Journal of the Economic Science Association (2025), **11**, 270–278
doi:10.1017/esa.2025.10024

ORIGINAL PAPER

Asymmetric group loan contracts: experimental evidence

Francesco Carli[1], Sigrid Suetens[2], Burak Uras[2,3] and Philine Visser[4]

[1]Department of Economics, Deakin University, Burwood, VIC, Australia
[2]Department of Economics, Tilburg University, Tilburg, Netherlands
[3]Department of Economics, Williams College, Williamstown, MA, United States
[4]Rabobank, Utrecht, Netherlands
Corresponding author: Burak Uras; Email: r.b.uras@uvt.nl

(Received 11 January 2025; revised 28 July 2025; accepted 23 September 2025; first published online 27 November 2025)

Abstract
We design an experiment to study the effect of asymmetry in the context of group lending with joint liability. The performance of group loan contracts crucially hinges on borrowers engaging in peer monitoring and the common practice is to offer participants of a group loan symmetric contract terms. Our experiment shows that asymmetric contracts, in which monitoring is a dominant strategy for one borrower, increase the monitoring rate, and thus the repayment rate, without leaving borrowers substantially worse off. In addition, asymmetric contracting also raises expected profits of the lending institution. Overall, our experiment reveals that asymmetric group loan contracts are worth considering as part of a policy to maintain both financial stability and higher lender profits.

Keywords: asymmetric contracts; coordination game; crowdfunding; group loan contracts; joint liability; laboratory experiment; microfinance

JEL Codes: C91; C92; G21; O16

1. Introduction

Group loan contracts are a common tool used by microfinance (MFI) institutions in developing countries to lend to borrowers who lack collateral.[1] For example, De Quidt et al. 2018 document that between 2008 and 2014, group loans, in the form of joint liability contracts covered about 30% of the global microcredit market.[2] Group loans have also made a recent appearance in fintech crowdfunding platforms in developed countries to enhance the financial access of borrowers who lack adequate collateral (Hildebrand et al., 2017). Yet evidence from behavioral experiments indicates that group loan contracts do not necessarily increase repayment rates above what is achieved with individual contracts (e.g.Attanasio et al., 2015; Cason et al., 2012; Giné & Karlan, 2014).[3] This is consistent with

[1]See Armendáriz de Aghion and Morduch 2010 and Ghatak and Guinnane (1999) for detailed accounts of the economics of microfinance.

[2]The popularity of group loan contracts was spurred by the theoretical argument that joint liability induces peer monitoring among borrowers, which mitigates problems arising from informational and enforcement frictions between the lenders and the borrowers (Banerjee et al., 1994, Stiglitz, 1990, Varian, 1990), especially in communities with a high level of social connectedness (Besley & Coate, 1995).

[3]See Abbink et al. (2006) for an experiment showing that individual contracts outperform group lending in a case without monitoring opportunities. Cason et al. (2012) show that group loan contracts outperform individual contracts only if peer monitoring is relatively less costly.

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the shift that can be observed in microcredit towards individual liability loans (seeDe Quidt et al., 2018, for empirical evidence).

A crucial question is whether group loan contracts can be designed to guarantee high performance and high repayment rates. As shown in the game-theoretic model of Carli and Uras (2017), one way to achieve this is to maximize the extent of peer monitoring among the borrowers by introducing asymmetry in the lending contract. In their model a lending institution is faced with two *ex ante* identical borrowers who make a private investment. The borrowers can choose whether to monitor each other's investments, and monitoring is not observable to the lending institution and costly.[4] If a borrower monitors her peer, then the latter behaves diligently, which leads her investment project to have positive net present value. If a borrower does not monitor her peer, however, the latter can behave neglectfully and reduce the profitability of her project. The crux of the model is contained in the borrowers' monitoring choices. If the terms of repayment are the same for both borrowers, they both have an incentive not to monitor if they believe the other will not monitor. A multiplicity of equilibria then exists, including a low-performance outcome in which none of the two borrowers monitors and a high-performance outcome in which both borrowers monitor. If the lending institution instead sets up the repayment terms such that it is a dominant strategy for one borrower to monitor, then the best response for the other borrower is to monitor as well, making monitoring by both borrowers the unique equilibrium.

