Social Norms and Strategic Default*

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Abstract

During the recent financial crisis the delinquency rate on residential mortgages increased tremendously. Survey evidence suggests that a substantial share of these defaults were strategic. And that the increased propensity to default strategically was partly driven by a break-down in moral constraints and social norms to repay loans. In this paper we use the methods of experimental economics to shed new light on the behavioral mechanisms underlying the tendency to default strategically. 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 also weakens the enforcement of social norms to repay debt: In times of a crisis, peers of defaulting households have a hard time distinguishing between strategic and fundamental defaults and are therefore reluctant to ostracize defaulting households.

Keywords: Strategic Default, Moral Constraints, Social Norms, Prisoner's Dilemma
JEL codes: G01, G02, C91

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1 Introduction

The delinquency rate on US residential mortgages increased from roughly 2% in the period 2000-2006 to more than 10% in the period 2009-2011. Mortgage defaults were to a large extent triggered by the illiquidity of households, confronted with higher mortgage interest payments and lower income (Elul et al., 2010). However, existing evidence also points to a substantial share of strategic mortgage 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 mortgage default by households during an economic downturn. Guiso et al. (2013) argue that in the recent financial crisis a change in households' attitudes may have led to a contagious propagation of defaults in the US mortgage market. In their survey of US 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: First, households feel less obliged to repay their mortgage if others around them are defaulting (weaker moral constraints). Second, in an economic crisis 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 mortgage 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). 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. Indeed 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. 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 constraints or a breakdown of social norms. Strategic 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 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 social cost of defaults imposed on society). In our experiment the ability of the borrowers to cooperate is stochastic: with a probability p they have a sufficiently high income so that they can choose to repay or (strategically) default. With a probability $1 - p$ 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 observer 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 through interventions by peers.

In our experiment we study the behavioral determinants of strategic default across economic conditions by exogenously manipulating the frequency of fundamental defaults in the economy (i.e., we implement treatments varying the probability with which each borrower can repay). In addition, we not only study treatments with and without third-party observers, but we also vary the information that observers have about borrowers' behavior (i.e., whether or not observers can distinguish strategic from fundamental defaults). Together our six treatments allow us to i) identify the extent to which moral constraints alone prevent borrowers from engaging in strategic default under varying economic conditions, 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 in adverse economic conditions. In the absence of punishing third-party

observers roughly half of all borrowers repay their loans when the state of the economy is strong. Under weak economic conditions, however, the frequency of strategic defaults increases by more than 20 percent. The presence of third party observers who can enforce social norms to repay through sanctions helps to mitigate the negative impact of an economic downturn on the strategic default rate. However, as long as observers are only partially informed and cannot distinguish between fundamental and strategic defaults the effect is limited and the strategic default rate in the weak economy still increases by roughly 10 percent relative to the strong economy. The reason is that many observers are reluctant to intervene if there is a large risk that they hit "innocent" borrowers who were forced to default because of illiquidity. This finding lends explicit support to Guiso et al. (2013)'s interpretation that an economic crisis not only softens moral constraints, but also weakens the enforcement of social norms. However, we also show that when impartial observers 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 observers seem to perceive strategic defaults as equally (un)acceptable in the weak and the strong economy and therefore sanction strategic defaulters equally harshly in both environments. This finding implies that an economic downturn does not lead to a break-down of social norms per se, but rather creates informational uncertainty that makes it difficult to enforce the norm. Our study therefore suggests that in close-knit local economies where households may be well informed about each others' economic conditions social norms are more likely to deter strategic default in an economic downturn.

Our paper provides two 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 succeeds in isolating 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.

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

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 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 loan defaults, (ii) a game which captures the enforcement of social norms to repay loans 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, 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.[1]

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. If the other borrower does, however, not repay her loan (because of fundamental or strategic default), the borrower's endowment

[1] 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 mortgage defaults on homeowners in the same vicinity (i.e. higher local lending rates or a reduction in house values (Towe and Lawley, 2013)). Our parameter choice implies that there is a negative welfare effect of mortgage 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 200 points. Fundamental default if the other borrower repays yields a profit of 150. 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 get a positive income.

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

In our **no obsever conditions** the outcome of the prisoner's dilemma game is not communicated to any other participant. Third parties have therefore no possibility to enforce social norms. In this benchmark condition, we therefore exclude third parties from the setup. The only force that can prevent borrowers from engaging in strategic default in these conditions are internalized moral constraints, i.e., bad feelings about imposing a negative externality on somebody else.

In our **partial information conditions** the outcome of the prisoner's dilemma is observed by a 3rd player (the observe) who has not participated in the prisoner's dilemma game. However, observers 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, observers cannot distinguish between a fundamental default and a strategic default. Observers are endowed with 300 points[2] 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 observer.

In the **full information conditions** the outcome of the prisoner's dilemma is also observed by a 3rd player who has the possibility to exert costly punishment and reduce the income of one or both of the borrowers. The endowments and costs of punishment are identical to the partial information conditions. However, in this full information condition observers get to know incomes and choices of the two borrowers and can therefore unambiguously differentiate between fundamental defaults and strategic defaults in case of a non-repayment.

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 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 treatment conditions in a 3x2 design. We implement these 6 conditions in

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

a pure between-subject design, i.e., each participant participates in only one of the conditions. Table 2 presents an overview of the treatments.

Table 2: Treatment Overview

	No obsever	Partial information	Full information
Weak economy	WE no obsever	WE partial info	WE full info
Strong economy	SE no obsever	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 obsever describes treatments without impartial 3rd parties. Partial information: Treatments with possible punishment of an impartial obsever. Observers receive information about default but not about the nature (fundamental of strategic) of the default. Full information: Treatments with an impartial obsever. Observers 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 obsever 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 observer for the whole 20 periods. In these conditions 2 borrowers and 1 observer are randomly matched at the beginning of each period.

