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Preliminary

An Empirical Analysis of the Signaling and Screening Models of Litigation*

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Abstract

In this paper, we present an experimental analysis of the signaling and screening models of litigation. In both models, bargaining failure is driven by asymmetric information. The difference between the models lies in the bargaining structure: In the signaling game, the informed party makes the final offer, while in the screening game the uninformed party makes the final offer. We conduct experiment for both models under a common set of parameter values, allowing only the identity of the party making the final offer to change. We find that both models have significant predictive ability, but that in both cases the data fail to support the theory along some important dimensions.

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1. Introduction

Civil trials, strikes and wars are all examples of costly forms of dispute resolution which can result from failed negotiations. One of the leading explanations for costly bargaining failure is asymmetric information. We consider a stylized legal bargaining framework in which an informed "plaintiff" knows whether she has either a strong or weak case against an uninformed "defendant." Within this class of models, when the informed party makes the final offer, it is called the signaling model (as the informed plaintiff tries to signal her type with her offer), and when the uninformed party makes the final offer it is called the screening model (as the uninformed defendant tries to screen weak and strong cases with his offer). We examine both of these models experimentally.

There has been previous experimental analysis of both the signaling and screening models, and the screening model has previously been analyzed in the context of civil litigation.[1] To our knowledge, however, there has not been a previous experimental analysis of the signaling model in the litigation context. As such, this part of our experiments is a major focus of our paper. We use the same parameter values in both the signaling and screening experiments; the only difference between the two is whether the informed plaintiff or the uninformed defendant makes the offer. This allows us to make a side-by-side empirical comparison of how well each model performs.

Our data suggest that both models have significant predictive power. In line with previous results, we find that most subjects in the screening game can find a screening offer as predicted by the theory. A screening offer by the defendant is a low offer that plaintiffs with a

[1] For example, Forsythe, Kennan and Sopher (1991) analyze strikes in a model with asymmetric information. Bradts and Holt (1992, 1993) conduct signaling experiments to test certain refinement concepts which have been developed by game theorists to help select among the multiple equilibria that are prevalent in signaling games. Cooper et al. (1997) analyze a signaling model in the context of limit pricing. Previous work on the screening game in the litigation context includes Pecorino and Van Boening (2001, 2004).

weak case will accept, but plaintiffs with a strong case will reject. Empirically, the screening offer made by our players in the role of the defendant is higher than predicted by theory. In addition, disputes occur in the states of the world in which they are not supposed to occur. On the other hand, when disputes are predicted to occur, they do so with a very high probability. This mixed performance is very much in line with past experiments.

The signaling game too brings mixed results. Under the refinement D1, a pure strategy separating equilibrium is predicted for this game.[2] In this equilibrium, plaintiffs with a weak case make a low offer which reveals their type, and plaintiffs with a strong case make a high offer which is also revealing of their type. The high offers are rejected with a sufficiently high probability so as to discourage bluffing on the part of plaintiffs with a weak case. In practice, we find that some plaintiffs with a weak case reveal their type via a low offer, while others bluff by making a higher offer. In addition, while plaintiffs with a strong case make significantly higher offers than plaintiffs with a weak case, they generally do not make the unique offer predicted by the pure strategy separating equilibrium. Our results are very roughly consistent with a Bayes – Nash semi-pooling equilibrium, but they are not consistent with the pure strategy separating equilibrium implied by the refinement D1. In addition, we find some anomalous behavior in the signaling model in the sense that some offers which should never be accepted are in fact accepted. This occurs when some players in the role of the defendant (apparently) fail to infer that plaintiffs with a strong case will never make an offer below the payoff they obtain at trial.

2. The Theory

The screening model we describe is a simplified version of Bebchuk (1984), while the signaling model is a simplified version of Reinganum and Wilde (1986). Both the plaintiff and

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[2] See Cho and Kreps (1987). We will discuss D1 in more detail below.

defendant are risk neutral. The level of damages to be awarded at trial is known by the plaintiff but not the defendant. The defendant only knows that with probability q he faces a high damage plaintiff J^H and with probability 1-q he faces a low damages plaintiff J^L. Using this simple environment, we first present the screening model and then the signaling model.

In all of our analyses, the probability p that the plaintiff prevails at trial is common knowledge, and we furthermore assume that $p = 1$. The plaintiff is one of two types, type H with a strong case or type L with a weak case. If the case proceeds to trial, the plaintiff receives judgment J^i, $i = H,L$ with $J^H > J^L$. The amounts of the state-contingent judgments are common knowledge. The court costs for the plaintiff and defendant are, respectively, C_P and C_D. (These costs are incurred only if the case proceeds to trial.) We assume that $J^L - C_P > 0$ so that the plaintiff always has a credible threat to proceed to trial.[3]

2.1 The Screening Game

The stages of the game are as follows:

0. Nature determines the plaintiff's type to be either H with judgment J^H or L with judgment J^L. The plaintiff is type H with probability q and type L with probability 1-q. The plaintiff knows her type, but the defendant knows only the probability q that the plaintiff is type H (and hence probability 1-q that the plaintiff is type L).

1. The defendant makes an offer O_D to the plaintiff.

2. The plaintiff accepts or rejects the offer. If the offer is accepted, the game ends with the plaintiff receiving a payoff of O_D and the defendant receiving a payoff of $-O_D$ (i.e., the defendant incurs a cost equal to O_D).

[3] Nalebuff (1987) analyzes a model in which this is not always true.

3. If the offer is rejected, trial occurs. The plaintiff receives the payoff $J^i - C_P$, and the defendant receives the payoff $-J^i - C_D$ (or incurs cost $J^i + C_D$), where $i = H, L$.

