Settlement Escrows: An Experimental Study of a Bilateral Bargaining Game*

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Abstract

This paper reports the results of a bargaining experiment. We follow the pretrial bargaining model of Gertner and Miller (1995) under uncertainty and examine the effect of a litigation institution, called a settlement escrow and uncertainty on the timing and quality of settlement outcomes. Our findings indicate that settlement rates are significantly higher when a settlement escrow is added to the bargaining process where there is asymmetric information. Quality of outcomes, measured as the percentage of the true damage that the outcome represents, is positively and significantly influenced by the addition of a settlement escrow.

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1 Introduction

Bargaining processes are found in at least four different domains: civil litigation, labor negotiations, international negotiations and market operations (trade). Delayed settlement or impasse during these processes of bargaining cause high costs for the parties and for society. These costs range from the resources devoted to attorneys' fees, to costs related to work stoppages, war, and suspension of trade operations.[1]

In civil litigation, although most cases settle before trial, many do not settle early, and some do not settle at all. Applied models of pre-trial settlement bargaining have been developed to explain the sources of negotiation breakdown and to propose mechanisms to improve efficiency. Primarily law, economics and game theory have influenced these models. However, there are surprisingly few empirical tests of these models, perhaps because most settlement outcomes are partially or totally unobserved by researchers, so data sources are rarely available (Daughety, 1997).

The proposed research is an attempt to test, using experimental methods, the effect of a litigation institution called a settlement escrow and uncertainty on the timing and quality of settlement outcomes. We will follow the pretrial bargaining model of Gertner and Miller (1995) under uncertainty, and a variation of this model under certainty.

Gertner and Miller present a pretrial bargaining model of asymmetric information. They propose a new litigation institution, consisting of the addition of a component in the pre-trial bargaining process called a settlement escrow. In a settlement escrow, a neutral agent receives settlement offers from both parties in a lawsuit. If the defendant offers more than the plaintiff demands, the court imposes a settlement at the midpoint of the offers. If the offers do not overlap in this way, the offers remain secret and litigants proceed to pretrial bargaining. Their claim is that an escrow reduces settlement delays in pre-trial bargaining because it lowers the costs of making reasonable settlement offers by diminishing the negative effect that a reasonable offer has on the inferences of the opponent about the strength of the offerer's case. In addition, the solution of the model suggests that the reduction of uncertainty will result in increasing the number of early settlements and therefore, lowering the effect of the escrow institution.

[1] To assess the magnitude of cases and expenditures in civil litigation, take the case of the American tort system. The number of new lawsuits filed each year in the United States, in state and federal courts, is approximately 19 million. The estimated cost of the American tort system is 117 billion dollars. Only 40 percent of these expenses serve to compensate victims while most of the rest represents lawyers' fees (The Economist, 1992; Hyde, 1995; and O' Beirne, 1995; as quoted in Coghlan and Plott, 1997)

We have designed an experiment that will permit us to examine the effect of the escrow institution on settlement outcomes, when bargaining is performed under uncertainty. We will also assess how a reduction in uncertainty affects settlement outcomes and the effectiveness of the escrow by studying the limiting case of certainty.

This experimental investigation is important for two reasons. First, from a theoretical perspective, our experimental conditions will allow us to verify if the theoretical model has captured the main variables that determine settlement outcomes. These findings will contribute to the improvement of game theoretic models of pretrial bargaining. Second, Gertner and Miller's model emphasizes the importance of an alternative litigation institution in improving settlement outcomes. However, this litigation institution has not been previously subjected to any experimental or field-testing. Therefore, our experiment will provide valuable information for the implementation of new litigation institutions.

Among the few experimental studies on pretrial bargaining, litigation institutions and information is the work of Coughlan and Plott (1997). They study the effect of two institutions for allocating legal fees, the American and the English rules, on bargaining outcomes under two information conditions, complete and two-sided incomplete.[2] They found that settlement rates were higher under certainty for both allocation rules and that the English rule generated higher settlement rates under both information conditions. Babcock, Loewenstein and Wang (1995) designed a bargaining experiment to study the combined effect of uncertainty and contract zone size.[3] They found that the presence of incomplete information about the reservation value of the other party increased settlement time. The effect of the contract zone size depended on whether or not there was uncertainty about the location and size of the contract zone. Consistent with Ashenfelter et al. (1992),[4] they found that under uncertainty about the opponent, an increase in the size of the contract zone reduced settlement time. Under certainty, however, an increase in the size of the contract zone produced an increase in settlement time.

[2] Under the American rule, parties must pay their own legal expenses. Under the English rule, however, the losing party must pay the prevailing party's attorney fees in addition to her own expenses. Under the complete information condition, the relative merit of plaintiff's case, defined as the probability that the plaintiff wins the case, is known by both parties. In the case of incomplete information, the merit is revealed to both parties with uncertainty, with subjects having a 60 percent chance of having the correct merit revealed to them.

[3] Contract zone is defined as the range of settlement values that make both sides better off than not settling.

[4] They examined negotiations where disputes were resolved via arbitration. They found that as uncertainty about the arbitrator increased, dispute rates decreased. If bargainers are risk averse, increases in uncertainty about the arbitrator increase the effective magnitude of the contract zone. So, these findings indicate that under uncertainty, increases in the contract zone increase efficiency.

The experimental findings about the negative effect of uncertainty on timing of settlement are also supported by field data. Farber and White's (1991) econometric study on medical malpractice and litigation process found that cases were resolved earlier when the plaintiffs were more certain about the likelihood of negligence.

The rest of the paper is organized as follows. Section Two outlines the theoretical models. Section Three describes the experimental design. Section Four examines the results from the experimental sessions. Section Five concludes the paper and outlines avenues for future research.

