before the lending game started, the participants took part in three short pre-experimental games aimed at measuring their levels of risk aversion, strategic reasoning, trust and trustworthiness. Appendix B describes these pre-experimental games in detail and provides summary statistics for their outcomes in the E and NE treatments. We show there that there are no significant differences in behavior in these games between the two treatments. The instructions for these games are available from the authors upon request.

[10] Roe and Wu (2009) show that the behavior of players in a repeated gift-exchange game is related to their behavior in one-shot social preference games.

Throughout the pre-experimental games subjects received no feedback. They were not informed about other subjects' decisions or their own payoffs until the end of the experiment. Subjects were informed about this at the beginning of the experiment. They also knew that the decisions in each pre-experimental game had no effect on the lending game.

After the three pre-experimental games and before starting our lending experiment, each subject had to read a detailed set of instructions. The instructions can be found in Appendix C. The experimental instructions were framed in a credit market language.[11] After reading the instructions participants had to pass a test with control questions. The lending game did not start until all subjects had correctly answered all control questions.

Sessions in which the NE or E treatment was played lasted approximately 120 minutes. Sessions in which the 1S treatment was played lasted on average 60 minutes. Subjects received a show-up fee of 5 Euros and 1 additional Euro for every 25 points earned during the experiment. They received an additional sum of 3 Euro at the end of the sessions in which the 1S treatment was played. This was done to avoid very low earnings for subjects in this treatment. On average subjects earned 10 euro per 60 minutes of participation.

3. Predictions

Under the assumption of common knowledge of rationality and selfishness of all market participants, the predictions for each of our three treatments are straightforward. Since repayments are not enforceable, a borrower's best response is to never repay a loan in a one period game. Lenders, anticipating this behavior, will never offer credit in the 1S treatment.

[11] The reason why we chose a context-specific and not a neutral framing was that the experiment was relatively complex. In complex experiments a completely neutral language bears the danger that subjects create their own (potentially misleading) interpretation of the decision environment. Thus, the context specific framing gives us control over what our participants have in mind. In our view, this not only reduces noise but also increases the external validity of the experiment. See also Brown and Zehnder (2007) for a discussion of this issue.

As our E and NE treatments last for a finite number of periods, a simple backward induction argument ensures that this equilibrium is played in each period of these treatments as well.

A broad body of experimental evidence suggests, however, that not all people will simply maximize monetary payoffs in our experiment. Social preferences based on reciprocity (Dufwenberg and Kirchsteiger, 2004) or distributional concerns (Fehr and Schmidt, 1999) can induce borrowers in our experiment to repay loans even in the 1S treatment. Evidence from similar one-period trust games or investment games (Berg et al., 1995) suggests that a substantial share of second movers, i.e. borrowers in our context, do exhibit such social preferences.

We examine our three treatments under the assumption that some (non-distinguishable) borrowers are conditionally reciprocal: they are willing to meet their repayment obligations in a one-shot situation, as long as the repayment requested by the lender does not exceed a threshold value. We assume that this threshold $\overline{R}_t = \bar{r} S_t$ can be characterized by the maximum (gross) interest rate $\bar{r}$ that a social borrower is willing to pay. We assume that the remaining borrowers are selfish in the sense that they never repay loans in a one-shot situation. In accordance with previous experimental evidence, we assume that the share of social borrowers is positive but not large. Therefore, it is not profitable for risk-neutral lenders to lend in a one-shot game. Based on these assumptions, we provide an analytical examination of the E and NE treatments in Appendix A. In the following we outline the qualitative predictions per treatment resulting from that analysis and use these to establish hypotheses for our main treatment effects.

Our assumption on the share of social borrowers implies that, in a one-shot game, lenders will not be willing to lend, since only social borrowers repay loans. Therefore, we predict that lending will collapse in our 1S treatment.

Since borrower types are a priori indistinguishable, the E and NE treatments can be characterized as finitely repeated games of incomplete information. Theory suggests that such games have multiple equilibria (Kreps et al, 1982). We distinguish between two types of equilibria and, within each type, concentrate on the profit-maximizing equilibria for the lender, as he makes loan offers (as in Thomas and Worrall, 1994). In the first type of equilibria, *reputation equilibria*, selfish borrowers imitate the behavior of social borrowers during the first periods but separate by defaulting towards the end of the game. In the second type of equilibria, *screening equilibria*, selfish borrowers are screened out by the lender in the first period, and from period 2 onwards the lender only lends to (now identified) social borrowers.

In the **NE treatment** the profit-maximizing reputation equilibrium for the lender has the lender extend loans of maximum size 10 in periods 1 to 6 and a smaller loan in period 7. Loan offers in periods t=2, 3… 7 are contingent on the borrower repaying all past loans. Therefore, a selfish borrower has an incentive to imitate the social one by repaying in periods 1 through 5 with certainty. In period 6 the selfish borrower is indifferent between repaying and defaulting, as the loan size in period 7 falls, and repays with positive but smaller than one probability. This allows the lender to learn about the borrower's type in period 6 and lend profitably in period 7. Thus, in the NE treatment the profit-maximizing reputation equilibrium for the lender has maximum lending in periods 1 through 6 and full repayment in periods 1 through 5.

No screening equilibrium exists in the NE treatment. If such equilibrium would exist, selfish borrowers would default with certainty in the first period of the game. After their default, the lender would offer maximum loans of 10 to the borrowers who did not default, i.e. social borrowers. However, given that the lender offers maximum loans in subsequent periods, a selfish borrower has no incentive to default in the first period.

In the **E treatment**, the potential to expropriate and reinvest loaned funds increases the borrower's incentive to default. Still, reputation equilibria exist in this treatment. However, these equilibria must be characterized by "starting small" loan profiles: to meet the borrower's incentive constraint, the lender must start with non-maximum loans and increase the loan size offered to the borrower, if he or she repays. The intuition for this result is simple: if the lender offers the maximum loan of 10 in period 1, a selfish borrower could default and reinvest these funds in all future periods without paying interest. The selfish borrower only stands to gain from repaying initial loans if future loans are higher. Thus, the lender earns most profits by offering an increasing loan profile, with the maximum possible starting loan size.

In contrast to the NE treatment, a screening equilibrium does exist in the E treatment. If the lender offers a large enough loan in the first period, a selfish borrower prefers to default straight away. For example, a selfish borrower will never repay a maximum loan of 10, with desired repayment of $10\,\bar{r}$, while a social borrower will repay such a loan.

Whether the reputation or a screening equilibrium yields higher profits for the lender in the E treatment depends on the parameters of the game: the gross return on investment (3 in our experiment) the share of social borrowers, and the threshold interest rate of social borrowers $\bar{r}$. In Appendix A, we show that if $\bar{r}$=2 the lender earns a higher profit in the reputation equilibrium than in a screening equilibrium.[12]

Comparing our predictions for the E and NE treatments, we expect lower levels of credit volume in the E than in the NE treatment. There are two reasons for this. First, reputation equilibria in the E treatment should be characterized by “starting small”, and thus by lower initial loan sizes than in the NE treatment. Second, in the E treatment screening equilibria which imply no lending to selfish borrowers in periods 2 through 7 exist, in contrast to the NE treatment. The repayment rate in the E treatment should be lower in initial periods but higher

[12] The assumption that $\bar{r}$=2 implies that social borrowers demand at least half the surplus from a loan contract. As we show in section 4, this assumption is supported by observed behavior in our experiment. We find that the 2 is the most common interest rate demanded in all three of our treatments.

in subsequent periods, than in the NE treatment, if some relationships in the E treatment are characterized by screening. Aggregate investment may be either higher or lower in the E than in the NE treatment. If both treatments are characterized by reputation equilibria we expect higher investment in the NE than in the E treatment due to lower lending volumes in the E treatment. However, a screening equilibrium in the E treatment characterized by the maximum loan of 10 in period 1 implies full efficiency due to expropriation and reinvestment by selfish borrowers.

Hypothesis 1 (E treatment vs. NE treatment): *credit volume in the E treatment is lower than in the NE treatment. The repayment rate in the E treatment should be lower in initial periods and higher in later periods, compared to the NE treatment. Aggregate investment may be either higher or lower in the E treatment due to the potential for fully efficient screening equilibria.*

The predictions for our E treatment and the 1S treatment suggest that we should see a higher credit and investment volume in the former. Moreover, if reputation equilibria emerge in the E treatment, the aggregate repayment rate should be higher in that treatment.

Hypothesis 2 (E treatment vs. 1S treatment): *credit volume, repayment rate and investment volume in the E treatment is higher than in the 1S treatment.*

4. Results

We report our results in two steps: Section 4.1 provides an overview of our aggregate treatment effects by comparing the outcomes from the E, NE and 1S treatments. This sets the

stage for a detailed comparison of loan offers, borrower repayment and profits in the E and NE treatments.

4.1. Aggregate treatment effects

Table 2 presents mean statistics by treatment for lenders' offers and borrowers' repayment behavior, as well as the resulting level of investment and payoffs. Our matching process implies that each lender (borrower) played the lending game with three different borrowers (lenders). Panel A of Table 2 reports summary statistics based on the observed outcome in all three rounds. Panel B reports results for 3rd round behavior only. In both panels the significance of treatment effects between the E and NE, as well as between the E and 1S treatments are measured by p-values of two-sided Mann-Whitney tests which use the means per matching group as independent observations.

Comparing the **E treatment and the NE treatment** we find that the *Credit volume*, defined as the average loan size per period, is significantly lower in the E treatment compared to the NE treatment, as predicted in Hypothesis 1. If we consider all three rounds (Panel A) the average credit volume per period is 3.17 in the E treatment, compared to 5.67 in the NE treatment (p=.01). A similar result is obtained if we consider only the third round (Panel B). The *Interest rate* offered by lenders, defined as the desired repayment divided by the loan size, is close to 2 in both treatments, which implies that most lenders offered an equal split of the surplus. After learning, in round 3, the interest rate is not significantly different between the E and NE treatments (p=.42).

Turning to borrower behavior, Table 2 shows that the large majority of loan offers are accepted. We also find a high *Repayment* rate in both the E and NE treatments. Considering all three rounds, the repayment rate is 65% in the E treatment and 79% in the NE treatment.

The difference between the two treatments is significant (p=.05). If we consider the last round, this difference disappears with repayment rates at 70% and 83%, respectively (p=.15).

Considering all three rounds, we find a similar level of *Investment* in the E (5.45) and the NE treatment (5.54). However, by round 3, investment falls substantially in the E treatment and is significantly lower than in the NE treatment (p=.03). *Lender profits* differ significantly between the E and NE treatments. In the E treatment lenders just break even and earn significantly less than in the NE treatment (10.8 vs. 13.3, p<.01). Conversely, *Borrower profits* are higher in the E than in the NE treatment although this difference is not statistically significant (20.1 vs. 17.8, p=.13).

Result 1: *The possibility of expropriation leads to a lower credit volume in the E treatment compared to the NE treatment. Aggregate repayment rates however do not differ. These two facts lead to lower investment, and thus efficiency, in the E treatment compared to the NE treatment.*

Table 2 here

Comparing the **E treatment and the 1S treatment** we find a significantly higher rate of loan repayment by borrowers (64% vs. 10%, p<.01). This does not however translate into higher credit volumes. Contrary to our hypothesis 2, we find no significant difference in credit volume between the E and 1S treatment (3.17 vs. 3.81, p=.39). These results are robust to learning effects across rounds, as shown in Panel B of Table 2. A look at lender profits in the 1S treatment reveals why we observe a similar level of lending in the E and 1S treatments: lenders are over-optimistic in the 1S treatment. In this treatment they earn less than their outside option on average (7 vs. the outside option of 10) as the low repayment rate implies

that those lenders who do extend credit make substantial losses. Such behavior is likely to disappear and loans to fall to 0 with more repetitions (as observed in Brown and Zehnder, 2007).

