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Pretrial Bargaining with Asymmetric Information: Unilateral versus Bilateral Payoff Relevance*

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Abstract

Asymmetric information is a leading explanation for settlement failure which results in a costly trial. Typically, the information in question is assumed to have bilateral payoff relevance meaning it affects the expected payoffs of both the plaintiff and defendant. When there is bilateral payoff relevance, trials may be predicted, regardless of whether it is the informed or uninformed party who makes the offer. However, there may be important cases in which information has unilateral payoff relevance. For example, if the plaintiff's risk preferences are private information, this information will affect the plaintiff's expected payoff at trial, but will have no effect on the expected payoff of the defendant. When there is unilateral payoff relevance, inefficient trials never occur when the informed party makes the offer. Trials can occur when the uninformed party makes the offer assuming that the private information affects the payoff of the individual holding the private information. However, if (for example) the defendant holds information relevant to the plaintiff's expected payoff, but not his own, then trials will not occur even when the uninformed plaintiff makes the offer.

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1. Introduction

Asymmetric information is a leading explanation for bargaining failure, and the role of asymmetric information has been extensively analyzed in the civil litigation literature.[1] Most of this literature concerns information which has bilateral payoff relevance in the sense that the information in question affects the expected payoff at trial of both the plaintiff and defendant. When there is bilateral payoff relevance, trials may be predicted in the equilibrium of the bargaining game, regardless of whether the informed or uninformed party makes the offer. In this paper, we analyze information which has unilateral payoff relevance meaning that it affects the expected payoff of one of the two parties to the dispute, but not the other. As an example, suppose the plaintiff has private information on her risk preferences. This affects her expected payoff at trial, but not the defendant's. When there is unilateral payoff relevance, there are never inefficient trials in the equilibrium of the game where the informed party makes the offer.[2] However, there may still be costly disputes in the equilibrium of the game in which the uninformed party makes the offer.

Examples of information with bilateral payoff relevance include information on the probability that the plaintiff will prevail at trial, and information on the amount of the judgment to be awarded at trial in the event the plaintiff is victorious. In both cases, the information clearly affects the expected payoff of both the plaintiff and defendant at trial, and these are the types of informational asymmetry considered most often in the literature. What type of information has only unilateral payoff relevance? One example, mentioned above, is information on risk

[1] The key early papers are Bebchuk (1984) for the screening model and Reinganum and Wilde (1986) for the signaling model. A survey of the early literature may be found in Cooter and Rubinfeld (1989), while a more recent survey is presented by Daughety (1999).

[2] In this paper, efficiency is defined narrowly by the sum of the payoffs of the two parties to the dispute. This issue is further discussed at the end of Section 2. In a larger context, costly trials may be efficient via the effect they have on incentive for care. See Polinsky and Rubinfeld (1988). Trials may also provide positive externalities in the form of valuable legal precedent.

preferences. Farmer and Pecorino (1994), Swanson and Mason (1998) and Heyes, Rickman and Tzavara (2004) all examine asymmetric information on risk preferences within the context of the screening model in which the uninformed party makes the offer.[3] In each case, trials are predicted in the equilibrium of these models, as long as trials are not too costly for the participants. However, there are other types of information which also only have unilateral payoff relevance. A large literature on the ultimatum game has provided convincing evidence that under certain circumstances individuals will express a preference for being treated fairly.[4] This preference may be expressed specifically by the percentage of her own court costs a player is willing to concede to her opponent via his settlement offer.[5] Since this preference is not observable and presumably differs across individuals, the proposer in a screening game must decide how much of the joint surplus of settlement he will attempt to extract without knowledge of how low he can go before triggering a rejection.

Suppose the judgment is 100,000 and the plaintiff's court costs are $30,000. A plaintiff without a taste for fairness will accept an offer of $70,000 rather than proceed to trial. A plaintiff with a taste for fairness might (as an example) accept no less than $90,000. The defendant then must choose between an offer of $90,000 and $70,000 without knowledge of whether the other party has a taste for fairness or not. The defendant will make the low offer if he believes it will be accepted with a sufficiently high probability; if the plaintiff does indeed have a taste for fairness, she will reject the low offer and a trial will result. Presumably a mechanism along these lines explains the persistence of disputes in ultimatum game experiments.

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[3] In addition, in Curry and Pecorino (1993) and Faurot (2001) recourse to final offer arbitration results from asymmetric information on risk preferences.

[4] A small recent sampling of this literature includes Andreoni, Castillo, and Petrie (2003), Fehr and Schmidt (2000), and Slonim and Roth (1998).

[5] This is the approach taken by Farmer and Pecorino (2004), but they model the preference as observable.

Another example of information with unilateral payoff relevance is the degree of litigiousness, which can be modeled as differences in perceived court costs on the part of the plaintiff (Eisenberg and Farber 1997). A litigious plaintiff perceives lower trial costs than a nonlitigious plaintiff who may incur psychological or other intangible costs from pursuing trial. Since the degree of litigiousness in not directly observable, the defendant would have to choose between a low offer that only the nonlitigious would accept and a higher offer acceptable to both plaintiff types. Also note that the plaintiff's degree of litigiousness does not affect the defendant's payoff at trial.

A fourth example concerns self-serving bias. Individuals suffering from a self-serving bias may interpret the facts of a case in a way which is favorable towards themselves. This phenomenon has been documented in the experimental literature, and an excellent survey of this literature is provided by Babcock and Lowenstein (1997). The extent of an individual's self-serving bias is not directly observable. Moreover, if the plaintiff has a self-serving bias, this affects her perceived payoff from trial, but not the payoff for the defendant. Self-serving bias has been addressed in theoretical models by Farmer and Pecorino (2002), Bar-Gill (2006) and Langlais (2008). Langlais models the extent of self-serving bias as a form of asymmetric information which can lead to trials in equilibrium. As with the work on risk preferences, this is done in a model in which the uninformed player makes the offer.