2 The Theoretical Models

Alternative dispute resolution procedures (ADR) such as arbitration or mediation have been designed to promote settlement in litigation. The theoretical and empirical findings suggest that these procedures can be of some value when parties disagree about expected trial outcomes or when there are principal-agent problems between the lawyer and client (see Posner, 1986; Mnookin, 1993). However, if asymmetric information is the main barrier to settlement, these procedures are unlikely to increase settlement.

Asymmetric information leads to costly delay in pretrial bargaining because of the effect an offer has on the other party's beliefs about the offerer's private information. In fact, if the informed party, in the absence of the ADR, has an incentive to not reveal its private information, compelling it to participate in the ADR would not change the incentives (Bernstein, 1993). In the context of incomplete information, Gertner and Miller's study seeks to advance the design of alternative dispute resolution procedures, by putting forward a model in which parties holding private information have incentives to make reasonable settlement offers.

Gertner and Miller present an incomplete information model that includes a component called the settlement escrow into the bargaining process. They evaluate the effect of the escrow on bargaining outcomes by contrasting the predictions of the escrow model to the predictions of the model without the escrow.

The escrow is predicted to increase the rate of settlement and increase the quality of the settlement outcome. In addition, the model suggests a reduction in uncertainty will increase the number of early settlements and will therefore, lower the effect of the escrow. We evaluate the effect of a reduction of uncertainty on bargaining outcomes by comparing the theoretical predictions of the

escrow and no-escrow models under uncertainty to the predictions of the escrow and no escrow models under the limiting case of certainty.

2.1 Gertner and Miller's Bargaining Models

Gertner and Miller propose an asymmetric information bargaining model called the escrow model, where two parties, a plaintiff and a defendant, are negotiating prior to a costly trial. Both parties are risk-neutral and the plaintiff possesses private information about the amount the court will award, should the case go to trial. The plaintiff's private information denoted by X is drawn from a commonly known probability density function, at the beginning of the game. The density function is uniform on $[X_L, X_H]$. It is assumed that each side knows that the defendant will be found liable with certainty, so X is also the expected court award. The structure of the game and the defendant's prior beliefs are common knowledge.

This bilateral game consists of the escrow component that precedes the pretrial bargaining stages and two pretrial stages.[5] The game proceeds as follows. Each party can make a settlement offer to the escrow agent prior to any pretrial bargaining. If the plaintiff's demand is less than or equal to the defendant's offer, the court imposes settlement at the average of the two offers. If the plaintiff 's demand exceeds the defendant's offer, the officer of the court announces only that there has been no settlement; it does not reveal either party's offer. Parties are free to submit no offer into the escrow.[6]

After the escrow, in the first bargaining period the plaintiff must decide whether to make a settlement demand to the defendant. If the plaintiff does not make a demand, each side incurs litigation costs of k_1 and proceed to the second bargaining period. On the other hand, if the plaintiff

[5] As Gertner and Miller notice, "settlement escrow are not effective because they add an extra round of bargaining into an artificially constrained model. In fact, if the settlement escrow replaced the first round of bargaining, it would be even more effective. Since there are no costs incurred between the escrow and the first postescrow round, it adds nothing to the ability of parties to signal or screen."

The model specification is designed to demonstrate the efficacy of settlement escrows: at least two stages of bargaining are necessary in order to have a reasonable first-round offer rejected and followed by a counteroffer that reflects the inferences from the first offer.

[6] It is important to notice, however, that the escrow device reduces, but does not eliminate, the adverse inferences about the strength of the offerer's case that the offeree can draw from a reasonable offer. Consider the following two possible cases: 1) when the defendant does not propose a settlement in the escrow and therefore, he cannot infer anything about the type of plaintiff he is confronting; and, 2) when the defendant makes a reasonable proposal into the escrow. He expects to settle via the escrow with plaintiffs who submit low demands, that is, those who know that they are likely to do poorly at trial. When no settlement in the escrow is reported to the defendant, the defendant will think that he is facing a high-damage plaintiff. This inference benefits a plaintiff in subsequent negotiations and reduces the incentive to make a reasonable offer in the escrow for some type of plaintiffs.

decides to make a demand and the defendant rejects it, each side pays k_1 and the game proceeds to the second bargaining period. If the defendant accepts, the game ends and the defendant pays the plaintiff an amount equal to the plaintiff's proposal. In the second bargaining period, the defendant can make a counteroffer. If the defendant makes an offer that the plaintiff accepts, the game ends and the defendant pays the amount offered. If an offer is not made, each side incurs litigation costs of k_2 and litigation occurs. If the defendant proposes an offer and the plaintiff rejects it, each party incurs litigation costs of k_2, and litigation occurs. In litigation the court awards a judgment of X to the plaintiff. The basic solution concept adopted is the Perfect Bayesian Equilibrium. The focus here is on pure-strategy equilibria.

The no-escrow model has a bargaining structure similar to the escrow model, except that the no-escrow model does not include the escrow component. The two games have different structures of defendant's (posterior) beliefs about the plaintiff's damages.

The qualitative predictions of the models, under uncertainty, are as follows: 1) the number of cases that settle (and settle earlier) under the escrow institution is greater than in its absence, and therefore, the litigation costs are lower under the escrow institution than under the no-escrow institution; 2) the expected outcomes are closer to true damages under the escrow institution than in its absence, i.e., the expected quality of outcomes is higher under the escrow; 3) efficiency rate, defined as the percentage of the total cases that settle without incurring any litigation costs (i.e., in the escrow or/and in the first period), is higher under the escrow institution than under the no-escrow institution; and, 4) expected defendant's total payment, defined as the expected defendant's payment plus the defendant's litigation costs, is not affected by the addition of the escrow component in the bargaining process.

Additionally, the solutions of the models suggest that the reduction of uncertainty will result in increasing the number of early settlements and therefore, in lowering the effect of the escrow. We shall explore the influence of the reduction of uncertainty on settlement outcomes and on escrow effects, under the limiting case of certainty.