The plaintiff will accept any offer that leaves her at least as well off as the expected outcome at trial. In other words, a type i plaintiff will accept any offer such that $O_D \geq J^i - C_P$. The defendant is free to make any offer he chooses, but the optimal offer will be one of the following:

$$O_D^L = J^L - C_P \tag{1a}$$

$$O_D^H = J^H - C_P \tag{1b}$$

In making his offer O_D, the defendant will choose either a high pooling offer O_D^H that both plaintiff types will accept or the low screening offer O_D^L that only a type L plaintiff will accept. The defendant offers O_D^L iff

$$(1-q)(J^L - C_P) + q(J^H + C_D) < J^H - C_P. \tag{2}$$

The left hand side represents the expected payout from the offer O_D^L which is accepted with probability 1-q. If this offer is rejected by a type H plaintiff, the defendant proceeds to trial and pays $J^H + C_D$. The right hand side is the defendant's payout from the higher offer, which is accepted by both plaintiff types. Rearranging equation (2), the defendant will make the low offer iff

$$q < \frac{(J^H - J^L)}{(J^H - J^L) + C_P + C_D}. \tag{3}$$

The defendant makes a low screening offer if the probability q of encountering a high damage plaintiff is sufficiently small. When the screening offer is made, trials will occur with probability q. If the condition in (3) fails to hold, the defendant will make the pooling offer under which all cases settle. In our experiment, we choose parameter values such that (3) holds. Therefore, our theoretical predictions are that the player in the role of the defendant will offer O_D^L, and that players in the role of a type L plaintiff will accept this offer with 100% probability and players in the role of a type H plaintiff will reject it will 100% probability.

2.2 The Signaling Game

The stages of the game are similar to those above with 1' and 2' replacing stages 1 and 2.

1'. The plaintiff makes an offer O_P to the defendant.

2'. The defendant accepts or rejects the offer. If the offer is accepted, the game ends with the plaintiff receiving payoff O_P and the defendant receiving payoff $-O_P$ (or incurring cost O_P).

Multiple equilibria are a problem in signaling games. In this particular game, the refinement concept D1 has been used to eliminate all but a pure strategy separating equilibrium. We will consider that equilibrium first, but then briefly consider others that are not consistent with D1. The refinement D1 places restrictions on out-of-equilibrium beliefs. It requires that the defendant believe than an out-of-equilibrium offer be made by the plaintiff type most likely to benefit from that offer.[4] In the separating equilibrium, each plaintiff makes a unique offer associated with her type. These offers are as follows:

[4] In our model, this works as follows: Suppose an L plaintiff would be willing to deviate to a particular out of equilibrium offer if it were accepted with a probability of ½ or higher, but that an H plaintiff would only switch if the same offer were accepted with a probability of ¾ or higher. In this case, the L plaintiff is considered to have the

$$O_P^L = J^L + C_D \quad (4a)$$

$$O_P^H = J^H + C_D \quad (4b)$$

In the separating equilibrium, *H* plaintiffs make the offer O_P^H and *L* plaintiffs offer O_P^L. Since the plaintiff follows a pure strategy, these offers are revealing of the plaintiff's type. In other words, a defendant receiving an offer O_P^H believes with probability 1 that this offer has been made by a type *H* plaintiff.

The low offer O_P^L will be accepted by the defendant with probability 1.[5] Type *L* plaintiffs will reveal their type via the offer O_P^L only if O_P^H is rejected with a sufficiently high probability. Note that the revealing offer O_P^H leaves the defendant indifferent between acceptance and rejection. Thus, the defendant is free to respond to this offer with a mixed strategy. The offer O_P^H will be rejected by the defendant with probability ϕ such that

$$(1-\phi)(J^H + C_D) + \phi(J^L - C_P) \leq J^L + C_D. \quad (5)$$

Rearranging yields the condition

$$\phi \geq \frac{(J^H - J^L)}{(J^H - J^L) + C_P + C_D}. \quad (6)$$

greater incentive to make the offer and the defendant must put a weight of 1 on the probability that such an offer comes from an *L* player. See Cho and Kreps (1987).

[5] It is a dominant strategy to accept offers below O_P^L, so these out of equilibrium offers must be accepted with probability 1. To support the equilibrium, we must avoid a jump up in the acceptance rate as offers fall below O_P^L. Thus, O_P^L must also be accepted with probability 1. See Reinganum and Wilde (1986, p. 565).

The probability of a trial is $q\phi$, the probability that the plaintiff is type H times the probability that the high offer is rejected. More specifically, the dispute rate for A_L plaintiffs is 0% and the dispute rate for A_H plaintiffs is ϕ%. Under the refinement D1, the expression in (6) will hold as an equality. (See Daughety 1999: 133-4).

Out-of-equilibrium beliefs and actions are as follows: An offer $O_P < O_P^L$ is believed to be from a type L plaintiff and is accepted with probability 1 while an offer $O_P > O_P^H$ is believed to be from a type H plaintiff and is rejected with probability 1. An offer $O_P^L < O_P < O_P^H$ is believed to be from a type L plaintiff and is rejected with probability 1. It is straightforward to show that these beliefs are consistent with D1 (Cho and Kreps 1987). Furthermore it is possible, using D1, to rule out all potential pooling and semi-pooling equilibria (Reinganum and Wilde, p. 566).

Whether or not the D1 refinement places valid restrictions on out-of-equilibrium beliefs is an empirical question. As such, it is worth discussing some equilibria of the signaling game that do not satisfy D1. First, we can eliminate a pure strategy pooling equilibrium if we impose the following parameter restriction: $C_P + C_D < (1 - q)(J^H - J^L)$.[6] Our experimental parameters satisfy this restriction.