At the end of every 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 at the matching group level. This information differs depending on the information structure of the treatment: In the no obsever 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 obsever 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.[3]

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. (2012) 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 great detail.[4] 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 single subject had correctly solved all exercises. 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.

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.[5]

2.4 Discussion of the Experiment Design

Our aim is to study the role of moral constraints and social norms in resolving the conflict between the private benefit and the social cost of mortgage defaults. The prisoner's dilemma underlying our experiment captures this trade-off in its most simple and parsimonious way. In reality defaults obviously also have a direct cost to the lender. However, we find it more plausible that social norms to repay are enforced because defaults are harmful to society and less much because they lower bank profits. Because our experiment focuses on the social aspect of strategic default, we therefore abstract from the impact of the borrower's decision on bank

[3]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 observer could not distinguish between the two cases when they assigned punishment points) and could have misled participants to false conclusions.

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

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

profits. This allows us to keep the experiment simple and understandable for participants.

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, some studies exploring the effect of uncertainty in social dilemmas suggest that moral constraints to cooperate decay when outcomes are uncertain. For example, Xiao and Kunreuther (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 in a group 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 under different economic conditions we allow for costly punishment in our partial and full information conditions (Homans, 1950). The punishment patterns displayed by impartial observes 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 impartial third-party observers 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. An impartial obsever 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 observer receives about the intentions behind a borrower's action in our design. In the partial information conditions an observer can only infer from the underlying probability of fundamental default, whether or not an observed default was actually strategic in nature. In this condition observers face the risk of punishing 'innocent' borrowers who had to default. In the full information conditions, in contrast, observers 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 to isolate the role of information for social norm enforcement in a very clean and simple way. In particular, we will be able to see whether a shock to the economic conditions affects the social norm itself (i.e., the perception of a strategic default under full

information) or only the way in which the norm is enforced (the level of punishment under partial information). 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 analyze the game from the point of view of the self-interest model assuming that all borrowers and observers maximize their monetary payoff. We then explore the implications of a richer model in which we assume that borrowers are characterized by heterogeneous moral concerns and observers 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 (d)	Fund. Default
Borrower i	Repay (r)	R,R	L,W	L,w
	Strat. Default (d)	W,L	D,D	D,d
	Fund. default	w,L	d,D	d,d

Notes: Borrower's payoff dependend on own decision and the other borrower's actions. R is payoff if both borrowers repay (300). W highlights payoff from strategic default if the other borrower repays (400). D is the payoff from strategic default if the other borrower also defaults (strategically or fundamentally) (250). L is profit from repayment if the other borrower defaults (strategically or fundamentally) (150). d is payoff from fundamental default if the other borrower defaults (strategically or fundamentally) (50). Hence: $W > R > D > w > L > d > 0$.

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).

In some versions of the game we also consider a third player—a randomly drawn observer k. The observer receives a fixed endowment E and his payoff is not affected by the decisions of the borrowers. However, the observer can induce a costly punishment for each of the two borrowers separately. For simplification, we assume that the punishment of a borrowers is a binary decision, i.e., if the observer punishes a borrower, he reduces the borrower's payoff by P at a cost $\kappa < P$.

3.2 The self-interest model

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

Self-interest hypothesis: *The strategic default rate amounts to 100% in all our treatments. In the treatments in which observers are present 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 the 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, $c_i \in \{r, d\}$ is borrower i's choice to repay (r) or default (d) and δ is a term which is equal to zero if the borrower repays ($\delta_i(r) = 0$) and positive if the borrower defaults ($0 < \delta_i(d) < 1$). The δ function captures the intuition that defaulting borrowers experience a moral cost (the borrowers utility is decreased by $\delta_i(d)\pi_i$). We model the moral cost as proportional to the borrower's payoff, so that the utility loss from defaulting is largest if the other borrower repays ($\delta_i(d)W > \delta_i(d)D$). We assume that $\delta_i(d)$ is borrower specific and characterized by a continuously differentiable distribution 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 obsever):*

- *Type 1: Unconditional repayments*
  Borrowers with strong moral concerns ($\delta_i(d) > 1 - \frac{L}{D}$) 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 $\delta_i(d) \in [1-\frac{R}{W}, 1-\frac{L}{D}]$ repays if the probability that other borrowers with a positive income repay is at least equal to $\frac{(1-\delta_i(d))D-L}{\gamma\delta_i(d)\Delta}$.

- *Type 3: Unconditional defaults*

Borrowers with weak moral concerns ($\delta_i(d) < 1 - \frac{R}{W}$) 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 $\delta_i(d) > \bar{\delta}$ repay their loan whenever they can. Given this belief borrower i repays if the following condition is satisfied:

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

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

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

Proposition 1 (Equilibrium without observers)**.** *In the absence of observers 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 strictly decreasing in γ so that that the fraction of repaying borrowers is strictly higher in the strong economy than in the weak economy: $\delta_N^*(\gamma_{SE}) < \delta_N^*(\gamma_{WE})$.

We model a borrowers' (expected) moral cost through an increase or decrease of own income depending on the other borrower's action (repayment or default). While mathematically robust (e.g., to an individually different moral cost function) this allows us to formalizes the

following intuition in proposition 1: In an economic downturn fundamental defaults become more likely and borrowers interact more frequently with defaulting borrowers—even if solvent borrowers were not to change their behavior. 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 enforcing observers a negative economic shock unambiguously increases the strategic default rate.

3.4 Social Norm Enforcement

Next we consider the behavior of observers. The previous literature on norm enforcement through third-party punishment suggests that some unaffected third-parties who are willing to intervene if they observe violations of social norms (see section 2.4 for more details). We model the observer's enforcement 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 observer'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 ($\phi_k(r, 0) = \phi_k(d, 1) = 0$) and positive otherwise ($0 < \phi_k(d, 0) \leq \phi_k(r, 1) < 0.5$). This function captures the intuition that observers 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 unjustifed punishment is at least as large as the one caused by an unsanctioned violation of the norm. For expositional simplicity, we model the two disutilities as perfectly correlated: $\phi_k(r, 1) = \beta\phi_k(d, 0)$, where $\beta \geq 1$. We further assume that $\phi_k(d, 0)$ is observer 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 observer k punishes a borrower i if and only if his belief b_{ki} that the borrower engaged in strategic default satisfies the following condition:*

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

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 observers 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 creates a utility increase if the observer punishes a borrower who violated the social norm to repay.