It is an open question to which extent introducing asymmetry in the lending contract is *behaviorally* effective in increasing the extent to which borrowers monitor each other. The current paper investigates this question in a lab experiment. Before bringing asymmetric contracts to the field, it is important to have information about the potential of such policy under tightly controlled conditions. Lab experiments with student subjects are ideal for this purpose because they generate behavioral data at a relatively low cost and allow generalizable inferences about behavior (e.g. Snowberg & Yariv, 2021). If it turns out that there is not much scope for asymmetric contracts to increase the monitoring rate above that achieved with symmetric contracts in lab conditions, then such policy will most likely fail to achieve its purpose in the field. The results of the experiment can thus guide the design of policies that improve the performance of group loan contracts.

In the experiment participants adopt the role of borrower and are matched with another borrower. They choose whether to monitor the other or not. They are randomly allocated to a treatment in which contract terms are symmetric or to a treatment in which contract terms are asymmetric. They make twenty monitoring decisions and after each round of decision-making they are informed about the outcomes and the choice of the matched borrower. In part of the treatments, participants are randomly rematched to another partner-borrower after each round, whereas in the other treatments the partner-borrower is fixed for all twenty rounds.[5]

Asymmetry increases the monitoring rate in our experiment independent of the matching protocol. In the case of random partners, asymmetry increases the monitoring rate by 60 percentage points whereas with fixed partners the increase is equal to 45 percentage points. Overall, a monitoring equilibrium occurs around 60% of the time with asymmetric contracts versus 8% or less with symmetric contracts. Furthermore, asymmetric contracts also increase the expected profit for the lending institution, which turns out positive with asymmetric contracts, while it is negative with symmetric contracts. We conclude that asymmetric contracting induces both improved financial stability and higher profits compared to the symmetric contracts and thus it is likely to provide a new alternative to substantially raise the efficiency of group loan practices.

[4]The model builds upon Stiglitz (1990) but relaxes the assumption that peer monitoring comes at no costs for the lender.

[5]Random rematching is reminiscent of the context of FINCA in Peru (Karlan, 2007), whereas a repeated relationship between borrowers is present in programs that allow people with former ties to form groups, such as FUNDAP in Guatemala (Wydick, 1999). As documented by Freedman and Jin (2017), heterogeneity in social connectedness of borrowers is also observed in the context of crowdfunding lending.

https://doi.org/10.1017/esa.2025.10024 Published online by Cambridge University Press

Our paper relates to the literature that studies the performance of alternative microfinance methods using lab experiments. The findings from this literature reveal that credit-union style microfinance schemes (i.e., rotating saving-and-credit associations) reduce the likelihood of default (El-Gamal et al., 2014), while allowing for progressive lending could induce over-borrowing and increase loan defaults (Cecchi et al., 2021). Also in this literature Barboni (2017) shows that the flexibility of repayment schedules in microfinance contracts can increase MFI profits by improving the sorting of good and bad borrower types. Our paper complements these studies by showing in an experiment that asymmetry in group lending contracts is yet another mechanism that may improve the performance of microfinance contracts.

Our paper also contributes to the literature that studies using field experiments how the performance of microfinance contracts can be improved.[6] For instance, Field and Pande (2008) evaluate the effect of repayment frequency on default rates in India, and find no difference between monthly and weekly repayment schedules. Transaction costs for borrowers can thus be decreased without changing the default rate. Giné et al. (2010) show that installing dynamic incentives can be beneficial for an MFI operating in Peru. They find that cutting off defaulting borrowers from access to future finances reduces the tendency to invest in high-risk projects, and thus increases the likelihood of repayment.

The remainder of the paper is organized as follows. In Section 2 we provide the theoretical background. In Section 3 we discuss the experimental design and procedures. In Section 4 we show the results. Section 5 concludes.

2. Theoretical background

The experiment is inspired by the model of Carli and Uras (2017), in which two borrowers choose between a *good* and a *bad* investment project and a lender (an MFI) decides whether to lend.[7] Both projects generate the same return in the case of success and no return in the case of failure. The good project has a higher success probability than the bad project, and the bad project provides an unpledgeable private benefit to the borrower, which the good project does not provide. Both borrowers need 100% external MFI finance to operate an investment project and the MFI does not observe the project choice of the borrowers.

In the absence of the right incentives, borrowers may prefer the bad project, and a key element in the model is that the MFI can incentivize the borrowers' investment choices to opt for the good project by stimulating *peer monitoring*. Peer monitoring refers to borrowers costly monitoring one another. Because peer monitoring is not observable to the MFI, and thus non-contractible, incentivizing borrowers to monitor is not trivial.

