Social Norms and Strategic Default*

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Abstract

A significant share of the mortgage defaults in the U.S. during the 2007-2009 crisis were strategic. Survey evidence suggests that the increased propensity to default strategically was partly driven by a breakdown in moral constraints and social norms to repay loans. In this paper we use experimental methods to shed new light on the behavioral mechanisms underlying the increased tendency to default strategically in an economic crisis. Our experiment isolates two important channels: First, adverse economic conditions soften moral constraints. When economic shocks cause fundamental defaults to surrounding borrowers solvent households feel less bad if they default strategically. Second, an economic contraction weakens the enforcement of social norms to repay debt: In a crisis, peers of defaulting households have a hard time distinguishing between strategic and fundamental defaults and are therefore reluctant to punish defaulting households. An economic downturn does not lead to a break-down of social norms per se, but rather creates informational uncertainty which makes it difficult to enforce the norm.

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1 Introduction

The delinquency rate on U.S. residential mortgages increased from below 2% in the period 2000-2006 to more than 10% in the period 2009-2011. Mortgage defaults were mainly triggered by the insolvency and illiquidity of households, confronted with higher mortgage interest payments and lower income (Elul et al., 2010). However, existing evidence also points to a significant share of strategic defaults: Households walked away from homes in which they had negative equity due to the significant collapse of house prices (Demyanyk and Van Hemert, 2011; Ghent and Kudlyak, 2011).

In this paper we examine the role of moral constraints and social norms in restraining strategic default during an economic downturn. Guiso et al. (2013) argue that a change in household or societal attitudes may have led to a contagious propagation of defaults in the mortgage market. In their survey of U.S. households, they find that the individual propensity to engage in strategic default is amplified if the respondent is acquainted to someone who has strategically defaulted him- or herself. Guiso et al. (2013) interpret their findings as evidence for a collapse in moral constraints or a breakdown of social norms in an economic crisis through which strategic defaults may propagate: Households feel less obliged to repay their mortgage if others around them are defaulting (weaker moral constraints). Also, households no longer expect to be ostracized by their peers if they strategically default (weaker enforcement of social norms).

Insights from behavioral economics suggest that social norms may play an important role in discouraging strategic default. A wide body of evidence documents that individuals are willing to incur personal costs to punish those who deliberately impose social costs on a community (see e.g., Fehr and Fischbacher, 2004; De Quervain et al., 2004). Besides imposing a loss on the lender, mortgage defaults do impose negative pecuniary externalities on the surrounding community. High mortgage delinquency rates as observed in the U.S. during the financial crisis have led to a substantial increase in foreclosures.[1] Recent evidence suggests that high foreclosure rates are associated with substantial price declines for owners of nearby properties due to both an increase in local housing supply as well as to the disamenity of being located close to ill-maintained property (Anenberg and Kung, 2013; Hartley, 2010). Given these negative spillover effects of foreclosure, neighbors may be willing to sanction homeowners who default strategically.

However, as pointed out by Towe and Lawley (2013) the observation that strategic defaults may propagate from one household to another does not necessarily imply a change in moral

[1] The annual number of homes subject to a foreclosure sale increased from less than 100'000 in 2005-2006 to nearly 1 million in 2008-2011.

sentiments or a breakdown of social norms. Defaults by neighbors that impact on current local house prices or on future price expectations can trigger further strategic defaults, because of a purely economic effect (expected negative equity) rather than a change in individual or societal attitudes. Using localized foreclosure data for Maryland during the crisis Towe and Lawley (2013) show that the contagion effect in local mortgage defaults goes well beyond what one could expect due to immediate price effects. However, they cannot distinguish the effect of (unobservable) price expectations from the effect of changes in individual and societal attitudes.

In this paper, we use experimental methods to examine the behavioral channels underlying the increase in strategic mortgage defaults in an economic crisis. We implement a stochastic prisoner's dilemma game that mirrors a borrowers' repayment decision situation in a stylized and simplified way: Two players (borrowers) play a prisoner's dilemma game in which they decide to cooperate (repay a loan) or to defect (default on a loan). Repaying a loan is costly for the individual player, while defaulting has negative consequences for the paired partner (reflecting the negative externality of defaults imposed on society). In our experiment the ability of the borrowers to cooperate is stochastic: with a probability γ they have a sufficiently high income so that they can choose to repay or (strategically) default. With a probability $1 - \gamma$ they have no income so that they cannot repay and there is a fundamental default. In some of our treatments we add a third-party enforcer to the game. The third player sees the outcome of the prisoner's dilemma game and has the possibility to sanction one or both players (at a cost). This feature of our game allows us to directly measure the extent to which social norms are enforced by peers.

We study the behavioral determinants of strategic default across economic conditions by exogenously manipulating the frequency of fundamental defaults in the economy: We compare treatments which vary in the probability with which each borrower can repay. In addition, we not only study treatments with and without third-party enforcers, but also vary the information that enforcers have about borrowers' behavior (i.e., whether or not they can distinguish strategic from fundamental defaults). Together our six treatments allow us to i) identify the extent to which adverse economic conditions undermine the role of moral constraints in preventing strategic default, ii) to disentangle the effect of individual moral constraints from that of social norms enforced by peers, and iii) to study the role of information for the enforcement of social norms by peers.

In line with the evidence of Guiso et al. (2013) we find that moral constraints to repay loans are weakened under adverse economic conditions. In the absence of third-party enforcers roughly half of all borrowers repay their loans when the state of the economy is strong. Under weak economic conditions, the frequency of strategic defaults increases by nearly 25 percent. The presence of third party enforcers mitigates the impact of an economic downturn on the strategic default rate. However, norm enforcement by third-party enforcers does depend on how well they can distinguish between fundamental and strategic defaults. The reason is that many enforcers are reluctant to intervene if there is a large risk that they hit "innocent" borrowers who were forced to default because of illiquidity. When enforcers can differentiate strategic defaults from fundamental defaults, the disciplining ensures that there is no longer a statistically significant increase in the strategic default rate in the weak economy. The reason is that perfectly informed enforcers perceive strategic defaults as equally (un)acceptable in the weak and the strong economy and therefore sanction strategic defaulters equally harshly in both environments. These findings imply that an economic downturn does not lead to a break-down of social norms per se, but rather creates informational uncertainty that makes it more difficult to enforce the norm. This finding qualifies Guiso et al. (2013)'s interpretation that an economic crisis not only softens moral constraints, but also weakens social norms to repay.

Our paper provides three main contributions to the existing literature. First, by exogenously manipulating both the economic conditions and the extent to which social norms can be enforced by peers our study can isolate the different behavioral channels through which an economic downturn may affect strategic defaults in personal credit markets. Since the previous literature was based on field observations and survey data these studies were unable to pin down the causal relations that we report in our study (Guiso et al., 2013; Towe and Lawley, 2013). Second, we provide a novel contribution to the extant literature which examines behavior in public good games (see e.g. Camerer, 2003; Chaudhuri, 2011; Ledyard, 1995, for reviews of the literature). Expanding on the work of Charness et al. (2008) and Xiao and Kunreuther (2015) we document that third party sanctioning of non-cooperative behavior in such games depends strongly on the information available to potential punishers. Third, we contribute to the experimental literature which examines the role of social norms and implicit contracting in enforcing credit contracts.(Brown and Zehnder, 2007; Fehr and Zehnder, 2009; Brown and Serra-García, 2014) We expand upon this literature by exploring the impact of economic conditions on the efficacy of social norms in deterring default.

The remainder of this paper is organized as follows: Section 2 describes the experiment design and procedures. Section 3 derives our hypotheses, section 4 reports our results and section 5 concludes.

2 Experiment Design and Procedures

The objective of our experiment is to identify how strategic loan default and the enforcement of social norms of repayment are affected by adverse economic conditions. To do this we implement an experimental design with three key ingredients: (i) An underlying game which captures the negative social externalities of individual defaults, (ii) a game which captures the enforcement of social norms to repay and (iii) a game which allows us to vary the underlying economic conditions exogenously. Our experiment builds on a stochastic prisoner's dilemma game with third party punishment. We first present the details of our design and then discuss the reasons for this design choice.

2.1 Stochastic Prisoner's Dilemma Game

We implement a prisoner's dilemma game in which the ability of each player to cooperate is stochastically determined. Our game is framed in the personal credit context: Both players in the prisoner's dilemma are borrowers who have an illiquid endowment of 200 points and an outstanding loan of 100 points. Nature determines – independently for each borrower – if the borrower can repay her loan: With probability γ the borrower has an income of 200 points. With probability $1 - \gamma$ the borrower has no additional income.[2]

If a borrower has an income of zero she cannot repay her debt: this constitutes a "fundamental default". In case of a fundamental default the borrower keeps her illiquid endowment of 200 points and makes no payment. If the borrower has an income of 200 points she decides whether to repay her loan or to default strategically. If she repays the outstanding loan, the payment (100 points) is deducted from her income (200 points), leaving a net income of 100 points. In addition the borrower keeps her illiquid endownment, so that she ends up with a total of 300 points. If the borrower defaults strategically she retains her full income of 200 points plus her illiquid endowment of 200 points, so that she realizes a total payoff of 400 points.

The symmetric illiquid endowment of 200 points constitutes a baseline utility which is not affected as long the other borrower repays her loan. However, if the other borrower does not repay her loan (because of fundamental or strategic default), the borrower's endowment

[2]Whether or not a borrower receives an income is randomly determined by a public roll of a 10–sided dice. Before the dice was rolled, we displayed on each subject's screen the numbers one to ten and the corresponding income (0 points or 200 points). The assignment of incomes (0 and 200) to the possible dice outcomes (1 to 10) was individually different and random. The dice was rolled and the resulting number was publicly announced by the experimenter and then entered into z-Tree. Subsequently, the realized number and the corresponding period income appeared on the subjects' screen. This procedure rules out that subjects may have doubts about the randomness of their income.

is reduced by 150 points, to 50 points. This reduction captures the negative externality of defaults on other borrowers. Our parameter choice implies that there is a negative welfare effect of default, because the monetary gain from strategic default is 50 points lower than the imposed social cost to the other borrower.

Table 1 summarizes borrowers' payoffs as a function of their behavior. As the social cost of a default outweighs the private benefit of a strategic default the efficient outcome of the game is achieved if both players choose to repay (conditional on having an income). The unique Nash-equilibrium of the game is, however, to strategically default (conditional on having an income).

Table 1: Prisoner's Dilemma Payoffs

			Borrower 1		
			Income=200		Income=0
			Repay	Strat. Default	Fund. Default
Borrower 2	Income=200	Repay	300,300	150,400	150,200
		Strat. Default	400,150	250,250	250,50
	Income=0	Fund. default	200,150	50,250	50,50

Notes: The dashed box displays payoffs from the prisoner's dilemma if both borrowers receive an additional income of 200 points and can make a repayment decision. If both repay, their payoff results to 300 points (because repayment cost 100 points). Repayment if the other borrower strategically defaults yields a payoff of 150 (a defaulting borrower imposes a cost of 150 on the other borrower). Strategic default if the other borrower repays earns the highest income of 400 points. Payoffs under (and right of) the dashed line are consequenses of one (or two) fundamental defaults by borrowers. Repayment if the other borrower defaults fundamentally yields 150 points. Fundamental default if the other borrower repays yields a profit of 200. If one borrower strategically defaults and the other borrower defaults fundametally the strategically defaulting borrower secures 250 points and the fundamentally defaulting borrower earns 50 points. If both borrowers fundamentally default, they receive 50 points.

