Journal of Economic Behavior and Organization 218 (2024) 423–455

Contents lists available at ScienceDirect

Journal of Economic Behavior and Organization

journal homepage: www.elsevier.com/locate/jebo

Research Paper

Communication and hidden action: A credit market experiment ☆

Martin Brown [a], Jan Schmitz [b,*], Christian Zehnder [c]

[a] Study Center Gerzensee and University of St. Gallen, Dorfstrasse 2, CH-3115 Gerzensee, Switzerland
[b] Radboud University, Heyendaalseweg 141, NL-6525AJ Nijmegen, Netherlands
[c] University of Lausanne, UNIL-Dorigny, Internef 612, CH-1015 Lausanne, Switzerland

ARTICLE INFO

JEL classification:
G21
G41
C91

Keywords:
Pre-contractual communication
Hidden action
Trust game
Credit market

ABSTRACT

We study the impact of pre-contractual communication on market outcomes when economic relationships are subject to hidden action. Our experiment is framed in a credit market context and borrowers (second movers) can communicate with lenders (first movers) prior to entering the credit relationship. Communication reduces moral hazard (strategic default) and increases trust (credit provision) in an environment where opportunistic behavior by borrowers is revealed ex-post to lenders. By contrast, in an environment where strategic defaults are hidden behind a veil of uncertainty, we find a substantially weaker impact of communication. Borrowers are more likely to renege on repayment promises when they can hide opportunistic behavior from lenders. As a consequence, lenders extend less credit to borrowers who promise to repay. Hidden action undermines the positive effect of communication on market outcomes. Our findings have implications for the design of contracts and how to structure relationships with a risk of hidden action: for pre-contractual communication to unfold its full potential it needs to go hand-in-hand with post-contractual monitoring.

1. Introduction

Opportunistic behavior, i.e., post-contractual moral hazard, is a key risk to economic exchange in many contexts. Before entering into an exchange, economic agents do not know whether their counterparty will adhere to the agreed terms. Economic agents therefore need to trust that the counterparty behaves trustworthily and fulfills its obligations (Arrow, 1969; Falk and Fischbacher, 2006; Fehr et al., 1993, 1998; Sapienza and Zingales, 2011). Research in behavioral economics documents that pre-contractual communication may be a powerful tool to increase trust and trustworthiness and to mitigate opportunistic behavior when behavior is perfectly observable ex-post (see, e.g., Balliet, 2009; Brandts et al., 2015; Cooper and Kühn, 2014; Ellman and Pezanis-Christou, 2010; Lei et al., 2014). In many relevant situations, however, observed outcomes do not perfectly reveal the behavior of the trading partner; i.e., economic relations are subject to hidden action.

☆ We thank the editor, Daniela Puzzello as well as one anonymous Associate Editor and two anonymous referees for their comments and suggestions during the review process. We further thank Sascha Behnk, Lisa Bruttel, Michalis Drouvelis, Paul Smeets, Martijn van den Assem, Matthias Weber, Boris van Leuween and Immanuel Lampe for their valuable comments and suggestions. We further thank seminar participants at the University of Lausanne, ETH Zurich and BRIC – University of Bonn; University of Nijmegen, University of Lugano, Goethe University Frankfurt, University College Dublin, ESRI Dublin, ZEW Mannheim, as well as participants at various conferences for helpful comments. We thank Olaf Bock, Mario Kohler, Andre Kuhn, Felix Schlueter, Merlinde Tews and Jeffrey Yusof for excellent research assistance. Financial support by the Swiss Finance Institute (2012-1-005) is acknowledged.

* Corresponding author.
E-mail addresses: martin.brown@szgerzensee.ch (M. Brown), jan.schmitz@ru.nl (J. Schmitz), christian.zehnder@unil.ch (C. Zehnder).

https://doi.org/10.1016/j.jebo.2023.12.019
Received 23 January 2023; Received in revised form 18 September 2023; Accepted 10 December 2023

Available online 29 December 2023

In this paper, we provide empirical evidence from laboratory experiments showing that the impact of pre-contractual communication is undermined in relationships involving the possibility for hidden action. Our findings confirm existing evidence on communication under complete information: trust and trustworthiness increase when agents can communicate. This has beneficial effects on market outcomes. The positive effect of communication disappears, however, in situations where behavior is not perfectly revealed to the paired economic agent ex-post. Participants in our experiment are more likely to renege on promises when they can hide opportunistic behavior from their trading partner. We disentangle whether the positive effect of communication is impaired by market uncertainty or hidden action (which is only possible if there is uncertainty about market outcomes). Our results show that hidden action and not uncertainty about outcomes per-se undermines the effect of pre-contractual communication on market outcomes. Pre-contractual communication and post-contractual monitoring preventing hidden action are therefore important for communication to unfold its full potential and to increase economic outcomes.

Our experiment is framed in a credit market context because credit relationships are a prime example for asymmetric information with the potential for moral hazard. Borrowers may hide opportunistic behavior (strategic default) behind the veil of economic uncertainty and pretend to be incapable of repayment while they are actually solvent. Moreover, communication before entering credit relationships is a common practice in credit markets. In retail lending, for example, borrowers interact with loan officers collecting soft information about a borrower's ability and willingness to repay (Briceno Ortega et al., 2008; Hertzberg et al., 2010; Uchida et al., 2012; Qian et al., 2015). Peer-to-peer platforms likewise enable borrowers to communicate with prospective lenders (Gao et al., 2018; Xu and Chau, 2018). In addition, several websites from the mortgage lending industry encourage their brokers to communicate with borrowers and find out more about their intentions and honesty (see, the website (LINK) of Expert Mortgage Assistance as just one of many examples).

In our experiment, we study a variation of the investment game introduced by Berg et al. (1995). In this game, the lender (first mover) can trust and extend credit to the borrower (second mover) who can decide whether to repay or not. Glaeser et al. (2000) and Karlan (2005) document that behavior in this game predicts behavior in real credit markets. We implement a "hidden action" condition in which the ability of the borrower to repay the lender is stochastic and strategic defaults are not revealed to the lender. We compare the hidden action condition to a baseline condition in which borrowers can always repay if they want to and thus strategic defaults are automatically revealed to the lender. In the hidden action condition lender incomes are in expectation lower than in the baseline condition, because some borrowers are forced to default. To rule out that our main results are driven by a direct effect of uncertainty, we also implement a third condition. In this "revealed action" condition the ability of a borrower to repay is stochastic (as in the hidden action condition) but borrower income and thus the repayment decision is revealed to the paired lender after each period (as in the baseline condition). In all conditions we compare a treatment with pre-contractual communication to a treatment without communication. In the communication treatments borrowers can send free form text messages to the paired lender before the lender makes his decision on credit provision. The borrower thus has the opportunity to promise that she will repay.

We rely on data from laboratory experiments because causal effects of communication are hard to study with observational field data. In real-life credit markets, the decision to communicate is endogenous and may correlate with unobservable borrower characteristics that also affect post-contractual behavior. Moreover, repayment choices are hard to identify with field data as strategic defaults by solvent borrowers can rarely be perfectly disentangled from forced defaults by borrowers who do not have the means to repay.[1] In our laboratory experiment, we exogenously vary borrowers' (second movers') ability to communicate and we are able to perfectly disentangle opportunistic behavior (strategic defaults) from involuntary breach of contracts (forced defaults). Our laboratory experiment allows us to study (i) whether borrowers endogenously choose to make pre-contractual repayment promises to lenders, (ii) whether these repayment promises are kept or broken (iii) how repayment promises affect the credit provision by lenders and (iv) whether the ex-post revelation of strategic defaults to lenders plays a crucial role for credit provision and/or repayment.

We find that communication has a significantly positive effect on the average credit volume and repayment frequency in the baseline condition without hidden action. In this condition, communication leads to higher average payoffs for both lenders and borrowers. By contrast, in our hidden action condition the effect of communication is weak. In this environment, communication does not reduce strategic default, credit volumes are only slightly higher compared to the no-communication treatment, and borrower or lender payoffs do not increase. Difference-in-difference estimates confirm a weaker impact of communication on credit provision and payoffs in the hidden action condition as compared to the baseline condition. In the revealed action condition, where the repayment decision is revealed to the paired lender, we find that the positive impact of communication on credit provision, repayment behavior and payoffs is restored.

We add to the literature on communication and trust in behavioral economics (see, e.g., Cooper and Kühn, 2014; Balliet, 2009; Lei et al., 2014) by providing novel evidence on the effect of communication when opportunistic behavior can be hidden behind surrounding economic uncertainty.[2] Most experimental studies on the effect of communication focus on strategic interaction in deterministic economic environments without stochastic risk that partners cannot behave trustworthily, even if they wanted to (see, e.g., Ben-Ner and Putterman, 2009). Charness and Dufwenberg (2006) provide first empirical evidence on the effect of communication in stochastic economic conditions. They find that communication increases trust and trustworthiness in situations with low levels

[1] Demyanyk and Van Hemert (2011) and Ghent and Kudlyak (2011) for example, show that a large fraction of mortgage defaults during the financial crisis were presumably strategic in nature as borrowers were hiding behind surrounding defaults.

[2] Literature exploring behavior in the absence of communication in environments where subjects can hide their behavior shows that pro-social behavior may decrease (Brown et al., 2016; Dana et al., 2007; DellaVigna et al., 2012; Exley, 2015; Guiso et al., 2013; Xiao and Kunreuther, 2016). However, there are also exceptions where possibilities to hide opportunistic behavior do not increase selfishness (van der Weele et al., 2014).

of uncertainty.[3] Our experiment differs from Charness and Dufwenberg (2006) in two key dimensions. First, we expand their work by adding a revealed action condition which allows to study the differential impact of communication in an environment with and without hidden action. We can thus distinguish between the effect of communication when the trustor (lender) learns the trustee's (borrower's) action and when the actions are hidden and not perfectly revealed. Charness and Dufwenberg already discuss this interesting addition in their paper and speculate about the effect communication when opportunistic behavior is not revealed in this setting.[4] Second, our experiment features greater uncertainty about the ability of borrowers to repay. We conjecture that significant uncertainty about the second mover's income may undermine the beneficial effect of communication as it makes it easier for second movers to conceal opportunistic behavior.[5]

Our results reveal that the positive effect of communication is undermined when uncertainty is sufficiently large and opportunistic behavior can be well concealed. This finding indicates that the inclination of economic agents to keep their word is not fully driven by unconditional preferences for promise-keeping (Ellingsen and Johannesson, 2004; Vanberg, 2008), but is more in line with a preference for being seen as honest (Abeler et al., 2019) or (expectation-based) guilt aversion (Di Bartolomeo et al., 2019; Ederer and Stremitzer, 2017).[6] Our findings differ from recent findings by Hoppe and Schmitz (2018) who conduct a variant of the Charness and Dufwenberg experiment with multiple contract negotiation and communication phases and a hidden action condition.[7] Communication reduces the strategic uncertainty in their experiment and increases effort and payoffs. Our findings imply that the level of uncertainty (which is higher in our setting) and/or the possible to make counter-offers (which is not possible in our setting) play an important role for the effectiveness of communication.

Our findings also contribute to the literature on credit provision and loan repayment in financial economics. While a broad body of empirical studies in finance documents that lender and borrower behavior are systematically influenced by bankruptcy laws (Ghent and Kudlyak, 2011; Gropp et al., 1997), credit information sharing (Brown and Zehnder, 2007; Liberman, 2016; Pagano and Jappelli, 1993), and collateral (Mian and Sufi, 2011; Stroebel, 2016), recent evidence also suggests an important role for moral constraints and social norms in reducing loan default and fostering credit provision in retail markets (Karlan, 2005; Guiso et al., 2013; Fisman et al., 2017). We contribute to this evidence by showing that soft factors such as pre-contractual communication can reduce credit risk. Our findings suggest, however, that pre-contractual communication is only effective when borrowers anticipate that moral hazard is likely to be revealed to the lender.

Bursztyn et al. (2019) and Karlan et al. (2016) show that *post-contractual* lender-to-borrower communication can improve repayment in consumer lending (Bursztyn et al., 2019; Karlan et al., 2016).[8] The findings of Bursztyn et al. and Karlan et al. inform on how to interact with borrowers in the post-contractual loan monitoring and loan recovery process. Our findings complement this literature by informing how to jointly design pre-contractual lender-borrower interaction with post-contractual loan monitoring.

The remainder of this paper is organized as follows: In Section 2 we present and discuss the experiment design. In Section 3 we provide testable hypothesis for our cross-treatment comparisons. In Section 4, we present our results and Section 5 discusses our findings.

2. Design of the experiment

2.1. Trust game

We implement a repeated trust game with a strangers matching protocol. Subjects are randomly assigned to be either a second mover borrower (she) or a first mover lender (he) in a matching group of 10 subjects (5 lenders and 5 borrowers) for 10 periods. In each period, each borrower (second mover) is randomly matched with one lender (first mover) out of the same matching group.

[3] Ederer and Schneider (2022) show that in situations with limited uncertainty, the effect of communication is robust when there is a time gap between the decision to trust and to behave trustworthily.

[4] Specifically, in Footnote 6 of their paper Charness and Dufwenberg state: "Independently of the contract-theoretic angle, we note that whether or not B's choice is observable by A may matter to the players' motivation (if they are not selfish). Perhaps B would feel worse choosing *Don't Roll* if he knew that A would know? We do not explore this interesting issue."

[5] In Charness and Dufwenberg subjects further only make one decision while our experiment gathers more observations on the individual level when subjects decide on credit sizes and repayment in several periods. Lastly, the strategy set is broader in our experiment (lenders can decide on a credit size from a set of four credits and borrowers decide on repayment for each credit size). Charness and Dufwenberg limit the decision space to binary choices (trust/do not trust and be trustworthy/not being trustworthy) in presence and absence of communication.

[6] This discussion also relates to the broader literature on lying aversion (see, e.g., Erat and Gneezy, 2012; Fischbacher and Föllmi-Heusi, 2013; Gneezy et al., 2013; López-Pérez and Spiegelman, 2013; Vanberg, 2017) and truth telling (see, e.g., Ellingsen and Östling, 2010; Kartik and Ottaviani, 2007; Kartik and Tercieux, 2014; Matsushima, 2008). Our findings are in line with recent experimental evidence by Gneezy et al. (2018) who show that people lie more often when their actions cannot be observed by an experimenter. The findings are also in line with Andreoni and Bernheim (2009) who show that giving in dictator games may be reduced if subjects can hide behind stochastic outcomes.

[7] Our design differs from Hoppe and Schmitz (2018) in several domains. Hoppe and Schmitz introduce lower levels of uncertainty (1/6) and have several negotiation stages in which first and second movers can make proposals about the subsequently provided effort and pay. Moreover, Hoppe and Schmitz also have multiple rounds of free-form first and second mover communication.

[8] Bursztyn et al. (2019) report on a field experiment showing that text messages which emphasize the immorality of loan delinquencies are associated with higher subsequent repayment rates. Karlan et al. (2016) report on a similar experiment which randomized the content of text message reminders to microfinance clients prior to the due repayment date. Text messages which emphasize the personal relationship between the loan officer and the borrower are associated with higher repayment rates. Using observational data, Laudenbach et al. (2018) find support for the effectiveness of personal as opposed to impersonal communication in reducing delinquency. Ahlin and Townsend (2007) provide evidence that social sanctions encourage repayment of loans in rural Thailand. Breza (2012) shows that peer effects play an important role in fostering loan repayment.

Table 1
Payoffs in the baseline trust game.

Credit size	Investment		Borrower's Income		Lender's Income	
	Return	Repayment due	repayment	no repayment	repayment	no repayment
10	40	25	165	190	165	140
40	160	100	210	310	210	110
70	280	175	255	430	255	80
100	400	250	300	550	300	50

Note: Trust game payoffs for borrowers and lenders for each credit size with repayment and without repayment.

Note: Timing (from Step 0–5) below horizontal line. Actions/decisions above the horizontal line. B = borrower; L = lender. 0: Random matching within a matching group in all treatments; 1: Communication possible in C-B, C-H, C-R; 2: All treatments; 3: Stochastic Income in: N-H, C-H, N-R, C-R; 4: Lender observes B's income: All treatments. Actions revealed in: N-B, C-B, N-R, C-R. Period 6: Lenders receive info about behavior within matching group.

Fig. 1. Timing of actions and decisions in each period.

Lenders and borrowers have the same endowment of 150 points. Lenders can issue a credit of 10, 40, 70 or 100 points from their endowment to the paired borrower. Borrowers yield an investment return which is four times the credit size. Hence, if a borrower receives a credit of 10 (40, 70, 100) points, she obtains a return of 40 (160, 280, 400) points, respectively.

Borrowers' decisions are elicited with the strategy method: Each borrower decides to repay or not for each of the possible credit sizes before she is informed about the credit choice of the paired lender. We fix repayments to 2.5 times the credit size. Thus, a borrower's repayment obligation for a credit of 10 (40, 70, 100) points is 25 (100, 175, 250) points. This parameter choice enables borrowers to implement an equal split of income between themselves and the paired lender for every credit size. The payoff of the lender is given by his endowment minus the credit size plus the repayment by the borrower. The payoff of the borrower is given by her endowment plus the investment return minus the repayment. Table 1 presents the lender and borrower payoffs for each credit size and repayment choice.

After borrowers and lenders make their decisions, the period payoffs are realized. Borrowers and lenders are then randomly re-assigned to new pairs within their matching group for the next period. Borrowers and lenders only learn their own payoffs at the end of each period. However, given the deterministic nature of borrower income, both borrowers and lenders can calculate the payoff of their trading partner. Fig. 1 illustrates the timeline of actions and decisions within each period in our different treatments (described in detail in Section 2.2 below).

To facilitate learning, we provide lenders in period six with the information about the total number of issued credits by size, the total number of repaid credits by credit size and the average earnings of lenders by credit size in period 1–5.[9] Furthermore, in period one, five and ten, lenders were asked to state their belief about how many borrowers in their matching group will repay their credits.[10] Lender beliefs were not incentivized.

2.2. Treatments

Our aim is to study how the ability of borrowers (second movers) to hide opportunistic behavior affects the impact of communication in this trust game. To this end we study six treatments in a 2x3 design.

First, we vary the borrowers' ability to hide opportunistic behavior. In our "baseline" condition described above, the borrower's income is deterministic: She always yields a return which is four times the credit size. In this condition it is common knowledge that the borrower always has the ability to repay a loan. As a consequence any non-repayment of a loan is automatically identified as a strategic default. We compare this baseline condition to a "hidden action" condition in which the return of the borrower is stochastic. With probability $p = \frac{2}{3}$, the borrower's return is four times the credit size. With the complementary probability $1 - p = \frac{1}{3}$, the borrower's return is zero and the borrower is forced to default.[11] In this condition the income of a borrower is not revealed to the paired lender. As a consequence, lenders cannot disentangle whether the non-repayment of a loan is due to a strategic default or a forced default.

Second, we vary the ability of borrowers and lenders to communicate with each other. In the "no communication" condition borrowers cannot communicate with lenders. In the "communication" condition we allow for non-binding pre-contractual communication. Borrowers can send a text message with a maximum of 300 characters to the paired lender – before the lender makes his decision about the credit size. Lenders can read the message but cannot respond. Borrowers in the communication treatments thus have the possibility to promise that they will repay specific credit sizes (if they have the income to do so). Promises are, how-

[9] Lenders and Borrowers were told in the instructions that they would receive this aggregate information.
[10] We discuss lender beliefs in Appendix A.4.
[11] We assume that the borrower's endowment is illiquid and cannot be used to repay a loan.

Table 2
Treatment overview.

Borrower income:		Deterministic	Stochastic	
Borrower choice:		Revealed	Hidden	Revealed
Communication	No	No Communication Baseline (N-B)	No Communication Hidden action (N-H)	No Communication Revealed action (N-R)
	Yes	Communication Baseline (C-B)	Communication Hidden action (C-H)	Communication Revealed action (C-R)

Note: Treatment overview. Row 1: Treatments without communication. Row 2: Treatments with communication. Column 1: Treatments with deterministic borrower income (No Communication Baseline (N-B) and Communication Baseline (C-B)). Repayment choice revealed to the lender. Column 2–3: Stochastic borrower income with hidden repayment action (No Communication and Hidden action (N-H) and Communication Hidden action (C-H)) in Column 2. Stochastic borrower income with revealed repayment decision (No Communication Revealed action (N-R) and Communication Revealed action (C-R)) in Column 3.

ever, cheap talk because (i) they are non-binding for that period, and (ii) interaction is anonymous and lenders and borrowers are randomly rematched each period.

