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Litigation with Negative Expected Value Suits: An Experimental Analysis

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Comments

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Litigation with Negative Expected Value Suits: An Experimental Analysis*

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Abstract

The existence of lawsuits providing plaintiffs a negative expected value (NEV) at trial has important theoretical implications for signaling models of litigation. The signaling equilibrium possible absent NEV suits breaks down with NEV suits because plaintiffs do not have a credible threat to proceed to trial undermining the ability to signal type. Using a laboratory experiment, we analyze behavior with and without the possibility of NEV suits. Absent NEV suits, behavior largely follows predicted patterns. However, the possibility of NEV suits does not cause the signaling equilibrium to unravel and does not cause the dispute rate to increase. Plaintiffs only drop NEV lawsuits three-fourths of the time, the rejection rate by defendants for revealing demands rises less than predicted and, contra theory, the rejection rate on demands in the semi-pooling range remains unchanged.

JEL Codes: C91, K41, D82

Keywords: Dispute Resolution, Negative Expected Value Lawsuits, Laboratory Experiment

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1. Introduction

When the expected cost of proceeding to trial exceeds the expected judgment at trial, a plaintiff is said to have a negative expected value (NEV) suit. There is an extensive theoretical literature on NEV suits which suggests that they can raise the incidence of costly trials in the presence of asymmetric information. We provide the first controlled laboratory experiment exploring the effects of NEV suits in a setting with asymmetric information. We do this in the context of a signaling game, in which the informed party makes a pre-trial demand on the uninformed party. Compared to treatments in which all suits have positive expected value (PEV) for the plaintiff, we find important changes in the direction predicted by theory under the NEV treatment although the magnitude of these changes is much smaller than predicted. However, contrary to the predictions of theory, we do not observe a total breakdown of the signaling equilibrium. In addition, the overall dispute rate falls in the NEV treatment, in contrast to the prediction that it would increase.

Our experiment is based on a two-type version of the Reinganum and Wilde (1986) signaling model of litigation. In two treatments both high type, A_H, and low type, A_L, plaintiffs have PEV suits, where plaintiff type is associated with whether the plaintiff would receive a high or low award at trial. In our NEV treatment, the A_L plaintiff has an NEV suit, while A_H continues to have a PEV suit. In all of our treatments, if an offer is rejected, the plaintiff has an opportunity to drop the suit and is predicted to do so if and only if she has an NEV suit. Theoretical results from Farmer and Pecorino (2007) show that the possibility of NEV suits causes the signaling equilibrium to unravel. Among other predictions, in the NEV treatment all plaintiff demands are expected to be rejected. Thus, in that treatment all A_L type plaintiffs end up dropping their cases while all A_H type plaintiffs proceed to trial so that the overall dispute rate equals the proportion of A_H type plaintiffs. By contrast, when all plaintiffs have PEV suits, some plaintiffs of both types are predicted to settle and the overall dispute rate is predicted to be, at least weakly, lower than in the NEV treatment.

As predicted by theory, behavior in the two PEV treatments is quite similar, while behavior in the NEV treatment differs substantially from the other two treatments. Several of the changes we observe are in the direction predicted by the theory, but the magnitudes of these changes are smaller than predicted. First, A_L plaintiffs, who, as predicted, rarely drop their case in the PEV treatments, drop their case about 75% of the time in the face of a rejection in the NEV treatment, where the theoretical prediction is 100%. Second, revealing demands by A_L plaintiffs are about 25 percentage points more likely to be rejected in the NEV treatment than in the other treatments. These rejection rates rise from about 15% in the two PEV treatments to about 40% in the NEV treatment, whereas the theoretical prediction is that the rejection rate increases from 0% to 100%.[1] However, in one important dimension, a predicted change is not observed. Specifically, the rejection rate on demands in the semi-pooling region, associated with all A_H plaintiffs as well as bluffing A_L plaintiffs, are essentially unchanged in the NEV treatment as compared to the PEV treatments. These rejection rates range from 74% to 80% across the three treatments and are not statistically different from one another. Since most A_L plaintiffs drop their suit in the face of rejection in the NEV treatment and because high demands face no higher a rejection rate than in the other treatments, we do not observe an overall increase in the dispute rate when NEV suits are possible. On the contrary, we find dispute rates to be significantly *lower* in this setting.

While our results provide support for some key predictions of a signaling model with NEV suits, we do not observe a total breakdown of the signaling equilibrium. Part of the reason for this

[1] Under the theory, low revealing demands should be accepted 100% of the time in the PEV treatments. However, excess disputes, that is, disputes not predicted by the theory are common in settings such as this. Pecorino and Van Boening (2018) report dispute rates of 10% for low type, revealing demands. See their Table 5.

is that 25% of the cases in which a demand is rejected and the plaintiff has an NEV suit proceed to trial. This, in turn, weakens defendant's incentive to reject all demands. One possible motivation for A_L plaintiffs with an NEV suit proceeding to trial in the face of rejection is spite (Guha 2016, 2019). We explore the counterintuitive result that spite can increase settlement after presenting our empirical results.

2. Background

NEV suits can arise from a case that has merit, but for which the stakes are so small relative to the costs of going to trial that it is unprofitable for the plaintiff to proceed. Alternatively, NEV suits can arise from nuisance suits, which are suits without any merit. Regardless of the merit of NEV suits, there is a consistent implication from the theoretical literature that such suits can raise the overall dispute rate, quite possibly by a large amount.

In Bebchuk (1984), an uninformed plaintiff makes a settlement demand to an informed defendant. For this screening model, Bebchuk assumes that all plaintiffs have PEV suits; however, Nalebuff (1987) extends the model to consider plaintiffs with NEV suits. Under the equilibrium derived by Bebchuk (1984), a plaintiff might find that she does not have a credible threat to proceed to trial in the face of a rejection. The reason is that defendants with weak cases accept the settlement demand, leaving stronger defendants to proceed to trial. It cannot be an equilibrium for the plaintiff to drop the suit in the face of rejection, because then all defendants would reject the settlement demand. This forces the plaintiff to make a more aggressive equilibrium offer which is rejected by a wider range of defendants. This increases the plaintiff's expected payoff at trial among the defendants who reject, but also results in more trials. Hence, the presence of NEV plaintiff types may lead to increased disputes.

Bebchuk (1988) is also a screening model, but it posits that an uninformed defendant makes an offer to an informed plaintiff, where some fraction of these plaintiffs have NEV suits. If the fraction of plaintiffs with NEV suits is sufficiently high, the equilibrium changes from an interior one with substantial settlement to one where the defendant offers 0 and thereby takes all PEV plaintiffs to trial. This may be done because the defendant knows all NEV plaintiffs will drop their case prior to trial, resulting in a 0 cost for the defendant. By contrast, at the interior equilibrium, NEV plaintiffs receive and accept a positive settlement offer. Katz (1990) adds a filing decision to the model which leads to a mixed strategy equilibrium, but the implication that NEV suits can greatly increase the incidence of trial is preserved.

Reinganum and Wilde (1986) develop the signaling model of litigation in which the informed plaintiff makes a demand on an uninformed defendant assuming all plaintiffs have PEV suits. They use a refinement concept to eliminate all but a pure strategy separating equilibrium with a one-to-one mapping between a plaintiff's type (which reflects the judgement they would receive at trial) and the settlement demand. Farmer and Pecorino (2007) take the same model, but allow for some plaintiffs to have NEV suits. They find that the pure strategy equilibrium is totally unraveled and is replaced by an equilibrium under which all demands are rejected. An equilibrium with settlement is restored only when a filing fee is added to the model, but unless this fee is large, the potential presence of NEV suits will lead to a large increase in the dispute rate.[2]

[2] There are other notable works on NEV suits, such as Sobel (1989), who analyzes a model with two-sided asymmetric information. In one case he considers, one plaintiff type has an NEV suit and as a result, the rejection rate rises to 100%. There is also an extensive literature on NEV suits with symmetric information. Rosenberg and Shavell (1985) argue that the defendant may make a payment to a plaintiff with a nuisance suit in order to avoid the cost of a formal legal response. Bebchuk (1996) shows how a plaintiff with an NEV suit can have a credible threat to proceed to trial if costs are divisible and incurred gradually over time. On this issue, also see Klement (2003) and Schwartz and Wickelgren (2009). Farmer and Pecorino (1998) consider nuisance suits in a repeated game setting and find that lawyers can develop a reputation for taking such suits to trial in the face of a rejection. Chen (2006) argues that the use of contingency fee contracts can facilitate the success of nuisance suits. Other notable papers in the literature include Rosenberg and Shavell (2006) and Miceli and Stone (2014).