In each of the examples above, the information in question directly affects the payoff of the individual who holds the information.[6] For example, the plaintiff's risk preferences affect the plaintiff's expected payoff at trial, but not the defendant's. When unilateral payoff relevance takes this form, we find that disputes can occur when the uninformed party makes the offer, but not when the informed party makes the offer. When there is a two sided informational asymmetry, where each piece of information has only unilateral payoff relevance, the solution to the game involves only screening elements. When there is bilateral payoff relevance, the corresponding solution involves both signaling and screening elements. As we will demonstrate, solving a model with a two-sided asymmetry is much easier under unilateral payoff relevance than under bilateral payoff relevance.[7] In addition, in this setting disputes may occur regardless of which party makes the offer.

Our last example differs from those above, because it involves a situation where the defendant holds information which affects the plaintiff's expected payoff at trial, but not his own. In particular, the defendant may know whether the plaintiff will incur high costs or low costs in enforcing a judgment should she prevail at trial. For example, the defendant may know how difficult it will be for the plaintiff to uncover the defendant's assets so as to force payment of the judgment. Kaplan and Sadka (2008) analyze data from Mexican labor courts and find that many plaintiff awards go uncollected due to enforcement costs.[8] This suggests that enforcement costs are both uncertain and potentially large. When the defendant has information that affects the plaintiff's payoff, but not his own, we find that there will be 100% settlement regardless of who makes the offer.

It should be clear from the discussion above that there are a wide variety of circumstances in which the distinction between unilateral and bilateral payoff relevance is of importance. Furthermore, the full implications of unilateral payoff relevance are not well understood in the literature. In particular, while models have been worked out for several of the

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[6] In the case of self-serving bias, the effect is on the perceived payoff rather than the actual payoff.
[7] For models with two-sided informational asymmetries, see Sobel (1989), Schweizer (1989), and Daughety and Reinganum (1994).
[8] The Kaplan and Sadka (2008) is mainly an empirical investigation, but there is a brief theory section. In the theory section, they focus on a case which is not addressed in our paper, namely a situation where collection costs may be so high that the plaintiff fails to collect, even after a positive decision in her favor.

examples above, these typically have the uninformed party making the offer. The models in which the informed party makes the offer have not been analyzed with one exception. In a nontechnical discussion of the model with asymmetric information on risk preferences, Daughety (1999: 145-146) notes that trial will not occur if the informed party makes the offer. Thus, Daughety is the first to make this point in regard to the model with asymmetric information on risk preferences. We provide a more formal analysis and extend this insight to an entire information class, i.e., to the class of information with unilateral payoff relevance. In addition, we also consider informational structures which (to our knowledge) have not been previously analyzed in a model in which there is unilateral payoff relevance. These include two-sided informational asymmetries and a model in which private information is held by one player, but only affects the payoff of the other player.

2. Some Preliminaries

In most of the literature on pretrial bargaining, private information has bilateral payoff relevance. In order to fully understand the implications of unilateral payoff relevance, we will cover a number of cases in what follows. Here, we introduce a relatively simple but general notation which characterizes all the cases we discuss. In order to keep the analysis simple there will be no more than two player types for both the plaintiff and defendant. The plaintiff's expected payoff at trial is denoted Π and the defendant's expected cost at trial is denoted C. Note that for the sake of the generality of our notation, we are defining C to be the defendant's total expected cost at trial (inclusive of the expected judgment), and not simply court costs as is often the case in this literature.

A plaintiff may either have a high expected payoff at trial Π^H, or a low expected payoff $\Pi^L > 0$.[9] These are referred to as type *H* and type *L* plaintiffs respectively. In some of our games there will be two defendant types. Those with a high expected cost at trial C^H will be called type *H* defendants, and those with a low expected cost C^L will be referred to as type *L*. In the case of bilateral payoff relevance, there is a 100% correlation in player types. In other words, when the plaintiff is type *H* and therefore expects a high payoff at trial, this implies that the defendant is also type *H* and has a high expected cost at trial. Similarly, a type *L* plaintiff implies a type *L* defendant under bilateral payoff relevance. Note that a player need not know his or her own type, but at a minimum will know the unconditional distribution of both player types.

When there is unilateral payoff relevance, player types are independent of one another. For example, in one version of the model discussed below, the plaintiff's expected payoff may either be Π^H or Π^L, but the defendant's expected cost is always *C*. The expected payoffs and costs are measured in dollar terms, but the framework is flexible enough to capture elements such as risk aversion. If we interpret the asymmetric information to be over risk preferences, then we will interpret Π^H to be the expected payoff of a risk neutral plaintiff and Π^L to be the certainty equivalent that a risk averse plaintiff is willing to accept rather than proceed to a risky trial. When there is two-sided asymmetric information, similar interpretations may be given to C^H and C^L, where C^L is the expected cost of a risk neutral defendant. In the appendix, we explicitly show how Π^L and C^H can be computed as the certainty equivalents of trial.

In the model with bilateral payoff relevance, the payoff received by the plaintiff at trial is equal to the cost incurred by the defendant net of the trial costs of both parties to the dispute. This setting naturally gives arise to the parameter restrictions $C^L > \Pi^L$ and $C^H > \Pi^H$, which we

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[9] Since $\Pi^L > 0$, the plaintiff will always have a credible threat to proceed to trial.

assume hold in the model with bilateral payoff relevance.[10] With unilateral payoff relevance, we will consider the restriction $C > \Pi^H$ to be the "usual" case. However, violations of this condition are possible under certain circumstances. For example, if the type H plaintiff is risk loving rather than risk neutral (and assuming a sufficiently low cost of trial) we may have $\Pi^H > C$.[11] This could also arise if the plaintiff exhibited an extreme degree of litigiousness such that she experienced a negative cost of proceeding to trial. Finally, this inequality could arise if the plaintiff were a repeat player with an eye on future litigation. For example, if the plaintiff is pursing intellectual property violations, the publicity of a trial might be valued positively if it discouraged future possible violators.

