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# Sharing of information prior to settlement or litigation

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*In this article the voluntary sharing of information prior to settlement negotiations is studied in a model where one type of litigant—plaintiffs, to be exact—possesses private information. In equilibrium, plaintiffs whose expected judgments would exceed a certain threshold will reveal their information (if they can credibly establish it) and settle for higher amounts than if they were silent; plaintiffs with lower expected judgments will remain silent and settle. The effect of the legal right of "discovery" is also examined.*

## 1. Introduction

■ Parties in a legal dispute often communicate and share information before reaching a settlement or, failing that, proceeding to trial. One presumes that the reason a party may choose to supply information to an opposing party is to foster settlement or to obtain a more favorable amount in settlement. This is the notion investigated in the model considered here.[1]

In the model I assume that prior to any communications, one party possesses "private" information, that is, information unknown to the other party. The party with private information is taken to be the plaintiff; his information pertains to the expected judgment he would obtain from trial—to the likelihood of prevailing at trial or to the size of the judgment he would receive in that event. The plaintiff initially decides whether to reveal his information to the defendant, supposing that the plaintiff is able to establish his information to the satisfaction of the defendant. The defendant then makes a settlement offer, and the plaintiff either accepts the offer or goes to trial.

I shall study two versions of the model which differ in whether all, or only some, plaintiffs are able to establish their information to defendants.

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[1] This model builds in a natural way on previously studied models of the litigation process. The first models of settlement and litigation *assumed,* without inquiry, that parties' beliefs about the likelihood of prevailing at trial or the size of judgments are different; see Landes (1971), Gould (1973), and Shavell (1982). More recent models *explain* differing beliefs as due to asymmetry of information relevant to trial outcomes; see Bebchuk (1984), Cooter, Marks, and Mnookin (1982), Nalebuff (1987), P'ng (1983), Reinganum and Wilde (1986), and Salant (1984). These models do not allow for the possibility that *voluntary communication* of information might reduce or eliminate differing beliefs, although Sobel (1985) studies the required disclosure of information prior to trial (see note 14). By allowing for the voluntary communication of information, the model here takes a logical next step in the study of the litigation process.

In the first version, all plaintiffs are assumed to be able to establish their information to defendants. I shall show that plaintiffs whose information indicates that their expected judgment would be less than or equal to a certain threshold level will not reveal their information and will settle. The amount these silent plaintiffs obtain in settlements reflects the inference rationally made by defendants that silent plaintiffs are those who would obtain low expected judgments from trial. Plaintiffs whose expected judgments would exceed the threshold level will reveal their information and will settle. They do this in order to obtain a higher amount in settlement than defendants would offer were they silent.

Note that even though all plaintiffs have the opportunity to share their information—and thereby to eliminate asymmetry of information—asymmetry of information remains since plaintiffs with unfavorable information decide to keep silent.[2] The asymmetry of information does not, however, lead to the (Pareto-inefficient) outcome of trial, as all plaintiffs who are silent accept defendants' settlement offers. The reason that plaintiffs who decide to be silent accept the settlement offers is, in essence, simple. A silent plaintiff would want to reject the settlement offer and go to trial only if that would yield him more. Yet if this were so, he would not have decided to remain silent in the first place; he would have elected to reveal his information to obtain a higher settlement offer.

If defendants enjoy the right of "discovery," whereby they can require plaintiffs to share information, they will choose to exercise that right in order to settle for less with otherwise silent plaintiffs. Discovery will not reduce the frequency of trial, though, for there would be no trial in the absence of discovery.

In the second version of the model, I assume that some plaintiffs are unable to establish their information about expected judgments to defendants before trial. (For example, the necessary documentation may not be immediately available; for discussion, see the concluding section.) In this version there is still a threshold level of expected judgment below which plaintiffs will be silent and settle, and above which they will want to reveal their information to obtain a better settlement. However, some of the latter plaintiffs will now be unable to establish their favorable information to defendants. These plaintiffs will go to trial.

A point of contrast, therefore, between the first and second versions of the model is that there are trials in the second version. Trials are wholly due to the inability of plaintiffs with favorable information to establish that information to defendants before trial.

The right of discovery in the second version of the model will, as in the first, lower the amount that otherwise silent plaintiffs obtain in settlements. Also, discovery will reduce the frequency of trial.

The concluding section of this article discusses the effects of possible variations of assumption in the model; reasons why parties may or may not be able, before trial, to communicate credibly information relevant to trial outcomes; the right of discovery; and whether the main results of the model may carry over to bargaining in contexts other than litigation.

## 2. The model

■ **Assumptions and notation.** Risk-neutral plaintiffs are assumed to have brought suit against risk-neutral defendants. Plaintiffs initially possess private information bearing on their expected judgments should there be trials. (The information could concern either the probability of prevailing at trial or the magnitude of the judgment the plaintiff would obtain

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[2] That there is not complete revelation of information contrasts with the result in Grossman (1981) and Milgrom (1981); see note 11.

were he to prevail.) A defendant and a plaintiff will agree on the plaintiff's expected judgment from trial if the defendant comes to possess the plaintiff's information. A plaintiff decides whether to reveal his information to a defendant if he can establish its validity. (However, if the defendant has the legal right of discovery, he may force the plaintiff to reveal his information; this will be discussed subsequently.) Then there is bargaining over settlement, which is assumed to take the form of a defendant making a single settlement offer. If a plaintiff rejects a settlement offer, he will go to trial, which will involve costs for him and the defendant. The sequence of events is shown below.[3]

| | | |
|---|---|---|
| Plaintiff decides whether to reveal information (if he is able to) | Defendant makes settlement offer | Plaintiff accepts, or rejects and goes to trial |

Define the following notation.