While there has been an extensive amount of experimental work analyzing the litigation process, relatively little of this work has focused on asymmetric information.[3] Stanley and Coursey (1990) use an experiment to explore the Priest and Klein (1984) hypothesis where there is two-sided asymmetric information (see also Inglis et al. 2005). Sullivan (2016) is an experimental test of the Spier (1992) model in which there are multiple bargaining periods. Previous experimental work on the signaling model includes Pecorino and Van Boening (2018, 2019a, 2019b) and Solomon (2022).[4] While these authors find some anomalous behavior, the experimental results are broadly in line with the predictions of theory. In particular, behavior of subjects in these experiments is roughly consistent with a semi-pooling equilibrium under which some A_L plaintiffs make a low revealing demand while others bluff by making a demand similar to those made by A_H plaintiffs.

3. The Model

We utilize a two-type version of the Reinganum and Wilde (1986) signaling model augmented to consider NEV suits as in Farmer and Pecorino (2007) in which player *A* has initiated litigation against player *B*. Thus, player *A* is the plaintiff and player *B* is the defendant. The plaintiff's type, A_i, $i = H,L$, is determined by nature and fully revealed at trial where the monetary judgment will be J^i, where $J^H > J^L$. The ex-ante probability that player *A*'s type is A_H equals *p*. Each party bears their own costs at trial, C_A and C_B, respectively. The game proceeds as follows:

> *Stage 1*. Nature determines player *A*'s type (A_H or A_L), where A_H is chosen with probability *p*. Player *A* knows her type, while player *B* only knows the probability each type is chosen.

[3] An important strand of work which does not incorporate asymmetric information concerns self-serving bias. Babcock and Lowenstein (1997) provide a review of this literature.

[4] Pecorino and Van Boening (2019a) analyzes costly voluntary disclosures in a signaling game, while Pecorino and Van Boening (2019b) analyzes a costly discovery procedure. Solomon (2022) considers how role switching (between the plaintiff and defendant roles) may facilitate learning with the signaling model of litigation.

Stage 2. Player A makes the settlement demand S to player B.

Stage 3. Player B decides to accept or reject the demand.
-If it is accepted, the game ends. Player A's payoff is S and player B's payoff is $-S$.
-If the demand is rejected, the game proceeds to stage 4.

Stage 4. Player A decides to either drop the case or continue to trial.
-If she drops the case, each player receives a payoff of 0.
-If she continues, the game proceeds to stage 5.

Stage 5. At trial, a plaintiff of type A_i with $i \in \{H, L\}$ receives the monetary award J^i. The plaintiff's payoff is $J^i - C_A$ and the defendant's payoff is $-(J^i + C_B)$.

In order to focus attention on an interesting case, we derive a parameter restriction that allows us to eliminate the possibility of a pure strategy pooling equilibrium. If there is a dispute, A_H would receive a payoff of $J^H - C_A$. If the pooling demand S is accepted, A_H receives S. Under the lowest possible pooling demand, $S = J^H - C_A$. Player B would reject this demand if $J^H - C_A \geq p(J^H + C_B) + (1-p)(J^L + C_B)$, where the right-hand side of this expression is player B's expected cost at trial when a pooling demand is rejected. If player B rejects the lowest possible pooling demand, player B will reject all possible pooling demands. Rearranging our expression we can conclude that pooling is not possible if

$$(1-p)(J^H - J^L) \geq C_A + C_B. \qquad (1)$$

We assume this parameter restriction holds and will focus on semi-pooling equilibria, assuming initially that A_L has a credible threat to proceed to trial if her demand is rejected. The low revealing demand S^L is given by (2a). The high demand associated with a pure strategy separating equilibrium, S^H, is given by (2b). The entire range of high semi-pooling demands, S^{SP} is given by (2c).

$$S^L = J^L + C_B, \tag{2a}$$

$$S^H = J^H + C_B. \tag{2b}$$

$$S^H - C_A - C_B \leq S^{SP} \leq S^H \tag{2c}$$

Note that the demand in (2a) extracts B's dispute cost conditional on facing A_L and that the demand in (2b) extracts the dispute cost conditional on facing A_H. In the pure strategy separating equilibrium, A_L makes the demand in (2a) and A_H makes the demand in (2b). In a semi-pooling equilibrium, all A_H make a semi-pooling demand S^{SP} within the range in (2c) and some A_L players bluff by making this same demand. Note that the demand associated with a pure strategy separating equilibrium, S^H is the limiting case of the semi-pooling demands. Thus, our consideration of semi-pooling includes the pure strategy separating equilibrium as a special case.[5]

In a semi-pooling equilibrium, the high demand must be rejected with a sufficiently high probability ϕ so as to make A_L indifferent between making the high demand, S^{SP}, and the revealing low demand, S^L. This rejection rate must satisfy the following:

$$J^L + C_B = (1-\phi)S^{SP} + \phi(J^L - C_A).$$

Solving the previous expression for the rejection rate ϕ, yields

$$\phi = \frac{S^{SP} - [J^L + C_B]}{S^{SP} - [J^L - C_A]}. \tag{3}$$

[5] Data from previous experiments, for example, Pecorino and Van Boening (2018) and Solomon (2022), are more consistent with a semi-pooling equilibrium, than with a pure strategy separating equilibrium. Demands in the neighborhood of S^H tend to be rejected at a 100% rate and as a result, most A^H players make more moderate demands within the semi-pooling range.

This rejection rate is increasing in the size of the semi-pooling demand.

In the semi-pooling equilibrium, A_L bluffs with probability Ω, where this bluffing probability makes B indifferent between accepting and rejecting S^{SP}. The probability that A_L bluffs is

$$\Omega = \left(\frac{p}{1-p}\right)\left(\frac{S^H - S^{SP}}{S^{SP} - S^L}\right). \tag{4}$$

Note that Ω is decreasing in S^{SP}. In the limiting case of the pure strategy separating equilibrium, $S^{SP} = S^H$ and $\Omega = 0$.

The credibility constraint for A_L is $J^L - C_A \geq 0$. When this condition holds, she is willing to proceed to trial in the face of a rejected demand. In our treatments with only PEV suits, this constraint holds and the semi-pooling equilibria we have described in this section provide the range of predicted outcomes in the experiment. When this condition is violated, A_L has an NEV suit and an A_L player is always predicted to drop the suit in the face of rejection. If the demand S^L is made, player B now rejects it, knowing that A_L will subsequently drop the suit. If the demand S^{SP} is accepted with a positive probability, then all A_L will make this demand, because they earn 0 by revealing their type with the low demand. Thus, S^{SP} must be rejected at the rate of 100%. This, in turn, causes any potential signaling equilibria to break down with the result that player B rejects all demands in equilibrium (Farmer and Pecorino 2007).

As noted previously, the lowest pooling demand that A_H would accept is $S = J^H - C_A$. Now, if this demand is rejected, all A_L drop the suit, so if $J^H - C_A \geq p(J^H + C_B)$, pooling is not possible. This may be expressed as

$$(1-p)J^H \geq C_A + pC_B. \tag{5}$$

If (1) holds, then equation (5) will also hold and when it does, we cannot have a pure strategy pooling equilibrium with NEV suits. As noted above, we also cannot have a semi-pooling equilibrium with a positive rate of settlement. All A_L drop their case in the face of a rejection and all A_H proceed to trial. The dispute rate for A_H rises to 100% whereas this dispute rate is $\phi < 1$ in a semi-pooling equilibrium, when the credibility constraint holds and where ϕ is given by (3). When A_L cannot credibly proceed to trial, it is consistent with equilibrium for all A_L to pool on the demand made by A_H within the semi-pooling range and for B to reject all such demands.[6]

4. Experimental Design

4.1 Treatments

To explore how the potential for NEV suits affects disputes empirically, we rely on a laboratory experiment. The laboratory provides an idealized setting to test the theoretical model described in the previous section because it affords control of the underlying parameters whereas these values are unobservable in natural settings. Specially, we employ a within-subject experimental design with three treatments: PEV, NEV, and PEV$^+$. Unless otherwise noted, all monetary amounts below are stated in terms of experimental dollars where 1000 experimental dollars equals \$US 1. Player *A*'s earnings equaled the sum of the payoffs from each individual round. Player *B*'s earnings equaled a lump sum endowment minus the sum of the costs from each

[6] Other equilibria are possible, but there must be a sufficient degree of pooling of A_L with A_H within the semi-pooling range such that player *B* is induced to reject all such demands. To avoid the tedious exercise of delineating all of these possibilities, we will focus on the equilibrium under which 100% of A_L players bluff by mimicking A_H behavior.

individual round. The lump sum was 21,000.[7] The average salient payoff was $US 9.03 and all subjects also received an additional $US 5 show-up payment.