Result 2: *The repayment rate of borrowers is significantly higher in the E treatment than in the 1S treatment. However, credit volumes are similar in the two treatments due to over-optimistic lending behavior of lenders.*

Having described the aggregate effects of expropriation on credit volume, repayment and efficiency in this section we now turn to investigating *how* these effects come about. In sections 4.2 and 4.3 we provide a detailed comparison of lender and borrower behavior over the course of their relationships in the E treatment to the NE treatment. In section 4.4 we examine how differences in lender and borrower behavior impact on their respective profits.

4.2. Loan offers

Figure 1A displays the distribution of loan offers in the first period of relationships in the E and NE treatments. The figure reveals that large loans are less frequent in the initial period in the E compared to the NE treatment. In the NE treatment more than 35% of lenders chose the maximum loan size of 10, and 60% offer loan sizes of 6 and above. By contrast, in the E treatment only 19% of lenders offer a loan of 10 in period 1 and only 30% of loans offered are 6 and above. Figure 1B shows that the distribution of interest rates is similar in the E and NE treatments: In both treatments the surplus sharing gross interest rate of 2 is most common.

Figure 1 here

Table 3 reports the results of OLS regressions relating first-period loan offers to the treatment (E or NE), round of the experiment (round 1, 2 or 3) and characteristics of the lender. Period 1 loans are significantly smaller in the E than NE treatment in round 2 and 3 of the experiment, but not in round 1 (see column 3). Table 3 also confirms that there is no difference in first-period interest rates between the two treatments (columns 4-6).

The variation in period 1 loan offers across lenders seems to be strongly related to individual risk attitudes. In Table 3 we control for three measures of lender characteristics using data from the pre-experimental games discussed in section 2.3. We find that lenders with higher indicators of risk aversion offer smaller period 1 loans. This finding confirms field evidence by Schaechter (2007) suggesting that first-mover behavior in trust-games is significantly related to individual risk attitudes. We find no relation between loan offers in period 1 and our measures of strategic reasoning or trust.

Result 3: *In the E treatment lenders offer smaller loans in the initial period of relationships compared to the NE treatment, while interest rates are similar in both treatments.*

Table 3 here

Figure 2 displays how relationships develop over time in the E and NE treatment. We classify each lender-borrower relationship into one of three types at the end of each period: relationships in which no loan has been extended (No loan), relationships in which a loan has been extended in at least one period and no default has occurred (No default), and relationships in which at least one loan has been extended and the borrower has defaulted at least once (Default). Figure 2 shows that in the E treatment more relationships are

characterized by default in earlier stages of the relationship than the NE treatment. By period 3 less than 40% of relationships are without default in the E treatment, while almost 70% are in the NE treatment (p=.01). After period 5 more relationships feature defaults in the NE treatment. These patterns support our prediction that relationships are less likely to be characterized by reputation building and more likely to involve screening in the E treatment.

Figure 2 here

Lenders react strongly to repayment behavior in our experiment. Table 4 examines loan sizes and interest rates offered by lenders over the course of relationships. Loan sizes offered by lenders in both treatments are significantly higher if there was no default by the borrower in previous periods (columns 1-2). As revealed by the negative coefficient of *E * No default*, in column 3, lenders reward borrowers less strongly for repayments in the E than in the NE treatment. Interest rates are not significantly affected by repayment behavior in either treatment (columns 4-5).

Table 4 here

Figure 3 and Table 5 examine the **time structure of the loan size in relationships without previous default** in more detail. Figure 3A displays the mean loan size over the course of a relationship for those relationships with no prior default. In the NE treatment, the mean loan size to non-defaulting borrowers increases strongly over time; from 6.3 in period 1 to 8.8 in period 5. This result is in contrast to the profit-maximizing equilibrium for the lender in the NE treatment, a flat profile of loans of size 10, but is in line with previous experimental research (Anderhub et al, 2002; Cochard et al, 2004; King-Casas et al, 2005 and Bonhorst et

al, 2009). These studies show that in repeated trust games first-movers do increase the stakes over time, and that this can be explained by learning (Anderhub et al, 2002).[13] By contrast, the loan size remains almost constant over time in the E treatment. Here the mean loan size to non-defaulting borrowers increases from 4.4 in period 1 to 5.4 in period 2. After this, however, the mean loan size hovers between 4.9 and 5.5 until period 6 before falling to 2 in the final period.

The constant loan sizes over time in the E treatment are surprising. After all, in this treatment the lender can only motivate (selfish) borrowers to repay by increasing loan sizes over time. Analyzing loan offers in more detail we find that the flat pattern of mean loan size in the E treatment over time is driven by some lenders who stop lending, although the borrower did not default. In Figure 3B we therefore examine the mean loan size in "fully active" relationships only, i.e. relationships in which lenders always offered a strictly positive loan between periods 1 and 5. Considering these relationships only, we find a significant increase in the mean loan size for both the NE and the E treatment. In particular in the E treatment the loan size increases from 4.4 in period 1 to 8.4 in period 6.

Figure 3 here

Table 5 provides a multivariate analysis of loans in relationships without previous default. We relate the loan size offered by lenders to the period of the relationship and the round of the experiment. To account for non-linear time trends of loan offers we include the period of the relationship as well as its squared value in the model. We start by pooling the data across all lenders, columns (1-3). We then account for heterogeneity in loan offers across lenders with lender random effects in columns (4-6). Our results in columns (1-3) confirm the time pattern

[13] In our experiment loan sizes increase substantially during the first periods of the first round of the NE treatment (from 5.6 in period 1 to 9.8 in period 6), but the loan profile becomes flatter in the third round (starts at 6.7 and peaks in period 5 at 8.8). Such a change over time is not observed in the E treatment.

of loan sizes presented in Figure 3A. We find that the coefficient of *Period* is only significantly positive in the NE treatment, but not in the E treatment. Controlling for heterogeneity of behavior across lenders in columns (1-4) we confirm the pattern presented in Figure 3B. We find a significant positive coefficient of *Period* and a negative coefficient of its squared value for both treatments. These results suggest that, once we control for the (significant) heterogeneity in behavior across lenders, loan sizes in no-default relationships increase over time, but at a declining growth rate, in both treatments.

In unreported regressions we replace the lender random effects in columns (4) and (5) of Table 5 with our measures of risk aversion, strategic reasoning, and trust from our pre-experimental games. Confirming our results from Table 4 we find that in both treatments risk averse lenders offer lower loans to borrowers, even when they have never defaulted in the past. We also find that the lenders' level of trust is strongly correlated with loan offers to non-defaulting borrowers in the E treatment, but not in the NE treatment. Lenders' level of strategic reasoning is not correlated with loan offers to non-defaulting borrowers in either treatment.

Table 5 here

Result 4: *In the E and NE treatments, lenders increase loan sizes to borrowers who repaid all prior loans, but do not alter interest rates.*

4.3. Repayment behavior

Figure 4 displays the repayment behavior of borrowers in the E and NE treatment. Figure 4A displays repayment behavior in period 1 depending on the loan size offered to borrowers. The figure shows that in the E treatment, the repayment rate in period 1 is higher for loans of

sizes 1-5, than for loans of 6-9 and loans of size 10. By contrast, in the NE treatment the repayment rate is equally high for small and large loans. This finding supports our hypothesis 1, which suggests that the possibility of expropriation gives borrowers stronger incentives to default on large loans at the beginning of a relationship.

Figure 4B displays repayment rates by period in the E and NE treatments. The repayment rate in the NE treatment exceeds 80% in the initial periods and then falls substantially in periods 6 and 7. As in Brown and Zehnder (2007) this pattern suggests the presence of strong reputation incentives. Selfish borrowers imitate social ones during the first periods and start defaulting in periods 6 and 7, as the game comes close to an end. By contrast, in the E treatment we find no time trend in the repayment rate. Comparing the E to the NE treatment we find a lower repayment rate in initial periods but a higher repayment rate in the final periods of relationships. This finding supports our hypothesis that the E treatment may be characterized by more screening and less reputation building than the NE treatment.

Figure 4 here

Table 6 presents the results of a regression analysis of individual borrower repayment behavior in the E and NE treatments. The results in the table suggest that in both treatments the probability of a borrower repaying a loan is hardly related to the loan size but negatively related to the interest rate. Confirming the pattern observed in Figure 4 the table reports a stronger time trend on loan repayment in the NE than in the E treatment.

In unreported regressions we replace borrower random effects in columns (1) and (2) of Table 6 with the measures of risk aversion, strategic reasoning and trustworthiness from our pre-experimental games. Interestingly we find that repayment behavior in the E and NE

treatments are unrelated to risk aversion and trustworthiness. We find that repayment rates are positively related to strategic reasoning in the NE but not in the E treatment.

Table 6 here

Result 5: *In the E treatment the repayment rate in initial periods is lower than in the NE treatment, but the fall in the repayment rate towards the end of the game is also more moderate. This suggests that there is more screening out of selfish borrowers and less reputation based relational contracts in the E compared the NE treatment.*

4.4. Profits

Our results above show that lenders in the E treatment are less likely to offer high first-period loans than in the NE. Lenders in both treatments increase their loan sizes when the borrower has repaid previous his loans. In this section we examine how these lending strategies pursued in the E and NE treatments affected lender and borrower profits.

Figure 5 displays the average profit of lenders per period over the course of each relationship with a borrower. We classify each lender-borrower relationship into one of three profiles: (i) Relationships in which the lender offers the maximum loan size in the first period (which we label "Start big"); (ii) relationships in which the lender offers a first-period loan of less than 10, but then raises his loan offer between period 1 and period 5 (which we label "Start small and increase"); and (iii) "Other" relations. According to this classification there are 12 “Start big” relations, 19 “Start small and increase” relations and 32 “Other” relations in the E treatment. In the NE treatment there are 26 “Start big” relations, 23 “Start small and increase” relations and 23 “Other” relations.

The figure shows that in the NE treatment the strategies of "Start big" and "Start small and increase" are most profitable, yielding significantly higher profits than "Other" relations (Wilcoxon signed ranks test, p=.03 in both cases). By contrast, in the E treatment "Start small and increase" only yields slightly higher profits than "Other"(p=.13) and "Start big" (p=.83 comparing.

Figure 5 here

The regression analysis presented in Table 7 confirms that lenders in the E treatment were not better off if they pursued a strategy of "Start big" or "Start small and increase", compared to "Other" strategies. The OLS estimates presented in column (1) suggests that average lender profits in the E treatment were similar for all three relationship types. By contrast, the estimates in column (2) suggest that lenders in the NE treatment earned roughly 40% less from "Other" than from "Start big" or "Start small and increase". These results suggest that the observed lending strategies in the E and NE treatments were rational from the point of view of the lender.

Columns (4-6) of Table 7 examine how borrowers' payoffs are affected by the lending strategy of the lender. The results reported show that in both treatments borrowers earned more if lenders pursued a strategy of "Start big" or "Start small and increase". Not surprisingly, borrowers in the E treatment benefit more than those in the NE treatment from "Start big" as they more often default on large first-period loans.

Table 7 here

Result 6: *The different lending strategies observed in the E and NE treatments are rational from a lender's perspective: in the E treatment lenders do not earn higher profits from "Starting small" compared to offering high first-period loans or pursuing other strategies. By contrast lenders, in the NE treatment earn substantially higher profits when they offer high initial loans or "Start small" and then increase their loan size.*

5. Conclusion

In countries with weak creditor rights and debt enforcement relational contracting in the credit market may be hampered by the potential expropriation of funds by borrowers. We examine the impact of potential expropriation on lender-borrower relationships in an experimental credit market.

Our results suggest that potential expropriation reduces the number of relational contracts in which moral hazard is mitigated through reputation incentives. Instead, potential expropriation increases the number of relationships in which moral hazard is reduced by screening out selfish agents. When relational contracts do emerge under expropriation they are characterized by smaller credit volumes and thus less efficient than without expropriation.

Our findings provide strong support to the conjecture that observed patterns of investment in microfinance and FDI relationships may be driven by concerns over borrower default. In particular, the small initial investment sizes, observed in such relationships (Armendariz and Morduch, 2006; Rauch and Watson, 2003) may be driven by the fear that borrowers or host-country partners may expropriate funds.