2.2 Modified Versions of Gertner and Miller's Models: Escrow and No-Escrow Models Under Certainty

The analysis under certainty follows modified versions of Gertner and Miller's models. These models resemble the structure of the original models with the only variation of providing complete

information to both players (see Appendix for details). The equilibrium solution adopted is Subgame Perfect Nash Equilibrium and the focus is on pure-strategy equilibria. The solutions of the escrow and no escrow games under certainty are as follows.

The expected outcomes under certainty are: 1) no effect of the escrow on bargaining outcomes, i.e., bargaining outcomes will be the same under both institutional conditions; 2) under both institutional conditions, settlement rate under certainty will be higher than the settlement rate under uncertainty (100 percent of cases settling in the escrow or in the first period), and therefore, total litigation costs will be lower under certainty (equal to 0) than those under the uncertainty condition; 3) under both institutional conditions, quality of outcomes is expected to be higher under certainty that in the case of uncertainty; 4) under both institutional conditions, the efficiency rate under certainty will be higher than the efficiency rate under uncertainty; and, 5) under both institutional conditions, expected defendant's total payment under certainty will be lower than the expected defendant's payment under uncertainty. Table 1 summarizes the direction of the effects of escrow and uncertainty on bargaining outcomes.

[**INSERT TABLE 1**]

3 Experimental Design

In assessing the validity of the theoretical predictions and building upon the literature previously reviewed, our experimental study combines the analysis of the effect of uncertainty levels and litigation institutions on settlement outcomes.

We have specified the experimental setting in such a way that satisfies the assumptions of the theory while controlling for the information and beliefs of the players.[7] Although our experiment cannot predict the effects of adding the escrow component into bargaining processes in richer environments, the experiment can provide a reasonable amount of evidence regarding whether the addition of the escrow into the pre-trial bargaining process we have structured here will have the desired effects.

The experimental design is a $2X2$: two uncertainty levels (certainty, where the plaintiff and

[7]Even though the theoretical model assumes risk neutrality in subjects, we have decided to not control for risk preferences. If the behavior of subjects deviates systematically from the qualitative theoretical predictions based on risk neutrality, then the models will not capture essential elements of bargaining such as risk preferences. Therefore, a modification of the game theoretic model should be pursued (see Davis and Holt, 1993; Smith, 1989).

defendant know the true level of damages and uncertainty, where the plaintiff knows the damage level but the defendant is uncertain about the damages caused to the plaintiff) and 2 institutional conditions (no escrow and escrow). As Table 2 shows, the uncertainty levels and institutional conditions have been combined in 4 experimental cells: 1) Game 1, certainty/no-escrow; 2) Game 2, certainty/escrow; 3) Game 3, uncertainty/no-escrow; and, 4) Game 4, uncertainty/escrow. Manipulations of these treatments will allow us to check the effects of institutions and uncertainty levels on settlement outcomes.

[INSERT TABLE 2]

3.1 The Bargaining Games

Procedural regularity was accomplished by developing software program that permitted subjects to play the game by using networked personal computers. The software consisted of 4 versions of the game, reflecting the four experimental conditions. To facilitate subjects' tasks, the software included a "tool menu" consisting of a calculator and the game tree (a graphical representation of the stages of the game version played).

The experiment is a multi-stage pre-trial bargaining game. We used a laboratory currency called the "token" (1 dollar = 227.5 tokens). Subjects were each given 2000 tokens at the beginning of the game.[8] At every point in the game, the software provided the subject's account balance at the top of the screen. Before bargaining begins, a damage level is drawn by the computer from a uniform distribution on $[500, 1500]$ and this level of damage is subtracted from the plaintiff's account. In the certainty condition (Games 1 and 2), this number was revealed to both the plaintiff and the defendant. In the uncertainty condition (Games 3 and 4), the level of damage was revealed only to the plaintiff and the defendant knew the distribution from which the damage amount was drawn.

In the no escrow condition (Games 1 and 3) there are 2 bargaining stages. In the first period of pretrial bargaining, the plaintiff decides whether or not to make a demand to the defendant. If the plaintiff chooses to make a demand, he submits an amount and the defendant accepts or rejects it. In the event of acceptance, the game ends. If the defendant rejects the plaintiff's proposal or if the plaintiff decides not to make a proposal, each player incurs litigation costs k_1, and move to the second period of the game. In this second period, the defendant chooses whether or not to

[8] The initial token account was the same for both players to avoid any initial endowment effect on players' decisions.

make an offer. If she makes an offer, the plaintiff can accept or reject the proposal. In the case of acceptance, the game ends and the defendant pays the plaintiff the amount she proposed. If the plaintiff rejects the offer or if the defendant makes no offer, each player incurs litigation costs k_2 and move to the trial stage. In this stage the court awards the plaintiff the true level of damage, which the defendant is required to pay.

The amount of litigation costs ($k_1 = 80$ and $k_2 = 100$) as well as the minimum and maximum level of damages (500 and 1500), used by the computer software were equal to the ones used by Gertner and Miller (1995) in their numerical examination of the model under high uncertainty.

In the escrow condition (Games 2 and 4), the game is identical to that described above except an additional stage is included before the first period of bargaining. In this *escrow* stage, each party decides whether to make a private offer into the escrow. If the plaintiff's demand is less than or equal to the defendant's offer, the defendant pays to the plaintiff an amount equal to the average of the two offers; otherwise, the computer announces that there is no settlement, does not reveal the amounts of the private offers, and the game proceeds to the first pretrial bargaining period.

Figure 1 shows the pre-trial bargaining process with the escrow component.

[INSERT FIGURE 1]

3.2 The Experimental Sessions

We ran 15 sessions of 8 to 24 subjects each (252 subjects in total) at the experimental laboratory of the Department of Economics, University of Pittsburgh. The subject pool was recruited mostly by posting advertisements on an electronic bulletin board and from undergraduate classes at the University of Pittsburgh. In 10 of the sessions we ran the all 4 versions of the game, and in the rest of sessions, we ran only the two uncertainty conditions (Games 3 and 4).