In all three treatments, the probability player A's type is A_H is p = 1/3. The dispute costs are $C_A = C_B = 100$. PEV serves as the baseline and imposes $J^H = 450$ and $J^L = 150$. As such, player A should always proceed to trial if her initial demand is rejected because $J^{\mathrm{H}} - C_A > J^L - C_A > 0$. NEV is the main treatment of interest with J^{H} and J^L shifted down by 100 relative to PEV, so that $J^{\mathrm{H}} = 350$ and $J^L = 50$. As a result, $J^{\mathrm{H}} - C_A > 0 > J^L - C_A$. This implies that A_H has a credible threat to proceed to trial but that A_L does not. Thus, A_L should drop her suit in the face of a rejection in the NEV treatment and the signaling equilibrium is predicted to breakdown entirely. As a result, player B rejects all demands with A_L subsequently dropping their suit and 100% of A_H players proceeding to trial.

The PEV$^+$ treatment is a control for the effect of shifting values with J^{H} and J^L shifted up by 100 relative to PEV, so that $J^{\mathrm{H}} = 550$ and $J^L = 250$. As in PEV, in PEV$^+$ both player A types should proceed to trial in the face of a rejected demand. The range of semi-pooling demands in PEV$^+$ is shifted up by 100 relative to PEV. Adjusting for the shift, semi-pooling demands are predicted to be rejected at the same rate in these two treatments. For example, a semi-pooling demand of 400 in PEV corresponds to a semi-pooling demand of 500 in PEV$^+$ and from equation (3) both of these demands are predicted to be rejected with a probability of 43%. Of course, it is possible that behavior is consistent with different semi-pooling equilibria in the PEV and PEV$^+$ treatments or that behavior differs in other ways between the two treatments. If behavior does differ between the PEV and PEV$^+$ treatments, it would call into question whether behavioral

[7] The lump sum is revealed to *B*, but not to *A*. Theoretically it does not matter whether or not the lump sum is revealed, but behaviorally it might. In the field, the plaintiff is unlikely to have precise knowledge of the defendant's wealth.

differences between the PEV and NEV treatments are due to the presence of NEV suits or the shift in values. However, if behavior is similar in the PEV and PEV$^+$ treatments, it suggests differences between the PEV and NEV treatments are attributable to the possibility of NEV suits in the latter.

Table 1 summarizes the theoretical predictions for each treatment. Many of the predictions in this table are generated via equations (3) and (4). However, the "predicted" range for revealing demands warrants specific mention and is based on equation (2a). Strictly speaking, A_L should demand $J^L + C_B$, claiming all of the available surplus, but previous litigation experiments, and ultimatum game experiments more generally, consistently find people are willing to share surplus. For this reason, the ranges for revealing demands shown in the table include all demands that yield positive surplus to both parties when the outcome is J^L.[8]

Table 1. Theoretical Prediction by Treatment

Treatment	NEV	PEV	PEV$^+$
Values of J^H , J^L	350, 50	450, 150	550, 250
Predicted Range of Demands by Player A			
if A^H or Bluffing A^L	[250,450][a]	[350, 550]	[450, 650]
if Revealing A^L	[0,150][a]	[50, 250]	[150, 350]
Probability of Bluffing by A^L	100%	0% - 100%	0% - 100%
Predicted Rejection Rate by Payer B of Demands			
if revealing A^L	100%	0%	0%
if in semi-pooling range	100%	33% - 60%	33% - 60%
Predicted Dispute Rate following Rejection			
if A^H	100%	100%	100%
if A^L	0%	100%	100%
Unconditional Dispute Rate	33%	20% - 33%	20% - 33%

[a] For NEV, player B should reject any positive demand. Player A demands should be concentrated in the semi-pooling range. However, for the purpose of making comparisons to the other treatments demands in the range of [0,150] are treated as A^L revealing demands. The range is not [-50,150] because negative demands are not allowed. Similarly, player A demands in NEV in the range of [250,450] are treated as being in the semi-pooling range.

[8] The range of revealing demands for the NEV treatment also reflect the limitation that subjects could not make negative demands.

As shown in Table 1, the predictions for PEV and PEV$^+$ are identical accounting for the shift of 100 in J^H and J^L. As described in the previous section, there are multiple semi-pooling equilibria in the PEV and PEV$^+$ treatments. However, when comparing the PEV and NEV predictions it is clear that bluffing should be at least as common in NEV as in the other treatments, while player *B*'s rate of rejecting demands should be at least as high as in the other treatments.

4.2 Procedures

Each laboratory session lasted about one hour and involved eight subjects who were randomly assigned to the role of player A or player B.[9] All subjects maintained their assigned role throughout the session. A session involved 36 decision periods broken into blocks of 12 periods per treatment. To control for order effects, two sessions were conducted under each possible treatment ordering. In each period of each session, subjects were randomly and anonymously paired with a subject in the opposite role. Within a period, each pair of subjects proceeded through the stages of the game shown in the previous section; however, the wording in the experiment replaced loaded terms such as "trial" and "demand" with more neutral terms such as "verification" and "request," respectively.[10]

After each period, both subjects in a bargaining pair learn *A*'s payoff and *B*'s cost for the round. A history table provided all of the information that a player had observed in previous rounds, but information that was not revealed in a period was not included in the history table. For example, player B only learned if player A was bluffing if the pair actually reached Stage 5.

[9] Previous economics experiments have found that a group of size four is typically sufficient to yield non-cooperative behavior (e.g. Huck et al. 2004).

[10] There are litigation experiments, such as those surveyed in Babcock and Loewenstein (1997), in which context is integral to the experiment. Generally, however, tests of litigation theory have been conducted in a context free environment (Landeo 2015). Cardella and Kitchens (2017) run a litigation experiment both with and without legal context and do not find statistically significant differences in their results.

The experiment was conducted at The University of Alabama's TIDE Lab and computerized using z-Tree (Fischbacher, 2007). The 96 subjects (= 8 subjects / session × 2 sessions / treatment order × 6 treatment orders) were recruited from the lab's standing pool of student volunteers. While some subjects had participated in other studies, none had participated in any related study in the lab. Upon entering the lab, subjects provided informed consent to participate in the study. Participants in a session were brought en masse to one of the lab's computer rooms and were seated at separate, visually isolated workstations where they received a pencil, a calculator, and a paper copy of the instructions. The instructions were also displayed on the subject's computer screen throughout the experiment. After the subjects were seated, a researcher read the instructions aloud and provided an opportunity for subjects to ask questions. A short comprehension quiz was then administered before the paid portion of the study began. Copies of the instruction and the quiz can be found in Appendix A.

5. Behavioral Results

Our data consists of 1728 interactions equally split among the three treatments. We begin with a general overview of the behavioral patterns and then provide statistical analysis of the treatment effects. Table 2 and Figure 1 provide a basic summary of the data. In Figure 1, "Between" refers to the range of demands falling strictly between the revealing range and the semi-pooling range.[11] "Above" ("Below") refers to the region above (below) the semi-pooling (revealing) region.[12] As indicated by Figure 1, almost 90% of player *A* demands are in either the

[11] Between demands are below A_H's dispute payoff, so she should never make such a demand. These demands are above *B*'s dispute cost against A_L, so he should always rejected such a demand. Hence, A_L should never make such a demand. The logic here reflects a refinement known as the 'test of dominated strategies' (Kreps 1990: 436). However, Pecorino and Van Boening (2018) and Solomon (2022) have documented that 'between' demands are made and are sometimes accepted.
[12]There is no Below region for NEV as demands were required to be nonnegative.

semi-pooling or revealing regions. Further, player *B*s do not accept demands in the "above" region (i.e. they do not accept demands larger than the maximum payment from a dispute). Together, these patterns suggest subjects understood the structure and incentives of the experiment.