For the model with unilateral payoff relevance we will assume that $C > \Pi^L$ when there is one defendant type and that $C^H > \Pi^L$ when there are two defendant types. When a result requires stronger conditions than these, we will state the condition explicitly and discuss what happens when the needed condition fails to hold. In the absence of these minimal conditions trials are efficient in the sense that the sum of the payoffs of the plaintiff and defendant are higher at trial than when the case settles prior to trial. When trials are efficient, all plaintiffs proceed to trial even under complete information due to the absence of a contract zone between the defendant and both plaintiff types. By contrast, when the conditions stated above hold, trials are inefficient in the sense that the sum of the payoffs of the two parties are higher under settlement than under a trial. In this paper, we are primarily concerned with inefficient trials which arise as the result of asymmetric information.

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[10] If K is the sum of the plaintiff and defendant court costs, then in the standard model with bilateral payoff relevance, we typically have $C^L = \Pi^L + K$ and $C^H = \Pi^H + K$.

[11] This case is considered in Faurot (2001).

Given below is a general form of the game which is flexible enough to capture the individual cases analyzed in this paper. The stages of the game are as follows:

0. Nature determines the general structure of the game to be played. This includes whether information has unilateral or bilateral payoff relevance and the identity of the player who makes the games only settlement offer.
1. Both player types are determined. The information each player has regarding their own type and the other player's type is also determined.
2. A single offer O is made by one of the players.
3. The player receiving the offer chooses to accept or reject it. If the offer is accepted, the game ends. The plaintiff receives a payoff of O and the defendant receives a payoff of $-O$. If the offer is rejected, a trial occurs.
4. The payoffs at trial are determined by each player's type.

We will first review some standard results in games where information has bilateral payoff relevance and then proceed, in Sections 4 and 5, to analyze games where information has unilateral payoff relevance.

3. The Model with Bilateral Payoff Relevance

We will first analyze models with bilateral payoff relevance (determined by Nature in stage 0) so that we can later compare these standard results to those derived from a model with unilateral payoff relevance. In this model, there is a 100% correlation between the plaintiff and defendant types. We analyze both the game where the uninformed party makes the offer and the game where the informed party makes the offer. The game in which the uninformed party makes the offer is a simplified version of Bebchuk (1984), and the game in which the informed party makes the offer is a simplified version of Reinganum and Wilde (1986). These results are well known, and an excellent discussion can be found in Daughety (1999).

The plaintiff's expected payoff at trial is Π^H with probability q and Π^L with probability 1-q. A type H plaintiff is always associated with a type H defendant and a type L plaintiff is always associated with a type L defendant. Also, we assume that $C^H > \Pi^H$, and $C^L > \Pi^L$; this reflects the legal expenditures incurred at trial by both parties to the dispute. The defendant does not directly observe whether he is type H or type L, but he knows the prior probability q that he is type H.

3.1 The Uninformed Party Makes the Offer

In this case, we assume that the defendant makes an offer O_D to the plaintiff which the plaintiff chooses to accept or reject. If the offer is accepted, the game ends with the plaintiff receiving a payoff of O_D and the defendant paying a cost of O_D. If the offer is rejected, trial occurs. If the plaintiff is type H, her expected payoff is Π^H and the defendant's expected cost is $C^H > \Pi^H$. If the plaintiff is type L, her expected payoff is Π^L and the defendant's expected cost is $C^L > \Pi^L$.

The plaintiff will accept any offer that leaves him at least as well off as the expected outcome at trial. In other words, a type i plaintiff will accept any offer such that $O_D \geq \Pi^i$, $i = H, L$. In making his offer O_D, the defendant will choose either a high pooling offer $O_D^H = \Pi^H$ that both plaintiff types will accept or the low screening offer $O_D^L = \Pi^L$ that only a type L plaintiff will accept. The low offer is rejected with probability q (the probability the plaintiff is type H). The defendant offers O_D^L if and only if $(1-q)\Pi^L + qC^H < \Pi^H$. Rearranging, this may be expressed as

$$q < \frac{\Pi^H - \Pi^L}{C^H - \Pi^L}. \qquad (1)$$

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 (1) fails to hold, the defendant will make the pooling offer under which all cases settle.

3.2 The Informed Party Makes the Offer

In this game the plaintiff makes an offer O_P to the defendant who chooses to accept or reject the offer. For this game we adopt the convention that if the informed player is indifferent between two offers, she will make the offer associated with the weaker player type. In this case, that would be the offer associated with the type L plaintiff.

The relevant solution concept for this form of the game is a perfect Bayesian equilibrium. This solution concept requires, among other things, that agents update their equilibrium beliefs in accord with Bayes rule in a manner which accurately reflects the equilibrium actions of the players. We also need to specify the out of equilibrium beliefs of the defendant. The equilibrium refinement concept D1 (Cho and Kreps 1987) places structure on out of equilibrium beliefs. [12] Under D1, there is a unique separating equilibrium in this game under which type H plaintiffs make the offer $O_P^H = C^H$ and type L plaintiffs make the offer $O_P^L = C^L$. Since the plaintiff follows a pure strategy, these offers are revealing of the plaintiff's type. In other words, in equilibrium a defendant receiving an offer O_P^H believes with probability 1 that this offer has

[12] The refinement D1 places restrictions on out of equilibrium beliefs. In particular, it requires the recipient believe that an out of equilibrium offer is made by the player type most likely to benefit from such an offer. Suppose there are two player types, *A* and *B*, and the player *A* would benefit from a given out of equilibrium offer if it were accepted 20% of the time or more and that player *B* would benefit from the same offer if it were accepted 30% of the time or more. Under D1, the recipient of the offer would have to place 100% weight on the probability that the offer is made by type *A*. The refinement D1 can be used to rule out pooling or semi-pooling equilibria. See Reinganum and Wilde (1986: 566).

been made by a type *H* plaintiff. Likewise an offer O_P^L is believed with probability 1 to have been made by a type L plaintiff.