Under our experimental parameters, a semi-pooling equilibrium is possible. In this equilibrium, the L plaintiff plays a mixed strategy in which she makes the revealing offer O_P^L with some probability and bluff by offering O_P with some probability where $J^H - C_P \le O_P < J^H + C_D$. If L is to mix between these strategies, she must be indifferent

[6] A type H plaintiff will accept no less than $J^H - C_P$ in a pooling equilibrium. If the condition in the text holds, the defendant will prefer to take all types to trial rather than settling at $J^H - C_P$ in a pure pooling equilibrium. Obviously, the defendant would reject all higher offers as well, if they were part of a pure pooling equilibrium.

between the offers. The low offer is accepted with probability 1. If the higher offer is accepted with probability

$$r = \frac{C_P + C_D}{O_P - J^L + C_P}, \tag{7}$$

then L will be indifferent between the two offers.

In this semi-pooling equilibrium, the defendant must be indifferent between accepting or rejecting O_P. If s is the conditional probability that the offer O_P is made by L, then the defendant is indifferent between acceptance and rejection when

$$s = \frac{J^H + C_D - O_P}{J^H - J^L}. \tag{8}$$

An infinite number of semi-pooling equilibria are possible, since O_P can take on a range of values. However, in any particular semi-pooling equilibrium, all the H plaintiffs and all of the bluffing L plaintiffs will pool on one and only one value of O_P.

3. Experimental Design

Table 1 summarizes the six sessions in our experimental design. In sessions Scr1, Scr2 and Scr3, subjects played the screening game and in sessions Sig1, Sig2 and Sig3, they played a signaling game. Subjects were recruited from summer business classes at the University of Alabama. The number of bargaining pairs per session ranges from 5 to 8, while each session lasted 12 or 13 rounds. The player in the role of the plaintiff is referred to as the *A* player, and thus there are A_L players for type L plaintiffs and A_H players for type H plaintiffs. The player in the role of the defendant is referred to as the *B* player. In each round of the experiment, the *A* and *B* players were randomly and anonymously paired. Subjects were not informed ahead of time how many rounds there would be. A typical session, inclusive of an instructional period at the beginning and private payment at the end, lasted between one-and-a-half and two hours. The mean and median earnings for our subjects were about $30 with a minimum of $7.05 and a maximum of $46.75. (Subjects were not paid a show-up fee; all earnings were from decision-making.)

As they arrived to a session, subjects were randomly assigned to one of two rooms, with subjects in one room being player *A* and subjects in the other room player *B*. An experimenter was assigned to each room. Subjects were not informed of their role until the end of the experimental instructions; all subjects received common instructions that explained how both player *A* and player *B* made decisions and earned money. Subjects maintained the same role throughout the session, and other than the written messages transmitted by experimenters between the two rooms, there was no interaction between the *A* and *B* players. Each subject had a private Record Sheet, and each experimenter had forms on which to record information. Players wrote their decisions on their respective Record Sheet, and an experimenter recorded this information on his form. After all subjects in a room had made their decisions, the experimenters met in the hallway between the two rooms, silently copied information from one another's forms, and then returned to the rooms and wrote the results on the respective subject's Record Sheet.

Table 1. Experimental Design

Session	Number of pairs	Number of rounds
I. Screening Game		
Scr1	7	12
Scr2	5	13
Scr3	8	13
II Signaling Game		
Sig1	6	12
Sig2	8	12
Sig3	8	12

Note: All sessions conducted at the University of Alabama.

The parameters for both experiments are the same. The "judgments" at trial J^L = \$1.50 for A_L players and J^H = \$4.50 for A_H players. Trial costs are $C_P = C_D$ = \$.75, so that total dispute costs are \$1.50. The probability that a plaintiff is A_H is $q = 1/3$. Of course, in the experiment, we did not use verbiage like plaintiff, defendant, judgment at trial, court costs, etc.

3.1. The Screening Game

The sequence in a round of the screening game is as follows (this is very similar to language and appearance used in the subjects' instruction):

1. Player *A* and Player *B* are randomly and anonymously paired.
2. A 6-sided die is rolled for each Player *A*. A roll of 1, 2, 3, or 4 is called outcome *L*. A roll of 5 or 6 is called outcome *H*. Only Player *A* knows the outcome of the die roll.
3. Player *B* decides on an offer to submit to Player *A*. This offer may be any number between (and including) \$0.00 and \$6.99.

4. Player *B*’s offer is then communicated to Player *A*. Player *A* is given a few moments to decide whether or not to accept the offer. Player *A*’s decision is then communicated to Player *B*.

5. If Player *A* accepts Player *B*’s offer, then the round is over for that pair.

Players *A*’s Payoff for the round	=	Player *B*’s offer
Player *B*’s Cost for the round	=	Player *B*’s offer.

6. If Player *A* does not accept *B*'s offer, both *A* and *B* incur a fee of 75. *A*’s payoff and *B*’s cost for the round depend on the die roll and the fees:

Under outcome L:	Player *A*’s Payoff for the round	=	150 – 75 = 75
	Player *B*’s Cost for the round	=	150 + 75 = 225
Under outcome H	Player *A*’s Payoff for the round	=	450 – 75 = 375
	Player *B*’s Cost for the round	=	450 + 75 = 525.

Player *A*'s payoff from the experiment is the sum of her payoffs from all rounds. Player *B*'s payoff from the experiment is lump sum minus the sum of his costs from all rounds; the lump sum is known in advance by player *B* but is never revealed to player *A*.

3.2. The Signaling Game

The parameters and procedures for the signaling game are identical to the screening game, except that player *A* makes the take-it-or-leave-it offer to player *B*. The steps of a round are identical to the screening game except for the following modifications.

3’. Player *A* decides on an offer to submit to Player *B*. This offer may be any number between (and including) $0.00 and $6.99.

4’. Player *A*’s offer is then communicated to Player *B*. Player *B* is given a few moments to decide whether or not to accept the offer. Player *B*’s decision is then communicated to Player *A*.

5’. If Player *B* accepts Player *A*’s offer, then the round is over for that pair.

Players *A*’s Payoff for the round	=	Player *A*’s offer
Player *B*’s Cost for the round	=	Player *A*’s offer.