The sequence of events is modeled as a dynamic game with two stages. In the first stage, the MFI offers a group lending contract to the borrowers, which consists of a collection of repayments that depend on one's own and the peer's project outcomes. If both borrowers accept the group lending contract, they choose the monitoring effort. Monitoring leads to a disutility for the borrower exerting the effort but eliminates the bad project from the set of feasible investments of the peer, thus inducing borrowers to choose the good project. In the second stage, the borrowers privately select a project, either the good or the bad project. Subsequently, the investment outcomes realize and borrowers repay.

As can be shown, under certain restrictions[8], the optimal contract has two important features (Proposition 5.4 and Lemmas 5.5 and 5.6 inCarli and Uras, 2017). First, it exhibits joint liability, implying that borrowers are liable for their peer's low investment return, which is needed to incentivize monitoring. Second, the contract includes an asymmetric treatment of *ex ante* identical borrowers. In particular, if both borrowers monitor and thus choose the good project, the MFI

[6]See Hermes and Lensink (2011) for a discussion on the outreach and sustainability of microfinance.
[7]More details and calculations are in Section A.1 of the Appendix.
[8]See Section A.2 in the Appendix.

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rewards one borrower with a lower required repayment, making thextent to which the borrowers are attractedis borrower's expected repayments smaller than those of the other borrower. Asymmetric contracts yield a unique equilibrium in the monitoring subgame in which both borrowers monitor.

If the contracts were symmetric, there would be a second Nash equilibrium in the borrowers' monitoring subgame because of the strategic complementarities between borrowers' monitoring decisions (Proposition 6.1 in Carli and Uras, 2017). In this second equilibrium borrowers choose not to monitor and invest in the bad project. Overall, it can be expected that the extent to which borrowers monitor each other, and repay, is (weakly) lower if no asymmetry is included in the contracts. Yet, whether asymmetric contracts should be preferred is ultimately a behavioral question, and the answer depends on the extent to which the borrowers are attracted by the "bad" equilibrium in the case that contracts are symmetric.

Whether contractual asymmetry increases or decreases expected MFI profits, as compared to symmetric contract terms, depends on (i) the repayment schedule that is optimally determined by the group loan contract, and (ii) the borrowers' monitoring behavior. There are two countervailing effects at work (see Section A.3 in the Appendix). On the one hand, mobilizing monitoring by one borrower by means of an asymmetric contract induces additional costs for the MFI. On the other hand, by using an asymmetric contract the MFI can avoid losses associated with a no-monitoring equilibrium. Which of the two effects dominates—and determines the effect on expected profits—thus depends on the equilibrium achieved when contracts are symmetric. This is another motivation why a controlled experiment is informative.

3. Experiment and hypothesis

3.1 Procedures

The experiment was conducted in May and October, 2019, in CentERlab at Tilburg University, and has been pre-registered.[9] Participants were recruited by email among students who had indicated a willingness to take part in experiments. Upon arrival in the lab, they were randomly allocated to a computer terminal and were distributed instructions. To ensure incentive-compatibility, the instructions were written in neutral language (see Appendix A). To ensure a sufficient understanding of the instructions, participants had to correctly answer comprehension questions prior to making choices.

Participants were informed that earnings in Euros would depend on their choices and the choices of others as indicated in the games shown in Figure 1. They were informed that at the end of the experiment one round would be randomly selected for payment.

3.2 Design

In the experiment we focus on the monitoring behavior of the borrowers. We assume that the borrowers have accepted the terms of the loan contract proposed by the MFI at the beginning of the first stage of the (monitoring) game. Moreover, we assume that in the second stage borrowers behave according to the subgame perfect Nash equilibrium; they optimally choose a good or bad investment project conditional on the outcome of the monitoring stage.[10] Doing so allows us to study the monitoring behavior of the borrowers—which is at the core of the theoretical model—in a clean way, thereby ruling out possible confounds due to non-optimizing behavior in other stages of the game.

This leads to a decision-making setting in which two borrowers choose whether to monitor each other (M) or not (N), and where the contract is either symmetric or asymmetric. Figure 1 shows the payoffs of the borrowers depending on the choices they make. With a symmetric contract there exist two equilibria in pure strategies, namely (M, M) and (N, N), whereas with an asymmetric contract,

[9]The *Same partner* treatments were ran in May and the *Random partners* treatments were ran in October.
[10]For each combination of first-stage choices, there exists a unique optimal second-stage choice.