The low offer will be accepted by the defendant with probability 1. Type *L* plaintiffs will reveal their type via the offer O_P^L, only if O_P^H is rejected by the defendant with a sufficiently high probability ϕ. 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 equilibrium offer O_P^H will be rejected by the defendant with probability [13]

$$\phi = \frac{C^H - C^L}{C^H - \Pi^L}. \qquad (2)$$

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.

To complete the description of the equilibrium, we need to specify out of equilibrium beliefs and actions. It is a dominant strategy for the defendant to reject any offer greater than C^H and to accept any offer less than C^L. Any offer such that $C^L < O_P < C^H$ is believed to be made by a type *L* plaintiff and is rejected with probability 1.

For our purposes, the key result from the standard models with bilateral payoff relevance is that disputes can potentially occur regardless of which party makes the offer. We would also reach a similar conclusion if there were a two-sided informational asymmetry. Note that even in a fairly simple setting, models with two-sided asymmetries are considerably more difficult to work through than models with one-sided asymmetries.

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[13] This is the smallest value of the rejection rate consistent with a separating equilibrium. Higher values are ruled out by D1. See Daughety (1999: 133-4). Nothing in what follows crucially depends upon ϕ taking on its lowest possible value.

4. Unilateral Payoff Relevance

Next, we consider a model with unilateral payoff relevance. Models with asymmetric information on risk preferences, a taste for fairness, or the degree of litigiousness are all consistent with the analysis in this section.[14] We first re-analyze the basic litigation games, assuming a one-sided informational asymmetry that has unilateral payoff relevance. In section 4.1, we analyze the game where the uninformed party makes the offer and in section 4.2, we analyze the game in which the informed party makes the offer. In section 4.3 we consider a model with a two-sided informational asymmetry, where each player has private information that has only unilateral payoff relevance.

In sections 4.1 and 4.2, stage 1 of the game has the following form: It is determined that the defendant's expected cost at trial is C, and this is common knowledge. With a probability q, the plaintiff is type H and receives an expected payoff of Π^H at trial and with probability 1-q, the plaintiff is type L and receives an expected payoff of Π^L, where $C > \Pi^L$. The plaintiff knows her own type, but the defendant only knows the unconditional probabilities with which each plaintiff type is encountered.

4.1. The Uninformed Party Makes the Offer

We first consider the game in which the uninformed defendant makes the offer. As summarized in Proposition 1, the equilibrium of this game is very similar to the game with bilateral payoff relevance:

<u>Proposition 1:</u> *In a game with the following properties:*

i. There is unilateral payoff relevance.

ii. *There is one-sided asymmetric information in which the plaintiff is type H with probability q or type L with probability 1-q.The plaintiff knows her own type, but the defendant only knows the unconditional probabilities, q and 1-q, with which each type is encountered. The defendant's costs at trial, C, are common knowledge.*

iii. *The uninformed defendant makes the offer.*

If $q < \frac{\Pi^H - \Pi^L}{C - \Pi^L}$, *the defendant offers* Π^L, *which is accepted by type L plaintiffs and rejected by type H plaintiffs. Trials occur with probability q. If* $q > \frac{\Pi^H - \Pi^L}{C - \Pi^L}$, *the defendant offers* Π^H, *which both plaintiff types accept. Trials occur with probability 0.*

Proof:

Stage 3: A type i plaintiff will accept any offer such that $O_D \geq \Pi^i$, *i = H, L. If* $O_D = \Pi^H$ *then both plaintiff types will accept yielding a cost to the defendant of* Π^H. *If* $O_D = \Pi^L$ *the type L plaintiff will accept and the type H plaintiff will reject, yielding an expected cost to the defendant of* $(1-q)\Pi^L + qC$. *Thus, the defendant offers* Π^L *if and only If* $(1-q)\Pi^L + qC < \Pi^H$ *or* $q < \frac{\Pi^H - \Pi^L}{C - \Pi^L}$. *If* Π^L *is offered, it is accepted by type L plaintiffs and rejected by type H plaintiffs . If* $q > \frac{\Pi^H - \Pi^L}{C - \Pi^L}$, *the defendant offers* Π^H *which both plaintiff types accept.*

[14] With minor modifications, the analysis below could be applied to the case of self-serving bias as well. In this case, there is a need to distinguish between a player's perceived payoff at trial and their true payoff at trial.

Thus far, the work in the law and economics literature which has considered formal models where information has unilateral payoff relevance has done so in the context of the screening game in which the uninformed party makes the offer. As Proposition 1 shows, the outcomes of these games are very similar to the standard model in which information has bilateral payoff relevance.

4.2 The Informed Party Makes the Offer

In this sub-case of the unilateral payoff, one sided asymmetric information game, the informed party (the plaintiff) makes the offer. We will also initially impose the additional restriction that $C > \Pi^H$. In the model with bilateral payoff relevance, the defendant's decision to reject or accept depends upon his beliefs regarding the plaintiff's type, because his payoff at trial depends on the plaintiff's type. When there is unilateral payoff relevance, the defendant's payoff is independent of the plaintiff's type. The defendant will be willing to accept the offer $O_P = C$, regardless of which plaintiff type makes this offer. This is the offer made in equilibrium, and as a result, trials do not occur in the signaling version of the game:

<u>Proposition 2:</u> *In a game with the following properties:*

i. *There is unilateral payoff relevance.*

ii. *There is one-sided asymmetric information in which the plaintiff is type H with probability q or type L with probability 1-q.The plaintiff knows her own type, but the defendant only knows the unconditional probabilities, q and 1-q, with which each type is encountered. The defendant's costs at trial, C, are common knowledge.*

iii. *The informed plaintiff makes the offer.*

Both plaintiff types offer C, which the defendant accepts. Trials occur with probability 0.