Our findings also provide support to the hypothesis that sovereign lending is adversely affected by the lack of legal recourse (Bulow and Rogoff, 1989). Our results suggest that in a lending environment where the borrower can expropriate the lender’s funds, as is the case in sovereign lending, borrowers will face credit constraints.

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Table 1. Treatments and subjects

Treatment	Conditions	Matching groups & relations
Expropriation (E Treatment)	7 period game, borrower can expropriate loan principal	7 matching groups = 63 lender-borrower relations
No Expropriation (NE Treatment)	7 period game, borrower cannot expropriate loan principal	8 matching groups = 72 lender-borrower relations
One-Shot (1S Treatment)	1 period game borrower cannot expropriate loan principal	6 matching groups = 54 lender-borrower relations

Table 2. Summary Statistics by Treatment

The table reports means for each variable by treatment, at the matching group level. It also reports the Mann-Whitney test p-values comparing outcomes across treatments. *Credit volume* is the size of the loan offered by the lender and has a minimum value of 0 and a maximum value of 10. *Interest* is the gross interest rate calculated as desired repayment / loan size for all loan offers exceeding 0. By design *Interest* lies between 0 and 3. *Acceptance* is a dummy variable which is 1 if loan size > 0 and the offer was accepted and 0 if loan size > 0 and the offer was declined. *Repayment* is a dummy variable which is 1 if a loan was accepted and the desired repayment was made, and 0 if a loan was accepted and the desired repayment was not made. *Investment volume* is defined as the accepted loan size plus the accumulated capital of the borrower. *Lender profit* and *Borrower profit* are the per-period payoffs of the lender / borrower.

Panel A. All rounds

	Mean			Mann-Whitney test (p-values)	
	E	NE	1S	E vs. NE	E vs. 1S
Credit volume	3.17	5.67	3.81	0.01	0.39
Interest	2.13	1.99	1.96	0.05	0.20
Acceptance	88%	96%	95%	0.04	0.14
Repayment	64%	79%	10%	0.05	0.00
Investment volume	5.45	5.54	3.61	0.91	0.02
Lender profit	10.83	13.26	7.02	0.01	0.00
Borrower profit	20.06	17.82	20.20	0.13	0.89

Panel B. Round 3

	Mean			Mann-Whitney test (p-values)	
	E	NE	1S	E vs. NE	E vs. 1S
Credit volume	2.40	5.87	2.28	0.00	0.83
Interest	2.09	2.00	1.55	0.42	0.03
Acceptance	92%	99%	100%	0.09	0.04
Repayment	70%	83%	0%	0.15	0.00
Investment volume	4.41	5.78	2.28	0.03	0.00
Lender profit	11.09	14.14	7.72	0.01	0.00
Borrower profit	17.73	17.42	16.83	0.42	0.57

Table 3. Determinants of first-period loan offers

The table reports OLS estimates for the dependent variables *Loan size* (columns 1-3) and *Interest* (columns 4-6), using observations from the first period of each relationship only. *Round 2* and *Round 3* are dummy variables which are 1 only for observations from the corresponding round, while *E Treatment* is a dummy variable which is 1 for all observations from the E treatment and zero for those from the NE treatment. The variables *Risk aversion* , *Strategic reasoning* and *Trust* are lender-specific measures elicited from pre-experiment games. Standard errors are reported in brackets and are corrected for clustering at the matching group level. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Loan size*			*Interest*		
Treatment	E	NE	E and NE	E	NE	E and NE
Round 2	-0.905	1.125***	1.125***	0.098	0.032	0.027
	[0.556]	[0.284]	[0.274]	[0.117]	[0.064]	[0.065]
Round 3	-1.952***	1.042	1.042*	-0.068	0.052	0.048
	[0.425]	[0.575]	[0.554]	[0.176]	[0.067]	[0.068]
E Treatment			-0.51			0.158
			[0.746]			[0.140]
E * Round 2			-2.030***			0.059
			[0.594]			[0.134]
E * Round 3			-2.994***			-0.1
			[0.685]			[0.174]
Risk aversion	-0.440*	-0.632**	-0.575***	-0.021	0.030*	0.014
	[0.187]	[0.208]	[0.111]	[0.034]	[0.013]	[0.021]
Strategic Reasoning	-0.015	-0.039	-0.026	-0.003	0.003	-0.001
	[0.057]	[0.038]	[0.042]	[0.005]	[0.004]	[0.003]
Trust	0.33	0.057	0.154	-0.029	0.028*	0.012
	[0.285]	[0.140]	[0.128]	[0.025]	[0.012]	[0.013]
Constant	7.165	12.082***	10.224**	2.630***	1.422***	1.892***
	[6.001]	[2.852]	[3.437]	[0.384]	[0.300]	[0.307]
Method	OLS	OLS	OLS	OLS	OLS	OLS
Lender effects	no	no	no	no	no	no
Observations	63	72	135	63	72	135
Number of Lenders	21	24	45	21	24	45
R^2	0.26	0.13	0.24	0.07	0.17	0.07

Table 4. Loan offers in periods 2-7

The table reports panel estimates for *Loan size* (columns 1-3) and *Interest rate* (columns 4-6) offered to borrowers in periods 2 through 7. *No default* is a dummy for those borrowers which received at least one loan and never defaulted in prior periods. *Round 2* and *Round 3* are dummy variables which are 1 only for observations from the corresponding round, while *E Treatment* is a dummy variable which is 1 for all observations from the E treatment and zero for those from the NE treatment. All regressions include random effects per lender and time fixed effects which are not reported for brevity. Standard errors are reported in brackets and are corrected for clustering at the matching group level. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Loan size*			*Interest*		
Treatment	E	NE	E and NE	E	NE	E and NE
No default	3.416***	5.144***	5.161***	0.081	0.021	0.018
	[0.282]	[0.312]	[0.279]	[0.069]	[0.038]	[0.047]
Round 2	-1.786***	-1.212***	-1.215***	-0.062	-0.006	-0.007
	[0.314]	[0.322]	[0.292]	[0.071]	[0.033]	[0.041]
Round 3	-1.869***	-1.157***	-1.161***	-0.128*	-0.018	-0.022
	[0.286]	[0.327]	[0.296]	[0.066]	[0.033]	[0.041]
E Treatment			-0.362			0.135
			[0.616]			[0.095]
E * No default			-1.758***			0.088
			[0.419]			[0.069]
E * Round 2			-0.576			-0.061
			[0.475]			[0.069]
E * Round 3			-0.705			-0.109*
			[0.453]			[0.066]
Constant	2.934***	2.866***	3.056***	2.178***	2.015***	2.021***
	[0.495]	[0.547]	[0.468]	[0.101]	[0.057]	[0.072]
Method	OLS	OLS	OLS	OLS	OLS	OLS
Lender random effects	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes
Observations	306	432	738	193	307	500
Number of Lenders	21	24	45	21	24	45
R^2 - overall	0.44	0.46	0.50	0.02	0.01	0.05

Table 5. Loan size and interest rates in relationships without default

This table reports panel estimates for *Loan size,* using pooled OLS (columns 1-3) and random effects per lender (columns 4-6) in relationships without any previous default. *Period* and *Period*^{2} are variables denoting the period of the relationship and its squared value, respectively. *E treatment* is a dummy variable which is 1 for all observations from the E treatment and zero for those from the NE treatment. *Round 2* and *Round 3* are dummy variables which are 1 only for observations from the corresponding round. Standard errors are reported in brackets and are corrected for clustering at the matching group level. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Loan size (pooled OLS)*			*Loan size (random effects)*		
Treatment	E	NE	E and NE	E	NE	E and NE
Period	1.032	3.328***	3.328***	2.382***	3.133***	3.128***
	[0.982]	[0.684]	[0.701]	[0.684]	[0.520]	[0.512]
Period^2	-0.155	-0.416***	-0.416***	-0.295***	-0.413***	-0.413***
	[0.114]	[0.078]	[0.080]	[0.079]	[0.059]	[0.058]
Round 2	-3.264***	-1.603***	-1.603***	-1.213**	-0.816**	-0.797**
	[0.671]	[0.482]	[0.494]	[0.518]	[0.402]	[0.396]
Round 3	-2.680***	-1.067**	-1.067**	-1.015**	-0.713*	-0.707*
	[0.651]	[0.468]	[0.479]	[0.504]	[0.375]	[0.370]
E Treatment			2.571			-1.111
			[2.322]			[1.826]
E * Period			-2.296*			-0.809
			[1.175]			[0.875]
E * Period^2			0.261*			0.125
			[0.135]			[0.100]
E * Round 2			-1.661**			-0.529
			[0.811]			[0.666]
E * Round 3			-1.612**			-0.408
			[0.787]			[0.638]
Constant	5.648***	3.077**	3.077**	1.957	3.240***	3.245***
	[1.930]	[1.368]	[1.401]	[1.428]	[1.097]	[1.088]
Method	OLS	OLS	OLS	OLS	OLS	OLS
Lender random effects	No	No	No	Yes	Yes	Yes
Observations	151	275	426	151	275	426
Number of Lenders	-	-	-	20	24	44
Adj. R^2 (overall for random effects)	0.166	0.135	0.250	0.126	0.133	0.235

Table 6. Determinants of repayment

The table reports panel estimates for the dependent variable *Repayment* which is 1 if the borrower made the desired repayment after accepting a loan offer and 0 if the borrower did not make the desired repayment. *Loan size* and *Interest* are size of the loan and the gross interest rate (desired repayment / loan size) offered by the lender in the accepted loan contract. *Period* is the period (1-7) of the relationship. *Round 2* and *Round 3* are dummy variables which are 1 only for observations from the corresponding round, while *E Treatment* is a dummy variable which is 1 for all observations from the E treatment and zero for those from the NE treatment. All regressions include borrower random effects. Columns (1-3) report probit estimates. Column 4 reports OLS estimates. Standard errors are reported in brackets. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)
Treatment	E	NE	E and NE	E and NE
Loan size	-0.037	0.034	0.001	0.013*
	[0.039]	[0.036]	[0.025]	[0.008]
Interest	-0.870***	-1.516***	-1.130***	-0.342***
	[0.273]	[0.412]	[0.223]	[0.079]
Period	-0.131**	-0.296***	-0.216***	-0.065***
	[0.062]	[0.052]	[0.038]	[0.011]
Round 2	-0.165	0.244	0.102	0.064
	[0.270]	[0.212]	[0.163]	[0.051]
Round 3	0.24	0.455**	0.368**	0.091*
	[0.253]	[0.215]	[0.162]	[0.049]
E Treatment			-0.483*	-0.281
			[0.286]	[0.247]
E * Loan size				-0.018
				[0.012]
E* Interest				0.094
				[0.103]
E* Period				0.036*
				[0.018]
E * Round 2				-0.108
				[0.086]
E * Round 3				-0.032
				[0.081]
Constant	2.744***	4.531***	3.763***	1.527***
	[0.719]	[1.034]	[0.598]	[0.185]
Method	Probit	Probit	Probit	OLS
Borrower random effects	yes	yes	yes	yes
Observations	216	365	581	581
Number of Borrowers	21	24	45	45
R^2 overall				0.12

Table 7. Lender and borrower profits

The table reports OLS estimates for the dependent variables Lender profits (columns 1-3) and Borrower profits (columns 4-6), which are calculated as the average profit over the 7 periods for a relationship. *Start big* is a dummy variable which is one for all relations in which the lender offers a first-period loan of 10, and zero otherwise. *Start small & increase* is a dummy variable which is one for all relations in which the lender offers a higher loan in period 3 than in period 1, and zero otherwise. Round 2 and Round 3 are dummy variables which are 1 only for observations from the corresponding round, while E Treatment is a dummy variable which is 1 for all observations from the E treatment and zero for those from the NE treatment. Standard errors are reported in brackets and are corrected for clustering at the matching group level. *, **, *** indicate significance at the 10%, 5%, and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	*Lender profits*			*Borrower profits*		
Treatment	E	NE	E and NE	E	NE	E and NE
Start big	1.192	4.182***	4.296***	8.807***	5.164***	5.275***
	[1.140]	[0.456]	[0.427]	[1.378]	[0.694]	[0.701]
Start small & increase	0.811	3.971***	3.814***	3.525**	3.706***	3.735***
	[0.463]	[0.458]	[0.347]	[1.147]	[1.026]	[0.979]
Round 2	-1.474**	0.794	-0.297	-1.535	-1.536	-1.543**
	[0.502]	[0.966]	[0.621]	[1.041]	[1.018]	[0.696]
Round 3	-0.279	1.277	0.527	-3.429**	-1.965*	-2.647***
	[0.422]	[0.909]	[0.545]	[1.044]	[1.013]	[0.733]
E Treatment			-0.113			2.595*
			[0.590]			[1.413]
E * Start big			-3.084**			3.671**
			[1.155]			[1.447]
E * Start small & increase			-3.069***			-0.271
			[0.640]			[1.462]
Constant	10.945***	9.791***	10.413***	18.975***	15.934***	16.114***
	[0.535]	[0.798]	[0.527]	[1.302]	[1.311]	[1.091]
Method	OLS	OLS	OLS	OLS	OLS	OLS
Lender random effects	no	no	no	no	no	no
Borrower random effects	no	no	no	no	no	no
Observations	72	63	135	72	63	135
R^2	0.09	0.37	0.35	0.34	0.34	0.36

Figure 1. Period 1 loan offers in the NE and E Treatments

This figure displays the distribution of *Loan size* and *Interest* in period 1 loan offers by treatment.