Table 2. Summary of Observations by Treatment

Treatment	NEV	PEV	PEV^{+}
Number of Interactions	576	576	576
Percent of Player A Demands			
in Semi-pooling Range when Outcome is H	89.13%	91.98%	86.87%
in Revealing Range when Outcome is L	57.65%	61.84%	65.08%
in Semi-Pooling Range when Outcome is L	28.83%	22.95%	21.69%
Rejection Rate by Payer B of Demands			
if Demand in Revealing Range	40.17%	13.90%	15.60%
	n = 234	n = 259	n = 250
if Demand in Semi-Pooling Range	74.01%	73.77%	79.53%
	n = 277	n = 244	n = 254
Dispute Rate by Player A following Rejection			
if outcome is H	99.29%	100%	100%
	n = 141	n = 122	n = 155
if outcome is L	24.15%	88.73%	92.68%
	n = 207	n = 142	n = 123
Unconditional Dispute Rate	32.99%	43.06%	46.70%

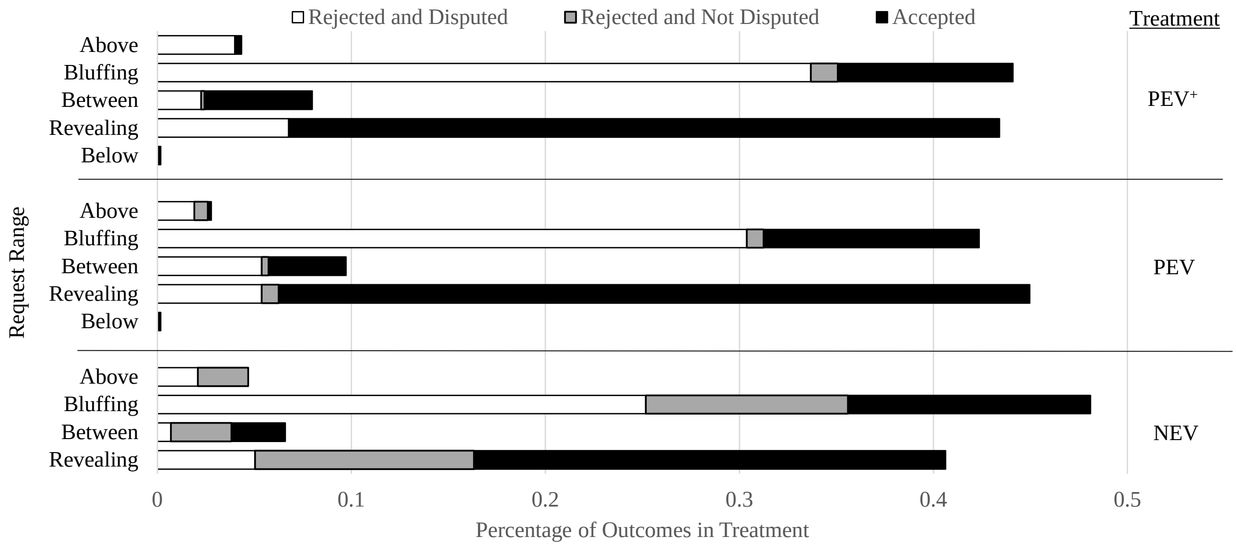
For NEV, player B should reject any positive demand. Player *A* demands should be concentrated in the semi-pooling range, but are otherwise indeterminate. However, for the purpose of making comparisons to the other treatments, demands in the range of [0,150] are treated as being analogous to a revealing demand by A_L. The range is not [-50,150] because negative demands are not allowed. Similarly, for NEV player A demands in the range of [250,450] are treated as being in the semi-pooling range. The denominators for player B rejection rates do not sum to the total number of observations (576) because 12-13% of player A demands fall outside the predicted ranges. Similarly, the sum of the denominators for player A dispute rates following rejection do not match the sum of the numerators for player B rejections.

The overall dispute rate is 43% in PEV and about 47% in PEV^{+}, but only 33% in NEV. The proportion of interactions that result in disputes in NEV is similar to the theoretical prediction, but the dispute rates in the other two treatments are substantially greater than predicted. As a result, the incidence of disputes falls rather than rises in the NEV treatment. The difference in dispute rates between NEV and either PEV or PEV^{+} is statistically significant while the difference between the dispute rates in PEV and PEV$^+$ is not statistically significant.[13] Figure 1 shows that rejection of a demand almost always leads to dispute in PEV and PEV$^+$ as predicted. From Table 2 it is clear that A_H players also dispute a rejection in NEV, consistent with the model. However for NEV, the model predicts A_L players will always drop their case after a rejection, while the observed rate is only 75%.

Player B rejects demands consistent with bluffing about 75% - 80% of the time, regardless of treatment. This rejection rate is higher than the prediction for PEV and PEV$^+$ as equation (3) indicates the highest semi-pooling demand should be rejected only 60% of the time. By contrast, the observed rate is lower than the 100% prediction for NEV. As predicted, revealing demands in PEV and PEV$^+$ are generally accepted as the rejection rate in this region is only about 15%. For NEV, revealing demands are rejected 40% of the time, which represents a substantial increase in comparison to the other treatments, but which is far below the prediction of 100%. Thus, we observe a treatment effect in the direction predicted, but the size of the effect is much smaller than predicted. The greater than expected rate at which A_L players with an NEV suit proceed with a dispute after experiencing a rejection is consistent with a weakened incentive to reject revealing demands. Relatedly, the lack of an increase in *B*'s rejection rate for demands in the semi-pooling range may reflect the fact that signaling does not entirely breakdown, with a substantial fraction of A_L players continuing to make revealing demands that are more likely to be accepted than was predicted. There is an increase in bluffing by A_L in the NEV treatment, but the magnitude of the increase is much smaller than predicted. In particular, in the PEV and PEV$^+$ treatments, the bluffing rate is about 22.5% while in NEV it increases to 29% versus a predicted value of 100%.

[13] Our conclusions on statistical significance are derived from a probit regression using individual fixed effects and standard errors clustered by Session. We can reject at the 1% level the hypotheses that dispute rates are equal in NEV and PEV or NEV and PEV$^+$. The p-value for the test that PEV and PEV$^+$ have the same rejection rate is 0.232. The regression results are available upon request.

Figure 1: Distribution of Outcomes by Treatment



Before proceeding to our statistical analysis, we note that Table 2 and Figure 1 suggest that behavior in PEV and PEV$^+$ is indistinguishable. This similarity is borne out statistically as shown below and indicates that merely shifting the values of J^H and J^L uniformly does not cause behavior to change substantially. Rather the differences between NEV and the treatments with only positive expected value suits are being driven by the introduction of negative expected value suits in the NEV treatment.

5.1 Analysis of Player A Dispute Behavior

We do not offer statistical analysis of the A_H decision to dispute a rejection (i.e., proceed to trial) as Table 2 reveals there was only a single instance among 418 opportunities across the three treatments where a rejection was not disputed. Clearly, there is no evidence of a difference in behavior across treatments for A_H post rejection. However, for A_L there is a difference in the dispute rate following a rejection as shown in Table 3. For this analysis, the unit of observation is A_L experiencing a rejection and the dependent variable is an indicator function that the subject disputes the rejection. The probit analysis controls for treatment order and includes subject level fixed effects while standard errors are clustered at the session level. Table 3 contains two specifications. Specification (1) is a simple comparison of the treatments, while specification (2) includes the *Demand* amount, standardized to account for the shift in J^L and J^H across treatments. Including *Demand* identifies whether the size of the surplus player A sought to obtain impacts player A's decision to dispute a rejection.

Table 3. Analysis of Dispute Rate following Rejection when Outcome is L

	(1)	(2)
Constant	1.23***	1.30***
	(0.30)	(.27)
PEV^+	-0.01	0.32
	(0.49)	(0.50)
NEV	-2.67***	-2.77***
	(0.43)	(0.41)
Demand		-0.00
		(0.00)
Demand × PEV^+		-0.00**
		(0.00)
Demand × *NEV*		0.00
		(0.00)
Observations	472	472
p-value for Ho:		
$PEV^+ = NEV$	<0.001	<0.001

Estimation is based on probit regression. Demand is the amount of the initial demand made by player A, standardized so that 0 is the midpoint between the revealing and semi-pooling ranges. Dummy variables for the treatment order and subject fixed effects are included in the specification, but not displayed in the table. Standard errors, shown in parentheses, are clustered at the session level. *,**, and *** denote significance at the 10%,5%, and 1% level, respectively. p-values in the lower portion of the table are for tests against the two-sided alternative.