Proof:

Stage 3:The defendant will accept $O_P \leq C$.

Stage 2: An offer less than C is accepted but yields the plaintiff less than an offer of C. An offer greater than C is rejected and yields the type H plaintiff $\Pi^H < C$ *and the type L plaintiff* $\Pi^L < C$*. Thus, both plaintiff types offer* $O_P = C$ *which is accepted with probability 1.*[15]

Thus, when the informed party makes the offer, there is a sharp difference between a model with bilateral payoff relevance and a model with unilateral payoff relevance. The model with bilateral payoff relevance predicts disputes, while the model with unilateral payoff relevance does not. By contrast, when the uninformed party makes the offer, both models predict disputes.

Note that Propositions 1 and 2 are not a function of the fact that the plaintiff is the informed party. We would obtain the same results in a model where the defendant is the informed party. That is, the model would predict disputes when the uninformed plaintiff made the offer and would predict 100% settlement when the informed defendant made the offer.

Suppose the condition $C > \Pi^H$ were violated? In this case, type *L* plaintiffs would offer $O_P = C$ and settle, while all type *H* plaintiffs would make a demand $O_P > C$. This offer would be rejected and type *H* plaintiffs would proceed to trial with a 100% probability. There are a couple things to note about this case. First, trials are bilaterally efficient since $\Pi^H > C$.[16] Second, trials would occur even if the plaintiff's type were common knowledge, because there is no

[15] If this offer were rejected with a positive probability, the plaintiff would deviate to $C - \varepsilon$. It is a dominant strategy for the defendant to accept this offer, so it will be accepted with probability 1. Note that under a perfect Bayesian equilibrium, any threat by the defendant to reject offers less than *C* is not credible and will not be believed in equilibrium. Thus, the equilibrium offer is unique.

contract zone between the type *H* plaintiff and the defendant. Importantly, we can conclude that *inefficient* trials never occur in the equilibrium of the game in which the informed party makes the offer.

4.3 Two-Sided Asymmetric Information with Unilateral Payoff Relevance

If disputes never occur in the model in which the informed party makes the offer, then institutions might evolve to take advantage of this fact in order to avoid the joint costs of a dispute. Specifically, when private information has unilateral payoff relevance, all disputes would be avoided if the parties arrange it so that the informed party makes the final offer prior to trial.[17] However, it is possible to have unilateral payoff relevance with a two-sided informational asymmetry. For example, each player could have private information on their own degree of litigiousness, where this information has no impact on the other players expected payoff from a trial. As we shall see, this model is consistent with disputes regardless of which party makes the offer. Also, solving this model is trivial compared to solving the corresponding model of bilateral payoff relevance. When the there is bilateral payoff relevance, the solution to a model with a two-sided asymmetry contains both signaling and screening elements. However, when there is unilateral payoff relevance, the solution involves only a minor variation on the screening model.

Up to now, our notation has been flexible enough to capture both risk aversion as well as other forms of asymmetric information with only unilateral payoff relevance. In what follows, this is no longer so. For the analysis below, we will assume that all agents are risk neutral. In the

[16] The sum of the payoffs at trial is $\prod^H - C > 0$. If the case settles prior to trial, the sum of the payoffs is 0.
[17] In our examples in Section 4.1 and 4.2, the defendant is better off if he makes the final offer, but the sum of the payoffs of the plaintiff and defendant are higher if the plaintiff makes the final offer. Thus, the efficient outcome could be achieved if there were side payments to determine the order of the offers. This seems unlikely, but the efficient institution could also evolve through prior contracting. If the two parties enter a contract with the knowledge that a dispute could later occur, it might be possible for the contract to structure the pretrial bargaining so as to obtain the efficient outcome. This is analogous to the idea that contracting parties would include arbitration clauses at the time of contract, if arbitration was deemed the more efficient mechanism for resolving disputes. See

appendix, we consider the case of risk aversion. While consideration of risk aversion does change the exact expressions found below in Proposition 3, the general flavor of the result is the same whether we are considering risk aversion or some other form of informational asymmetry.

Assume specifically then that in this variant of the general game, in stage 1 Nature chooses both the plaintiff and defendant types which are uncorrelated across the players. As before, the plaintiff's expected payoff is Π^H with probability q and Π^L with probability 1-q, where these probabilities are independent of the defendant's type. Similarly, the defendant has expected cost C^H with probability 1-r and C^L with probability r, where these probabilities are independent of the plaintiff's type and $C^H > \Pi^L$. Each player knows their own expected payoffs, but only knows the distribution of expected payoffs which apply for their bargaining partner. In stage 2, both players are uninformed. We allow the defendant to make the single offer.

The proposition below will make use of the following conditions on the parameters of the model:

$$q < \frac{\Pi^H - \Pi^L}{C^L - \Pi^L}. \quad (3)$$

$$q < \frac{\Pi^H - \Pi^L}{C^H - \Pi^L}. \quad (4)$$

It is worth noting in regards to the results below that because $C^L < C^H$, the condition in (4) is more restrictive than the condition in (3) in the sense that it is satisfied for fewer values of q. The equilibrium of the model is summarized as Proposition 3:

<u>*Proposition 3:*</u> *In a game with the following properties:*

i. There is unilateral payoff relevance.