The hidden action condition allows borrowers to conceal strategic defaults because their income is stochastic and is not revealed to lenders. Our conjecture is that this condition undermines the effectiveness of communication as borrowers may be more likely to renege on promises to repay. However, compared to the baseline condition the hidden action condition is also characterized by stochastic borrower income and thus lower expected payoffs for borrowers and lenders. Thus any differential effect of communication between the two conditions could potentially be attributable to the greater uncertainty and/or an income effect, rather than to the ability of borrowers to hide opportunistic behavior.

In order to assess the role of hidden action as opposed to the effect of uncertainty and income effects, we study the effect of communication in a third condition. In the "revealed action" condition, borrower income is stochastic, however the realized borrower income and thus borrower repayment choice is revealed to the lender after each period. In this condition, it is common knowledge that lenders can disentangle whether a borrower defaulted strategically or was forced to do so due to lack of income. We again implement a treatment without communication and a treatment with communication.

Our treatment variations lead to six treatments (see Table 2 for a treatment overview): The ***Communication - Baseline (C-B)*** treatment, the ***No Communication - Baseline (N-B)*** treatment, the ***Communication - Hidden Action (C-H)*** treatment, the ***No Communication - Hidden Action (N-H)*** treatment, ***No Communication - Revealed Action (N-R)***, and the ***Communication - Revealed Action (C-R)*** treatment. These treatments allow us to compare the effect of communication on lender credit provision, borrower repayment behavior and payoffs under stochastic income and hidden action to stochastic income and revealed action to that in the baseline condition. We are interested in the differential effect of communication between these conditions.

2.3. Procedures

The experiment was conducted between March and May 2015 (main treatments) and between May and June 2017 (additional treatments) at the University of Hamburg Experimental Laboratory. The experiment was programmed in z-Tree (Fischbacher, 2007) and subjects were recruited using hroot (Bock et al., 2014). 600 subjects participated in 30 sessions of the experiment.[12] There were 20 subjects in each session, so that we elicited 2 observations at the matching group level per session. At the end of each session, two periods (one period from period 1–5 and one period from period 6–10) were randomly chosen for payments. A session lasted about 80 minutes and subjects earned on average 13.66 Euro.[13] Roughly half of the subjects were female (55%) and subjects were on average 25 years old. Appendix A.5 shows that these key socio-demographics of subjects are balanced across treatments.

Upon arrival, subjects had to pick a number from a shuffled deck of cards (numbers 1–20). The number determined their computer cubical and whether they were a borrower or a lender. Subjects then had to read a set of instructions. While borrowers and lenders had individual instructions, both were informed about the action set, information set, and payoff consequences for the respective other role. Before the experiment started, subjects had to answer a set of computerized control questions. The experiment only started after all subjects answered the control questions correctly. After the experiment, we asked subjects to fill in a questionnaire in which we elicited socio economic variables.

2.4. Discussion of the design

Our experiment design was chosen to capture (in a stylized fashion) key features of economic interactions with hidden action. Hidden action is a threat to economic exchange in many situations (e.g., online retail where products are received after payment, one-off contracts in the gig economy where buyers have limited knowledge about quality, interactions involving the purchase of credence goods or insurance contracts in general). One specific context in which hidden action is arguably a particularly important

[12] Note: The data for the NR and CR treatments were collected in 2017. Therefore, we ran two additional sessions also in the NB and NH treatment to highlight the consistency of subject behavior across years. Table 14 in Appendix A.6 presents 2015 and 2017 summary statistics for these treatments.

[13] At the time of the experiment, the average student salary in Germany was 10 Euro per hour.

issue is unsecured, non-repeated lending. Such credit relationship exists in a wide variety of contexts including personal lending, small-business lending, person-to person lending, and trade-credit. Our experiment is framed in the lending context as here, all features needed to study hidden action are present. Our framing is well suited to study communication with hidden action as in lending relationships the potential borrower may interact with the potential lender before they contract. The lender then decides upon how much to lend, knowing that the borrower may not be able to or may not be willing to repay. Our experiment mirrors the key factors of these interactions. A common challenge in laboratory experiments including morally charged behavior is that all possible choices are explicitly permitted by the experimental protocol. In our context, this might imply that strategic default is seen as more socially acceptable than in contexts outside of the laboratory. However, it is important to emphasize that this point holds for all our treatments. As we are only interested in between-treatment comparisons and not in the absolute frequencies with which certain behaviors occur, our results remain unaffected by these potential issues. Moreover, the credit market frame makes sure that all subjects understand the situation and prevents that some of the subjects associate the game with a different context which might affect their behavior.

There are four design choices in our experiment which warrant particular discussion: The first major design choice is the type of uncertainty we implement in the "hidden action" condition. In our experiment, the borrower's investment income is the only stochastic variable. Lenders must fear that a borrower may not be able to repay a loan, even if she wants to. The stochastic nature of borrowers' ability to repay is particularly interesting when studying the role of pre-contractual communication. In particular, borrowers may promise to repay loans, but then hide behind their potential solvency risk when breaking these promises and defaulting strategically. Our choice of uncertainty for the "hidden action" condition reflects the potential solvency or liquidity risk of debtors in a variety of credit contexts. Our choice also reflects of economic uncertainty in other market environments where participants can hide behind exogenous factors and engage in risky behavior (e.g., insurance markets). By contrast, our baseline-condition with deterministic borrower income hardly corresponds to real-life contexts. We implement the baseline-condition as one of two benchmark conditions (besides the revealed action condition) as it has been widely applied in experimental studies of communication in trust-games (see, e.g., Cooper and Kühn, 2014; Balliet, 2009; Lei et al., 2014).

A second major design choice is the type of communication we implement. We study pre-contractual communication by borrowers to lenders. We choose one-sided communication by borrowers only, as previous evidence has shown that second-mover communication can strongly influence the behavior of both second-mover and first-mover behavior in trust games (Charness and Dufwenberg, 2006; Ben-Ner and Putterman, 2009). pre-contractual communication allows second-movers to signal their type and intentions to first-movers. Thus this direction of communication is particularly important in a strategic situation where the first movers cannot enforce second-mover behavior and have imperfect information about the type and behavior of second movers.

Our design also differs from recent field experiments which study post-contractual (lender-to-borrower) communication (Bursztyn et al., 2019; Karlan et al., 2016). The difference in timing and communicating party reflects the difference in research questions between the studies. Karlan et al. (2016) and Bursztyn et al. (2019) are interested in how reminders and moral appeals from lenders (first movers) affect the propensity of borrowers (second movers) to repay outstanding loans. We are interested in how communication by borrowers about their intended repayment behavior can foster lending in the first place. As in Karlan et al. (2016) and Bursztyn et al. (2019) we allow for text-message communication only, rather than allowing borrowers to communicate face to face with lenders. We choose this type of communication in order to study the effect of communication in an anonymous, one-shot interaction and to be able to rule out any dynamic incentives from potential repeated interaction.[14] In contrast to Bursztyn et al. (2019) and Karlan et al. (2016), we do not exogenously vary the content of text-messages but communication is endogenous and borrowers can decide about the content of their messages. This is also different to (e.g., Bracht and Feltovich, 2009), who force second movers to communicate. We do not do this as it may undermine the intention of messages and the cost of lying. To account for the fact that the decision to communicate is endogenous we always benchmark the effect of communication in the different information conditions against treatments without communication in the same condition (i.e. revealed vs. hidden action with or without uncertainty about borrower actions). To assess the effectiveness of communication across information and economic conditions we use a difference-in-difference approach in our main analysis. We thereby capture differences in the propensity to communicate in different situations and measure the relative effectiveness of communication (see Section 3 below for hypotheses and Section A.1 in the Appendix for theoretical foundations for our predictions).

A third design choice concerns the strategy space of the lenders. In our experiment, lenders could choose between a loan of 10, 40, 70 or 100. They were thus not able to abstain from lending at all.[15] We forced lenders to make a loan of at least 10 in order to circumvent "certainty" effects. Previous research has demonstrated that agents have a strong preference for certain rather than risky (or ambiguous) prospects (Kahneman and Tversky, 1979). In our experiment, lenders were exposed to the risk of non-repayment no matter what loan size they chose. On the other hand we limited the number of non-minimum loan sizes to three, i.e., a small loan (40), a medium loan (70) and a large loan (100). We chose to limit the strategy space of lenders to simplify the elicitation of borrower repayment choices. This design choice implies that we examine the intensive rather than the extensive margin of credit provision. Seminal papers of lending under information asymmetries highlight both margins (Stiglitz and Weiss, 1981; Jaffee and Russell, 1976).

[14] We are aware that face-to-face communication may enhance cooperation more than anonymous (see, e.g., Balliet, 2009, for a meta-analysis). However, assuming that treatment effects are constant across conditions, our results should hold.

[15] In Appendix B we explore the implications of an alternative design in which lenders have the option to also offer a credit size of 0. Our assessment is that this no credit option is likely to reduce credit supply in all treatments. However, our assessment is that the no credit option would not invalidate our main cross-treatment finding: The effect of communication on loan repayment and credit supply is stronger in the baseline (and revealed action) conditions than in the hidden action condition.

Kirschenmann (2016) provides evidence for the impact of information asymmetries on the intensive margin in small business lending.

Our fourth major design choice was to elicit repayment decisions in our trust game with the strategy method. In each period, a borrower had to state whether she would repay a loan size of 10, 40, 70 or 100 if (i) she received such a loan, and (ii) she was able to repay the loan (in the hidden and revealed action conditions). We chose to elicit borrower choices with the strategy method in order to get a complete picture of intended repayment behavior, no matter which loan size was actually offered to the borrower. Also, in the hidden action condition (and revealed action condition) we can elicit intended repayment behavior even for those borrowers who are forced to default. In a survey of the literature Brandts and Charness (2011) find no systematic difference in first-mover or second-mover behavior in trust/investment games which compare the strategy method to direct response elicitation.

3. Hypotheses

Our aim is to study the impact of pre-contractual communication on trust (credit provision) and trustworthiness (repayment behavior) when second movers (borrowers) can hide opportunistic behavior (strategic defaults) behind surrounding uncertainty in the market. The effect of interest in our study is thus a difference-in-difference effect: we will measure the difference in borrower repayment choice and lender credit offers between the C-H and N-H treatment and compare this to the difference in outcomes between the C-B and N-B and the C-R and N-R treatment. We present an intuitive signalling model with formal predictions in Appendix A.1. Our theory builds on the existing literature on social preferences (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999) and known behavior from second movers in the trust game (Karlan, 2005; Johnson and Mislin, 2011). In this section, we summarize the intuition and the assumptions of this model and present testable hypotheses which guide our analysis in Section 4 below.

We assume that at least some borrowers (second movers) face moral costs when not making a repayment (not behaving trustworthily) if they have an income and could do so (i.e., their utility is reduced if they strategically default and behave selfishly). Borrowers thus face a trade-off between the monetary benefit from strategic defaults and the negative (psychological) effect due to strategic default. We assume that these cost from strategic default are borrower specific and heterogeneous. Borrowers with high moral costs will always repay when they can, whereas borrowers with low moral costs will never repay. We further assume that borrowers' moral costs depend on two additional elements: i) moral costs increase if opportunistic behavior can be identified by the lender, i.e., borrowers feel worse if the paired lender knows that the borrower strategically defaulted, and ii) moral costs of strategic default increase if borrowers made a repayment promise, i.e. borrowers dislike breaking a promise. Consequently, borrowers with intermediate moral costs may make repayments in certain situations (e.g., when their actions are observable and/or when they made a repayment promise) and may strategically default in others (e.g., when their actions are not observable and/or when they did not make a repayment promise).

Our assumptions on borrower behavior are based on evidence suggesting that individuals experience *(expectation based) guilt aversion* (Di Bartolomeo et al., 2019; Ederer and Stremitzer, 2017) or have a preference for *being seen* as honest (Abeler et al., 2019). As a consequence, the effect of communication and promise keeping may be weakened if borrowers believe that lenders' expectations to receive payment are lower in the presence of uncertainty and hidden action or if their actions are not observable in these situations.

For simplicity, we assume in our model that lenders either extend the maximum credit (trust fully) or give no credit at all (do not trust). Thus, lenders face a trade-off between the monetary benefit a credit relationship with repayment may yield and the risk of (strategic or forced) credit default. Before entering in a credit relationship lenders hold a belief about the repayment probability of borrowers. This belief depends on the underlying economic situation (stochastic or deterministic income of borrowers) and the assumed moral costs for strategic default by borrowers. The assumed moral costs are influenced by whether or not borrowers communicated and made a repayment promise and whether or not borrower actions are observable.

Hypothesis 1 presents our hypotheses for the effect of communication in the baseline and hidden action conditions (the comparison follows intuitively from the descriptions about lender and borrower behavior above and is based on our predictions by treatment as summarized in Table 7 in Section A.1 in the appendix).

Hypothesis 1 *(The effect of communication in the baseline and hidden action conditions).*

1.A In the C-B treatment, borrowers are more likely to choose to repay large credits and lenders are more likely to offer large credits than in the N-B treatment.
1.B In the C-H treatment, borrowers are more likely to choose to repay large credits and lenders are more likely to offer large credits than in the N-H treatment.
1.C The impact of communication on borrower behavior is weaker in the hidden action condition (C-H vs. N-H) compared to the baseline condition (C-B vs. N-B). The impact of communication on lender behavior may be weaker or stronger in the hidden action condition (C-H vs. N-H) compared to the baseline condition (C-B vs. N-B).

In the C-B and C-H, two possible equilibria may arise: there is a no-communication equilibrium in which borrower and lender behavior is identical to that in the N-B treatment. In addition, there is a communication equilibrium in which all borrowers promise to repay large loans. In the communication equilibrium of the C-B treatment (C-H treatment) more borrowers will choose to repay large loans compared to the N-B treatment (N-H treatment). As a consequence, lenders are more likely to offer large loans in the communication equilibria of the C-B and C-H treatment compared to the N-B and N-H treatment. However, because borrowers can

hide opportunistic behavior in the C-H treatments, the treatment effect of communication on borrower behavior should be weaker in the hidden action condition (C-H vs. N-H) compared to the baseline condition (C-B vs. N-B).

The treatment effect of communication on lender behavior can be weaker or stronger in the hidden action condition (C-H vs. N-H) compared to the baseline condition (C-B vs. N-B). There are two countervailing effects at play: on the one hand communication has a weaker impact on borrower repayment choices in the hidden action condition (see above). On the other hand, due to stochastic borrower income the threshold belief required for lenders to offer credit is higher cet. par. in the hidden action condition compared to the baseline condition. This implies that for a given increase in the share of borrowers who repay the decrease in the threshold belief that borrowers do not repay is larger in the hidden action than in the baseline condition.

In our model, the mechanism driving this effects underlying Hypothesis 1 is that when strategic defaults are not revealed to lenders, less borrowers feel compelled to honor their promises to repay. In our empirical analysis we will compare borrower promises and subsequent repayment behavior in the C-B and C-H treatment. Hypothesis 2 summarizes our predictions for this comparison.

Hypothesis 2 *(Promises, repayment behavior and credit in the communication treatments).*

- Borrowers are equally likely to promise to repay (large) loans in the C-H and C-B treatments.
- In the C-H treatment, borrowers are more likely to break a promise to repay than in the C-B treatment.
- Lenders are less likely to offer large loans to borrowers who promise to repay in the C-H treatment than in the C-B treatment.

To disentangle the role of hidden action from the role of stochastic income per se, we examine the effect of communication in our revealed action condition. This condition is identical to the hidden action condition except that the realized borrower income is revealed ex-post to the lender. This allows the lender to distinguish strategic defaults from forced defaults. If the effect of communication in the hidden action condition is weakened due to the increased uncertainty and lower expected income of lenders then we would expect a similar weak effect of communication in the revealed action condition. By contrast, if the ability to hide opportunistic behavior is responsible for the weak effect of communication in the hidden action condition, then we should see stronger effects of communication in the revealed action condition. Hypothesis 3 summarizes our conjecture that hidden action rather than uncertainty and income effects drive the weak effect of communication in the hidden action condition:

Hypothesis 3 *(The effect of communication in the revealed action condition).*

- In the C-R treatment, borrowers are more likely to choose to repay large credits and lenders are more likely to offer large credits than in the N-R treatment.
- The differential impact of communication between the baseline condition (C-B vs. N-B) and the revealed action condition (C-R vs. N-R) is smaller than between the baseline condition and the hidden action condition (C-H vs. N-H).

To derive alternative hypotheses for our cross-treatment comparisons we relax the assumption that borrowers incur higher moral costs if they default strategically after they have promised to repay. We also relax the assumption that moral costs of strategic default are even higher if promise-breaking behavior is revealed to the lender. Consider first that promise-breaking does not affect the individual costs of strategic default at all. It is apparent that under this assumption lender and borrower behavior is independent of the ability to communicate. We would thus predict no difference in strategic default (or lender credit provision) between the C-B and N-B treatments or the C-H and N-H treatments. Now consider that promise-breaking does affect the moral costs of strategic default, but these costs are independent of whether promise-breaking is revealed to the lender or not. Under this assumption we predict less strategic default in the C-B compared to the N-B treatment and in the C-H compared to the N-H treatment. However, in contrast to Hypothesis 1.C above, there should be no differential effect in the impact of communication on borrower behavior between the baseline and hidden action conditions. Moreover, under this condition, we expect a stronger impact of communication on credit provision in the hidden action compared to the baseline condition.

4. Results

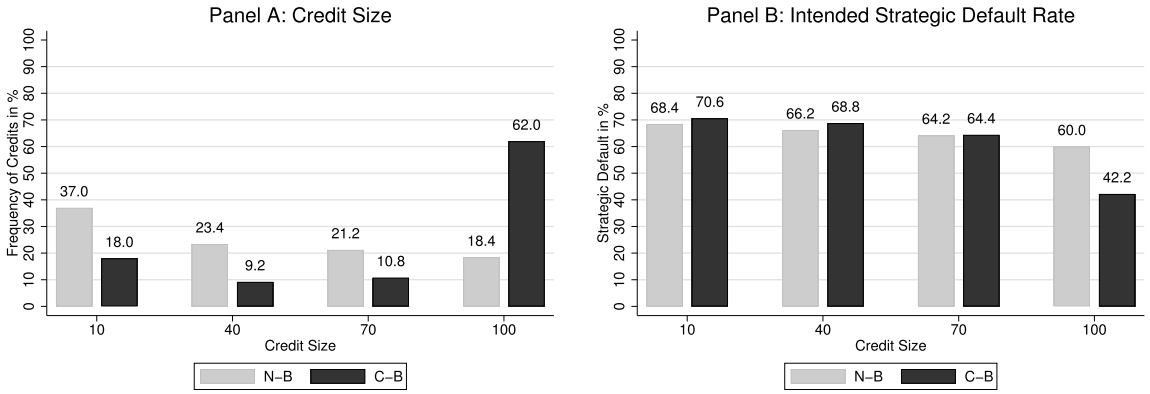
We report our findings in two subsections. In Section 4.1, we test Hypothesis 1 by comparing the effect of communication across our two main conditions: the hidden action condition and the baseline condition. We confirm a significant weaker treatment effect of communication on market outcomes in the hidden action condition. In Section 4.2 we examine the mechanism behind this differential treatment effect. Here, we first confirm Hypothesis 2 by documenting that borrowers are more likely to break promises to repay in the hidden action than in the baseline condition. We then confirm Hypothesis 3 by showing that in our revealed action treatment (as opposed to the hidden action treatment) communication has a significant impact on borrower and lender behavior.

Table 3 presents descriptive statistics for realized outcome variables by treatment. We report the average credit size (*Credit Size*), the frequency of strategic default among those borrowers who can repay (*Strategic Default*) as well as the resulting profits for borrowers (*Borrower Profit*) and for lenders (*Lender Profit*) by treatment.

Table 3
Realized outcome variables by treatment.