We first consider how the presence of partially informed observers 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 observers)**.** *In the presence of partially informed observers the fraction of repaying borrowers in equilibrium is $1 - F(\delta_P^*(\gamma))$, where $\delta_P^*(\gamma)$ is implicitly defined by the condition:*

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

where $b_{ki} = \frac{\gamma F(\delta_P^*)}{1-\gamma(1-F(\delta_P^*))}$. $\delta_F^*(\gamma)$ is 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 observers changes borrowers' incentives. The most striking difference to the previously discussed case without observers is that borrowers now face a threat of punishment. Observers with a strong preference for norm enforcement (i.e., a high $\phi_k(0, d)$) 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 observer. 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 observers 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 observers)**.** *In the presence of fully informed observers 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 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 observers' information affects borrowers' repayment behavior. The big difference to the situation with partially informed observers is that fully informed observers can cleanly distinguish between strategic and fundamental defaults. This information advantage makes a big difference, in particular in the weak economy where observers have a hard time identifying strategic defaults 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 in the absence of observers)**.** *In the no observers 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 social norm enforcement under partial information)**.** *Defaults will be punished in both the strong and the weak economy, but more harshly so in the strong economy. Expected punishment by partially informed observers reduces the strategic default rate in both the strong and the weak economy. The strategic default rate is higher in the weak economy than in the strong economy. It is ambiguous whether the difference between weak and strong economy is smaller or larger than in the absence of observers.*

Lemma 2 implies that observers 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 observers can be rather certain that an observed default is the consequence of a borrower's strategic decision. Thus, observers are likely to punish defaulters even if their disutility from observing a norm violation is moderate. Since many observers 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 observers know little about the underlying reason of a default. As a consequence, observers 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 observers 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 observers 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 observers 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 observers 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 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 social norm enforcement with fully informed observers)**.** *In the strong economy full information as opposed to partial information for observers will only have a weak impact on outcomes. 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 observers or partial information.*

In the strong economy even partially informed observers 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 observers know little about the underlying reason for an observed

default and are therefore reluctant to punish. Additional transparency that allows observers 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, ranging from 18 to 60 years. In each session we collected data on two (or three) independent matching groups. Our data set consist of 10 observations (i.e., 10 independent matching groups) for each of the six treatments. For expositional clarity, we present the results in two parts: We first provide an overview of the main, static outcomes of our experiment in subsection 4.1. Subsequently, we discuss the robustness of the effects over time in subsection 4.2.

4.1 Main Results

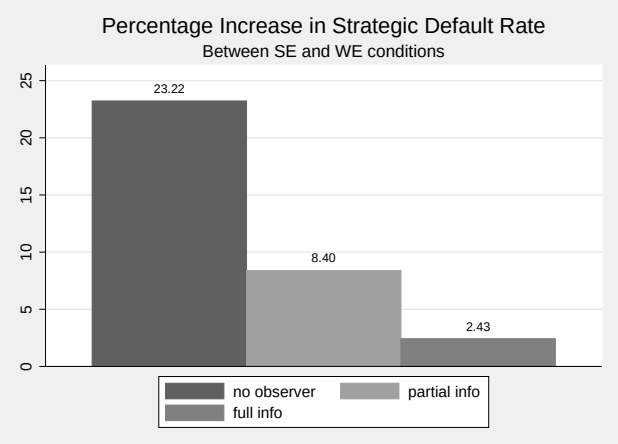
Our main interest in this paper is to better understand the role of moral constraints and social norms for the effect of an economic downturn on borrowers' repayment behavior in personal credit markets. Table 4 summarizes our results. Further, figure 1 highlights how a negative economic shock (i.e., an exogenous increase in the fundamental default rate from 10% to 50%) affects the strategic default rate in our three information conditions (no observer, partial information, full information). The bars in the figure represent the percentaged increase in the strategic default rate in the weak economy relative to the strong economy.

Table 4: Summary Statistics by Treatment

	no observer		partial info		full info	
	WE	SE	WE	SE	WE	SE
Fundamental Default Rate	0.485	0.0938	0.491	0.106	0.507	0.0794
	(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 Repay			7.771	9.867	2.847	15.58
			(350)	(678)	(411)	(785)
Punishment if Default			36.59	58.96		
			(1250)	(922)		
Punishment if Fundamental					3.227	13.54
					(812)	(127)
Punishment if Strategic					55.60	63.76
					(377)	(688)

Notes: Summary statistics of experimental results showing mean of variables with number of observations in parentheses. Fundamental Default Rate shows the percentage of borrowers who did not have an income to repay their credits and highlights the successfull randomization in the experiment. Strategic default rate depicts the proportion of strategic defaults in all treatments. The strategic default rate is highest in the no observes conditions and lowest in the full info conditions. Punishment of Repay highlghtes average punishment if a borrower repays. Punishemnt if Default highlights punishment of a borrower who defaults. Punishment of Fundamental and Punishment of Strategic depicts punishment of fundamentally defaulting or strategically defaulting borrowers. Defaulting borrowers are higher punished in the SE under partial information than in the WE. Under full information the difference in punishment of strategic defaults between the WE and SE condition is very small.

Figure 1: Increase in Strategic Default Rate in Percent



Notes: Percentage difference in strategic default rate between no observer conditions (WE no observer and SE no observer - 23.2%), partial info conditions (WE partial info and SE partial info - 8.4%) and full info conditions (WE full info and SE full info 2.4%). Difference in strategic default rate decreases under partial information. The negative effect of an economic downturn is almost fully moderated in the full information condition.

We first focus on the effect of an economic downturn in the no obsever conditions. We observe that in the absence of third-party norm enforcement an increase in the fundamental default rate triggers a substantial increase in the strategic default rate. In fact, the strategic default rate increases from 54.8% (SE no obsever) to 67.5% (WE no obsever). This corresponds to an increase of 23.2% (12.7 percentage points). 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).[6] We summarize this finding as our first result:

Result 1 (Effect of an economic downturn in the no obsever treatments)**.** *In the absence of third-party norm-enforcement an economic downturn has a large negative impact on borrowers' repayment behavior. The strategic default rate increases by 23% in the weak economy as compared to the strong economy.*

Result 1 is consistent with Hypothesis 1 and our theoretical approach presented in section 3.3. 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. 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 only borrowers with very strong moral concerns are willing to repay their loans.

Next, we investigate the effect of an economic downturn in our partial information treatments. Figure 1 reveals that the presence of partially informed observers substantially reduces the negative impact of an adverse economic shock on the strategic default rate. While there was an increase of 23.2% in the no obsever treatments, the strategic default rate in the partial information conditions "only" increases by 8.4%. This difference in the strategic default rate between the WE partial info and the SE partial info condition is statistically insignificant (one sided ranksum test: I: N=160; p=0.22 /M: N=20; p=0.22). However, it is significantly (on the individual level) smaller than the difference observed in the no obsever conditions (one sided ranksum test: I: N=320; p=0.023/M: N=40; p=0.16).[7] A separate analysis of the impact of the partially informed observers in the strong and the weak economy shows

[6] We always report non-parametric tests using two different types of observations. The conservative testing method uses each matching group as just one observation (i.e., it assumes that all observations within a matching group are dependent). This procedure implies that we only have 10 independent observations per treatment. A more powerful but statistically less pure approach is to consider the decisions of each person as independent observations. This procedure takes into account that decisions of the same person are dependent, but ignores the fact that there may dependencies across people within matching groups).

[7] To test for differences between the no obsever and partial info conditions, we perform one sided ranksum

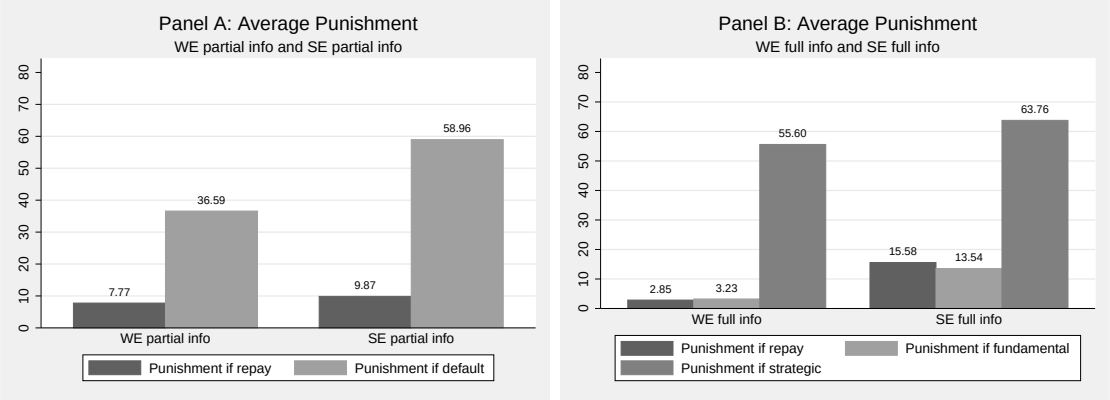
that the overall effect is mostly driven by a change in borrowers' repayment behavior in the weak economy. In fact, the presence of partially informed observers causes only a small and non-significant reduction in the strategic default rate in the strong economy (from 54.8% in the SE no obsever condition to 52.5% in the SE partial information condition, 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 obsever condition to 57.0% in the WE partial information condition, (I: N=160; p<0.01/M: N=20; p=0.09)).

To understand how the presence of partially informed observers affects the impact of an economic downturn, it is informative to examine observed punishment patterns in the strong and the weak economy. As observers in the partial info conditions cannot distinguish between fundamental and strategic defaults, we analyze punishments of defaults in general. Panel A of Figure 2 displays the observers' average punishment conditional on whether the borrower repays or defaults. The figure shows that partially informed observers 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).[8] The punishment for defaults implemented by observers 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.

test over all no obsever (WE and SE) and partial info treatments (WE and SE) and differentiate by the presence of an obsever.

[8]Evidence that observers 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, observer punish borrowers who repay on average with about 7.77 points. Defaults are punished 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).

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



Notes: **Panel A:** Average punishment of repayments and defaults in the partial info conditions. Defaults are punished higher than repayments. Defaults are much more sanctioned in the SE partial info treatment where strategic default is more likely. The mean difference between punishment of defaults in the SE and WE condition is 22.37 points. **Panel B:** Average punishment of repayments, fundamental default and strategic default. Strategic defaults are much higher punished than fundamental defaults and repayments in both full info conditions. The mean difference between punishment of strategic default is reduced to 8.16 points.

We summarize these findings as our second result:

Result 2 (Effect of social norm enforcement by partially informed observers)**.** *When observers have only partial information the punishment of defaulting borrowers is weaker when economic conditions are weak. Despite this, social norm enforcement under partial information mitigates the negative impact of an economic downturn on the strategic default rate. This result is mainly a consequence of the fact that norm enforcement impacts stronger on the strategic default rate under adverse economic conditions.*

Result 2 corroborates the theoretical arguments behind our Hypothesis 2. The fact that partially informed observers are reluctant to punish in the weak economy is consistent with our assumption that observers 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 (strategic or fundamental) 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 observers has a stronger positive impact on the strategic default rate in the weak economy, although observers 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 seems to be a consequence of the

fact that the stronger 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 punishment threat created by the observers does not seem to motivate many additional borrowers to repay. This seems to be different in the weak economy where there is more room for an impact of norm enforcement. In the weak economy, borrowers with intermediate moral concerns who would engage in strategic default in the absence of social norm enforcement seem to abstain from doing so, because of the threat of punishment established by partially informed observers.

Finally, we turn to our full information treatments. 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. This small increase is statistically insignificant (one sided ranksum I: N=160; p=0.35/M: N=20; p=0.30) and is significantly smaller than the increase in both other environments (pooled one sided ranksum test over full info, partial info and no observer conditions: I: N=480; p<0.01/M: N=60; p=0.024).[9] The strategic default rate drops from 52.6% under partial information to 46.7% under full information (one sided ranksum test: I: N=160; p=0.11/M: N=20; p=0.27). In the weak economy, in contrast, the strategic default rate is reduced from 57% under partial information to 47.8% under full information. This constitutes a significant reduction of 16.15% (one sided ranksum test: I: N=160; p=0.01/M: N=20; p=0.085). When comparing to the corresponding no obsever condition, we even see a reduction of roughly 30% in the strategic default rate.[10]

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 observers conditional on the borrower's observed choice (repayment, strategic default, fundamental default). In the weak economy, observers assign on average 55.6 points to strategic defaulters. These are 19 points more than the average punishment for defaulters of 36.6 points 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). The stronger punishment implies that under full information strategic default becomes less attractive for borrowers in the weak economy. This is consistent with the observed decrease in the strategic default rate. In the strong economy the availability of full information has only a small impact. Fully informed observers assign on average 63.8 punishment points to strategic defaulters. This does not differ significantly from the punishment points assigned to defaulters in the

[9]One sided ranksum test (full info and no observer conditions): I: N=320; p<0.01/M: N=40; p=0.025; One sided ranksum test (full info and partial info condition): I: N=320; p<0.01/M: N=40; p=0.07.

[10]Oone sided ranksum WE conditions: I: N=160; p<0.01/M: N=20; p=0.012; SE conditions: I: N=160; p= 0.04/M: N=20; p=0.35.

strong economy of the partial information conditions (one sided ranksum test: I: N=57; p=0.25/M: N=20; p=0.24)[11] The lack of an impact on punishment in the strong economy explains why the presence of full information does not alter repayment behavior much in this setup.

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

Result 3 (Effect of social norm enforcement by fully informed observers)**.** *The availability of full information eliminates the negative impact of an economic downturn on borrowers' repayment behavior. This result is a consequence of the fact that in the weak economy fully informed observers punish strategic defaulters much more harshly than partially informed observers. 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. The observed increase in the punishment intensity in the weak economy under full information strongly reinforces our earlier interpretation that the weak punishment under partial information is driven by observers' fear to accidentally punish innocent borrowers. In particular, our finding that under full information there is no longer a significant difference between average punishments for strategic defaulters in the weak and the strong economy rules out the alternative explanation that observers 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.

Overall, our main results imply that both personal moral constraints and externally enforced social norms play an important role for borrowers repayment behavior. Our experiment

[11] As in the partial information conditions also the punishment pattern in the full information condition is very systematic. Figure 2 highlights that fully informed observers 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, observer 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).

highlights 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 to distinguish between strategic and fundamental defaults and are therefore less likely to punish defaulters (weaker enforcement of social norms).

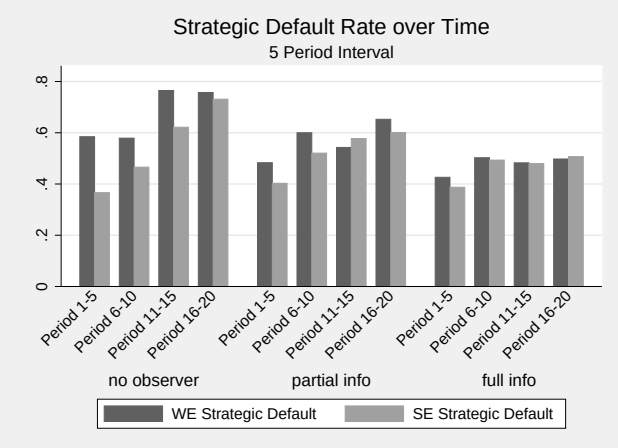
4.2 Dynamics in Strategic Defaults and Norm Enforcement

In this section we discuss how the decisions of borrowers and observers change over time. We first investigate borrowers' tendency to engage in strategic default, and then turn to observers' punishment decisions. The observed time trends provide further insights about the mechanisms underlying our main results and demonstrate the robustness of our findings.

Figure 3 displays the development of the strategic default rate in all our treatments over time. The bars display strategic default rates for five-period intervals for our weak and strong economy treatments in each of the three information conditions (no obsever, partial information, full information). A first observation is that the figure largely confirms the pattern described in Results 1 to 3 for each time interval. The distance between the strategic default rates in the weak and the strong economy tends to be large in the no obsever 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 obsever conditions.[12]

[12]One sided ranksum test: No observes conditions: Period 1–5: I: N=157; p<0.01/M: N=20; p=0.08; Period 6–10: I: N=159; p=0.012/M: N=20; p=0.13; Period 11–15: I: N=155; p<0.01/M: N=20; p=0.09; Period 16–20: I: N=158; p=0.24/M: N=20; p=0.34; Partial info conditions: Period 1–5: I: N=157; p=0.14/M: N=20; p=0.14; Period 6–10: I: N=158; p=0.07/M: N=20; p=0.14; Period 11–15: I: N=157; p=0.47/M: N=20; p=0.41; Period 16–20: I: N=160; p=0.33/M: N=20; p=0.38; Full info conditions: Period 1–5: I: N=155; p=0.32/M: N=20; p=0.14; Period 6–10: I: N=157; p=0.28/M: N=20; p=0.14; Period 11–15: I: N=159; p=0.39/M: N=20; p=0.41; Period 16–20: I: N=160; p=0.33/M: N=20; p=0.38.

Figure 3: Strategic Default Rate over Time



Notes: The figure highlights mean strategic defaults in the WE and SE in 5 period intervals for the no obsever, partial information and full information condition. The difference in strategic default rates between WE and SE is highest in the no observer and partial info condition. In the full information condition the difference disappears.

A second insight provided by the figure is that the strategic default rate seems to exhibit a positive time trend in the no obsever conditions and the partial information conditions, but not in the full information condition.. This graphical impression receives further support from regression analysis reported in Table 5. The table presents results from several linear probability regressions (GLS), which have an indicator variable for strategic default as the dependent variable. Observations are limited to cases in which the borrowers obtains an income of 200 points. In Panel A we report specifications in which we include dummy variables for the different five-period intervals and individual fixed effects as independent variables. The columns represent regressions by treatment. Standard errors are clustered on the matching group level. The coefficients indicate that the observed positive time trends are very significant in the no obsever and partial information conditions, The time effect is weaker in magnitude and statistical significance in the full information conditions.

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

Panel A:	no observer		partial info		full info	
DV: Strategic Default	WE	SE	WE	SE	WE	SE
Period 6-10	0.0238	0.0961*	0.132**	0.107**	0.0508	0.0977*
	(0.0496)	(0.0437)	(0.0540)	(0.0372)	(0.0363)	(0.0455)
Period 11-15	0.199***	0.256***	0.0840	0.156**	0.0518	0.0833
	(0.0513)	(0.0554)	(0.0736)	(0.0662)	(0.0717)	(0.0695)
Period 16-20	0.180**	0.363***	0.185***	0.196**	0.0619	0.109
	(0.0696)	(0.0522)	(0.0517)	(0.0842)	(0.0566)	(0.0911)
Constant	0.571***	0.368***	0.469***	0.411***	0.436***	0.394***
	(0.0378)	(0.0322)	(0.0410)	(0.0441)	(0.0350)	(0.0489)
Observations	824	1450	814	1430	788	1473
F	6.428	17.36	8.303	2.798	0.826	1.692
Panel B:	no observer		partial info		full info	
DV: Strategic Default	WE	SE	WE	SE	WE	SE
Lag Strategic Default Rate	0.222***	0.346***	0.0132	0.390***	0.104	0.377***
	(0.0619)	(0.0859)	(0.0823)	(0.0805)	(0.105)	(0.0897)
Period 6–10	0.00719	0.0567	0.128*	0.0700***	0.0587	0.0249
	(0.0382)	(0.0340)	(0.0669)	(0.0196)	(0.0526)	(0.0273)
Period 11–15	0.156***	0.163***	0.0976	0.0972**	0.119**	0.00880
	(0.0380)	(0.0403)	(0.0836)	(0.0318)	(0.0480)	(0.0270)
Period 16–20	0.131**	0.233***	0.196***	0.142***	0.105*	0.0332
	(0.0552)	(0.0444)	(0.0571)	(0.0425)	(0.0469)	(0.0473)
Lag of Mean Punishment if Default/100			-0.154*	-0.0810***		
			(0.0711)	(0.0208)		
Lag of Mean Punishment if Strategic/100					-0.0745*	-0.0798***
					(0.0382)	(0.0224)
Constant	0.452***	0.254***	0.524***	0.302***	0.442***	0.350***
	(0.0575)	(0.0398)	(0.0496)	(0.0437)	(0.0604)	(0.0601)
Observations	776	1376	766	1362	615	1316
F	8.199	27.39	6.093	9.263	2.106	12.35

Notes: Cluster Robust Standard Errors in parentheses. Standard errors clustered on the unique matching group. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. **Panel A:** Individual fixed effects regression with five period interval dummies. Strategic default increases over time in no obsever and partial info conditions. **Panel B:**: Controls for peer and contagion effects added. Observing a high strategic default rate in the no obsever conditions increases strategic default. Punishment deters strategic default.

To shed more light on the origins of these different time trends, we consider more complex dynamic patterns in Panel B of Table 5. In particular, we add controls for peer and contagion effects by including variables that depict the post period information a borrower receives (i.e., the one-period-lagged strategic default rate (in all conditions) and the one-period-lagged mean punishment intensity for defaults (in the partial information conditions) or strategic defaults (in the full information conditions)). In the no obsever conditions (see columns 2

and 3), observing a higher strategic default rate significantly increases the likelihood that a borrower engages in strategic default. This effect is consistent with our theoretical approach. The higher the overall default rate is, the less bad borrowers feel about the social damage caused by a 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 fact that the effect is more pronounced in the strong economy is consistent with Results 2 and 3, which both show that a change in the overall default rate affects the strong economy more strongly. In light of these results, it is most plausible to see the increasing time trend in the strategic default rate as a convergence to a steady state. It seems that (some) borrowers enter the game with overoptimistic beliefs and then adjust their expectations over time. This process is similar to the frequently observed decline in contributions in public good experiments (see e.g., Ledyard, 1995) and is likely to be also present in real-world environments (see e.g., Feld and Torgler, 2007, who show that tax morale in Eastern Germany strongly decreased after the reunification and leveled with the tax morale of Western Germany).

The regressions using data from the partial and full information conditions (see columns 4 to 7) reveal that the same updating effects also play a role in the presence of third-party observers. In addition, however, these estimations also reveal that borrowers respond to observed punishment levels. In all four environments higher observed punishment levels in the past period decrease borrower's inclination to engage in strategic default.

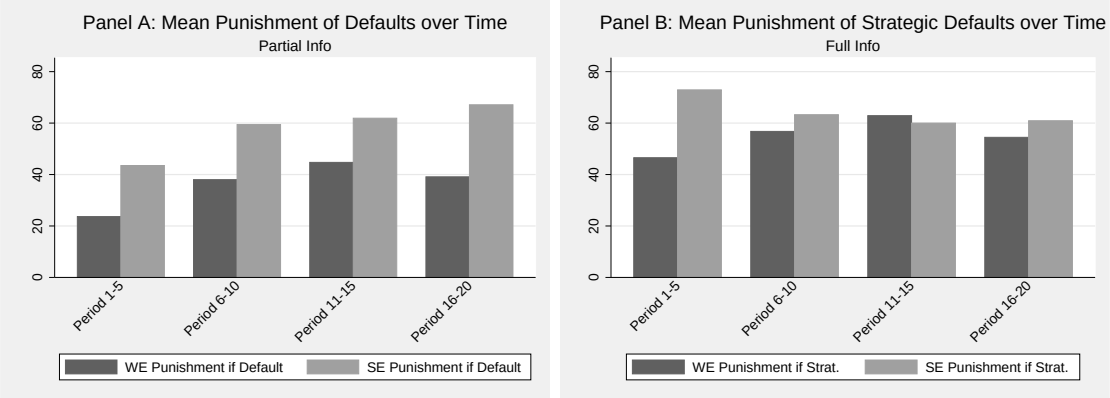
Finally, we also analyze the dynamics of observers' punishment decisions. Figure 4 illustrates the development of third-party punishment over time. The bars represent average punishment for a default (in the partial information conditions) or average punishment for strategic default (in the full information conditions) for five-period intervals of the experiment. It is evident from the figure that the differences in the punishment intensity for strategic defaults and are stable over time. The punishment of defaults under partial info is significantly higher in the SE than in the WE.[13] The punishment of strategic defaults however is not significantly different between SE and WE under full information.[14] These different punishment patterns between the partial info and full info conditions mirror the results of our previous analysis of strategic default. While there is still some difference in behavior when information is only partial, the effect is moderated under full information. Observers do not

[13]One sided ranksum tests: Period 1–5: I: N=79; p=0.06/M: N=20; p<0.01; Period 6–10: I: N=80; p=0.07/M: N=20; p=0.05; Period 11–15: I: N=80; p=0.19/M: N=20; p=0.2; Period 16–20: I: N=80; p=0.12/M: N=20; p=0.07.

[14]One sided ranksum tests: Period 1–5: I: N=73; p=0.16/M: N=20; p=0.09; Period 6–10: I: N=76; p=0.38/M: N=20; p=0.5; Period 11–15: I: N=72; p=0.46/M: N=20; p=0.34; Period 16–20: I: N=72; p=0.44/M: N=20; p=0.38.

deem strategic default more acceptable when economic conditions are adverse. Further, the figure highlights that the punishment of defaults in the partial info condition increases over time. Whereas punishment of strategic default only increases in the WE full info condition in the second five period interval and is stable thereafter. The opposite is the case in the SE full info condition. Punishment of strategic default is highest in the first five periods and stabilizes on the same level as punishment of strategic default in the WE full info condition. Because of this increasing trend of punishment in the partial info condition and the stabilizing trend of punishment in the full info condition we conclude that punishment is contagious in the partial info condition. In contrast, a larger share of observers already disciplines norm violating behavior in the first periods in the full information condition.

Figure 4: Mean Punishment over Time



Notes: **Panel A:** Average punishment of defaults in the WE and SE partial info 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 info 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.

To give a more detailed picture we present results from individual fixed effect regressions in table 6. We split the table into two parts: Panel A and Panel B. In both panels the dependent variable is the number of punishment points an observer assigns to defaults in the partial info conditions (column 2 and 3) and strategic defaults in the full info conditions (column 4 and 5). Like in the analysis for borrower behavior, we first run regressions including only dummies for the different five period intervals. Punishment of defaults increases significantly over time in the partial info conditions while in the full info condition punishment of strategic defaults only increases in the WE condition. Confirming the results from figure 4, a large share of impartial observers already sanctions in the first periods in the full information condition. In Panel B, we include variables that describe the information observers receive in the different information conditions. Again, we find that punishment of defaults increases over time in

the WE partial information treatment and that punishment is contagious as well. Column two highlights this. We see similar, yet less (and insignificant) contagious behavior in the SE partial information treatment. We do not observe this in the full info treatments (column 4–5). Here too, the results from figure 4 and Panel A are reinforced: a larger share of observers who punish conditional on the punishment of others discipline strategic defaults already in the first periods of the experiment. In conclusion, a smaller share of conditional punisher engages in costly punishment due to the observed punishment of others in later periods. Whereas in the weak economy under partial information, observers recognize that a substantial share of other observers punishes after several periods, and as a result, they themselves start to enforce the social norms.

Table 6: Fixed Effects Linear Regressions: Punishment of Default and Strategic Default within Treatment

Panel A:	partial info		full info	
	WE	SE	WE	SE
Punishment of	Default	Default	Strategic	Strategic
Period 6-10	14.09*	14.73*	-0.666	0.499
	(7.416)	(7.693)	(6.733)	(15.65)
Period 11-15	29.49**	16.91	13.13	-6.683
	(11.88)	(9.303)	(8.458)	(17.23)
Period 16-20	20.65**	22.80**	13.44	-5.320
	(8.273)	(8.731)	(12.73)	(19.62)
Constant	21.97***	45.64***	56.24***	72.55***
	(6.207)	(4.792)	(6.412)	(12.58)
Observations	761	639	319	517
F	2.350	3.620	0.966	0.117
Panel B:	partial info		full info	
	WE	SE	WE	SE
Punishment of	Default	Default	Strategic	Strategic
Period 6-10	7.930*	9.218	-3.991	-2.943
	(3.619)	(9.727)	(7.764)	(14.82)
Period 11-15	16.06**	9.210	11.82	-7.466
	(6.240)	(13.08)	(7.686)	(17.00)
Period 16-20	7.896	14.96	15.35	-6.489
	(5.821)	(9.501)	(13.21)	(15.93)
Lagged Strategic Default Rate	-8.478	11.94	-1.739	-22.98
	(7.890)	(13.47)	(8.566)	(29.74)
Lag of Mean Punishment if Default/100	44.76***	10.72		
	(11.07)	(11.07)		
Lag of Mean Punishment if Strategic/100			0.298	10.73
			(7.002)	(6.961)
Constant	18.61***	39.10***	53.26***	79.88***
	(4.644)	(9.433)	(5.864)	(17.00)
Observations	721	610	274	487
F	29.00	1.725	0.923	1.459