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for example, Drahozal and Hylton (2003) and Dari-Mattiacci (2007). Of course, this argument would not apply to a *ii.* *There is by two-sided asymmetric information. The plaintiff is type H with probability q or type L with probability 1-q.The plaintiff knows her own type, but the defendant only knows the unconditional probabilities, q and 1-q, with which each type is encountered. The defendant is type L with probability r and type H with probability 1-r. The defendant knows his own type, but the plaintiff only knows the unconditional probabilities r and 1-r with which each type is encountered.*

iii. *The defendant makes the offer.*

Then, the following results hold:

(a) *When the conditions in (3) and (4) hold, both defendant types offer* Π^L*. This offer is accepted by type L plaintiffs and rejected by type H plaintiffs. Trials occur with probability q;*

(b) *the condition in (3) holds but the condition in (4) does not, type L defendants offer* Π^L*. This offer is accepted by type L plaintiffs and rejected by type H plaintiffs. Type H defendants offer* Π^H*. This offer is accepted by both plaintiff types. Trials occur with probability qr;*

(c) *the conditions in both (3) and (4) fail to hold, both defendant types offer* Π^H *and both plaintiff types accept. There is a 100% settlement rate.*

Proof:

Stage 3: The Plaintiff's Accept or Reject Decision:

A type L plaintiff will accept any offer $O_D \geq \Pi^L$*, while a type H plaintiff will accept any offer* $O_D \geq \Pi^H$.

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dispute arising from a tort, since in this case, there is no prior contracting.

Stage 2: Defendant's Offer:

If the defendant offers Π^H, both plaintiff types accept yielding a cost of Π^H. If the defendant offers Π^L it is accepted by type L plaintiffs and rejected by type H plaintiffs yielding a expected cost of $(1\text{-}q)\Pi^L + qC^j$ or Π^H where j = H, L is the defendant's type. A type j defendant will offer Π^L iff $(1-q)\Pi^L + qC^j \le \Pi^H$ *or* $q < \frac{\Pi^H - \Pi^L}{C^j - \Pi^L}$.

Otherwise the offer is Π^H.

(a) If (3) and (4) hold, both types offer Π^L. Type L accept, type H reject.

(b) If (3) holds and (4) fails, type L offers Π^L which is rejected by type H and type H offers Π^H which is accepted. Trials occur with probability qr.

(c) If both fail, both types offer Π^H which is accepted.

As in previous screening games (Sections 3.1 and 4.1) a low offer will be made if and only if the probability of rejection (i.e., the probability of encountering a type *H* plaintiff) is sufficiently low. However, now the screening condition itself is a function of the defendant's own type, which is independent of the plaintiff's type. Since (3) is less restrictive than (4), the type *L* defendant is more likely to make a low screening offer than a type *H* defendant.

The solution to the model is only slightly more complicated than the solution to a simple screening game in which the uninformed party makes the offer. Despite the two-sided asymmetric information, the private information of the party making the offer (the defendant) is irrelevant, because the plaintiff's willingness to accept an offer is independent of the defendant's type. By contrast, when there is a two-sided informational asymmetry, the bilateral payoff model retains signaling elements, which makes it considerably more difficult to solve.

It should be clear that if we redo the analysis and allow the plaintiff to make the offer, we will obtain conditions analogous to (3) and (4). Thus, the fact that the model predicts disputes (under certain conditions) is not sensitive to the bargaining structure. Note that if $\Pi^L > C^L$, then type *L* defendants will make an offer $O_D < \Pi^L$ which both plaintiff types reject, resulting in 100% probability of trial for type *L* defendants.[18] Trial is bilaterally efficient in this case and would occur even in the absence of asymmetric information.

5. Information Regarding the Expected Payoff of Your Bargaining Partner

In this section we consider the variant of the general game in which the player with private information has knowledge regarding their bargaining partner's expected payoff at trial. For example, suppose the defendant has private information regarding the plaintiff's costs of enforcing a settlement on the defendant in the event the plaintiff is victorious at trial. If enforcement costs are low, then the plaintiff is type *H*, and if these costs are high, then the plaintiff is type *L*. The defendant knows the plaintiff's type, while the plaintiff merely knows that she is type *H* with probability *q*. The defendant's expected cost at trial, *C* is independent of the plaintiff's type, where $C > \Pi^H$. The motivating example for this section (which involves the plaintiff's costs of recovering the judgment) lead naturally to the restriction $C > \Pi^H$.[19]

5.1 The Uninformed Party Makes the Offer

The results of this game are summarized as Proposition 4:

<u>Proposition 4:</u> *In a game with the following properties:*

i. There is unilateral payoff relevance.

[18] The condition $\Pi^L > C^L$ could arise if, for example, the defendant were risk loving.

ii. *There is one-sided asymmetric information in which the plaintiff is type H with probability q or type L with probability 1-q.The defendant knows the plaintiff's type, but the plaintiff only knows the unconditional probabilities for each type, q and 1-q. The defendant's costs at trial, C, are common knowledge.*

iii. *The uninformed plaintiff makes the offer.*

The plaintiff offers C which the defendant accepts. Trials occur with probability 0.

Proof:

Stage 3: The defendant will accept any offer $O_P \leq C$, their expected trial costs.

Stage 2: Since $O_P = C$ will be accepted, the plaintiff will not offer $O_P < C$. Any offer $O_P > C$ is rejected resulting in a payoff $\Pi^H < C$ for type H plaintiffs and $\Pi^L < C$ for type L plaintiffs. Thus, both plaintiff types offer C.

When there is unilateral payoff relevance where the defendant is informed about the plaintiff's expected payoff at trial, there is 100% settlement when the plaintiff makes the offer. This is in contrast to the model of bilateral payoff relevance, and the game with unilateral payoff relevance, where the plaintiff has private information about her own payoff. In both of these games, trials are predicted with a positive probability, if the probability of encountering a type *H* plaintiff is sufficiently low. Trials do not occur in this game, because the defendant's private information does not affect his willingness to accept an offer from the plaintiff.

It should be clear that there would also be 100% settlement if we switched the information structure so that the plaintiff was informed about the defendant's expected cost at trial, and the defendant made the offer to the plaintiff.