The payoffs in the event of a dispute (i.e., *B* does not *A*’s offer) are the same in the two games.

3.3. Predictions

In the screening game, the predictions are:

1. Player *B* will make a low screening offer 75 to player *A*.[7]

2. A_L players accept all offers greater than or equal to 75 and reject all offers below 75. If prediction 1 is correct, this implies a 0% dispute rate for A_L players.

3. A_H players accept all offers greater than or equal to 375 and reject all offers less than 375. If prediction 1 is correct, this implies a 100% dispute rate for A_H players.

For the signaling game matters are a bit more complicated, but here we will list the predictions of the unique equilibrium outcome that applies under the refinement D1. Note however that if D1 is not a valid refinement for our experimental game, then semi-pooling equilibria are possible. We discuss this further in the results section.

Under D1, we have the following prediction for the signaling game:

1. A_L players offer 225 to player *B*.

2. A_H players offer 525 to player *B*.

3. Player *B* accepts all offers of 225 or less. All offers between (and including) 226 and 524 are rejected with 100% probability. An offer of 525 is rejected with a probability of $\phi = 2/3$.

3.4. Caveat on Point Predictions

Our predictions ignore the role of fairness (or "other regarding preferences"), and assume that the player making the offer can (and will) extract all of the joint surplus from settlement. From the ultimatum game literature, we know that fairness can play a role in bilateral bargaining. To the extent that this is true, we should not be surprised if the actual offers in the experiments provide more surplus than is implied by the model of narrow rationality. However, even if we

[7] An offer of 75 leave an A_L player with none of the joint surplus of settlement. For the purposes of exposition, we will ignore (here and elsewhere) the extra penny of surplus we might expect players to offer to ensure settlement under the predictions of the fully rational model. If fairness plays a role, then players may need to offer substantially more than one penny of surplus in order to ensure settlement.

observe such deviations from the theory, this will not necessarily prevent the emergence of some of the important central tendencies predicted by the theory. For example, in the screening game, even if the offers are not as aggressive as predicted by theory, we may still observe offers which are clearly designed to be acceptable to A_L players, but not to A_H players. Similarly, in the signaling game, it may be possible to observe separating offers made by A_L and A_H players, even if they are not as aggressive as the offers predicted by the theory.

In an experiment such as this, it would be surprising to hit the point predictions on the offers with great precision, but we do want to test if the theories predict the central tendencies of player behavior. Also, it is typical in experiments such as these for there to be excess disputes (relative to the predictions of theory), but if the theories have reasonable predictive ability, we should observe far more disputes in the state of the world in which they are predicted to occur compared to the states in which they are not predicted to occur.

4. Results

We will first present the results of the screening game. As noted earlier, previous experimental research has analyzed this game, but its inclusion allows us to compare the performance of its theoretical predictions with those of the signaling game.

4.1. The Screening Game

Figure 1 shows the player B offers in the screening game. Note that the median offer is 112. While this is clearly above the theoretical prediction of 75, it is also clearly a screening offer. Seven percent of the offers are above 375, and these are clearly intended as pooling offers, which is contrary to the predictions of theory. If these pooling offers are excluded, the median offer is 100, which is fairly close to the theoretical prediction of 75. Eighty-three percent of the

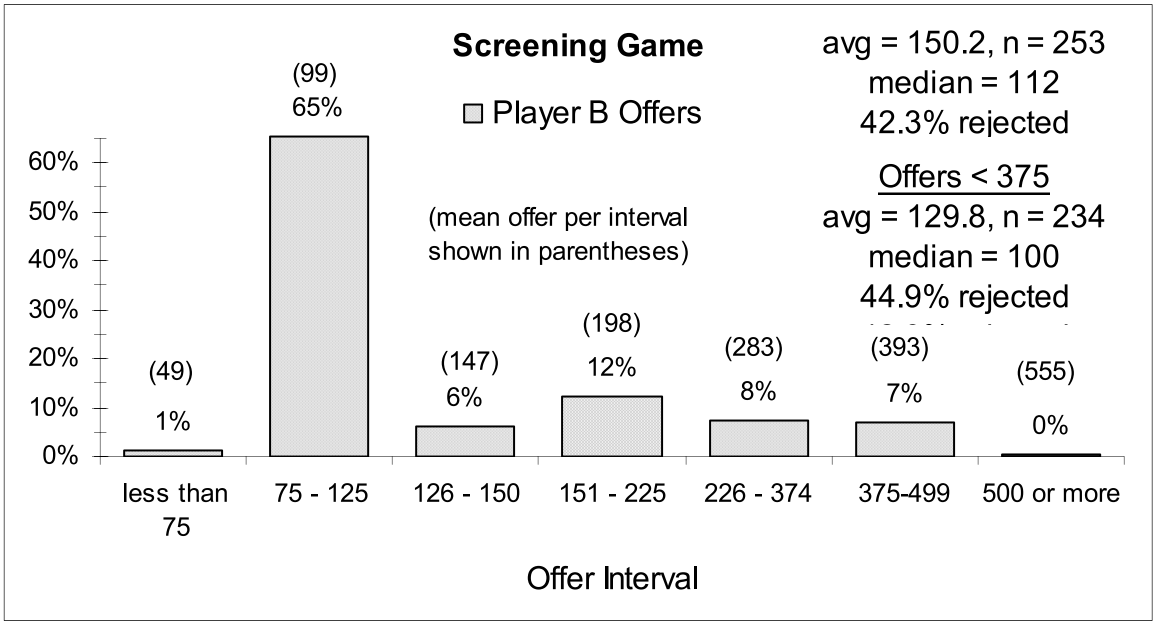

Figure 1

offers are between A_L's dispute payoff of 75 and player *B*'s dispute payoff verses A_L of 225. Though some of these offers are well above the theoretical prediction, all would appear to be separating offers as predicted by theory. One percent of the offers are less than 75, while 8% are between 225 and 374. These offers are clearly at variance with the theory. Overall, while there are some important deviations from the theory, the predictions on player *B*'s offers give a pretty good guide to the central tendencies of his behavior.