Borrower income:	Deterministic		Stochastic			
Borrower choice:			Hidden		Revealed	
Communication	No	Yes	No	Yes	No	Yes
Treatment:	N-B	C-B	N-H	C-H	N-R	C-R
Credit Size	46.30	75.04	45.10	58.24	41.32	63.10
	[27.4; 75.4]	[67; 92.8]	[28.6; 68.2]	[41.8; 78.4]	[29.2; 71.8]	[53.2; 71.2]
Strategic Default	0.65	0.44	0.547	0.52	0.60	0.46
(cond. on income)	[0.26; 0.84]	[0.18; 0.78]	[0.26; 0.73]	[0.33; 0.70]	[0.47; 0.75]	[0.33; 0.61]
Borrower Profit	290.5	329.4	233.7	249.8	227.5	251.9
	[245.1; 356.6]	[297.3; 370.2]	[193.1; 291]	[193.6; 296.1]	[195.4; 281.4]	[236.1; 281.3]
Lender Profit	148.4	195.7	139.5	142.7	135.4	148.3
	[120.2; 202.9]	[136.2; 242.7]	[128.5; 154.2]	[122.7; 167.1]	[131; 145.2]	[130.5; 176.3]

Note: The table reports the mean of matching group averages for each variable. The range of matching group averages is shown in brackets [min; max]. We implemented 10 matching groups for each treatment.



Notes: Panel A shows the mean frequency with which lenders give credits of the different size (10, 40, 70, and 100) in the C-B and N-B treatments. Panel B shows the mean intended strategic default rate for each credit size (10, 40, 70, and 100) in the C-B and N-B treatments.

Fig. 2. Credit offers and intended strategic default: baseline condition.

4.1. The effect of communication: hidden action vs. baseline condition

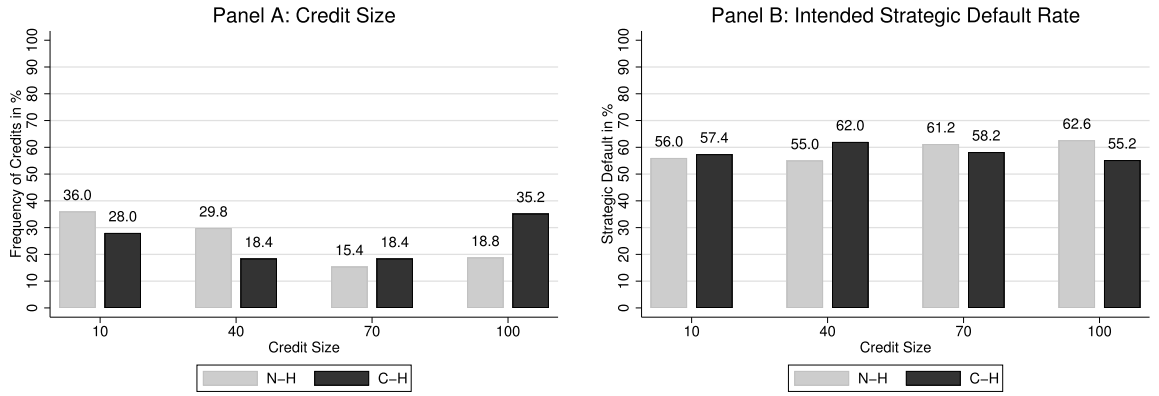
We first report the effect of communication in our baseline condition. Table 3 documents a 62% increase in the average credit size in the C-B treatment compared to the N-B treatment (75.0 vs. 46.3). A two sided rank-sum test at the matching group level confirms that this increase is statistically significant ($N = 20$, $p<0.01$).[16] Panel A of Fig. 2 confirms that communication impacts on lender behavior in the baseline condition. Lenders offer the maximum credit size (credit of size 100) more than three times as often in the C-B treatment compared to the N-B treatment (62% vs. 18.4%; $N = 20$, $p<0.01$).

Communication also has an impact on repayment behavior in the baseline condition. Table 3 reveals a substantial and statistically significant decrease in the realized strategic default rate in the C-B treatment compared to the N-B treatment (44.2% vs. 65%; $N = 20$, $p = 0.015$). This improvement in loan repayment may be driven by two effects: First, borrowers may be less likely to default on a loan of a given size in the C-B compared to the N-B treatment. Second, borrowers in both treatments may be less likely to default on larger loans. As a result, the higher average credit size in the C-B compared to the N-B treatment would go hand in hand with a higher loan repayment rate. Our data reveals that both effects are at play. Panel B of Fig. 2 shows that the intended strategic default (ISD) rate is decreasing in loan size in both treatments. The higher intended strategic default rates on lower loan sizes may be because these loan sizes may be associated with lower trust by the lender and are hence reciprocated less frequently compared with high loans. But this decline is stronger in the C-B than in the N-B treatment. The figure shows that the ISD rate for credits of size 10 is similar in both treatments. By contrast, the ISD for credits of size 100 is significantly lower in the C-B treatment than in the N-B treatment (42.2% vs. 60%; $N = 20$, $p = 0.044$).[17]

In our baseline condition, communication leads to a substantial increase in the provision of credit and a substantial reduction in the strategic default rate. As a consequence, both lenders and borrowers yield higher payoffs in the treatment with communication.

[16] If not explicitly stated, we always use two-sided tests with matching group averages as unique observations to determine statistically significant differences between our treatments.

[17] We do not find a significant effect of communication on borrower repayment behavior for other credit sizes.



Notes: Panel A shows the mean frequency with which lenders give credits of the different size (10, 40, 70, and 100) in the N-H and C-H treatments. Panel B shows the mean intended strategic default rate for each credit size (10, 40, 70, and 100) in the N-H and C-H treatments.

Fig. 3. Credit offers and intended strategic default: hidden action condition.

Borrowers earn on average 13% more in the C-B treatment compared to the N-B treatment (329 vs. 291 points; N = 20, p = 0.012). Lenders earn on average 32% more in the C-B treatment compared to the N-B treatment (196 vs. 148 points; N = 20, p<0.01).

Result 1.A *(The effect of communication in the baseline condition). In the C-B treatment, borrowers are more likely to repay large loans and lenders are more likely to offer large loans than in the N-B treatment. Communication leads to a pareto improvement: Borrowers and lenders yield higher average payoffs in the C-B compared to the N-B treatment.*

We next examine the effect of communication in the hidden action condition. The summary statistics in Table 3 show that the average credit size offered by lenders is 30% higher in the C-H treatment compared to the N-H treatment (58.2 vs. 45.10; N = 20, p = 0.05). Fig. 3 (Panel A) shows that the frequency of credits of size 100 is almost twice as high in the C-H treatment compared to the N-H treatment (35% vs. 19%; N = 20, p = 0.03).

Table 3 reveals that there is no difference in the realized strategic default rate between the C-H and the N-H treatment (54.7% vs 51.5%; N = 20, p = 0.4). Fig. 3 shows that intended strategic default is hardly related to loan size in the C-H treatment or the N-H treatment. Moreover, there is no statistically significant difference in borrower behavior between the C-H and N-H treatments for any loan size.[18]

Table 3 shows that there is only a small, statistically insignificant increase in borrower profits from the N-H treatment to the C-H treatment (233.7 vs. 249.8; N = 20, p = 0.19). The average profit of lenders hardly differs between the two treatments (N = 20, p = 0.65).

Result 1.B *(The effect of communication in the hidden action condition). Lenders offer larger credit volumes in the C-H compared to the N-H treatment but borrowers are not more likely to repay loans. Communication does not lead to a significant increase in average lender or borrower profits.*

Our analysis so far suggests that communication has a significant positive effect on credit provision, repayment behavior, and payoffs in the baseline condition. By contrast, the effect of communication is much weaker in the hidden action condition. To formally test for differential treatment effects of communication across the two conditions, we present results from difference–in–difference regressions with matching group averages as observations. Table 4 presents results for six dependent variables: Average credit size (CS – Column 1), the realized strategic default rate contingent on repayment ability (Strategic Default – Column 2), borrower profit (Borrower Profit – Column 3) and lender profit (Lender Profit – Column 4), the frequency of credit size 100 (Credit Size 100 – Column 5) and the intended strategic default rate for credits of 100 (ISD 100 – Column 6). The explanatory variables are *Hidden Action*, a dummy variable indicating the hidden action condition, *Communication* which is a dummy variable indicating the communication treatments. The interaction between the two *Hidden Action* × *Communication* is our variable of interest.

The results presented in Table 4 confirm that there is a significant weaker impact of communication on realized outcome variables in the hidden action condition. The interaction term *Hidden Action* ×*Communication* is large and statistically significant for the average credit size (Column 1), the realized strategic default rate (Column 2) and lender profits (Column 4). The differential impact of communication across conditions is smaller and weaker for borrower profits (Column 3). The results in columns (5–6) of Table 4 suggest that the differential treatment effect of communication on the above outcome variables can be attributed more to lender rather borrower behavior. The column (5) estimates show a significant differential effect of communication on lender credit offers. By contrast, the column (6) estimates suggest a weaker differential impact of communication on borrower repayment behavior.

[18] ISD 10: N = 20, p = 0.93; ISD 40: N = 20, p = 0.13; ISD 70: N = 20, p = 0.49; ISD 100: N = 20, p = 0.36.

Table 4
Difference in difference regressions: hidden action vs. baseline.

	Outcome				Behavior	
Dependent variable:	Credit Size (1)	Strategic Default (2)	Borrower Profit (3)	Lender Profit (4)	Credit Size 100 (5)	ISD 100 (6)
Hidden Action	-1.200	-0.103	-56.73***	-8.950	0.00400	0.0260
	(5.708)	(0.0697)	(13.59)	(9.870)	(0.0617)	(0.0830)
Communication	28.74***	-0.208***	38.96***	47.26***	0.436***	-0.178**
	(5.708)	(0.0697)	(13.59)	(9.870)	(0.0617)	(0.0830)
Hidden Action × Comm.	-15.60*	0.176*	-22.86	-44.10***	-0.272***	0.104
	(8.073)	(0.0985)	(19.21)	(13.96)	(0.0872)	(0.117)
Constant	46.30***	0.650***	290.5***	148.4***	0.184***	0.600***
	(4.036)	(0.0493)	(9.607)	(6.979)	(0.0436)	(0.0587)
Observations	40	40	40	40	40	40
F	11.87	3.071	19.99	14.25	22.09	2.387
R^2	0.497	0.204	0.625	0.543	0.648	0.166

Note: Difference–in–difference (OLS) regressions with matching group averages as observations. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Columns (1–4) present regressions with market outcomes as dependent variables. Columns (5–6) present regressions with lender and borrower behavior as dependent variables. In all regressions, the no communication baseline treatment (N-B) is the benchmark condition. *Hidden Action* is a variable indicating the treatments with forced default. Communication is a dummy variable which is equal to one in the treatments with communication and zero otherwise. *Hidden Action × Comm.* captures the interaction effect between the hidden action and communication treatment.

Result 1.C *(Differential effect of communication in hidden action vs. baseline condition). The positive effect of communication on credit volume and lender profits is significantly weaker in the hidden action condition compared to the baseline condition.*

4.2. Mechanism: hidden action and promise breaking

In this section we provide evidence which supports our conjecture that the ability of borrowers to hide opportunistic behavior reduces the effectiveness of communication in the C-H compared to the C-B treatment.

4.2.1. Borrower promises and behavior

We first report on borrower-lender communication in our C-H and C-B treatments as well as the subsequent behavior by borrowers and lenders. We show that borrowers are much more likely to break their promises to repay loans in the C-H compared to the C-B treatment. As a consequence lenders offer less credit to borrowers who promise repayment in the C-H than the C-B treatment.

We explore how borrowers communicated with the paired lender in Table 5. The table presents summary statistics for coded chat variables.[19] The table first reports the frequency of borrower-lender communication (*Messaging*). Second, we report the content of messages communicated by borrowers to the paired lender. *Promise* captures any promise by a borrower to repay a credit, i.e. any promise to repay a specific credit size or any promise unrelated to a specific credit size. *Promise 100* captures specific promises to repay a credit of size 100. *Request* is a variable describing a request of a borrower for credit of any specific size as well as any request for a loan without mentioning a specific credit size. *Request 100* captures the requests for credits of size 100. *Threat* is a variable which captures all threats to only repay a specific credit size. *Threat 100* captures threats to only repay credits of 100. Finally, the table reports whether there are general differences in the way that borrowers communicate with lenders in the different treatments. *N-words* reports the average length of a message and *N-grams* reports the average length with respect to the number of words with meaning of a message.[20] *Mistake* reports the average number of spelling and grammar mistakes detected by Microsoft Word's German spell checker for messages within a matching group. The table also summarizes the share of messages which had been identified to use a friendly 'tone' (*Friendly*) by the independent coders.

Table 5 shows that borrowers communicate very similar in all treatments and that treatments did not affect the most common messages that borrowers send to the paired lender. They send messages 71% of the time in the C-H treatment, compared to 66.4% of the time in the C-B treatment. This treatment difference is not statistically significant (N = 20, p = 0.50). The most common message in both treatments involves a repayment promise and a request for credits of any (unspecific) size (*Promise+Request*: 54.2% vs.

[19] Note: Messages (983) of borrowers were coded by three research assistants independently. Research assistants were unaware of the research question and at least two coders had to agree that a message falls into a certain category for a variable to be included in the analysis. A borrower's message could fall in multiple categories. We use Krippendorff's α as a measure for inter-coder reliability (Hayes and Krippendorff, 2007). Most categories included in the analysis are above (*Threat* = 0.883;*Threat 100* = 0.872; *Request 100* = 0.753; *Request* = 0.786; *Promise* = 0.90; *Promise 100* = 0.77; *Friendly* = 0.12) the cut-off value proposed by Krippendorff ($\alpha = 0.667$). Furthermore, our values are in and above the values reported in other economic experiments (see, e.g., Bartling et al., 2017; Brandts et al., 2014; Cason et al., 2017; Eisenkopf, 2014; Leibbrandt and Sääksvuori, 2012). Coder instructions are available in Online Appendix.

[20] We follow common practice in text-analysis (Gentzkow et al., 2019) and report n-grams related to words which carry a meaning. We follow Schonlau et al. (2017) to generate n-grams and when excluding the most common stop words (see LINK).

Table 5
Borrower communication.

	Matching group averages			P-values (two-sided ranksum tests)		
	C-B	C-H	C-R	C-B		C-H
				vs. C-H	vs. C-R	vs. C-R
Messaging	0.664	0.710	0.592	0.50	0.54	0.36
	[0.4; 0.88]	[0.4; 0.88]	[0.2; 0.94]			
Promise	0.494	0.404	0.532	0.09	0.67	0.21
	[0.12; 0.62]	[0.18; 0.78]	[0.12; 0.84]			
Promise 100	0.466	0.356	0.486	0.11	0.54	0.14
	[0.12; 0.6]	[0.12; 0.68]	[0.02; 0.82]			
Promise+Request	0.542	0.53	0.556	0.64	0.86	0.56
	[0.12; 0.7]	[0.18; 0.78]	[0.18; 0.9]			
Promise+Request 100	0.484	0.416	0.498	0.24	0.62	0.28
	[0.12; 0.7]	[0.18; 0.68]	[0.2; 0.82]			
Threat	0.102	0.0240	0.0340	< 0.01	0.04	0.79
	[0; 0.2]	[0; 0.16]	[0; 0.22]			
Threat 100	0.0800	0.0220	0.0340	0.08	0.21	0.66
	[0; 0.2]	[0; 0.16]	[0; 0.22]			
N-words	14.94	13.78	13.53	0.68	0.68	0.91
	[5; 23.38]	[4.92; 21.08]	[3.9; 28.9]			
N-grams	7.23	6.73	6.29	0.79	0.56	0.52
	[2.46; 12.02]	[3.02; 9.42]	[2; 14.1]			
Mistakes	0.522	0.384	0.48	0.81	0.36	0.67
	[0.06; 1.26]	[0.1; 0.84]	[0; 1.96]			
Friendly	0.38	0.41	0.31	0.83	0.20	0.14
	[0.12; 0.74]	[0.2; 0.78]	[0; 0.8]			

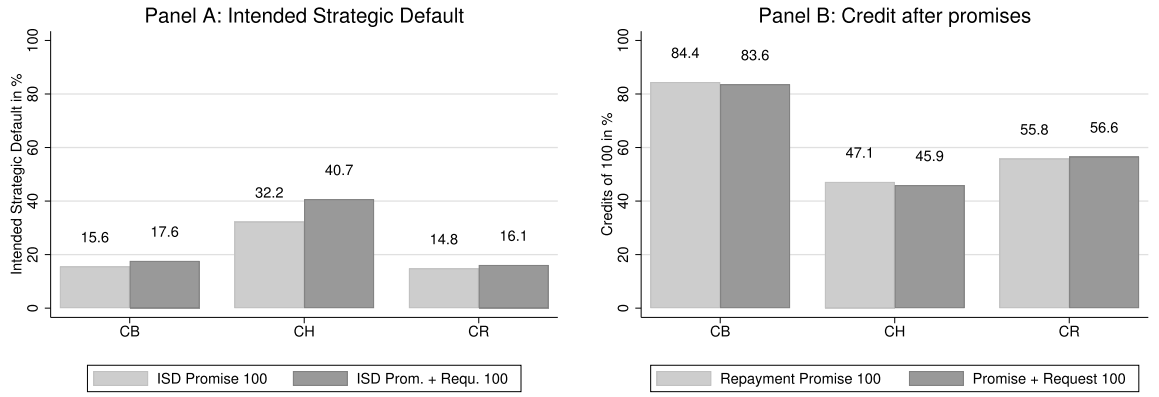
Note: Summary statistics for coded chat variables. Variables describe mean of matching group averages in Columns (1–3). The range of matching group averages is shown in brackets [min; max]. P-values from two-sided ranksum tests in Columns (4–6). *Messaging* captures any incidence of borrower communication with the paired lender. *Promise* captures specific (for a certain credit size) and unspecific (for any credit size or credits in general) promises to repay credit. *Promise 100* captures promises to repay credits of 100. *Promise+Request* is a variables capturing any specific request or repayment promise (for a specific credit size) or unspecific request or repayment promise for credit. *Promise + Request 100* captures requests or promises for credits of size 100. *Threat* is a variable describing a threat to only repay certain credit sizes. *Threat 100* captures threats to only repay credits of size 100. Note that borrowers can make multiple threats, promises or requests within one message. *N-words* captures the average number of words per message. *N-grams* captures the average number of n-grams (words with meaning) of a message. *Mistake* shows the average number of spelling and grammar mistakes detected by Microsoft Word's German spell checker. *Friendly* summarizes the share of messages which were written using friendly language.

53%; N = 20, p = 0.62). The second most frequent message contains a repayment promise and a requests for a credit size of 100 (*Promise+Request 100*: 48.4% vs. 41.6%; N = 20, p = 0.24). Borrowers in the C-B treatment more often promise to repay credits of 100 compared with borrowers in the C-H treatment. The difference between treatments, although substantial is marginally insignificant (*Promise 100*: 46.6% vs. 35.6%; N = 20, p = 0.11). Moreover, there is only a marginally significant difference in the frequency that borrowers send promises for any credit size between the C-B and the C-H treatment (*Promise*: 49.4% vs. 40.4%; N = 20, p = 0.09). The treatment conditions further do not influence the number of words per message, (*N-words*: 14.94 vs. 13.78; N = 20, p = 0.68), the number of words with meaning (*N-grams*: 7.23 vs. 6.73; N = 20, p = 0.79), the likelihood of making mistakes (*Mistakes*: 0.522 vs. 0.384; N = 20, p = 0.81) or the general 'tone' of the messages (*Friendly*: 0.38% vs. 0.41%; N = 20, p = 0.83).[21]

Consistent with our assumption about borrower behavior, borrowers mostly promise to repay large loans as these are most profitable. For example in the C-B treatment, 49.4% of all messages are promises and 46.6% of all the messages are repayment promises for credits of 100. In the C-H and C-R treatment the fraction of promises for large loans is equally large. That credits of 100 are most relevant for borrowers is also reflected in the fraction of threats that are related to repayments of the highest credit size. Borrowers only infrequently threat lenders to only make repayments for certain credits. If they do, however, it is for credits of 100 and borrowers are marginally more likely to do so in the C-B compared with the C-H treatment (*Threat 100*: 0.08 vs. 0.022; N = 20, p = 0.08). The way borrowers communicate also supports the interpretation that the somewhat higher intended strategic default rates on small credit sizes (smaller than a credit 100) in all treatments can be a direct consequence of lower borrower reciprocity for low levels of trust by the lender which has the additional intention of shifting lenders' credit decision towards the highest and most profitable credits.