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[19] Whether the recovery cost is high or low, this cost combined with the cost of the trial will ensure that the plaintiff

5.2 The Informed Party Makes the Offer

The game is as outlined above except that the defendant makes the single offer to the plaintiff. Recall that in the game of section 4.2, there is 100% settlement when the informed party makes the offer. This is due to the fact that the informed plaintiff has nothing of value to signal to the defendant because the defendant's expected cost at trial is independent of the plaintiff's type. In the current game, the defendant has something of value to signal to the plaintiff – her type. But in contrast to the traditional analysis, the information the defendant is attempting to signal has no effect on his own payoff.

The analysis of this game is summarized as Proposition 5:

<u>Proposition 5:</u> *In a game with the following properties:*

i. *There is unilateral payoff relevance.*

ii. *There is one-sided asymmetric information in which the plaintiff is type H with probability q or type L with probability 1-q.The defendant knows the plaintiff's type, but the plaintiff only knows the unconditional probabilities for each type, q and 1-q. The defendant's costs at trial, C, are common knowledge.*

iii. *The informed defendant makes the offer.*

There is no separating equilibrium for this game. There exist a continuum of pooling equilibria such that trials occur with probability 0.

Proof:

<u>Stage 3</u>: . *The uninformed plaintiff will accept any offer that leaves her as well off as she expects to be at trial conditional on the updated beliefs she may have upon observing the offer. Let* $\gamma(O_d)$ *be the plaintiff's updated belief that she is type H*

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receives less than what the defendant pays out in total.

conditional on the defendant's offer. (The functional dependency will be suppressed in the notation that follows.) The plaintiff will accept an offer O_D from the defendant iff $O_D \geq \gamma\Pi^H + (1-\gamma)\Pi^L$.

<u>Stage 2:</u> *We will consider both a separating and pooling equilibrium. Consider first a separating offer such that defendants offer Π^H to a type H and Π^L to a type L. In equilibrium, a plaintiff receiving the offer Π^H has an updated belief $\gamma = 1$, and a plaintiff receiving Π^L has the updated belief $\gamma = 0$. For this equilibrium to be supported, Π^L must be rejected with a sufficiently high probability to discourage defendants who know that the plaintiff is type H from making the low offer. Specifically, a defendant who knows the plaintiff is type H will make a high offer iff* $\Pi^H \leq \varphi C + (1-\varphi)\Pi^L$, *where φ is the probability that the low offer is rejected. The lowest value of φ consistent with this behavior is* $\varphi^* = \dfrac{\Pi^H - \Pi^L}{C - \Pi^L}$.

Suppose that the defendant knows that the plaintiff is type L and offers Π^L. This defendant also expects to pay $\varphi C + (1-\varphi)\Pi^L$, *so that φ^* will also discourage this defendant from offering Π^L.*[20] *Because the defendant's cost is independent of the plaintiff's type, any rejection rate on the low offer either discourages all defendants from making the low offer or it discourages none of them. It is straightforward to show that separation is also not possible for any intermediate offer* $\Pi^L < O_D < \Pi^H$.

[20] Recall the convention introduced in Section 3.2 that when the informed player is indifferent between two offers, he will make the offer associated with the weaker type, in this case Π^H. In the absence of this convention it is possible to have a separating equilibrium, where defendants who know the plaintiff is type *H* offer Π^H, defendants who know the plaintiff is type *L* offer Π^L, and the low offer is rejected with probability φ in (5). However, the

<u>Pooling</u>: There exist a continuum of pooling equilibria on offers in the interval $q\Pi^H + (1-q)\Pi^L \leq O_D \leq C$. The plaintiff accepts the pooling offer and there is a 100% settlement rate. The plaintiff rejects all offers below the pooling amount and believes all such offers are made by a defendant holding the information that she is type H.[21] *In a pooling equilibrium, both defendant types make the same offer, so γ=q. As a result, the plaintiff's expected payoff at trial is $q\Pi^H + (1-q)\Pi^L$. Thus, the plaintiff is willing to accept an offer in the specified range. Since the plaintiff rejects all offers below the pooling amount, the defendant is willing to make the pooling offer, because it is less than C.*

The reason there cannot be a signaling equilibrium in this game is that it is equally costly for the defendant to make the low offer regardless of what private information he holds regarding the plaintiff's expected payoff at trial. Note also that this is similar to the result in the game with unilateral payoff relevance, where the informed player has private information on her own payoff. It should be clear that an analog to Proposition 5 would apply to a model where the plaintiff makes an offer with information about the defendant's expected cost at trial, but where the plaintiff's expected payoff is independent of this information.

The pooling equilibrium is efficient since there is 100% settlement. The sum of the player payoffs is 0 in the pooling equilibrium. If the signaling equilibrium existed, the sum of the payoffs would be $q\varphi^*(\Pi^H - C) < 0$, reflecting the inefficient trial which would occur in a

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implied behavior seems implausible. All defendants are indifferent between the two offers yet one type follows a pure strategy of making the high offer and the other type follows the pure strategy of making the low offer.

[21] These are admissible out of equilibrium beliefs. In models with bilateral payoff relevance, the refinement D1 is used to eliminate pooling equilibria. Since, in our model, the defendant's payoff is independent of the plaintiff's type, the defendant's incentive to defect from equilibrium is independent of the information he holds. Thus, D1 will not restrict out of equilibrium beliefs in this situation.

signaling equilibrium. Thus, from an efficiency standpoint, the pooling equilibrium is to be preferred.

