Laws and Norms: Experimental Evidence with Liability Rules

B. Deffains[*], R. Espinosa[†], C. Fluet[‡]

March 1, 2017

PRELIMINARY DRAFT, PLEASE DO NOT CIRCULATE

Abstract

Subjects facing varying circumstances choose between actions which provide private benefits but may impose losses on strangers. We compare three legal environments: no law, strict liability and an efficiently designed negligence rule. Liability rules are either perfectly enforced (Strong Law) or only weakly so (non-deterrent Mild Law). Under Strong Law, when self and group interest conflict, strict liability and the negligence rule efficiently regulate behavior and do much better than no law; in circumstances without conflict, no law and the negligence rule are equally efficient but strict liability does less well because it over-deters. Under non-deterrent Mild Law, in circumstances with conflict, both liability rules still regulate behavior better than no law but strict liability does better than the negligence rule even though monetary incentives are the same; in circumstances without conflict, strict liability again over-deters while no law and the negligence rule are equally efficient. We investigate how legal sanctions and social preferences might interact to yield this pattern.

[1]Université Paris 2, CRED, University of Liverpool, IUF.
[2]Université Paris 2,CRED.
[3]Université Laval, CRREP, CRED.

1 Introduction

A main purpose of liability rules is to deter behavior generating negative externalities. Under the so-called strict liability rule, individuals must compensate the harm they impose on others, i.e., the harm is internalized irrespective of precautions or circumstances. Under a negligence or fault-based rule, individuals must compensate if their behavior fell short of some legal standard of conduct. In either case, and provided the legal standard of conduct in the negligence rule is appropriately set, perfectly enforced liability rules yield socially efficient incentives to avoid causing harm. Conversely, when legal liability is nonexistent or is only imperfectly enforced, e.g., injurers are not always detected or victims seldom file suit, individuals are underdeterred. The usual prediction is then that behavior will be socially inefficient and negative externalities will arise too often.

Casual observation, however, and quite a few empirical studies suggest that there are many situations where people avoid privately profitable but socially harmful behavior irrespective of legal sanctions. There is also a voluminous experimental literature on social dilemma situations, e.g., experiments on voluntary contributions to a public good, showing that individuals are not solely motivated by their own material payoff. One strand of this literature examines how contributions to the public good might be influenced by the "legal obligation" to contribute, even if such an obligation is weakly enforced. We study a variant of the public good game where individuals must trade-off their private gain against the harm caused to others and may or may not face legal sanctions in the form of liability rules.

In our experiment, subjects repeatedly interact with strangers in a game where each participant must choose between actions which provide private benefits but may also cause losses to others. Participants face varying and randomly occurring circumstances over time. In some circumstances, the net private gain from the harmful action (over that of the harmless action) is greater than the loss imposed on others. The harmful action is then socially efficient in the sense that in the long run everyone's wealth would be greater if everyone chose the harmful action in such circumstances. In other circumstances the situation is reversed. While the net private gain from the harmful action remains positive, it is smaller than the loss imposed on others. From a social point of view, the harmful action should then be avoided in such circumstances because it reduces average per capita wealth.

We compare three legal environments: no legal liability which we refer to as No Law, strict liability and an efficiently designed negligence rule. In the latter, the legal standard of conduct is that individuals avoid liability if the loss imposed on others is smaller than the net private gain from the harmful action. Essentially, individuals must then trade-off appropriately their private gain against negative externalities, otherwise they are legally liable. Liability rules are either perfectly enforced (Strong Law) or only weakly so (Mild Law). Under Strong Law, individuals causing harm are always detected. When the rule is strict liability rule, the individuals detected are forced to fully compensate victims; under the negligence rule, they must do so only if their behavior did not conform with the legal standard of conduct. Under Mild Law, the individuals causing harm are detected only half of the time. The calibration of payoffs is such that Mild Law should be non-deterrent for most individuals; that is, except for those with an exceptionally high degree of risk aversion.

Under either No Law or Mild Law, and assuming common knowledge of self-regarding individuals, the prediction is that participants should always choose the harmful action irrespective of circumstances. Under Strong Law, they should always behave efficiently from a social point of view. Our experiment, however, demonstrates a somewhat different pattern of behavior. Under Strong Law, in circumstances where self and group interest conflict, strict liability and the negligence rule efficiently regulate behavior and do much better than no law, as would be expected if individuals had purely self-regarding preferences. However, in circumstances without conflict, while no law and the negligence rule are equally efficient as again would be expected, strict liability does less well because it over-deters. Under Mild Law, in circumstances with conflict, both liability rules do significantly better than No Law even though the threat of legal sanction is essentially non-deterrent; moreover, strict liability then does better still than the negligence rule even though monetary incentives are exactly the same. Finally, in circumstances without conflict, strict liability under Mild Law again over-deters while no law and the negligence rule are equally efficient. We investigate how legal sanctions and social preferences might interact to yield this pattern of behavior.

The paper proceeds as follows. Section 2 briefly reviews the relevant experimental literature. Section 3 presents the experimental design. Section 4 draws on the theoretical literature on social preferences to develop a simple model from which predictions are derived for our experiment. Section 5 presents the results. Section 6 discusses additional points of interpretation and Section 7 concludes.

2 Literature Review

To be completed...

3 The Experiment

Subjects must choose between actions which provide private benefits but may also impose losses on others. They make decisions in situations differing in the liability rule for the harm caused to others and the extent to which the law is enforced.

3.1 Design

The experiment consists of three phases. The first phase is a series of short games testing for the participants' risk aversion and social preferences. The second phase is the core of the experiment. Subjects play the *Liability Game*, a game in which legal rules and the enforcement policy change across treatments. This game is repeated 10 times with blaming points and is followed by a modified version of the same game, the *Punitive Liability Game*, in which blaming points are replaced by costly punishment points, also repeated 10 times. Finally, in the third phase, we run a questionnaire for demographics and additional control questions.

3.1.1 Liability Game

Common Set-up. After the preliminary phase, participants are introduced to the liability game with a new set of instructions. They are told that they are going to play a game that will be repeated 10 times. At each round, they will be randomly and anonymously matched into groups of 4 participants.

Participants start each round with an initial endowment of 20 ECU. At each round they need to choose between two actions, Y and X. Action Y yields an income of 6 ECU and does not affect the other participants' earnings. Action X yields a state-dependent income and reduces by 4 ECU the earnings of each other participant in the group. At the beginning of each round, a random state is drawn for each participant among four possible states, A, B, C and D, with equal probability (i.e., 25%). States are independently drawn and are private information all along the game. The states define a participant's circumstances with respect to the private benefit of action X: action X yields an income of 14 ECU in state A, 16 ECU in state B, 20 ECU in state C, and 22 ECU in state D.

Treatments. Participants were subjected to five different treatments defined in terms of the applicable liability rule and the enforcement policy.

- **No Law (NL).** In the first treatment, there is no liability rule. Each participant has to bear the losses caused by the actions X of other participants in the group. A participant's net payoff per period, in addition to the endowment at the start of the round, is therefore (i) the private benefit from one's own action Y or X, (ii) minus the losses caused by the actions X of other participants.

- **Strong Strict Liability (SSL).** In the second treatment, participants are are told they will be required to compensate the other group members for the losses caused by their decision to engage in action X. Therefore no one suffers from the other participants' decision to engage in X. The net period income equals (i) the private benefit from one's own action Y or X, (ii) minus the damages (12 ECU) for compensation if action X was chosen.
- **Strong Negligence Rule (SNR).** In the third treatment, participants are told they will be required to compensate for the losses caused by their action X only if they were in state A or B. A participant therefore suffers from the other participants' actions X only if these actions were undertaken in the circumstances C or D. The net period income equals (i) the private benefits from one's own action Y or X, (ii) minus the damages (12 ECU) for compensation if they choose X in state A or B, (iii) minus the losses caused by the other participants' decision to engage in X in the circumstances C or D.
- **Mild Strict Liability (MSL).** The fourth treatment is similar to the second treatment, except that participants who engage in X are made to compensate only with a probability equal to 0.5, henceforth the detection or enforcement probability. The net period income equals (i) the private benefit from one's own action Y or X, (ii) minus the eventual damages (12 ECU) for compensation if they choose X and are detected, (iii) minus the losses caused by the other participants' decisions to engage in X that were not detected.
- **Mild Negligence Rule (MNR).** The fifth treatment is similar to the third treatment, except that participants who engage in X in state A and B are made to compensate only with a probability of one half. The net period income equals (i) the private benefit from one's own action Y or X, (ii) minus the eventual damages (12 ECU) for compensation if the participant chooses X in state A or B and is detected, (iii) minus the losses caused by the other participants' decision to engage in X when either they were in state C or D or they were in the states A or B but were not detected.

Blaming Points and Payoffs. At the end of each period, participants learn the number of other group members who chose action X. In all treatments but *No Law*, participants also know whether each of the other three group members (anonymously identified as player 1, 2 or 3) had to compensate other participants, i.e., was held "liable". Individual actions and states of nature are therefore private information except in so far as actions and states can be inferred from the assignment of liability.

After receiving this information and learning their period payoff, participants have the opportunity to assign blaming points (between 0 and 6) to each other participant in their group. The blaming points are individual. After the assignment of blaming points, a final screen displays to each participant the amount of blaming points he/she received.

In the liability game, the total period payoff of individual i in state $s(i) \in \{A, B, C, D\}$ is given by:

$$\text{payoff}_i = 20 + X_i(R_{s(i)} - 12\,\text{cond}_i) + 6(1 - X_i) - 4\sum_{j \neq i} X_j(1 - \text{cond}_j) \tag{1}$$

where X_i is a dummy variable equal to 1 if the individual i chooses action X and 0 if action Y is chosen; cond_i is a dummy variable if individual i has been required to compensate for the losses due to action X; $R_{s(i)}$ is the income from action X in state $s(i)$.