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(a) Symmetric contract

		2: M	2: N
1	M	5 , 5	8 , 4.5
1	N	4.5 , 8	8.5 , 8.5

(b) Asymmetric contract

		2: M	2: N
1	M	9 , 5	10 , 4.5
1	N	6 , 8	9.5 , 8.5

Fig. 1 Monitoring games in the experiment (a) **Symmetric contract** b) **Asymmetric contract**
Notes: The figure depicts decision-making and related payoffs for borrowers labeled 1 and 2 when the contract is symmetric (left-hand-side panel) or asymmetric (right-hand-side panel). M refers to monitoring and N to non-monitoring. Numbers at the left (right) of the parentheses refer to the payoffs of borrower 1 (2).

the game has a unique pure-strategy equilibrium, namely (M, M). The payoffs are based on a parameterization of the Carli-Uras model described above that ensures that none of the two equilibria in the game with symmetric contracts are risk dominant (see Section B of the Appendix for details).[11]

Participants in the experiment played 20 rounds of the symmetric or asymmetric monitoring game. At the end of each round they were informed about the choice of the matched partner and realized payoffs in that round. In all treatments participants kept the same role (borrower 1 or 2) throughout.

We implemented two different matching protocols which varied between treatments. In the *Random partners* treatments participants were randomly rematched with another participant after each round of play.[12] The purpose of these treatments was to mimic the one-shot nature of the theoretical model in Carli and Uras (2017) as closely as possible. In the *Same partner* treatments, participants were matched to the same partner for all rounds. From these treatments we aim to learn whether the model's equilibrium predictions are valid if borrowers repeatedly interact, which is likely more representative of interactions in real-world loan markets.

Table 1 gives an overview of the number of sessions, independent observations and participants in each of the treatments, as well as descriptive statistics on the share of female participants, the share of economics students, and the share of European students, which were collected at the session level. As can be seen in the table, within the *Random partners* or *Same partner* treatments, the sessions with *Symmetric* and *Asymmetric* were balanced in terms of these variables, which implies that we can interpret differences in behavior between *Symmetric* and *Asymmetric* treatments as caused by asymmetry in contracts. Yet, the composition of the subject pool in the *Random partners* and *Same partner* sessions differs quite substantially, possibly due to the different timing of the two series of sessions, making us reluctant to draw a causal inference about the effect of the matching protocol on behavior.[13]

3.3 Research hypothesis

We build our hypothesis upon the model discussed in Section 2, focusing on the effect of asymmetry of contract terms on the extent of monitoring, which is directly connected to the likelihood of ending up in the full monitoring equilibrium (M, M). Specifically, our hypotheses are:

[11] Risk dominance is key for predicting which equilibrium behavior in experiments converges in games with multiple equilibria (e.g. Battalio et al., 2001, Cooper et al., 1990, Schmidt et al., 2003).

[12] Participants were randomly rematched in matching groups of 10 participants each but they were unaware of the size of the matching group.

[13] We refrain from reporting statistical test results in Table 1 because the data on the share of female participants, the share of economics students, and the share of European students are only available at the session level, and not so at the individual level, and the experiment covers just 8 sessions.

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Table 1 Information on treatments

	Random partners		*Same partner*		
	Symmetric	*Asymmetric*	*Symmetric*	*Asymmetric*	Total
#Sessions	2	2	2	2	8
#Participants	36	40	24	28	128
#Independent obs.	4	4	12	14	34
Female (in %)	58.7	47.7	61.1	65.1	56.9
Economics (in %)	87.3	87.7	47	55.8	72.4
European (in %)	58.7	79.1	70.3	59	69.1
Timing of the sessions	October 2019		May 2019		

Notes: Independent observations refer to matching groups (in the case of random partners) or to pairs of matched borrowers (in the case of same partners). Matching groups consisted of 10 participants.

(i) The percentage of monitoring in the case of random-partners is higher in the asymmetric treatments than in the symmetric treatments.
(ii) The percentage of monitoring in the case of same-partners is higher in the asymmetric treatments than in the symmetric treatments.

Our experiment also allows us to infer the effect of asymmetry of contract terms on MFI profits and on profits of borrowers. If the monitoring rate is substantially higher with asymmetric contract terms than with symmetric contract terms, then it can be expected that MFI profits are higher in the former than in the latter case, but it is an open question whether borrowers are also better off.