In this experiment, two players, A and B, played one of the four versions of the one-shot game, i.e., each pair of subjects played only one game and played that game only once.[9] At the beginning of the session, every participant in the experiment was randomly assigned a game version and a role and randomly and anonymously paired with another participant. Each player was equally likely to be paired with any other participant and players were completely anonymous to one another. Communication between players was done through a computer terminal.

[9]We decided to use a one-shot game because we wanted to simulate, if possible, the field environment where litigants do not necessarily have the opportunity of getting experience.

General instructions about the game and the software used were presented aloud by the experimenter. Subjects were informed about the random process of allocating game versions and roles and about the randomness and anonymity of the process of forming pairs. Game structure, initial endowment, litigation costs, prior beliefs about the distribution of X and how the court determines award were common knowledge among subjects paired with one another. Subjects were informed only about the institutional conditions and uncertainty levels of the game version they were assigned to play. Subjects were also instructed that they would receive the dollar equivalent of the tokens they held at the end of the experiment and knew the token/dollar equivalence. The participation fee was \$10.00 and the average total payoff was \$16.50. At the end of each experimental session, subjects received in cash their monetary payoffs.

4 Results

In general, our findings are consistent with the qualitative theoretical predictions under uncertainty. Tables 3, 4, and 5 summarize the experimental qualitative results.

[**INSERT TABLE 3**]

The first column of Table 3 presents information regarding the combined effect of litigation institutions and uncertainty levels on settlement rates. Settlement rate was defined as the percentage of total cases that settle out-of-court (i.e., cases that settle in the escrow, first or second pretrial bargaining periods). As predicted by the model, when uncertainty was present (Games 3 and 4), settlement rates were positively and significantly influenced by the escrow bargaining institution. In fact, 69 percent of the pairs in Game 4 (escrow and uncertainty) settled, but only 49 percent of cases in Game 3 (no-escrow and uncertainty) settled–a marginally significant difference ($p = 0.09$). Consistent with the theoretical predictions of the model under uncertainty, we found that settlement rates are negatively (but not significantly, $p = 0.27$) influenced by uncertainty, under the no-escrow institution (Games 1 and 3).

One finding of note is that even under certainty (Games 1 and 2) there are a significant number of disputes (38 percent) suggesting that there may be other important factors causing disagreement in bargaining, besides the asymmetry of information between litigants (Roth, 1995).

The second and third columns of Table 3 summarize the results about total litigation costs and bargaining efficiency rates under the different experimental cells. We defined total litigation costs

as the sum of costs incurred by each litigant. The findings about total litigation costs provide strong support for the theoretical predictions about the effect of the addition of an escrow in reducing the total litigations costs, under uncertainty. We found that, when pairs bargained under uncertainty, the total litigation costs with an escrow were 37 percent lower than those without an escrow, a significant difference ($p = 0.07$). We also found that certainty positively and significantly reduced ($p = 0.06$) litigation costs, under the no escrow bargaining institution (Games 1 and 3). Total litigation costs in Game 1 (no escrow and certainty) were 35 percent lower than those in Game 3 (no escrow and uncertainty).

We used information about the stage in which the bargainers reached an agreement to construct an indicator of the efficiency of the bargaining process. We specifically defined an efficient bargaining outcome as an outcome that was achieved without incurring any litigation cost. The measure of bargaining efficiency (efficiency rate) expresses the percentage of the total cases that settle in the escrow or in the first pretrial bargaining period. The third column of Table 3 reports our results. When uncertainty was present (Games 3 and 4), we found a positive and significant effect ($p = 0.02$) of escrow on bargaining efficiency. In fact, the efficiency achieved in Game 4 (escrow and uncertainty) was 112 percent higher than the efficiency achieved in Game 3 (no-escrow and uncertainty). Our findings also show a positive influence of certainty ($p = 0.02$) on bargaining efficiency. This influence is significant only under the no escrow bargaining institution (Games 1 and 3).

In addition, we found support for Gertner and Miller's claim that under the escrow institution, not only settlement rates are higher, but also the number of cases that settle early are higher: 75 percent of the cases that settled in Game 4 (escrow and uncertainty) reached an agreement in the escrow or in the first period but only 50 percent of the cases that settled in Game 3 (no-escrow and uncertainty) reached an agreement in the first period–a weakly significant difference ($p = 0.10$).

In general, we observe that escrow only affects settlement outcomes when bargaining was performed under uncertainty (Games 3 and 4). Furthermore, certainty only affects settlement outcomes when bargaining was performed under the no-escrow institution (Games 1 and 3). These findings suggest first that the escrow is a useful device for improving efficiency when bargaining is conducted under uncertainty and second, that the escrow fully compensates for the negative effect of uncertainty on bargaining processes.

Tables 4 (pooled data on uncertainty levels) and 5 (pooled data on institutional conditions)

report the results about the quality of outcomes and defendant's payment. We defined the outcome as the net compensation that the plaintiff received (net of litigation costs) and the quality of outcomes as the percentage of the true damage that the outcome represents. Defendant's payment included the plaintiff's compensation and the litigation costs incurred by the defendant.

[**INSERT TABLE 4**]

The first column of Table 4 indicates a positive and weakly significant ($p = 0.109$) effect of the addition of an escrow on the quality of outcomes: the quality of outcomes under the escrow was 12 percent higher than the quality of outcomes under the process of bargaining that does not include the escrow. The theoretical prediction about the effect of the addition of an escrow on the quality of outcomes is thus weakly confirmed.[10] The second column of Table 4 shows no effect of the addition of the escrow on the defendant's total payment. These results strengthen the positive effect of the escrow: plaintiffs are better off and defendants are equally well-off when bargaining is performed under the escrow institution.