Next, we turn to player *A*'s rejection behavior. The overall dispute rate for A_L players is 20%, while the theoretical prediction is 0%. This level of excess disputes is in line with previous screening experiments.[8] The dispute rate for A_H players is 89%, while the theoretical prediction is 100%. Part of this result from the fact that 10% of the offers to the A_H players exceeded 375. For offers less than 375, the A_H dispute rate of 96% is quite close to the theoretical prediction.

[8] See Pecorino and Van Boening (2001, 2004).

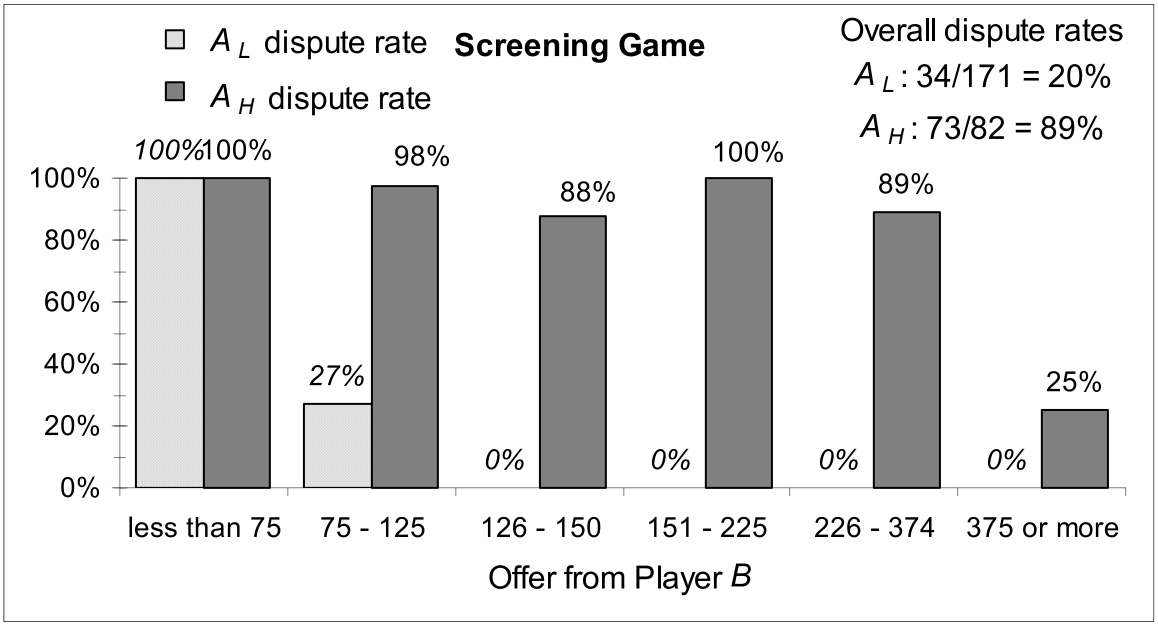

Figure 2

The excess disputes among the A_L players are all in the 75-125 interval, where the dispute rate is 27%. Offers of 126 and above were always accepted by these players. The 27% probability of rejection in this interval is clearly one factor driving player *B* offers above the theoretical prediction of 75, but it cannot explain why player *B* would make an offer in excess of 125. Even if we ignore the pooling offers (those above 375), 26% of the player *B* offers are too generous, given the rejection behavior by player *A*.

The excess rejections by player *A* are concentrated in a region where fairness concerns may be of importance. A_L players reject all offers less than 75 (though this constitutes just 1% of the offers), while A_H players reject 96% of offers below 375. All told, rejection behavior is very much in line with the predictions of theory.

4.2. The Signaling Game

The signaling game offers are shown in Figure 3. The percentage of offers falling within each interval is shown above each bar, and the mean offer within the interval is shown in parentheses.

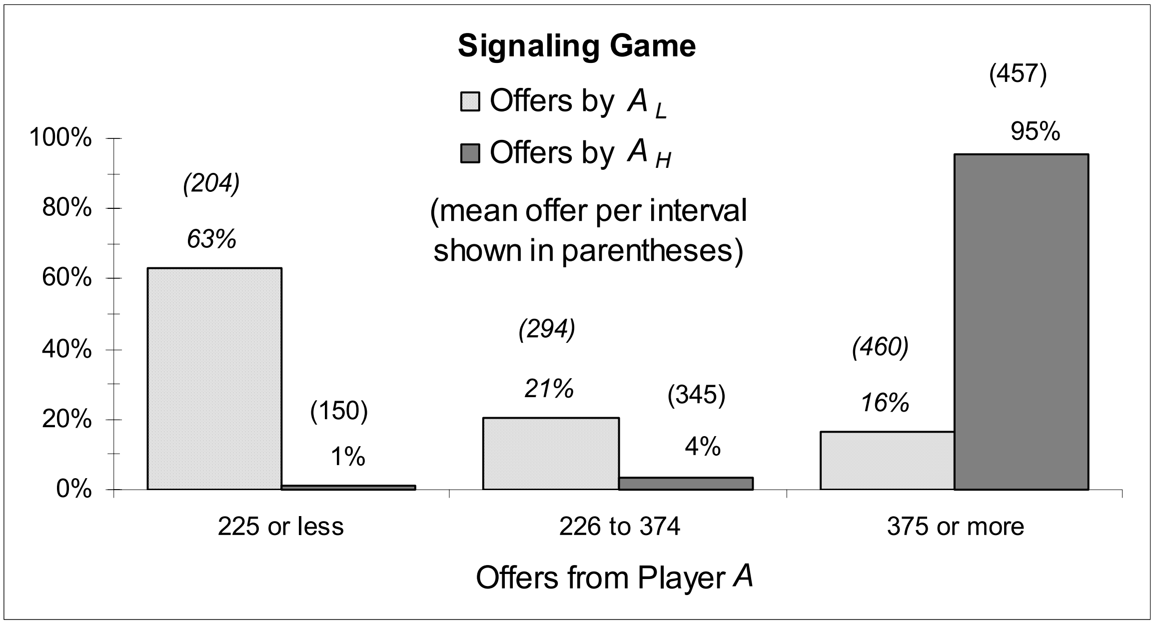

Figure 3

A_L players are predicted to make an offer of 225, and 63% make an offer of 225 or less, with a mean of 204 within this range. The mean value of this offer is close to the theoretical prediction, particularly if we make some allowances for fairness considerations. Sixteen percent of the A_L offers are greater than 375. Clearly, these offers are "bluffs" designed to be confused with offers from A_H players. While these bluffs are not predicted in the unique equilibrium which satisfies D1, it is not that surprising that we see some of this behavior on the part of A_L players. More puzzling are the offers between 226 and 374. Player *B* should always reject these offers, because he should rationally conclude that such an offer would never be made by an A_H player. (If accepted, the resulting payoff for A_H is below her dispute payoff.) Furthermore, empirically it is the case that only 8.3% of these offers are made by A_H, but these offers are nevertheless accepted by B with probabilities ranging from 24% to 74%. (See Figure 6 below.)

Ninety-five percent of the A_H offers are greater than 375, but the mean in this interval is 457, which is well below the theoretical prediction of 525. Also, note that the A_H offers are less aggressive relative to the theoretical predictions than the A_L offers. Finally note that the A_L offers greater than 375 have a mean of 460, and by this measure are indistinguishable from the A_H offers. While the offer behavior shown in Figure 3 is not strictly compatible with a semi-pooling equilibrium, it is at least roughly consistent with such an equilibrium. Sixty-three percent of A_L players make low revealing offers, while 16% "bluff", by making offers that are similar to A_H offers.

To gain a better insight into player behavior, we need to take a more detailed look at the offers. This is done in Figures 4 for A_L players and in Figure 5 for A_H players.

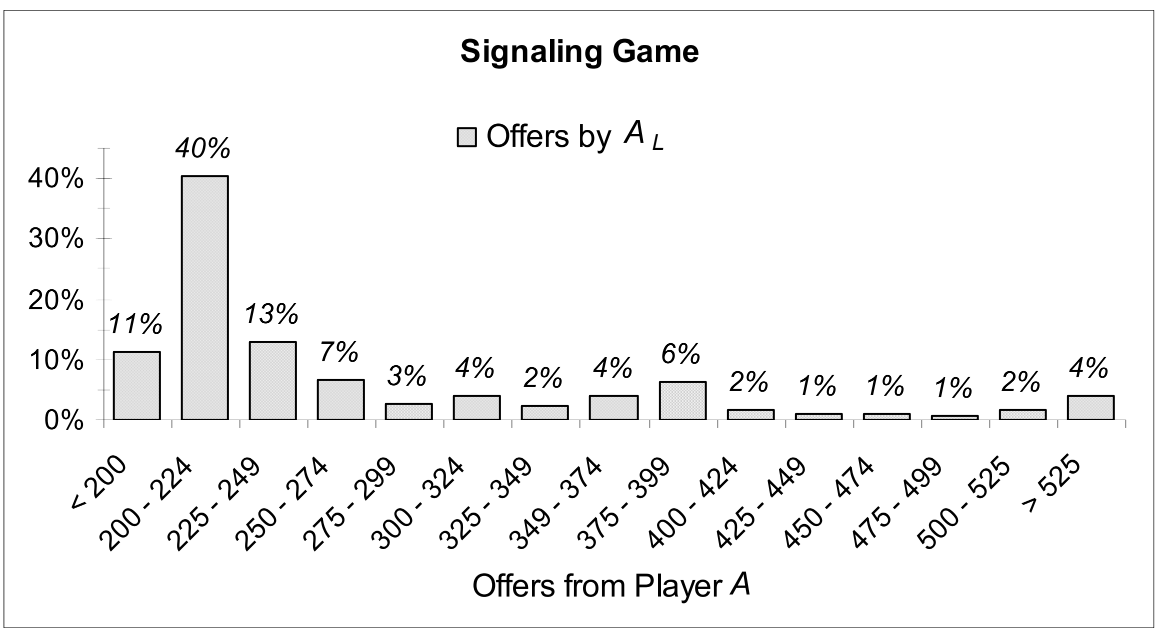

Figure 4

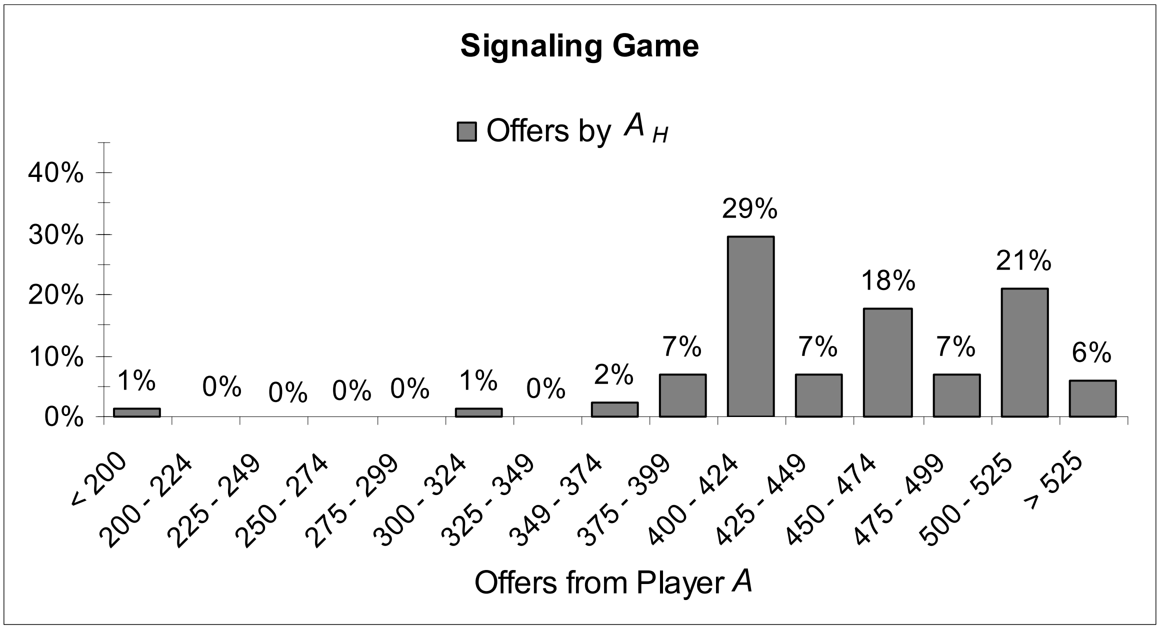

Figure 5.

As can be seen in Figure 4, the bulk of the revealing offers by A_L (those 225 or below) are between 200 and 225. Thus, conditional on making a revealing offer, the behavior is quite close to the theoretical prediction. Aside from the 375-399 interval, the bluffs (offers > 375) by A_L are fairly uniformly distributed. Note from Figures 4 and 5 that 4% of the A_L offers and 6% of the A_H offers are greater than 525. These are anomalous, since *B* has a dominant strategy to reject such offers and does in fact reject them all. In Figure 5, most offers by A_H are greater than 375, and the offers are spread widely in this range, with spikes occurring in the 400-424 interval, the 450-474 interval and the 500-525 interval.

In the unique equilibrium predicted by D1, there is no bluffing by A_L and A_H makes an offer of 525. These implications are clearly rejected by the data. Some A_L bluff, and the A_H offers are spread throughout the 375-525 interval. We can get a better handle on this behavior by looking at the player *B* rejection behavior.

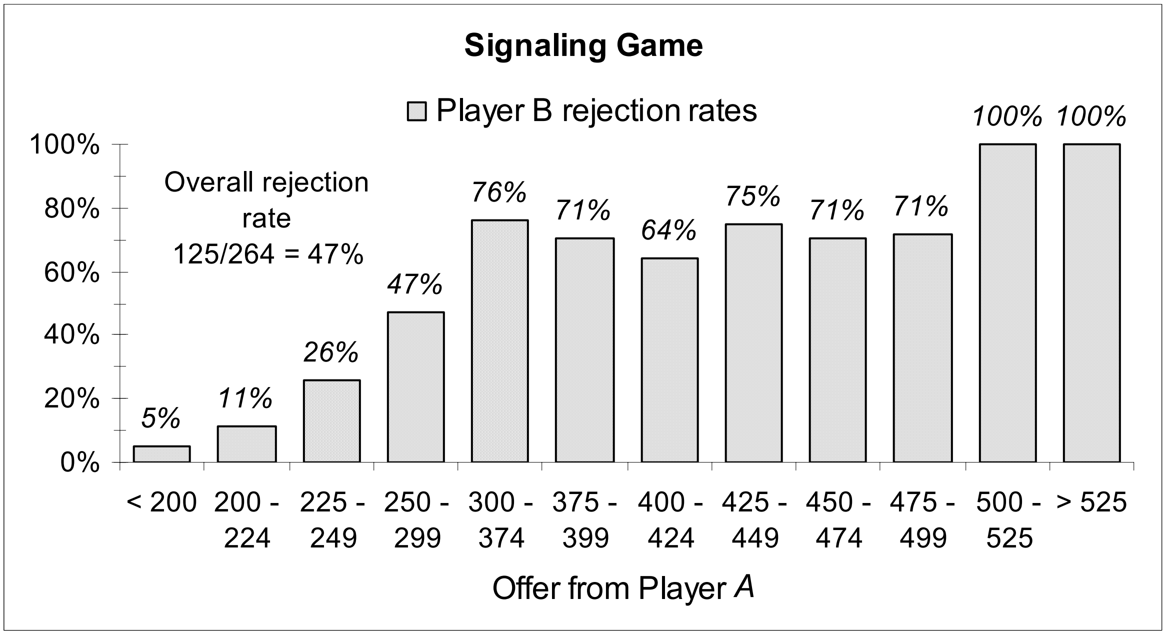

Figure 6.

Theory predicts that all offers less than 225 will be accepted, while the data in Figure 6 show that 95% of offers below 200 are accepted and 89% of offers between 200-224 are accepted. If we make some allowances for fairness considerations, this behavior seems to correspond quite well with the theory.

By contrast, offers between 226 and 374 should always be rejected by *B*. This prediction follows from a simple dominance argument. A_H should never make such an offer, since it is below her dispute payoff. Thus, *B* should conclude the offer is from A_L and reject it. From Figure 6 it is clear that these offers are not all rejected, while empirically, the overwhelming majority of these offers are made by A_L players. In many ways, this is the most troubling result for theory observed in our paper, because it is not a prediction stemming from the refinement D1, but instead follows from a dominance argument which is much more fundamental to game theory.

Although the rejection behavior on offers greater than 375 does not conform to the requirements of D1, the behavior is quite sensible. The rejection in each interval above 375 is sufficient to make bluffing by A_L players unprofitable for any offer between 375 and 525. This may explain why the amount of bluffing we observe (16% of A_L players) is rather limited.