$x$ = expected judgment from trial for a plaintiff of type $x$; $x \in [a, b]$; $0 < a < b$;
$f(x)$ = probability density of $x$; $f$ is continuous and positive on $[a, b]$;
$c_p$ = cost of trial to plaintiffs; $a > c_p > 0$;
$c_d$ = cost of trial to defendants; $c_d > 0$;
$\phi$ = silence on the part of a plaintiff;
$s$ = settlement offer of a defendant; $s = s(x)$ if a plaintiff reveals his type $x$; $s = s(\phi)$ if a plaintiff is silent.

Thus, the plaintiff's type $x$ is identified with his private information. The assumption that $a > c_p$ justifies the simplifying assumption that any plaintiff who rejects the defendant's offer will go to trial.[4] The symbol "$\phi$" will be interpreted either as literal silence on the part of a plaintiff about his type, or as a statement about his type that he is unable to establish. When it is said that the plaintiff "reveals" his type, it will be understood that he is able to establish $x$ to the defendant and has done so.

□ **The parties' decisions and sequential equilibrium.** We shall want to identify sequential equilibria in the model. A sequential equilibrium is a situation in which (roughly) two things are true: first, at each stage, parties act optimally given their information and the strategies of other parties; and second, defendants' probabilistic beliefs about silent plaintiffs' types are correct.[5]

It is convenient to describe sequential equilibrium by considering the last stage, then the middle and first stages. At the final stage, a plaintiff will accept a settlement offer $s$ if

$$x - c_p \leq s; \tag{1}$$

otherwise he will go to trial.[6]

At the middle stage a defendant will choose his settlement offer to minimize his expected payments, given that (1) determines whether plaintiffs accept offers. Thus, if a plaintiff reveals $x$, the defendant will offer $s(x) = x - c_p$, and the plaintiff will accept this offer.

[3] Were the model different, such that plaintiffs made a demand or defendants were the ones to have private information, the qualitative nature of the results would be similar. See the concluding section.

[4] If $a < c_p$, there will be plaintiffs with $x < c_p$. These plaintiffs would not be willing to go to trial, but they might still sue in the hope of obtaining a positive settlement; see Bebchuk (1988). To take this factor into account would mean introducing an added and unnecessary element of complication into the present model.

[5] For the general definition of sequential equilibrium, see Kreps and Wilson (1982). The general definition specializes in the present model to the one under consideration.

[6] It is assumed for concreteness that the plaintiff will settle if he is indifferent between settling and going to trial, and similar conventions are adopted below concerning the choice whether to reveal information.

(This is the minimum offer the plaintiff will accept;[7] a lower offer would result in trial and the defendant paying $x + c_d$.) If a plaintiff is silent, the defendant's offer $s(\phi)$ will depend on the defendant's probabilistic beliefs about silent plaintiffs. Let

$$G = \text{set of silent plaintiffs}$$

and

$$g(x) = \text{probability density of } x \text{ conditional on } G; \text{ otherwise } g(x) = 0.$$

The defendant's expected costs as a function of an offer $s \in [a - c_p, b - c_p]$ are

$$s \int_a^{s+c_p} g(x)dx + \int_{s+c_p}^{b} (x + c_d)g(x)dx; \tag{2}$$

for (by (1)) the first term is the expected cost of settlements and the second is that of trials. Therefore the optimal offer $s(\phi)$ is the $s \in [a - c_p, b - c_p]$ that minimizes (2).[8] The derivative of (2) with respect to $s$ is

$$\int_a^{s+c_p} g(x)dx - (c_p + c_d)g(s + c_p). \tag{3}$$

The first term is the marginal cost of raising an offer due to paying more to those plaintiffs already willing to settle. The second term is the reduction in costs due to inducing, at the margin, $g(s + c_p)$ more plaintiffs to settle, thereby saving $c_p + c_d$ per plaintiff (by avoiding going to trial, the defendant saves $c_d$ in legal costs and also extracts $c_p$ from the plaintiff in settlement).

At the first stage, if a plaintiff is unable to establish his type he will have no decision to make—he will "announce" $\phi$.

If, at the first stage, a plaintiff is able to establish his type and does so, he will be offered $s(x) = x - c_p$ and will accept this. If he does not reveal his type, he will be offered $s(\phi)$, and if he rejects this offer and goes to trial, he will obtain $x - c_p$. Hence, a plaintiff will be silent and accept $s(\phi)$ when

$$x - c_p \leq s(\phi). \tag{4}$$

When (4) does not hold and $x - c_p > s(\phi)$, if the plaintiff can reveal his type he will prefer to do so to obtain and accept the offer $s(x) = x - c_p$.[9] However, if he cannot reveal his type, he will reject $s(\phi)$ and go to trial.

Thus, as I emphasized in the Introduction, plaintiffs who can establish their type will never go to trial even though they may choose to remain silent. The reason, as stated previously, is that if they would refuse the offer to the silent because $x - c_p > s(\phi)$, they would not choose to be silent.

It follows from (4) and the paragraph including it, that the silent set

$$G = [\mathrm{a}, s(\phi) + c_p] \cup \{\text{plaintiffs with } x > s(\phi) + c_p \text{ who are unable to reveal their type}\}. \tag{5}$$

[7] The reader may, of course, wish to imagine that the offer is slightly above $x - c_p$, so that the plaintiff strictly prefers settlement.

[8] For all $s \leq a - c_p$, the defendant's offer will be rejected, so his expected costs would be $\int_a^b (x + c_d)g(x)dx$; thus $s < a - c_p$ need not be considered. For all $s \geq b - c_p$, his offer will be accepted, so his expected costs would equal $s$, which is minimized at $s = b - c_p$; thus $s > b - c_p$ need not be considered.

[9] If $x - c_p > s(\phi)$, the plaintiff could be silent and then go to trial and obtain $x - c_p$, which is the same as the settlement offer he would receive if he were to reveal his type. Thus, in principle, he would be indifferent about the two choices. However, I assume here that he would not be silent and go to trial. The motivation for this assumption is again that if the plaintiff reveals $x$, the defendant could be imagined to offer him an amount slightly higher than $x - c_p$, making him better off than if he went to trial.