In Panel A of Fig. 4, we report the intended strategic default rate for loans of 100 (ISD 100) conditional on borrower communication. The first bar (light gray) reports ISD 100 for those borrowers who promise to repay such a loan (ISD 100 Promise 100). The second bar (dark gray) reports ISD 100 for those borrowers who promise to repay a credit of 100 or request such a credit (ISD Prom. + Requ. 100). The results show that borrowers are much more likely to break their repayment promises when their actual repayment

[21] Note that also for general aspects of communication like, e.g., whether or not borrowers reveal information about themselves, whether messages have non-topic related content, are written in a fuzzy or somewhat weird manner or the coders identify and aggressive tone, we do not find differences in communication between treatments (all p-values from pairwise comparisons >0.1).



Notes: Panel A of the figure shows the mean intended strategic default rate for borrowers who promise to repay credits of 100 (light gray bars) and borrowers who also include requests for credits of 100 in their repayment promise (dark gray bars) in the C-B, C-H, and C-R treatment. Panel B of the figure presents the mean frequency with which lenders give credits of 100 in the C-B, C-H, and C-R treatment conditional on receiving a promise to repay a credit of 100 (light gray bars) or a repayment promise for a credit of 100 which also explicitly included a request for such a credit (dark gray bars).

Fig. 4. Borrower and Lender behavior after communication.

behavior is hidden. In the C-B borrowers break their promises about 15.6% of the time compared to 32.2% in the C-H treatment (N = 20, p = 0.07). Likewise, borrowers who combine repayment promises and repayment requests for credit of 100 are much more likely to default in the C-H treatment (40.7%) compared with borrowers in the C-B treatment (17.6%), (N = 20, p = 0.01).[22]

Lenders anticipate that borrowers are more likely to renege on their promises in the hidden action condition. Panel B of Fig. 4 reveals that lenders give credits of 100 84.4% of the time after receiving a message containing a repayment promise for this credit size in the C-B treatment (light gray bar - Repayment Promise 100). If borrower includes requests for such credits in the message, the credits are granted with equal frequency (83.6%) as the variable Promise + Request 100 (dark gray bar) shows. In the C-H treatment, lenders are less likely to respond to promises (47.1%; N = 20, p<0.01) and promises combined with requests (45.9%; N = 20, p<0.01) of borrowers.[23]

Result 2 *(Borrower promises, repayment and credit in the C-B and C-H treatments). In the C-H treatment, borrowers are more likely to break promises to repay than in the C-B treatment. Lenders are less likely to offer large loans to borrowers who request and promise to repay such loans in the C-H treatment than in the C-B treatment.*

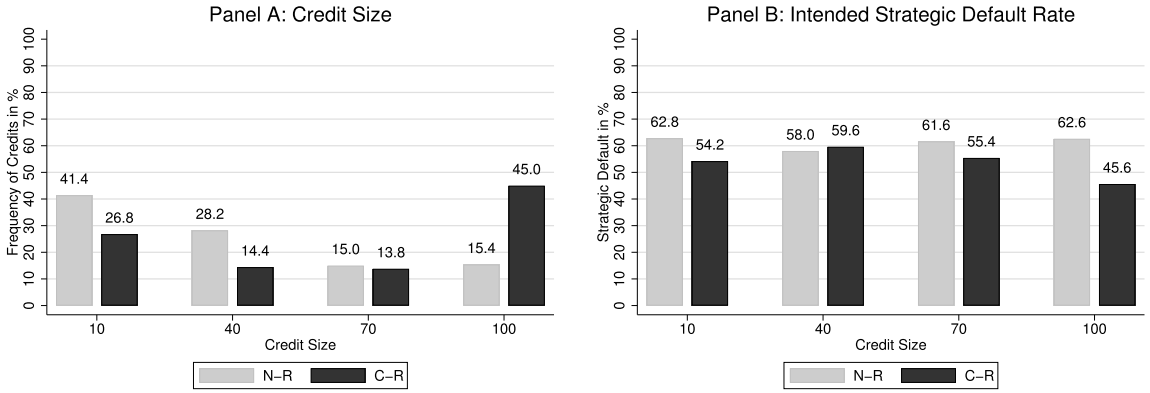
Our results are in line with our conjecture that the positive effect of communication is undermined when uncertainty is sufficiently large and opportunistic behavior can be well concealed. We interpret these findings as supportive evidence for the view that borrower's repayment behavior is driven by a preference for being seen as honest (Abeler et al., 2019) or (expectation-based) guilt aversion (Di Bartolomeo et al., 2019; Ederer and Stremitzer, 2017). However, we find it important to also consider alternative explanations. One plausible possibility is that our result could be the consequence of differential reputation concerns across treatments.[24] Although we randomly rematch our participants in every period, borrowers might still be concerned about their reputation, because they may encounter the same lender several times over the duration of the experiment. It seems logical to assume that such reputation concerns would be substantially stronger in the baseline environment than in the hidden action environment where borrowers can hide their selfish behavior. Such a difference might provide an alternative explanation for why borrowers are more likely to keep their promises in the baseline condition.

We can explore the empirical relevance of such reputational effects through an analysis of the dynamic patterns in our data. A theoretically predicted and commonly observed effect in finitely repeated games (where reputation concerns are naturally important) is a stark decreases in cooperation towards the end of the experiment (see, e.g., Brown et al., 2004; Fehr and Zehnder, 2009; Kamei and Putterman, 2017). Translated to our experiment, we would thus expect stark increases in strategic default in the baseline treatment in the last periods of the experiment where reputation would become less valuable. In the hidden action treatments where

[22] Borrowers were also more likely to default on credits of 100 if they communicated in a friendly tone in the C-H compared with the C-B treatment (55.9% vs. 18.2%; N = 20, p<0.01). For the other communication variables (*N-grams*, *Mistakes*, or aggressiveness of language, personal information, or fuzzy language, which – because of minor relevance and very low incidence – are not reported in the table) we do not find differences between treatments (all p-values >0.1) or events were too infrequent to make meaningful comparisons (occurrences in only a few matching groups).

[23] Lenders were also less likely to provide a credit of 100 in response to friendly messages sent by borrowers in the C-H compared with the C-B treatment (46% vs. 80%; N = 20, p<0.01). They were also less likely to extent credit if borrowers had mistakes in their messages in the C-H compared with the C-B treatment (42% vs. 75%; N = 20, p<0.01) which indicates that the hidden action condition undermined also how lenders react to soft aspects of communication like the effect of friendliness of messages or the extent to which mistakes are forgiven. We do not find any differences between treatments with regard to the other communication variables (*N-words*, *N-grams*, aggressiveness of language, personal information, or fuzzy language. P-values >0.1 or events were too infrequent to make meaningful inferences (occurrences in only a few matching groups)).

[24] We thank an anonymous referee for raising this point.



Notes: Panel A shows the mean frequency with which lenders give credits of the different size (10, 40, 70, and 100) in the N-R and C-R treatment (Panel A). Panel B shows the mean intended strategic default rate for each credit size (10, 40, 70, and 100) in the N-R and C-R treatment.

Fig. 5. Credit offers and intended strategic default: revealed action condition.

reputation is less valuable, we would likely not see stark increases in strategic default over time. Our effects, however, are present from the outset and follow almost parallel trends in all conditions over time (see Fig. 7 and Fig. 8 in the appendix). This indicates that, in our experiment, rather than differential effects of reputation on communication in environments with and without hidden action being at play, the benefits of communication per-se are undermined if actors can hide their actions behind uncertainty in the economic environment.

4.2.2. Hidden action vs. uncertainty

In this section we report on lender behavior, borrower behavior and payoffs in the revealed action condition. As discussed in Section 2.2 this condition is identical to the hidden action condition except that the borrowers income is revealed ex-post to the lender. This allows the lender to distinguish strategic defaults from forced defaults. If the effect of communication in the hidden action condition was weakened due to the increased uncertainty and lower expected income of lenders then we would expect a similar weak effect of communication in the revealed action condition. By contrast, if the ability to hide opportunistic behavior is responsible for the weak effect of communication in the hidden action condition, then we should see stronger effects of communication in the revealed action condition.

Table 3 shows that the average credit size is 52% higher in the C-R treatment compared to the N-R treatment (63.1 vs. 41.3; $N = 20$, $p<0.01$). Panel A of Fig. 5 further shows that this increase in average credit size is driven by a higher frequency of maximum credit offers (100) in the C-R treatment compared to N-R treatment (45% vs. 15.4%; $N = 20$, $p<0.01$).

Table 3 shows that the strategic default rate is significantly lower in the C-R treatment compared to the N-R treatment (46.2% vs. 60.4%; $N = 20$, $p<0.01$). Panel B of Fig. 5 reveals that, in particular, the intended strategic default rate for credits of 100 is higher in the N-R treatment compared to the C-R treatment (62.6% vs. 45.6%; $N = 20$, $p<0.01$).

In the revealed action condition communication leads to a pareto improvement. Table 3 shows that lenders' profits increase by 9.5% from 135 points in the N-R treatment to 148 points in the C-R treatment ($N = 20$, $p = 0.04$). Borrower profits increase by 10.5% from 227.5 in the N-R treatment to 251.9 in the C-R treatment ($N = 20$, $p = 0.02$).

Table 6 provides a formal test for differential treatment effects of communication between the revealed action condition and the baseline condition. Again, we present results from difference–in–difference regressions with matching group averages as observations. And again we present results for six dependent variables: Average credit size (CS – Column 1), the realized strategic default rate contingent on repayment ability (Strategic Default – Column 2), borrower profit (Borrower Profit – Column 3) and lender profit (Lender Profit – Column 4), the frequency of credit size 100 (Credit Size 100 – Column 5) and the intended strategic default rate for credits of 100 (ISD 100 – Column 6). The explanatory variables are *Revealed Action*, a dummy variable indicating the revealed action condition, *Communication* which is a dummy variable indicating the communication treatments. The interaction between the two *Revealed Action* × *Communication* is our variable of interest.

The results presented in Table 6 suggest small and statistically insignificant differences in the impact of communication on realized outcome variables in the hidden action condition compared to the baseline condition. Moreover, comparing the Table 6 results to those in Table 4 we find a much more similar impact of communication in the revealed action and the baseline conditions as when comparing the revealed action condition to the baseline condition. In particular, the magnitude and statistical significance of the difference-in-difference estimates for credit extension by lenders is smaller in Table 6 than in Table 4.

Result 3 *(The effect of communication in the revealed action condition). In the revealed action condition, communication improves credit provision, repayment behavior and the average payoffs for both borrowers and lenders. The impact of communication in the revealed action condition is more similar to that in the baseline condition, than the impact of communication in the hidden action treatment.*

Table 6
Difference in difference regressions: revealed action vs. baseline.

	Outcome				Behavior	
Dependent variable:	Credit Size (1)	Strategic Default (2)	Borrower Profit (3)	Lender Profit (4)	Credit Size 100 (5)	ISD 100 (6)
Revealed Action	-4.980	-0.0464	-62.91***	-13.07	-0.0300	0.0260
	(4.987)	(0.0647)	(11.67)	(9.786)	(0.0539)	(0.0747)
Communication	28.74***	-0.208***	38.96***	47.26***	0.436***	-0.178**
	(4.987)	(0.0647)	(11.67)	(9.786)	(0.0539)	(0.0747)
Revealed Action × Comm.	-6.960	0.0665	-14.62	-34.34**	-0.140*	0.00800
	(7.052)	(0.0914)	(16.50)	(13.84)	(0.0763)	(0.106)
Constant	46.30***	0.650***	290.5***	148.4***	0.184***	0.600***
	(3.526)	(0.0457)	(8.252)	(6.920)	(0.0381)	(0.0528)
Observations	40	40	40	40	40	40
F	19.35	5.074	29.30	14.72	34.14	3.724
R^2	0.617	0.297	0.709	0.551	0.740	0.237

Note: Difference–in–difference (OLS) regressions with matching group averages as observations. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Columns (1–4) present regressions with market outcomes as dependent variables. Columns (5–6) present regressions with lender and borrower behavior as dependent variables. In all regressions, the no communication baseline treatment (N-B) is the benchmark condition. *Revealed Action* is a variable indicating the treatments with forced default and revealed borrower behavior. Communication is a dummy variable which is equal to one in the treatments with communication and zero otherwise. *Revealed Action × Comm.* captures the interaction effect between the hidden action and communication treatment.

To support our finding that the positive impact of communication is restored in the revealed action condition, we conclude with a discussion of communication behavior in this condition. Table 5 and Fig. 4 document borrower communication and subsequent behavior by lenders and borrowers in the C-R treatment. Table 5 documents that borrowers communicate very similar in all treatments ($p > 0.1$ for most pairwise comparisons between C-B and C-R and $p > 0.1$ for all pairwise comparisons between C-H and C-R).

The Fig. 4, Panel A results, however, show that borrowers break promises to repay credits of 100 only 14.8% of the time in the C-R treatment. This is significantly less often than the 32% in the C-H treatment (N = 20, p = 0.06). Similarly, the intended strategic default rate when including requests for credits of 100 in the message is significantly lower in the C-R than in the C-H (16.1% vs. 40.7%; N = 20, p = 0.01).[25]

Panel B of Fig. 4 shows that lenders, respond different to borrower communication in the C-R compared with the C-H treatment. Following a borrower repayment promise for credits of 100, lenders are more likely to provide this credit in the C-R treatment (55.8%) than in the C-H treatment (47.1%). Similarly, combinations of repayment promises with credit request for high credits of 100 are more likely to trigger a corresponding loan in the C-R treatment (56.6%) than in the C-H treatment (45.9%). These substantial differences are, however, not statistically significant.[26]

The results presented above support our conjecture that the ability to hide strategic defaults undermines the effectiveness of communication in our hidden action condition. Once borrower behavior is revealed to lenders – as in our revealed action condition – communication leads to a substantial increase in gains from trade – even if borrower income is stochastic.

5. Discussion and conclusion

We implement a communication experiment in a trust game framed in the credit market context. We exogenously vary (i) whether borrowers (second movers) can communicate with lenders (first movers) prior to contracting and (ii) whether strategic defaults (opportunistic behavior) are revealed to lenders. Our results show that borrowers are more likely to renege on promises to repay when their strategic default is not subsequently revealed to lenders. As a consequence, communication has a weaker impact on credit provision and loan repayment in an environment with hidden action compared to an environment without hidden action.

Our results add to existing findings from behavioral economics showing that communication is a tool to increase trust and trustworthiness (see, Charness and Dufwenberg, 2006; Hoppe and Schmitz, 2018, for evidence on situations with hidden action). We show that this may not always be the case. In our experiment, uncertainty in the surrounding economic environment offers the possibility to hide opportunistic behavior which significantly undermines the effect of communication. Adding to this literature, we show that ex-post monitoring is a necessary complement to pre-contractual communication in supporting trustworthy behavior. In our experiment, the full benefit of pre-contractual communication can only be unfolded if behavior can be identified ex-post.

[25] Confirming the differences between the C-B and C-H treatment borrower ISD for credits of 100 after communicating in a friendly manner is different between the C-H and C-R (55.9% vs. 9%; N = 20, p<0.01). There are no differences between the treatments with regards to other aspects affecting communication.

[26] Credit after Promise 100: C-H vs. CR: N = 20, p = 0.4; Credit after Promise + Request 100: C-H vs. CR: N = 20, p = 0.22. Moreover, there are no significant differences in lender behavior with regard to other communication variables (*N-grams*, *Friendly*, *Mistakes* aggressiveness of language, personal information, or fuzzy language in messages between the C-H and C-R treatments (all pairwise comparisons p>0.01). These results suggest that lender responses to borrower communication are at least partially influenced by the underlying uncertainty between the C-B and the C-H and C-R treatments.

The findings from our experiment further complement recent field experiments in credit markets which document that lender-borrower communication can harness moral incentives and increase the willingness of borrowers to repay loans (Bursztyn et al., 2019; Karlan et al., 2016). The findings of these studies show that post-contractual loan reminders can mitigate credit default. However, the effectiveness of loan reminders hinges on harnessing the moral or personal obligation of borrowers to repay. Our results document that pre-contractual communication can also mitigate credit risk, especially if borrowers personally commit to repay loans. However, the effectiveness of pre-contractual promises in encouraging loan repayment depends strongly on whether promise-breaking by borrowers is revealed to lenders ex-post. This finding implies that borrower behavior is not primarily caused by an (unconditional) preference for promise-keeping (Ellingsen and Johannesson, 2004), but may actually be more strongly driven by a preference for being seen as honest (Abeler et al., 2019) or (expectation-based) guilt aversion. Our findings therefore suggest that preferences for promise keeping and lying aversion may be more fragile than previously thought of.

Our findings suggest that lenders—be it traditionally brick and mortar banks or their novel online competitors—can employ pre-contractual communication as a tool of credit risk management. However, pre-contractual communication will be most effective in encouraging loan repayment, when borrowers anticipate that subsequent strategic defaults can be identified by the lender. Promise making reduces credit risk when promise breaking is likely to be revealed. If pre-contractual communication is accompanied by intensive post-contractual monitoring the positive benefits of communication set in which improve outcomes beyond monitoring in isolation.

This finding is important as strategic defaults are usually hard to identify in the field. Relying on communication in settings with economic uncertainty (like credit markets) is not a viable tool to substantially reduce credit risk. Our results suggest that lenders should combine pre-contractual communication with a credible post-contractual loan monitoring process. This seems natural to traditional retail banks whose loan officers interact with clients face-to-face throughout the loan cycle. For fintech lenders relying on online environments our results suggest that if communication with prospective borrowers is to be used as a credit risk management tool—rather than just as a sales instrument—then personal interaction needs to be followed up on consequently after the loan is disbursed.

Declaration of competing interest

We have nothing to disclose.

Data availability

Data will be made available on request.

Appendix A. Internal appendix

A.1. Model

In this section we derive predictions for our treatments which are the basis for the testable hypotheses for cross-treatment comparisons presented in the main body of the paper. Recent evidence suggests that repayment behavior in personal loan markets is influenced by social norms and moral constraints (Guiso et al., 2013; Bursztyn et al., 2019). Previous studies in the field and the lab have also documented that second mover behavior in the trust game is influenced by moral concerns and that first movers anticipate such prosocial behavior (Karlan, 2005; Johnson and Mislin, 2011). In the context of our experiment, we therefore expect that some lenders will offer loans which exceed the minimum credit size and some borrowers will choose to repay loans.

In the following we derive predictions for our treatments and establish testable hypotheses for cross-treatment effects. We build on a model in which borrowers differ in their personal (moral) costs of strategic default. Lenders cannot identify borrower types and have heterogeneous beliefs about the distribution of borrowers' costs of strategic default.

A.1.1. Borrower and lender behavior

We assume that the utility of a borrower i can be modeled as

$$U_i = e_i + \theta \cdot c - r_i(c) \cdot \beta \cdot c - (1 - r_i(c)) \cdot k_i(c), \tag{1}$$

where c is the loan amount received and $r_i(c) = \{0, 1\}$ is the repayment decision of the borrower for a loan of size c. The parameter e_i is the borrowers endowment, θ is the investment return per unit of credit and β is the required repayment per unit of credit. Each borrower suffers a personal cost $k_i(c)$ if she defaults strategically on a loan of size c.