2.2 Treatments

In order to cleanly identify the impact of an economic shock on strategic defaults and the enforcement of a social repayment norm we exogenously vary two dimensions separately. First, we isolate the impact of social norm enforcement by varying the extent to which third parties are informed about borrowers' behavior. Second, we manipulate the state of the economy by changing the probability with which borrowers have a positive income.

Regarding the information available to third-parties, we implement three different information structures in the experiment:

In our **no enforcer conditions** third parties have therefore no possibility to enforce social norms. In this benchmark condition, we exclude third parties from the setup. The only force that can prevent borrowers from engaging in strategic default in these conditions are individual moral constraints. Moral constraints thereby capture the idea that a borrower experiences an utility loss if she acts not according to her idiosyncratic moral values.[3]

In our **partial information conditions** the outcome of the prisoner's dilemma is observed by a 3rd player (the enforcer) who has not participated in the prisoner's dilemma game. Enforcers only have partial information, i.e, they observe whether a borrower has repaid or not repaid her loan, but they do not know the income of each borrower. Accordingly, enforcers cannot distinguish between a fundamental default and a strategic default. Enforcers are endowed with 300 points[4] and have the possibility to exert costly punishments and reduce the income of one or both of the borrowers. Deducting points is possible in steps of 10 points. Reducing a borrower's payoff by 10 points is associated with a cost of 1 point for the enforcer.

In the **full information conditions** the outcome of the prisoner's dilemma is also observed by a 3rd party enforcer. The endowment of the enforcer and costs of punishment are identical to the partial information conditions. However, in this condition enforcers get to know incomes and choices of the two borrowers and can therefore unambiguously differentiate between fundamental defaults and strategic defaults.

For the state of the economy we implement two different conditions: In the **weak economy (WE) condition** the probability of a borrower having an income of 200 is 50%. With a counter probability of 50% borrowers have no income, are illiquid and must default on their loan. In the **strong economy (SE) condition** the probability of a borrower having an income of 200 is 90%. The difference in the frequency of fundamental defaults in these conditions allows us to identify how the state of the economy (weak vs. strong) affects strategic default and third party norm enforcement.

Fully crossing our three information conditions with the two possible states of the economy yields six different treatments in a 3x2 design. We implement these six treatments in a between-subject design, i.e., each participant participates in only one of the treatments. Table

[3]We use moral constraints as an umbrella term that describes a reduction of own utility due to strategic default. Moral cost can vary between individuals (in nature and magnitude) and may arise due to e.g., an aversion to guilt (Dufwenberg and Gneezy, 2000; Battigalli and Dufwenberg, 2007), an aversion to unequal payoffs (Fehr and Schmidt, 1999), a fear of reciprocating negatively (Bolton and Ockenfels, 2000; Dufwenberg and Kirchsteiger, 2004), or any deviation from intrinsic values.

[4]An endowment of 300 points for enforcers implies that in the event of full repayment and no punishment the two borrowers and the enforcers have the same income. This avoids equality-driven punishments in those situations.

2 presents an overview of the treatments.

Table 2: Treatment Overview

	No enforcer	Partial information	Full information
Weak economy	WE no enforcer	WE partial info	WE full info
Strong economy	SE no enforcer	SE partial info	SE full info

Notes: Weak economy (WE): probability of fundamental default 0.5. Strong economy (SE) probability of fundamental default 0.1. No enforcer describes treatments without impartial 3rd parties. Partial information: Treatments with possible punishment of an impartial enforcer. Enforcers receive information about default but not about the nature (fundamental of strategic) of the default. Full information: Treatments with an impartial enforcer. Enforcers receive full information about the nature of a default.

2.3 Procedures and Data

We allocate subjects into matching groups and the experiment lasts 20 periods. In the No enforcer condition, there are 8 subjects in a matching group and all are in the roles of borrowers. In this condition borrowers are randomly matched into four separate pairs at the beginning of each period. In the full information and partial information conditions the matching groups consist of 12 subjects of whom 8 subjects are randomly assigned to the role of a borrower and 4 subjects are randomly assigned to the role of an enforcer for the whole 20 periods. In these conditions 2 borrowers and 1 enforcer are randomly matched at the beginning of each period.

At the end of each period subjects receive information about the number of points they earned in that period. Each subject also receives aggregate information regarding the behavior of all subjects in his/her matching group. This information differs depending on the information structure of the treatment: In the no enforcer conditions the post period information summarizes: i) the number of borrowers in a borrowers' matching group who could repay their loan and repaid, ii) the number of borrowers within a matching group who could repay their loan and did not repay and, iii) the number of borrowers within a matching group who were illiquid. In the partial information conditions post period information includes that provided in the no enforcer conditions. In addition subjects are also informed about: iv) the average number of punishment points assigned to defaulters in their matching group, and v) the average number of punishment points assigned to borrowers who repay loans in their matching group. In the full information conditions post period information is identical to that received in the partial information conditions except for the fact that now the participants get separate information on: iv.a) the average number of punishment points assigned to strategic defaulters in their matching group, and iv.b) the average number of punishment points assigned to fundamental defaulters in their matching group.[5]

The experiment was programmed in z-Tree (Fischbacher, 2007) and conducted at the University of Hamburg Experimental Laboratory between April and July 2014. The University of Hamburg uses the HROOT software by Bock et al. (2014) to recruit subjects. A session lasted about 90 minutes and 2 - 3 matching groups (16 - 24 subjects) participated in a session. Before an experimental session was started each subject had to read a set of instructions which explained the consequences of each possible choice in the experiment in detail.[6] At the end of the instructions there was a set of exercises in which participants had to execute a series of payoff calculations for different scenarios that could potentially have arisen during the experiment. The experiment was not started before each subject had correctly solved all exercises.

At the end of the 20 periods two periods were randomly chosen for payment. We converted experimental points to Euro at an exchange rate of 100 points = 2.5 Euro. Subjects received a fixed show-up fee of 5 Euro. On average subjects received a payment of EUR 15.78.[7]

Between the end of the experiment and the payment phase, subjects had to complete a post-experimental questionnaire in which we elicited demographics and some information on what participants thought about their own behavior and the behavior of others during the experiment.

2.4 Discussion of the Experiment Design

Our aim is to study the role of moral constraints an social norms in mitigating strategic mortgage default across economic conditions. A default by a household may impose two types of social costs: First, the lender suffers a financial loss proportionate to the private benefit of default for the borrower. The lenders loss will depend on the outstanding loan amount and the amount potentially recovered through bankruptcy or foreclosure proceedings.[8] Second, a

[5] In principle, it would have been possible to provide the same information in the partial and full information conditions. However, we decided not to give separate punishment information for fundamental and strategic defaults in the partial information conditions, because any difference between these two numbers would have been random (as enforcers could not distinguish between the two cases when they assigned punishment points) and could have misled participants to false conclusions.

[6] An English translation of the originally German instructions is available from the authors upon request.

[7] The average hourly wage of a student subject in Germany is about EUR 10.

[8] The loss to the lender will typically exceed the private benefit to the borrower due to the substantial costs of the loan recovery process. The World Bank "Doing Business" database documents that the recovery rate on a private claim secured by a mortgage is on average 72% in OECD economies while the resolvement of the claim through a bankruptcy process takes on average 1.7 years. See http://www.doingbusiness.org/data/exploretopics/resolving-insolvency for details.

mortgage default may impose costs on other households not part to the loan contract. Foreclosures associated with mortgage defaults may trigger substantial price declines for owners of nearby properties due to both an increase in local housing supply as well as to the disamenity of being located close to ill-maintained property (Anenberg and Kung, 2013; Hartley, 2010). In addition, existing and potential borrowers may face higher costs of credit as lenders raise interest spreads to account for increased local credit risk.

The social costs suffered by the lender and/or other households will give rise to moral contraints on the part of some borrowers which may restrain them from defaulting strategically. Motivated by concerns about reciprocity (Bolton and Ockenfels, 2000; Dufwenberg and Kirchsteiger, 2004), guilt aversion (Dufwenberg and Gneezy, 2000; Battigalli and Dufwenberg, 2007), or inequity aversion (Fehr and Schmidt, 1999) the household may incur a personal, non-monetary cost from defaulting. Moreover, as a default imposes negative externalities on others a household which defaults strategically may be sanctioned by its peers. In particular, a strategic defaulter violates the norm by which households are expected to repay their debts. This norm may be enforced either because a default imposes a loss on the lender, or because it imposes a loss on society in general.

In this experiment we focus on the social aspect of strategic default. We study the role of moral constraints and social norms in mitigating strategic default, because such defaults may impose costs on other households. We hereby purposely abstract from the negative impact of defaults on the lenders profits. We thus do not consider the role of social norms when the costs of default are borne primarily be the lender, while they have little effect on other households.[9]

The prisoner's dilemma underlying our experiment captures the negative externality of strategic defaults on other households in a simple and parsimonious way. In our prisoner's dilemma game, the social cost of a default is imposed directly to the other player in reducing his income by 150 points. Evidence from public goods experiments highlights that cooperation is independent from group size if the benefit from cooperation is held constant (Isaac and Walker, 1988; Isaac et al., 1994). Hence, we decided to use a minimal group design to facilitate the game and increase the salience of the social cost to subjects.

We add an element of uncertainty to the standard prisoner's dilemma game. This not only allows us to vary the state of the economy in a straightforward and transparent manner, but also introduces the realistic feature that borrowers can hide their opportunistic actions behind potential economic hardship. Consistent with this line of reasoning, Xiao and Kunreuther

[9]See e.g. Brown and Zehnder (2007) for an experimental analysis of reciprocity in trust-games which capture the pure interaction between a lender and borrower. Fehr and Rockenbach (2003) and Charness et al. (2008) study the role of social norms (as captured by 2nd party or 3rd party punishment) in such a setting

(2015), Ambrus and Greiner (2012) and Grechenig et al. (2010) highlight that opportunistic behavior is more likely to occur if payoffs are uncertain and information is asymmetric.

Social norms are defined as commonly held beliefs about how individuals in a group should behave in specific situations. Importantly, for social norms to be maintained (some) individual members must be willing to sanction non-conforming behavior even if this is costly (Fehr and Gächter, 2002; Fehr et al., 2002). To study social norm enforcement we allow for costly third-party punishment in our partial and full information conditions (Homans, 1950). The punishment patterns displayed by enforcers who are not party to the prisoners dilemma game enable us to directly measure the strength of social norms to repay (see also the literature on strong or social reciprocity Gintis, 2000; Fehr et al., 2002; Gintis et al., 2003; Carpenter et al., 2004). It has been shown that punishment executed by third-party enforcers is substantially weaker than punishment by directly affected second-party enforcers (Fehr and Fischbacher, 2004). We chose to rely on third parties, because observed punishment behavior of involved second-parties is not a clean measure of social norm violations. The reason is that second-parties have strategic reasons to engage in punishment, because they themselves directly benefit from a high repayment rate. A third-party enforcer has no such motives.

To explore under which informational conditions the social norms to repay are more or less likely to collapse in economic downturns, we vary the information the enforcer receives about borrower's actions in our design. In the partial information conditions an enforcer can only infer from the underlying probability of fundamental default, whether or not an observed default was actually strategic in nature. In this condition enforcers face the risk of punishing 'innocent' borrowers who had to default. In the full information conditions, by contrast, enforcers are fully aware of the intentions of defaulting borrowers and can take this into account when deciding whether to punish or not. The comparison of these conditions allows us to explore the role of information for social norm enforcement in a very clean and simple way. In particular, we will be able to see whether adverse economic conditions affects the social norm itself or only the strength with which the norm is enforced. While our extreme information conditions are designed to provide clean experimental measures and not to be fully transferable to reality, they nevertheless approach certain real-life environments. The partial information situation mirrors environments outside the laboratory in which anonymity of economic actors is prevailing, e.g., large cities. The full information conditions, in contrast, approach situations in which the economic conditions of households are more transparent, e.g., small villages.