Evidence for the similarity between PEV and PEV^+ is provided by the lack of significance for the PEV^+ term in both specifications. However, the NEV term is negative and significant in both specifications indicating disputes, conditional on a rejection, are less likely in NEV than in PEV. Further, the hypothesis that $PEV^+ = NEV$ is rejected as shown in the lower portion of the table indicating that a dispute following a rejection is less likely in NEV than in PEV^+. Finally, we note that the amount demanded does not significantly affect whether A_L disputes a rejection, except in PEV$^+$ where disputes are slightly less likely to occur the greater the demand.

5.2 Analysis of Player B Rejection Behavior

To determine how the treatment affects *B*'s decision to reject a demand, we rely on the probit analysis presented in Table 4. The dependent variable is an indicator for whether *B* accepted the demand or not. As before, the analysis controls for treatment order and includes subject level fixed effects while standard errors are clustered at the session level. Table 4 provides separate analysis for revealing demands and for demands in the semi-pooling range. Additionally, separate analysis is presented with and without controlling for the amount demanded.

Table 4. Analysis of Rejection Rates

	(1)	(2)	(3)	(4)
Constant	1.43***	-2.62***	0.61***	-0.11
	(0.09)	(0.36)	(0.12)	(0.20)
PEV^+	0.07	-0.22	0.183	-0.04
	(0.11)	(.43)	(0.13)	(0.23)
NEV	1.22***	1.15	-0.03	0.09
	(0.22)	(0.94)	(0.11)	(0.21)
Demand	-	0.01***	-	0.01***
		(0.00)		(0.00)
$Demand \times PEV^+$	-	0.00	-	0.00
		(0.00)		(0.00)
$Demand \times NEV$	-	0.00	-	-0.00
		(0.01)		(0.00)
Range of Demand	Revealing	Revealing	Semi-Pooling	Semi-Pooling
Observations	743	743	775	775
p-value for Ho:				
$PEV^+ = NEV$	<0.001	0.172	0.211	0.698
$Demand \times PEV^+ = Demand \times NEV = 0$	-	0.782	-	0.264

Estimation is based on probit regression. Demand is the amount of the initial demand made by player A, standardized so that 0 is two hundred below the upper bound of the relevant range. Dummy variables for the treatment order and subject fixed effects are included in the specification, but not displayed in the table. Standard errors, shown in parentheses, are clustered at the session level. *,**, and *** denote significance at the 10%,5%, and 1% level, respectively. p-values in the lower portion of the table are for tests against the two-sided alternative.

We first note that the coefficient on PEV^+ in all four specifications and the coefficient on $Demand \times PEV^+$ in both of the specifications in which it appears are not statistically different from 0, providing further evidence that behavior is similar in PEV and PEV$^+$. Turning to how the possibility of negative expected value suits impacts behavior, the lack of significance for the coefficients on *NEV* (as well at the failure to reject Ho: $PEV^+ = NEV$ as shown in the lower portion of the table) in specifications (3) and (4) indicates that rejection rates for demands in the semi-pooling range are similar across treatments, as previously suggested by Table 2. The positive and significant coefficient for *NEV* (as well at the rejection of Ho: $PEV^+ = NEV$) in specification (1), indicates that revealing demands are more likely to be rejected in NEV, as previously suggested by Table 2. It is worth noting that the coefficient for *NEV* is not statistically significant in specification (2), which controls for the demand amount, but it is very similar in magnitude to specification (1).

For both the revealing and semi-pooling ranges, the analysis shows a strong, significant effect of player *A*'s demand on player *B*'s decision to reject it. Interestingly, this response to the demand does not vary by treatment as evidenced by the lack of significance for the relevant interaction terms and the joint test in the lower portion of the table. That player *B*s are more likely to reject the greater the demanded amount in the semi-pooling range is consistent with the theory given the continuum of semi-pooling equilibria, at least for PEV and PEV$^+$. Standard theory suggests the amount of the demand within the revealing range should not affect player *B*'s acceptance behavior, but behaviorally it does. This is consistent with a demand for fairness on the part of player *B* such that he is unwilling to accept demands which provide too small a portion of the surplus from settlement. Such a demand for fairness has been well documented in the ultimatum game literature.[14]

5.3 Analysis of Player A Demands

To compare demands across treatments, we rely upon the analysis in Table 5. In this analysis, the dependent variable is the amount demanded by player A. As before, the analysis controls for treatment order and includes subject level fixed effects while standard errors are clustered at the session level. The variable *High* is an indicator variable that takes the value 1 when the outcome is H and is 0 otherwise.

Table 5. Analysis of Initial Demands

	(1)	(2)	(3)
Constant	263.94***	213.67***	404.50***
	(8.76)	(4.59)	(7.01)
High	197.94***	-	59.15***
	(11.06)		(9.00)
PEV^{+}	94.85***	97.21***	120.14***
	(17.02)	(7.38)	(10.16)
NEV	-78.80***	-102.22***	-101.69***
	(18.09)	(12.55)	(9.43)
$High \times PEV^{+}$	4.34	-	-26.48**
	(20.29)		(13.30)
$High \times NEV$	-32.69*	-	-8.04
	(17.16)		(10.21)
A Types	Both	A_L only	Both
Range	Unrestricted	Revealing	Semi-pooling
Observations	1728	728	775
p-value for Ho:			
$PEV^{+} = 100$	0.762	0.705	0.048
$NEV = -100$	0.241	0.860	0.858
$PEV^{+} + High \times PEV^{+} = 100$	0.923	-	0.190
$NEV + High \times NEV = -100$	0.089	-	0.112

Dummy variables for the treatment order and subject fixed effects are included in the specification, but not displayed in the table. Standard errors, shown in parentheses, are clustered at the session level. *,**, and *** denote significance at the 10%,5%, and 1% level, respectively. p-values in the lower portion of the table are for tests against the two-sided alternative.

[14] For a review of this literature, see Güth and Kocher (2014).

Specification (1) of Table 5 considers all demands made by all players A. The results from this specification indicate that overall, A_H players adjust their demands almost exactly with the shift in the value of J^H. Specifically, when changing from PEV to PEV$^+$, J^H increases by 100 and demands increase by 94.85 + 4.34 = 99.19, which is not statistically different from 100 as shown in the lower portion of the table. Similarly, when changing from PEV to NEV, J^H decreases by 100 and demands change by –78.80 – 32.69 = –111.49, which is not significantly different from –100 as shown in the lower portion of the table. Similarly, A_L players respond to the increase in J^L when moving from PEV to PEV$^+$ with an approximately one-to-one change in demand. As shown in the lower portion of the table, the coefficient for PEV^+ is not statistically different from 100.

The decrease in J^L when moving from PEV to NEV reduces the average demand by –78.80. While this is not statistically different from –100, the point estimate is further away from its predicted value than the other cases considered above. Part of the reason the shift in average demands for A_L players may be less than the change in J^L when moving from PEV to NEV is that these players are more likely to bluff in NEV than in PEV, as shown in Table 2. Specification (2) of Table 5 considers only the behavior of A_L players making demands in the revealing range. As shown in the lower portion of the table, conditional on being in the revealing range, A_L demands adjust one to one with the shift in J^L between treatments.[15]

As a final point, we consider how effectively A_L players bluff. Specification (3) of Table 5 considers only demands that are in the semi-pooling region. If A_H and bluffing A_L players behave identically, then one would expect the coefficient for *High* to equal 0, but it is not.

[15] Because A_H players overwhelmingly make demands in the semi-pooling region as shown in Table 2, we do not provide separate analysis of A_H demands conditional on being in the semi-pooling region, as those results are effectively the same as the results in specification (1) of Table 5.

Instead, A_H players demand 59.15 more than bluffing A_L players in the PEV treatment. The lower portion of the table again confirms that A_H players adjust their demand one for one with the change in J^H. In the NEV treatment, bluffing A_L players reduce their demands by 100 on average as shown in the lower portion of the table, meaning that the gap between the demands of the two player types persists in this treatment too. Interestingly, the coefficient on PEV^+ is statistically larger than 100 indicating that bluffing demands are closer to A_H demands in that treatment, but still differ by 59.15 – 26.48 = 32.67. While A_L players are not fully masking their decision to bluff in any treatment, B players are apparently unaware of this pattern as they reject larger demands more frequently than smaller demands within the semi-pooling range as shown in specification (4) of Table 4. A comparison of the payoffs for A_L players who bluff relative to those who make a revealing demand shows that bluffing is profitable in NEV. The expected payoff from bluffing averages –31.19, –71.93, and +30.39 for PEV, PEV$^+$, and NEV, respectively. The higher rejection rate of revealing demands in NEV makes bluffing relatively more attractive and there is a limited increase in bluffing by A_L as a result. The greater prevalence of bluffing in the NEV treatment and the fact that most A_L drop their suit in the face of rejection both raise the benefit to B of rejecting demands in the semi-pooling region, but B fails to respond with a higher rejection rate. Overall, in the NEV treatment we only observe partial movements in the direction of theory.

