SHARING OF INFORMATION PRIOR TO SETTLEMENT OR LITIGATION

Steven Shavell

Discussion Paper No. 53

4/89

Program in Law and Economics
Harvard Law School
Cambridge, MA 02138

The Program in Law and Economics is supported by a grant from the John M. Olin Foundation.

forthcoming, Rand Journal
of Economics, 1989

SHARING OF INFORMATION PRIOR TO SETTLEMENT OR LITIGATION

Steven Shavell

forthcoming, Rand Journal of Economics, 1989

Sharing of Information Prior to Settlement or Litigation

Steven Shavell

Abstract

The voluntary sharing of information prior to settlement negotiations is studied in a model where one type of litigant -- plaintiffs, for concreteness -- possesses private information. In equilibrium, plaintiffs whose expected judgments would exceed a threshold will reveal their information (if they can credibly establish it) and will 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.

Sharing of Information Prior to Settlement or Litigation

Steven Shavell[1]

I. 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 settlement. This is the notion investigated in the model considered here.[2]

It is assumed in the model 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 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

---

[1]Harvard Law School and National Bureau of Economic Research. I am grateful for financial support from the National Science Foundation (grant SES-8420226) and for comments from L. Bebchuk, A. M. Polinsky, D. Rubinfeld, J. Sobel, and two anonymous referees.

[2]This model builds in a natural way on previously studied models of the litigation process. The first models of settlement and litigation <u>assumed</u>, 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 <u>explain</u> 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 of <u>voluntary</u> <u>communication</u> of information that might reduce or eliminate differing beliefs, although Sobel [1985] studies the required disclosure of information prior to trial (see note 15). By allowing for the voluntary communication of information, the model here takes a logical next step in the study of the litigation process.

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.

Two versions of the model are studied which differ in whether all, or only some, plaintiffs are able to establish their information to defendants.

In the first version, all plaintiffs are assumed to be able to establish their information to defendants. It is shown 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 that these silent plaintiffs will obtain in settlements will reflect the inference that defendants rationally make 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 will do this in order to obtain a higher amount in settlement than defendants would offer were they silent.

Note from this description 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.[3] 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

---

[3]That there is not complete revelation of information contrasts with the result in Grossman [1981] and Milgrom [1981]; see note 12.

more; but if this is so, the plaintiff would not have decided to be 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 their information, defendants will choose to exercise the 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, some plaintiffs are assumed to be unable to establish their information about expected judgments to defendants before trial. (A plaintiff may not be able to establish his information before trial because, for instance, the necessary documentation is not immediately available; for further discussion, see the concluding section.) In this version, there will again be a threshold level of expected judgment below which plaintiffs will keep silent and settle, and above which plaintiffs will want to reveal their information to obtain a better settlement. But now some of the latter plaintiffs will be unable to establish their favorable information to defendants. These plaintiffs will go to trial.

A point of contrast, therefore, between the second version of the model and the first is that there are trials in the second version. Trials are wholly due to the inability of plaintiffs with favorable information to establish their 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 the paper 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 different from litigation.

II. The Model

A. 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 a plaintiff prevailing at trial or the magnitude of the judgment he would obtain if he prevails.) A defendant and a plaintiff will agree about 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 the plaintiff 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 for the defendant. The sequence of events is shown below.[4]

---

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

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; $c_d > 0$;

ϕ = 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.[5] The symbol "ϕ" 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.

[5] 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 introduce an added and unnecessary element of complication into the present model.

B. The Parties' Decisions and Sequential Equilibrium

We will be interested in identifying 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. Second, defendants' probabilistic beliefs about silent plaintiffs' types are correct.[6]

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

(1) $x - c_p \leq s$;

otherwise he will go to trial.[7]

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. (This is the minimum offer the plaintiff will accept;[8] 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 = set of silent plaintiffs; and

[6]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.

[7]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.

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

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

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

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

for (by (1)) the first term is the expected cost of settlements and the second is that of trials. Hence, the optimal offer $s(\phi)$ is the $s \in [a-c_p, b-c_p]$ that minimizes (2).[9] The derivative of (2) with respect to s is

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

The first term is the marginal cost of raising an offer due to paying more to plaintiffs who are 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, and 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" ϕ.

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

[9] 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. And 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.

and goes to trial, he will obtain $x - c_p$. Hence, a plaintiff will be silent and accept $s(\phi)$ when

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

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 $s(x) = x - c_p$,[10] but if the plaintiff cannot reveal his type he will reject $s(\phi)$ and go to trial.