3 Predictions and Hypotheses

In this section we provide predictions based on a formal analysis of the game underlying our experiment. As a benchmark, we first provide the prediction of the self-interest model assuming that all borrowers and enforcers maximize their monetary payoff. We then explore the implications of a richer model in which borrowers are characterized by heterogeneous moral concerns and enforcers exhibit heterogeneous aversions against violations of social norms.

3.1 Notation

To simplify the exposition of our formal analysis we first clarify some notational details. We consider a game in which a borrower i interacts with another randomly drawn borrower j. Table 3 declares the symbols that we use to describe the payoffs associated with all possible strategy combinations in the simultaneous game that the borrowers play:

Table 3: Notation

			Borrower j	
		Repay (r)	Strat. Default (s)	Fund. Default (f)
	Repay (r)	R,R	L,W	L,w
Borrower i	Strat. Default (s)	W,L	D,D	D,d
	Fund. default (f)	w,L	d,D	d,d

Notes: A borrower's payoff depends on his or her own decision, the other borrower's decision and nature (exogenous income assignment). R (300) is the payoff if both borrowers repay. W (400) stands for the payoff from strategic default if the other borrower repays. D (250) is the payoff from strategic default if the other borrower also defaults (strategically or fundamentally). L (150) is the payoff from repayment if the other borrower defaults (strategically or fundamentally). w (200) and d (50) are the payoffs from fundamental default depending on whether the other borrower repays or defaults (strategically or fundamentally).

where $W > R > D > w > L > d > 0$. We use $\Delta = R - L = W - D$ to describe the negative externality of a borrower i's default on borrower j's payoff. The probability that a borrower has sufficient income to repay her loan is denoted by γ. Weak economic conditions are represented by a lower γ, which corresponds to a higher fundamental default rate $(1-\gamma)$. We use γ_{SE} and γ_{WE} to distinguish between the strong (SE) and the weak economy (WE).

When analysing the partial information and full information conditions we also consider a third-party enforcer k. The enforcer receives a fixed endowment E and his or her payoff is not affected by the decisions of the borrowers. However, the enforcer can induce a costly punishment for each of the two borrowers separately. For simplification, we assume that punishing a borrower is a binary decision. Punishment reduces the borrower's payoff by P and imposes a cost $\kappa < P$ on the enforcer.

3.2 The self-interest model

If all borrowers and enforcers are pure payoff-maximizers, the predictions for our experiment are straightforward: In the absence of enforcers, borrowers never repay, because conditional on having a positive income repaying is a dominated strategy for both players ($W > R$ and $D > L$). The presence of enforcers does not alter this prediction. Costly punishment implies that self-interested enforcers will never engage in punishment, so that borrowers have no incentive to repay even if enforcers are present. This yields the following prediction:

Self-interest hypothesis: *All borrowers always default in all treatments. In treatments with enforcers punishment never occurs.*

3.3 Moral constraints

Previous research has piled up evidence documenting that many people are not only concerned with their own material outcomes but also care about the social implications of their own and others' decisions (for surveys of the relevant literature see, e.g., Fehr and Schmidt, 2003; Camerer, 2003). Building on insights of this earlier research we assume that borrowers' utility function has the following form:

$$U_i = (1 - \delta_i(c_i))\pi_i,$$

where π_i is borrower i's payoff, $c_i \in \{r, s\}$ is borrower i's choice to repay (r) or default (s) and δ is a term which is equal to zero if the borrower repays ($\delta_i(r) = 0$) and positive if the borrower defaults ($0 < \delta_i(s) < 1$). The δ function captures the intuition that strategically defaulting borrowers experience a moral cost (the borrowers utility is decreased by $\delta_i(s)\pi_i$). We model the moral cost as proportional to the borrower's payoff, so that the utility loss from strategic default is largest if the other borrower repays ($\delta_i(s)W > \delta_i(s)D$).[10] We assume that $\delta_i(s)$ is borrower specific and characterized by a continuously differentiable distribution

[10] Alternatively, we could also have included an explicit moral cost function in the model. In particular, we could have formalized the borrower's utility as $U_i = \pi_i - k_i(c_i, c_j)$, where $k_i(r, c_j) = 0$ and $k_i(s, r) > k_i(s, d) = k_i(s, f) > 0$. While such a model leads to identical results, it requires additional assumptions and complicates notation considerably.

function $F(\cdot)$ with support $[\delta_{min}, \delta_{max}]$, where $0 < \delta_{min} < 1 - \frac{R}{W}$ and $1 - \frac{L}{D} < \delta_{max} < 1$.

Lemma 1 shows that these assumptions imply the existence of three different types of borrower behavior:

Lemma 1 (Types of borrower behavior)**.** *Heterogeneity in moral concerns leads to three different types of borrower behavior (in the absence of enforcers):*

- *Type 1: Unconditional repayments*
  Borrowers with strong moral concerns ($\delta_i(s) > 1 - \frac{L}{D}$) repay whenever they have a positive income, irrespective of the repayment behavior of other borrowers.

- *Type 2: Conditional repayments*
  Borrowers with intermediate moral concerns and a positive income are willing to repay their loan if they believe that there is a sufficiently large probability that other borrowers repay as well. In particular, a borrower with $\delta_i(s) \in [1-\frac{R}{W}, 1-\frac{L}{D}]$ repays if the probability that other borrowers with a positive income repay is at least equal to $\frac{(1-\delta_i(s))D-L}{\gamma\delta_i(s)\Delta}$.

- *Type 3: Unconditional defaults*
  Borrowers with weak moral concerns ($\delta_i(s) < 1 - \frac{R}{W}$) never repay their loan irrespective of the repayment probability of other borrowers.

Proof. See Appendix. □

The behavior of borrowers with either weak or strong moral concerns is independent of the state of the economy. Borrowers with strong moral concerns (Type 1) repay whenever their income allows them to do so and borrowers with weak moral concerns (Type 3) never repay independently of their income. For the behavior of borrowers with intermediate moral concerns (Type 2), in contrast, the state of the economy is of relevance. An economic downturn corresponds to an increase in the fundamental default rate. For a given fraction of borrowers who are willing to repay, an increase in the fundamental default rate decreases the fraction of actually repaying borrowers and therewith reduces the motivation of conditional cooperators to repay their loans. Borrowers who repay conditionally are willing to repay as long as the expected utility from repaying is at least as large as the expected utility from strategically defaulting. Suppose that borrowers believe that all borrowers with $\delta_i(s) > \bar{\delta}$ repay their loan whenever they can. Given this belief borrower i repays if the following condition is satisfied:

$$U_i(r) = L + \gamma(1 - F(\bar{\delta}))\Delta \geq (1 - \delta_i(s))(D + \gamma(1 - F(\bar{\delta}))\Delta) = U_i(s).$$

The condition is intuitive: The stronger the borrower's moral concerns (i.e., the higher $\delta_i(s)$), the more likely it is that she is willing to cooperate given a certain fraction of other borrowers who repay when they can $(1 - F(\bar{\delta}))$.

Before we turn to the analysis of equilibrium repayment behavior, we introduce an additional assumption:

Assumption 1 (Distribution of borrowers' moral concerns)**.** *The distribution $F(\delta)$ fulfills the following property: If $(1-\delta')D-L < \delta'(1-F(\delta'))\gamma\Delta$, then $(1-\delta'')D-L < \delta''(1-F(\delta''))\gamma\Delta$, $\forall \delta'' > \delta'$.*

Assumption 1 is technical in nature and guarantees uniqueness of equilibrium. The assumption holds for a wide variety of distributions (including uniform distributions, heavily positively skewed distributions, heavily negatively skewed distributions and many symmetric distributions). Excluded are distributions which put almost all the probability weight on values of δ that approach $1 - \frac{L}{D}$ from below. We provide a detailed justification for Assumption 1 in the Appendix.

Proposition 1 characterizes the unique equilibrium in the absence of enforcers as a function of the state of the economy (represented by γ, the probability that a borrower's income is sufficient to repay her loan):

Proposition 1 (Equilibrium without enforcers)**.** *In the absence of enforcers the fraction of repaying borrowers in equilibrium is $1 - F(\delta_N^*(\gamma))$, where $\delta_N^*(\gamma)$ is implicitly defined by the condition:*

$$L + \gamma(1 - F(\delta_N^*))\Delta = (1 - \delta_N^*)(D + \gamma(1 - F(\delta_N^*))\Delta).$$

$\delta_N^*(\gamma)$ is unique and strictly decreasing in γ so that that the fraction of repaying borrowers is strictly higher in the strong economy than in the weak economy: $\delta_N^*(\gamma_{SE}) < \delta_N^*(\gamma_{WE})$.

Proposition 1 formalizes the following intuition: In an economic downturn fundamental defaults become more likely and (conditionally cooperating) borrowers interact more frequently with defaulting borrowers. This reduces the (expected) moral cost of a strategic default, because the negative externality of the default is now more likely to hit other defaulters. The decrease in the (expected) moral cost makes strategic defaults more likely. In equilibrium the negative effect on repayments is further reinforced by the fact that the increase in strategic defaults also motivates conditionally repaying borrowers with stronger moral concerns to refrain from repaying. Thus, in the absence of norm enforcers a negative economic shock unambiguously increases the strategic default rate.

3.4 Social Norm Enforcement

Next we consider the behavior of third-party enforcers. The previous literature on norm enforcement through third-party punishment suggests that some unaffected third-parties are willing to intervene if they observe violations of social norms (see section 2.4 for details). We model the enforcer's motive using the following utility function:

$$U_k = (1 - \phi_k(c_i, p_{ki}) - \phi_k(c_j, p_{kj}))E_k - (p_{ki} + p_{kj})\kappa,$$

where $p_{ki}, p_{ki} \in \{0, 1\}$ are the enforcer's punishment decisions regarding borrowers i and j, and ϕ is a factor that is equal to zero if the borrower has either not violated the social norm or has been punished for his violation ($\phi_k(r, 0) = \phi_k(s, 1) = 0$) and positive otherwise ($0 < \phi_k(s, 0) \leq \phi_k(r, 1) < 0.5$). This function captures the intuition that enforcers may experience a utility loss if they either observe a violation of the social norm to repay without sanctioning the borrower for his behavior or if they punish a borrower without reason. We hypothesize that the disutility created by an unsanctioned violation of the norm is at least as large as the one caused by unjustifed punishment. For expositional simplicity, we model the two disutilities as linearly correlated: $\phi_k(r, 1) = \beta\phi_k(s, 0)$, where $\beta \leq 1$. We further assume that $\phi_k(s, 0)$ is enforcer specific and characterized by a continuously differentiable distribution function $G(\cdot)$ with support $[\phi_{min}, \phi_{max}]$, where $0 < \phi_{min} < \phi_{max} \leq 0.5$.

Lemma 2 (Observer behavior)**.** *An enforcer k punishes a borrower i if and only if his belief b_{ki} that the borrower engaged in strategic default satisfies the following condition:*

$$b_{ki} \geq \frac{\beta\phi_k(s, 0)E + \kappa}{(1 + \beta)\phi(s, 0)E}.$$

This implies that—for a given belief b_{ki}—the probability that a borrower i is punished amounts to

$$\rho(b_{ki}) = Prob(p_{ki} = 1|b_{ki}) = 1 - G\left(\frac{\kappa}{((1 + \beta)b_{ki} - \beta)E}\right).$$

$\rho(b_{ki})$ is strictly increasing in b_{ki}.