Figure 1A. Loan size

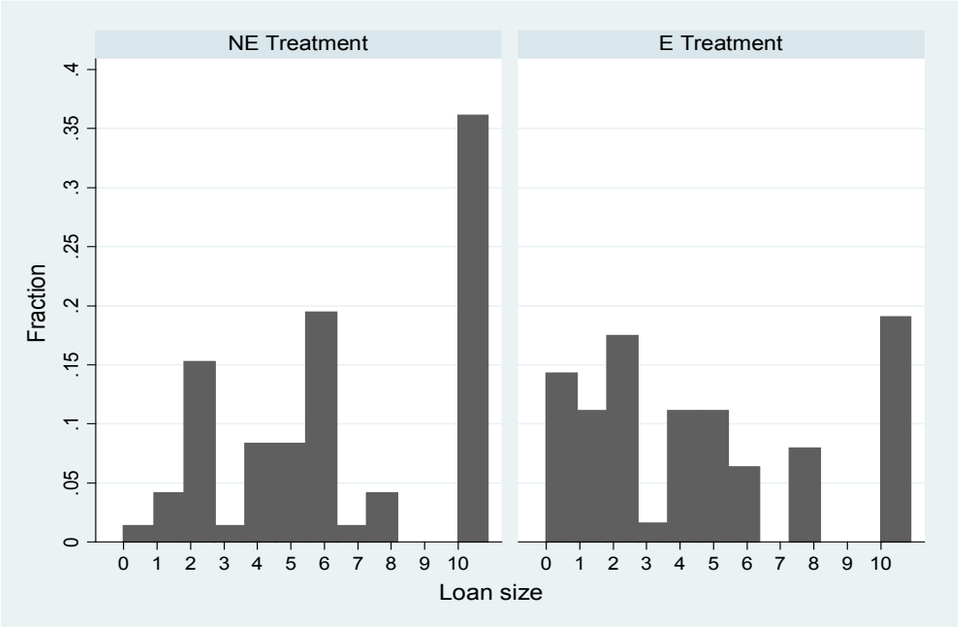


Figure 1B. Interest

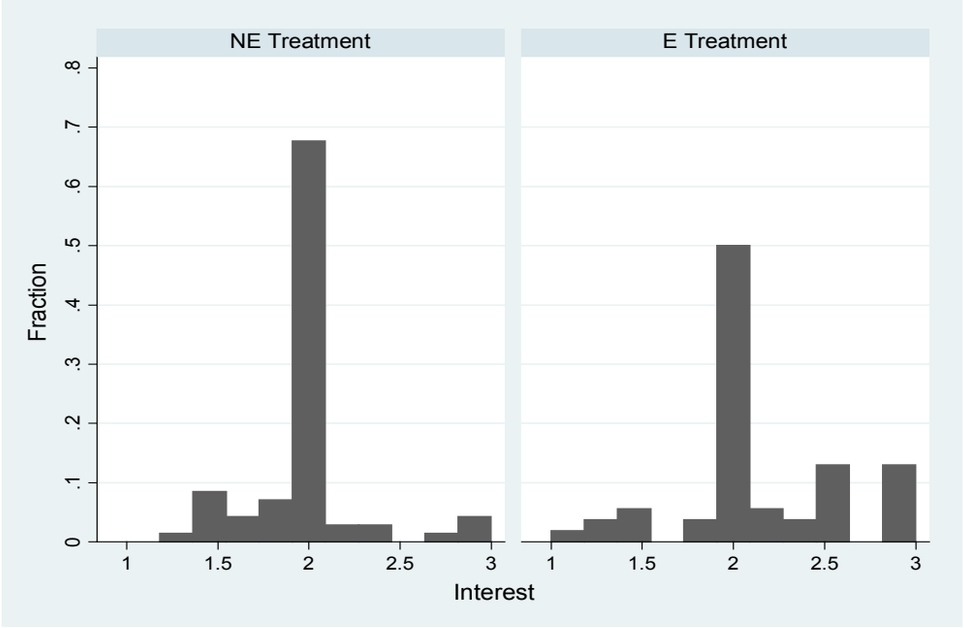


Figure 2. Lender -borrower relationships

This figure classifies each relationship into one of three types at the end of each period: Relationships in which no loan has been extended in any period so far (*No loan*), relationships in which a loan has been extended in at least one period and no default has occurred (*No default*), and relationships in which at least one loan has been extended and the borrower has defaulted at least once (*Default*).

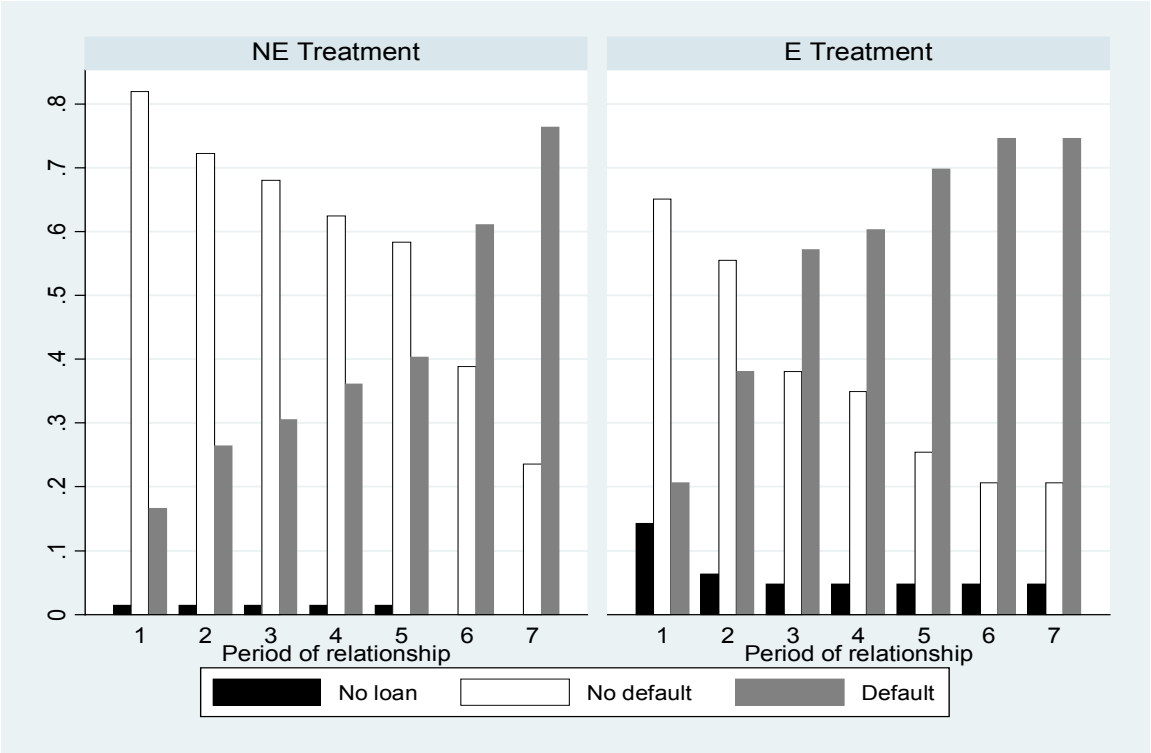


Figure 3. Relationships without default

Figure 3A displays the mean *Loan size* offered by treatment and period in no default relationships (classified as in Figure 2). For period 1 we report the mean loan size and interest rate across all offers. Figure 3B considers only those no default relationships which are "fully active", i.e. those *relationships* in which the lender always offered a strictly positive loan size.