6. Discussion

In some ways, the introduction of NEV suits impacts behavior in a manner consistent with the theoretical predictions of the model. A large majority of A_L players drop their suit in the face of rejection in the NEV treatment. There is a sizeable increase in the rejection rate for revealing demands in the NEV treatment. There is also evidence of an increase in bluffing behavior by A_L

in the NEV treatment. However, there are important interrelated ways in which behavior clearly deviates from the predictions of theory.

One way in which behavior in the NEV treatment does not match the theoretical predictions is that the dispute rate is lower, rather than higher as compared to the PEV and PEV$^+$ treatments. Specifically, the dispute rates in the PEV and PEV$^+$ treatments are considerably above their predicted values, while the rate for NEV is near its predicted value. In part this pattern is driven by the fact that in three quarters of suits involving NEV, A_L players drop their suit when rejected. It is also due to there being excess disputes stemming from the rejection of revealing demands in PEV and PEV$^+$. In addition, demands in the bluffing range are rejected more frequently than predicted in PEV and PEV$^+$, so bluffing A_L players have excess disputes in those treatments, whereas in NEV many A_L players caught bluffing drop the suit. The mechanism by which the dispute rate is to rise under NEV is via a higher (100%) rejection rate on high demands which leads all A_H to proceed to trial. Contra the theory, rejection of demands in the bluffing range is no more frequent in NEV compared to PEV or PEV$^+$, so the higher dispute rate for A_H does not occur.

A related way in which behavior does not follow the theoretical predictions is that signaling does not completely unravel under NEV. This is driven by the fact that a quarter of the time A_L players in the NEV treatment proceed with the dispute in the face of a rejection, thereby weakening the incentive for B to reject all demands. Since a majority of revealing demands are accepted in the NEV treatment, there remains a substantial incentive for A_L to make such a demand. In turn, because there is only a small increase in bluffing behavior, there is a substantial probability that a high demand is made by A_H as in the other treatments.

So why might a fourth of A_L players proceed to a dispute even when they receive a negative payoff from doing so? One possibility is spite under which a player receives a positive benefit from inflicting costs on their opponent. Guha (2016, 2019) incorporates spite in models with symmetric information and finds spite leads to more disputes, since it offers a means to inflict costs on an opponent. In Appendix B, we similarly incorporate spite into our model with asymmetric information in a signaling game. In our signaling game, it remains true that spite leads to more disputes as long as plaintiff's can only have PEV suits. However, spite relaxes the plaintiff's credibility condition, making it more likely that she will proceed to trial in the face of a rejection even over some ranges where the monetary payoff is negative.

In particular, if we let μ be the benefit that the plaintiff receives per dollar of inflicted cost on the defendant, the credibility constraint becomes $\mu(J^L + C_B) + J^L - C_A > 0$ compared with the constraint $J^L - C_A > 0$ in the absence of spite. For our experimental parameters, we would require $\mu \geq 1/3$ for the credibility condition to continue to hold in the NEV treatment. If spite allows the credibility condition to hold, then we do not have the predicted breakdown of the signaling equilibria and, contra Guha (2016, 2019), spite can actually lower dispute rates.

As shown in (B3) of Appendix B, the existence of spite raises the dispute rate on demands in the semi-pooling range, assuming the credibility constraint holds sans spite. For our PEV parameters, the predicted dispute rate on the highest possible semi-pooling demand is 60%, while the observed dispute rates on such demands are in the neighborhood of 75-80%. While this does not constitute a test for spite, it is consistent with such a motive.

We do note that if our plaintiffs are motivated by spite, it is not universal as A_L players drop their NEV suits most of the time in face of a rejected demand. Of course, since we did not design the experiment to test for spite, we cannot rule out the possibility that some other factor is playing a role in NEV suits not being dropped. We see this as an important avenue for future research.

7. Conclusion

The theoretical litigation literature provides a robust prediction that the presence of NEV suits will raise the dispute rate, perhaps by a great deal. In the laboratory, we study such an environment and, to the best of our knowledge, this is the first paper to do so. Our key finding is at odds with the theoretical literature as we find that the dispute rate actually falls when NEV suits are possible.

The behavior of our experimental subjects clearly changes in our NEV treatment as compared to the other two treatments, but the magnitude of these changes is less, sometimes much less, than the predictions of theory. Most importantly, while many subjects with NEV suits drop their case in the face of rejection, 25% of the time such cases are not dropped. The rejection rate on revealing demands in the NEV treatment rises, but only to 40%, which is well shy of the 100% prediction. Bluffing increases, but by much less than predicted. For one key prediction, that dispute rates on high demands will rise to 100%, there is no movement in the direction predicted by theory. In short, while there is some unraveling of the signaling equilibrium, this occurs to a much smaller degree than predicted by theory.

While our experiment was not designed to identify why observed behavior differs from the theoretical predictions, one plausible explanation is plaintiff spite. Specifically, spite can help maintain a credible threat to proceed to trial with an NEV suit in the face of rejection. The potential for spite to lower dispute rates in our setting contrasts with previous theoretical incorporations of spite. It remains for future experimental work to determine the robustness of our results and to verify what role if any spite may play.

References

Babcock, Linda, and George Loewenstein. 1997. Explaining Bargaining Impasse: The Role of Self-Serving Biases." *Journal of Economic Perspectives* 11: 109-126.

Bebchuk, Lucian. A. 1984. "Litigation and Settlement under Imperfect Information." *RAND Journal of Economics* 15: 404-415.

Bebchuk, Lucian. A. 1988. "Suing Solely to Extract a Settlement Offer." *Journal of Legal Studies* 17: 437-450.

Bebchuk, Lucian A. 1996. "A New Theory Concerning the Credibility and Success of Threats to Sue." *Journal of Legal Studies* 25: 1-25.

Cardella, Eric and Carl Kitchens. 2017. "The Impact of Award Uncertainty on Settlement Negotiations." *Experimental Economics* 20: 333-367.

Chen, Zhiqi. 2006. "Nuisance Suits and Contingent Attorney Fees." *Review of Law and Economics* 2: 363-370.

Farmer, Amy and Paul Pecorino. 2007. "Negative Expected Value Suits in a Signaling Model." *Southern Economic Journal* 74: 434-447.

Farmer, Amy and Paul Pecorino. 1998. "A Reputation for Being a Nuisance: Frivolous Lawsuits and Fee Shifting in a Repeated Play Game." *International Review of Law and Economics* 18: 147-57.

Fischbacher, Urs. 2007. "z-Tree: Zurich toolbox for ready-made economic experiments." *Experiment Economics* 10: 171-178.

Guha, Brishti. 2016. "Malicious Litigation." *International Review of Law and Economics* 47: 24-32.

Guha, Brishti. 2019. “Malice in Pretrial Negotiations.” *International Review of Law and Economics* 58: 25-33.

Güth, Werner, and Martin G. Kocher. 2014. “More than Thirty Years of Ultimatum Bargaining Experiments: Motives, Variations, and Survey of the Recent Literature.” *Journal of Economic Behavior and Organization* 108: 396-409.

Huck, Steffan, Hans-Theo Norman, and Jörg Oechssler. 2004. “Two are Few and Four are Many: Number Effects in Experimental Oligopolies.” *Journal of Economic Behavior and Organization* 53(4): 435-446.

Inglis, Laura, Kevin McCabe, Steve Rassenti, Daniel Simmons, and Erik Tallroth. 2005. “Experiments on the Effect of Cost-Shifting, Court Costs, and Discovery on the Efficient Settlement of Tort Claims.” *Florida State University Law Review* 33: 89-117.

Katz, Avery. 1990. "The Effect of Frivolous Lawsuits on the Settlement of Litigation." *International Review of Law and Economics* 10: 3-27.

Klement Alon. 2003. “Threat to Sue and Cost Divisibility under Asymmetric Information.” *International Review of Law and Economics* 23: 261-272.

Kreps, David. 1990. *A Course in Microeconomic Theory*. Princeton: Princeton University Press.

Landeo, Claudia. 2015. “Law and Economics and Tort Litigation Institutions: Theory and Experiments.” In Kathryn Zeiler and Joshua Teitelbaum eds., *The Research Handbook on Behavioral Law and Economics*. Edward Elgar.