To simplify our analysis we assume that lenders can either offer no credit or a credit of size $c_{max} > 0$. From equation (1) it follows that a borrower who has received a loan c_{max} will repay this loan, i.e. $r(c_{max}) = 1$, if

$$k_i(c_{max}) \geq \beta \cdot c_{max}. \tag{2}$$

We impose three assumptions on borrowers' personal costs of strategic default $k_i(c_{max})$. First, we assume that personal costs of strategic default are heterogeneous across borrowers. Second, we assume that for each borrower the cost of strategic default is higher if she had previously promised to repay that loan. Third, we assume that the personal cost due to a broken promise is higher if the

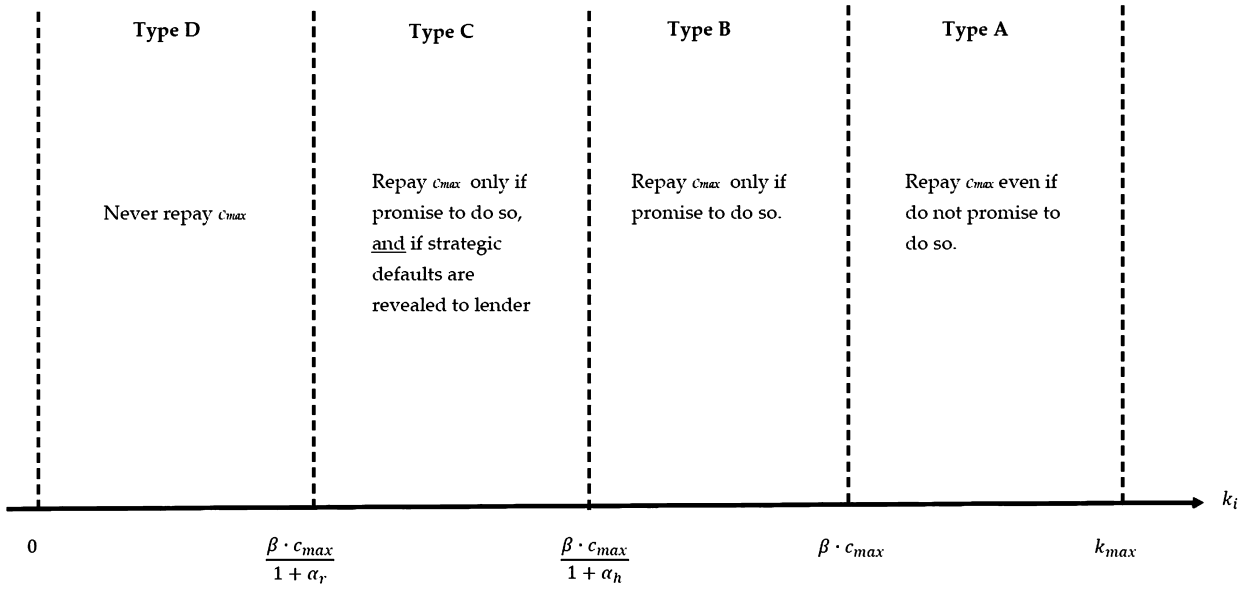


Fig. 6. Borrower types.

Table 7
Equilibrium predictions.

	No Communication Equilibria			Communication Equilibria		
Treatments	N-B	N-H	N-R	C-B	C-H	C-R
k^*	$\beta \cdot c_{max}$	$\beta \cdot c_{max}$	$\beta \cdot c_{max}$	$\frac{\beta \cdot c_{max}}{1+\alpha_R}$	$\frac{\beta \cdot c_{max}}{1+\alpha_H}$	$\frac{\beta \cdot c_{max}}{1+\alpha_R}$
b^*	$\frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta - 1)}$	$\frac{\frac{2}{3}\beta^2 \cdot c_{max}}{k_{max} \cdot (\frac{2}{3}\beta - 1)}$	$\frac{\beta^2 \cdot \frac{2}{3} \cdot c_{max}}{k_{max} \cdot (\frac{2}{3}\beta - 1)}$	$\frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta - 1) \cdot (1+\alpha_R)}$	$\frac{\frac{2}{3}\beta^2 \cdot c_{max}}{k_{max} \cdot (\frac{2}{3}\beta - 1) \cdot (1+\alpha_H)}$	$\frac{\frac{2}{3}\beta^2 \cdot c_{max}}{k_{max} \cdot (\frac{2}{3}\beta - 1) \cdot (1+\alpha_R)}$

Note: Overview of equilibrium predictions without communication (Columns 1–3) and with communication (Columns 4–6). k^* defines the threshold of moral costs above which borrowers repay credits. b^* represents the threshold of beliefs about maximum moral costs of default above which lenders offer credits. Note that for all three communication treatments (C-B, C-H, C-R) an equilibrium without and with communication exist.

strategic default is revealed to the lender than if it is hidden from the lender. To be specific, we assume that the personal cost of strategic default in the case of no prior promise to repay k_i is distributed uniformly across borrowers on the range $[0, k_{max}]$, where $k_{max} > \beta \cdot c_{max}$ to ensure that some borrowers are always willing to repay. We further assume that for each borrower i the personal cost of default after promising to repay is $(1 + \alpha_H) \cdot k_i$ if the strategic default is not revealed to the lender and $(1 + \alpha_R) \cdot k_i$ if the strategic default is revealed to the lender, where $\alpha_R > \alpha_H > 0$.

In line with (Guiso et al., 2013) our behavioral assumptions for borrowers imply that moral constraints affect the decision to default strategically. Our specific assumptions are consistent with evidence which suggests that individuals experience (expectation based) guilt aversion (Di Bartolomeo et al., 2019; Ederer and Stremitzer, 2017). or have a preference for being seen as honest (Abeler et al., 2019). As a consequence, their behavior largely depends on the lenders' expectations about the likelihood of repayment and on the likelihood that their actions are revealed to the lender.

Based on the assumptions above we can define four main types of borrowers (see Fig. 6):

- Type "A" borrowers repay a loan of c_{max} even if they have not promised to do so. These are the borrowers for which: $k_i \geq \beta \cdot c_{max}$.
- Type "B" borrowers always repay a loan of c_{max} if they have promised to repay that loan. However, they will not repay if they did not promise to do so. These are the borrowers for which: $(1 + \alpha_H) \cdot k_i \geq \beta \cdot c_{max} > k_i$.
- Type "C" borrowers repay a loan of c_{max} only if they have promised to repay that loan and strategic defaults are revealed to lenders. These are the borrowers for which: $(1 + \alpha_R) \cdot k_i \geq \beta \cdot c_{max} > (1 + \alpha_H) \cdot k_i$.
- Type "D" borrowers never repay a loan of c_{max}. These are the borrowers for which: $(1 + \alpha_R) \cdot k_i < \beta \cdot c_{max}$.

We define k^* as the threshold of moral costs above which borrowers will repay a loan of c_{max}, i.e. all borrowers with $k_i \geq k^*$ will choose to repay. From Fig. 1 it follows that the threshold k^* depends on (i) whether borrowers promised to repay a loan, and (ii) whether strategic defaults will be revealed to lenders. If no borrower has promised to repay we have $k^* = \beta \cdot c_{max}$. If borrowers have promised to repay and strategic defaults are revealed we have $k^* = \frac{\beta \cdot c_{max}}{1+\alpha_R}$. If borrowers have promised to repay and strategic defaults are not revealed we have $k^* = \frac{\beta \cdot c_{max}}{1+\alpha_H}$.

For each lender j the expected payoff L_j is given by

$$L_j = e_j - c + p \cdot \lambda_j(c) \cdot \beta \cdot c, \tag{3}$$

where p is the probability that the borrower can repay the loan and $\lambda_j(c)$ is the belief of lender j about the repayment choice of the borrower.

From equation (3) it follows that a lender j will prefer to offer c_{max} rather than no credit if:

$$\lambda_j(c_{max}) \geq \frac{1}{\beta \cdot p}. \tag{4}$$

We assume that lenders have heterogeneous beliefs about the repayment choice of borrowers $\lambda_j(c_{max})$ arising from individual beliefs about the distribution of the personal costs of default k_i. Each lender j believes that these costs are distributed uniformly across borrowers on the range $[0, k_j]$, with $k_j = k_{max} * b_j$. We assume that b_j is distributed uniformly across lenders with $E[b_j] = 1$ so that some lenders are overoptimistic about the repayment behavior of borrowers $b_j > 1$, while others are pessimistic $b_j < 1$. On average, lenders' beliefs are consistent with the actual distribution of borrowers' personal costs of strategic default.

Suppose a lender with belief b_j expects all borrowers with $k_i \geq k^*$ to repay a loan c_{max}. The lenders belief about the repayment choice of any borrower is thus:

$$\lambda_j(c_{max}) = 1 - \frac{k^*}{b_j \cdot k_{max}}. \tag{5}$$

From equation (2) and (3) it follows that – conditional on k^* – all lenders will offer the loan c_{max} for which b_j is at least:

$$b^*(k^*) = \frac{\beta \cdot p \cdot k^*}{(\beta \cdot p - 1) \cdot k_{max}}. \tag{6}$$

A.1.2. Predictions by treatment

Propositions 1–4 provide equilibrium predictions by treatment. Table 3 summarizes the resulting equilibrium conditions for the threshold of moral costs k^* above which borrowers choose to repay and the threshold of beliefs b^* above which lenders will offer c_{max}.

Proposition 1 presents our equilibrium predictions for the no communication treatments (N-B, N-H, N-R). As borrowers cannot make promises to lenders, the personal cost of strategic default for any borrower is identical in all three treatments. As a consequence, the prediction for borrower behavior (k^*) is identical in all three treatments: only Type A borrowers choose to repay. The difference in predictions between treatments arises from the fact that the probability that borrowers will be able to repay is higher in the N-B ($p = 1$) than in the N-H or N-R treatments ($p = 2/3$). As a consequence, the threshold belief b^* above which a lender will offer the maximum credit is lower in the N-B than in the N-H or N-R treatments.

Proposition 1 *(Equilibria in N-B, N-H and N-R treatments).*

- *In the no communication treatments, only type A borrowers choose to repay the maximum loan size. The threshold of personal default costs above which loans are repaid is:* $k^*_{N-B} = k^*_{N-H} = k^*_{N-R} = \beta \cdot c_{max}$.
- *In the N-B treatment, the threshold belief above which lenders choose to offer* c_{max} *is:* $b^*_{N-B} = \frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta - 1)}$.
- *In the N-H and N-R treatments, the threshold belief above which lenders choose to offer* c_{max} *is:* $b^*_{N-H} = b^*_{N-R} = \frac{\beta^2 \cdot \frac{2}{3} \cdot c_{max}}{k_{max} \cdot (\beta \cdot \frac{2}{3} - 1)}$.

Proof of Proposition 1.

Borrower behavior:

In the no communication treatments borrowers cannot make promises to lenders. Thus for each borrower we have $k_i(c_{max}) = k_i$. From Equation (1) therefore only the borrowers for which $k_i \geq \beta \cdot c_{max}$ will repay a loan c_{max}. These are (by definition) the Type "A" borrowers. For the no communication treatments we therefore have $k^*_{N-B} = k^*_{N-H} = k^*_{N-R} = \beta \cdot c_{max}$.

Lender behavior in the N-B Treatment:

In the N-B treatment borrowers can always repay a loan ($p = 1$). From Equation (4) we therefore have:

$$b^*(k^*) = \frac{\beta \cdot k^*}{(\beta - 1) \cdot k_{max}}. \tag{7}$$

From above we know that $k^*_{N-B} = \beta \cdot c_{max}$. Therefore we have $b^*_{N-B} = \frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta - 1)}$.

Lender behavior in the N-H and N-R Treatments:

In the N-H and N-R treatments we have $p = \frac{2}{3}$. From Equation (4) we therefore have:

$$b^*(k^*) = \frac{\beta \cdot \frac{2}{3} \cdot k^*}{(\beta \cdot \frac{2}{3} - 1) \cdot k_{max}}. \tag{8}$$

From above we know that $k^*_{N-H} = k^*_{N-R} = \beta \cdot c_{max}$. Therefore we have: $b^*_{N-H} = b^*_{N-R} = \frac{\beta^2 \cdot \frac{2}{3} \cdot c_{max}}{k_{max} \cdot (\beta \cdot \frac{2}{3} - 1)}$. □

In the treatments with communication (C-B, C-H, C-R) borrowers can send messages to lenders before the lenders make their decisions. In particular, borrowers can promise to repay loans. As borrowers are heterogeneous in their personal cost of strategic default k_i and lenders cannot distinguish borrowers by type, the ability to send non-binding messages implies that interaction in the communication treatments resembles a signalling game. Proposition 2 shows that in this signalling game a pooling equilibrium without communication, i.e., an equilibrium in which no borrower promises to repay c_{max}, exists for all three treatments. In such an equilibrium the behavior of borrowers and lenders is identical to that in the corresponding no communication treatments.

Proposition 2 *(No communication outcome equilibrium in the C-B, C-H and C-R treatments). In each of the three communication treatments C-B, C-H, C-R there exists a pooling equilibrium with no communication. In such an equilibrium no borrower promises to repay a loan of c_{max} and behavior of borrowers and lenders is identical to that in the equilibrium of the corresponding no communication treatment (see Proposition 1).*

Proof of Proposition 2.
Borrower behavior:

Consider a pooling equilibrium without communication in the C-B, C-H or C-R Treatment. If no borrower promises to repay then for each borrower we have $k_i(c_{max}) = k_i$. Borrower behavior is identical to that in the no communication treatments (see proof of Proposition 1): $k^*_{C-B,nocom} = k^*_{C-H,nocom} = k^*_{C-R,nocom} = \beta \cdot c_{max}$.

Lender behavior:

Borrower behavior in the no communication equilibrium of the C-B, C-H and C-R treatments is identical to that in the N-B, N-H and N-R treatments. Consequently lenders' threshold beliefs in equilibrium must also be identical to those in the respective no communication treatment: In the no communication treatment of the C-B treatment we have $b^*_{C-B,nocom} = \frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta - 1)}$. In the C-H and C-R treatments we have $b^*_{C-H,nocom} = b^*_{C-R,nocom} = \frac{\beta^2 \cdot \frac{2}{3} \cdot c_{max}}{k_{max} \cdot (\beta \cdot \frac{2}{3} - 1)}$.

For a pooling equilibrium without communication to exist, no borrower must have an incentive to deviate and promise to repay c_{max}. This is the case if lenders have off-equilibrium beliefs that any borrower who does promise to repay c_{max} will actually default. □

Proposition 3 shows that a pooling equilibrium with communication, i.e., an equilibrium in which all borrowers promise to repay c_{max}, also exists for all three communication treatments. In this equilibrium a higher share of borrowers repay loans than in the equilibrium without communication for the same treatment. The reason is that for each borrower i the personal cost of strategic default k_i is higher after promising to repay. The proposition further clarifies that in any equilibrium with communication some borrowers renege on their promises: Those borrowers with low personal costs of strategic default promise to repay, but choose to default.

Proposition 3 *(Communication equilibria in the C-B, C-H and C-R treatments).*

- *In all communication treatments, a pooling equilibrium exists in which all borrowers promise to repay a loan of c_{max}.*
- *In the C-B and C-R treatments, all borrowers of Type A, B and C choose to repay the maximum loan size, while Type D borrowers choose to default. The threshold of personal default costs above which loans are repaid is: $k^*_{C-B,com} = k^*_{C-R,com} = \frac{\beta \cdot c_{max}}{1+\alpha_R}$.*
- *In the C-H treatment, borrowers of Type A and B choose to repay the maximum loan size, while Type C and D borrowers choose to default. The threshold of personal default costs above which loans are repaid is: $k^*_{C-H,com} = \frac{\beta \cdot c_{max}}{1+\alpha_H}$.*
- *In the C-B treatment, the threshold belief above which lenders choose to offer c_{max} is: $b^*_{C-B,com} = \frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta - 1) \cdot (1+\alpha_R)}$.*
- *In the C-H treatment, the threshold belief above which lenders choose to offer c_{max} is: $b^*_{C-H,com} = \frac{\frac{2}{3}\beta^2 \cdot c_{max}}{k_{max} \cdot (\frac{2}{3}\beta - 1) \cdot (1+\alpha_H)}$.*
- *In the C-R treatment, the threshold belief above which lenders choose to offer c_{max} is: $b^*_{C-R,com} = \frac{\frac{2}{3}\beta^2 \cdot c_{max}}{k_{max} \cdot (\frac{2}{3}\beta - 1) \cdot (1+\alpha_R)}$.*

Proof of Proposition 3.
Borrower behavior in the C-B and C-R treatments:

Consider a pooling equilibrium with communication in the C-B and C-R treatments. In these treatments strategic defaults are revealed to lenders. Thus if a borrower promises to repay, her costs of strategic default are: $k_i(c_{max}) = k_i \cdot (1+\alpha_R)$. In communication equilibria where all borrowers promise to pay, all borrowers with $k_i \cdot (1+\alpha_R) \geq \beta \cdot c_{max}$ will thus choose to repay. These are (by definition) the Type "A", Type "B" and Type "C" borrowers. We therefore have $k^*_{C-B,com} = k^*_{C-R,com} = \frac{\beta \cdot c_{max}}{1+\alpha_R}$.

Borrower behavior in the C-H treatment:

In the C-H treatment strategic defaults are not revealed to lenders. Thus if a borrower promises t, repay her costs of strategic default are: $k_i(c_{max}) = k_i \cdot (1+\alpha_H)$. In a communication equilibrium where all borrowers promise to pay, all borrowers with $k_i \cdot (1+\alpha_H) \geq \beta \cdot c_{max}$ will thus choose to repay. These are (by definition) the Type "A", and Type "B" borrowers. We therefore have $k^*_{C-H,com} = \frac{\beta \cdot c_{max}}{1+\alpha_H}$.

Lender behavior in the C-B Treatment:

In the C-B treatment borrowers can always repay a loan ($p = 1$). From Equation (4) we therefore have:

$$b^*(k^*) = \frac{\beta \cdot k^*}{(\beta - 1) \cdot k_{max}}. \tag{9}$$

From above we know that: $k^*_{C-B,com} = \frac{\beta \cdot c_{max}}{1+\alpha_R}$. Therefore we have $b^*_{C-B,com} = \frac{\beta^2 \cdot c_{max}}{k_{max} \cdot (\beta-1) \cdot (1+\alpha_R)}$.

Lender behavior in the C-H Treatment:

In the C-H treatments we have $p = \frac{2}{3}$. From equation (4) we therefore have:

$$b^*(k^*) = \frac{\beta \cdot \frac{2}{3} \cdot k^*}{(\beta \cdot 2\frac{2}{3} - 1) \cdot k_{max}}. \tag{10}$$

From above we know that: $k^*_{C-H,com} = \frac{\beta \cdot c_{max}}{1+\alpha_H}$. Therefore we have: $b^*_{C-H,com} = \frac{\beta^2 \cdot p \cdot c_{max}}{k_{max} \cdot (\beta \cdot p - 1) * (1+\alpha_H)}$.

Lender behavior in the C-R Treatment:

In the C-R treatments we have $p = \frac{2}{3}$. From Equation (4) we therefore have:

$$b^*(k^*) = \frac{\beta \cdot \frac{2}{3} \cdot k^*}{(\beta \cdot 2\frac{2}{3} - 1) \cdot k_{max}}. \tag{11}$$

From above we know that: $k^*_{C-R,com} = \frac{\beta \cdot c_{max}}{1+\alpha_R}$. Therefore we have: $b^*_{C-H,com} = \frac{\beta^2 \cdot p \cdot c_{max}}{k_{max} \cdot (\beta \cdot p - 1) \cdot (1+\alpha_R)}$.

For a pooling equilibrium with communication to be sustained, no borrower must have an incentive to deviate and remain silent. This is the case if lenders have off-equilibrium beliefs that any borrower who does not promise to repay c_{max} will actually default. □

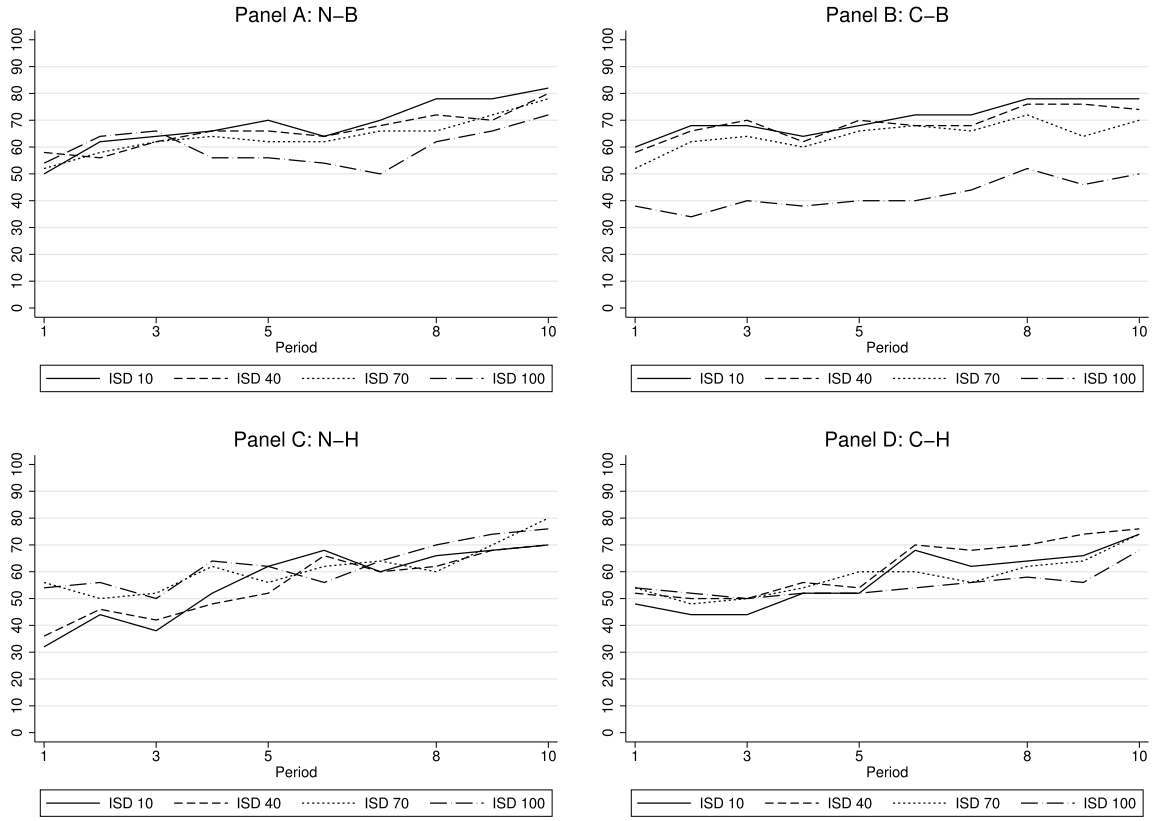
Finally, Proposition 4 shows that none of our communication treatments features a separating equilibrium in which only some borrowers promise to repay c_{max} and lenders only offer a loan c_{max} to those borrowers.

Proposition 4 *(Separating equilibria in the C-B, C-H and C-R treatments). In the three communication treatments C-B, C-H, C-R there is no separating equilibrium in which some borrowers promise to repay c_{max} while other borrowers remain silent and lenders only offer a loan c_{max} to those borrowers who promise to repay.*

Proof of Proposition 4. In a separating equilibrium a silent borrower would receive a loan of $c_{min} = 0$ and thus yield a payoff of: e_i. Now consider a borrower with $k_i(c_{max}) = 0$. This borrower would prefer to deviate and promise to repay c_{max}. The borrower would receive c_{max} and default on that loan, yielding a payoff of $e_i + \theta * c_{max}$. Thus the presence of selfish borrowers for whom imitation is costless rules out a separating equilibrium in all treatments with communication. □

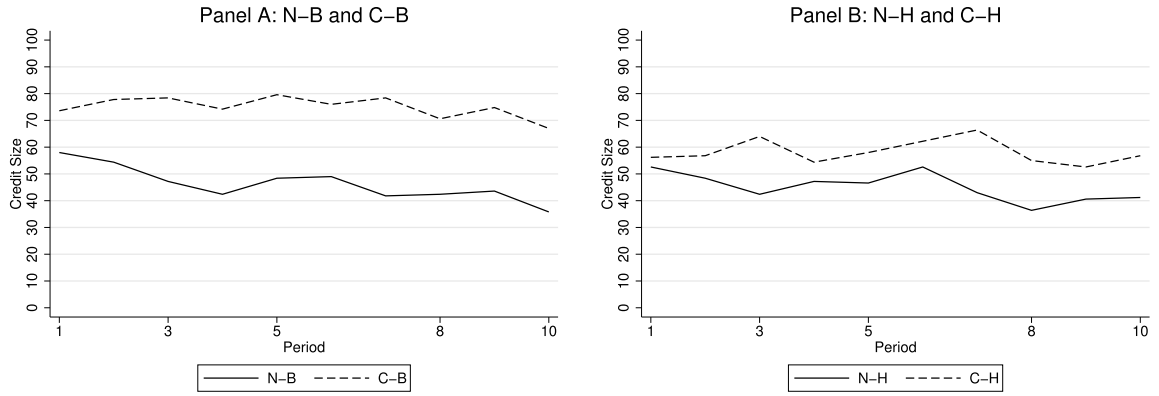
A.2. Borrower behavior over time

Fig. 7 depicts the average strategic default rate for each credit size over time. Panels A-D show strategic default rates in the N-B, C-B, N-H and C-H treatments, respectively. The figure shows that there is an upward trend in strategic default for all credit sizes over time in all treatments. The regressions presented in Table 8 and Table 9 confirm the graphical results presented in Fig. 7. The tables present linear GLS regressions with individual borrower fixed effects. The dependent variables are a borrower's decision to strategic default on the different credit sizes. In all regressions, standard errors are clustered at the matching group level and explanatory variables are period dummies to capture the time trends. From the tables it is apparent that the strategic default rate for all credit sizes increases over time in all treatments.



Notes: The figure highlights the intended strategic default rate for each credit size (10, 40, 70, and 100) in all treatments over time. Panel A presents time trends in the N-B treatment. Panel B shows the intended strategic default rate in the C-B treatment. Panel C presents time trends in the N-H treatment and Panel D in the C-H.

Fig. 7. Intended strategic default rate over time by treatment.



Notes: The figure highlights the average credit size in all treatments over time. Panel A presents time trends in the N-B an C-B treatment. Panel B shows the average credit size in the N-H and C-H treatments.

Fig. 8. Average credit size over time.

A.3. Lender behavior over time

Fig. 8 displays lender behavior over time. Panel A of the figure shows the average credit size over time in the N-B and the C-B treatment. Panel B highlights the average credit size over time in the N-H and the C-H treatment. The figure documents two important features of our communication effects: First, from the outset lenders issue higher credits in the communication treatments. Second, there is a decline in credit size over time in the treatments without communication. In the treatments with communication however, credit sizes are more stable over time.

Table 8
Linear GLS regressions: strategic default over time (N-B and C-B treatment).

Panel A: N-B	Credit Size			
DV: Strategic Default	10	40	70	100
	(1)	(2)	(3)	(4)
Period 2	0.120*	-0.0200	0.0600	0.100*
	(0.0617)	(0.0559)	(0.0525)	(0.0451)
Period 3	0.140	0.0400	0.100*	0.120*
	(0.0854)	(0.0840)	(0.0542)	(0.0538)
Period 4	0.160*	0.0800	0.120*	0.0200
	(0.0725)	(0.0862)	(0.0617)	(0.0559)
Period 5	0.200**	0.0800	0.100	0.0200
	(0.0851)	(0.0807)	(0.0752)	(0.0471)
Period 6	0.140**	0.0600	0.100	4.94e-15
	(0.0605)	(0.0905)	(0.0752)	(0.0737)
Period 7	0.200**	0.100	0.140*	-0.0400
	(0.0673)	(0.0864)	(0.0740)	(0.0586)
Period 8	0.280***	0.140	0.140**	0.0800**
	(0.0617)	(0.109)	(0.0605)	(0.0330)
Period 9	0.280***	0.120	0.200**	0.120*
	(0.0749)	(0.0913)	(0.0673)	(0.0617)
Period 10	0.320**	0.220**	0.260***	0.180**
	(0.101)	(0.0925)	(0.0525)	(0.0559)
Constant	0.500***	0.580***	0.520***	0.540***
	(0.0538)	(0.0676)	(0.0488)	(0.0384)
Observations	500	500	500	500
Cluster	10	10	10	10
Individual FE	Yes	Yes	Yes	Yes
F	5.476	232.4	60.69	23.57
R^2	0.0705	0.0391	0.0436	0.0449
Panel B: C-B				
Period 2	0.0800	0.0800	0.100*	-0.0400
	(0.0862)	(0.0913)	(0.0451)	(0.0586)
Period 3	0.0800	0.120	0.120**	0.0200
	(0.0446)	(0.0749)	(0.0446)	(0.0925)
Period 4	0.0400	0.0400	0.0800	2.62e-15
	(0.0840)	(0.0840)	(0.0617)	(0.0602)
Period 5	0.0800	0.120	0.140***	0.0200
	(0.0686)	(0.0862)	(0.0431)	(0.0635)
Period 6	0.120*	0.100	0.160**	0.0200
	(0.0617)	(0.0810)	(0.0503)	(0.0821)
Period 7	0.120	0.100	0.140**	0.0600
	(0.0749)	(0.0963)	(0.0605)	(0.0905)
Period 8	0.180**	0.180**	0.200***	0.140**
	(0.0702)	(0.0635)	(0.0602)	(0.0605)
Period 9	0.180**	0.180**	0.120*	0.0800
	(0.0702)	(0.0635)	(0.0538)	(0.0749)
Period 10	0.180**	0.160*	0.180**	0.120*
	(0.0702)	(0.0785)	(0.0559)	(0.0617)
Constant	0.600***	0.580***	0.520***	0.380***
	(0.0591)	(0.0657)	(0.0386)	(0.0536)
Observations	500	500	500	500
Cluster	10	10	10	10
Individual FE	Yes	Yes	Yes	Yes
F	.	8.838	8.838	8.437
R^2	0.0600	0.0434	0.0405	0.0304

Note: Cluster Robust Standard Errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the unique matching group level. The DV in all regressions is a borrower's decision to strategic default (Column 1: 10, Column 2: 40, Column 3: 70, Column 4: 100). All regressions include individual fixed effects. Explanatory variables are period dummies (Period 1-Period 10) to capture effects over time. Panel A: N-B treatment. Panel B: C-B treatment.

Table 10 complements Fig. 8 by presenting linear fixed effect GLS regressions for lender behavior over all ten periods of the experiment. The dependent variable in all regression is a lender's decision to issue a credit of different size. We include individual fixed effects and cluster standard errors at the unique matching group level in all regressions. The results confirm the time trends depicted in Fig. 8. Credit sizes significantly decline in the treatments without communication (N-B, N-H) but are stable over time in the respective communication treatments (C-B, C-H).

Table 9
Linear GLS regressions: strategic default over time (N-H and C-H treatment).

Panel A: N-H	Credit Size			
DV: Strategic Default	10	40	70	100
	(1)	(2)	(3)	(4)
Period 2	0.120**	0.100*	-0.0600	0.0200
	(0.0446)	(0.0451)	(0.0676)	(0.0635)
Period 3	0.0600	0.0600	-0.0400	-0.0400
	(0.0676)	(0.0854)	(0.0840)	(0.0785)
Period 4	0.200*	0.120	0.0600	0.100
	(0.0998)	(0.0686)	(0.0740)	(0.0689)
Period 5	0.300**	0.160	4.08e-15	0.0800
	(0.114)	(0.108)	(0.0673)	(0.0617)
Period 6	0.360***	0.300**	0.0600	0.0200
	(0.0942)	(0.0963)	(0.0799)	(0.0702)
Period 7	0.280***	0.240**	0.0800	0.100
	(0.0862)	(0.0840)	(0.0913)	(0.0915)
Period 8	0.340***	0.260***	0.0400	0.160**
	(0.0854)	(0.0799)	(0.0785)	(0.0659)
Period 9	0.360***	0.320***	0.140*	0.200*
	(0.0785)	(0.0862)	(0.0740)	(0.0903)
Period 10	0.380***	0.340***	0.240**	0.220**
	(0.0875)	(0.0431)	(0.0840)	(0.0875)
Constant	0.320***	0.360***	0.560***	0.540***
	(0.0606)	(0.0608)	(0.0614)	(0.0590)
Observations	500	500	500	500
Cluster	10	10	10	10
Individual FE	Yes	Yes	Yes	Yes
F	144.9	382.9	370.8	907.8
R^2	0.108	0.0856	0.0637	0.0625
Panel B: C-H				
Period 2	-0.0400	-0.0200	-0.0600	-0.0200
	(0.0404)	(0.0635)	(0.0605)	(0.0362)
Period 3	-0.0400	-0.0200	-0.0400	-0.0400
	(0.0586)	(0.0764)	(0.0503)	(0.0503)
Period 4	0.0400	0.0400	3.53e-15	-0.0200
	(0.0586)	(0.0840)	(0.0737)	(0.0635)
Period 5	0.0400	0.0200	0.0600	-0.0200
	(0.0404)	(0.0559)	(0.0740)	(0.0559)
Period 6	0.200***	0.180**	0.0600	1.09e-15
	(0.0602)	(0.0702)	(0.0676)	(0.0602)
Period 7	0.140	0.160*	0.0200	0.0200
	(0.0799)	(0.0725)	(0.0821)	(0.0764)
Period 8	0.160**	0.180***	0.0800	0.0400
	(0.0659)	(0.0471)	(0.0807)	(0.0586)
Period 9	0.180***	0.220***	0.100	0.0200
	(0.0471)	(0.0635)	(0.0689)	(0.0635)
Period 10	0.260***	0.240***	0.200**	0.140**
	(0.0605)	(0.0586)	(0.0673)	(0.0605)
Constant	0.480***	0.520***	0.540***	0.540***
	(0.0414)	(0.0469)	(0.0503)	(0.0388)
Observations	500	500	500	500
Cluster	10	10	10	10
Individual FE	Yes	Yes	Yes	Yes
F	1414.8	1150.3	68807.4	12.79
R^2	0.0933	0.0996	0.0529	0.0275

Note: Cluster Robust Standard Errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the unique matching group level. The DV in all regressions is a borrower's decision to strategic default (Column 1: 10, Column 2: 40, Column 3: 70, Column 4: 100). All regressions include individual fixed effects. Explanatory variables are period dummies (Period 1-Period 10) to capture effects over time. Panel A: N-H treatment. Panel B: C-H treatment.

A.4. Lender beliefs

In period 1, 6, and 10 we elicited lenders' beliefs concerning the share of borrowers who would repay a loan of each loan size in that period. Prior to this elicitation in periods 6 and 10 we presented the lenders with information on aggregate repayment behavior of the five borrowers in their matching group for all previous periods. In this appendix we provide evidence that lenders update their beliefs correctly over time.

Table 10
Linear GLS regressions: credit size over time.

DV: Credit Size	N-B	C-B	N-H	C-H
	(1)	(2)	(3)	(4)
Period 2	-3.600	4.200	-4.200	0.600
	(4.156)	(3.133)	(4.607)	(3.548)
Period 3	-10.80**	4.800	-10.20***	7.800*
	(3.700)	(5.401)	(3.133)	(3.727)
Period 4	-15.60**	0.600	-5.400	-1.800
	(5.355)	(3.431)	(3.185)	(5.712)
Period 5	-9.600	6.000	-6.000*	1.800
	(7.775)	(4.944)	(3.254)	(5.712)
Period 6	-9.000	2.400	-4.49e-13	6.000
	(7.565)	(6.201)	(4.329)	(6.122)
Period 7	-16.20**	4.800	-9.600*	10.20
	(5.853)	(7.210)	(4.960)	(6.257)
Period 8	-15.60*	-3.000	-16.20***	-1.200
	(7.288)	(6.524)	(3.727)	(6.980)
Period 9	-14.40	1.200	-12.00***	-3.600
	(7.879)	(7.648)	(2.854)	(7.616)
Period 10	-22.20***	-6.600	-11.40**	0.600
	(4.694)	(7.190)	(4.642)	(6.599)
Constant	58.00***	73.60***	52.60***	56.20***
	(4.595)	(3.773)	(2.268)	(3.979)
Observations	500	500	500	500
Cluster	10	10	10	10
Individual FE	Yes	Yes	Yes	Yes
F	22.37	9.991	393.5	300.6
R^2	0.0578	0.0146	0.0472	0.0247

Note: Cluster Robust Standard Errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the unique matching group level. The dependent variable in all regressions is the lenders decision about the credit size (10, 40, 70, 100). All regressions include individual fixed effects. Explanatory variables are period dummies (Period 1–Period 10) to capture effects over time. Column 1: Regressions restricted to lenders in the N-B treatment. Column 2: Regressions restricted to lenders in the C-B treatment. Column 3: Regressions restricted to lenders in the N-H treatment. Column 4: Regressions restricted to lenders in the C-H treatment.

Table 10, Panel A presents lender beliefs in period one of the experiment. Before borrowers make their first repayment decision and before lenders first decide which credit to give to the paired borrower beliefs about strategic default for high credits are very similar across all treatments. Panel B and Panel C demonstrate a shift in beliefs in the C-B treatment. By period six, lenders expect that 48% of the borrowers strategic default on their credits in the C-B treatment. By contrast, the beliefs about borrower defaults in the other treatments increase over time.

Table 12 provides statistical evidence for the differences in lender beliefs over time. The table presents within treatment GLS regressions with individual fixed effects for lender beliefs over time. In all regressions, standard errors are clustered at the matching group level. The table confirms the descriptive statistic results from Table 11. The regressions highlight that within all treatments lenders adjust their beliefs about the strategic default rate in their matching group upwards. An exception are the beliefs about strategic defaults of credits 100 in the C-B treatment (Column 4 in Panel B). In this treatments, lenders adjust their beliefs downwards.

We present Fig. 9 as an example of how well lenders adjust their beliefs (and lending decisions) to the borrowers repayment behavior. The figure graphically highlights a lenders' belief about borrower strategic default rate for credits of 100 (light gray bar), the average percentage of credits 100 issued by the lenders (dark gray bar) and the average strategic default rate of credits 100 (black bar). Panel A-D describes the behavior in the N-B, C-B, N-H and C-H treatments respectively. The figure shows that lenders initially overestimate the strategic default rate within their matching group but adjust their beliefs over time. Beliefs about strategic default and actual strategic default rates become more and more aligned as the experiment proceeds. The figure also shows that high beliefs about strategic default also directly translate into low credit volumes. It is apparent from Fig. 9 that communication only impacts on beliefs and credit sizes in the communication treatments where borrower behavior is revealed (C-B treatment). In fact, it is in this treatment where lenders adjust their overestimated beliefs about strategic default rates downwards and increase the frequency with which they give credits of 100.

Table 11
Summary of lender beliefs over time by treatment.

Prob. of Fundamental Default:	$p=0$		$p=\frac{1}{3}$	
Borrower behavior:	Revealed		Hidden	
Panel A: Period 1 Beliefs	N-B	C-B	N-H	C-H
	(1)	(2)	(3)	(4)
Strategic Default 10	0.320	0.336	0.384	0.384
	(0.212)	(0.140)	(0.172)	(0.171)
Strategic Default 40	0.468	0.428	0.472	0.464
	(0.166)	(0.0885)	(0.129)	(0.140)
Strategic Default 70	0.640	0.596	0.592	0.604
	(0.116)	(0.0610)	(0.123)	(0.111)
Strategic Default 100	0.736	0.704	0.700	0.704
	(0.155)	(0.0826)	(0.139)	(0.107)
Prob. of Fundamental Default:	$p=0$		$p=\frac{1}{3}$	
Borrower behavior:	Revealed		Hidden	
Panel B: Period 5 Beliefs	N-B	C-B	N-H	C-H
Strategic Default 10	0.468	0.580	0.436	0.560
	(0.213)	(0.250)	(0.181)	(0.0980)
Strategic Default 40	0.576	0.548	0.568	0.600
	(0.214)	(0.190)	(0.125)	(0.112)
Strategic Default 70	0.720	0.524	0.684	0.668
	(0.208)	(0.201)	(0.112)	(0.113)
Strategic Default 100	0.864	0.480	0.748	0.752
	(0.0888)	(0.208)	(0.136)	(0.141)
Prob. of Fundamental Default:	$p=0$		$p=\frac{1}{3}$	
Borrower behavior:	Revealed		Hidden	
Panel C: Period 10 Beliefs	N-B	C-B	N-H	C-H
Strategic Default 10	0.636	0.724	0.624	0.636
	(0.228)	(0.167)	(0.213)	(0.101)
Strategic Default 40	0.700	0.672	0.680	0.716
	(0.200)	(0.177)	(0.147)	(0.0832)
Strategic Default 70	0.752	0.612	0.792	0.704
	(0.218)	(0.198)	(0.108)	(0.174)
Strategic Default 100	0.876	0.480	0.812	0.732
	(0.124)	(0.203)	(0.125)	(0.218)

Note: Mean of matching group averages with standard deviation in parentheses. Panel A: Mean beliefs about strategic default rates for all credit sizes in the first round of belief elicitation (Period 1). Panel B: Mean beliefs about strategic default rates for all credit sizes in the second round of belief elicitation (Period 5). Panel C: Mean beliefs about strategic default rates for all credit sizes in the third round of belief elicitation (Period 10). *Strategic Default 10*, *Strategic Default 40*, *Strategic Default 70* and, *Strategic Default 100* indicate the belief that borrowers strategic default on the different credit sizes.

A.5. Socio demographic characteristics by treatment

See Table 13.

A.6. Summary statistics N-B and N-H 2015 and 2017

See Table 14.

Appendix B. Additional analysis: the effect of a no-credit option for lenders on credit supply and strategic default

In our experiment there are two key outcomes which we compare across treatments: the average size of credit extended and the observed repayment rate of borrowers who have income. We compare the impact of pre-play, non-binding, borrower-to-lender communication on these two outcome variables in three environments: baseline, hidden-action and revealed-action. We are interested in the differential effects of communication on our two outcome variables across environments.