Lemma 2 shows that enforcers are willing to punish a borrower only if they are sure enough that the borrower engaged in strategic default. This is intuitive, because punishment is costly and only increases utility if the enforcer punishes a borrower who violated the social norm to repay.

Next we consider the effect of enforcers on equilibrium repayment behavior both under partial and full information. Doing so requires an additional assumption:

Assumption 2 (Distributions of borrowers' and enforcers' moral concerns)**.** *The distributions $F(\delta)$ and $G(\phi)$ jointly fulfill the following property: If* $(1-\delta')\left(D-\left(1-G(\phi^T)\right)P\right)-L<\delta'(1-F(\delta'))\gamma\Delta$*, then* $(1-\delta'')\left(D-\left(1-G(\phi^T)\right)P\right)-L<\delta''(1-F(\delta''))\gamma\Delta$*, $\forall\delta''>\delta'$, where*

a) ϕ^T is equal to $\frac{\kappa}{((1+\beta)\gamma F(\delta)(1-\gamma(1-F(\delta))^{-1}-\beta)E}$ under partial information.

b) ϕ^T is equal to $\frac{\kappa}{E}$ under full information.

Assumption 2 is the equivalent of Assumption 1 for the case with enforcers present. The assumption restricts the set of admissible distributions so that uniqueness of equilibrium is guaranteed. Please see the Appendix for further discussion.

We first consider how the presence of partially informed enforcers affects borrower behavior. Proposition 2 characterizes the unique equilibrium of the game with partial information as a function of the state of the economy:

Proposition 2 (Equilibrium with partially informed enforcers)**.** *In the presence of partially informed enforcers the fraction of repaying borrowers in equilibrium is $1-F(\delta_P^*(\gamma))$, where $\delta_P^*(\gamma)$ is implicitly defined by the condition:*

$$L+\gamma(1-F(\delta_P^*))\Delta=(1-\delta_P^*)\left(D-\left(1-G\left(\frac{\kappa}{((1+\beta)b^*-\beta)E}\right)\right)P+\gamma(1-F(\delta_P^*))\Delta\right),$$

where $b^*=\frac{\gamma F(\delta_P^*)}{1-\gamma(1-F(\delta_P^*))}$. $\delta_P^*(\gamma)$ is unique and strictly decreasing in γ so that the fraction of repaying borrowers is strictly higher in the strong economy than in the weak economy: $\delta_P^*(\gamma_{SE})<\delta_P^*(\gamma_{WE})$.

Proposition 2 illustrates how the presence of partially informed enforcers changes borrowers' incentives. The most striking difference to the previously discussed case without enforcers is that borrowers now face a threat of punishment. Enforcers with a strong preference for norm enforcement (i.e., a high $\phi_k(0,s)$) are willing to punish defaulting borrowers even if they are only partially informed (see Lemma 2). This positive punishment probability lowers the expected utility of a strategic default and therefore motivates borrowers to repay. The positive impact of punishment is somewhat mitigated by the equilibrium effect that an increase in the fraction of repaying borrowers reduces the punishment probability (because a higher repayment rate lowers the belief that an observed default is strategic). An economic downturn has a negative impact on the cooperation rate also in the presence of a partially informed enforcer. In this case an increase in the fundamental default rate not only has a negative impact on repayment behavior (see Proposition 1), but also reduces the threat of punishment (because the belief that an observed default is strategic is decreasing in γ).

Finally, we turn to the impact of fully informed enforcers on borrower behavior. Proposition 3 describes the unique equilibrium with full information as a function of the state of the economy.

Proposition 3 (Equilibrium with fully informed enforcers). *In the presence of fully informed enforcers the fraction of repaying borrowers in equilibrium is* $1 - F(\delta_F^*(\gamma))$*, where* $\delta_F^*(\gamma)$ *is implicitly defined by the condition:*

$$L + \gamma(1 - F(\delta_F^*))\Delta = (1 - \delta_F^*) \left(D - \left(1 - G\left(\frac{\kappa}{E}\right)\right) P + \gamma(1 - F(\delta_F^*))\Delta \right).$$

$\delta_F^*(\gamma)$ *is unique and strictly decreasing in* γ *so that the fraction of repaying borrowers is strictly higher in the strong economy than in the weak economy:* $\delta_F^*(\gamma_{SE}) \leq \delta_F^*(\gamma_{WE})$.

Proposition 3 reveals how an improvement in enforcers' information affects borrowers' repayment behavior. The big difference to the situation with partially informed enforcers is that fully informed enforcers can cleanly distinguish between strategic and fundamental defaults. This information advantage strongly increases the punishment threat, in particular in the weak economy where enforcers have a hard time identifying strategic defaults and are therefore reluctant to punish under partial information.

3.5 Testable Hypotheses

Propositions 1 - 3 allow us to formulate a number of directly testable hypotheses that will help us to organize the presentation of our results.

Hypothesis 1 (Effect of economic conditions with no enforcers). *In the no enforcers conditions the strategic default rate is higher in the weak economy treatment than in the strong economy treatment.*

Hypothesis 1 is directly implied by Proposition 1. An increase in the fundamental default rate decreases the moral cost of strategic default, because it becomes less likely that the negative externalities hurt repaying borrowers. This effect is reinforced in equilibrium, because emerging strategic defaults further lower moral costs.

Hypothesis 2 (Effect of economic conditions with partially informed enforcers). *Defaults will be punished in both the strong and the weak economy, but more harshly so in the strong economy. The strategic default rate is higher in the weak economy than in the strong economy. Expected punishment by partially informed enforcers reduces the strategic default rate in both the strong and the weak economy. It is, however, ambiguous whether the difference in strategic* *default rate between weak and strong economy is smaller or larger than in the absence of enforcers.*

Lemma 2 implies that enforcers are willing to punish defaulting borrowers if the expected disutility from observing an unpunished norm violation outweighs both the monetary cost of punishing the wrongdoer and the risk of harming an innocent borrower. In the strong economy fundamental defaults are rare and therefore even partially informed enforcers can be rather certain that an observed default is the consequence of a borrower's strategic decision. Thus, enforcers are likely to punish defaulters even if their disutility from observing a norm violation is moderate. Since many enforcers will punish defaulting borrowers, strategic defaulters should expect substantial punishments that considerably reduce the monetary benefit of a strategic default. In the weak economy, in contrast, fundamental defaults are frequent and therefore partially informed enforcers know little about the underlying reason of a default. As a consequence, enforcers will be more reluctant to punish defaulting borrowers (because the disutility from observing a norm violation is discounted with the low probability that an observed default is actually strategic in nature). This implies that in the weak economy only enforcers who experience a large disutility when observing a norm violation will punish. Accordingly, strategic defaulters should expect only moderate punishments so that the monetary benefit of a strategic default will be reduced less in the weak economy than in the strong economy.

However, it is important to notice that we cannot make a clear prediction about whether the impact of norm enforcement by partially informed enforcers on strategic default will be more pronounced in the strong or the weak economy. This depends on how strong the disciplining effect of moral costs is in the absence of enforcers and on the distribution of types in the borrower population. For example, if in the strong economy most conditional cooperators are already repaying in the absence of enforcers and the fraction of selfish borrowers is small, even a powerful punishment threat will only have a limited impact on the strategic default rate. It is therefore possible that the weaker punishment threat in the weak economy has a similar-sized or even larger effect, simply because there is much more room for improvement.

Hypothesis 3 (Effect of economic conditions with fully informed enforcers)**.** *In the strong economy full information as opposed to partial information for enforcers will only have a weak impact on punishment behavior. In the weak economy, in contrast, transparency will increase the punishment of strategic defaulters substantially. We therefore expect the strategic default rate in the weak economy to drop significantly. The difference in the strategic default rate in the WE and SE is lower than under no enforcers or partial information.*

In the strong economy even partially informed enforcers can be rather certain that observed defaults are strategic in nature. Adding additional transparency should therefore not affect the expected punishment of strategic defaulters much. As a consequence we expect only a small impact on the strategic default rate. In the weak economy the situation is very different. Here partially informed enforcers know little about the underlying reason for an observed default and are therefore reluctant to punish. Additional transparency that allows enforcers to clearly distinguish between fundamental and strategic defaults will therefore make a big difference in this case. In particular, we expect that strategic defaulters in the weak economy receive substantially more punishment under full information than under partial information. The lower monetary benefit from a strategic default under full information should motivate additional borrowers in the weak economy to refrain from engaging in strategic default so that we expect a substantial reduction in the strategic default rate.

4 Results

In total 640 subjects (undergraduate students and graduate students from the University of Hamburg) participated in 29 sessions of the experiment. About 54% of the subjects were female. The average subject was 24 years old. For each of the six treatments we observe 10 independent matching groups. As there are 8 borrowers in each matching group and the experiment lasts for 20 periods our data set consists of 160 borrower level-observations for each matching group. The number of borrower decisions varies across treatments due to varying economic conditions and thus instances in which borrowers can decide whether to repay or not. In the partial and full information conditions we observe 80 punishment decisions by enforcers for each matching group.

In section 4.1 we present our main results by comparing our variables of interest across treatments. In section 4.2 we examine individual subject behavior in order to study the underlying behavioral determinants of our cross-treatment findings.

4.1 Treatment Effects

Table 4 presents descriptive statistics of our variables of interest, separately for each of the six treatments. The *Strategic Default Rate* is our main variable of interest.[11] It measures the relative frequency with which borrowers decided to default strategically although they

[11]The *Fundamental Default Rate* depicts the frequency with which borrowers did not receive an income. This variable is designed to be 0.5 in the weak economy and 0.1 in the strong economy (the small observed departures from these values are a consequence of the fact that incomes were randomly assigned in the experiment).

had sufficient income to repay. The table also displays punishment patterns in the partial and full information treatments. As enforcers in the partial information condition cannot distinguish between fundamental and strategic defaults, we report average punishment for defaults irrespective of the type of default for this treatment (*Punishment if Default*). In the full information condition, in contrast, enforcers know what type of default they observe and therefore we report average punishment for fundamental (*Punishment if Fundamental*) and strategic defaults (*Punishment if Strategic*) separately. For completeness we also list average punishments in case of repayment (*Punishment if Repay*).