In equilibrium, since defendants' beliefs are correct, (5) determines $G$ given $s(\phi)$. On the other hand, $s(\phi)$ must also be the defendant's best offer to plaintiffs in $G$; that is, $s(\phi)$ must minimize (2) over $s \in [a - c_p, b - c_p]$. These two conditions will be referred to as the *equilibrium conditions*. Any $s(\phi)$ and $G$ obeying the equilibrium conditions determine a sequential equilibrium.

I shall now examine sequential equilibrium in the two versions of the model discussed in the Introduction: where all plaintiffs are able to establish their type, and where only some are able to do so.

□ **All plaintiffs are able to establish their type.** In this situation, (5) implies that $G = [a, s(\phi) + c_p]$. One possible sequential equilibrium is associated with $s(\phi) = a - c_p$. To check this, note that if $s(\phi) = a - c_p$, then $G = \{a\}$—the plaintiffs of the least type $a$. Trivially, if this is $G$, the best offer for a defendant to make is $a - c_p$; thus the second equilibrium condition is satisfied. In this equilibrium, all plaintiffs but those of the lowest type are led to reveal their type, and all settle with defendants for $x - c_p$.

In general, however, there are sequential equilibria in which $s(\phi)$ exceeds $a - c_p$. To see this, observe that for such an $s(\phi)$, $G$ is the nondegenerate interval $[a, s(\phi) + c_p]$, and $g(x) = f(x)/P(G)$ on the interval and is 0 elsewhere. ($P$ indicates probability.) The second equilibrium condition is that when (2) is minimized over $s$ with this $g$, the solution must be $s = s(\phi)$. Now the derivative of (2) is, from (3),

$$[1/P(G)]\{P[a, s + c_p] - (c_p + c_d)f(s + c_p)\} \tag{6}$$

for $s < s(\phi)$; for $s = s(\phi)$, (6) is the left-hand derivative and

$$[1/P(G)]\{P[a, s + c_p]\} = 1 \tag{7}$$

is the right-hand derivative. 1 is also the derivative for $s > s(\phi)$. It follows that if (6) is non-positive for $s \leq s(\phi)$, then $s(\phi)$ must minimize (2). But (6) is clearly negative for all $s$ in a neighborhood above $a - c_p$. Therefore, for any $s(\phi)$ in this neighborhood, $s(\phi)$ will minimize (2) and thereby satisfy the second equilibrium condition. It has thus been shown that all $s(\phi)$ in a neighborhood exceeding $a - c_p$ are associated with equilibria.

The highest possible equilibrium $s(\phi)$ turns out to be the offer, denoted $s^*$, that a defendant would make if it were true that all plaintiffs were unable to establish their type. (The intuition is as follows. Presumably, $s(\phi)$ could not be *higher* than $s^*$ since, in fact, plaintiffs with favorable information will reveal it. Therefore, the silent set will have lower $x$ on average than the whole population; hence, surely defendants should not be willing to offer more than $s^*$. That defendants should be willing to offer *as much as* $s^*$ is a somewhat subtle point, which requires examination of the proof to appreciate.) To demonstrate this, observe that if all plaintiffs were unable to establish their types, the defendant would choose $s \in [a - c_p, b - c_p]$ to minimize

$$s\int_a^{s+c_p} f(x)dx + \int_{s+c_p}^{b} (x + c_d)f(x)dx. \tag{8}$$

Since $s^*$ is assumed to minimize (8) over all $s$ in $[a - c_p, b - c_p]$, $s^*$ in particular minimizes (8) over $s$ in $[a - c_p, s^*]$. This implies that if $s(\phi) = s^*$ and $G = [a, s^* + c_p]$, then $s^*$ minimizes (2) over the interval $[a - c_p, s^*]$: in this interval (2) equals (8) multiplied by $1/P[a - c_p, s^*]$. Since the derivative of (2) is 1 for $s$ exceeding $s^*$, it has been shown that (2) is minimized at $s^*$ if $s(\phi) = s^*$; thus $s^*$ is an equilibrium $s(\phi)$. It remains to be shown that there cannot be an $s(\phi) > s^*$. Assume the contrary. Since $s^*$ minimizes (8) over all $s$ in $[a - c_p, b - c_p]$, it does so over the interval $[a - c_p, s(\phi)]$. Therefore, $s^* < s(\phi)$

minimizes (2) over $[a - c_p, s(\phi)]$, contradicting the assumption that $s(\phi)$, being an equilibrium offer, minimizes (2) over $[a - c_p, s(\phi)]$.[10]

In an equilibrium it is evident that all plaintiffs with $x$ less than or equal to $s(\phi) + c_p$ will remain silent and settle for $s(\phi)$. Other plaintiffs will reveal their types and settle for $x - c_p$.

It should be stressed that in an equilibrium, defendants find it optimal to offer an amount sufficiently high to induce *all* silent plaintiffs to settle—and not just the silent plaintiffs with moderate or low expected judgments. Defendants find their offer worthwhile because going to trial would hurt them in a discontinuous way; they would have to pay their trial costs $c_d > 0$.[11] They may thus rationally offer enough to guarantee that they avoid trial, as long as they aren't sacrificing too much in so doing. This is true if the silent group is not too large.