Miceli, Thomas J. and Michael P. Stone. 2014. “Piggyback Lawsuits and Deterrence: Can Frivolous Litigation Improve Welfare?” *International Review of Law and Economics* 39: 49-57.

Nalebuff, Barry. 1987. “Credible Pretrial Negotiation.” *RAND Journal of Economics* 18: 198-210.

Pecorino, Paul and Mark Van Boening. 2018. “An Empirical Analysis of the Signaling and Screening Model of Litigation.” *American Law and Economics Review* 20: 214-244.

Pecorino, Paul and Mark Van Boening. 2019a. “Costly Voluntary Disclosure in a Signaling Game.” *Review of Law & Economics* 15 (July): 1-32.

Pecorino, Paul and Mark Van Boening. 2019b. “An Empirical Analysis of Litigation with Discovery: The Role of Fairness.” *Journal of Behavioral and Experimental Economics* 81: 172-184.

Priest, George L. and Benjamin Klein. 1984. “The Selection of Disputes for Litigation.” *Journal of Legal Studies* 13: 1-55.

Reinganum, Jennifer. F. and Louis. L. Wilde. 1986. “Settlement, litigation, and the allocation of litigation costs.” *RAND Journal of Economics* 17: 557-566.

Rosenberg, David and Steven Shavell. 1985. "A Model in Which Suits Are Brought for Their Nuisance Value." *International Review of Law and Economics* 5: 3-13.

Rosenberg, David and Steven Shavell. 2006. “A Solution to the Problem of Nuisance Suits: The Option to Have the Court Bar Settlement.” 26: 42-51.

Schwartz, Warren F., and Abraham L. Wickelgren. 2009. Credible Discovery, Settlement, and Negative Expected Value Suits. *RAND Journal of Economics* 40: 636-657.

Sobel, Joel. 1989. An analysis of discovery rules. *Law and Contemporary Problems* 52: 133–59.

Solomon, Michael. 2022. "Switching Roles in Experiments: Learning in a Signaling Game." Manuscript, Colby College.

Spier, Kathryn E. 1992. "The Dynamics of Pretrial Negotiation." *Review of Economic Studies* 59: 93-108.

Stanley, Linda R., and Don L. Coursey. 1990. "Empirical Evidence on the Selection Hypothesis and the Decision to Litigate or Settle." *Journal of Legal Studies* 19: 145-72.

Sullivan, Sean P. 2016. “Why Wait to Settle?: An Experimental Test of the Asymmetric Information Hypothesis.” *Journal of Law and Economics* 59: 497-525.

Appendix A: Subject Instructions and Quiz

Subjects received a sheet of paper with the following instructions, which were also displayed on their computer screens and read aloud.

INSTRUCTIONS

This is a study about decision-making. Please pay careful attention as we proceed through the instructions as they explain how your payment will be determined. You will be paid in cash at the end of the study. If you have a question at any point, please raise your hand. Otherwise, you should not talk or communicate with anyone during the study. Also, please take a moment to make sure your phone and other electronics are turned off and put away.

You are in a group of 8 people. Everyone in the group has been assigned a role as a “Person A” or a “Person B” and half of the group has been assigned to each role. Your role will be displayed on your computer screen. You will maintain the same role throughout the study.

Today's study will consist of several "rounds". At the start of each round, you will be randomly and anonymously paired with a person in the other role. Therefore, one person in the pair will be "Person A" and the other will be "Person B". During a round, Person A’s payoff and Person B’s cost will be determined. These payoffs and costs will determine each person’s earnings:

<u>Person A’s earnings.</u> At the end of the study the computer will sum Person A’s payoffs from all rounds. This total is divided by 1000, and the result is Person A’s earnings in U.S. dollars:

(Sum of Person A’s Payoffs from all rounds) ÷ 1000 = Person A’s U.S. dollar earnings.

Note that a higher payoff in a given round increases Person A's earnings from the study.

<u>Person B’s earnings.</u> At the end of the study, the computer sums Person B’s costs from all rounds. This sum is subtracted from Person B’s Endowment. This difference is divided by 1000, and the result is Person B's earnings in U.S. dollars:

(Person B’s Endowment – sum of B’s Costs from all rounds) ÷ 1000 = Person B’s U.S. dollar earnings.

Note that a higher cost in a given round decreases Person B's earnings from the study. Also note that Person B will know the value of Person B’s Endowment but Person A will not.

In a moment, we will describe the steps of a round. We will refer to outcome H and outcome L, where H and L are numbers and H is greater than L. At the beginning of each round, the computer will inform everyone of the values of H and L that are applicable for the round. **H and L will change periodically during the experiment.** Later in a round, the computer will determine if the actual outcome for a specific pair is H or L for that round. Every round, the computer will go through the process of determining the outcome separately for each pair.

Steps of a Round.

1. Person A and Person B are randomly and anonymously paired and informed of the values of outcome H and outcome L which are potentially applicable for the round.

2. For each pair, the computer determines whether outcome H or outcome L applies for the round. There is a 2/3 chance that outcome L is selected and a 1/3 chance that outcome H is selected. **The outcome that is selected is then displayed on Person A's computer screen, but not on Person B's computer screen.**

3. Person A submits a *Request* to Person B. All *Requests* must be whole numbers between 0 and 900. After A enters a *Request* and clicks the Submit button, the *Request* is displayed on each person's computer screen. After viewing the *Request*, B clicks either the "Accept" or "Not Accept" button.

   If B "Accepts" the *Request*, the round ends for that pair. Both A's payoff and B's cost for the round are determined by the *Request*:

   A's payoff for the round = A's *Request*.
   B's cost for the round = A's *Request*.

   If B does "Not Accept" A's *Request*, the round proceeds to step 4.

4. Person A decides whether to "Stop" or to have the computer "Verify" the outcome which applies for the round.

   If Person A chooses "Stop", the round ends for that pair. Both A's payoff and B's cost for the round are 0:

   A's payoff for the round = 0.
   B's cost for the round = 0.

   If Person A decides to have the computer "Verify" the outcome, then we proceed to step 5.

5. When the computer is used to verify the outcome, both Person A and Person B incur a fee of 100 and the computer reveals the outcome that applies to the round for the pair. The round ends for that pair. Both A's payoff and B's cost for the round are determined by the outcome and the fee:

   If outcome H applies to the round

   A's payoff for the round = H - 100.
   B's cost for the round = H + 100.

   If outcome L applies to the round

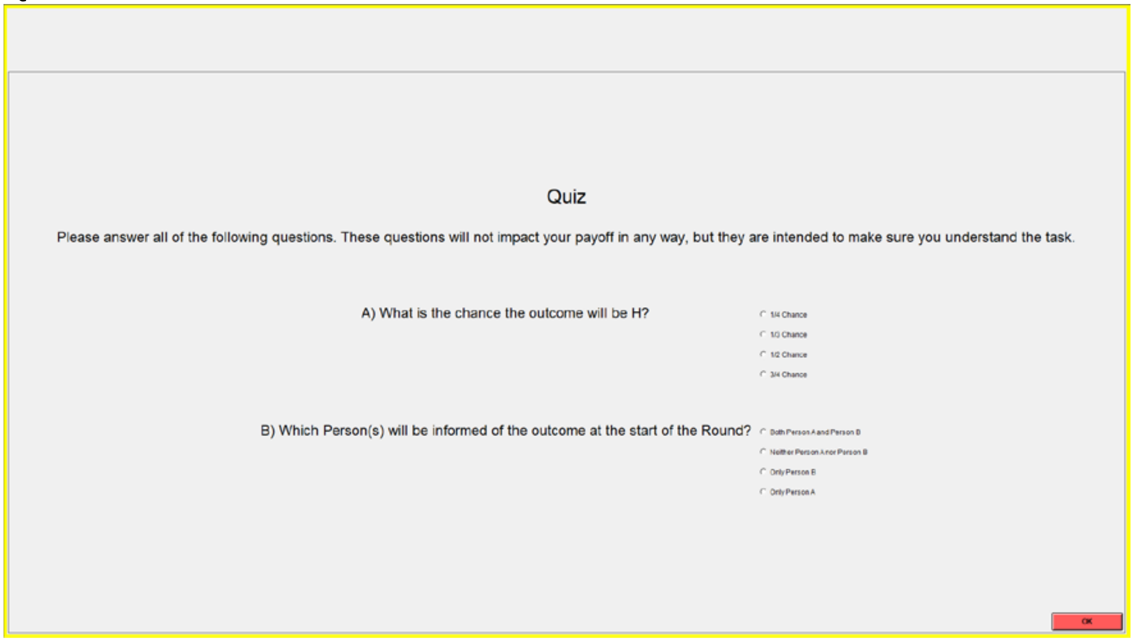
   A's payoff for the round = L - 100.
   B's cost for the round = L + 100.