Table 4: Summary Statistics by Treatment

	no enforcer		partial info		full info	
	WE	SE	WE	SE	WE	SE
Fundamental Default Rate	0.485	0.094	0.491	0.106	0.507	0.079
	(1600)	(1600)	(1600)	(1600)	(1600)	(1600)
Strategic Default Rate	0.675	0.548	0.570	0.526	0.478	0.467
	(824)	(1450)	(814)	(1430)	(788)	(1473)
Punishment if Default			36.59	58.96		
			(1250)	(922)		
Punishment if Fundamental					3.23	13.54
					(812)	(127)
Punishment if Strategic					55.60	63.76
					(377)	(688)
Punishment if Repay			7.77	9.87	2.85	15.58
			(350)	(678)	(411)	(785)

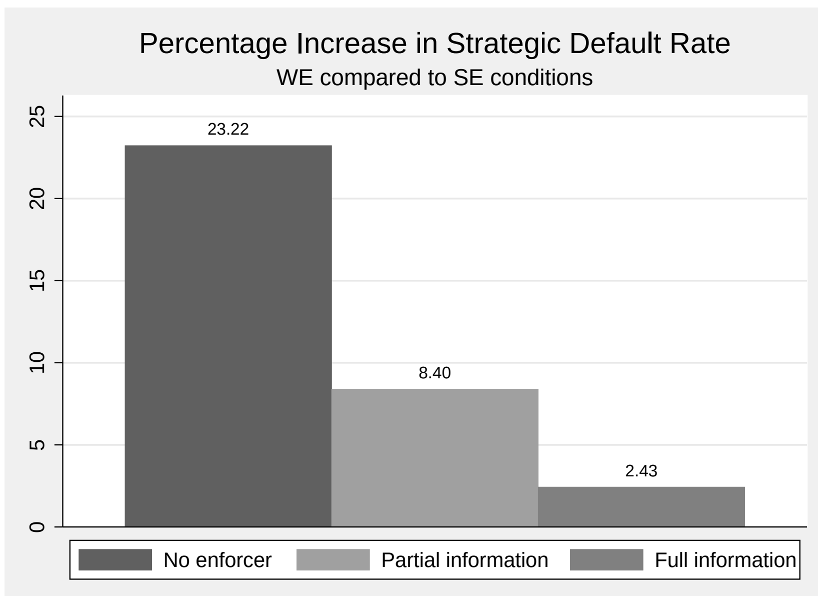
Notes: The table provides summary statistics of experimental results showing means of variables with number of observations in parentheses. *Fundamental Default Rate* shows the relative frequency of cases in which borrowers who did not have an income to repay their credits. *Strategic Default Rate* depicts the relative frequency with which borrowers chose not to repay although the had sufficient income to do so. *Punishment if Default* shows average punishment in case of a default. This variable does not distinguish between fundamental and strategic defaults. *Punishment if Fundamental* and *Punishment if Strategic* reveals average punishment of fundamentally defaulting or strategically defaulting borrowers. *Punishment if Repay* shows average punishment attributed to repaying borrowers.

Our objective is to explore the role of moral constraints and social norms in preventing strategic default across economic conditions. Our main outcome of interest is thus the difference in the strategic default rate between the weak and strong economy and how this difference varies across information conditions. Figure 1 shows the percentage increase in the strategic default rate in the weak economy relative to the strong economy by information conditions.

We first consider the no enforcer conditions, in which by design third-party norm enforcement cannot restrain strategic default. In this treatment the increase in the fundamental default rate (50% in WE, 10% in SE) is associated with a substantial increase in the strategic default rate. Table 4 reveals that the strategic default rate increases from 54.8% (SE no enforcer) to 67.5% (WE no enforcer). This corresponds to an increase of 23.2% (12.7 percentage points) as presented in Figure 1. One-sided ranksum tests indicate that this difference is significant (Individuals (I): N=160, $p<0.01$ / Matching Groups (MG): N=20, $p=0.06$).[12] We summarize this finding as our first result:

Result 1 (Effect of weak economic conditions with no enforcers)**.** *In the absence of third-party norm-enforcement the fundamental default rate has a large impact on the strategic default rate. The strategic default rate increases by 23% in the weak economy as compared to the strong economy.*

Figure 1: Strategic Default Rate



Notes: The figure shows the percentage increase in the strategic default rate resulting from an exogenous increase in the fundamental default rate (50% in the WE as opposed to 10% in the WE). Each bar represents one of the three information conditions (no enforcers, partial information and full information).

Result 1 is consistent with Hypothesis 1 and our predictions presented in section 3.3. There we argue that morally constrained borrowers face a trade-off between the monetary benefit of not repaying their loan and the moral cost of a socially harmful, strategic default.

[12] We always report non-parametric tests using two different types of observations. The conservative testing method uses each matching group (i.e., all decisions of 8 individuals) as just one observation. The assumption that all observations within a matching group are dependent is overly restrictive (e.g., observations in the first period cannot be dependent) and the procedure implies that we only have 10 independent observations per treatment. A more powerful but statistically less pure approach is to consider each person as an independent observation. This procedure takes into account that decisions of the same person are dependent, but ignores the fact that there may be dependencies across people within matching groups. We see reporting both types of tests as a balanced approach.

An economic downturn changes this trade–off, because the presence of more defaulters in the borrower population lowers the moral cost of a strategic default. The intuition is that borrowers feel less bad about the social cost they impose on society if they can safely assume that their strategic default most likely hurts others who defaulted themselves. This effect leads to a downward spiral towards a newly emerging equilibrium in which most borrowers act opportunistically and only borrowers with very strong moral concerns are willing to repay their loans.

Next, we consider the effect of a weak economy vs. a strong economy in our partial information conditions (WE partial information vs. SE partial information). Figure 1 reveals that the negative impact of an adverse economic shock on the strategic default rate is substantially mitigated in the presence of partially informed enforcers. Table 4 shows that the strategic default rate increases from 52.6% in the partial information WE condition to 57.0% in the partial information SE condition. This is an increase of "only" 8.4%. Statistically, this increase is no longer significant (one sided ranksum test: I: N=160; p=0.22 /M: N=20; p=0.22).

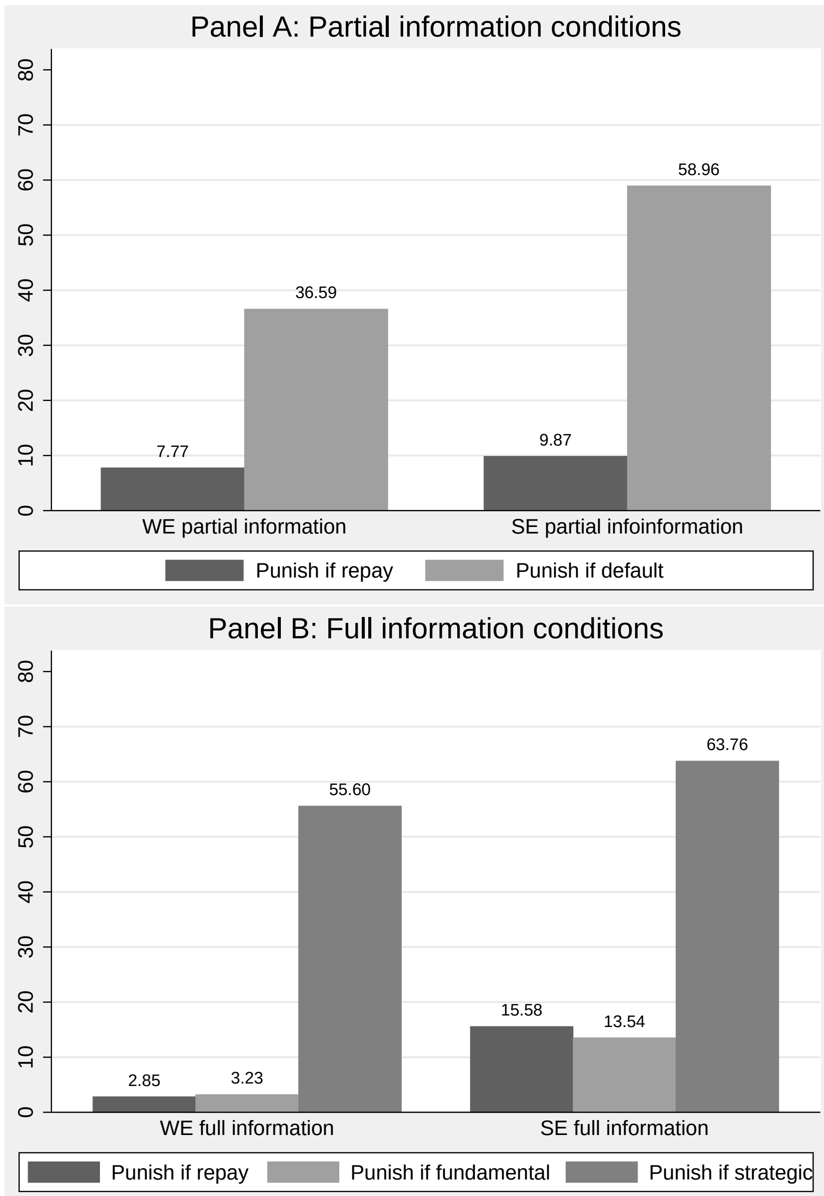
A separate analysis of the impact of the partially informed enforcers in the strong and the weak economy shows that the overall effect is mostly driven by a change in borrowers' repayment behavior in the weak economy. Table 4 reveals that the presence of partially informed enforcers causes only a small and non–significant reduction in the strategic default rate in the strong economy (from 54.8% in the SE no enforcer condition to 52.6% in the SE partial information condition, one sided ranksum test: I: N=160; p=0.4/M: N=20; p=0.46). In the weak economy, in contrast, we observe a much larger and significant reduction in the strategic default rate (from 67.5% in the WE no enforcer condition to 57.0% in the WE partial information condition, one sided ranksum test: I: N=160; p<0.01/M: N=20; p=0.09).

To understand how the presence of partially informed enforcers affects the impact of an economic downturn on strategic default, it is informative to examine observed punishment patterns in the strong and the weak economy. As enforcers in the partial information conditions cannot distinguish between fundamental and strategic defaults, we analyze punishments of defaults in general. Panel A of Figure 2 displays the enforcers' average punishment conditional on whether the borrower repays or defaults. The figure shows that partially informed enforcers punish defaulters significantly more harshly in the strong economy (average punishment of 58.96 points) than in the weak economy (average punishment of 36.59 points, one-sided ranksum test: I: N:80; p=0.05/M: N=20; p=0.06).[13] The punishment for defaults

[13]Evidence that enforcers do not punish randomly but rather enforce a social repayment norm is given by comparing the mean punishment levels for repaying and defaulting borrowers. In the WE partial information treatment, enforcer punish borrowers who repay on average with about 7.77 points. Defaults are punished

implemented by enforcers reduces the incentive to default strategically. Relative to the situation without punishment, defaulting now not only entails a moral cost, but also triggers material punishment with positive probability.

Figure 2: Average Punishment in Partial Information and Full Information Conditions



Notes: **Panel A:** Average punishment of repayments and defaults in the partial information conditions. **Panel B:** Average punishment of repayments, fundamental defaults and strategic defaults in the full information conditions.

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with an average of about 36.59 points. This difference is significant at the 1% level as a one sided signrank test shows (I: N=40; p<0.01/M: N=10; p<0.01). We observe the same punishment pattern in the SE partial information treatment. Repayments are punished with an average of 9.86 points and defaults are punished with an average of 58.96 points. This difference is also significant at the 1% level (one sided signrank test: I: N=40; p<0.01/M: N=10; p<0.01).

We summarize these findings as our second result:

Result 2 (Effect of weak economic conditions with partially informed enforcers)**.** *Partially informed enforcers are more reluctant to punish defaulters in the weak economy than in the strong economy. Nevertheless, the threat of punishment is still powerful enough to mitigate the strategic default rate. With partially informed enforcers the strategic default rate in the weak economy is only 8.4% higher than in the strong economy.*

Result 2 corroborates the theoretical arguments behind our Hypothesis 2. The fact that partially informed enforcers are reluctant to punish in the weak economy is consistent with our assumption that enforcers experience a disutility if they wrongfully punish an innocent borrower (i.e., a borrower who defaulted fundamentally instead of strategically). In the weak economy there is an increased uncertainty about the nature of an observed default so that the likelihood of mistakenly punishing a fundamental default is amplified.