Figure 3A. Loan size in relationships without default

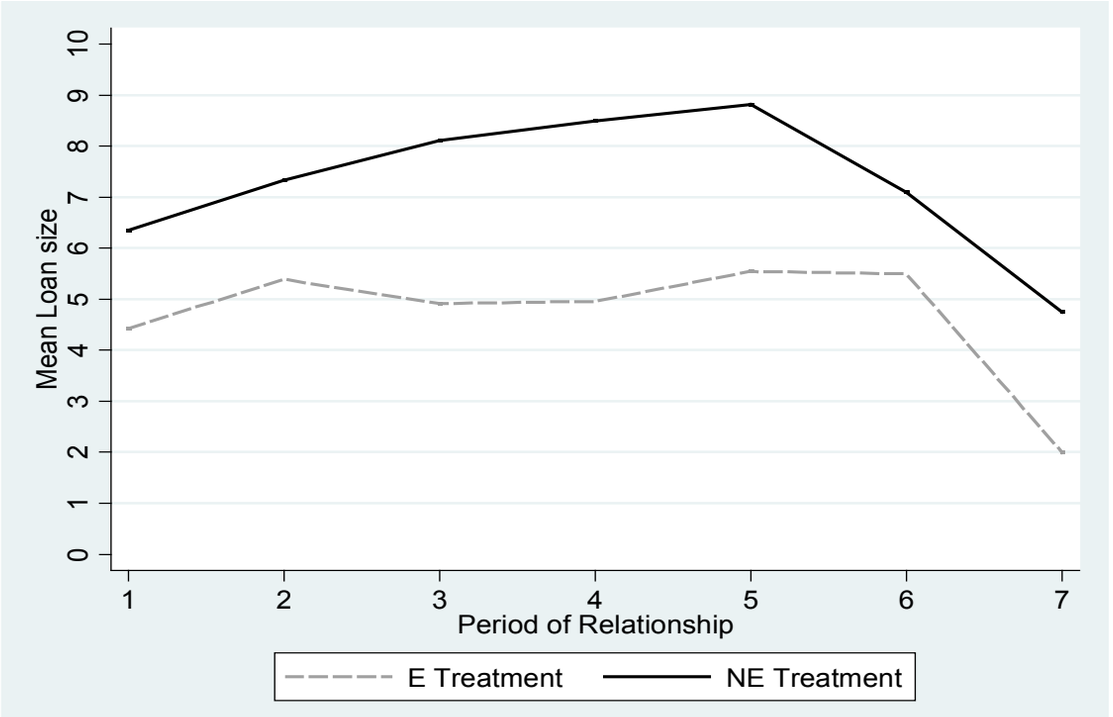


Figure 3B. Loan size in "fully active" relationships without default

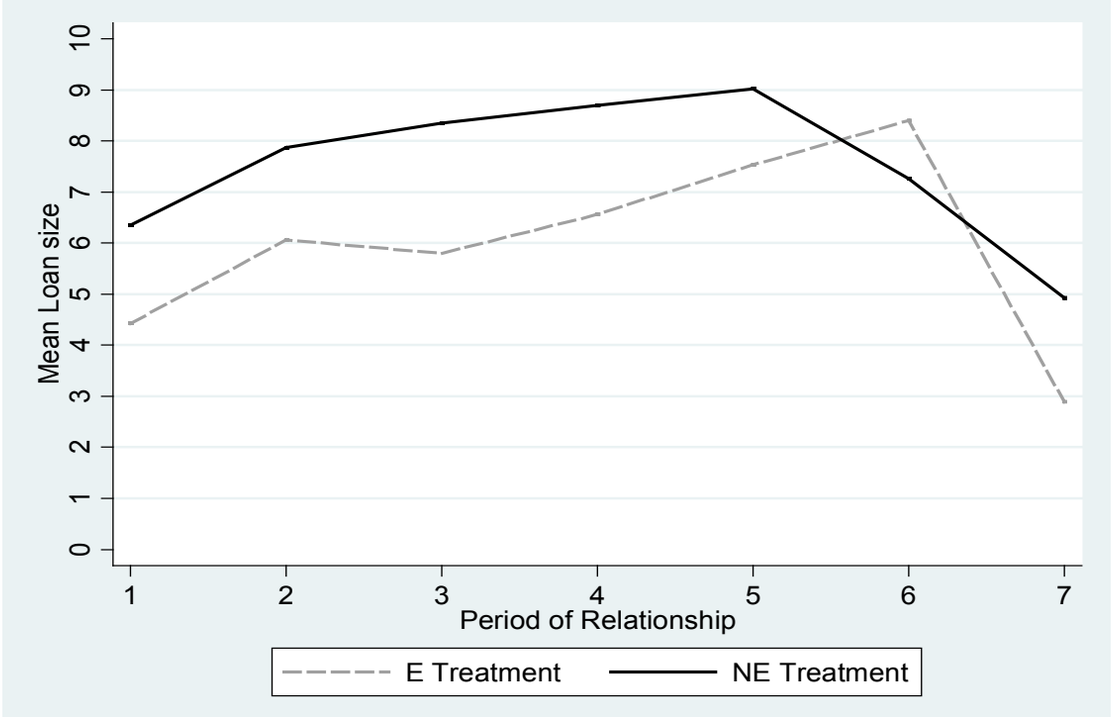


Figure 4. Repayment of loans

Figure 4A displays the average repayment, by groups of loan sizes (loans from 1 to 3, from 4 to 6 and 7 to 10), in period 1. Figure 4B displays the average repayment rate of loans over time, by treatment. The average repayment rate is calculated at the matching group level.

Figure 4A. Repayment by loan size in period 1

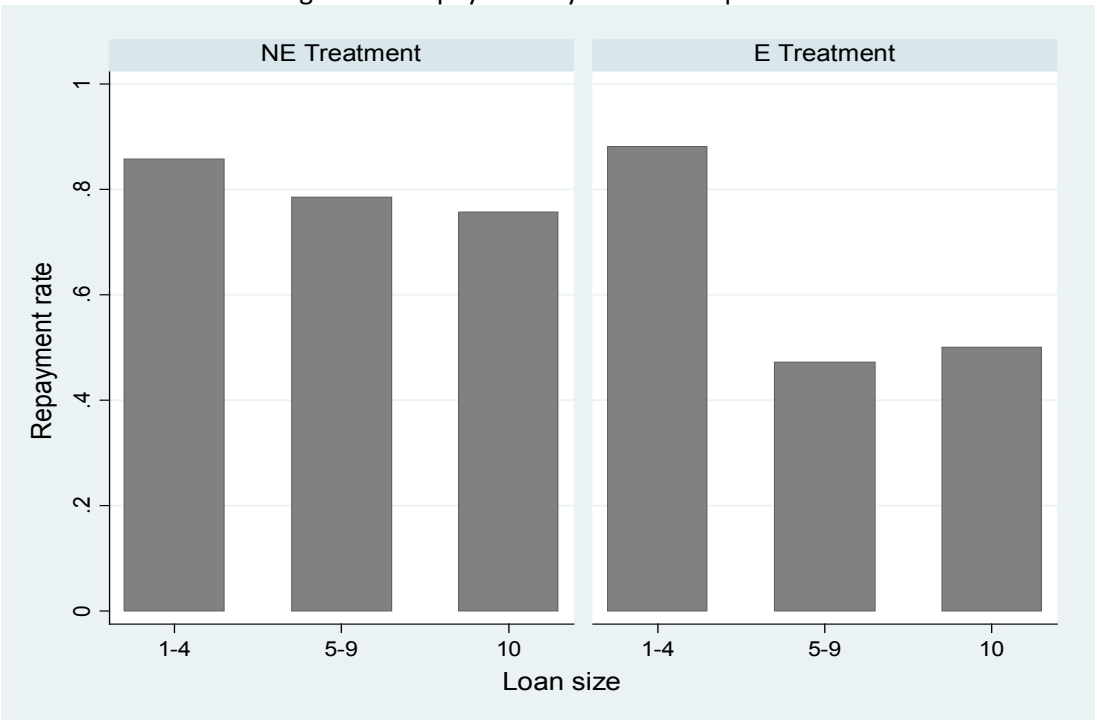


Figure 4B. Repayment by period

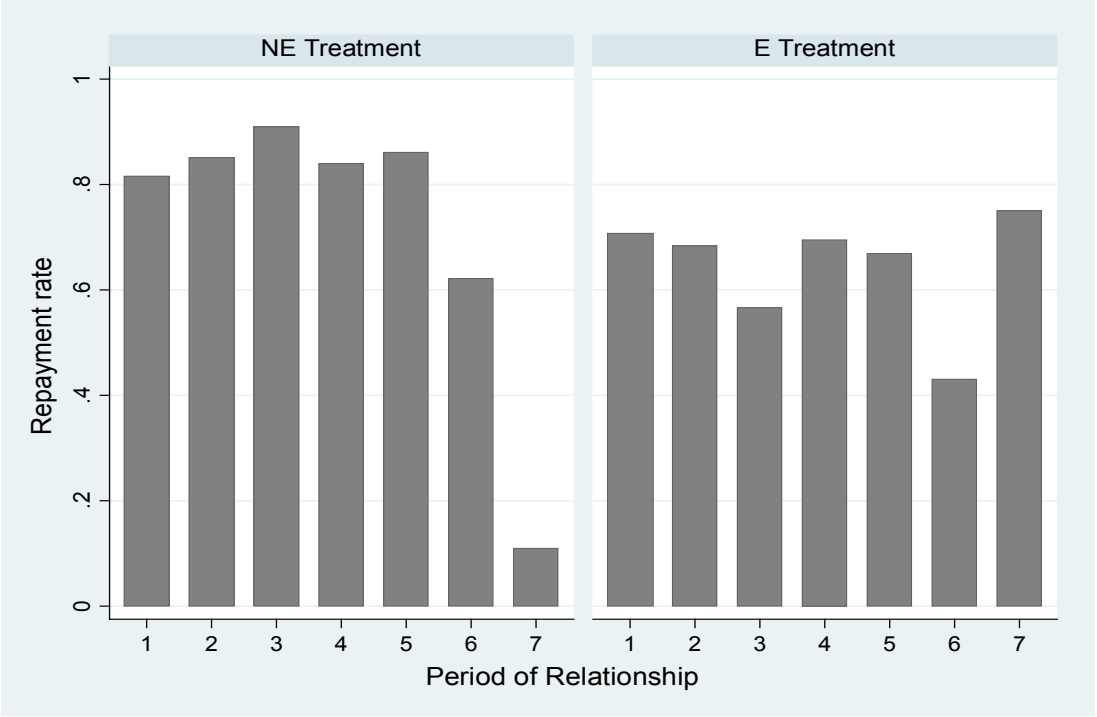
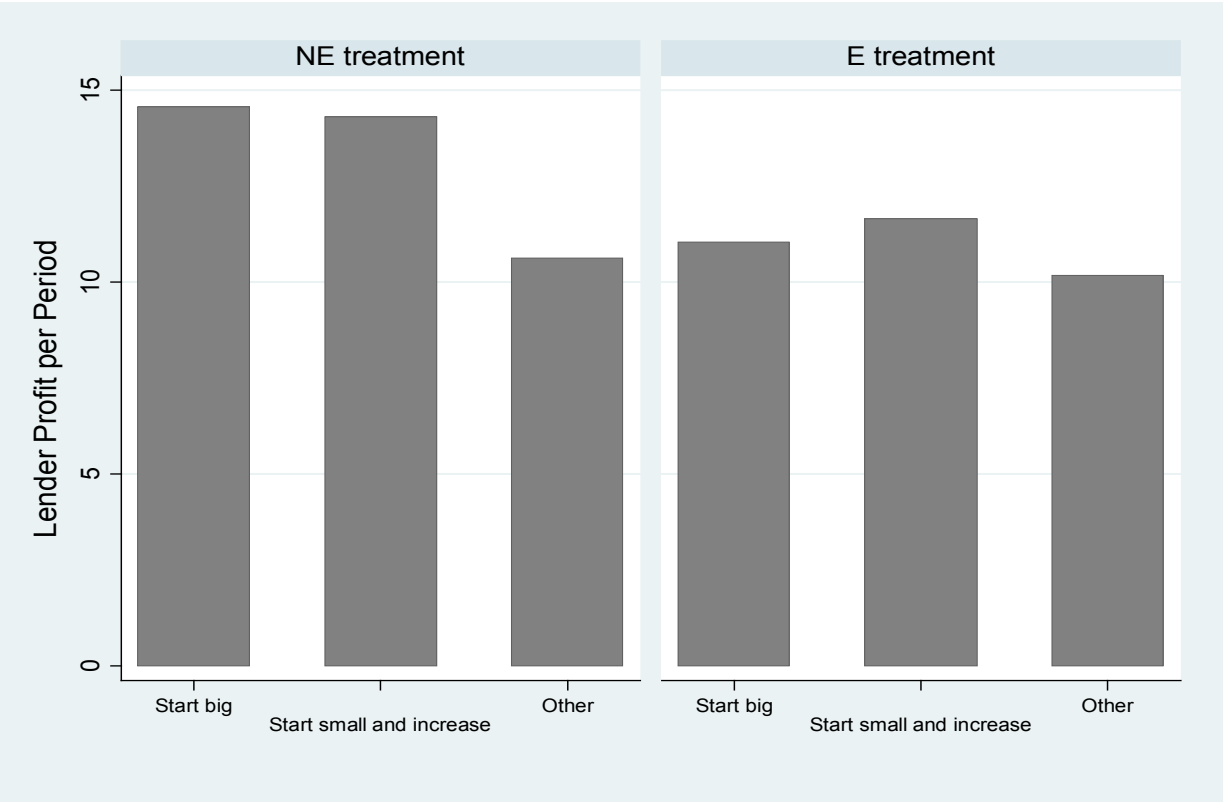


Figure 5. Initial loan offers and lender profits

The bars in this figure report the average lender profits per period in a relationship, averaged at the matching group level and then across matching groups per treatment. We distinguish 3 types of lender-borrower relations: Relationships in which the lender offers a loan of 10 in the first period (*Start big*). Relations in which the lender offers a first-period of less than 10 and then raises his loan offer from period 1 to 3 (*Start small and increase*), and "other" relationships, which do not fall in the previous 2 categories.