Thus, as was emphasized in the Introduction, plaintiffs who can establish their type will never go to trial even though they may choose to remain silent; and the reason is indeed what was mentioned, 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 before the preceding one that the silent set

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

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 <u>equilibrium conditions</u>. Any $s(\phi)$ and G obeying the equilibrium conditions determines a sequential equilibrium.

---

[10] 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 reveals his type. Thus, in principle, he would be indifferent between the two. However, it is assumed here that he would not be silent and go to trial. The motivation for the assumption is again that if the plaintiff reveals x, the defendant could be imagined to offer the plaintiff an amount slightly higher than $x - c_p$, making him better off than if he went to trial.

Sequential equilibrium will now be examined 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.

C. 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 $a - c_p$, so 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 $x - c_p$.

There are, however, in general, sequential equilibria in which $s(\phi)$ exceeds $a - c_p$. To see this, observe that for such an $s(\phi)$, G is the non-degenerate 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 be $s = s(\phi)$. Now the derivative of (2) is, from (3),

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

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

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

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 $a - c_p$. Hence, 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, to be denoted s^*, that a defendant would make if it was true that all plaintiffs were unable to establish their type. (The intuition is as follows. Presumably, $s(\phi)$ could not be <u>higher</u> than s^* since, in fact, plaintiffs with favorable information will reveal it; hence 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 <u>as much as</u> s^* is a somewhat subtle point, which requires examination of the proof to appreciate.) To demonstrate this, observe that were all plaintiffs unable to establish their types, the defendant would choose $s \in [a-c_p, b-c_p]$ to minimize

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

Since s^* is assumed to minimize (8) over all s in $[a-c_p, b-c_p]$, in particular s^* 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, for s exceeding s^*, the derivative of (2) is 1, it has been shown that (2) is minimized at s^* if $s(\phi) = s^*$; thus s^* is an equilibrium $s(\phi)$. It remains to show that there cannot be an $s(\phi) > s^*$. Assume to the contrary. Since s^* minimizes (8) over all s in $[a-c_p, b-c_p]$, it does so over the interval $[a-c_p, s(\phi)]$. Hence, $s^* < s(\phi)$ minimizes (2) over $[a-c_p, s(\phi)]$, contradicting the assumption that $s(\phi)$, being an equilibrium offer, minimizes (2) over $[a-c_p, s(\phi)]$.[11]

---

[11]While it has now been proved 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

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 <u>all</u> silent plaintiffs to settle -- and not just the silent plaintiffs with moderate or low (among the silent plaintiffs) 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 $c_d > 0$. They may thus rationally offer enough to guarantee that they avoid trial if they aren't sacrificing too much in so doing; this is true if the silent group is not too large.[12]

---

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 $[a-c_p, s(\phi)]$.

[12] It is in essence this feature of the present model that explains why not all parties will reveal their information, unlike in Grossman [1981] and Milgrom [1981]. It is instructive 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 wants. If a seller reveals the value of his good to a buyer, suppose that he will receive the value from the buyer; and if a seller is silent, suppose that he will receive 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 values. These parties would be able to sell their goods at a higher price than the mean by revealing the value of their goods. They would therefore reveal the value of their good, causing an unraveling of the silent group. Hence, the silent group can contain at most the sellers whose goods have the minimum value.

The unraveling phenomenon would not necessarily occur if buyers' situation were analogous to that of defendants in the model of the present paper. Namely, suppose that, rather than a buyer being assumed to offer the mean value of the silent group's values, a buyer decides how much to offer taking into account that if he offers too little, the seller will not sell, and the buyer will lose some consumer surplus. Then 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 -- he would offer the highest value; and the

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. Hence, (6) is

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

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 $s = s(\phi)$; and 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 was proved had to be the case, $a + c_d$ is the amount that would be offered by defendants were all plaintiffs unable to establish their expected judgments.[13]

For instance, suppose 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 \$14,000; others will reveal their expected judgments and settle for more than \$14,000. Moreover, defendants will know that the

---

conclusions would be similar to those of the present paper. See note 24 below.