As discussed in section 3.5, the finding that the presence of partially informed enforcers has a stronger impact on the strategic default rate in the weak economy, although enforcers punish less harshly, is not entirely surprising. The effectiveness of punishment in a particular state of the economy strongly depends on the distribution of types in the borrower population. Thus, whether punishment is more effective in the weak economy or in the strong economy is ex ante ambiguous. In our case, the result that punishment is more effective in reducing the strategic default rate in the weak economy suggests that the disciplining effect of moral constraints in the strong economy leaves little room for further improvements. In the strong economy many borrowers repay even in the absence of social norm enforcement, and the relatively strong punishment threat created by enforcers does not seem to motivate many additional borrowers to repay. This is different in the weak economy where there is more room for an impact of norm enforcement. Here even the relatively weak threat of punishment established by partially informed enforcers is sufficient to motivate borrowers with intermediate moral concerns who engage in strategic default in the absence of social norm enforcement to abstain from doing so.

We now turn to our full information conditions. Figure 1 illustrates that in the full information condition the weak economy only leads to an increase by 2.4% in the strategic default rate compared to the strong economy. The difference in the strategic default rate between the WE full information (47.8%) and the SE full information (46.7%) is small and statistically insignificant (one sided ranksum I: N=160; p=0.35/M: N=20; p=0.30). Thus, in our setup, norm enforcement through fully informed enforcers eliminates the negative impact of an economic downturn on the strategic default rate.

A more detailed analysis shows that it is again the weak economy in which fully informed enforcers have a big impact. When comparing to the partial information condition, the strategic default rate in the weak economy is reduced from 57% to 47.8% (see also Table 4). This constitutes a significant reduction of 16.2% (one sided ranksum test: I: N=160; p=0.01/M: N=20; p=0.085). If we compare the full information condition to the no enforcer condition the strategic default rate in the weak economy even drops from 67.5% to 47.8%. This implies a decline in strategic defaults of 29.2% (one sided ranksum test I: N=160; p<0.01/M: N=20; p=0.012). In the strong economy, the strategic default rate drops from 54.8% in the no enforcer treatment to 52.6% in the partial information treatment to 46.7% in the full information treatment. For the strong economy only the comparison of the no enforcer condition to the full information condition is significant (but only if the test uses individuals as observations: one sided ranksum test I: N=160; p= 0.04/ M: N=20; p=0.35).

An analysis of punishment patterns sheds more light on the forces underlying the effect of full information. Panel B of Figure 2 shows average punishment of fully informed enforcers conditional on the borrower's observed choice (repayment, strategic default, fundamental default). In the weak economy, enforcers assign on average 55.6 punishment points to strategic defaulters. These are 19 points more than the average punishment for defaulters in the corresponding partial information condition (see Panel A of Figure 2). This difference is marginally significant (one sided ranksum: I: N=80; p=0.16/M: N=20; p=0.06). In the strong economy the availability of full information has only a small impact. Fully informed enforcers assign on average 63.8 punishment points to strategic defaulters. This does not differ significantly from the average punishment points (58.9) assigned to defaulters in the strong economy of the partial information conditions (one sided ranksum test: I: N=57; p=0.25/M: N=20; p=0.24).[14]

We summarize the results of the full information condition in Result 3:

Result 3 (Effect of weak economic conditions with fully informed enforcers)**.** *In the presence of fully informed enforcers an economic downturn is no longer associated with a substantial increase in the strategic default rate. This result is a consequence of the fact that in the*

[14] As in the partial information conditions also the punishment pattern in the full information condition is very systematic. Figure 2 highlights that fully informed enforcers in the weak economy assign on average 55.60 punishment points to strategic defaults and only 2.85 points to borrowers who repay. This difference is significant at the 1% level (one sided signrank test: I: N=40; p<0.01/M: N=10; p<0.01). They assign an average of 3.2 points to borrowers if they fundamentally default. Again the difference to punishment of strategic defaults is significant (one sided signrank test: I: N=40; p<0.01/M: N=10; p<0.01). We observe the same pattern in the strong economy (SE full information). Here, enforcer assign an average of 63.76 points to borrowers who engage in strategic default. Repayments are punished on average with 15.58 points which is significantly lower than punishment of strategic default (one sided signrank test: I: N=40; p<0.01/M: N=10; p<0.01). Fundamental defaults are punished with 13.54 points. This is also a significant difference to the 63.76 points with which strategic defaults are punished (one sided signrank test: I: N=40; p<0.01/M: N=10; p<0.01).

weak economy fully informed enforcers punish strategic defaulter more harshly than partially informed enforcers. In fact, under full information there is no longer a difference in the punishment intensity with which strategic defaulters are sanctioned between the weak and the strong economy.

Result 3 provides support for our Hypothesis 3. In the weak economy condition the increase in the punishment of strategic defaulters under full information supports our earlier conjecture that the weak punishment under partial information is driven by enforcers' fear to accidentally punish innocent borrowers. Moreover, the similar punishment intensity for strategic defaulters in the weak and the strong economy under full information rules out the alternative explanation that enforcers simply punish less intensely, because they perceive strategic defaults as more acceptable in the weak economy. This is clearly not the case. Our results rather indicate that strategic default is equally (un)accepted in both economic conditions. This finding has important implications: The strong negative impact of an economic downturn on the strategic default rate does not seem to be the consequence of a breakdown of social norms under adverse economic conditions, but rather follows from the fact that the negative shock leads to inferior information conditions that cause norm enforcers to become more cautious.

Figure A.3 and Figure A.4 in the Appendix document that our main treatment effects are robust over the course of experiment. Figure A.3 displays the strategic default rates for five-period intervals of each of our treatments. Although there are time trends in some treatments, the distance between the strategic default rates in the weak and the strong economy tends to be large in the no enforcer conditions, intermediate in the partial information condition, and small in the full information condition. In fact, if ordered according to size, the three largest differences are the ones in periods 1 to 15 of the no enforcer conditions. Figure A.4 displays the mean punishment points assigned to defaulters (in the partial information conditions) and strategic defaulters (in the full information conditions) again for five-period intervals of our four treatments with enforcers. This figure confirms that throughout the experiment defaulters are punished more severely by partially informed enforcers in the strong than in the weak economy. By comparison the punishment of strategic defaulters in the full information conditions is more similar between the strong and weak economy.

Overall, the main treatment effects presented above imply that both individual moral constraints and externally enforced social norms influence borrowers repayment behavior across economic conditions. Our results suggest two mechanisms that help to explain why strategic default rates increase strongly when an economy is hit by a crisis: First, borrowers feel less obliged to repay in situations in which many other borrowers do not repay either (weaker moral constraints). Second, in adverse economic conditions peers have a hard time distinguishing between strategic and fundamental defaults and are therefore less likely to punish defaulters (weaker enforcement of social norms).

4.2 Individual Behavior within Treatments

In this section we examine individual subject behavior within our six treatments. We provide supporting evidence suggesting that the differences in outcomes across treatments are driven by the behavioral mechanisms postulated in our theoretical analysis. In section 3.3 we conjectured that a weak economy undermines moral constraints to repay because borrowers expect to interact more frequently with other defaulters. We would therefore expect that – in all treatments – borrowers are more likely to default strategically if they believe that a high share of other borrowers do so as well. In section 3.4 we conjectured that the presence of third-party enforcers in the partial information and full information conditions reduces strategic default because borrowers fear being punished by enforcers. We would therefore expect that borrowers are less likely to default strategically if they expect to be punished more strongly.

Our data does not include measures of borrowers' beliefs about the behavior of other subjects in their matching group. However, it is reasonable to assume that the post-period information shared with borrowers about matching group-level outcomes influences their beliefs about future behavior within their matching group. Specifically, a borrower who observes a high frequency of strategic default in her matching group in period 1 is likely to expect a high frequency of strategic default by other borrowers in period 2. Likewise, a borrower who observes a high level of punishment by enforcers for strategic default in period 1 is likely to expect a high level of punishment should she default strategically in period 2. The fact that post-period information at the matching group level is likely to influence beliefs of borrowers implies that we can study the behavioral mechanisms underlying our experiment by examining how variations in post-period information affects subsequent borrower behavior within treatments.

We examine borrower behavior at the individual level in Table 5. The table presents results from regressions where the dependent variable is a borrower's decision to default strategically. We relate borrower behavior in period t to the observed behavior for the borrower's matching group in period $t-1$.[15] All models include fixed-effects per borrower and for four period-intervals of the experiment. Standard errors are clustered at the matching group level.

[15] All regressions are limited to observations where borrowers receive an income and can therefore decide whether to repay or default strategically. Only observations from period 2 onwards are included.

Columns (1-2) of Table 5 present results for the no enforcer conditions. The estimates suggest that observing a higher strategic default rate in the matching group significantly increases the likelihood that a borrower engages in strategic default in the subsequent period. This effect is consistent with our predictions: The higher the overall default rate, the less bad borrowers feel about the social damage caused by their own strategic default. Thus, an upward update of a borrower's belief about the defaulting probability of others leads to less binding moral constraints and a higher propensity to default strategically. The magitude of the coefficients suggest strong a "contagion" effect among borrowers. Consider a borrower who repaid her loan in period 1: If the post-period information reveals that all other borrowers with incomes in period 1 defaulted our borrower is 22 percentage points (WE condition) to 35 percentage points (SE condition) more likely to default strategically in period 2 than if all other borrowers repaid in period 1.

Table 5: Fixed Effects Linear Probability Models: Individual Decisions to Strategic Default within Treatment

	no enforcer		partial info		full info	
DV: Strategic Default	WE	SE	WE	SE	WE	SE
Lagged SD Rate-Matching Group	0.222***	0.346***	0.0132	0.390***	0.104	0.377***
	(0.0653)	(0.0885)	(0.0870)	(0.0830)	(0.112)	(0.0925)
Lagged Punishment of Default/100-Matching Group			-0.154*	-0.0810***		
			(0.0751)	(0.0214)		
Lagged Punishment of SD/100-Matching Group					-0.0745	-0.0798***
					(0.0410)	(0.0231)
Period 6-10	0.00719	0.0567	0.128	0.0700***	0.0587	0.0249
	(0.0403)	(0.0350)	(0.0707)	(0.0202)	(0.0564)	(0.0282)
Period 11-15	0.156***	0.163***	0.0976	0.0972**	0.119**	0.00880
	(0.0401)	(0.0415)	(0.0883)	(0.0327)	(0.0514)	(0.0279)
Period 16-20	0.131*	0.233***	0.196***	0.142**	0.105*	0.0332
	(0.0583)	(0.0457)	(0.0603)	(0.0438)	(0.0502)	(0.0488)
Constant	0.452***	0.254***	0.524***	0.302***	0.442***	0.350***
	(0.0607)	(0.0410)	(0.0524)	(0.0450)	(0.0648)	(0.0620)
Observations	776	1376	766	1362	615	1316
F	7.359	25.81	5.460	8.723	1.833	11.61
R^2	0.568	0.553	0.396	0.454	0.478	0.399

Notes: Standard Errors in parentheses. Standard errors are clustered at the matching group level. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual fixed effects regression with controls for five period interval time trends. Dependent variable: strategic default (when income is high). Regressions include variables controlling for the behavior of others within a matching group: L.Mean SD Rate–Matching Group describes the one period lagged Strategic Default Rate within a matching group. L.Punishment of Default/100–Matching Group describes the one period lag of mean punishment points/100 a defaulting borrower receives within a matching group. L.Punishment of SD/100–Matching Group describes the one period lag of mean punishment points/100 a strategic default receives within a matching group.

Columns (3-4) of Table 5 present results for the partial information conditions. Here we again relate a borrower's behavior to the past strategic default rate of her matching group. In addition, we examine how past punishment of defaulters in the matching group impacts on borrower behavior. We find that observing more strategic defaults of borrowers in the same matching group increases subsequent strategic default. This effect is however only sizable and statistically significant in the strong economy. In both economic conditions (WE and SE) observed punishment by enforcers significantly reduces the likelihood to engage in strategic default. Columns (5-6) of Table 5 present results for the full information conditions. In the SE full information treatment, an observed increase in strategic default on the matching group level increases the individual likelihood to strategic default significantly. In the WE full information treatment this effect is also positive, but economically weaker and not significant. In both economic conditions observed punishment of strategic defaulters reduces subsequent strategic default. However, this effect is only significant in the SE treatment.

Overall, the Table 5 results support our conjecture that beliefs about the default behavior of other borrowers and the punishment behavior of enforcers are crucial determinants of strategic default. The results also confirm the survey evidence by Guiso et al. (2013), suggesting that strategic defaults may be contagious: Borrowers are more likely to default strategically if they see other borrowers doing so. Interestingly, we find that the contagion of strategic defaults between borrowers over time is stronger when economic conditions are good rather than when they are bad. This finding may be explained by the fact that borrowers default more often in the WE than in the SE condition from the outset (see Figure A.4 in the Appendix). Thus, there is less potential for borrowers to negatively influence each other in the WE condition. It is also plausable that borrowers are more surprised by strategic defaults of others in the strong economy than in the weak economy. An observed default will therefore induce a stronger update of beliefs about other borrowers' behavior.

We complete our empirical analysis by exploring whether the behavior of enforcers also exhibits peer effects. We present a regression analysis of individual enforcer behavior in Table 6. The dependent variable is the number of punishment points an enforcer assigns to defaults in the partial information conditions (columns 1-2) and strategic defaults in the full information conditions (columns 3-4). Our main explanatory variable is the one-period-lagged mean punishment intensity for defaults (in the partial information conditions) or strategic defaults (in the full information conditions) which captures peer effects, i.e. increased punishment due to the observation of stronger punishment by other enforcers in the same matching group. We control for the one-period-lagged strategic default rate to estimate the effect of observing more borrowers defaulting on punishment intensity. All regressions include dummies for five-period intervals as well as enforcer fixed effects. Standard errors reported in parentheses are clustered at the matching group level.

Table 6: Fixed Effects Regressions: Individual Decisions to Punish within Treatment

	partial info		full info	
	WE	SE	WE	SE
Punishment of	Default	Default	Strategic	Strategic
Lagged SD Rate-Matching Group	-10.56	10.96	-1.731	-24.05
	(8.254)	(13.60)	(9.107)	(30.40)
Lagged Punishment of Default/100-Matching Group	37.50***	6.778		
	(11.29)	(9.984)		
Lagged Punishment of SD/100-Matching Group			0.466	9.599
			(7.658)	(7.267)
Period 6-10	8.037*	10.18	-4.003	-2.125
	(3.789)	(9.956)	(8.365)	(15.72)
Period 11-15	17.96**	10.42	11.77	-7.225
	(7.610)	(13.42)	(8.172)	(17.88)
Period 16-20	11.55	16.46	15.33	-6.390
	(6.357)	(9.955)	(14.18)	(16.93)
Constant	21.08***	40.83***	53.20***	81.09***
	(4.995)	(9.274)	(6.445)	(16.42)
Observations	721	610	274	487
F	24.41	1.340	0.822	0.847
R^2	0.722	0.565	0.748	0.635

Notes: Cluster Robust Standard Errors in parentheses. Standard errors clustered on the unique matching group. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual fixed effects regression with controls for five period interval time tends on the number ob punishment points assigned to defaults (column 2 and 3) and strategic defaults (column 3 and 4). Regressions include variables controlling for the behavior of others within a matching group: L.Mean SD Rate–Matching Group describes the one period lagged Strategic Default Rate within a matching group. L.Punishment of Default/100–Matching Group describes the one period lag of mean punishment points/100 a defaulting borrower receives within a matching group. L.Punishment of SD/100–Matching Group describes the one period lag of mean punishment points/100 a strategic default receives within a matching group.

Our results document significant peer effects among enforcers only in the WE partial information condition (column 1). In this treatment a 10 point increase in observed average punishment of defaulters raises subsequent punishment by an enforcer by roughly 3.75 points. In all other treatments the impact of observed punishment is economically small and statistically insignificant. It seems reasonable that we find peer-effects of punishment only in the WE partial information treatment: It is exactly this condition in which there is a high risk that enforcers may accidentally punish a fundamental default. Hence, enforcers that are willing to punish strategic defaults but reluctant to punish fundamental defaults are likely to be influenced by the behavior of their peers. They observe others in their matching-group taking the risk of also punishing borrowers who defaulted fundamentally and subsequently worry less about punishing the wrong person.

5 Conclusion

This paper empirically investigates behavioral mechanisms underlying the increased propensity of consumers to default strategically during an economic downturn. Identifying theses mechanisms is important, because the recent financial crisis triggered a tremendous increase in the default rate on residential mortgages. Recent survey evidence suggests that a substantial share of these defaults were strategic and driven by a breakdown of moral obligations and/or social norms to repay.

The results of our experiment highlight two important factors of borrowers' behavior: First, a negative shock in the economic environments weakens moral constraints that prevent strategic defaults in times when economic conditions are good. When liquidity problems lead to an increasing rate of fundamental defaults in the surrounding environment, borrowers seem to feel less obliged to repay their loans. We argue that this is the case, because borrowers feel less bad if the negative externality that their strategic default imposes on society is more likely to hurt others who defaulted as well. This is an immediate result of the economic downturn.

Our second finding highlights that an economic contraction also weakens the enforcement of social norms to repay in a community. However, it is important to emphasize that third-parties reluctance to take action against defaulters is not a consequence of a break-down of the social norm per se. In fact, if outside-enforcers are fully informed about the nature of a default, their willingness to intervene does not depend on the state of the economy. The main reason for the decrease in norm enforcement is that an economic downturn creates informational uncertainty. In times of a crisis, partially informed enforcers of defaulting household can less clearly distinguish between strategic and fundamental defaults. As outside-enforcers, such as e.g., future lenders or peers, dislike punishing innocent borrowers who defaulted for fundamental reasons, they are less likely to intervene under adverse economic conditions. This finding implies that the impact of an economic shock on the strategic default rate also depends importantly on the information situation in a particular environment. Thus, in close-knit environments with full disclosure of household behavior social norms are more likely to deter strategic default in an economic downturn than in large and very anonymous environments. Our findings inform bank managers and regulators about (concentrated) credit risk in mortgage lending: In times of an economic downturn, portfolios predominantly consisting of mortgages in urban areas may become considerably more risky, since social norms to prevent strategic default are less likely to be enforced.

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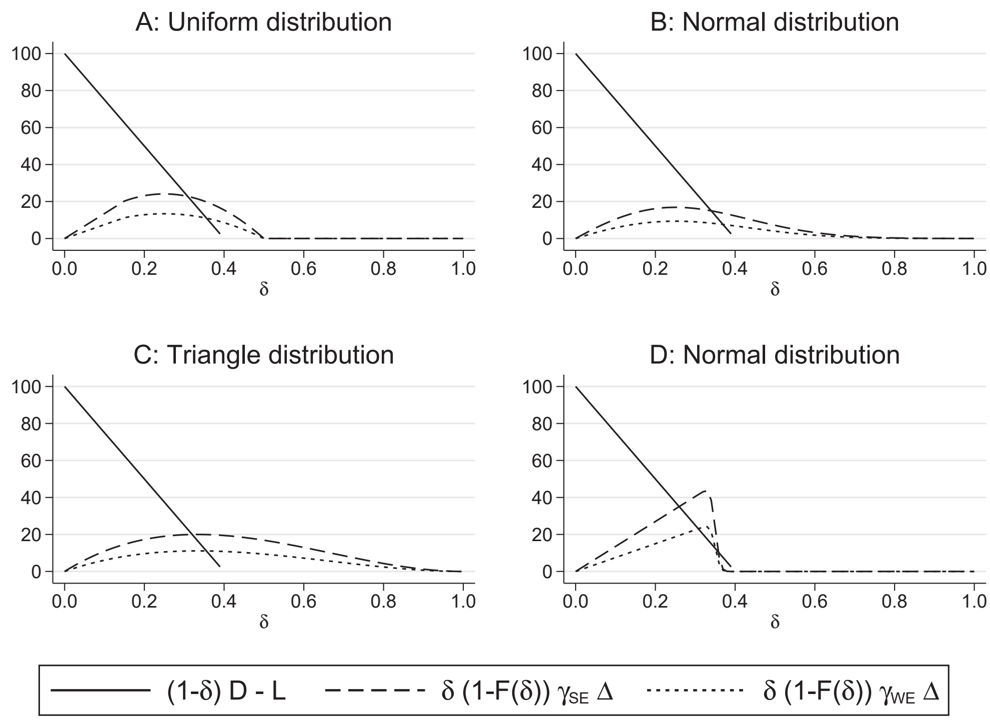
Appendix: Proofs

Proof: Lemma 1. Unconditional repayments occur if a borrower repays his loan even if he knows that no other borrower ever repays. For this behavior to be optimal the borrower's utility function needs to satisfy the following condition: $(1-\delta_i(s))D < L$. This yields $\delta_i(s) > 1 - \frac{L}{D}$. Unconditional defaults occur, if a borrower does not repay even if he knows that all other borrowers repay with certainty. For this behavior to be optimal the borrower's utility function needs to satisfy the following condition: $(1-\delta_i(s))W > R$. This yields $\delta_i(s) < 1 - \frac{R}{W}$. The remaining part of the borrower population $(1 - \frac{L}{D} < \delta_i(s) < 1 - \frac{R}{W})$ make their repayments contingent on the repayment rate in the population, i.e. they are willing to repay if the probability that other borrowers repay is sufficiently high. Denote the probability that other borrowers repay (conditional on having a positive income) as α. To ensure that repaying is optimal for a conditional cooperator the following condition needs to be met: $L + \gamma\alpha\Delta \geq (1-\delta_i(s))(D + \gamma\alpha\Delta)$. This yields the following condition for the minimally necessary repayment rate of solvent other borrowers: $\alpha \geq \frac{(1-\delta_i(s))D-L}{\gamma\delta_i(s)\Delta}$. $\square$

Justification for Assumption 1: Borrowers are willing to repay if the expected utility from repaying is at least as large as the expected utility from strategically defaulting. Suppose that all borrowers with $\delta_i(s) > \bar{\delta}$ repay whenever they can. The expected utility from repaying is given by: $U_i(r) = L + \gamma(1 - F(\bar{\delta}))\Delta$. The expected utility of a strategic default is given by $U_i(s) = (1-\delta_i)(D + \gamma(1-F(\bar{\delta}))\Delta)$. In equilibrium the marginal borrower must be indifferent between repayment and strategic default which yields the condition: $L + \gamma(1 - F(\delta_N^*))\Delta = (1-\delta_N^*)(D + \gamma(1 - F(\delta_N^*))\Delta)$ (see Proposition 1 in the text). Rearranging the condition yields: $(1-\delta_N^*)D - L = \delta_N^*(1-F(\delta_N^*))\gamma\Delta$. Figure A.1 provides a graphical representations of the left-hand and right-hand sides of the equilibrium condition for four different distributions of δ. In order for the equilibrium to be unique there can only be one intersection point between the line representing the left-hand side and the curve representing the right-hand side. Assumption 1 ensures that the curve intersects the line exactly once from below: : If $(1-\delta')D - L < \delta'(1-F(\delta'))\gamma\Delta$, then $(1-\delta'')D - L < \delta''(1-F(\delta''))\gamma\Delta$, $\forall\delta'' > \delta'$. Panels A to C of Figure XXX show distributions for which Assumption 1 holds. Panel D depicts an example of a distribution that violates Assumption 1.