The variable cond_i is defined as follows:

$$\text{cond}_i = \begin{cases} 0 & \text{in No Law} \\ X_i & \text{in Strong Strict Liability} \\ \mathbb{1}_{A,B} X_i & \text{in Strong Negligence Rule} \\ \mathbb{1}_{\text{det}} X_i & \text{in Mild Strict Liability} \\ \mathbb{1}_{\text{det}} \mathbb{1}_{A,B} X_i & \text{in Mild Negligence Rule} \end{cases}$$

where $\mathbb{1}_{A,B}$ is a dummy variable equal to 1 if individual i is in state A or B and equal to 0 otherwise; $\mathbb{1}_{\text{det}}$ is a dummy variable equal to 1 if individual i is detected when he/she engages in action X, and is 0 otherwise.

Control Questions. Before playing the game, participants were asked a series of question to insure that the game was well understood. We generated a mock stage game in which we displayed the actions, situations and condemnations of all four participants. Control questions were designed to address all the mechanisms that affect the period payoff. Participants had to fulfill, step by step, a table which required to compute the losses each participant imposed and bore, the compensation each of them gave and received, and their final payoff. In the appendix, we show the control questions for the *Mild Negligence Rule* which was the most demanding regarding the complexity of the mechanisms at play.

3.1.2 Punitive Liability Game

After the ten rounds of the *Liability Game*, participants are given a new set of instructions for the *Punitive Liability Game* and learn that they will play another 10 rounds of the previous game. The only change compared to the 10 previous rounds is that blaming points are replaced by sanction points. Participants have the opportunity to impose sanction points on other group members. Each point decreases both the participant's and the target's payoff by 0.5 ECU. Each participant can assign up to 6 sanction points to each group member.

In the *punitive* liability game, payoffs are given by:

$$\begin{aligned} \text{payoff}_i \quad = \quad & 20 + X_i(R_{s(i)} - 12\ \text{cond}_i) + 6(1 - X_i) \\ & -4 \sum_{j \neq i} X_j(1 - \text{cond}_j) - 0.5\ [\sum_{j \neq i} \text{sanct}_{i,j} + \sum_{j \neq i} \text{sanct}_{j,i}] \end{aligned} \tag{2}$$

where $\text{sanct}_{k,m}$ is the number of sanction points imposed by participant k on participant m.

3.1.3 Questionnaire

After the *Punitive Liability Game* participants are asked to fill out a questionnaire on demographics (age, gender) and on preferences and self-perception. These include (i) self-declared political orientation, (ii) attitude with respect to state intervention in the economy, (iii) self-assessed risk aversion, (iv) the extent to which they see themselves as selfish, (v) how much they think others see them as selfish, (vi) the extent to which they feel concerned about the well-being of others, (vii) how much they think others see them as being concerned by the well-being of others. For cross-study comparison purposes, the last four questions were adapted from Angelova et al. (2014).

4 Model and Predictions

To be completed...

5 Results

Procedures. The experiment was computerized using z-Tree (Fischbacher 2007). We ran 10 sessions (two per treatment) in May, July and September 2016 in Québec (Canada) and Strasbourg (France). Each session included 20 participants, amounting to five groups of four subjects at each round, except for one *No Law* session that included only 16 participants.

Overall, 196 participants took part in the experiment. An ECU was convertible to Canadian dollars at 30 ECU = 1 dollar or to Euros at 40 ECU = 1 Euro.

In the following paragraphs, we are firstly interested in decisions to undertake X across treatments. Second, we investigate how blaming/sanctioning decisions were made. Finally, we discuss the overall efficiency of the five legal frameworks.

5.1 Decision to undertake X

5.1.1 Proportion of X actions across treatments

The main objective of the liability rules is to regulate the undertaking of non-efficient actions. The above theoretical section develops predictions about the behaviour of *homo œconomicus* agents under the five legal systems under scrutiny. In this section, we propose to confront these predictions with actual observed behaviours.

Figure 1 displays the proportion of actions X undertaken in every situation and every context. First of all, it appears that the presence and the strength of a legal system greatly impacts the choices to undertake the socially efficient choice in case of discrepancy between public and private optima (i.e. cases A and B). We observe indeed the greatest proportion of actions X in situations A and B under *No Law*, and the lowest proportion under *Strong Strict Liability* and *Strong Negligence Rule*. In this regard, it seems that the legal systems successfully achieve their main objective: by modifying private incentives, they partially align them with the public interests, and thus reduce the level of socially inefficient negative externalities.

However, the observed data partially contradict several of the theoretical predictions based on the *homo œconomicus*. Indeed, two phenomena are in contradiction with the predictions developed in the above section. First, we observe that the *Strict Liability* systems, both in mild and in strong enforcement frameworks, yield a lower proportion of actions X than the *Negligence Rule* and the *No Law* systems in situations C and D (i.e. in cases where it is optimal to do so). In the *homo œconomicus* theory, all participants would be expected to undertake the same level of X action, namely 100% of the choices. Second, we observe a lower proportion of X actions in situations A and B in mildly enforced systems than in *No Law*. In these cases, it is privately inefficient to undertake Y but about half of the participants choose to do so. Third, we observe a proportion of X actions which is increasing with the situation: more participants tend to undertake X in situation B than situation A, or in situation D than situation C, while the *homo œconomicus* theory would predict similar choices.

In order to understand the main factors that the drive the choices to undertake X, we propose a first and naive exploration of the data. First, we run a probit regression of the individual decision to undertake X. To account for the proportion of the data that could be explained by the *homo œconomicus* theory, we consider a dummy variable indicating if X is privately optimal as an explanatory variable. Such a model explains about 31% of the data.[1] Using the estimates, we predict the probability of undertaking X for each observation, and we plot this probability per situation and per legal system (figure 2). As one can see, this model partially corrects the *homo œconomicus* theory by allowing a natural proportion of participants who take non-optimal choices (i.e. Y actions in cases A and B and X actions in cases C and D). However this model fails at explaining three above characteristics of the data. Second, we consider the expected relative gain of doing X rather than Y as the main explanatory variable. In a probit regression, we observe that 40.4% of the variations in the decisions can be explained by this single variable. Figure 3 shows the prediction based on this last model. As one can see, this model reproduces more features of the observed data. It accounts indeed for all trends discussed above. Finally, we add to this last model the social benefit of undertaking X rather than Y. A probit estimation including both the private and social gains explain 41.6% of the variations of the data. The inclusion of the social gain explains a low proportion of the observations, but its contribution can be observed graphically. Figure 4 shows indeed that the last model is closer

[1] It corresponds to the pseudo R^2 statistics.

to the observed data than the model without the social gains[2]: proportions of actions X are increased in situations C and D under SSL and decreased in situations A and B under MSL.

This preliminary observations imply few results. First, the *homo œconomicus* theory alone fails at explaining the behaviours observed in each legal system. Second, it seems much more likely that participants have a propensity of undertaking X which is increasing with the private benefits of doing so. In other words, participants face a trade-off between a inconfort of undertaking X and its relative benefits. By modifying this tradeoff, legal systems affect the participants' behaviours. The last model suggests that the social benefits of undertaking X might also enter in play: the more efficient actions X are, the more participants agree to undertake X.

5.1.2 Individual decisions to undertake X

In order to deepen these results, we investigate several econometric models. Investigating the factors that drive individual decisions in the five treatments faces one main challenge: because of the very nature of the situations addressed in the literature on liability rules, the social and private gains are strongly correlated: since the costs of accident are fixed, variations of the social gains are (almost) equivalent to variations of the private gains.[3] It follows that private gains and social gains are correlated *within* treatments but not *across* treatments. Given the low amount of treatments and the necessity to cluster data per session, standard econometric model may be too conservative and reject too often one of the two variables.

We thus propose two strategies to econometrically investigate individual decisions to undertake X. First, we propose to use a linear probability model with individual random effects models and robust standard errors clustered at the session level. Second, we propose to use hierarchical models with nested random effects: each individual is assigned to one and only one session, which, in turn, is made of one and only one treatment.

Tables 1 show the estimates of the two kinds of estimations. The first model regress the decision to undertake X on the expected private gain of doing it rather than Y, the social gain of doing X relatively to Y, a linear time trend, and socio-demographic variables[4]. The second model focuses on the first half of the experiment, and integrates the number of blames received at the previous period. The third model is similar to the second model but integrates sanction points rather than blaming points.

Estimates of table 1 yield three main results. First, the private gains are significantly affecting one's decision to undertake X: the higher the expected gain, the more individuals are choosing X. Second, some elements indicate that individuals are also concerned by the social welfare: the greater the social gains to undertake X, the more individuals choose X over Y. The coefficient associated to *socialGain* is indeed significant in the hierarchical models. The lack of significance in the linear probability models may result from the strong correlation between the private gain and the social gain within each session, as discussed above. Third, it seems that social stigmatisation significantly affects one's decision to undertake X. The estimated coefficients associated with blame and sanction are both negative, which suggests that individuals are less likely to engage in X when they have been blamed at the previous period. These coefficients are significant for both types of models for the sanctions and for the hierarchical model for the blames.

Finally, we take advantage of the hierarchical model to plot the estimated treatment random effects (figure **??**). These estimates result from hierarchical model 1.[5] They represent the overall

[2] A likelihood ratio test rejects the fact that the social gain has no impact ($p<0.001$).

[3] Variations are equivalent in systems with no uncertainty, and are almost equivalent in systems with mild enforcement.