Appendix A. Predictions for the E and NE treatments

A.1. The Repeated Lending Game

A lender and a borrower interact for $T = 7$ periods. In every period, the schedule of events is the following:

1. The lender has an endowment of 10 in every period t. The borrower has a capital of C_t, where $C_1 = 0$.
2. The lender makes an offer (S_t, R_t) to the borrower. Whereby $S_t \in [0, 10 - C_t]$ and $R_t \in [1, v]S_t$, where $v > 1$.
3. The borrower chooses to accept $(A_t = 1)$ or reject $(A_t = 0)$ the offer.
4. If the offer is accepted the borrower earns an investment income of $I_1 = v \cdot (S_t + C_t)$ and chooses whether to repay $(D_t = 0)$ or default $(D_t = 1)$

We examine behavior in this game under two different conditions. First, in what we call the lending game without expropriation (or no-expropriation case), the capital of the borrower is $C_t = 0$ in all periods. Second, in the lending game with expropriation, where we have that the borrower's capital for $t > 1$ is:

$$C_t = \sum_{k=1}^{t-1} S_t D_t$$

The monetary payoff for the lender Π_t is 10 if he decides not to give a loan or if his loan offer is not accepted. If he gives out a loan, his offer specifies a loan size S_t and a repayment of $R_t = i_t S_t$, where $i_t \in [1, v]$. If the borrower accepts the offer $(A_t = 1)$, he receives S_t and chooses whether to repay or not. Thus the lender's payoff Π_t in period t is:

$$\Pi_t = 10 - A_t S_t (1 - i_t (1 - D_t))$$

In turn, the borrower's income stems from two sources. He has a fixed income from other self-financed projects or income from other activities of 10. Additionally, he earns an investment income, which depends on whether he accepts a loan offer and the loan size offered S_t, as well as his own capital. If the borrower decides to repay, $R_t = i_t S_t$ is transferred to the lender. If he defaults, he accumulates capital for the next period, C_{t+1}, if in the lending game with expropriation. The borrower's payoff U_t in period t is:

$$U_t = 10 + v \cdot (A_t S_t + C_t) - A_t R_t (1 - D_t) - C_{t+1}$$

There are two borrower types, social (H for 'high') and selfish (L for 'low'), not observable to the lender. An L type repays a loan if it maximizes his monetary payoffs. An L type borrower will thus never repay a loan in period T. Assuming that lenders offer contracts (S_t, i_t) only to a borrower who repays in all prior periods, the incentive constraint of an L type borrower in the game without expropriation for periods $k = t...T - 1$ is:

$$\textbf{[IC}_{\textbf{L, No expropriation}}\textbf{]} \ \sum_{k=t+1}^{T-1} (v - i_k) S_k + v S_T \geq v S_t$$

In the game with expropriation the incentive constraint for the L type borrower is

$[\mathbf{IC_{L,\ Expropriation}}]\ \sum_{k=t}^{T-1}(v-i_k)\,S_k + vS_T \geq \sum_{k=t}^{T-1}(v-1)\,S_t + vS_t$

Note that in both incentive constraints, the monetary payoff of the borrower is positive. His participation constraint is therefore satisfied and has an incentive to accept any loan offer.

The H type borrower repays any loan he has accepted. However, the H type also cares about relative payoffs, which makes him yield negative utility if the gross interest rate is above a threshold $\bar{r} \in (1, v)$.The participation constraint of the H type can thus be written as

$[\mathbf{PC_H}]\ i_t \leq \bar{r}$

The lender's prior about the borrower being of type H is $\bar{p} \in (0,1)$, i.e. $\bar{p}$ is the ex-ante probability that the borrower is of type H. For any period $t > 1$ the lender updates his belief p_t on the borrower's type using Bayes' Rule. If selfish borrowers repay in period $t-1$ with a probability $\gamma_{t-1} \in [0,1]$, then the lenders updated belief is given by $p_t = \frac{p_{t-1}}{p_{t-1}+\gamma_{t-1}(1-p_{t-1})}$.

Assuming that the participation constraint of H borrowers is met in all periods ($i_t \leq \bar{r}$) and that L type borrowers repay with a repayment probability $\gamma_1, ...\gamma_7$, whereby $\gamma_7 = 0$, the participation constraint of the lender can be defined as

$[\mathbf{PC\ Lender}_t]\ \sum_{k=t}^{T} S_k\left(\left(p_k + \gamma_k(1-p_k)\right)i_k - 1\right) \geq 0$, whereby $i_k \leq \bar{r}$

Since $\gamma_7 = 0$, for lenders to lend in the final periods we must have $p_T\bar{r} - 1 \geq 0$.

In what follows we will describe the equilibria of the repeated lending game, both with and without expropriation. The equilibrium concept used throughout is that of Perfect Bayesian Equilibrium (PBE). We will consider two types of equilibria: **reputation** and **screening** equilibria. Reputation equilibria are defined as those equilibria in which the L borrower repays loans at least in period 1. He thus builds a reputation, by imitating the H borrower for at least one period. Screening equilibria are defined as those in which the L type borrower defaults with certainty in period 1. Therefore, for the rest of the game L borrowers have been screened out and H types are identified. Whenever these equilibria exist, there exist a plethora of them. As is conventional in the literature (e.g. Thomas and Worral, 1994), we concentrate on the equilibrium which is profit-maximizing for the lender, as he is the player making offers and the borrower only has the option of accepting them or not.

We make the following assumptions regarding the ex-ante probability $\bar{p}$ that the borrower is of type H. Assumption 1 implies that the proportion of H type borrowers does not make it profitable to extend a loan in a one-shot situation:

Assumption 1: $\bar{p} < \frac{1}{\bar{r}}$

Assumption 2 implies that the proportion of H type borrowers is high enough to make a reputation equilibrium feasible in the repeated game with T periods feasible:

Assumption 2: $\bar{p} \geq \frac{1}{\bar{r}^T}$

A.2. Lending without expropriation

Given our assumptions about $\bar{p}$, the profit-maximizing reputation equilibrium for the lender has maximum loan sizes in all non-final periods, and a smaller loan in the final period. Borrowers pool in periods 1 through 5, during which L borrowers always repay. In period 6 L borrowers default with positive probability and in period 7 they default always.

Proposition A1: *In the lending game without expropriation the profit-maximizing reputation equilibrium for the lender is characterized by offers* $(S_t, i_t) = (10, \bar{r})$ if $t \leq 6$ and $(S_7, i_7) = \left(10\frac{\bar{r}}{v}, I\right)$. *The H type borrower accepts and repays in all periods. The L type borrower accepts in all periods, repays with* $\gamma_t = 1$ *in periods* $t \leq 5$, *with* $\gamma_6 = \frac{\bar{p}}{(1-\bar{p})}(\bar{r}-1)$ *and* $\gamma_7 = 0$.

Proof: We first consider whether the IC of the L type borrower is satisfied in periods 1 to 6. Then, we check whether the PC of the H type borrower is satisfied. Finally, whether the lender's PC is satisfied and whether the equilibrium is profit-maximizing.

- L type borrower repayment: Condition [$\text{IC}_{\text{L, No expropriation}}$] holds with inequality in all periods $t < 6$. In period 6 it holds with equality, so we know that the L type borrower is indifferent between repaying and not. Thus, $\gamma_1 = ... = \gamma_5 = 1$ and $\gamma_6 = \frac{\bar{p}}{(1-\bar{p})}(\bar{r}-1)$ is a best response behavior.

- H type borrower accepts and repays as $i_t = \bar{r}$ for all t.

- Lender contracts: Condition [PC Lender_T] is met with equality if he offers $(S_7, i_7) = \left(10\frac{\bar{r}}{v}, \bar{r}\right)$ as $p_T = \frac{\bar{p}}{\bar{p}+\gamma_6(1-\bar{p})} = \frac{1}{\bar{r}}$. The lender's profits from lending in period 6 are $S_{T-1}\left(\left(\bar{p}+\gamma_6(1-\bar{p})\right)i_{T-1}-1\right)$ which are positive for $(S_6, i_6) = (10, \bar{r})$,as $\bar{p} > \frac{1}{\bar{r}^2}$ (Assumption 2). Since $\gamma_t = 1$ in all periods $t \leq 5$ the lender's participation constraint is met.

- This equilibrium is profit-maximizing for the lender for three reasons: (i) $i_t = \bar{r}$, therefore the H type borrower repays, and the lender extracts the maximum surplus; (ii) since $\frac{\partial \pi_t}{\partial S_t} > 0$, conditional on repayment, offering maximum loan sizes (of 10) until period 6 is profit-maximizing; (iii) Since $\gamma_t = 1$ until period 5, he obtains maximum profits until this period and screening starts in the last period possible, 6.

In the game without expropriation, a **separating equilibrium**, in which L borrowers default with certainty in period 1, does not exist. In such an equilibrium the lender will offer maximum credit at the interest rate I for all periods 2 through 7 to borrowers who repay in period 1. Given this prospective loan schedule L borrowers would not default in period 1.

Proposition A2: *In the lending game without expropriation no fully separating equilibrium* $(\gamma_1 = 0)$ *exists.*

Proof: In a fully separating equilibrium the lender will set the maximum possible interest rate and loan size $(S_t, i_t) = (10, \bar{r})$ in all periods $t > 1$. The incentive constraint of L borrowers is then $\sum_{t=2}^{6}(v-\bar{r})\,10 + v10 \geq i_1 S_1$. Given that the interest rate in period

1 cannot exceed $\bar{r}$ it is impossible for the lender to offer a contract which does not meet [$\text{IC}_{\text{L, No expropriation}}$].

Finally, note that the equilibrium described in Proposition A1 is 'second-best', as the loan sizes are maximal until period 6, but must fall in period 7 to meet the L borrower's IC.

A.3. Lending with expropriation

Given the above parameters a **reputation equilibrium** exists in the expropriation game. In contrast to the non-expropriation treatments loans are of a smaller size in period 1 and increase over time, with maximum credit only in the final period. Repayment behavior is identical to the reputation equilibrium under non-expropriation: borrowers pool in periods 1 through 5, with L borrowers repaying always. In period 6 L borrowers default partly and in period 7 they default always.

Proposition A3: *In the game with expropriation the profit-maximizing reputation equilibrium for the lender is characterized by offers* $(S_7, i_7) = (10, \bar{r})$ *and for all periods* $t<7$: $i_t = \bar{r}, S_t = \frac{(v-I)}{((7-t)(v-1)+\bar{r})} \sum_{k=t+1}^{6} S_k + \frac{v}{((7-t)(v-1)+\bar{r})} 10$. *The H type borrower accepts and repays in all periods. The L type borrower accepts in all periods, repays with certainty in periods 1-5, with probability* $\gamma_6 = \frac{\bar{p}}{(1-\bar{p})}(v-1)$ *and* $\gamma_7 = 0$.

Proof:

- L type borrower repayment: The incentive constraint [$\text{IC}_{L,\text{Expropriation}}$] holds with equality in all periods $t \leq 6$. As a result $\gamma_6 = \frac{\bar{p}}{(1-\bar{p})}(\bar{r}-1)$ and $\gamma_t = 1$ if $t < 6$ is a best response behavior.
- H type borrower accepts and repays as $i_t = \bar{r}$ for all t.
- Lender contracts: Proposition A1 shows that the participation constraint of the lender is met in all periods. The same holds under expropriation, as the repayment behavior of the L type borrowers is identical.
- By the same reasons as in Proposition A1, the interest rate and the repayment behavior are profit-maximizing for the lender. To incetivize the L type borrower to repay until period 6 loan sizes have to be increasing, as follows from $\text{IC}_{L,\text{Expropriation}}$. Therefore, to reach maximum profits the lender starts by choosing the maximum loan size of 10 in the last period, 7. In the previous periods, the loan size is chosen such that the borrower's IC is satisfied with equality.

Under expropriation a **separating equilibrium** exists in which L borrowers default with certainty in period 1.

Proposition A4: *In the lending game with expropriation a fully separating equilibrium* $(\gamma_1 = 0)$ *exists. The profit-maximizing screening equilibrium for the lender has offers* $(S_1, i_1) = \left(10\frac{6v-5}{6(v-1)+I}, \bar{r}\right)$; $(S_2, i_2)...(S_7, i_7) = (10, \bar{r})$.

Proof: In a screening equilibrium, which maximizes the lender's profits, the lender will set the maximum interest rate ($i_t = \bar{r}$)and loan size ($S_t = 10$) in each period $t > 1$. In

period 1 the lender offers the maximum interest rate and lowest loan size such that the borrower does not prefer to default in period 2. This implies that $6(v-1)S_1 + vS_1 > (v-i_1)S_1 + 5(v-1)10 + v10$. This implies that $i_1 = \bar{r}$ and $S_1 = 10\frac{6v-5}{6(v-1)+\bar{r}}$.

Note that the screening equilibrium is more efficient than the reputation equilibrium. This is due to the fact that loan sizes are larger in period 1 under the screening equilibrium and L type borrowers default and reinvest these large loans until period 7. Therefore, investment levels are higher than under the reputation equilibrium. However, full efficiency is not reached, because this would require an initial loan size of 10, which is not profit-maximizing for the lender, who can screen by giving out a loan of $S_1 = 10\frac{6v-5}{6(v-1)+\bar{r}} < 10$.

Whether the lender earns a higher profit under the reputation equilibrium or the separating equilibrium depends on the schedule of loan sizes in the reputation equilibrium, as well as the share of H type borrowers. In the next subsection, we use the parameters in place in our experiment, to generate the predicted loan sizes and compare profits.

A.4. Application to the experiment

In our experiment we have that $v = 3$. We assume that H type borrowers are fair-minded and will repay only if the receive at least half of the gains from trade in any period, i.e. $\bar{r} = 2$. This gross interest rate also coincides with that observed in the experiment. Assuming $\bar{r} = 2$, our assumptions 1 and 2 on the share of H borrowers hold if $\frac{1}{2} > \bar{p} > \left(\frac{1}{2}\right)^7$.

This implies from assumption 2 that a reputation equilibrium would be possible even in a 2 period repeated game. These parameters also imply the following schedule of loan sizes.

Period	No-expropriation	Expropriation
1	10	4.19
2	10	4.51
3	10	4.92
4	10	5.47
5	10	6.25
6	10	7.5
7	6.666667	10

Table A: Predicted loan sizes over time

The profits from the reputation equilibrium are $(4.19 + 4.51 + 4.92 + 5.47 + 6.25)(\bar{r} - 1) + 7.5(\bar{p} + (1-\bar{p})\gamma_6)\bar{r} - 7.5 = 25.34 + 7.5\left(\bar{p}\bar{r}^2 - 1\right) = 25.34 + 7.5 * 4\bar{p} - 7.5 = 17.84 + 30\bar{p}$. In contrast, the profits from the screening equilibrium are $9.29\left(\bar{r}\bar{p} - 1\right) + 60\bar{p}(\bar{r} - 1) = 9.29\left(2\bar{p} - 1\right) + 60\bar{p} = 78.58\bar{p} - 9.29$.The lender prefers the screening equilibrium only if $78.58\bar{p} - 9.29. > 17.84 + 30\bar{p}$. This is not the case for any $\bar{p} < 27.13/48.58 = 0.56$.If $\bar{p} < 1/\bar{r} = 1/2$, as in assumption 1, the lender does not prefer the screening equilibrium.

Appendix B. Behavior in Pre-experiment Games

Table B summarizes the behavior of our subjects in the three pre-experiment games described in section 2.3. The table shows that there is no significant difference in pre-experiment game behavior between the E and NE treatments.

Table B. Behavior in pre-experiment games in the E and NE treatments.

Treatment	E					NE					T-test E vs. NE
	Obs	Mean	Std.	Min	Max	Obs	Mean	Std.	Min	Max	Pr(|T| > |t|)
Risk aversion	42	5.9	2.0	0	11	48	6.1	1.5	3	10	0.54
Strategic Reasoning	42	71.7	16.1	20	97	48	71.8	12.1	40	94	0.98
Trust	42	5.8	3.2	0	10	48	5.1	3.6	0	10	0.32
Trustworthiness	42	19.5	13.6	0	46	48	18.6	13.1	0	44	0.76

The first game was a risk preference elicitation task (following Dohmen et al, forthcoming). In this task, each player made eleven decisions, each of which had two options, A and B. Option A was a lottery with two outcomes, 0 and 100 points. The probability that the second outcome would be drawn was one half in each decision. Option B was a certain amount, which ranged from 0 points (in decision number 1) to 100 points (in decision number 11) and incremented by 10 points as the decision number increased. The indicator *Risk aversion* in Table B reports the number of times a subject chose option B in this game.

The second game was a one-shot guessing game (Nagel 1995). Each participant was randomly matched with 5 other participants. Each participant had to choose a number between 0 and 100. The participant whose choice was closest to 2/3 of the average choice would be the winner of a prize of 150 points. The indicator *Strategic Reasoning* in Table B is the choice made by subjects in this guessing game.

The third game was identical to the lending game of our 1S treatment, but played in the strategy method. First, subjects were asked to make decisions in the role of borrower. They were shown a table in which each column displayed a loan size in steps of 2 (2, 4, 6, 8 and 10), while each row displayed a requested repayment in steps of 2 (2, 4, ..., 30). They were asked whether they would make the desired repayment, in each cell of the table for which the desired repayment was smaller or equal to three times the loan size. The subject then moved onto a different screen in which he was asked to make his decisions as a lender, i.e. to make a loan offer and request a repayment, both in steps of 2. The indicator *Trust* in Table B is the loan offer a subject chose to make as a lender in this game. The indicator *Trustworthiness* in Table B is the number of times a subject chose to repay as a borrower in this game.

Appendix C. Instructions

The instructions displayed below are for all treatments. Parts of the text which are specific to a treatment are presented in brackets and the corresponding treatment is mentioned. We use the following code for treatments: **E**: Expropriation Treatment, **NE:** No Expropriation Treatment, and **1S:** One-Shot Treatment.

Instructions for Lenders

For simplicity, throughout these instructions we refer to the lender in the masculine form, i.e "he", and the borrower in the feminine form, i.e. "she".

Overview of the experiment

a) For this experiment you have been grouped together with 5 other participants. In this group there are 3 lenders and 3 borrowers. **You will be a lender for the entire duration of the experiment.**

b) The experiment consists of 3 rounds: **in each round you will be matched with a different borrower**. You will not be matched with the same borrower twice. You will not be informed about the identity of the other participants at any point.

c) Each round consists of [NE, E: 7 periods][1S:1 period]. **You will interact with the same borrower for** [NE, E: **7 periods**][1S:**1 period**] only.

d) In each period you have an endowment which you can use to offer credit to the borrower. If you offer credit you can ask for a repayment from the borrower. If you make a credit offer, the borrower decides whether to accept this offer. If the borrower accepts your credit offer, she decides whether to make the repayment desired by you.

e) The points you earn in each period depend on the amount of credit you offer in each period, your desired repayment, whether the borrower accepts the offer, and whether the borrower makes your desired repayment.

f) All points that you earn during the course of the experiment will be exchanged into euro at the end of the experiment. The exchange rate will be:

25 points = 1 euro

g) This is the final experiment. Your earnings from this experiment will be paid out together with your earnings from the previous 3 experiments after this experiment is completed.

Experimental Procedures

There are 3 lenders and 3 borrowers in this experiment. You are a lender for the entire duration of the experiment. The experiment lasts for 3 rounds, and in each round you will be matched with a different borrower. Each round consists of [NE, E: 7 periods][1S:1 period], so that you interact with the same borrower for [NE, E: 7 periods][1S:1 period]. In the following we describe in detail how you and the borrower make decisions in each period. Attached to these instructions are screen shots of each screen on which either you or the borrower will be required to enter a decision.

1. Investment

In each period of this experiment the borrower has an investment opportunity. The amount the borrower invests is determined [**E**: by her capital and] by the credit amount the borrower receives from you. The borrower's investment amount cannot exceed 10 points in any period.

[**E**:
In period 1 the borrower's capital is 0. Her capital in periods 2-7 depends on her and your decisions in periods 1-6. How the borrower's capital in period 2-7 is determined is explained in detail in section 4.
]

Section 2 describes in detail how the borrower's credit amount in each period is determined.

In each period the investment income of the borrower is three times her investment amount.

Investment amount = [E: Capital +] Credit amount ≤ 10

Investment income = 3 x Investment amount

2. Credit offers

In each period you have an endowment of **10 points.** With this endowment you can make a credit offer to the borrower. For this purpose, the "credit offer" screen (screen shot attached to these instructions) will be shown to you at beginning of each period.

At the top of the screen you can see which round of the experiment you are in, what your identification number is, and the identification number of the borrower you are matched with for this round. All lenders and borrowers keep their identification number for the whole duration of the experiment. This allows you to check that within each round of 7 periods you are always matched with the same borrower, and that in each new round you are matched with a new borrower. At the top of the screen you also see which period you are in, and the remaining time left to make your credit offer (in seconds). In each period you have 30 seconds to make your credit offer.

To make a credit offer you first choose the **credit amount**. As the borrower has a maximum investment amount of 10 [**E**: which also includes her capital], the maximum credit amount you can offer in any period is 10 [**E**: – the borrower's capital].

You then choose your desired repayment. The **desired repayment** may not exceed three times the credit amount.

0 ≤ Credit amount ≤ 10 [**E**: **– Capital**]

0 ≤ Desired repayment ≤ 3 x Credit amount

You do not have to make a credit offer to the borrower in any period. If you do not want to make a credit offer you can enter a credit amount of 0 and a desired repayment of 0.

[**E**:

If the borrower's capital equals the maximum investment amount of 10, then you cannot make a credit offer in this period. In this case the credit offer screen will inform you that no credit offer can be made.]

After you have determined your credit offer by entering a credit amount and desired repayment you must click on the "enter" button to finalize this offer. As long as you have not clicked on "enter" you may revise your offer.

[NE, E: On the left hand side of the "Credit offer" screen you can see the **history** of your interaction for all completed periods in this round. The history displays the following items for each period: [**E**: the borrower's capital,] your credit amount offered, your desired repayment and whether the desired repayment was made (yes/no).]

3. Accepting the credit offer and making the desired repayment.

If you make a credit offer, the borrower will see the details of this offer on the **"Credit acceptance" screen** (screen shot attached). The borrower can then **decide whether to accept the credit offer or not**.

If the borrower accepts a credit offer she then chooses her Actual repayment. The borrower's actual repayment can either be your desired repayment or 0. The borrower decides whether to make the desired repayment by choosing "yes" or "no" on the "**Repayment decision" screen** (screen shot attached).

Actual repayment =	**Desired repayment** *or* **0**

[**E**:

4. The borrower's capital

In period 1 the borrower's capital is 0.

The borrower's capital for periods 2, 3, 4, 5 ,6 , or 7 depends on her credit amount and her actual repayment in the previous periods.

- If the borrower did not accept a credit offer in the previous period, her capital is equal to that in the previous period.
- If the borrower accepted a credit in the previous period and made the desired repayment to the lender, her capital is equal to that in the previous period.
- If the borrower accepted a credit in the previous period and did not make the desired repayment to the lender, her capital is equal to that in the previous period *plus* the credit amount in the previous period.

Capital for periods 2, 3, 4, 5, 6 or 7	= Capital in previous period	if no credit offer is accepted in the previous period.
	= Capital in previous period	if a credit offer is accepted and the desired repayment is made in the previous period
	= Capital in previous period + Credit Amount in previous period	if a credit offer is accepted and the desired repayment is not made in the previous period

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5. Income calculation

If you did not make a credit offer or your offer was not accepted by the borrower your income equals your endowment of 10 points in this period. If you did make a credit offer and it was accepted by the borrower your income depends on the amount of credit you offered and the actual repayment of your borrower.

Your Income = 10 – Credit amount + Actual repayment

In each period the borrower has a certain income of 10 points. As mentioned in section 1 the borrower earns an additional investment income which is three-times the size of her investment

amount. The borrower's income in each period equals her 10 points plus her investment income minus her actual repayment [**E**: and minus the borrower's capital for the next period. As period 7 is the final period the borrower's income in this period equals her 10 points plus her investment income minus her actual repayment.]