Proof: Proposition 1. The equilibrium condition stated in Proposition 1 is derived above (see the justification for Assumption 1). Totally differentiating this condition gives: $(1 - F(\delta_N^*))\Delta d\gamma - \gamma f(\delta_N^*)\Delta d\delta_N^* = (1-\delta_N^*)(1-F(\delta_N^*))\Delta d\gamma - [D + \gamma(1-F(\delta_N^*))\Delta + (1-\delta_N^*)\gamma f(\delta_N^*)\Delta]\, d\delta_N^*$. Simplifying and rearranging leads to $\frac{d\delta_N^*}{d\gamma} = -\frac{D+\gamma\Delta(1-F(\delta_N^*)-\delta_N^* f(\delta_N^*))}{\delta_N^*(1-F(\delta_N^*))\Delta}$. Assumption 1 implies that this derivative is strictly negative. Notice: δ_N^* is bound above by $1 - \frac{L}{D}$, i.e. even if the probability of a positive income is zero, (unconditional) repayments occur in equilibrium. Moreover, δ_N^* cannot be inferior to $1 - \frac{R}{W}$, because borrowers with δ's below $1 - \frac{R}{W}$ do never repay irrespective of other borrowers' behavior (see Lemma 1). □

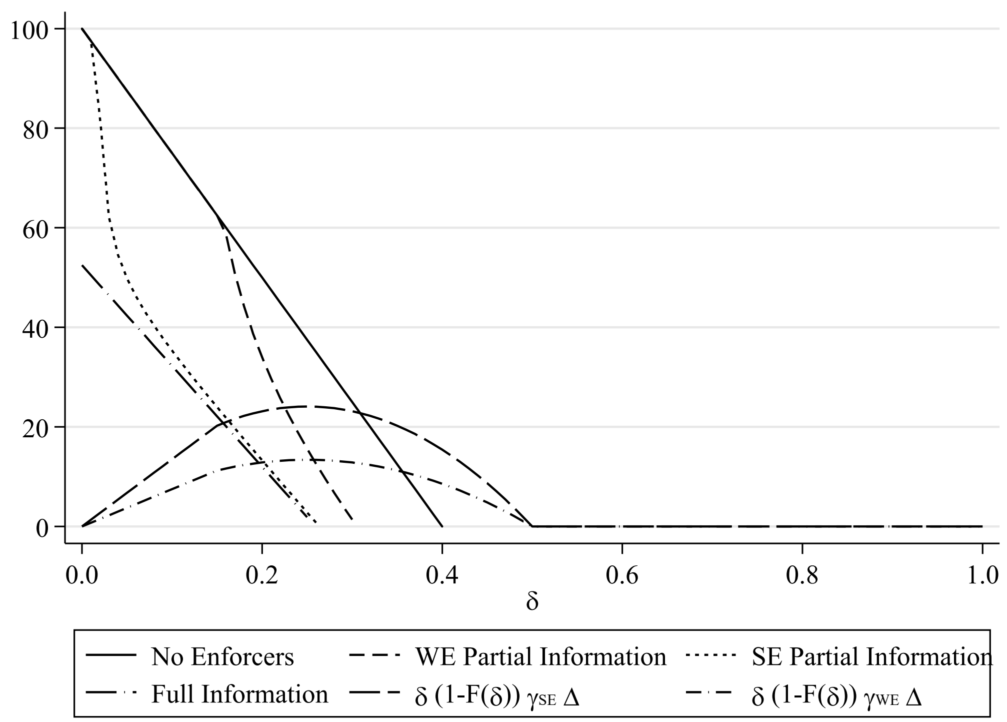
Figure A.1: Graphical Representation of Equilibrium Condition in Proposition 1



Proof: Lemma 2. Enforcers punish borrowers if the expected utility of punishing is larger than the expected utility of not punishing. Assume that the enforcer k's belief that borrower i has engaged in strategic default is given by b_{ki}. The expected utility of punishing the borrower (ignoring the terms related to borrower j) is given by: $U_k(p_{ik} = 1) = b_{ki}E + (1 - b_{ki})(1 - \phi_k(r, 1))E - \kappa$. The expected utility of not punishing the borrower amounts to: $U_k(p_{ik} = 0) = b_{ki}(1 - \phi(s, 0))E + (1 - b_{ki})E$. Equalizing $U_k(p_{ik} = 1)$ and $U_k(p_{ik} = 0)$ using our assumption that $\phi(r, 1) = \beta\phi(s, 0)$ yields the threshold belief necessary to make punishment optimal: $b_{ki} = \frac{\beta\phi_k(s,0)E+\kappa}{(1+\beta)\phi_k(s,0)E}$. Rearranging terms and solving for $\phi_k(s, 0)$ leads to the minimally necessary concern for norm violations: $\phi_k(s, 0) = \frac{\kappa}{((1+\beta)b_{ki}-\beta)E}$. □

Justification for Assumption 2: Lemma 2 implies that the expected punishment for strategic defaulters when enforcers are present corresponds to $1 - G\left(\frac{\kappa}{((1+\beta)b-\beta)E}\right)P$. Under partial information the belief b is calculated by dividing the fraction of borrowers who engage in strategic default $(\gamma F(\delta_P^*))$ by the total fraction of defaults $(1-\gamma(1-F(\delta_P^*)))$. Under full information enforcers can perfectly observe strategic defaults so that the belief is unity $(b=1)$. Subtracting the corresponding expected punishment from the payoff of defaulting in the the equilibrium condition in Proposition 1 directly yields the equilibrium conditions in Propositions 2 and 3. Rearranging the two equilibrium conditions yields $(1-\delta^*)\left(D-\left(1-G(\phi^T)\right)P\right)-L=\delta^*(1-F(\delta^*))\gamma\Delta$, where ϕ^T for partial and full information is defined in Assumption 2. Assumption 2 ensures that the line (curve) representing the left-hand side of the equation and the curve representing the right-hand side of the equation intersect exactly once. Figure A.2 shows a graphical example.

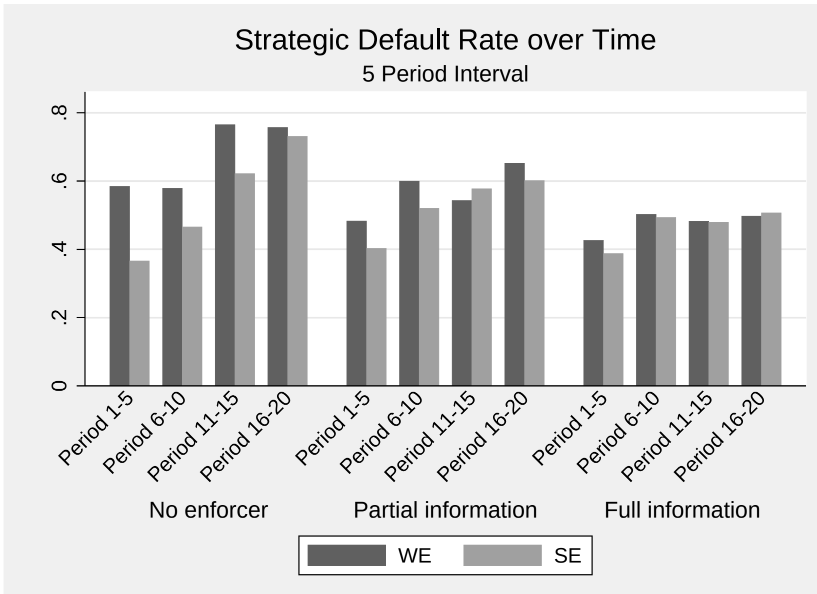
Figure A.2: Graphical Representation of Equilibrium Condition in Proposition 1



Proof: Proposition 2and Proposition 3. These proofs follow directly from the justification of Assumption 2. □

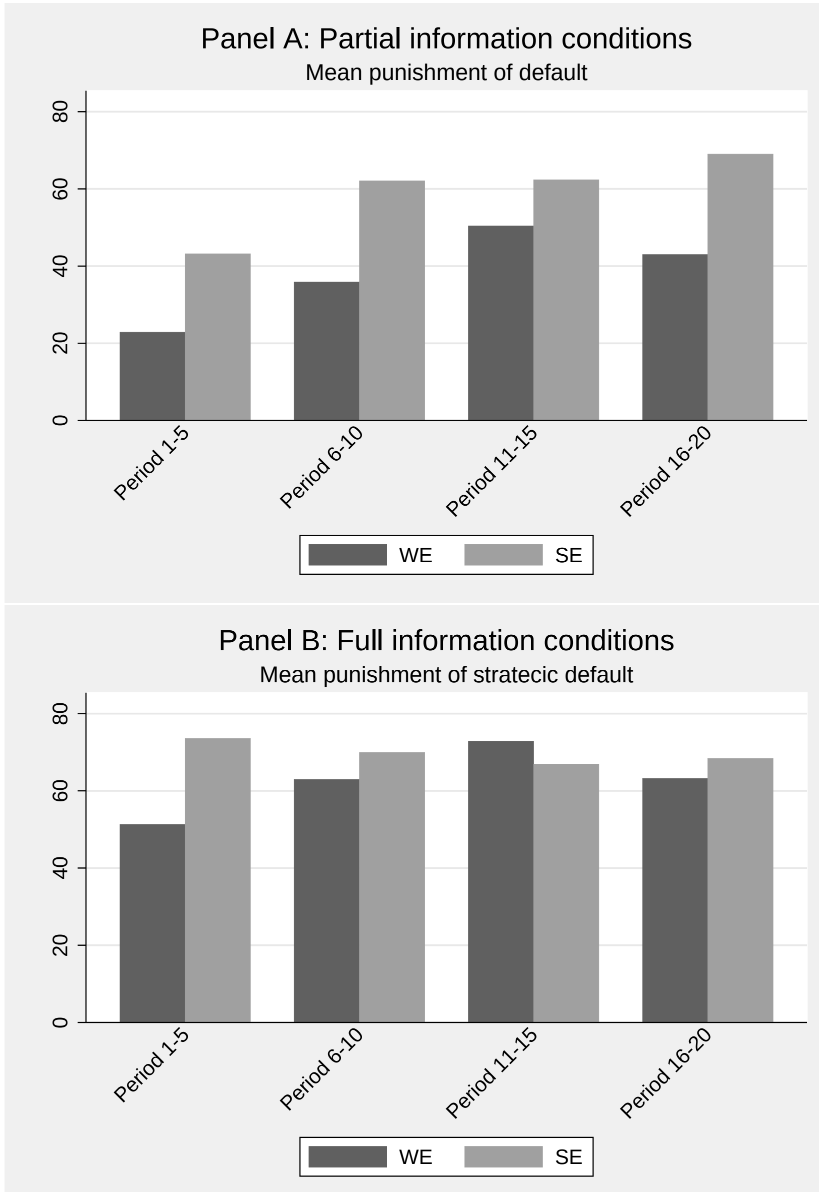
Appendix: Treatment outcomes over time

Figure A.3: Strategic Default Rate over Time



Notes: The figure displays strategic default rates for five-period intervals for our weak and strong economy treatments in each of the three information conditions (no enforcers, partial information, full information).

Figure A.4: Mean Punishment over Time



Notes: **Panel A:** Average punishment of defaults in the WE and SE partial information condition. Punishment of defaults is higher in the strong economy. In both conditions, punishment increases from period 1–5 to period 6–10 and stays constant in period 6–20. **Panel B:** Average punishment of strategic defaults in the WE and SE full information condition. In the SE condition punishment of strategic default is higher in period 1–5 and levels with punishment of strategic default in the WE in period 6–20.