*Uniform case.* To illustrate, consider the case where plaintiffs' expected judgments $x$ are uniformly distributed. Thus, $f(x) = 1/(b - a)$, $G = [a, s(\phi) + c_p]$, $P(G) = (s(\phi) + c_p - a)/(b - a)$, and $g(x) = 1/(s(\phi) + c_p - a)$ on $G$ and 0 elsewhere. Therefore (6) is

$$[1/(s(\phi) + c_p - a)][s - (a + c_d)], \tag{9}$$

which is negative for $s < a + c_d$, zero at $s = a + c_d$, and positive for greater $s$. Therefore, if $s(\phi) \leq a + c_d$, (2) is minimized at $s = s(\phi)$. If $s(\phi) > a + c_d$, (2) is minimized at $a + c_d < s(\phi)$. In other words, the set of equilibrium $s(\phi)$ is $[a - c_p, a + c_d]$. Note that, as shown above, $a + c_d$ is the amount that would be offered by defendants were all plaintiffs unable to establish their expected judgments.[12]

Suppose, for example, that expected judgments are uniformly distributed between $a$ = \$10,000 and $b$ = \$50,000, that plaintiffs' legal costs from trial would be $c_p$ = \$3,000, and that defendants' legal costs from trial would be $c_d$ = \$5,000. A sequential equilibrium is associated with any offer for silence between \$10,000 − \$3,000 = \$7,000 and \$10,000 + \$5,000 = \$15,000. If, for instance, the offer to the silent is \$14,000, then plaintiffs with expected judgments less than or equal to \$17,000 will remain silent and accept the offer of

[10] While it has now been proven that the possible equilibrium $s(\phi)$ are bounded from below by $a - c_p$ and from above by $s^*$, the set of equilibrium $s(\phi)$ may have gaps. The set may not equal the complete interval $[a - c_p, s^*]$. Indeed, any offer in $(a - c_p, s^*)$ such that (6) is positive cannot be an equilibrium $s(\phi)$ since such an $s(\phi)$ would not minimize (2) over $s$ in $[a - c_p, s(\phi)]$.

[11] In essence it is this feature of the present model that explains why not all parties will reveal their information, unlike Grossman (1981) and Milgrom (1981). It is useful to review their argument. (What follows is not precisely their argument, but is close in spirit.) Suppose that the value of a good (such as a used car) to buyers varies (some cars are sound, others aren't), that each seller knows the value of his good, and that he can reveal this value to a buyer if he chooses. If he reveals the value of his good to a buyer, suppose that he receives the value from the buyer. If a seller is silent, suppose that he receives the mean of the values of the goods sold by the silent group.

This leads to complete revelation by sellers due to an "unraveling" phenomenon. If the silent group's goods vary in value, then there must be some silent parties whose goods have a value above the mean of the silent group's. These parties would be able to sell their goods at a higher price than the mean by revealing the value of their goods. In revealing the value of their good they cause an unraveling of the silent group. Therefore the silent group can contain—at most—the sellers whose goods have the minimum value.

The unraveling phenomenon would not necessarily occur if buyers' situations were analogous to that of defendants in the model presented here. Suppose that, rather than a buyer being assumed to offer the mean value of the silent group's values, he decides how much to offer by taking into account that if he offers too little, the seller will not sell, and he will therefore lose some consumer surplus. If the silent group is not too large a buyer might well offer enough to induce all members of the silent group to sell their goods. The buyer would rationally offer more than the mean to the silent group—offering the highest value—and the conclusions would be similar to those found here. See note 23.

[12] For the uniform case, the derivative of (8) is $[1/(b - a)][(s + c_p - a) - (c_p + c_d)]$, and setting this equal to 0, we obtain $s = a + c_d$.

\$14,000; others will reveal their expected judgments and settle for more than \$14,000. Moreover, defendants will know that the silent plaintiffs' expected judgments are uniformly distributed between \$10,000 and \$17,000 and they will choose to offer \$14,000.[13]

*Discovery.* Consider the effect of a legal rule allowing a defendant (or, more generally, a party seeking information from an opposing party) to "discover" a plaintiff's type before trial, that is, to require a plaintiff to reveal his type. Under this rule, an equilibrium in which the set $G$ of silent plaintiffs contains more than the least type $a$ cannot exist, since otherwise defendants can pay less in settlement to plaintiffs in $G$ if defendants determine plaintiffs' types. Specifically, suppose there is an equilibrium where $s(\phi) > a - c_p$, so that $G = [a, s(\phi) + c_p]$. Then all plaintiffs in $G$ receive $s(\phi)$. By requiring plaintiffs in $G$ to reveal their type, however, a defendant will pay less in settlement with probability one, since he will pay $x - c_p$, which will be less than $s(\phi)$ with probability one. Therefore, the only equilibrium offer to silent plaintiffs, given the discovery rule, is $s(\phi) = a - c_p$. In that case all plaintiffs will settle for $x - c_p$ and all but the lowest type will reveal their type. Thus, the effect of discovery is to reduce the magnitude of settlements received by the plaintiffs with $x > a$ who would have remained silent. In the uniform example, the equilibrium with an offer to silent plaintiffs of \$14,000 would be upset. Only an equilibrium with an offer of \$7,000 to silent plaintiffs can exist, and in it all plaintiffs with expected judgments above \$10,000 will reveal their information.[14]

We may summarize our conclusions as follows:

*Proposition 1.* Suppose that all plaintiffs are able to reveal credibly their expected judgments $x$. Then sequential equilibria exist, and in a sequential equilibrium:

(a) Plaintiffs who are silent are offered an amount $s(\phi)$ by defendants. Plaintiffs who reveal their expected judgment are offered $x - c_p$—their expected judgment less the cost of going to trial $c_p$.

(b) Plaintiffs with expected judgments less than or equal to $s(\phi) + c_p$ keep silent and accept defendants' offers of $s(\phi)$. Plaintiffs with higher expected judgments reveal their information and settle for $x - c_p$.

(c) In particular, all plaintiffs settle; there are no trials.

(d) If discovery is allowed—if defendants have the right to force plaintiffs to reveal information before trial—then in equilibrium all plaintiffs reveal their information (except possibly for those plaintiffs with $x = a$, the minimum possible $x$). Thus, plaintiffs who without discovery would have kept silent receive less ($x - c_p$ rather than $s(\phi)$).

(e) Sequential equilibrium (in the absence of discovery) is not unique. In general, there are sequential equilibria with different $s(\phi)$. Such $s(\phi)$ can be as low as $a - c_p$ and as high as $s^*$ (the amount that defendants would offer were all plaintiffs unable to reveal their $x$ to defendants).