4. Results

We study the effect of asymmetry in contracts on the rate at which participants in the role of borrower choose to monitor. Figure 2 shows the monitoring rate averaged over all 20 rounds by treatment. As can be seen, asymmetry of contracts has a major effect on the monitoring rate; asymmetry increases the monitoring rate by more than 50 percentage points at the individual participant level. The effect is statistically significant in probit regressions with clustering at the level of independent observations based on all data ($p < 0.001$), the *Random partners* sessions ($p < 0.001$), or the *Same partner* sessions ($p < 0.001$).[14] Our research hypothesis is thus confirmed.[15]

To give an idea of the power, we calculate the power for the treatment effect that we get when collapsing the data by independent observation. The statistics are an average monitoring rate of 0.163 with standard deviation 0.234 based on 16 observations in the *Symmetric* treatment and an average monitoring rate of 0.674 with standard deviation 0.345 based on 18 observations in the *Asymmetric*. If we use $\alpha = 0.05$, then the estimated power of a two-sided t-test with unequal variances is equal to 0.99.[16]

The implication of the observed behavior for outcomes is that random partners end up 66% of the time in the monitoring equilibrium (that is, they mutually monitor) with asymmetric contracts versus 3% of the time with symmetric contracts. A non-monitoring outcome, in which both borrowers choose not to monitor, is observed 6% of the time with asymmetric contracts and 66% of the

[14]Regression results are in Table D.1 in the Appendix. The effect is also overall statistically significant ($p < 0.001$) in a Mann-Whitney U test based on independent observations.

[15]Notice that except for the fact that the monitoring rate increases across rounds in the asymmetric treatments, there are no noteworthy dynamic patterns (see Figure D.4 in the Appendix).

[16]From a different angle, for $\alpha = 0.05$ and a power of 0.9, the minimum detectable effect size of asymmetry of contracts is equal to 0.269 if, as observed, the average monitoring rate is 0.163 (s.d. of 0.234) in the *Symmetric* treatment and the numbers of observations in the two treatments are equal to 16 and 18, respectively.

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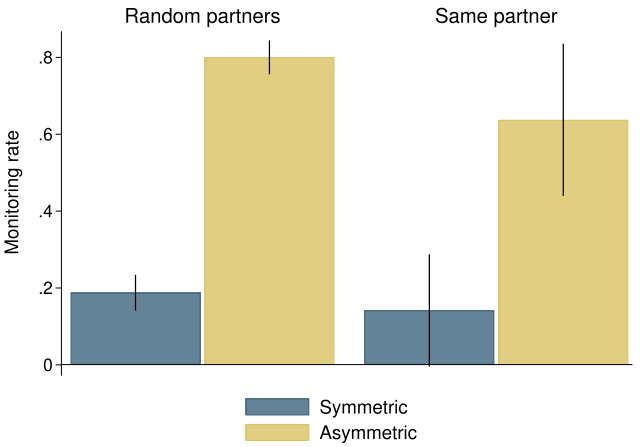


Fig. 2 Monitoring rate by treatment

Notes: The figure shows the monitoring rate by treatment, defined as the percentage of times participants choose to monitor. Error bars correspond to 95% confidence intervals estimated in probit regressions in which the dependent variable is a binary variable indicating whether a participant chooses to monitor in a particular round (equal to 1 if so) and the independent variable is an *Asymmetric* treatment dummy; standard errors are robust to clustering at the level of independent observations (see columns (2) and (3) of Table D.1 in the Appendix).

time with symmetric contracts (recall that only in the latter case did both borrowers not monitoring constitute an equilibrium). In the same partner treatments we find that borrowers with asymmetric contracts are 56% of the time in the monitoring equilibrium and 29% in the non-monitoring equilibrium. Borrowers with symmetric contracts are 8% of the time in a monitoring equilibrium and 80% of the time in a non-monitoring equilibrium.

Next, we answer the question whether the difference in monitoring rates between asymmetric and symmetric treatments is large enough to generate a difference in MFI profits. Calculations show that this is indeed the case: profits are larger with asymmetric contracts than with symmetric contracts. Specifically, computing profits using the parametrized model leads to a positive profit for the MFI with asymmetric contracts of 0.099 and a loss of 0.215 with symmetric contracts ($p < 0.001$ in a regression, see Table D.2 in the Appendix).[17] These results imply that asymmetric contracts lead to financial stability and higher expected MFI profits. The causal effect of asymmetry on monitoring is thus large enough to have the MFI to make a higher profit with asymmetric contracts compared to symmetric contracts. Moreover, the causal effect on monitoring behavior and MFI profits is robust to the matching protocol (random partners versus same partner).[18]

Finally, we investigate whether asymmetric contracts affect the welfare of borrowers. We find that asymmetry in contracts does not make borrowers substantially worse off. Across the *Random partners* and *Same partner* treatments, they earn 7.6 Euros with symmetric contracts and 0.4 Euros less with asymmetric contracts, and the difference is marginally significant (see Table D.3 in the Appendix). If we consider the *Random partners* and *Same partner* treatments separately, the effect is statistically not significant.[19]

5. Discussion

Understanding the efficiency of group loan contracts with joint liability is essential for the design of optimal financial development policies and for improving financial inclusion. These contracts have

[17]The p-value in a Mann-Whitney U test is 0.023.

[18]With random partners the MFI earns a profit of 0.229 in the case of asymmetric contracts and of -0.116 in the case of symmetric contracts, whereas with a fixed partner profits are respectively 0.062 and -0.248 (see Table D.2 for regression results).

[19]The same conclusion is reached if we employ Mann-Whitney U tests based on independent observations.

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been pervasively used by MFIs in developing countries and have received theoretical back-up. Yet a number of empirical and theoretical studies cast doubt on their performance. We show in an experiment inspired by Carli and Uras (2017) that performance can be increased if the MFI introduces asymmetric, borrower-specific contract terms that make monitoring a dominant strategy for one borrower (the leader). Such asymmetry breaks coordination by borrowers who jointly refuse to monitor each other, and mobilizes peer monitoring, which in turn increases the probability of repayment. Our experiment reveals that the monitoring behavior differs substantially when asymmetric and symmetric contracts are compared and profits are higher with asymmetric contracts — addressing the research questions that motivated the experimental design.

Asymmetric contracts of the type studied may be particularly attractive in cases or circumstances where joint liability contracts have not performed well in the past or are expected to lead to financial instability. Examples include cases in which the borrower groups consist of clients with little interpersonal trust or weak social ties (see e.g.Besley & Coate, 1995; Cassar et al., 2007; De Quidt et al., 2018; Hermes et al., 2006; Hermes et al., 2005; Karlan, 2007; Paxton et al., 2000). In such a context Paxton et al. (2000), Hermes et al. (2005) and Hermes et al. (2006) find that the quality of the group leader is positively related to its repayment performance, which could be seen as evidence for the fact that the group leader plays a prominent role in screening, monitoring and enforcing repayment within a group. That said, we find that in the treatment with random partners, which is arguably closest to the case of weak social ties, asymmetric contracts achieve a monitoring rate of 80%. This is almost 17 percentage points higher than that in the treatment where partners remain the same throughout the experiment. Although the difference is statistically not significant ($p = 0.118$), the qualitative effect is quite substantial and relates to Paxton et al. (2000) and Wydick (1999), who show that strong social ties do not improve loan repayment performance of the group, and may even have a negative effect.[20]

Finally, our results are relevant for forms of group lending in fintech crowdfunding platforms. On crowdfunding platforms borrowers can form groups to develop a reputation and to reduce information asymmetries vis-à-vis a large number of investors. Remarkably, Freedman and Jin (2017) find that in the context of crowdfunding social ties could weaken group loan performance due to easing up collusive behavior among borrowers. Moreover, empirical research by Iyer et al. (2016) and Hildebrand et al. (2017) shows that group loan contracts outperform individual contracts in terms of repayment in this context, and highlights that the presence of a leader-borrower is key for the performance of group loans. Interestingly, Hildebrand et al. (2017) show that the unconditional compensation of group leaders does not raise performance of group loans in crowdfunding. Our results suggest that if compensations were to take the form of conditional rewards, the repayment performance of the group may in fact increase also in the context of crowdfunding group loans.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/esa.2025.10024.

Acknowledgements. The experiment has been pregistered at the AEA RCT Registry under code AEARCTR-0004217. The replication material for the study is available at DOI link. We thank CentERlab for financial support and Lenka Fiala for assistance with experimental sessions. The views expressed in this paper are those of the authors and do not reflect those of Rabobank.

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[20] Paxton et al. (2000) show that the homogeneity of the group in terms of ethnicity reduce repayment performance using data from a group lending program in Burkina Faso. Wydick (1999), shows an insignificant effect of social ties on group loan performance in an experimental setting.

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Cite this article: Carli, F., Suetens, S., Uras, B., & Visser, P. (2025). Asymmetric group loan contracts: experimental evidence. *Journal of the Economic Science Association*, *11*(2), 270–278. https://doi.org/10.1017/esa.2025.10024

https://doi.org/10.1017/esa.2025.10024 Published online by Cambridge University Press