After all pairs have completed a round, new pairs will be formed randomly and anonymously, and the next round will begin. The values of H and L can change from round to round so you should be sure to check the values of H and L at the start of each round.

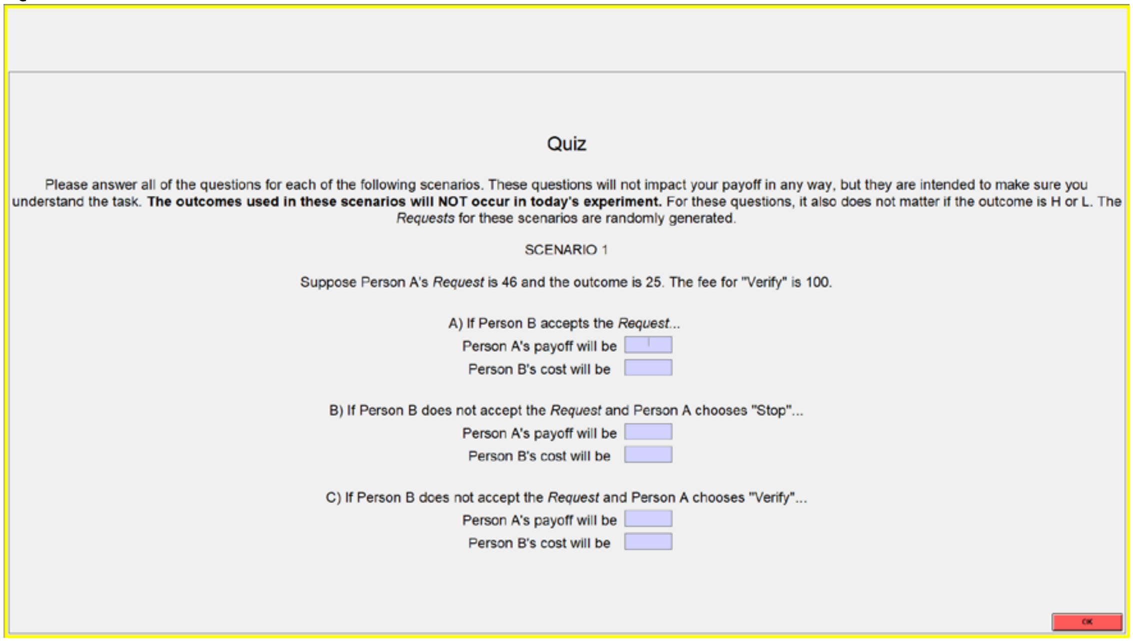
Are there any questions?
We will now take a short quiz before beginning the experiment.

Subjects answered the following comprehension quiz on the computer.

Quiz Screen #1



Quiz Screen #2



Appendix B. Litigation Model with Spite

Here we modify model from Section 3 to include the possibility of spite on the part of the plaintiff. This model will demonstrate how spite can prevent the signaling model from unraveling even when the monetary payoffs indicate that A_L players have an NEV suit. The sequence of the game is as specified in Section 3. To keep our model simple, we only consider possible spite borne by the plaintiff towards the defendant. A spiteful plaintiff potentially perceives a benefit from inflicting costs upon the defendant. Following Guha (2016, 2019) we assume this benefit equals a proportion $\mu > 0$ of the costs borne by the defendant. Stage 3 and stage 5 of our previously specified game are amended as follows:

Stage 3. Player B decides to accept or reject the demand. If it is accepted, the game ends. Player A's payoff is $S(1+\mu)$ and player B's payoff is $-S$. If the demand is rejected, the game proceeds to stage 4.

Stage 5. At trial, a plaintiff of type A_i with $i \in \{H, L\}$ receives the monetary award J^i. The plaintiff's payoff is $(1+\mu)J^i + \mu C_B - C_A$ and the defendant's payoff is $-(J^i+C_B)$.

First, consider the parameter restriction that allows us to eliminate the possibility of a pure strategy separating equilibrium. If there is a dispute, A_H would receive a payoff of $(1+\mu)J^H + \mu C_B - C_A$. If the pooling demand S is accepted, A_H receives $(1+\mu)S$. Under the lowest possible pooling demand, $(1+\mu)S$ equals the A_H dispute payoff. The lowest possible pooling demand is $S = J^H+C_B - (C_A + C_B)/(1+\mu)$. Player B would reject this demand if $J^H+C_B - (C_A + C_B)/(1+\mu) \geq p(J^H + C_B) + (1-p)(J^L + C_B)$, where the right-hand side of this expression is his expected cost at trial when a pooling demand is rejected. If he rejects the lowest possible pooling demand, he will reject all possible pooling demands. Rearranging our expression we can conclude the pooling is not possible if

$$(1-p)(J^H - J^L)(1+\mu) \geq C_A + C_B\,. \tag{B1}$$

Note that a positive value of the spite parameter μ makes it more likely that this condition will hold. Thus, if the condition in (1) holds, the condition in (B1) will necessarily hold. The demands in (2a) and (2b) are unchanged, because they reflect player B costs of arbitration and do not involve a spite term, but the lower bound for the semi-pooling demand S^{SP} is now reflected in the following:

$$S^H - (C_A + C_B)/(1+\mu) \leq S^{SP} \leq S^H \tag{B2}$$

Expression (B2) implies a smaller range for semi-pooling demands than (2c). A semi-pooling demand S^{SP} must be rejected with a sufficiently high probability ϕ so as to make A_L indifferent between making this high demand or making the revealing demand S^L. The rejection rate must satisfy the following:

$$(1+\mu)(J^L + C_B) = (1-\phi)(1+\mu)S^{SP} + \phi([1+\mu]J^L + \mu C_B - C_A)\,.$$

Letting the expression above hold as an equality, (B3) gives the value of ϕ that is consistent with a semi-pooling equilibrium with the high demand S^{SP}:

$$\phi = \frac{(1+\mu)(S^{SP} - J^L - C_B)}{(1+\mu)(S^{SP} - J^L) + C_A - \mu C_B}\,. \tag{B3}$$

It is easy to show that $\partial\phi/\partial\mu > 0$, so that the existence of spite raises the rejection rate ϕ conditional on the value of the semi-pooling demand, S^{SP}. Without spite, the gap between a semi-pooling demand and low demand is $S^{SP} - J^L$. With spite, this gap is $(1+\mu)(S^{SP} - J^L)$. Thus, there is a greater temptation for A_L to bluff by making a higher demand. Therefore, a given semi-pooling demand must be rejected more frequently to prevent A_L from making such a demand. Note that the bluffing probability in (4) is not affected because this probability is a function of B's costs only and these do not include the spite term.

The lowest pooling demand that A_H would accept is $S = J^H+C_B - (C_A + C_B)/(1+\mu)$. Now, if this demand is rejected, all A_L drop the suit, so if $p(J^H + C_B) \leq J^H+C_B - (C_A + C_B)/(1+\mu)$, pooling is not possible. This may be expressed as

$$(1-p)(J^H + C_B)(1+\mu) \geq C_A + C_B. \tag{B4}$$

If (B1) holds, then equation (B4) will also hold. If this condition holds, we cannot have pure strategy pooling.

Absent spite, the credibility constraint for A_L is $J^L - C_A > 0$. In the presence of spite, this condition is $(1+\mu)J^L + \mu C_B - C_A > 0$. Thus, the credibility constraint is more likely to hold in the presence of spite. Under condition (A5), the credibility condition holds when there is spite, but not in the absence of spite:

$$J^L - C_A < 0 < (1+\mu)J^L + \mu C_B - C_A \tag{A5}$$

Since dispute rates may be significantly higher when the credibility condition fails, we have a set of circumstances under which spite may reduce dispute rates. In Guha (2016, 2019), spite can lead to disputes even in the presence of symmetric information. Spite will raise dispute rates in a standard signaling model, when the credibility condition holds absent spite. However, if the credibility condition fails absent spite, the presence of spite has the potential to lower the dispute rate if it can ensure that A_L plaintiffs have a credible threat to proceed to trial.