[13]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 $s = a + c_d$.

silent plaintiffs' expected judgments are uniformly distributed between \$10,000 and \$17,000, and defendants will choose to offer \$14,000.[14]

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. Hence, the only equilibrium offer to the silent, given the discovery rule, is $s(\phi) = a - c_p$, in which 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.[15]

---

[14] An offer to the silent of, say, \$18,000, would not be associated with an equilibrium. The reason is that were \$18,000 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.

[15] 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

We may summarize our conclusions as follows.

Proposition 1. Suppose that all plaintiffs are able to reveal credibly their expected judgments x. Then there exist sequential equilibria, 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).

D. Some Plaintiffs Are Unable to Establish Their Type

Here $G = [a,s(\phi)+c_p] \cup \{$plaintiffs with $x > s(\phi) + c_p$ who are unable to reveal their type$\}$. For simplicity, assume that the fraction of plaintiffs unable to reveal x is independent of x; let

k = fraction of plaintiffs unable to reveal x.

---

mandatory disclosure is with a regime of voluntary disclosure, which, as has been seen, results in some parties disclosing information.

Then

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

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,

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

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

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

is the right-hand derivative and is 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 non-positive at $s(\phi)$ and that (12) be non-negative at $s(\phi)$.

Unlike in Section C, 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 the 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. Hence, 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.[16]

---

[16]That s^* is an equilibrium offer follows as before, except that here the derivative of (2) to the right of s^*, namely, (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

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 $x - c_p$, and those with higher x who are unable to establish this will go to trial.

<u>Uniform case</u>. 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 $x \epsilon [a,s(\phi)+c_p]$ and $[1/P(G)][k/(b - a)]$ for $x \epsilon (s(\phi)+c_p,b]$. Hence, (6) and (12) become

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

and

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

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 $s(\phi)$ are the interval $[a-c_p+k(c_p+c_d),a+c_d]$. It should be noted that, as was shown had to be true, 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).

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 the silent will be [\$11,000,\$15,000]. If the equilibrium offer to the silent 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

---

(2) over such s. That $s(\phi) > s^*$ cannot be an equilibrium, follows exactly as argued before.

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 of these plaintiffs will go to trial. The probability of trial will be .5[\$50,000 - \$16,000]/\$40,000 = .425.

Discovery. If discovery is allowed, it will be assumed that only the fraction (1-k) of plaintiffs that had been assumed able to establish x voluntarily will be able to, and will, comply with a discovery request.[17] Under this assumption, there cannot exist an equilibrium in which the silent set G includes any plaintiffs who are able to establish x; for, as before, were that the case defendants would request discovery in order to pay less in settlement with probability one. Hence, the equilibrium will be such that the silent are only those plaintiffs 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 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 fall 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 was \$13,000 the frequency of trial would be .425. With

---

[17]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 paper considered as well the assumption that even parties unable voluntarily to 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.

discovery, the equilibrium offer must be \$15,000, and the frequency of trial will be .5[\$50,000 - \$18,000]/\$40,000 = .40, which is lower.

The conclusions of this section are given by

<u>Proposition 2.</u> Suppose that some plaintiffs are able to reveal credibly their expected judgments and that others are not. Then there exist sequential equilibria, 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 $x - c_p$; but 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 the plaintiffs who are able voluntarily to reveal x can comply with requests to reveal x, 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^*).

(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^*.

III. 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 that will influence trial outcomes; the right of discovery; and the applicability of the conclusions from the model to contexts different from 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. Then it is straightforward to verify that in the case where all plaintiffs are able to establish their type, an equilibrium would exist where, if a plaintiff revealed his type, he 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 this.[18] All plaintiffs with x exceeding $s(\phi) - c_d$ would reveal x. Thus, the situation would be qualitatively similar to that

[18] An equilibrium in which plaintiffs who do not reveal x behave differently presumably also exists: 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], for example. It should be noted that, in such an equilibrium in the situation where some plaintiffs are unable to disclose x, the frequency of trials may be lower than in the present paper. For, unlike in the present paper, plaintiffs with favorable information are able to signal this with high demands and sometimes 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.

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 were found in the present paper, with defendants playing the role of plaintiffs and revealing their information or not doing so.

(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 plaintiffs first 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 defendants then make settlement offers. One suspects that in this model, as in the present paper, not all information that could be revealed would be revealed, but there would be differences in result. Notably, here a conclusion was that if all plaintiffs are able to reveal their 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 turn out to refuse a defendant's offer: unlike in the model of this paper, a silent plaintiff would not know with certainty the offer that would be made (defendants are different) and thus might rationally be silent even though there is a chance that he would refuse a defendant's offer. In view of such conjectures as this, 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 it would not alter the qualitative nature of the conclusions. Any plaintiff able to establish his type would settle, even if he did not reveal his type.[19]

(5) Suppose that the disclosure of information involves a positive cost d. In this case, in the model studied in this paper, 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. Also, an assumption that plaintiffs are risk averse would produce a similar result.