[**INSERT TABLE 5**]

The first column of Table 5 shows that there is a negative and significant ($p = 0.02$) influence of certainty levels on quality of outcomes. In fact, the quality of outcomes under the uncertainty condition was 19 percent higher than the quality of outcomes under the certainty condition. This result provides a plausible explanation for why all cases don't settle under certainty: giving defendants certainty about the damages does not necessarily guarantee that defendants are willing to fully compensate to the plaintiffs, and therefore, we cannot guarantee that all cases will settle prior to court under certainty. The second column of Table 5 indicates a negative and significant influence ($p = 0.054$) of uncertainty on defendant's payment. In fact, the defendant's payment under certainty was 16 percent lower than the payment under uncertainty. These previous results indicate that the addition of uncertainty benefits the plaintiffs and damages the defendants.

[10] Remember that the theoretical prediction indicates that there is a higher quality of outcome under the escrow institution than in the no escrow institution, for the uncertainty condition. However, in an additional analysis (not presented here) of the association of escrow and quality of outcomes under the uncertainty condition, we did not find statistical significance. Pooling data on uncertainty condition provided weak support for the theoretical prediction. An additional analysis (not included here) of the quality of out-of-court outcomes (cases that settle out-of-court; pooled data on uncertainty levels) provided stronger ($p = 0.084$) support for the positive effect of the escrow on the quality of outcomes.

As the next step we will analyze the quantitative predictions of the models (under both uncertainty levels) and the experimental results. Table 6 summarizes the quantitative theoretical predictions and experimental results.

[INSERT TABLE 6]

Under uncertainty for both institutions, the predicted values from the theory significantly underestimate the empirical results for the case of settlement and efficiency rates and significantly overestimate the empirical results for total litigation costs and defendant's payments. On the other hand, under certainty for both institutions, the predicted values significantly overestimate the empirical results for the case of settlement and efficiency rates and quality of outcomes, and significantly underestimate the empirical results for total litigation costs.

The results in Table 6 suggest two main findings. First, when there is certainty, the model predicts perfect settlement whereas there is a settlement rate of only 62 percent in the experiments. This suggests that there are other non-modeled factors–decision errors, non-risk neutrality, or perhaps judgment biases–that contribute to impasse. Second, when there is uncertainty the model predicts a settlement rate that is much too low. This suggests that the model overestimates the role of uncertainty in causing impasse.

Finally, we will analyze more in detail the observed behavior of players and the predictions about the equilibrium strategies. In general, these predictions are inconsistent with the experimental observations. For instance, when bargaining is performed under the escrow institution and uncertainty, the model predicts that there will be equilibria with settlement in the escrow stage for cases where damages are within the interval $[500, 820]$. The results show, however, that the damage level for cases that settle in the escrow stage are located in the interval $[549, 1194]$ and the mean damage is 933. In fact, only 25 percent of the cases that settle in the escrow were located in the damage interval predicted by the theory.

When bargaining is performed under the no escrow institution and uncertainty, the theory predicts that in equilibrium the plaintiff will not make any demand in the first pretrial bargaining period and the defendant will offer 600 in the second pretrial bargaining period. The empirical results show that 91 percent of plaintiffs made a demand in the first pretrial bargaining period,[11]

[11] The mean plaintiff's demand was equal to 992.9 and the mean damage was 1032.37.

and only 10 percent of the defendants who offer in the second period, submitted an offer equal to 600.[12]

We can inquire now about the reliability of the theoretical models in helping us to understand the patterns of data. The results indicate that the qualitative predictions of the model about the effect of the escrow on bargaining outcomes, when bargaining is performed uncertainty, are consistent with the observed behavior and outcomes. Therefore, the theoretical model contributes significantly to the understanding of the influence of litigation institutions on bargaining outcomes under uncertainty. Also, the expected positive effect of a reduction in uncertainty on settlement outcomes is validated by the experimental results, when bargaining does not include the escrow component. However, the quantitative predictions are not close to the empirical results and the predictions about equilibrium strategies are inconsistent with the experimental observations. This suggests either the theoretical model is incomplete or the experimental subjects did not satisfy the assumptions necessary for the model. For example, when bargaining occurs under uncertainty, anomalous litigant behavior may be a result of non-neutral attitudes toward risk. Since the theoretical model assumes risk neutral players, the risk aversion may explain why observed damages of cases that settle are higher than those stated by the theory. The patterns of the offers that plaintiffs made into the escrow and the comparison of these offers to the predicted values do suggest risk-averse attitudes. In fact, the mean plaintiff offer to the escrow, for the cases that settle in the escrow, was 475, a value lower than the predicted value (equal to 680), with 80 percent of these plaintiffs offering less than the predicted value.

5 Conclusions

This study reports several important findings. The escrow affects settlement outcomes as predicted by the theoretical model. Under uncertainty, settlement rates are significantly higher (and litigation costs are significantly lower) when a settlement escrow is added to the bargaining process. Quality of outcomes, measured as the percentage of the true damage that the outcome represents, is positively and significantly influenced by the addition of a settlement escrow, when data are pooled on uncertainty levels.

[12] We evaluated the defendant's offer in the interval [510, 690] and got that only 19 percent of defendants made an offer located in this interval. The mean of the defendant' s offer was 672.1. Approximately 33 percent of the defendants have offers lower than 600 and 57 percent of the defendants offer more than 600.

The effect of certainty on settlement outcomes is also as predicted by the theoretical model. When the escrow institution is not available, adding uncertainty lowers settlement rates (and raises litigation costs). Quality of outcomes is negatively and significantly influenced by the addition of certainty when data are pooled on institutional condition.

As predicted, the escrow has no effect on bargaining outcomes, under the certainty condition. We also observed that certainty has no effect on bargaining outcomes, under the escrow institution. These findings suggest first that the escrow is a useful device for improving efficiency when bargaining is conducted under uncertainty and second, that the escrow fully compensates the negative effect of uncertainty on bargaining processes.