□ **Some plaintiffs are unable to establish their type.** Here

$$G = [a, s(\phi) + c_p] \cup \{\text{plaintiffs with } x > s(\phi) + c_p \text{ who are unable to reveal their type}\}.$$

[13] An offer to the silent plaintiffs of, say, \$18,000, would not be associated with an equilibrium. The reason is that if \$18,000 were the offer, plaintiffs with expected judgments of up to \$21,000 would remain silent. Defendants, knowing this, would elect to offer less than \$18,000.

[14] In Sobel (1985), a regime of mandatory disclosure of information (by defendants) is compared to a regime of no disclosure (in a model with two-sided asymmetry of information). Here, by contrast, the comparison of mandatory disclosure is with a regime of voluntary disclosure, which, as has been seen, results in some parties disclosing information.

For simplicity, assume that the fraction of plaintiffs unable to reveal $x$ is independent of $x$; let

$$k = \text{fraction of plaintiffs unable to reveal } x.$$

Then

$$P(G) = P[a, s(\phi) + c_p] + kP[s(\phi) + c_p, b] \tag{10}$$

since all plaintiffs for whom $x \leq s(\phi) + c_p$ remain silent and, of plaintiffs with higher $x$, only the fraction $k$ who cannot establish $x$ remain silent. Also,

$$g(x) = \begin{cases} f(x)/P(G) & \text{for} \quad x \in [a, s(\phi) + c_p] \\ kf(x)/P(G) & \text{for} \quad \text{higher } x. \end{cases} \tag{11}$$

As in the previous section, the derivative of (2) is given by (6) for $s < s(\phi)$; for $s = s(\phi)$, (6) is the left-hand derivative but now

$$[1/P(G)]\{P[a, s + c_p] - k(c_p + c_d)f(s + c_p)\} \tag{12}$$

is the right-hand derivative and also the derivative for $s > s(\phi)$. A necessary condition for $s(\phi)$ to be an equilibrium offer and minimize (2) is that (6) be nonpositive at $s(\phi)$ and that (12) be nonnegative at $s(\phi)$.

Unlike in the previous section, there cannot be equilibrium offers $s(\phi)$ in a neighborhood above the offer $a - c_p$ that would be made to the lowest type of plaintiff, since (12) is negative for $s$ in a neighborhood of $a - c_p$.

The explanation is that the group of silent plaintiffs always includes those plaintiffs who cannot establish their type, and thus some plaintiffs who would obtain relatively high expected judgments from trial. These plaintiffs would reject an offer that was too low. Therefore the defendant would not make such an offer.

The highest possible equilibrium $s(\phi)$ is $s^*$, as can be shown by an argument similar to that given previously.[15]

In an equilibrium, all plaintiffs with $x$ less than or equal to $s(\phi) + c_p$ will remain silent. Those with higher $x$ will reveal $x$ if they can and will settle for $x - c_p$. Those with higher $x$ who are unable to establish this will go to trial.

*Uniform case.* Now $P(G) = (s(\phi) + c_p - a)/(b - a) + k(b - s(\phi) - c_p)/(b - a)$, and $g(x) = [1/P(G)][1/(b - a)]$ for $x \in [a, s(\phi) + c_p]$ and $[1/P(G)][k/(b - a)]$ for $x \in (s(\phi) + c_p, b]$. Therefore (6) and (12) become

$$[1/P(G)][1/(b - a)][s - (a + c_d)] \tag{13}$$

and

$$[1/P(G)][1/(b - a)][s + c_p - a - k(c_p + c_d)]. \tag{14}$$

Since both (13) and (14) are increasing in $s$, it is apparent that a necessary and sufficient condition for the minimum to occur at $s(\phi)$ is that (13) be non-positive at $s(\phi)$ and that (14) be non-negative. Therefore, the set of equilibrium $s(\phi)$ is the interval $[a - c_p + k(c_p + c_d), a + c_d]$. It should be noted that, as expected, the minimum equilibrium $s(\phi)$ exceeds $a - c_p$ and the maximum is again $a + c_d$. Notice too that the interval becomes smaller as $k$ increases, and the interval collapses to the point $a + c_d$ when $k = 1$ (when no plaintiffs can establish their type).

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[15] That $s^*$ is an equilibrium offer follows from the same argument as before, except that here the derivative of (2) to the right of $s^*$, that is, (12), is not necessarily positive. However, because the term in braces in (12) is greater than or equal to the derivative of (8), the fact that $s^*$ minimizes (8) over $s \geq s^*$ implies that $s^*$ minimizes (2) over such $s$. That $s(\phi) > s^*$ cannot be an equilibrium follows exactly as argued before.

In the previous numerical example, the interval of equilibrium values of the offer to silent individuals will now be [\$7,000 + $k$\$8,000, \$15,000] rather than [\$7,000, \$15,000]. For instance, if .5 is the fraction of plaintiffs unable to reveal $x$, the interval of possible equilibrium offers to silent plaintiffs will be [\$11,000, \$15,000]. If the equilibrium offer to them is, say, \$13,000, then all plaintiffs with expected judgments less than \$16,000 will be silent and accept the \$13,000 offer. The half of the plaintiffs with expected judgments between \$16,000 and \$50,000 who can establish their expected judgments will do so and settle for amounts higher than \$13,000, whereas the other half will go to trial. The probability of trial will be .5[\$50,000 − \$16,000]/\$40,000 = .425.

*Discovery.* If discovery is allowed, we shall assume that only the fraction $(1 - k)$ of plaintiffs that had been presumed able to establish $x$ voluntarily will be able to—and will—comply with a discovery request.[16] Under this assumption, there cannot exist an equilibrium in which the silent set $G$ includes any plaintiffs who are able to establish $x$. If that were the case, defendants would request discovery in order to pay less in settlement with probability one. Therefore, the equilibrium will be such that silent plaintiffs are only those who are unable to establish $x$. These plaintiffs will receive in settlement an amount $s(\phi)$ that minimizes (8) multiplied by $k$. It follows that $s(\phi) = s^*$. Consequently, the silent plaintiffs will obtain a settlement offer at least as high as that in an equilibrium without discovery, where recall $s(\phi)$ is at most $s^*$. These plaintiffs will go to trial if $x - c_p$ exceeds $s^*$. However, the frequency of trial can only decrease due to discovery since the offer to the silent is $s^*$, rather than a lower level. For instance, in the numerical example, where $k = .5$, the interval of possible equilibrium offers was [\$11,000, \$15,000], and if the offer were \$13,000 the frequency of trial would be .425. With discovery, the equilibrium offer must be \$15,000 and the frequency of trial .5[\$50,000 − \$18,000]/\$40,000 = .40, which is lower.

The conclusions of this section are given by

*Proposition 2.* Suppose that some plaintiffs are able to reveal credibly their expected judgments and that others are not. Sequential equilibria exist, and in a sequential equilibrium:

(a) Plaintiffs who are silent are offered an amount $s(\phi)$. Plaintiffs who reveal their expected judgment are offered $x - c_p$.

(b) Plaintiffs with expected judgments less than or equal to $s(\phi) + c_p$ keep silent and accept defendants' offers of $s(\phi)$.

(c) Plaintiffs with expected judgments exceeding $s(\phi) + c_p$ reveal their information if they can and settle for $x - c_p$. However, if they are unable to reveal their information, they go to trial.

(d) In particular, not all plaintiffs settle; there are some trials.

(e) If discovery is allowed and only those plaintiffs who are able to voluntarily reveal $x$ can comply with requests to do so, then in equilibrium all these plaintiffs reveal $x$ and settle for $x - c_p$. Silent plaintiffs are offered $s^*$ (the amount that defendants would offer were all plaintiffs unable to reveal their $x$ to defendants). Silent plaintiffs with $x - c_p \leq s^*$ settle for $s^*$; others go to trial. Also, there are fewer trials than in an equilibrium without discovery (presuming $s(\phi)$ without discovery is less than $s^*$). Plaintiffs who, without discovery, would have been silent but could have revealed $x$ receive less ($x - c_p$ rather than $s(\phi)$). Plaintiffs who, without discovery, would have been silent and could not have revealed $x$ receive more if they settle (presuming $s(\phi)$ without discovery is less than $s^*$).

[16] This assumption is natural if, for example, the reason for inability to reveal information credibly is that certain evidence is not available before trial (see the concluding section) and the court has no way to cure this problem. (A previous version of this article also considered the assumption that even parties unable to voluntarily reveal information would be able to do so given the discovery rule.) Note that for a discovery request to be enforceable when some can comply and some cannot, the court must be able to tell who can comply and who cannot.

(f) The sequential equilibrium (in the absence of discovery) is not unique. In general, there are sequential equilibria with different $s(\phi)$; such $s(\phi)$ must exceed $a - c_p$ and can be as high as $s^*$.

## 3. Concluding discussion

■ To help evaluate and interpret the model, it is useful to consider variations in the assumptions of the model; factors bearing on the ability or inability of parties to reveal credibly to their opponents information before trial which will influence trial outcomes; the right of discovery; and the applicability of the conclusions from the model to contexts other than litigation.

□ **Variations of assumption.** (1) Suppose that, instead of defendants making offers, plaintiffs make demands after they reveal or do not reveal their expected judgments $x$. It would then be straightforward to verify that, in the case where all plaintiffs are able to establish their type, an equilibrium would exist where a plaintiff revealing his type would demand $s(x) = x + c_d$ from the defendant, and the defendant would settle with him. If a plaintiff did not reveal his type, he would demand $s(\phi)$ from the defendant and receive it.[17] All plaintiffs with $x$ exceeding $s(\phi) - c_d$ would reveal $x$. Thus, the situation would be qualitatively similar to that studied above, with the plaintiff, rather than the defendant, extracting the surplus since he makes a take-it-or-leave-it demand.

(2) Suppose that, instead of plaintiffs having private information, it is defendants who possess such information. In this case the results would be essentially the same as those found here, with defendants playing the role of plaintiffs and either revealing or not revealing their information.

(3) Suppose that both plaintiffs and defendants have private information and that there is exchange of information prior to settlement offers. For instance, assume that first, plaintiffs choose whether to reveal $x$, defendants next choose whether to reveal their information $y$—where expected judgments are a function of $x$ and $y$—and then defendants make settlement offers. One suspects that in this model, as in the present article, not all information that could be revealed would be, but there would be differences in result. Notably, one conclusion here is that if all plaintiffs are able to reveal $x$, there will be no trials. It seems that this might not be true in the model where both plaintiffs and defendants have private information. Specifically, it seems likely that, in equilibrium, plaintiffs with $x$ below some threshold would be silent, in the hope of obtaining higher settlement offers than if they revealed their $x$. But it also seems likely that a silent plaintiff might refuse a defendant's offer: unlike in the model presented here, a silent plaintiff would not know with certainty what offer would be made (defendants being different) and thus might rationally be silent even though there were a chance he would refuse a defendant's offer. In view of such conjectures, a full examination of two-sided exchange of information seems warranted.