<u>ability to reveal, prior to trial, information relevant to trial outcomes.</u> An assumption of importance in this paper concerned the ability or the 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 to defendants or explain to

[19]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; and 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.

defendants arguments that they would be able to offer were the case to go to trial.

Why, however, would plaintiffs be unable to establish to defendants information 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 but not be able to convince the defendant of this before trial.[20] 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

---

[20]For example, a plaintiff may know fairly well what his business losses from defendant's wrongful act were but 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 that he will suffer but 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 this; trial dates are sometimes set by courts, or by past actions of the litigants. Moreover, although the model in the paper 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.

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 (for example, to rebut an assertion based on the information). For this reason, a plaintiff may decide not to reveal information in his favor and consequently will refuse the defendant's offer and go to trial.[21]

<u>discovery.</u> 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, 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."[22] 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.

---

[21] 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 $x' - c_p$. Hence, 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.

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

Consequently, both the situations in the model in which 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, for, as has been stressed, trial is due in the model to plaintiffs being unable <u>voluntarily</u> to reveal <u>favorable</u> information, and discovery hardly solves this problem.[23] The reason that discovery nevertheless reduces the chance of trial is that discovery raises the settlement offer that 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 a group that, on average would obtain more at trial and is therefore offered more by defendants (s^* instead of $s(\phi)$); see Prop. 2(e).) Since silent plaintiffs are offered more to settle, fewer go to trial.

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

<u>applicability of conclusions outside the area of litigation.</u> The principal conclusions reached in the model of this paper -- that some

[23]However, in the case discussed several paragraphs above 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 that would promote settlement. On the other hand, discovery is, as noted, not perfect; for instance, the privileged status of trial preparation material may preserve significant strategic advantage for the plaintiff.

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 paper, information asymmetry is one-sided, say sellers possess private information about the value of their goods and they first choose whether to reveal this information if they can and then buyers 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 convince buyers that their information was favorable would there be Pareto inefficient failures to transact.[24]

---

[24]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 in 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 given in this paper, 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

References

Bebchuk, Lucian, "Litigation and Settlement under Imperfect Information," 18 *Rand Journal of Economics*, 1984, 404-415.

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

Cooter, Robert, Steven Marks, and Robert Mnookin, "Bargaining in the Shadow of the Law," 11 *Journal of Legal Studies*, 1982, 225-252.

Gould, John, "The Economics of Legal Conflicts," 2 *Journal of Legal Studies*, 1973, 279-300.

Grossman, Sanford, "The Informational Role of Warranties and the Private Disclosure of Product Quality," 24 *Journal of Law and Economics*, 1981, 461-484.

James, Fleming, and Geoffrey Hazard, *Civil Procedure*, 2nd ed., Little Brown, Boston, 1977.

Kreps, David, and Robert Wilson, "Sequential Equilibria," 50 *Econometrica*, 1982, 863-894.

Landes, William, "An Economic Analysis of the Courts," 14 *Journal of Law and Economics*, 1971, 61-107.

Milgrom, Paul, "Good News and Bad News: Representation Theorems and Applications," 12 *Bell Journal of Economics*, 1981, 380-391.

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

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.)

Nalebuff, Barry, "Credible Pretrial Negotiation," 18 <u>Rand Journal of Economics</u>, 1987, 198-210.

P'ng, Ivan, "Strategic Behavior in Suit, Settlement, and Trial," 14 <u>Bell Journal of Economics</u>, 1983, 539-550.

Reinganum, Jennifer and Louis Wilde, "Settlement, Litigation, and the Allocation of Litigation Costs," 17 <u>Rand Journal of Economics</u>, 1986, 557-566.

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

Shavell, Steven, "Suit, Settlement, and Trial: A Theoretical Analysis under Alternative Methods for the Allocation of Legal Costs," 11 <u>Journal of Legal Studies</u> 1982, 55-82.

Sobel, Joel, "An Analysis of Discovery Rules," mimeographed, Dept. of Economics, Univ. of California at San Diego, 1985.