What Propositions 4 and 5 show is that there are never disputes in a model with unilateral payoff relevance when the private information is held by one player, but that information affects the expected payoff of the other player.[22]

6. Conclusion

The distinction between unilateral payoff relevance and bilateral payoff relevance is noteworthy, because there are clearly important classes of private information which have unilateral payoff relevance, and this has significant implications for pretrial settlement. Examples of information with unilateral payoff relevance include private information on risk preferences, a taste for fairness, the degree of litigiousness and the degree of self-serving bias. In each of these examples, the private information is held by the party who it affects. It is also possible to have unilateral payoff relevance but where the information affects the expected payoff of the player who does not possess the information. This would be the case if the defendant held private information on how costly it would be for the plaintiff to enforce a judgment post trial. For both sets of examples, we find that there are never inefficient trials when the informed party makes the offer. Disputes can occur when the uninformed party makes the offer only in the first set of examples in which information affects the payoff of the player in possession of that information. By contrast, when there is bilateral payoff relevance, disputes may occur regardless of which party makes the offer.

The results of this paper may have important implications for the efficient structure of bargaining. Suppose, for example, that the plaintiff has an unknown taste for fairness, but that the defendant (perhaps a corporation) is known not to have a taste for fairness. According to the results of the model, if the defendant makes the last offer before trial, some trials may result in equilibrium, while if the plaintiff makes the last offer, all cases will settle.

The kinds of information which are consistent with the analysis in Section 4 can be thought of as an information class, because of the commonalities they exhibit in the way they affect pretrial bargaining. In addition to the differences noted so far, this information class exhibits one other difference when compared with the traditional examples used in models of bilateral payoff relevance. The examples of informational asymmetries used in models with bilateral relevance typically involve evidence. This may be evidence related to the probability of a finding for the plaintiff or evidence regarding the expected size of the judgment. If this is indeed evidence to be presented at trial, then there is some presumption that this information is verifiable and can be revealed via the discovery process or via voluntary disclosures prior to trial. Farmer and Pecorino (2005) show that if information disclosures are not too expensive, then all private information will be revealed prior to trial.[23] Thus, there should be a strong tendency for informational asymmetries of this sort to be eliminated prior to trial with the result being that the parties settle.

By contrast, the examples of unilateral payoff relevance which lead to trial: risk aversion, a taste for fairness, and the degree of litigiousness, are not easily verifiable and are not subject to discovery. If there is no credible way to communicate this information, then the informational asymmetry will not be eliminated prior to trial. As a result, these particular informational asymmetries may be especially important in explaining trial. This in turn may have important policy implications. If asymmetric information on risk preferences is driving bargaining failure,

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[22] However, this result does rely on the convention discussed in footnote 20.

then this may have important implications for how we evaluate institutions such as fee shifting or contingency fees, because these institutions change the risk characteristics of trial. If asymmetric information is over the degree of self-serving bias, then efforts to debias the parties to the dispute may be particularly important in reducing disputes. Additional theoretical and empirical work exploring these issues will be crucial in providing sharper guidance for policy.

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[23] Whether this occurs via voluntary disclosure or discovery depends on whether it is a screening game or signaling game.

Appendix: A Further Treatment of Risk Aversion

In this section, we will elaborate a bit on the interpretation of the model in which the source of asymmetric information is the risk preference of one or both parties. In this interpretation, type *L* plaintiffs and type *H* defendants are risk averse, while type *H* plaintiffs and type *L* defendants are risk neutral. Let ∏ be the net monetary payment received by the plaintiff and $U_P(\Pi)$ be the utility function of a risk averse plaintiff: $U_p' > 0$, $U_p'' < 0$, where the prime denotes a derivative. The expected utility at trial for this plaintiff is

$$E(U_P) = pU_P(J - K_P) + (1-p)U_P(-K_P), \qquad \text{(A1)}$$

where *p* is the probability of a finding for the plaintiff, *J* is the judgment received by a victorious plaintiff and K_P are the plaintiff's court costs (including lawyer fees). The certainty equivalent of trial is the payoff, if received with certainty, which would give the plaintiff the same expected utility as trial. We can denote this payment as Π^L, where $U_P(\Pi^L) = pU_P(J - K_P) + (1-p)U_P(-K_P)$. By risk aversion, $\Pi^L < pJ - K_P$.

We can make similar calculations for a risk averse defendant. Let *C* be the total payment made by the defendant and $U_D(C)$ be the utility function of a risk averse defendant: $U_D' < 0$, $U_D'' < 0$. Note that utility is decreasing in the payment, *C*. For the defendant, the expected utility of a trial is

$$E(U_D) = pU_D(-J - K_D) + (1-p)U_D(-K_D), \qquad \text{(A2)}$$

Where K_D is the defendant's court costs. The certainty equivalent of trial for the defendant is the payment, which if made with certainty, that gives the defendant the same expected utility as trial. Denote this payment as C^H, where $U_D(C^H) = pU_D(-J - K_D) + (1-p)U_D(-K_D)$. For the risk averse defendant, $C^H > pJ + K_D$.

In Sections 4.1 through 4.3, it is sufficient to use Π^L to represent the certainty equivalent of trial for a risk averse plaintiff. However, in Section 4.3, it is not sufficient to use C^H to represent the payoff of a risk averse defendant. The reason is that such defendants face two types of risk. One stems from the trial and is captured by C^H. The other stems from the risk that a low pretrial offer is rejected. Thus, the condition in equation (4) must be modified for a risk averse defendant.

A type H defendant will make a low screening offer Π^L if the expected utility of such an offer is greater than the expected utility of the high offer Π^H. The low offer is rejected with probability q, which is the probability that the plaintiff is type H. Thus, the type H defendant will make the low offer if

$$qU_D(C^H) + (1-q)U_D(\Pi^L) \geq U_D(\Pi^H) . \tag{A3}$$

Keeping in mind that $U_D(C^H) - U_D(\Pi^L) < 0$, this condition may be expressed as

$$q < \frac{U_D(\Pi^L) - U_D(\Pi^H)}{U_D(\Pi^L) - U_D(C^H)} . \tag{A4}$$

While the expression in (A4) differs from that in (4), the nature of the equilibrium is very similar when there is a risk averse defendant. Since the type L defendant is risk neutral, there is no need to modify equation (3).

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