(4) Suppose that plaintiffs or defendants are risk averse. That would change the equilibrium amounts offered to silent plaintiffs but would not alter the qualitative nature of the

[17] There also presumably exists an equilibrium in which plaintiffs who do not reveal $x$ behave differently. It seems possible that such plaintiffs may demand an amount $s(\phi, x)$ increasing in $x$, and that defendants might settle with a probability that is decreasing in $s(\phi, x)$. This type of equilibrium, in which informed parties make demands that act in part as signals of their willingness to go to trial, is studied in Reinganum and Wilde (1986). It should be noted that, in such an equilibrium where some plaintiffs are unable to disclose $x$, the frequency of trials may be lower than here because, unlike in this article, plaintiffs with favorable information are able to signal this with high demands and sometimes are able to settle. But since defendants accept settlement demands only with a probability, the possibility of trial with silent defendants with favorable information would not be eliminated.

conclusions. Any plaintiff able to establish his type would settle, even if he did not reveal his type.[18]

(5) Suppose that the disclosure of information involves a positive cost $d$. In that case, in the model studied here, plaintiffs would never reveal their type $x$. If a plaintiff did so, he would receive $x - c_p$, so his net gain would be $x - c_p - d$, whereas if he remained silent and went to trial, his expected net gain would be $x - c_p$. (A similar point is emphasized by Sobel (1985).) However, it is clear that this conclusion—that plaintiffs would not pay $d > 0$ to reveal their type—is an artifact of the assumption that they lose the entire surplus in a settlement, since defendants make a take-it-or-leave-it offer. Under any change of assumption according to which settling plaintiffs would obtain a part of the surplus (as in (1) above, where plaintiffs make demands), some plaintiffs would voluntarily disclose their type for some positive $d$. An assumption that plaintiffs are risk averse would produce a similar result.

□ **Ability to reveal, prior to trial, information relevant to trial outcomes.** An important assumption of this article concerns the ability, or inability, of plaintiffs to reveal credibly, prior to trial, information that they know would influence trial outcomes.

Why plaintiffs may be able to reveal such information is not hard to explain. They may simply show evidence or explain to defendants arguments that they would be able to offer were the case to go to trial.

Why, however, would plaintiffs be *unable* to establish information to defendants before trial that *would affect* outcomes at trial? (Such inability, recall, is precisely what leads to trial. Trial arises only because plaintiffs with favorable information—$x$ exceeding $s(\phi)$—are not able to reveal $x$ to defendants before trial even though the favorable information will determine the expected judgment from trial.) One possible reason is that it may take time for a plaintiff to assemble evidence; he may know what the evidence will show at trial without being able to convince the defendant of this beforehand.[19] Another possibility is that a plaintiff may know something from his experience that makes him think he is likely to do well (perhaps the plaintiff's lawyer is adept in this kind of litigation or enjoys a good relationship with the judge), but there is no way to establish this experiential information to the defendant (the defendant hasn't seen the plaintiff's lawyer in action or the nods of approval from the judge to him in the past).

A closely related point is that although a plaintiff may be able to provide a defendant with information, he may not want to do so because silence will give him a strategic advantage: the defendant will not have sufficient time at trial to react to the information (e.g., to rebut an assertion based on the information). For this reason a plaintiff may decide not

[18] A risk averse plaintiff with $x - c_p \leq s(\phi)$ would be even more desirous of remaining silent and settling than a risk neutral plaintiff. A risk averse plaintiff with $x - c_p > s(\phi)$ would be even more desirous of revealing his $x$ and settling for $x - c_p$ than a risk neutral plaintiff.

[19] For example, a plaintiff may know fairly well what his business losses from a defendant's wrongful act were, but may await an accountant's report that will not be ready until the time of trial. Or a plaintiff may be able to predict fairly well the business losses he will suffer, but may await the actual materialization of the losses—losses which he will have suffered by the time of trial.

To examples like this the objection might be made that a plaintiff may put off the trial date until he obtains proof of his favorable situation. However, plaintiffs cannot always do so; trial dates are sometimes set by courts or by past actions of the litigants. Moreover, although the model presented here presumes that all litigation costs are incurred during trial, substantial litigation costs are in fact incurred during the (often long) period before trial. Thus, even if the trial date can be deferred, the time of settlement will still be delayed during the period when the plaintiff awaits proof of his favorable situation, and expenses will be incurred during this period. Thus, the point from the model now under discussion—that resources may be spent because of failure to settle—would still apply in regard to failure to settle immediately.

to reveal information in his favor, and consequently will refuse the defendant's offer and go to trial.[20]

□ **Discovery.** Parties in civil cases in the United States generally enjoy rights of discovery, enabling them prior to trial to obtain evidence (such as documents), to enter upon property and make inspections, or to obtain answers to written or oral interrogatories. The right of discovery is limited, however, in several ways. Information obtained by one side may not be discovered if it is protected by a "privilege" (such as the doctor-patient privilege) or, often, if it constitutes "trial preparation material." [21] Even where discovery is allowed, it may work imperfectly because the side engaging in discovery may not know what questions to ask of a person or what data to obtain, and the opposing side has no general duty to reveal the questions it will ask or the use it will make of data at trial. Consequently, both situations in the model where discovery is, and is not, allowed bear some relationship to the truth.

To the degree that parties are able to force the opposing side to reveal its information, the conclusions of the model were that those forced to reveal their information receive less in settlement, and that discovery tends to reduce the likelihood of trial. The latter conclusion bears comment since, as has been stressed, trial in the model is due to plaintiffs being unable *voluntarily* to reveal *favorable* information, and discovery hardly solves this problem.[22] The reason that discovery nevertheless reduces the chance of trial is that discovery raises the settlement offer which defendants rationally make to silent plaintiffs. This is so because, with discovery, the group of silent plaintiffs no longer includes any plaintiffs with unfavorable information who can comply with a discovery request. Thus the group of silent plaintiffs is one that, on the average, would obtain more at trial and therefore is offered more by defendants ($s^*$ instead of $s(\phi)$); see Proposition 2(e). Since silent plaintiffs are offered more to settle, fewer go to trial.

Put another way, the notion that discovery forces plaintiffs who would have gone to trial to share information and settle is wrong in the model. The only plaintiffs who are forced to share information are those who would have settled in any case.