[4] The control variables include age, political orientation, preference for state interventionism, risk aversion, self-perception of one's selfishness, self-reported third-party perception of one's selfishness, self-perception of one's social concerns, self-reported third-party perception of one's social concerns.

[5] Note that we observe the same qualitative effects if we include treatment fixed effects in the linear probability model 1.

likelihood to undertake X in each treatment net of the effects of private gains, social gains, time trends, individual controls, individual effects and session effects. As one can see, the two liability rules generate similar behaviours in case of perfect enforcement. The degenerescence of the legal enforcement does not seem to affect participants' behaviours beyond the factors already taken into account. We observe however a very high proportion of X under *Mild Negligence Rule*and *No Law*, which remain unexplained by the above factors.

5.2 Blames and sanctions

5.2.1 Intensity of blames and sanctions across treatments

The design of the experiment allowed participants to assign either blaming (first 10 periods) or sanction points (last 10 periods) to other members of their group. While blaming was free, sanctioning was as costly for the punisher as for the target.

Blame Graph 5 displays the average number of blaming points received by individuals per period in each treatment. The overall picture looks the opposite to the per period profit: blames are maximized under the *NoLaw* treatment, they are equivalent in mild enforcement (MSL and MNR), lower in SSL, and minimized in SNR. One possible explanation is that the normative message changes across treatments, and some systems generate more blamable actions than others. First, it appears that, in perfect enforcement, strict liability generates more blames than the negligence rule (SSL>SNR, $p<0.001$). This difference might result from the normative implication of the legal rules: under strict liability, participants might think that undertaking X is *per se* bad (because participants are then forced to compensate), while they might believe that undertaking X is somehow more acceptable under the Negligence Rule. Second, we note that the difference between the two legal rules is however not significant when enforcement becomes weaker (MSL>MNR, $p=0.249$). The overall increase of blaming points between the strictly and mildly enforced system reduces indeed the gap. This increase in blaming points might result from the increase in non-efficient choices (i.e. the increase in X) that the weakening of the mild enforcement generates. Finally, the *No Law* treatment generates the highest level of blames ($p<0.001$ for all pairwise comparisons). This effect is coherent with the fact that the *NoLaw* treatment maximizes the number of non-efficient choices and the amount of negative externalities.

Graph 7 further investigates the blaming decisions by presenting the number of received blaming points according to the compensation status of the participants (i.e. whether they had to compensate other participants). First, we observe a general trend toward more blames for participants who compensated (SSL, SNR, MSL : $p<0.001$). This result suggests that participants are more likely to blame people who undertook X. Indeed, in all treatments, participants who compensated had a higher probability to have undertaken X than those who did not. Second, we observe a non-zero level of blames for those who did not compensate. This is coherent with the blaming of X actions in some treatments but not in SSL. In strong strict liability, participants who did not compensate did not undertake X for sure. This observation suggests that other factors drive blaming than undertaking X only. We cannot exclude a natural level of blame, blind revenge, framing effects or other non-observed factors.

Sanctions From a descriptive perspective, the sanctioning decisions seem to differ from the blaming ones. Figure 6 shows the average number of sanction point received per individual per period across treatments. (Recall that one sanction point cost 0.5 ECU to both the target and the punisher.) The overall level of sanction points is significantly lower than the number of blames. It implies that the social stigma observed when blaming is non-costly are very sensitive to the cost of stigmatization. Second, we also observe that the strict liability system generates the highest amount of sanction points (SSL>all but MSL, $p<0.001$; MSL>all but SSL, $p<0.02$).

When looking at the number of received sanction points conditionally on the compensation status, we observe a similar trend as for blaming. Figure 8 shows indeed that individuals who compensated received higher sanctions than those who did not, in all treatments.

5.2.2 Blaming and sanctioning decisions

We now investigate blaming and sanctioning decisions at the individual level. To do so, we investigate several specifications. First, given the above observations, we seek to explain blaming decisions by the fact that the target has been condemned (Model 1). Second, we investigate blaming decisions in case of uncompensated accidents (Model 2): how the number of uncompensated accidents affect one's decision to blame/sanction condemned and uncondemned targets? Third, we analyze whether blind revenge blaming/sanctioning occurs in our context as it has been emphasized in public good games. We thus add a variable that accounts for the number of blaming/sanctioning points a punished has received during the previous round (Model 3). We then decompose this effect according to the action undertaken at the previous round. We aim at measuring whether blind revenge occurs when one was blamed/sanctioned for a rightful reasons (i.e. when he/she undertook X) or when one was blamed although he/she was not causing externalities (Model 4). Finally, we run a last specification which is equivalent to Model 4 but express the blaming/sanctioning behaviors in case a individual undertook X at the previous round as a deviation from the mean (Model 5).

Table 3 displays the results of these estimations for the blaming decisions. First, we observe that participants mainly blame those who have been condemned (models 1 to 5). Second, it appears that participants are increasing their blames the more uncompensated accidents remain (models 2 to 5). Altogether, these results show that participants dislike when actions X are undertaken. Third, the data show significant blind revenge behaviors: the more one has been played at the previous round, the more one is likely to blame (model 3). When we decompose this effect, we see that blind revenge occurs as well when one undertook X as when he/she undertook Y. The effect seems to be however larger when one was blamed after doing Y (model 4), but this difference of blind revenge is not statistically significant (model 5).

As far as sanctioning decisions are concerned, we observe a similar pattern. It appears indeed that individual who are condemned are primarily targeted by other participants: they receive a significantly higher number of sanction points (models 1 to 5). Second, one of the two estimation methods detects more sanctioning points for non-condemned participants when more X actions remain uncompensated (models 2 to 4 of Hierarchical model). Unlike the blaming behaviors, we observe here no blind revenge phenomenon: the cost of punishment prevents participants to engage in profit-decreasing revenge behaviors (models 3 to 5).

5.3 Efficiency

Finally we discuss the comparative efficiency of the different legal environments. A natural measure of efficiency is the average net social payoff per action, where the average is taken over all decisions made by the participants. In any round and for any legal environment, the average net social payoff per action is proportional to the average per capita net income of participants, abstracting from initial endowments. Of course, averaged over many rounds of play, the social payoff per action will depend on the frequencies of the circumstances A, B, C and D as well as the behavior of participants across circumstances.

Table ?? shows the average social payoff per action in each circumstance where decisions were made. As benchmark, we also show the maximum feasible net social payoffs that would have obtained had every participant chosen the action maximizing group wealth given the circumstances. Similarly, we show the minimum social payoffs that would have obtained had all participants behaved inefficiently.[6] Note that the social gain from behaving efficiently depends on the circumstances: the difference between the maximum and minimum social payoff is 4 ECU

[6] The maximum in the states A and B is the income from action Y; in the states C and D it is the income from X minus the harm to others. The minimum in the states A and B is the income from X minus the harm to others; it is the income from Y in the states C and D.

in the states A and D; it is only 2 ECU in the states C and D. Socially appropriate incentives matter more in some states than others.

	States			
	A	B	C	D
No Law	2.47	4.06	7.98	10
Strong Strict Liability	5.62	5.63	7.66	9.65
Strong Negligence Rule	5.4	5.7	7.88	9.88
Mild Strict Liability	4.33	4.72	7.67	9.87
Mild Negligence Rule	3.83	4.5	7.98	9.95
Minimum feasible	2	4	6	6
Maximum feasible	6	6	8	10

Consider first the circumstances A and B where self-interest is opposed to group interest. As would be expected, *Strong Law* does much better than *No Law* ($p < .001$ for both SSL and SRN in both states A and B). But the same is also true of *Mild Law.* It does less well than *Strong Law* ($p < .001$ for both legal rules) but still significantly better than *No law* ($p < .001$ for both MSL and MNR in both states A and B). As emphasized in the experimental literature on compliance, even non deterrent legal rules therefore play a role in partly aligning incentives with the group interest. When enforcement is perfect, strict liability and the negligence rule perform equally well. When the law is weakly enforced, however, *Mild Strict Liability* does somewhat better than the *Mild Negligence Rule* ($p = 0.0145$ for situation A and $p = 0.0141$ for situation B). We further discuss this result below. It may also be noted that in state A, where self-interest and group interest are most opposed, the social payoff per action under *No law* is itself greater than the minimum feasible (*). Even in the absence of legal rules, some individuals refrain from causing harm when their private benefit is small compared with the losses they would impose on others.

Consider next the circumstances C and D where there is no conflict between self-interest and group interest. The behavior of self-interested agents is then expected to be the same in all legal environments and yield the socially efficient decision. Indeed, participants almost always behave efficiently under *No Law* (**). As a rough approximation, this is also the case under *Strong Law* and *Mild Law.* But the equivalence is not perfect. Compared with *No Law* , both *Strong* and *Mild Strict Liability* significantly over-deter ($p < .001$ for SSL, and $p < .001$ and $p = 0.0153$ for MSL in states C and D respectively). By design, strict liability internalizes the harm to third parties, if only imperfectly so when the law is weakly enforced, and delegates to individuals the decision to make the appropriate trade-offs between private benefit and external harm. Our results suggest, however, that some individuals perceive the legal rule as an obligation to abstain from harm causing actions and are reluctant not to comply, even when compliance is both privately and socially costly. Thus, in circumstances such as C or D, *Strict Liability* does less well than *No Law.* By contrast, the *Negligence Rule*, which imposes no obligation in the circumstances C and D, performs better than *Strict Liability* ($p < .001$ and $p = .0158$ for Strict enforcement, and $p < .001$ and $p = .1698$ in case of mild enforcement), a little bit worse than *No Law* in perfect enforcement ($p = 0.0094$ and $p = 0.0198$), and similarly to *No Law* in mild enforcement ($p = 0.8493$ and $p = 0.1535$).