We first clarify the potential channels through which the option of a no-credit offer by lenders would alter outcomes in our experiment. We then provide an assessment of behavior and outcomes in the no-communication treatments and the communication

Table 12
Linear GLS regressions: lender beliefs over time.

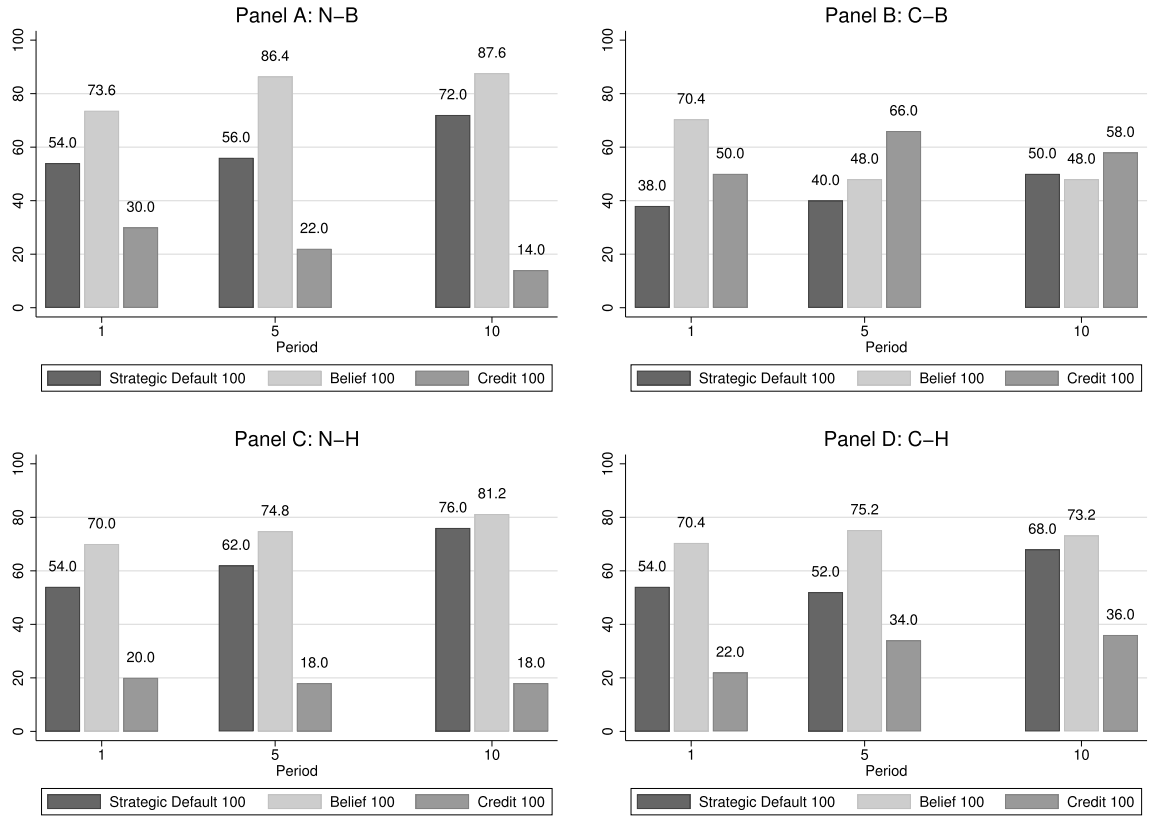
Panel A: N-B	Credit Size			
DV: Beliefs	10	40	70	100
Period 5	0.148	0.108	0.0800	0.128**
	(0.0962)	(0.0810)	(0.0630)	(0.0415)
Period 10	0.316**	0.232**	0.112	0.140**
	(0.113)	(0.0844)	(0.0679)	(0.0541)
Constant	0.320***	0.468***	0.640***	0.736***
	(0.0685)	(0.0532)	(0.0428)	(0.0308)
Observations	150	150	150	150
Cluster	10	10	10	10
F	7.095	5.877	1.605	4.770
R^2	0.209	0.181	0.0657	0.140
Panel B: C-B				
Period 5	0.244**	0.120*	-0.0720	-0.224***
	(0.0869)	(0.0609)	(0.0681)	(0.0598)
Period 10	0.388***	0.244***	0.0160	-0.224***
	(0.0721)	(0.0631)	(0.0688)	(0.0616)
Constant	0.336***	0.428***	0.596***	0.704***
	(0.0504)	(0.0398)	(0.0426)	(0.0380)
Observations	150	150	150	150
Cluster	10	10	10	10
F	17.88	10.92	1.740	7.734
R^2	0.342	0.267	0.0488	0.202
Panel C: N-H				
Period 5	0.0520	0.0960**	0.0920***	0.0480
	(0.0350)	(0.0335)	(0.0282)	(0.0293)
Period 10	0.240***	0.208***	0.200***	0.112***
	(0.0355)	(0.0267)	(0.0345)	(0.0311)
Constant	0.384***	0.472***	0.592***	0.700***
	(0.0226)	(0.0171)	(0.0186)	(0.0182)
Observations	150	150	150	150
Cluster	10	10	10	10
F	52.69	30.55	16.82	6.878
R^2	0.236	0.282	0.308	0.104
Panel D: C-H				
Period 5	0.176***	0.136***	0.0640*	0.0480
	(0.0381)	(0.0295)	(0.0324)	(0.0411)
Period 10	0.252***	0.252***	0.1000*	0.0280
	(0.0649)	(0.0425)	(0.0541)	(0.0695)
Constant	0.384***	0.464***	0.604***	0.704***
	(0.0320)	(0.0231)	(0.0262)	(0.0349)
Observations	150	150	150	150
Cluster	10	10	10	10
F	11.00	17.89	2.255	0.997
R^2	0.210	0.331	0.0633	0.0120

Note: Cluster Robust Standard Errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors clustered at the unique matching group level. The dependent variable in all regressions is the lenders belief about strategic default (10, 40, 70, 100). All regressions include individual fixed effects. Explanatory variables are period dummies (Period 5 and Period 10) to capture effects over time.

treatments, separately. Finally, we assess the potential impact of a no-credit option for lenders on our cross-treatment comparisons and difference-in-difference tests.

B.1. Theory perspective: channels through which a no-credit option might affect behavior

In the no-communication treatments our two outcome variables are determined by the interaction of two behavioral functions:



Notes: The figure shows the lender beliefs about borrower strategic default for credits of 100, the frequency with which lenders give credits of 100 and the strategic default rate for credits of 100. Panel A: N-B treatment. Panel B: C-B treatment. Panel C: N-H treatment. Panel D: C-H treatment.

Fig. 9. Lender beliefs for strategic default 100, mean frequency of credits of 100, strategic default rate for credits of 100.

Table 13
Socio demographics by treatment.

s Borrower income:	Deterministic		Stochastic			
Borrower repayment choice:			Hidden		Revealed	
Communication	No	Yes	No	Yes	No	Yes
Treatment:	N-B	C-B	N-H	C-H	N-R	C-R
Age	24.51	25.94	25.94	25.14	24.53	25.20
	(3.914)	(6.553)	(5.756)	(5.187)	(4.547)	(4.782)
Female	0.560	0.590	0.520	0.460	0.570	0.640
	(0.499)	(0.494)	(0.502)	(0.501)	(0.498)	(0.482)
Student	0.930	0.990	0.940	0.960	0.980	0.980
	(0.256)	(0.100)	(0.239)	(0.197)	(0.141)	(0.141)
Income after expenses	328.8	357.8	329.7	373.1	352.4	325.9
	(239.0)	(502.6)	(254.9)	(513.6)	(261.8)	(192.7)

Note: The table reports averages of socio demographic variables by treatment. Standard deviations are shown in parentheses. *Age Female* is a variable which is equal to one if a subject is female and zero if a subject is male. *Student* is a variable which is equal to one if a subject is enrolled as a student and zero otherwise (note that occasionally none students may participate in experiments). *Income after expenses* shows self reported income after all expenses (e.g., housing cost etc.).

1. Intended strategic default of the borrower $ISD_{(i,C)}$ for each possible credit-level C, conditional on the treatment conditions T.

$$ISD_{(i,C)} = f(T)$$

2. Credit supply of the lender, conditional on expected strategic default behavior of the paired borrower and the treatment T:

$$C_j = g(E_j[ISD_{(i,C)}|T], T)$$

Table 14
Summary statistics by treatment – N-B and N-H: 2015 and 2017.

	N-B – 2015	N-B – 2017	N-H– 2015	N-H – 2017
Credit	46.30	37.75	45.10	28
	(15.23)	(10.15)	(14.26)	(9.749)
ISD	0.650	0.62	0.587	0.615
	(0.157)	(0.078)	(0.112)	(0.113)
Borrower Profit	290.5	270.0	233.7	206.0
	(37.56)	(22.52)	(32.16)	(20.62)
Lender Profit	148.4	143.3	139.5	136
	(24.31)	(8.007)	(8.379)	(5.860)

Note: Mean of matching group averages with standard deviation in parentheses. Mean credit size (*Credit Size*), mean of realized strategic defaults over all credits (*RSD*), the mean of borrower profits (*Borrower Profit*) and the mean of lender profits (*Lender Profit*).

As we explain in detail in the main body of the paper, we assume that solvent borrowers face moral costs when not making a repayment. Borrowers thus face a trade-off between the monetary benefit from strategic defaults and the negative (psychological) effect due to strategic default. The function $f(\cdot)$ that determines a borrower's intended strategic default decision is therefore shaped by moral concerns and fairness perceptions. It is therefore conceivable that the intended strategic behavior of borrowers for each feasible credit level (10; 40; 70; 100) could be affected by giving lenders the option to offer no credit at all. In particular, models of intention-based reciprocity (see, e.g., Falk and Fischbacher, 2006) suggest that people's psychological perception of an outcome also depends on the set of available, but not chosen alternatives. Borrowers may view the same positive credit offer as a more generous action if the lender also had the option not to offer credit at all. Such an effect might plausibly lead to an increase in borrowers' moral costs so that the introduction of the no-credit option would shift down the function $f(\cdot)$.

We also allow for the possibility that borrowers' moral costs depend on whether the opportunistic behavior can be identified by the lender, because borrowers might feel worse if the paired lender knows that the borrower strategically defaulted. Basic on this logic we would predict that the impact of the no-credit option on borrower behavior would be smaller in the N-H treatment than in the N-B and N-R treatments.

From a purely theoretical point of view, it is not clear how the credit supply of the lenders will respond to the introduction of a no-credit option. We don't see any reason to assume that there would be a direct psychological effect for lenders. Changes in their behavior would therefore result from the impact of no-credit option on lenders' beliefs about borrower behavior. Lenders' response to this change in beliefs will depend on whether the intended strategic default rate is low enough to make the extension of large credits profitable and on their individual degree of risk aversion. Most likely there would be two opposing effects: pessimistic and/or strongly risk-averse lenders would prefer to offer no credit at all (rather than offering small credits as they do in the current design), optimistic lenders in contrast might become more likely to issue large credits. The net effect remains unclear.

In the communication treatments of our design we need to extend the framework to incorporate communication. In this setting, our two outcome variables are therefore determined by the interaction of three behavioral functions:

1. Intended strategic default of the borrower $ISD_{(i,C)}$ for each possible credit-level C, conditional on the borrower's communication M_i and the treatment conditions T.

$$ISD_{(i,C)} = f(M_i, T)$$

2. Credit supply of the lender, conditional on expected strategic default behavior of the paired borrower, given the observed communication of borrower M_i and the treatment T:

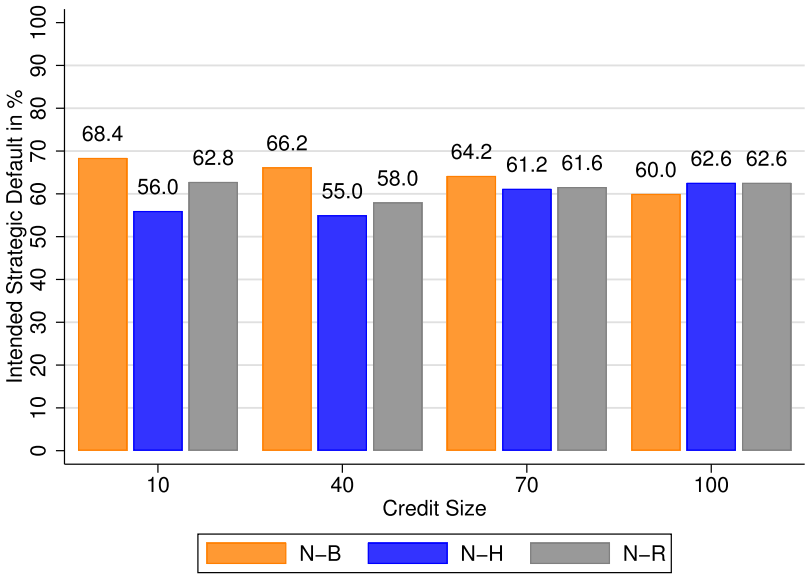
$$C_j = g(E_j[ISD_{(i,C)}|M_i, T], T)$$

3. Communication of the borrower, conditional on expected credit supply of the paired lender given the treatment conditions T.

$$M_i = h(E[C_j^*(M_i)|T])$$

The same arguments that apply for the no-communication treatments also apply here. In addition, it is conceivable that—if lenders have a no-credit option—borrowers may intensify their communication in order to induce lenders to supply credit. This could lead to more promises by borrowers to repay (large) loans.

In the main body of the paper we conjecture that the moral costs of strategic default increase if borrowers made a repayment promise, because people dislike breaking promises. If more and stronger promises are made in response to the presence of a no-credit option, the intended default rate in the communication treatments will further decrease. However, since moral costs are lower if strategic default can be hidden, this effect is likely to be weaker in the C-H than in the C-B or C-R treatments.



Notes: Mean intended strategic default rate for each credit size (10, 40, 70, and 100) in the N-B, N-H and N-R treatment.

Fig. 10. Intended strategic default (in %) in the no-communication treatments.

Cross-treatment comparison of the impact of communication on outcomes:

Our theoretical arguments suggest that a no-credit option would likely lead to a decrease in the intended default rate in all treatments. However, this effect would be more pronounced in the communication treatments. The directional impact on credit supply is not entirely clear, but the development would be more positive in the communication treatment (i.e. a smaller decline or a larger increase in credit supply). These effects would generally increase the efficiency-enhancing effects of communication. However, as all changes would most likely be smallest in the hidden action environment, we would still expect that the efficiency-enhancing effect of communication is weakest there. Relative to the current design, we would therefore expect—from a purely theoretical perspective—that the treatment difference becomes even stronger in the presence of a no-credit option.

B.2. Data perspective: expected effect of a no-credit option

B.2.1. No-communication treatments

Borrower strategic default

Consider Fig. 10 which summarizes the intended strategic default rate by credit size and treatment for the N-B, N-H and N-R treatments. As we elicited behavior of the borrower with the strategy method, this graph depicts the average function $ISD_C(T)$ for each of our current treatments.

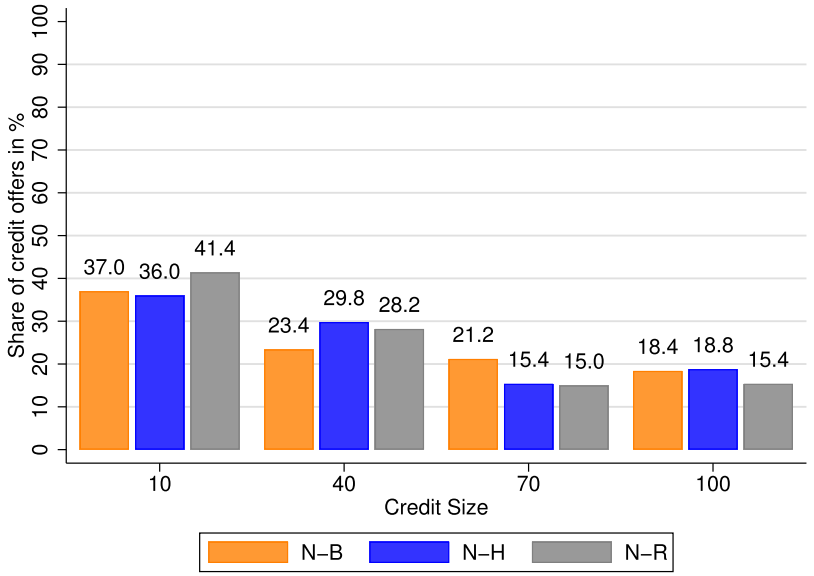
Two observations stand out:

1. There is no systematic correlation between the credit size offered and the intended strategic default rate. In the N-B treatment the function is slightly decreasing, in the N-H treatment it is slightly increasing and in the N-R treatment the function is flat.
2. Across treatments there is no difference in the intended strategic default rate on larger loans (70, 100) between the N-B treatment on one hand and the N-H and N-R treatments on the other hand.

These two observations call into question that intention-based reciprocity plays an important role in our setting. In the previous section we theoretically argued that a no-credit option might induce the borrowers to perceive positive credit offers as more generous so that the intended strategic default rate might fall. This hypothesis does not seem plausible given the observed data structure in our experiment.

Fig. 10 suggests that the generosity of loan offers has hardly any effect on the intended strategic default rate of borrowers in our no-communication treatments. It is important to keep in mind that the lowest credit size (10) is already a very safe option for the lender (which yields a guaranteed payoff of 140 points). The no-credit option would add another even safer option, but the difference would be small (guaranteed payoff of 150 points). There is no obvious reason to believe that the option of no-credit to lenders would lead to an important change in borrowers' behavioral pattern, because this additional option would not change the relative generosity of the positive credit offers.

Similarly, it is important to keep in mind that offering loans in the N-H and N-R treatments is a much more risky action for lenders as they face a 1/3 probability that the borrower cannot repay. Intention-based reciprocity would suggest that the same offer should



Notes: Mean credit size (10, 40, 70, and 100) in the N-B, N-H and N-R treatment.

Fig. 11. Credit supply (in %) in the no-communication treatments.

be perceived as much more generous in the N-H and N-R treatments than in the N-B treatment. As a consequence, the intended default rate should be substantially lower in these treatments, in particular for large credits. We do not at all observe such a pattern.

Given these results, it is hard to imagine that a no-credit option would generate strong 'generosity effects'. It therefore seems most plausible to expect that the presence of a no-credit option would not have any significant impact on borrower behavior.

Lender credit supply

Assuming no significant change in the behavior of borrowers, we now turn to the behavior of lenders.

In our current design (without the option of no credit) lenders choose a credit level $C \in \{10; 40; 70; 100\}$ to maximize:

In the N-B treatment: $(1 - ISD_{C,N-B}) \times 2.5C + 150 - C$

In the N-H/N-R treatments: $\frac{2}{3} \times (1 - ISD_{C,N-H/R}) \times 2.5C + 150 - C$

Note that in N-B if $ISD_{(C,N-B)} \leq 0.6$ for all credit sizes the lender should choose the maximum credit size $C = 100$. By contrast, if $ISD_{(C,N-B)} > 0.6$ for all credit sizes the lender should choose the minimum credit size $C = 10$. In N-H and N-R, in contrast, the threshold level the intended strategic default rate is $ISD_{(C,N-H/R)} = 0.4$.

From Fig. 10 we see that intended strategic default rates are around or above 60% for all credit sizes in the N-B, N-H and N-R treatments. The distribution of credit sizes offered by lenders under our current design is presented in Fig. 11 above. Under our present design, small credit offers (10;40) make up more than 60% of the credit supply in each of the no-communication treatments. This distribution of credit offers suggests that the majority of the lenders have a quite accurate picture of average borrower behavior and choose their credit offers accordingly.

Now, consider offering lenders the option to not extend credit at all. Based on the distribution in Fig. 11, we would expect that allowing lenders to offer no credit at all will lead to a reduction in observed credit supply, particularly in the N-H and N-R treatments. The lenders who offer low credit sizes (10; 40) under our present design are likely to abstain from offering credit if they have the option to do so. This would reduce overall credit supply, even if (as argued above) borrower repayment behavior is unaltered.