□ **Applicability of conclusions outside the area of litigation.** The principal conclusions reached in the present model—that some parties will choose not to reveal their information, and that if all can voluntarily reveal their information there will be no inefficient failures to agree—would seem to carry over to models of asymmetry of information in contexts other than litigation. An example is bargaining over the price of goods offered for sale. Suppose that, as in this article, information asymmetry is one-sided. Assume that sellers possess private information about the value of their goods, and they choose first whether to reveal this information if they can. Buyers then make take-it-or-leave-it offers. One supposes that in equilibrium all sellers with sufficiently unfavorable information would remain silent and accept buyers' offers; that all sellers with favorable information would reveal it if possible and accept higher offers; and that only if there were sellers who were unable to

[20] In the terminology of the model, if $x$ is revealed to the defendant, the expected judgment at trial will become $x' < x$ since the defendant will be able to prepare himself. Thus, although the plaintiff would like to settle for anything over $x - c_p$, if he reveals his information he will have to settle for only $x' - c_p$. Therefore, if $x' - c_p < s(\phi) < x - c_p$, the plaintiff will keep silent and go to trial—he will act as if he were unable to reveal $x$.

[21] See, for example, Chapter 6 of Fleming and Hazard (1977) for a general discussion of discovery.

[22] However, in the case discussed previously where trial is caused by the plaintiffs' unwillingness to give the defendant a strategic advantage, rather than by the plaintiff's inability to reveal information, discovery might lead directly to the sharing of information which would promote settlement. On the other hand, discovery, as noted, is not perfect; for instance, the privileged status of trial preparation material may preserve significant strategic advantage for the plaintiff.

convince buyers that their information was favorable would there be Pareto-inefficient failures to transact.[23]

## References

BEBCHUK, L.A. "Litigation and Settlement Under Imperfect Information." *RAND Journal of Economics*, Vol. 15 (1984), pp. 404–415.

———. "Suing Solely to Extract a Settlement Offer." *Journal of Legal Studies*, Vol. 17 (1988), pp. 437–450.

COOTER, R., MARKS, S., AND MNOOKIN, R. "Bargaining in the Shadow of the Law: A Testable Model of Strategic Behavior." *Journal of Legal Studies*, Vol. 11 (1982), pp. 225–251.

FLEMING, J., JAMES, F. AND HAZARD, G. *Civil Procedure*, 2nd ed. Boston: Little Brown, 1977.

GOULD, J. "The Economics of Legal Conflicts." *Journal of Legal Studies*, Vol. 2 (1973), pp. 279–300.

GROSSMAN, S.J. "The Informational Role of Warranties and Private Disclosure About Product Quality." *Journal of Law and Economics*, Vol. 24 (1981), pp. 461–483.

KREPS, D.M. AND WILSON, R. "Sequential Equilibria." *Econometrica*, Vol. 50 (1982), pp. 863–894.

LANDES, W.M. "An Economic Analysis of the Courts." *Journal of Law and Economics*, Vol. 14 (1971), pp. 61–107.

MILGROM, P.R. "Good News and Bad News: Representation Theorems and Applications." *Bell Journal of Economics*, Vol. 12 (1981), pp. 380–391.

NALEBUFF, B. "Credible Pretrial Negotiation." *RAND Journal of Economics*, Vol. 18 (1987), pp. 198–210.

P'NG, I.P.L. "Strategic Behavior in Suit, Settlement, and Trial." *Bell Journal of Economics*, Vol. 14 (1983), 539–550.

REINGANUM, J.F. AND WILDE, L.L. "Settlement, Litigation, and the Allocation of Litigation Costs." *RAND Journal of Economics*, Vol. 17 (1986), pp. 557–566.

SALANT, S. "Litigation of Settlement Demands Questioned by Bayesian Defendants." Social Science Working Paper No. 516, California Institute of Technology, March 1984.

SHAVELL, S. "Suit, Settlement, and Trial: A Theoretical Analysis under Alternative Methods for the Allocation of Legal Costs." *Journal of Legal Studies*, Vol. 11 (1982), 55–81.

SOBEL, J. "An Analysis of Discovery Rules," Mimeo, Department of Economics, University of California, San Diego, 1985.

[23] Specifically, suppose that $x$ is the private information possessed by the seller, where $x$ is distributed in $[a, b]$ according to the density $f(x)$; $u(x)$ is the value of the good to the seller if he does not sell it (perhaps the value from continued use), where $u$ is increasing in $x$; $v(x)$ is the value of the good to the buyer, where $v$ also is increasing in $x$ and $v(x)$ exceeds $u(x)$ (meaning that a sale would always be Pareto-efficient). Then, by essentially the arguments already presented, there are sequential equilibria, and in such an equilibrium the following is true. If a seller reveals $x$, he will be offered and will accept $s(x) = u(x)$; if a seller does not reveal $x$, he will be offered $s(\phi)$. Sellers who are able to reveal $x$ will do so if and only if $u(x) > s(\phi)$. Sellers for whom $u(x) \leq s(\phi)$ will be silent and accept $s(\phi)$. Hence, if all sellers are able to reveal $x$, there will always be agreement and sale of goods. If, however, some sellers with $u(x) > s(\phi)$ are unable to reveal $x$, they will refuse buyers' offers and sales will not occur.

To see that there will be $s(\phi) > u(a)$, so that the silent set will not be degenerate, consider the case where all sellers are able to reveal $x$. In this case, $s(\phi) > u(a)$ if $v(a) - u(a)$—the surplus from failing to make a transaction with the lowest type—is sufficiently large. This can be shown from the expression analogous to (2), the buyer's expected value given his offer $s$ to the silent, namely

$$(*) \int_a^{u^{-1}(s)} [v(x) - s]g(x)dx,$$

where $g(x)$ is the density of $x$ conditional on sellers being in the silent set $G = [a, u^{-1}(s(\phi))]$ and $u^{-1}$ is the inverse function of $u$. In equilibrium, it must be that the $s$ maximizing $(*)$ equal $s(\phi)$. It is easily verified that this condition will hold for all $s(\phi)$ in a neighborhood above $u(a)$ if $v(a) - u(a)$ is sufficiently large.