Summing up and now focusing on strict liability versus the negligence rule, we have the following stylized facts. When the law is perfectly enforced, both strict liability and the negligence rule perform equally well in circumstances where there is a conflict between self-interest and group interest. However, the negligence rule does better in circumstances with no conflict of interest because strict liability over-deters some individuals. Over all circumstances, under perfect enforcement, the negligence rule therefore does somewhat better. When enforcement is imperfect, however, deterrence is sub-optimal in situations where private and group interests conflict. In our results, mildly enforced strict liability does somewhat better than the mildly enforced negligence rule, even though material incentives are exactly the same. It is as though strict liability, which applies globally over all circumstances, conveyed a stronger sense of obligation not to engage in harm causing behavior. This seems to impact some individuals. On the other hand, and for the same reasons, strict liability does less well than the negligence rule when private and group interests do not conflict. The reason is the slight over-deterrence induced by strict liability in such cases. Over all circumstances, when enforcement is weak, whether one rule does better than the other will therefore depend on the relative frequencies of circumstances. In our set-up with equiprobable circumstances, the two rules turned out to be equally efficient overall (MSL $>$ MNR, $p = 0.967$).

6 Discussion

To be completed...

7 Conclusion

To be completed...

References

Ambrus A., Greiner B. (2012). Imperfect Public Monitoring with Costly Punishment: An Experimental Study. American Economic Review 102, 3317-3332.

Angelova V., Armentier O., Attanasi G., Hiriart Y. (2013). Relative Performance of Liability Rules: Experimental Evidence. Theory and Decision, DOI 10.1007/s11238-013-9405-0.

Becker G. (1968. Crime and Pumishment: An Economic Approach. Journal of Political Economy 76, 169-217.

Bénabou R., Tirole J. (2006). Incentives and Prosocial Behavior. American Economic Review 96, 1652-1678.

Bénabou R., Tirole J. (2011). Laws and Norms. NBER wp 17579.

Brennan G., Gonzales L. G., Güth W., Levati M. V. (2008). Attitudes toward private and collective risk in individual and strategic choice situations. Journal of Economic Behavior and Organization, 67, 253–262.

Carpenter J.P. (2007). The demand for punishment. Journal of Economic Behavior and Organization, 62, 522–542.

Carpenter J.P., Matthews P.H. (2012). Norm enforcement: Anger, indignation or reciprocity. Journal of the European Economic Association, 10, 555–572.

Charness G., Rabin M. (2002) Understanding Social Preferences with Simple Tests. Quarterly Journal of Economics, 117, 817–869.

Chaudhuri A. (2011). Sustaining Cooperation in Laboratory Public Goods Experiments: A Selective Survey of the Literature. Experimental Economics, 14, 47-83.

Cooter R. (2000a), Do Good Laws Make Good Citizens? An Economic Analysis. Virginia Law Review 86, 1577-1601.

Cooter R. (2000b), "Three Effects of Social Norms on Law: Expression, Deterrence and Internalization." Oregon Law Review, 79, 1-22.

Dal Bó E., Dal Bó P. (2014). Do the Right Thing: The Effect of Moral Suasion on Cooperation. Journal of Public Economics, 117, 28-38.

Deffains B., Fluet C. (2013). Legal Liability when Individuals Have Moral Concerns. Journal of Law, Economics, and Organization, 29, 930-955.

Dopuch N., King R. R. (1992). Negligence versus strict liability regimes in auditing: An experimental investigation. The Accounting Review, 67, 97–120.

Ellickson R. (1998) Law and Economics Discovers Social Norms. Journal of Legal Studies, 27, 537-552.

Fehr E., Schmidt K. (1999). A Theory of Fairness, Competition and Cooperation. Quarterly Journal of Economics, 114, 817-68.

Fehr E., Gächter S. (2000). Cooperation and Punishment in Public Goods Experiments." American Economic Review, 90, 980-994.

Fehr E., Fischbacher U. (2004). Third-Party Punishment and Social Norms. Evolution and Human Behavior, 25, 63-87.

Fischbacher U. (2007).

Fischbacher U., Gächter S., Fehr E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. Economics Letters, 71, 397–404.

Funk P. (2007). Is there an Expressive Function of Law? An Empirical Analysis of Voting Laws with Symbolic Fines. American Law and Economics Review, 9, 135-159.

Funk P. (2010). Social Incentives and Voter Turnout: Theory and Evidence. Journal of the European Economic Association, 8, 1077-1103.

Galbiati R., Vertova P. (2008). Obligations and Cooperative Behavior in Public Good Games. Games and Economics Behavior 64, 146-70.

Galbiati R., Vertova P. (2014). How Laws Affect Behavior: Obligations, Incentives and Cooperative Behavior. International Review of Law and Economics 38, 48-57.

Grechenig K., Nicklish A., Thöni C. (2010). Punishment Despite Reasonable Doubt – A Public Good Experiment with Sanctions and Uncertainty. Journal of Empirical Legal Studies 7, 847-867.

Harrison G.W., Johnson E., McInnes M. M., Rutström E. E. (2005). Risk aversion and incentive effects: Comment. American Economic Review, 95, 897–901.

Holt C. A., Laury S.K. (2002). Risk aversion and incentive effects. American Economic Review, 92, 1644–1655.

Kornhauser L., Schotter A. (1990). An experimental study of single-actor accidents. Journal of Legal Studies, 19, 203–233.

Kube S., Traxler C. (2011). The Interaction of Legal and Social Norm Enforcement. Journal of Public Economic Theory, 13, 639-660.

Landes W.M., Posner R.A. (1987). The Economic Structure of Tort Law. Harvard University Press, Cambridge, MA.

McAdams R.H., Rasmusen E.B. (2007). Norms in Law and Economics. In Polinsky, A. M. and S. Shavell (eds.), Handbook of Law and Economics, Vol. 1, North-Holland.

Markussen T., Putterman L., Tyran J.-R. (2014). Self-Organization for Collective Action: An Experimental Study of Voting on Sanction Regimes. Review of Economic Studies, 81, 301-324.

Masclet D., Noussair C., Tucker S., Villeval M.C. (2003). Monetary and Non-Monetary Punishment in the Voluntary Contribution Mechanism. American Economic Review 93, 366-380.

Polinsky M.A., Shavell S. (2007). The theory of public enforcement of law. In Polinsky A. M. and S. Shavell (eds.), Handbook of Law and Economics, Vol. 1, New York: North-Holland.

Posner E. (2000). Law and Social Norms. Harvard University Press.

Posner R.A. (1972). Economic Analysis of Law, 1st edn. Little, Brown and Company, Boston

Rabin M. (1993). Incorporating Fairness into Game Theory. American Economic Review, 83, 1281-1302.

Raz J. (1980). The concept of a legal system. Oxford University Press, Oxford.

Rege M., Telle K. (2004). The Impact of Social Approval and Framing on Cooperation in Public Good Situations. Journal of Public Economics, 88, 1625-1644.

Shavell S. (1980). Strict liability versus negligence. Journal of Legal Studies, 9, 1–25.

Shavell S. (2002). Law versus Morality as Regulators of Conduct. American Law and Economics Review 4, 227-257.

Sunstein C.R. (1996). On the Expressive Function of Law. University of Pennsylvania Law Review, 144, 2021–53.

Shavell (2007), Liability for Accidents. In Polinsky A. M. and S. Shavell (eds.), Handbook of Law and Economics, Vol. 1, New York: North-Holland.

Tyran J., Feld L. (2006). Achieving Compliance When Legal Sanctions are Non-Deterrent. Scandinavian Journal of Economics 108, 135-156.

Zasu Y. (2007). Sanctions by Social Norms and the Law: Substitutes or Complements? Journal of Legal Studies 36, 379-396.

A Tables

Table 1: Individual decisions to undertake X.

Method	LPM			Hierarchical Model		
Model	(1)	(2)	(3)	(1)	(2)	(3)
privateGain	0.0322***	0.0341***	0.0339***	0.2430***	0.2724***	0.2555***
	(0.00877)	(0.00662)	(0.00859)	(0.0351)	(0.0487)	(0.0655)
socialGain	0.0246	0.0234	0.0206	0.3761***	0.2868***	0.5644***
	(0.0230)	(0.0201)	(0.0241)	(0.0526)	(0.0719)	(0.1026)
blame_{t-1}		-0.00295			-0.0546***	
		(0.00203)			(0.0193)	
sanction_{t-1}			-0.0110***			-0.1416**
			(0.00379)			(0.0558)
Period	0.00254*	0.00521	0.00558	0.0389***	0.0852***	0.1466***
	(0.00153)	(0.00335)	(0.00415)	(0.0098)	(0.0318)	(0.0392)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual	RE	RE	RE	RE	RE	RE
Session	Cluster	Cluster	Cluster	RE	RE	RE
Treatment				RE	RE	RE
N	3920	1764	1764	3920	1764	1764

Table 2: Individual decisions to undertake X. (Cont'd)

Method	LPM			Hierarchical Model		
Model	(1)	(2)	(3)	(1)	(2)	(3)
privateGain	0.0334***	0.0334***	0.0312***	0.26828***	0.256190***	0.243858***
	(0.00566)	(0.00623)	(0.00950)	(0.04780)	(0.065795)	(0.035959)
socialGain	0.0240	0.0234	0.0262	0.31918***	0.556669***	0.378764***
	(0.0186)	(0.0213)	(0.0242)	(0.07088)	(0.102589)	(0.054129)
blame_{t-1} X_{t-1}	-0.00243			-0.08552***		
	(0.00297)			(0.02293)		
blame_{t-1} Y_{t-1}	0.00261			0.03990		
	(0.00456)			(0.03821)		
sanction_{t-1} X_{t-1}		-0.0154***			-0.202268***	
		(0.00433)			(0.067111)	
sanction_{t-1} Y_{t-1}		0.00662			-0.053027	
		(0.00708)		(0.093505)		
X_{t-1}	0.0919***	0.150***		0.46161	0.381295	
	(0.0299)	(0.0249)		(0.28066)	(0.258714)	
historyX			0.131*			0.417545
			(0.0781)			(0.669947)
Period	0.00347	0.00487	0.00300**	0.07287***	0.141789***	0.046930***
	(0.00260)	(0.00361)	(0.00152)	(0.02741)	(0.039118)	(0.010834)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Individual	RE	RE	RE	RE	RE	RE
Session	Cluster	Cluster	Cluster	RE	RE	RE
Treatment				RE	RE	RE
N	1,960	1,764	3,724	1,960	1,764	3,724

Table 3: Decision of individual i to blame individual j at period t.