Income of the Borrower =

10 + Investment income – Actual repayment [E: **– C**apital for next period **]**

You will be informed about your income [**E**:,][NE, 1S: and] the income of the borrower [**E**: and the borrower's capital] on the "**Income" screen** (screen shot attached).

After you have studied the income screen, you can record this information on your documentation sheet. You can then proceed to the next period or next round.

Exercises

The experiment will not commence, until all participants are completely familiar with all procedures. In order to secure that this is the case, we kindly ask you to solve the exercises that will be displayed on your computer screen. Wrong answers have no consequences for you. If you have any questions, please contact us.

Exercise 1:

[**E**: In period 1,] what is the maximum credit amount you can offer?

Maximum credit amount [**E**: in period 1 =]

Exercise 2:

In period 1 you do not make a credit offer. How high is your income and that of the borrower in period 1 [**E**: and the borrower's capital for period 2]?

Your income in period 1 =

[**E**: Borrower's capital for period 2=]

Income of the borrower in period 1=

Exercise 3:

In period 1 you make a credit offer with a credit amount of 8 and a desired repayment of 10. The borrower does not accept the offer. How high is your income and that of the borrower in period 1 [**E**: and the borrower's capital for period 2]?

Your income in period 1 =

[**E**: Borrower's capital for period 2=]

Income of the borrower in period 1=

Exercise 4:

In period 1 you make a credit offer with a credit amount of 8 and a desired repayment of 10. The borrower accepts the offer and makes the desired repayment of 10. How high is your income and that of the borrower in period 1 [**E**: and the borrower's capital for period 2]?

Your income in period 1 =

[**E**: Borrower's capital for period 2=]

Income of the borrower in period 1=

Exercise 5:

In period 1 you make a credit offer with a credit amount of 8 and a desired repayment of 10. The borrower accepts the offer and does not make the desired repayment of 10. How high is your income and that of the borrower in period 1 [**E**: and the borrower's capital for period 2?]

Your income in period 1 =

[**E**: Borrower's capital for period 2=]

Income of the borrower in period 1=

[**E**: **Exercise 6:**

In period 2 the borrower has a capital of 0. What is the maximum credit amount you can offer to the borrower?

Maximum credit amount period 2=]

[**E**: **Exercise 7:**

In period 2 the borrower has a capital of 8. What is the maximum credit amount you can offer to the borrower?

Maximum credit amount period 2=]

Documentation Sheet – Lenders

Round 1: you are matched with Borrower Nr. :					
Period	[**E**: Borrower's capital]	Credit Amount	Desired Repayment	Actual Repayment	Your Income
1	0				
[NE, E: 2					
3					
4					
5					
6					
7]					

Round 2: you are matched with Borrower Nr. :					
Period	[**E**: Borrower's capital]	Credit Amount	Desired Repayment	Actual Repayment	Your Income
1	0				
[NE, E: 2					
3					
4					
5					
6					
7]					

Round 3: you are matched with Borrower Nr. :					
Period	[**E**: Borrower's capital]	Credit Amount	Desired Repayment	Actual Repayment	Your Income
1	0				
[NE,E:2					
3					
4					
5					
6					
7]					

Instructions for Borrowers

For simplicity, throughout these instructions we refer to the lender in the masculine form, i.e "he", and the borrower in the feminine form, i.e. "she".

Overview of the experiment

h) For this experiment you have been grouped together with 5 other participants. In this group there are 3 lenders and 3 borrowers. **You will be a borrower for the entire duration of the experiment.**

i) The experiment consists of 3 rounds: **in each round you will be matched with a different lender**. You will not be matched with the same lender twice. You will not be informed about the identity of the other participants at any point.

j) Each round consists of [NE, E: 7 periods][1S:1 period]. **You will interact with the same lender for** [NE, E: **7 periods**][1S:**1 period**] only.

k) In each period the lender has an endowment which he can use to offer credit to you. If the lender offers credit he can ask for a repayment from you. If the lender offers credit, you decide whether to accept this credit offer. If you accept the credit offer, you decide whether to make the repayment desired by the lender.

l) The points you earn in each period depend the amount of credit offered by the lender, his desired repayment, whether you accept the lender's credit offer, and whether you make the desired repayment to him.

m) All points that you earn during the course of the experiment will be exchanged into euro at the end of the experiment. The exchange rate will be:

25 points = 1 euro

n) This is the final experiment. Your earnings from this experiment will be paid out together with your earnings from the previous 3 experiments after this experiment is completed.

Experimental Procedures

There are 3 lenders and 3 borrowers in this experiment. You are a borrower for the entire duration of the experiment. The experiment lasts for 3 rounds, and in each round you will be matched with a different lender. Each round consists of [NE, E: 7 periods][1S:1 period], so that you interact with the same lender for [NE, E: 7 periods][1S:1 period]. In the following we describe in detail how you and the lender make decisions in each period. Attached to these instructions are screen shots of each screen on which either you or the lender will be required to enter a decision.

1.Investment

In each period of this experiment you have an investment opportunity. The amount you invest is determined [**E**: by your capital and] by the credit amount you receive from the lender. Your investment amount cannot exceed 10 points in any period.

[**E**:
In period 1 your capital is 0. Your capital in periods 2-7 depends on your and the lender's decisions in periods 1-6. How your capital in period 2-7 is determined is explained below in section 4.]

Section 2 describes in detail how your credit amount in each period is determined.

In each period your investment income is three times your investment amount.

Investment amount = [E: Capital +] Credit amount ≤ 10

Investment income = 3 x Investment amount

2. Credit offers

In each period the lender has an endowment of **10 points.** With this endowment the lender can make a credit offer to you. For this purpose, the "credit offer" screen (screen shot attached to these instructions) will be shown to the lender at beginning of each period.

To make a credit offer the lender first chooses the **credit amount**. As you have a maximum investment amount of 10 [**E**: which also includes your capital], the maximum credit amount the lender can offer in any period is 10 [**E**: – capital].

The lender then chooses his desired repayment. The **desired repayment** may not exceed three times the credit amount.

0 ≤ Credit amount ≤ 10[**E**: **– Capital**]

0 ≤ Desired repayment ≤ 3 x Credit amount

The lender does not have to make a credit offer to you in any period. If the lender does not want to make a credit offer he can enter a credit amount of 0 and a desired repayment of 0.

[**E**:
If your capital equals your maximum investment amount of 10, then the lender cannot make a credit offer to you.]

3. Accepting credit offers and choosing the actual repayment

If the lender makes a credit offer to you, you will see the details of this offer on the **"Credit acceptance" screen** (screen shot attached).

At the top of the screen you can see which round of the experiment you are in, what your identification number is, and the identification number of the lender you are matched with for this round. All lenders and borrowers keep their identification number for the whole duration of the

experiment. This allows you to check that within each round of 7 periods you are always matched with the same lender, and that in each new round you are matched with a new lender. At the top of the screen you also see which period you are in, and the remaining time left to make your decision (in seconds). In each period you have 30 seconds to accept a credit offer.

On the right hand side of the screen you see the credit offer made by the lender. You can decide to **accept a credit offer or not** by clicking on the yes or no button on the right hand side of this screen. After you have made your decision you must click on the "enter" button to finalize this decision. As long as you have not clicked on "enter" you may revise your decision.

If you decide to accept the credit offer you then choose your Actual repayment. Your **Actual repayment** is either equal to the desired repayment of the lender or 0. You decide whether to make the desired repayment by choosing "yes" or "no" on the "**Repayment decision" screen** (screen shot attached).

Actual repayment =	**Desired repayment** *or* **0**

[NE, E: On the left hand side of the "Credit acceptance" screen and "Repayment decision" screen you can see the **history** of your interaction for all completed periods in this round. The history displays the following items for each period: [**E**: your capital,] the credit amount offered, the desired repayment and whether the desired repayment was made (yes/no).]

[**E**:

4. Your capital

In period 1 your capital is 0.

Your capital for periods 2, 3 , 4, 5, 6 or 7 depends on your credit amount and your actual repayment in the previous periods.

- If you did not accept a credit offer in the previous period, your capital is equal to that in the previous period.

- If you accepted a credit in the previous period and made the desired repayment to the lender, your capital is equal to that in the previous period.
- If you accepted a credit in the previous period and did not make the desired repayment to the lender, your capital is equal to that in the previous period *plus* the credit amount in the previous period.

Capital for periods 2, 3, 4, 5, 6 or 7	= Capital in previous period	if you did not accepted a credit offer in the previous period.
	= Capital in previous period	if you accepted a credit offer and made the desired repayment in the previous period
	= Capital in previous period + Credit Amount in previous period	if you accepted a credit offer and did not make the desired repayment in the previous period

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5. Income calculation

If the lender did not make a credit offer or you did not accept the lender's offer, the lender's income equals his endowment of 10. If the lender did make a credit offer and it was accepted by you, the lender's income depends on the amount of credit offered and your actual repayment.

Income of Lender = 10 – Credit amount + Actual repayment

In each period you earn a certain income of 10 points. As mentioned in section 1 you earn an additional investment income which is three-times the size of your investment amount. Your income in each period equals your 10 points plus your investment income minus your actual repayment [**E**: and minus your capital for the next period. As period 7 is the final period your income in this period equals your 10 points plus your investment income minus your actual repayment.]

Your Income =

10 + Investment income – Actual repayment [E: **–Capital for next period]**

You will be informed about your income[**E**:, your capital] and the income of the lender on the "**Income" screen** (screen shot attached).

After you have studied the income screen, you can record this information on your documentation sheet. You can then proceed to the next period or next round.

Exercises

The experiment will not commence, until all participants are completely familiar with all procedures. In order to secure that this is the case, we kindly ask you to solve the exercises that will be displayed on your computer screen. Wrong answers have no consequences for you. If you have any questions, please contact us.

Exercise 1:

[**E**: In period 1,] what is the maximum credit amount the lender can offer to you?

Maximum credit amount [**E**: in period 1 =]

Exercise 2:

In period 1 the lender does not make a credit offer. How high is your income and that of the lender in period 1[**E**: and your capital for period 2]?

[**E**: Your capital for period 2=]

Your income in period 1 =

Income of the lender in period 1=

Exercise 3:

In period 1 the lender makes a credit offer with a credit amount of 8 and a desired repayment of 10. You do not accept the offer. How high is your income and that of the lender in period 1 [**E**: and your capital for period 2]?

[**E**: Your capital for period 2=]

Your income in period 1=

Income of the lender in period 1=

Exercise 4:

In period 1 the lender makes a credit offer with a credit amount of 8 and a desired repayment of 10. You accept the offer and make the desired repayment of 10. How high is your income and that of the lender in period 1 [**E**: and your capital for period 2]?

[**E**: Your capital for period 2=]

Your income in period 1 =

Income of the lender in period 1=

Exercise 5:

In period 1 the lender makes a credit offer with a credit amount of 8 and a desired repayment of 10. You accept the offer and do not make the desired repayment of 10. How high is your income and that of the lender in period 1 [**E**: and your capital for period 2]?

[**E:** Your capital for period 2=]

Your income in period 1 =

Income of the lender in period 1=

[**E**: **Exercise 6:**

In period 2 you have a capital of 0. What is the maximum credit amount the lender can offer to you?

Maximum credit amount period 2=]

[**E**: **Exercise 7:**

In period 2 you have a capital of 8. What is the maximum credit amount the lender can offer to you?

Maximum credit amount period 2=]

Documentation Sheet - Borrowers

Round 1: you are matched with Lender Nr.:					
Period	[**E**: Capital]	Credit Amount	Desired Repayment	Actual Repayment	Your Income
1	0				
[NE, E: 2					
3					
4					
5					
6					
7]					

Round 2: you are matched with Lender Nr.:					
Period	[**E**: Capital]	Credit Amount	Desired Repayment	Actual Repayment	Your Income
1	0				
[NE, E: 2					
3					
4					
5					
6					
7]					

Round 3: you are matched with Lender Nr.:					
Period	[**E**: Capital]	Credit Amount	Desired Repayment	Actual Repayment	Your Income
1	0				
[NE, E: 2					
3					
4					
5					
6					
7]					