Our findings are relevant in terms of improvement of game theoretic models of litigation and in terms of field implementation of new bargaining institutions. In fact, the analysis of our results suggests that directions for future theoretical research include enhancements to the current models that may explain the discrepancies we found, perhaps by incorporating non-neutral attitudes toward risk in models of incomplete information and adding some relevant variables (i.e., behavioral characteristics of subjects like judgment biases and decision errors) that influence disputes in addition to the lack of complete information.

Our study shares a weakness in terms of external validity that is common to all experimental research. Although our experiment cannot predict the effects of adding the escrow component into bargaining processes in richer environments, this experiment provides a reasonable amount of evidence regarding whether the addition of the escrow into the pretrial bargaining process we have structured here will have the desired effects. Given that the potential benefits of the escrow are significant, and the implementation costs are minimum,[13] we consider that a worthwhile extension of this research would be to experimentally implement the settlement escrow in the current alternative dispute resolution procedures, in a few civil litigation courts, and monitor the effectiveness of this instrument in real settings.

[13]Gertner and Miller claim some positive features of the settlement escrows implementation: 1) simplicity of implementation (the clerk of the court could act as the escrow agent); 2) minimal implementation costs; and, 3) consensuality of settlement. It would be entirely within the parties' discretion whether or not to submit reasonable offers.

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Appendix. Modified Versions of Gertner and Miller's Models: No-Escrow and Escrow Models Under Certainty

The solutions of the Gertner and Miller's models under uncertainty indicate that efficient settlement (settlement without any litigation costs) depends on the level of uncertainty about the plaintiff's types ($X_H - X_L$) and on litigation costs (k_1 and k_2). These solutions also suggest that the reduction of uncertainty will result in increasing the number of early settlements and therefore, in lowering the effect of the escrow.

We will explore the influence of the reduction of uncertainty on settlement outcomes and on escrow effects by comparing the theoretical predictions of the escrow and no-escrow models under uncertainty and the escrow and no-escrow models under the limiting case of certainty.

The analysis under certainty follows modified versions of Gertner and Miller's models. The models resemble the structure of the original models with the only variation of providing complete information to both players. The equilibrium solution adopted is Subgame Perfect Nash Equilibrium and the focus is on pure-strategy equilibria.

Consider a damage level equal to X in the interval $[X_L, X_H]$; litigation costs equal to k_1 and k_2, imposed for failing to settle in the first and second period, respectively; a defendant who will be found liable with certainty by the court; a court award equal to the true damage, i.e., X; and, two games under certainty, escrow and no escrow, with the same bargaining structure of the escrow and no-escrow games under uncertainty, except that in the games under certainty, both players know the value of X.

No-Escrow Model Under Certainty

Starting from the last period, evaluate the optimal play at final decision nodes. If the plaintiff does not accept in the last period, she will receive a payoff equal to $(X - k_2 - k_1)$. Then, the defendant's offer in the second period needs to be $\geq (X - k_2)$. Thus, the defendant makes an offer equal to $(X - k_2)$ in the second period and the plaintiff accepts.

Reduce the game to the first period to the point when the defendant needs to accept or to not accept the plaintiff's proposal. The plaintiff should decide his proposal in the first period, such that the defendant be at least indifferent between accepting or not accepting the proposal. If the defendant does not accept the plaintiff's proposal in the first period, he will obtain in the second period a payoff equal to $-(X - k_2 + k_1)$. The proposal of the plaintiff in the first period should be$\leq (X - k_2 + k_1)$. Then, if the plaintiff proposes $(X - k_2 + k_1)$ in the first period the defendant will accept it.

Now, apply the same procedure and reduce the game to the point where the plaintiff needs to decide in the first period between proposing or not proposing. If the plaintiff does not propose, the plaintiff will obtain a payoff equal to $(X - k_2 - k_1)$. On the other hand, if the plaintiff proposes in the first period, she will get a payoff equal to $(X - k_2 + k_1)$. Then, the optimal decision for the plaintiff in the first period is to propose. Thus, we obtain a unique subgame perfect equilibrium with settlement in the first period.

Escrow Model Under Certainty

Follow the previous results and reduce the game to the point where the plaintiff and defendant need to decide to submit or to not submit a proposal into the escrow. Given that settlement in the first period instead of settlement in the escrow does not imply any litigation costs, if both players or at least one player do not submit a proposal into the escrow, the payoff for the plaintiff will be equal to $(X - k_2 + k_1)$ and the payoff for the defendant will be equal to $-(X - k_2 + k_1)$. Then, the optimal proposal for both players, that makes them to be indifferent between proposing to the escrow or settling in the first period, is equal to $(X - k_2 + k_1)$. Thus, there are multiple subgame perfect equilibria, with settlement in the escrow or in the first period: one subgame perfect equilibrium with settlement in the escrow and 3 subgame perfect equilibria with settlement in the first period.

The Solution of the Games

Define P = plaintiff and D = defendant.

The characterization of the solutions of the no escrow and escrow models under certainty are as follows.

No-Escrow Model Under Certainty

The parties settle prior to incurring any litigation costs. The settlement will be in the first period. The Subgame Perfect equilibrium can be characterized according to the following strategy profiles.

P's strategy: P proposes $(X - k_2 + k_1)$ in the first period; if P proposes in the first period and D does not accept, and if D proposes in the second period, P accepts if D's proposal $\geq (X - k_2)$; if P does not propose in the first period, and if D proposes in the second period, P accepts if D's proposal $\geq (X - k_2)$.

D's strategy: if P proposes in the first period, D accepts if P's proposal $\leq (X - k_2 + k_1)$; if P does not propose in the first period, D proposes $(X - k_2)$ in the second period.