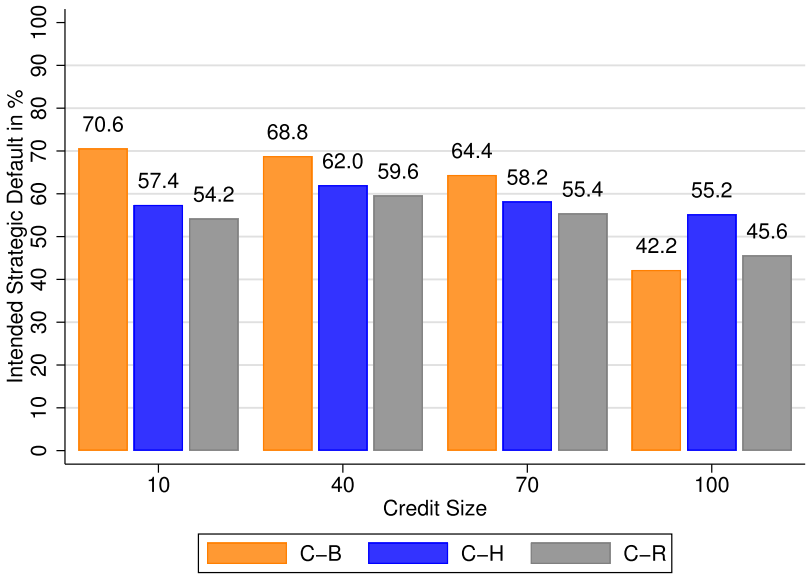
Our overall assessment is that in our no communication treatments N-B, N-H and N-R the option of no-credit offer for lenders would have the following effect:

- The intended strategic default rate of borrowers would be largely unaffected.
- The credit supply of lenders would decline as many lenders abstain from lending at all.

B.2.2. Communication treatments

Borrower Communication

In our design we study voluntary, pre-play, non-binding borrower communication. Table 5 in the main body of the paper reveals that 66% (71%, 59%) of borrowers in our C-B (C-H, C-R) treatment engage in communication with lenders. The majority of communication involves promises to repay the maximum loan size.



Notes: Mean intended strategic default rate for each credit size (10, 40, 70, and 100) in the C-B, C-H and C-R treatment.

Fig. 12. Intended strategic default (in %) in the communication treatments.

It is conceivable that—if lenders have a no-credit option—borrowers may intensify their communication in order to induce lenders to supply credit. This could lead to more promises by borrowers to repay (large) loans.

Borrower strategic default

We conjecture above that borrowers may intensify their communication with lenders if lenders have a no-credit option. The results under our current design suggest that additional communication may lead to less strategic default by borrowers. However, this effect is likely to be weaker in the C-H treatment than in the C-B or C-R treatments. Fig. 4 from our paper shows that borrowers are twice as likely to break promises to repay in the C-H treatment compared to the C-B and C-R treatments.

Fig. 12 summarizes the intended strategic default behavior in our C-B, C-H and C-R treatments under our current design. Under the assumption that borrowers communicate more with lenders (promising to repay loans of 100) we would expect the strategic default rate for loans of 100 to decline further in the C-B and C-R treatments. In the C-H treatment we would expect a less pronounced decline in strategic defaults on credit size 100.

Lender credit supply

Fig. 13 summarizes the lenders' credit supply behavior in our C-B, C-H and C-R treatments under our current design. We conjecture, that altering our design to allow lenders a no-credit option would lead to two countervailing effects.

First, as with our no-communication treatments we expect lenders to offer small credit sizes less frequently, preferring instead to abstain from offering credit at all. This should reduce credit supply in all three communication treatments. As the share of small loans is larger in the C-H and C-R treatments than in the C-B treatment we would expect a stronger decline in credit supply in the former compared to the latter.

Second, if borrowers communicate more with lenders and lenders expect borrowers to keep these promises we may see an increase in the frequency of credit size of 100. As discussed above though, we expect this effect to be stronger in the C-B and C-R than in the C-H treatments.

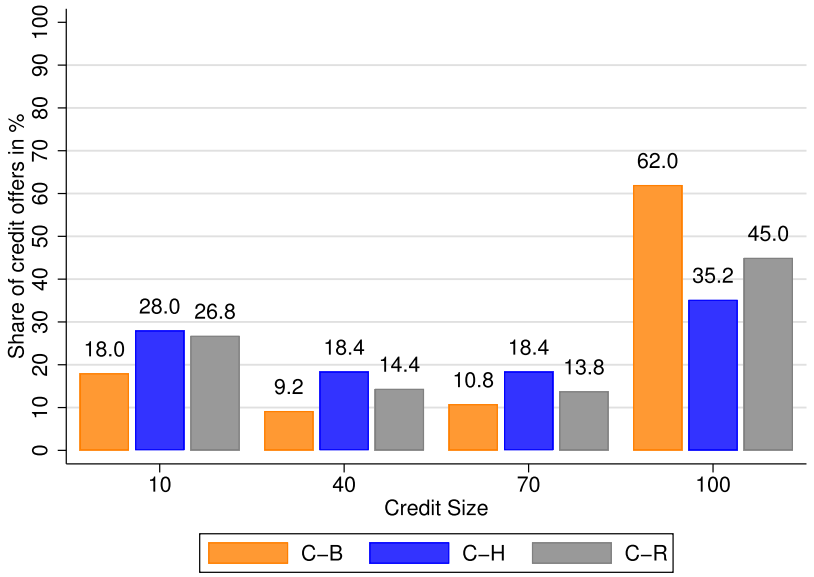
While it is not entirely clear in which direction the overall development of credit supply would go, the arguments above suggest that we expect a *relative* decrease in the credit supply in the C-H treatment compared to the C-B and C-R treatments.

Overall our assessment is that offering a no-credit option to lenders in our experimental design will have the following consequences in the communication treatments:

1. Borrowers are more likely to communicate with lenders and promise to repay loans.
2. Borrowers will be more likely to repay loans of credit size 100, whereby this effect is stronger in the C-B and C-R than in the C-H treatment.
3. Lenders will change credit supply in two ways. On the one hand they will abstain from offering credit. At the same time, they will offer more loans of credit size 100. The latter effect will be weaker in the C-H than in the C-B or C-R treatments.

Cross-Treatment comparisons

Our above analysis suggests the following implications of altering our design by offering a no-credit option to lenders:



Notes: Mean credit size (10, 40, 70, and 100) in the C-B, C-H and C-R treatment.

Fig. 13. Credit supply (in %) in the communication treatments.

The effect of communication on credit supply and strategic default

The effect of communication on credit supply and strategic default is strengthened in the baseline condition (C-B vs. N-B), hidden-action condition (C-H vs. N-H) and the reveal action condition.

- The intended strategic default rates of borrowers decline in the communication treatments compared to the no-communication treatments as borrowers intensify communication with lenders.
- Lender credit supply increases in relative terms in the communication treatments compared to the no-communication treatments.

Differential effect of communication across baseline, hidden-action and revealed-action conditions

The effects of communication on credit supply and strategic default become stronger in all environments, but more so in the baseline condition (C-B vs. N-B) and in the revealed-action condition (C-R vs. N-R) than in the hidden action condition (C-H vs. N-H).

Based on this analysis, we would therefore expect that our results are not only robust to the presence of a no-credit option, but that a no-credit option would actually further *strengthen* our main findings.

Appendix C. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jebo.2023.12.019.

References

Abeler, Johannes, Nosenzo, Daniele, Raymond, Collin, 2019. Preferences for truth-telling. Econometrica 87 (4), 1115–1153.
Ahlin, Christian, Townsend, Robert M., 2007. Using repayment data to test across models of joint liability lending. Econ. J. 117 (517), F11–F51.
Andreoni, James, Bernheim, Douglas B., 2009. Social image and the 50–50 norm: a theoretical and experimental analysis of audience effects. Econometrica 77 (5), 1607–1636.
Arrow, Kenneth J., 1969. The organization of economic activity: issues pertinent to the choice of market versus nonmarket allocation. In: The Analysis and Evaluation of Public Expenditure: The PPB System, vol. 1, pp. 59–73.
Balliet, Daniel, 2009. Communication and cooperation in social dilemmas: a meta-analytic review. J. Confl. Resolut.
Bartling, Björn, Grieder, Manuel, Zehnder, Christian, 2017. Competitive pricing reduces wasteful counterproductive behaviors. J. Public Econ. 156, 34–47.
Ben-Ner, Avner, Putterman, Louis, 2009. Trust, communication and contracts: an experiment. J. Econ. Behav. Organ. 70 (1), 106–121.
Berg, Joyce, Dickhaut, John, McCabe, Kevin, 1995. Trust, reciprocity, and social history. Games Econ. Behav. 10 (1), 122–142.
Bock, Olaf, Baetge, Ingmar, Nicklisch, Andreas, 2014. hroot: Hamburg registration and organization online tool. Eur. Econ. Rev. 71, 117–120.
Bolton, Gary E., Ockenfels, Axel, 2000. ERC: a theory of equity, reciprocity, and competition. Am. Econ. Rev., 166–193.
Bracht, Juergen, Feltovich, Nick, 2009. Whatever you say, your reputation precedes you: observation and cheap talk in the trust game. J. Public Econ. 93 (9), 1036–1044.
Brandts, Jordi, Charness, Gary, 2011. The strategy versus the direct-response method: a first survey of experimental comparisons. Exp. Econ. 14 (3), 375–398.
Brandts, Jordi, Cooper, David J., Weber, Roberto A., 2014. Legitimacy, communication, and leadership in the turnaround game. Manag. Sci. 61 (11), 2627–2645.
Brandts, Jordi, Ellman, Matthew, Charness, Gary, 2015. Let's talk: how communication affects contract design. J. Eur. Econ. Assoc. 14 (4), 943–974.
Breza, Emily, 2012. Peer effects and loan repayment: evidence from the Krishna default crisis. In: Job Market Paper. MIT.

Briceno Ortega, Ana Cecilia, Bell, Frances, et al., 2008. Online social lending: borrower-generated content. In: Proceedings of the Fourteenth Americas Conference on Information Systems.
Brown, Martin, Zehnder, Christian, 2007. Credit reporting, relationship banking, and loan repayment. J. Money Credit Bank. 39 (8), 1883–1918.
Brown, Martin, Falk, Armin, Fehr, Ernst, 2004. Relational contracts and the nature of market interactions. Econometrica 72 (3), 747–780.
Brown, Martin, Schmitz, Jan, Zehnder, Christian, 2016. Social Norms and Strategic Default. Working Paper.
Bursztyn, Leonardo, Fiorin, Stefano, Gottlieb, Daniel, 2019. Moral incentives in credit card debt repayment: evidence from a field experiment. J. Polit. Econ. 127 (4), 1641–1683.
Cason, Timothy N., Sheremeta, Roman M., Zhang, Jingjing, 2017. Asymmetric and endogenous within-group communication in competitive coordination games. Exp. Econ. 20 (4), 946–972.
Charness, Gary, Dufwenberg, Martin, 2006. Promises and partnership. Econometrica 74 (6), 1579–1601.
Cooper, David J., Kühn, Kai-Uwe, 2014. Communication, renegotiation, and the scope for collusion. Am. Econ. J. Microecon. 6 (2), 247–278.
Dana, J., Weber, R.A., Xi Kuang, J., 2007. Exploiting moral wiggle room: experiments demonstrating an illusory preference for fairness. Econ. Theory 33, 67–80.
DellaVigna, Stefano, List, John A., Malmendier, Ulrike, 2012. Testing for altruism and social pressure in charitable giving. Q. J. Econ. 127 (1), 1–56.
Demyanyk, Yuliya, Van Hemert, Otto, 2011. Understanding the Subprime Mortgage Crisis. Rev. Financ. Stud. 24 (6), 1848–1880.
Di Bartolomeo, Giovanni, Dufwenberg, Martin, Papa, Stefano, 2019. Promises, expectations & causation. Games Econ. Behav. 113, 137–146.
Ederer, Florian, Schneider, Frédéric, 2022. Trust and promises over time. Am. Econ. J. Microecon. 14 (3), 304–320.
Ederer, Florian, Stremitzer, Alexander, 2017. Promises and expectations. Games Econ. Behav. 106, 161–178.
Eisenkopf, Gerald, 2014. The impact of management incentives in intergroup contests. Eur. Econ. Rev. 67, 42–61.
Ellingsen, Tore, Johannesson, Magnus, 2004. Promises, threats and fairness. Econ. J. 114 (495), 397–420.
Ellingsen, Tore, Östling, Robert, 2010. When does communication improve coordination? Am. Econ. Rev. 100 (4), 1695–1724.
Ellman, Matthew, Pezanis-Christou, Paul, 2010. Organizational structure, communication, and group ethics. Am. Econ. Rev. 100 (5), 2478–2491.
Erat, Sanjiv, Gneezy, Uri, 2012. White lies. Manag. Sci. 58 (4), 723–733.
Exley, Christine L., 2015. Excusing selfishness in charitable giving: The role of risk. Rev. Econ. Stud. 83 (2), 587–628.
Falk, Armin, Fischbacher, Urs, 2006. A Theory of Reciprocity. Games Econ. Behav. 54 (2), 293–315.
Fehr, E., Schmidt, K., 1999. A Theory of Fairness, Competition and Cooperation. Q. J. Econ. 114, 817–868.
Fehr, Ernst, Zehnder, Christian, 2009. Reputation and Credit Market Formation: How Relational Incentives and Legal Contract Enforcement Interact. Tech. rep., Institute for the Study of Labor (IZA).
Fehr, Ernst, Kirchsteiger, Georg, Riedl, Arno, 1993. Does fairness prevent market clearing? An experimental investigation. Q. J. Econ. 108 (2), 437–459.
Fehr, Ernst, Kirchsteiger, Georg, Riedl, Arno, 1998. Gift exchange and reciprocity in competitive experimental markets. Eur. Econ. Rev. 42 (1), 1–34.
Fischbacher, Urs, 2007. z-Tree: Zurich Toolbox for Ready-made Economic Experiments. Exp. Econ. 10 (2), 171–178.
Fischbacher, Urs, Föllmi-Heusi, Franziska, 2013. Lies in disguise-an experimental study on cheating. J. Eur. Econ. Assoc. 11 (3), 525–547.
Fisman, Raymond, Paravisini, Daniel, Vig, Vikrant, 2017. Cultural proximity and loan outcomes. Am. Econ. Rev. 107 (2), 457–492.
Gao, Qiang, Lin, Mingfeng, Sias, Richard W., 2018. Words matter: The role of texts in online credit markets. Available at SSRN 2446114.
Gentzkow, Matthew, Kelly, Bryan, Taddy, Matt, 2019. Text as data. J. Econ. Lit. 57 (3), 535–574.
Ghent, Andra C., Kudlyak, Marianna, 2011. Recourse and Residential Mortgage Default: Evidence from US States. Rev. Financ. Stud. 24 (9), 3139–3186.
Glaeser, Edward L., Laibson, David I., Scheinkman, Jose A., Soutter, Christine L., 2000. Measuring trust. Q. J. Econ. 115 (3), 811–846.
Gneezy, Uri, Rockenbach, Bettina, Serra-Garcia, Marta, 2013. Measuring lying aversion. J. Econ. Behav. Organ. 93, 293–300.
Gneezy, Uri, Kajackaite, Agne, Sobel, Joel, 2018. Lying Aversion and the Size of the Lie. Am. Econ. Rev. 108 (2), 419–453.
Gropp, Reint, Scholz, John Karl, White, Michelle J., 1997. Personal bankruptcy and credit supply and demand. Q. J. Econ. 112 (1), 217–251.
Guiso, Luigi, Sapienza, Paola, Zingales, Luigi, 2013. The determinants of attitudes toward strategic default on mortgages. J. Finance 68 (4), 1473–1515.
Hayes, Andrew F., Krippendorff, Klaus, 2007. Answering the call for a standard reliability measure for coding data. Commun. Methods Meas. 1 (1), 77–89.
Hertzberg, Andrew, Liberti, Jose Maria, Paravisini, Daniel, 2010. Information and incentives inside the firm: Evidence from loan officer rotation. J. Finance 65 (3), 795–828.
Hoppe, Eva I., Schmitz, Patrick W., 2018. Hidden action and outcome contractibility: An experimental test of moral hazard theory. Games Econ. Behav. 109, 544–564.
Jaffee, Dwight M., Russell, Thomas, 1976. Imperfect Information, Uncertainty, and Credit Rationing. Q. J. Econ. 90 (4), 651–666.
Johnson, Noel D., Mislin, Alexandra A., 2011. Trust games: A meta-analysis. J. Econ. Psychol. 32 (5), 865–889.
Kahneman, Daniel, Tversky, Amos, 1979. Prospect theory: An analysis of decision under risk. Econometrica, 263–291.
Kamei, Kenju, Putterman, Louis, 2017. Play it again: Partner choice, reputation building and learning from finitely repeated dilemma games. Econ. J. 127 (602), 1069–1095.
Karlan, Dean, Morten, Melanie, Zinman, Jonathan, 2016. A personal touch: Text messaging for loan repayment. Behav. Sci. Policy 1 (2), 25–31 (17952).
Karlan, Dean S., 2005. Using experimental economics to measure social capital and predict financial decisions. Am. Econ. Rev. 95 (5), 1688–1699.
Kartik, Navin, Ottaviani, Marco, 2007. Credulity, lies, and costly talk. J. Econ. Theory 134 (1), 93–116.
Kartik, Navin, Tercieux, Olivier, 2014. Simple mechanisms and preferences for honesty. Games Econ. Behav. 83, 284–290.
Kirschenmann, Karolin, 2016. Credit rationing in small firm-bank relationships. J. Financ. Intermed. 26, 68–99.
Laudenbach, Christine, Pirschel, Jenny, Siegel, Stephan, 2018. Personal communication in a Fintech world: evidence from loan payments. CESifo Working Paper.
Lei, Vivian, Masclet, David, Vesely, Filip, 2014. Competition vs. communication: An experimental study on restoring trust. J. Econ. Behav. Organ. 108, 94–107.
Leibbrandt, Andreas, Sääksvuori, Lauri, 2012. Communication in intergroup conflicts. Eur. Econ. Rev. 56 (6), 1136–1147.
Liberman, Andres, 2016. The value of a good credit reputation: Evidence from credit card renegotiations. J. Financ. Econ. 120 (3), 644–660.
López-Pérez, Raúl, Spiegelman, Eli, 2013. Why do people tell the truth? Experimental evidence for pure lie aversion. Exp. Econ. 16 (3), 233–247.
Matsushima, Hitoshi, 2008. Role of honesty in full implementation. J. Econ. Theory 139 (1), 353–359.
Mian, Atif, Sufi, Amir, 2011. House prices, home equity-based borrowing, and the US household leverage crisis. Am. Econ. Rev. 101 (5), 2132–2156.
Pagano, Marco, Jappelli, Tullio, 1993. Information sharing in credit markets. J. Finance 48 (5), 1693–1718.
Qian, Jun, Strahan, Philip E., Yang, Zhishu, 2015. The impact of incentives and communication costs on information production and use: Evidence from bank lending. J. Finance 70 (4), 1457–1493.
Sapienza, Paola, Zingales, Luigi, 2011. Trust and finance. In: NBER Reporter Online, pp. 16–19.
Schonlau, Matthias, Guenther, Nick, Sucholutsky, Ilia, 2017. Text mining with n-gram variables. Stata J. 17 (4), 866–881.
Stiglitz, Joseph E., Weiss, Andrew, 1981. Credit Rationing in Markets with Imperfect Information. Am. Econ. Rev. 71 (3), 393–410.
Stroebel, Johannes, 2016. Asymmetric information about collateral values. J. Finance 71 (3), 1071–1112.
Uchida, Hirofumi, Udell, Gregory F., Yamori, Nobuyoshi, 2012. Loan officers and relationship lending to SMEs. J. Financ. Intermed. 21 (1), 97–122.
van der Weele, Joël J., Kulisa, Julija, Kosfeld, Michael, 2014. Resisting moral wiggle room: how robust is reciprocal behavior? Am. Econ. J. Microecon. 6 (3), 256–264.
Vanberg, Christoph, 2008. Why do people keep their promises? An experimental test of two explanations. Econometrica 76 (6), 1467–1480.
Vanberg, Christoph, 2017. Who never tells a lie? Exp. Econ. 20 (2), 448–459.
Xiao, Erte, Kunreuther, Howard, 2016. Punishment and cooperation in stochastic social dilemmas. J. Confl. Resolut. 60 (4), 670–693.
Xu, Jennifer J., Chau, Michael, 2018. Cheap talk? The impact of lender-borrower communication on peer-to-peer lending outcomes. J. Manag. Inf. Syst. 35 (1), 53–85.