Method	GLS with RE					Hierarchical Model				
Model	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
condemned$_j$	1.191***	1.729***	1.706***	1.705***	1.705***	1.130***	1.782***	1.759***	1.758***	1.758***
	(0.184)	(0.197)	(0.186)	(0.187)	(0.187)	(0.068)	(0.0879)	(0.0930)	(0.0930)	(0.0930)
condemned$_j\times$ incert$_{t-1}$		-0.0963	-0.116	-0.114	-0.114		0.0470	0.04919	0.0531	0.0531
		(0.189)	(0.157)	(0.155)	(0.155)		(0.0879)	(0.0946)	(0.0947)	(0.0947)
(1-condemned$_j$)$\times$ incert$_{t-1}$		0.535***	0.544***	0.545***	0.545***		0.678***	0.710***	0.710***	0.710***
		(0.089)	(0.093)	(0.092)	(0.092)		(0.040)	(0.042)	(0.042)	(0.042)
blame$_{t-1}$			0.0502***		0.074***			0.0203***		0.0405***
			(0.0121)		(0.0106)			(0.0068)		(0.0141)
blame$_{t-1}\times$ X$_{t-1}$				0.0498***	-0.0245				0.01646**	-0.0241
				(0.0166)	(0.0162)				(0.0083)	(0.0161)
blame$_{t-1}\times$ Y$_{t-1}$				0.0743***					0.0405***	
				(0.0106)					(0.0141)	
X$_{t-1}$				-0.0416	-0.0416				0.05113	0.0511
				(0.120)	(0.120)				(0.1006)	(0.1006)
Period	0.0536***	0.0495***	0.0234	0.0224	0.0224	0.05339***	0.04640***	0.02678**	0.0261**	0.0261**
	(0.0193)	(0.0176)	(0.0168)	(0.0161)	(0.0161)	(0.0085)	(0.0093)	(0.0109)	(0.0109)	(0.0109)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual	RE	RE	RE	RE	RE	RE	RE	RE	RE	RE
Session	Cluster	Cluster	Cluster	Cluster	Cluster	RE	RE	RE	RE	RE
Treatment						RE	RE	RE	RE	RE
N	5,880	4,800	4,320	4,320	4,320	5,880	4,800	4,320	4,320	4,320

Table 4: Decision of individual i to sanction individual j at period t.

Method	GLS with RE					Hierarchical Model				
Model	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
condemned$_j$	0.211***	0.274***	0.266***	0.266***	0.266***	0.185***	0.246***	0.243***	0.242***	0.242***
	(0.0483)	(0.0554)	(0.0643)	(0.0640)	(0.0640)	(0.0285)	(0.0389)	(0.040)	(0.040)	(0.040)
condemned$_j \times$ incert$_{t-1}$		-0.0793	-0.0851	-0.0956	-0.0956		0.0355	0.027	0.028	0.028
		(0.0638)	(0.0747)	(0.0770)	(0.0770)		(0.0387)	(0.040)	(0.040)	(0.040)
(1-condemned$_j$)$\times$ incert$_{t-1}$		0.0266	0.0241	0.0150	0.0150		0.0826***	0.074***	0.075***	0.075***
		(0.0390)	(0.0349)	(0.0398)	(0.0398)		(0.0179)	(0.019)	(0.019)	(0.019)
sanction$_{t-1}$			0.0173		0.00326			0.0065		0.023*
			(0.0144)		(0.0218)			(0.0075)		(0.013)
sanction$_{t-1} \times$ X$_{t-1}$				0.0178	0.0145				0.0004	0.022
				(0.0128)	(0.0176)				(0.0086)	(- 0.015)
sanction$_{t-1} \times$ Y$_{t-1}$				0.00326					0.023*	
				(0.0218)					(0.013)	
X$_{t-1}$				0.128	0.128				0.0190	0.019
				(0.111)	(0.111)				(0.033)	(0.033)
Period	-0.00938	-0.0159*	-0.0148**	-0.0151**	-0.0151**	-0.009***	-0.0178***	-0.0178***	-0.018***	-0.018***
	(0.00871)	(0.00932)	(0.00744)	(0.00742)	(0.00742)	(0.0037)	(0.0042)	(0.0049)	(0.0049)	(0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual	RE	RE	RE	RE	RE	RE	RE	RE	RE	RE
Session	Cluster	Cluster	Cluster	Cluster	Cluster	RE	RE	RE	RE	RE
Treatment						RE	RE	RE	RE	RE
N	5,880	4,800	4,320	4,320	4,320	5,880	4,800	4,320	4,320	4,320

Table 5: Titre du tableau à changer

	A			B			C		D	
	#	SI	SW	#	SI	SW	#	SI/SW	#	SI/SW
NL	195	88%	100%	160	97%	100%	187	99%	178	100%
SSL	190	91%		224	82%		190	83%	196	91%
SNR	207	85%		193	85%		200	94%	200	97%
MSL	182	42%	100%	194	64%	100%	208	84%	216	97%
MNR	197	54%	100%	202	75%	100%	226	99%	175	99%

Table 6: Titre du tableau à changer

	(1)	(2)	(3)	(4)
γ	.162***	.252***	.246***	.249***
	(.005)	(.01)	(.01)	(.01)
λ	.	.395***	.343***	.33***
	.	(.023)	(.035)	(.036)
δ	.	.	-.353**	-.213
	.	.	(.169)	(.171)
β	.	.	.	.137***
	.	.	.	(.043)
# obs	3920	3920	3920	3920
LL	-1453.6	-1389.4	-1387.1	-1382.1

B Figures

Figure 1: Proportion of X actions across treatments and situations.

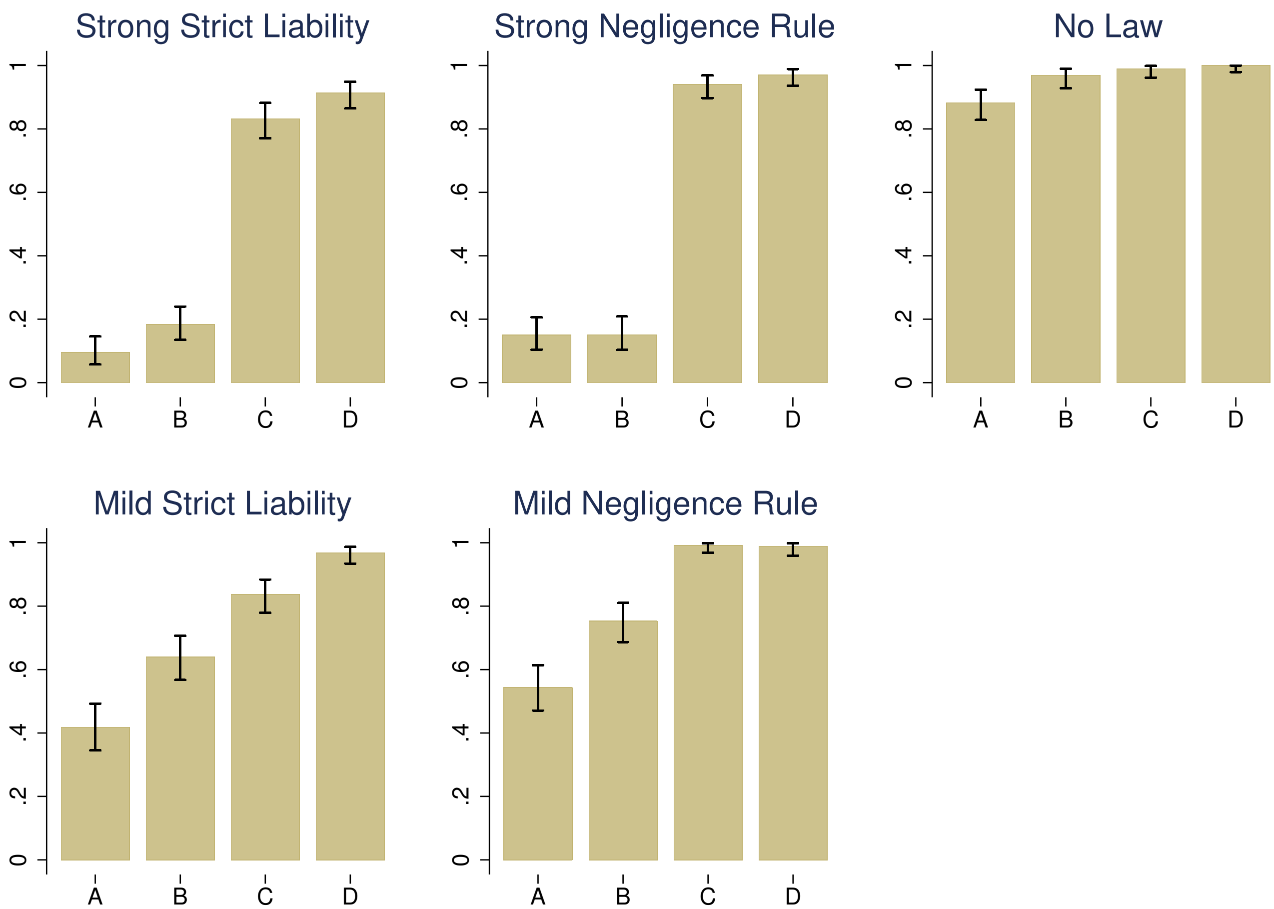

Figure 2: Prediction of behaviors after probit regression of choice to undertake action X on a dummy variable that accounts for the *homo œconomicus* theory's predictions.