Escrow Model Under Certainty

The parties settle prior to incurring any litigation costs. The settlement will either be through the escrow or the plaintiff's offer in the first period. There are four Subgame Perfect equilibria, which can be characterized according to the following strategy profiles.

1) Subgame Perfect equlibrium with settlement in the escrow.

P's strategy: P proposes $(X - k_2 + k_1)$ into the escrow; if there is no agreement in the escrow, P proposes $(X - k_2 + k_1)$ in the first period; if there is no agreement in the escrow, and if P proposes in the first period and D does not accept, and if D proposes in the second period, P accepts if D's proposal $\geq (X - k_2)$; if there is no agreement in the escrow, if P does not propose in the first period, and if D proposes in the second period, P accepts if D's proposal $\geq (X - k_2)$.

D's strategy: D proposes $(X - k_2 + k_1)$ into the escrow; if there is no agreement in the escrow, and if P proposes in the first period, D accepts if P's proposal $\leq (X - k_2 + k_1)$; if there is no

agreement in the escrow, and if P does not propose in the first period, D proposes in the second period $(X - k_2)$.

2) The characterizations of the 3 Subgame Perfect equilibria, when settlement is in the first period, are as follows.

1. P's strategy: P does not propose into the escrow; if there is no agreement in the escrow, P proposes $(X - k_2 + k_1)$ in the first period; if there is no agreement in the escrow, and if P proposes in the first period and D does not accept, and if D proposes in the second period, P accepts D's proposal $\geq (X - k_2)$; if there is no agreement in the escrow, and if P does not propose in the first period, and if D proposes in the second period, P accepts D's proposal $\geq (X - k_2)$.

D's strategy: D proposes $(X - k_2 + k_1)$ into the escrow; if there is no agreement in the escrow, and if P proposes in the first period, D accepts if P's proposal $\leq (X - k_2 + k_1)$; if there is no agreement in the escrow, and if P does not propose in the first period, D proposes $(X - k_2)$ in the second period.

2. P's strategy: P proposes $(X - k_2 + k_1)$ into the escrow; if there is no agreement in the escrow, P proposes $(X - k_2 + k_1)$ in the first period; if there is no agreement in the escrow, and if P proposes in the first period and D does not accept, and if D proposes in the second period, P accepts D's proposal $\geq (X - k_2)$; if there is no agreement in the escrow, and if P does not propose in the first period, and if D proposes in the second period, P accepts D's proposal $\geq (X - k_2)$.

D's strategy: D does not propose into the escrow; if there is no agreement in the escrow, and if P proposes in the first period, D accepts if P's proposal $\leq (X - k_2 + k_1)$; if there is no agreement in the escrow, and if P does not propose in the first period, D proposes $(X - k_2)$ in the second period.

3. P's strategy: P does not propose into the escrow; if there is no agreement in the escrow, P proposes $(X - k_2 + k_1)$ in the first period; if there is no agreement in the escrow, and if P proposes in the first period and D does not accept, and if D proposes in the second period, P accepts if D's proposal $\geq (X - k_2)$; if there is no agreement in the escrow, and if P does not propose in the first period, and if D proposes in the second period, P accepts if D's proposal $\geq (X - k_2)$.

D's strategy: D does not propose into the escrow; if there is no agreement in the escrow, and if P proposes in the first period, D accepts if P's proposal $\leq (X - k_2 + k_1)$; if there is no agreement in the escrow, and if P does not propose in the first period, D proposes $(X - k_2)$ in the second period.

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Table 1: Expected Direction of the Effects of Escrow and Uncertainty

	Effect of Escrow Under Uncertainty	Effect of Uncertainty for Both Escrow Institutions
1. Settlement Rate	increases	decreases
2. Expected Total Litigation Costs	decreases	increases
3. Efficiency Rate	increases	decreases
4. Quality of Outcomes	increases	decreases
5. Expected Defendant's Total Payment	no effect	increases

Table 2: Experimental Design

	Certainty	Uncertainty
No Escrow	Game 1 (G1) $[n = 22]$	Game 3 (G3) $[n = 33]$
Escrow	Game 2 (G2) $[n = 23]$	Game 4 (G4) $[n = 35]$

Note: Sample sizes are in brackets.

Table 3: Mean Settlement Rates, Total Litigation Costs, Bargaining Efficiency Rates

	Settlement Rates	Total Litigation Costs	Bargaining Efficiency Rates
(G1) Certainty/No-Escrow	0.636	145.455	0.545
$[n = 22]$	(0.103)	(36.708)	(0.106)
(G2) Certainty/Escrow	0.609	147.826	0.565
$[n = 23]$	(0.102)	(36.911)	(0.103)
(G3) Uncertainty/No-Escrow	0.485	224.242	0.242
$[n = 33]$	(0.087)	(26.625)	(0.075)
(G4) Uncertainty/Escrow	0.686	140.571	0.514
$[n = 35]$	(0.078)	(27.311)	(0.084)
(G3), (G4)	$p = 0.093$	$p = 0.068$	$p = 0.021$
(G1), (G3)	$p = 0.269$	$p = 0.059$	$p = 0.022$
(G2), (G4)	$p = 0.546$	$p = 0.335$	$p = 0.704$
(G1), (G2)	$p = 0.848$	$p = 0.815$	$p = 0.894$

Note: Standard errors are in parentheses; sample sizes are in brackets; p - values correspond to X^2 statistics tests.

Table 4: Mean Quality of Outcomes and Defendant's Payment
(Pooled Data on Uncertainty Levels)

	Quality of Outcomes	Defendant's Payment
No-Escrow	0.726	911.236
$[n = 55]$	(0.035)	(58.094)
Escrow	0.812	911.388
$[n = 58]$	(0.040)	(51.463)
	$p = 0.109$	$p = 0.998$

Note: Standard errors are in parentheses; sample size are in brackets; p - values correspond to two-sided t - statistic tests.