Notes: Cluster Robust Standard Errors in parentheses. Standard errors clustered on the unique matching group. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. **Panel A:** Individual fixed effects regression on assigned punishment points for defaults (partial information condition) and strategic defaults (full information condition) with controls for five period time intervals. Punishment is contagious in the partial infromation conditions. **Panel B:** Controls for lagged strategic default rate in a matching group and lagged mean punishment of a default (in partial info conditions) and a strategic default (in full info conditions) added. Again, punishment is contagious in the partial info conditions.

5 Conclusion

This paper empirically investigates behavioral mechanisms underlying borrowers' tendency to increasingly engage in strategic defaults during in 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 in nature and not directly caused by households' liquidity problems.

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 morally 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 a 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-observers are fully informed about the nature of a default, their willingness to intervene does not depend on the state of the economy. This reveals that impartial spectators deem it likewise unacceptable to increase ones own monetary benefit at the expense of someone else in good and bad economic conditions. The true reason for the decrease in norm enforcement is that an economic downturn creates informational uncertainty. In times of a crisis, partially informed peers of defaulting household can less clearly distinguish between strategic and fundamental defaults. As outside-observers 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 rather transparent household social norms are more likely to deter strategic default in an economic downturn than in large and very anonymous environments.

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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: $(1 - \delta_i(d))D < L$. This yields $\delta_i(d) > 1 - \frac{L}{D}$. 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: $(1 - \delta_i(d))W > R$. This yields $\delta_i(d) < 1 - \frac{R}{W}$. The remaining part of the borrower population $(1 - \frac{L}{D} < \delta_i(d) < 1 - \frac{R}{W})$ make conditional repayment. These borrowers 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 incime) as α. To ensure that repaying is optimal for a conditional cooperator the following condition needs to be met: $L + \gamma\alpha\Delta \geq (1 - \delta_i(d))(D + \gamma\alpha\Delta)$. This yields $\alpha \geq \frac{(1-\delta_i(d))D - L}{\gamma\delta_i(d)\Delta}$. □

Proof: Proposition 1. Borrowers are willing to repay if the expected utility from repaying is at least as large as the expected utility from strategically defaulting. Assuming that all borrowers with $\delta_i(d) > \bar{\delta}$ 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 $U_i(d) = (1 - \delta_i)(D + \gamma(1 - F(\bar{\delta}))\Delta)$. In equilibrium the marginal borrower must be indifferent between repayment and strategic default which yields the condition: $L + \gamma(1 - F(\delta_N^*))\Delta = (1 - \delta_N^*)(D + \gamma(1 - F(\delta_N^*))\Delta)$. 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 $\frac{d\delta_N^*}{d\gamma} = -\frac{D + \gamma(1 - F(\delta_N^*))\Delta - \delta_N^*\gamma f(\delta_N^*)\Delta}{\delta_N^*(1 - F(\delta_N^*))\Delta}$, which is strictly negative. Notice: Entering $\gamma = 0$ in the implicit definition reveals that δ_N^* is bound below by $1 - \frac{L}{D}$, i.e. if the probability of a positive income is zero, only unconditional repayments occur in equilibrium. Moreover, δ_N^* is strictly smaller than $1 - \frac{R}{W}$. This follows from the fact that $1 - F(1 - \frac{R}{W}) < 1$ (because $\delta_{min} < 1 - \frac{R}{W}$) and therefore $L + \gamma(1 - F(\frac{R}{W}))\Delta < (1 - \frac{R}{W})(D + \gamma(1 - F(\frac{R}{W}))\Delta)$. Thus, even if all borrowers have always a positive income ($\gamma = 1$), there are always some borrowers with $\delta_i(d) > 1 - \frac{R}{W}$ who do not repay in equilibrium. □

Proof: Lemma 2. Observers punish borrowers if the expected utility of punishing is larger than the expected utility of not punishing. Assume that the observers 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: $U_k(p_{ik} = 0) = b_{ki}(1 - \phi(d, 0))E + (1 - b_{ki})E$. Equalizing $U_k(p_{ik} = 1)$ and $U_k(p_{ik} = 0)$ using our

assumption that $\phi(r,1) = \beta\phi(d,0)$ yields the threshold belief necessary to make punishment optimal: $b_{ki} = \frac{\beta\phi_k(d,0)E+\kappa}{(1+\beta)\phi_k(d,0)E}$. Rearranging terms and solving for $\phi_k(d,0)$ leads to the minimally necessary concern for norm violations: $\phi_k(d,0) = \frac{\kappa}{((1+\beta)b_{ki}-\beta)E}$. □

Proof: Proposition 2. Lemma 2 implies that the expected punishment for strategic defaulter under partial information corresponds to $1 - G\left(\frac{\kappa}{((1+\beta)b_{ki}-\beta)E}\right)P$. Subtracting this from the payoffs of defaulting in the the equilibrium condition in Proposition 1 directly yields the equilibrium condition in Proposition 2. The belief b_{ki} is calculated by dividing the fraction of borrowers who engage in strategic default ($\gamma F(\delta_P^*)$) by the total fraction of defaults ($1 - \gamma(1 - F(\delta_P^*))$). □

Proof: Proposition 3. The equilibrium condition in Proposition 3 follows from inserting a belief of $b_{ki} = 1$ in the corresponding condition in Proposition 2. □