The data also make it clear why A_H players do not generally offer 525 as predicted by theory. Player *B* rejects all offers of 500 or above. To the extent that A_H players experiment with offers in this range, they find no success in having these offers accepted. If offers in this range are never accepted, then A_H players can do no worse by experimenting with lower offers that might be accepted with a positive probability. This is exactly what happens, though the A_H players are unable to converge on a single offer below 525 in this process (as required by a semi-pooling equilibrium). In other words, they realize they need to drop the offer below 500 to have it accepted, but the do not know how low they need to go. Furthermore since rejection rate are still about 70% in this range, some players who were not lucky enough to have an offer of, say, 475, accepted, might continue to drop their offer until it was accepted. Thus, given the high rejection rates, it is not surprising that different players might find different stopping points as they reduced their offers below 500.

5. Conclusion

Our results on the screening game are in line with previous experiments. While point predictions are missed, the theory does a good job in predicting the central tendencies of the offers and of the rejection behavior. As in previous experiments, player *B* generally makes low screening offers. In fact, 83% of the offers clearly fall into this category. This is consistent with the theory, but these offers are generous relative to theory and about 22% (18/83) of these offers are too generous given the empirical rejection behavior of player A. Overall, the screening model has fairly good predictive ability.

Using the same parameter values as in the screening game, we switched the identity of the player making the offer to create a signaling game. To the best of our knowledge, this has not been done previously in the context of a experimental setting which can which can be interpreted as highly stylized legal bargaining. We believe that the problem posed to the experimental subjects is much more difficult in the signaling game than in the screening game. In the screening game, the recipient of the offer is the informed party and has a fairly trivial decision to make in deciding whether or not to accept the offer. The player making the offer has a more difficult decision, but latching onto the idea of a screening offer does not appear to an extremely difficult task. In contrast, in the signaling game, both the sender and the recipient of the offer have difficult problems to solve. In the case of the senders, A_L players have to decide whether they should bluff and then decide what offer would constitute a good bluff, while A_H players have to decide how much below 525 they need to shade their offer in order to ensure a reasonable chance of acceptance. In the case of the recipient, player B has an extremely difficult decision to make when he is faced with an offer above 375, because he cannot be sure whether the offer is from an A_H player or a bluffing A_L player.

Given these difficulties, we expect less adherence to theory in the signaling game compared to the screening. Whether this is true is (to some degree) a matter of judgment, but some things are abundantly clear in the results. First, the refinement D1 can be rejected as descriptive of player's belief formation, since the corresponding implications for player behavior are clearly violated. This is not terribly surprising, and in and of itself does not imply any violations of basic rationality.

More disturbing is the acceptance of offers that should have been rejected using dominance arguments. This does appear to violate the rationality assumptions in a nontrivial way. It should be pointed out that there were not a large number of offers in the range in question. Also, the rejection function for player *B* under full rationality is discontinuous and nonmonotonic. In particular, the rejection rate jumps from 0% at 225 to 100% between 226 and 374, and then falls below 100% for offers above 375. The empirical rejection function rises monotonically up to the 300-374 range and then stays flat at near 70% until the 500 – 525 range is reached, where it jumps to 100%.

Other aspects of subject behavior appear to be in reasonable conformance with theory. Rejection behavior on offers below 225 and offers over 375 is roughly in line with theory, at least if we abandon the implications of D1. The offer behavior of the *A* players is also roughly in line with theory. A high percentage of A_L players make a revealing low offer, while almost all A_H players make offers which separate them from these A_L players. Sixteen percent of A_L players bluff, by making an offer that mimics those of the A_H players. The bluffing A_L players and the A_H players do not converge on a single offer as they would in a semi-pooling equilibrium, but it would have been rather miraculous if they had. There is a continuum of such equilibria, and player feedback was limited to their own bargaining experience.[9]

Clearly, the signaling model deserves more experimental attention. It is one of the two informational based models of pretrial bargaining, and it is therefore vital to gain further insights into how well the predictions of the model are reflected in actual behavior.

[9] Furthermore, if player *B* accepted a high offer, he would never learn whether it was a bluff or not.

References

Bebchuk, Lucian A . 1984. "Litigation and Settlement Under Imperfect Information." *RAND Journal of Economics* 15 (Autumn): 404-14.

Bradts**,** Jordi and Charles A. Holt. 1992. "An Experimental Test of Equilibrium Dominance in Signaling Games." *The American Economic Review*, 82(5): 1350-1365.

Bradts**,** Jordi and Charles A. Holt. 1993. "Adjustment Patterns and Equilibrium Selection in Experimental Games." *International Journal of Game Theory*, 22: 279-302.

Cho, In-Koo and David M. Kreps. 1987. "Signaling Games and Stable Equilibria." *Quarterly Journal of Economics* 102: 179-222.

Cooper, David J., Susan Garvin and John H. Kagel. 1997. "Signaling and Adaptive Learning in an Entry Limit Pricing Game." *The RAND Journal of Economics*, 28(4): 662-683.

Daughety, Andrew F. 1999. "Settlement." In *Encyclopedia of Law and Economics*, Vol. 5, ed. B. Brouckaert and G.de Geest. Cheltenham: Edward Elgar.

Forsythe, Robert; John Kennan, and Barry Sopher. 1991. "An Experimental Analysis of Strikes in Bargaining Games with One-Sided Private Information." *American Economic Review* 81 (March): 253-78.

Nalebuff, Barry. 1987. "Credible Pretrial Negotiation." *RAND Journal of Economics* 18 (Summer): 198-210.

Pecorino, Paul and Mark Van Boening. 2001. "Bargaining and Information: An Empirical Analysis of a Multistage Arbitration Game." *Journal of Labor Economics* 19: 922-48.

Pecorino, Paul and Mark Van Boening. 2004. "An Empirical Analysis of Bargaining with Voluntary Transmission of Private Information." *Journal of Legal Studies* 33 (January): 131-156.

Reinganum, Jennifer F., and Louis L. Wilde. 1986. "Settlement, Litigation, and the Allocation of Litigation Costs." *RAND Journal of Economics* 17 (Winter): 557-566.