Table 5: Mean Quality of Outcomes and Defendant's Payment
(Pooled Data on Institutional Conditions)

	Quality of Outcomes	Defendant's Payment
Certainty	0.691	817.744
$[n = 55]$	(0.042)	(64.811)
Uncertainty	0.823	973.235
$[n = 68]$	(0.034)	(46.349)
	$p = 0.016$	$p = 0.054$

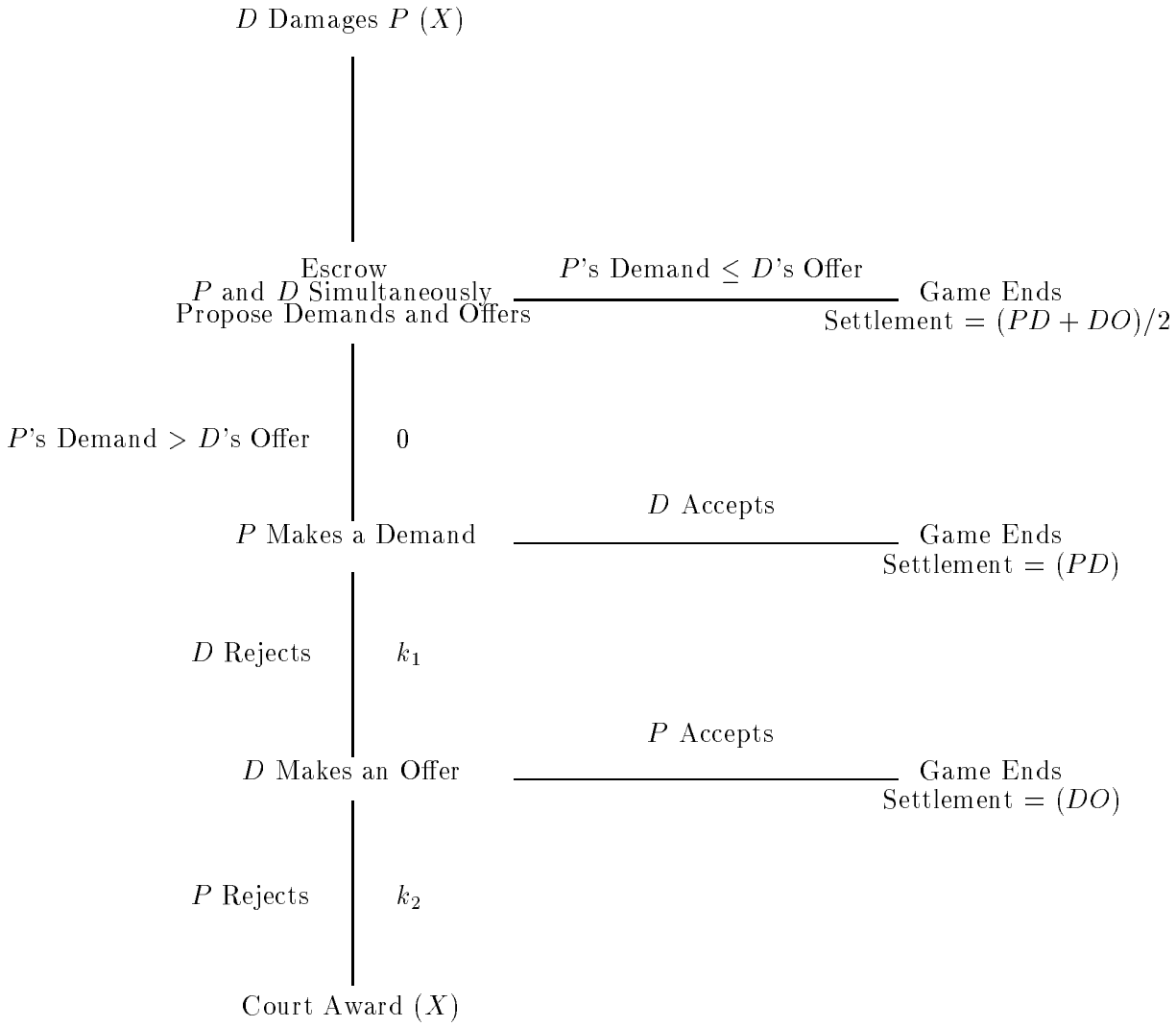
Note: Standard errors are in parentheses; sample size are in brackets; p - values correspond to two-sided t - statistic tests.

Table 6: Quantitative Theoretical Predictions and Experimental Results

	Certainty			High Uncertainty		
	Predicted	Actual	$p-value$	Predicted	Actual	$p-value$
No-Escrow						
1. Settlement Rate	1.00	0.64	0.002	0.20	0.49	0.003
2. Total Litigation Costs	0.00	145.46	0.001	320.00	224.24	0.001
3. Efficiency Rate	1.00	0.55	0.000	0.00	0.24	0.003
4. Quality of Outcome	0.98	0.63	0.000	0.84	0.79	0.145
5. Defendant's Payment	980.00	744.82	0.026	1160.00	1022.18	0.044
Escrow						
1. Settlement Rate	1.00	0.61	0.001	0.52	0.69	0.045
2. Total Litigation Costs	0.00	147.83	0.001	204.80	140.57	0.025
3. Efficiency Rate	1.00	0.57	0.001	0.32	0.51	0.030
4. Quality of Outcome	0.98	0.75	0.000	0.96	0.86	0.073
5. Defendant's Payment	980.00	887.50	0.286	1160.00	927.09	0.001

Note: The parameterization of the models is as follows. $k_1 = 80$ and $k_2 = 100$; for the high uncertainty condition, X uniformly distributed on $[500, 1500]$; for the certainty condition, $X = 1000$. The p - values correspond to two-sided t - statistic tests.

Figure 1: Pre-Trial Bargaining Process With The Escrow Component



Note: PD = Plaintiff's Demand, DO = Defendant's Offer