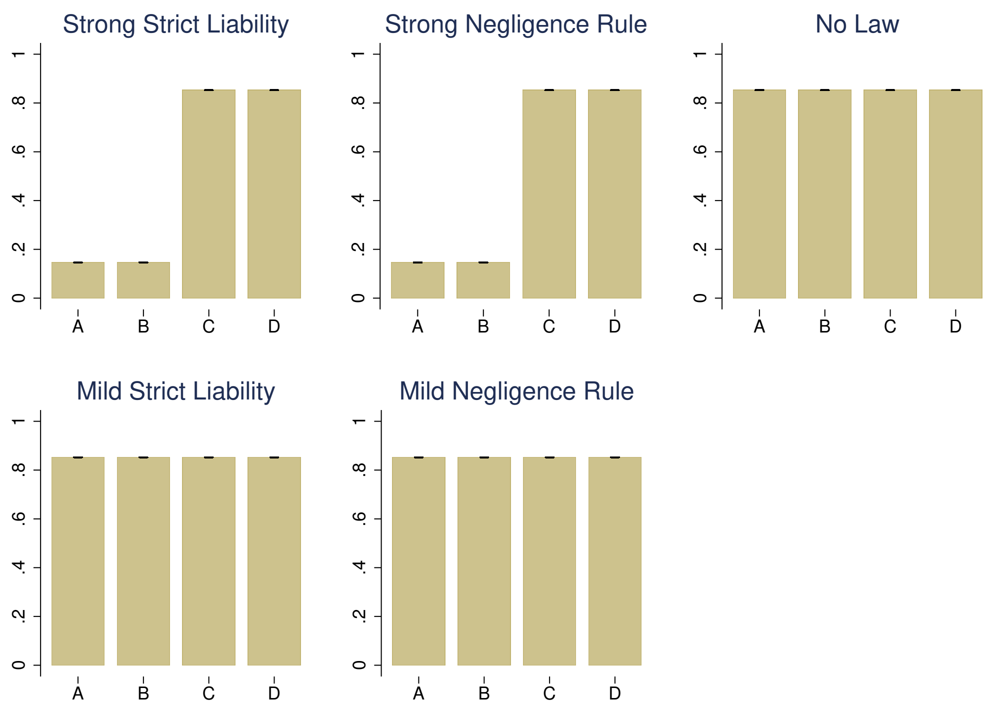

Figure 3: Prediction of behaviors after probit regression of choice to undertake action X on expected private gains.

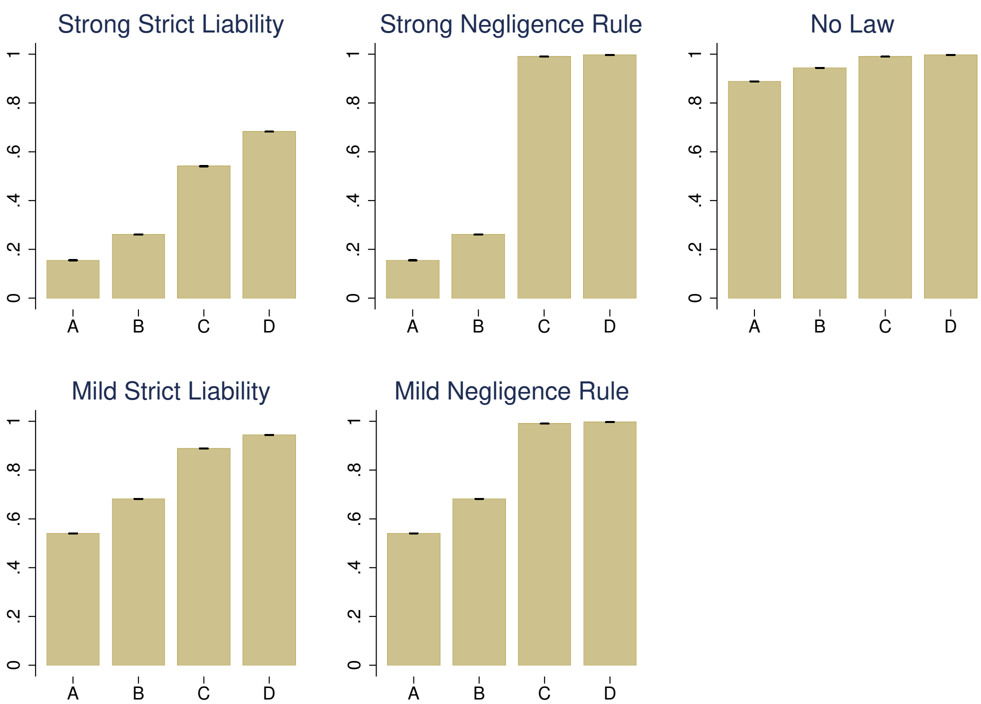

Figure 4: Prediction of behaviors after probit regression of choice to undertake action X on expected private gains and social gains.

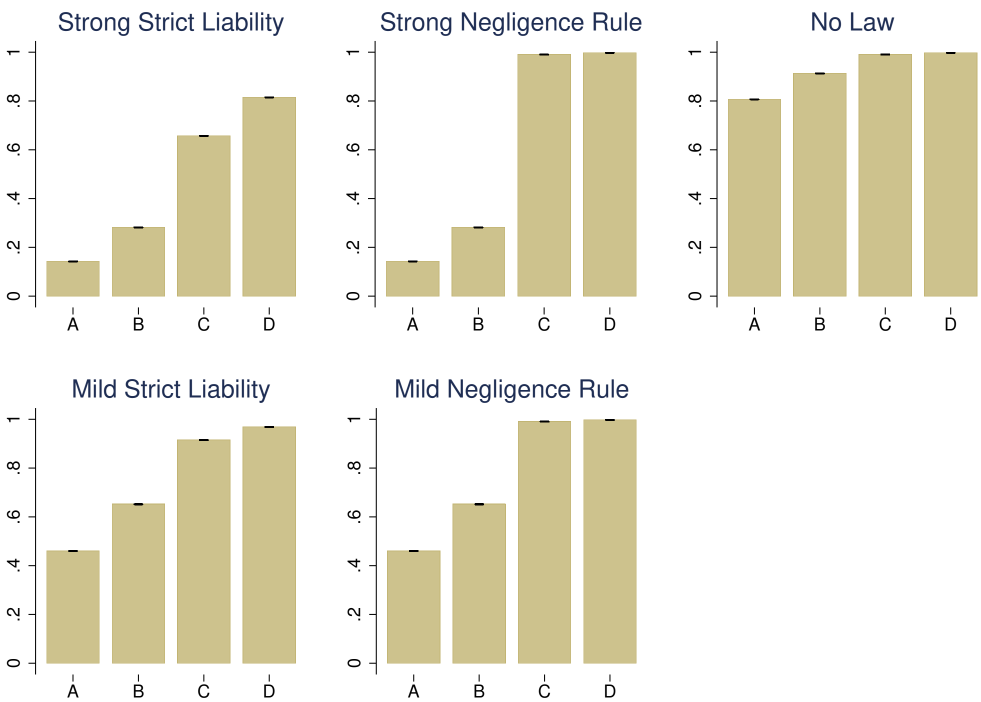

Figure 5:

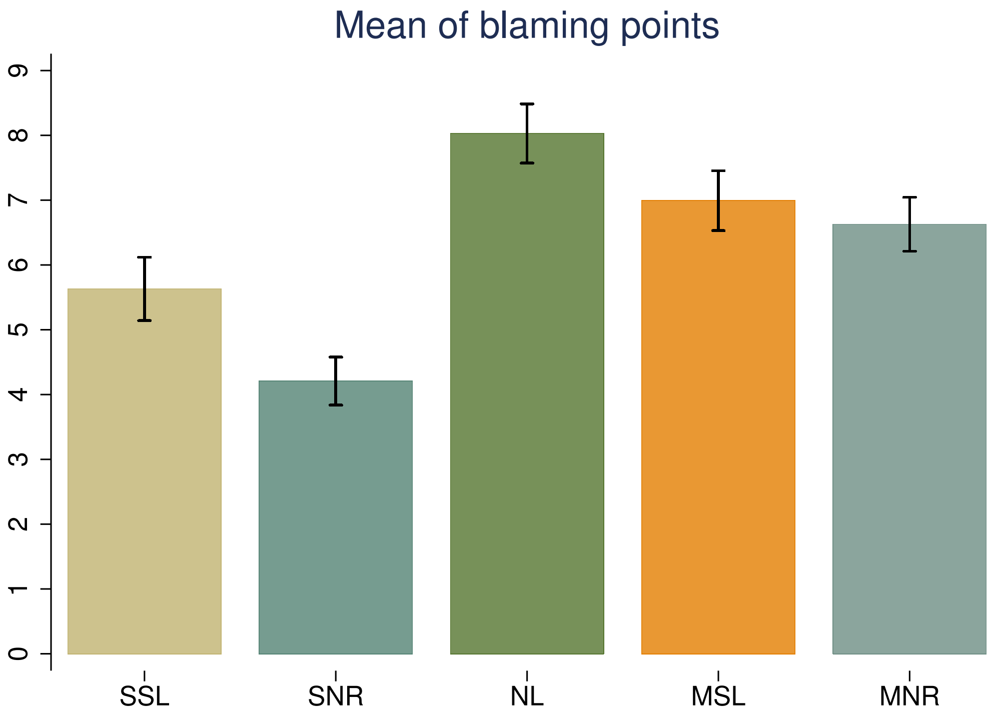

Figure 6:

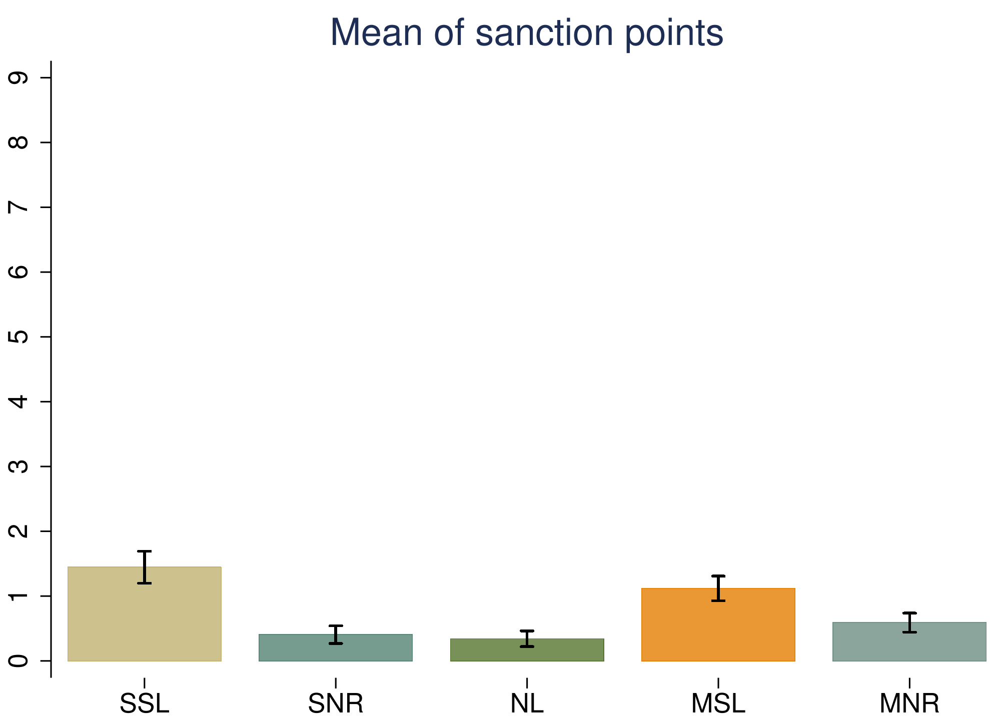

Figure 7:

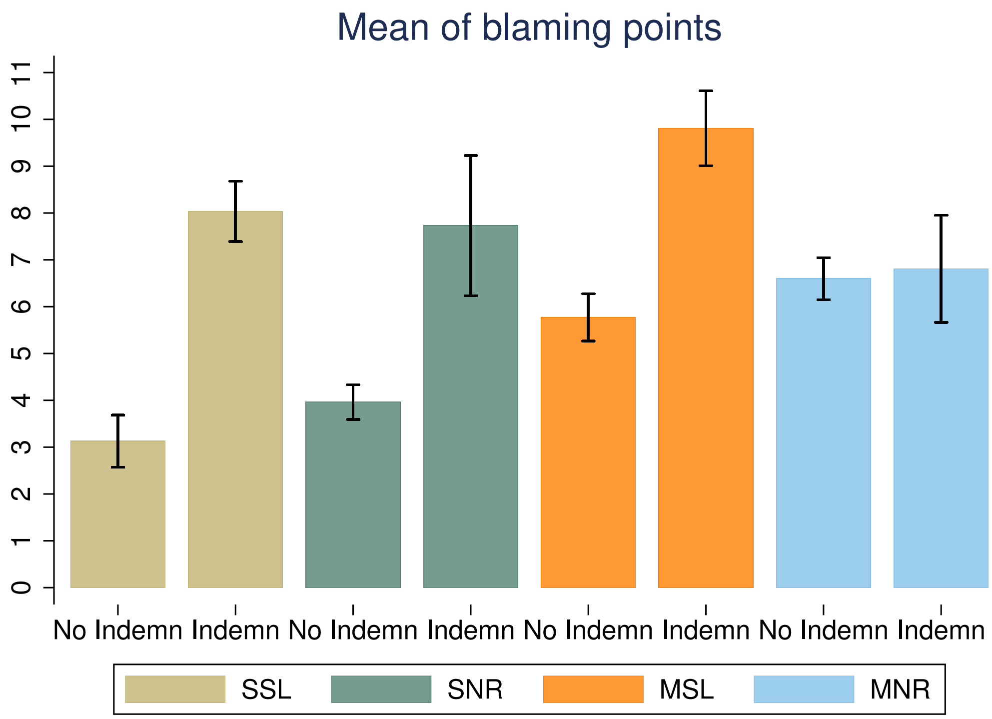

Figure 8:

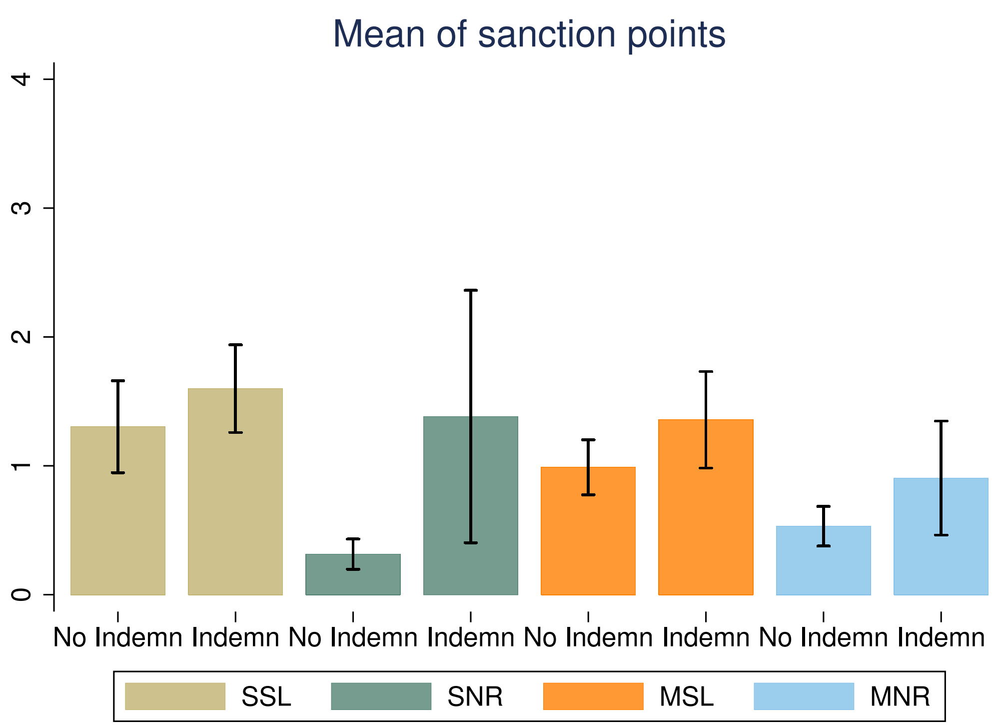

Figure 9:

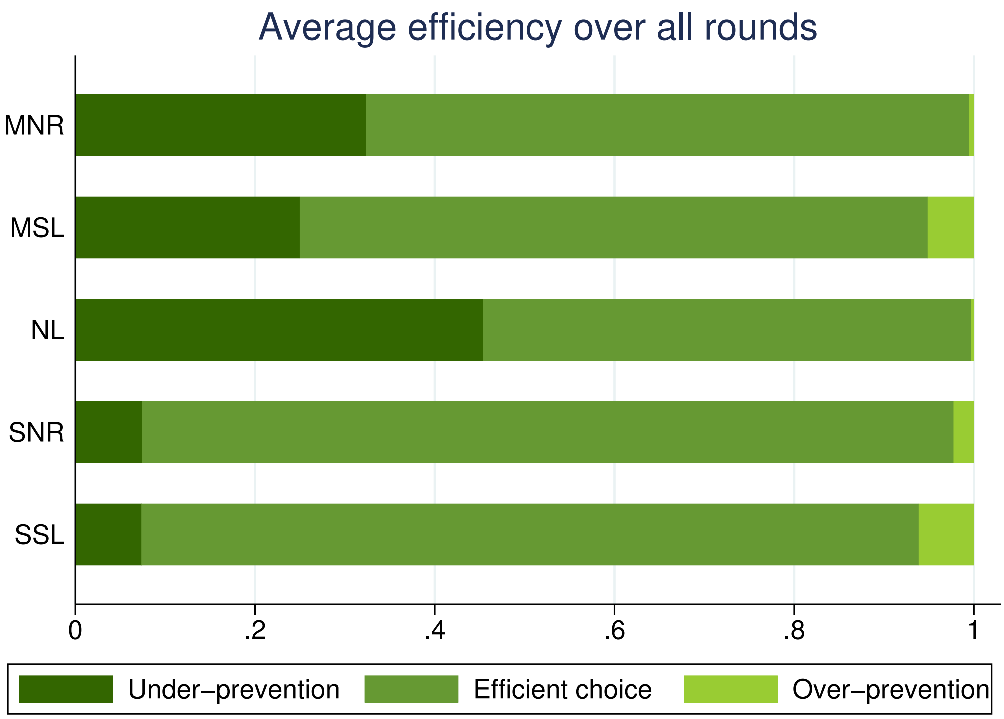

Figure 10:

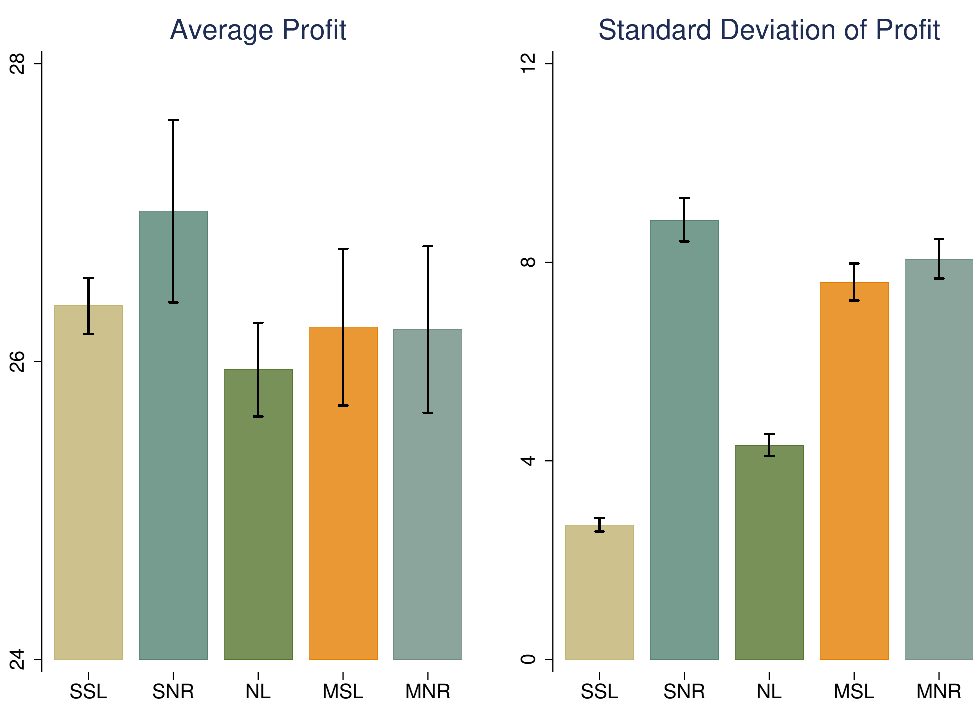

Figure 11:

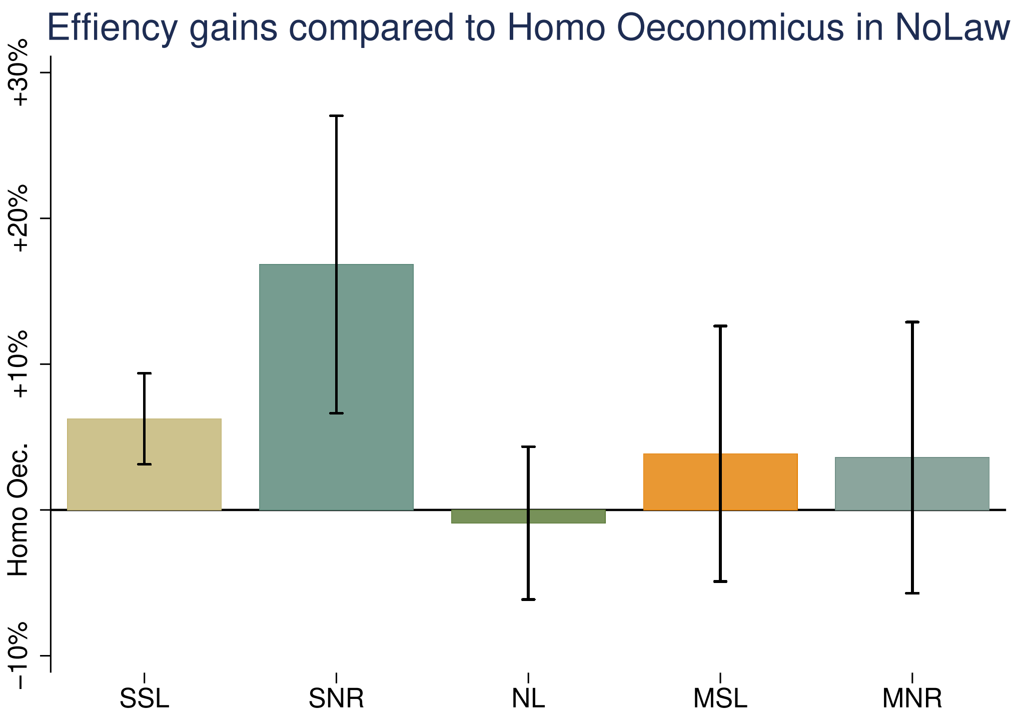

Figure 12:

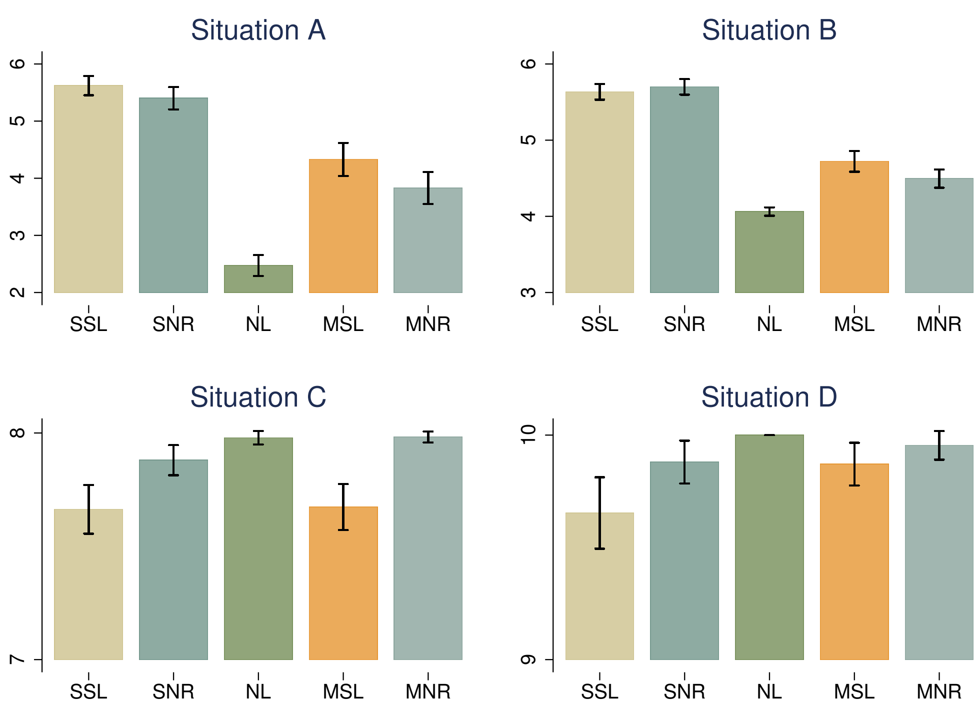

Figure 13:

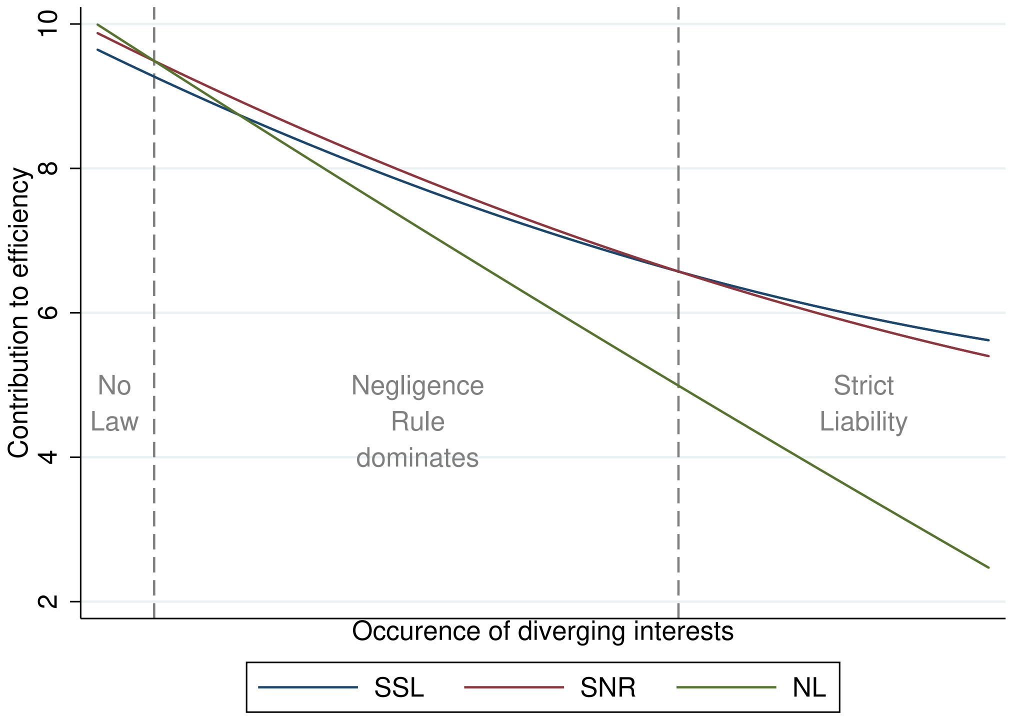

Figure 14: