

Litigation and settlement under imperfect information

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A model of parties' litigation and settlement decisions under imperfect information is studied. The model shows how informational asymmetry influences parties' decisions, and how it might lead to parties' failure to settle. The model is used to identify how the likelihood of settlement and the settlement amount are shaped by various factors—the size of the amount at stake, the magnitude of the parties' litigation costs, and the nature of the parties' information. The model is also used to examine how the likelihood of settlement is affected by various legal rules, such as those governing the allocation of litigation costs.

1. Introduction

■ The great majority of legal disputes is not resolved by courts, but rather through out-of-court settlements. The concern of this article is with the factors that determine the *likelihood of settlement* and (if a settlement does occur) the *settlement amount*. In particular, the article will focus on situations in which an informational asymmetry is present, and it will examine how the presence of such an asymmetry influences parties' settlement decisions.

The economic analysis of litigation and settlement decisions began with Landes (1971) and Gould (1973), and its first stage might be viewed as having culminated in Shavell (1982). These authors did not explicitly model the bargaining process, nor did they explicitly treat the possibility of an informational asymmetry between the parties to a dispute.¹ Subsequently, Ordoover and Rubinstein (1983), P'ng (1983), and Salant and Rest (1982) offered several bargaining models of settlement decisions in the presence of asymmetric information. These authors, however, used a very restrictive assumption—

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¹ Instead of modelling the bargaining process, these authors simply assumed that a settlement would take place (somewhere on the "contract curve") whenever the expected cost attached by the plaintiff to a possible trial exceeded the expected benefit attached by the defendant to such a trial. As to the parties' assessments of the expected outcome of a trial, these authors did assume that the assessments might diverge; but they did not explicitly model the possible sources of such a divergence, nor did they consider the possibility that one of the

that parties are not free to choose their settlement terms, but rather must adopt, if they are to settle, some externally determined settlement amount.² The present article seeks to advance the analysis of settlement decisions under imperfect information by putting forward a model in which parties are free to determine the size of their settlement offers.³

Section 2 develops a model to study both the settlement demand that a party will elect to make under imperfect information and the likelihood that this demand will be accepted by the other party. In choosing a settlement demand a party will balance two considerations: on the one hand, increasing his demand will be beneficial if the demand is accepted; on the other hand, increasing his demand will reduce the likelihood that the demand will be accepted. It will be seen that an informational asymmetry might be an important reason for parties' failure to settle.

In Section 3 the model is used to identify how the likelihood of settlement and the settlement amount are shaped by various factors—the size of the amount at stake, the magnitude of the parties' litigation costs, and the nature of the parties' information. Next, in Section 4 the model is applied to examine how the likelihood of settlement is affected

parties would recognize that, owing to the presence of an informational asymmetry, the other's assessment (which he does not know) is superior to his own.

One should note, however, two exceptions to the above characterization of the early work on litigation and settlement. First, Posner (1973, pp. 422–426) contains some insightful informal discussion about how the likelihood of settlement might be affected by the presence of informational asymmetry and by various rules of legal procedure; his view on this issue is similar to the one suggested by the analysis of the present article. Second, Cooter, Marks, and Mnookin (1982) studied an interesting bargaining model with incomplete information. Their model, however, differs from subsequent work on settlement under imperfect information. Although informational asymmetry is present in their model, they did assume that each party's expected utility from a trial is known to both parties.

² Models using this assumption cannot shed much light on the factors that determine the settlement amount. Moreover, the models' results concerning the effects of various factors on the likelihood of settlement are also open to question because, as the analysis below will demonstrate, such factors might affect the likelihood of settlement through their effect on the size of parties' settlement offers.

³ In recent independent work, Salant (1984) and Samuelson (1983) seek to advance the analysis in the same direction. Salant uses a bargaining procedure similar to that of the present article. But he focuses on an interesting issue from which this article abstracts—parties' ability to draw from their adversaries' offers inferences concerning their adversaries' private information. Incorporation of this issue, however, is bought at a price: Salant's model leads to a continuum of equilibria, and it yields fewer results about the factors shaping the likelihood of settlement and the settlement amount than does the model of this article. Samuelson (1983) uses a bargaining procedure that is significantly different from the one used by Salant and myself; in particular, he assumes that the settlement amount a party may choose to offer must be one of two exogenously given amounts.

Finally, it might be worthwhile to contrast my analysis not only with the literature on private law disputes, but also with the literature on bargaining with incomplete information in other contexts. First, there is a substantial recent literature on bargaining with incomplete information over the sale of a good or the division of a pie (e.g., Fudenberg and Tirole, 1983; Rubinstein, 1983). In these models, however, the private information that parties are assumed to have is only about their own preferences, and thus only about their *own* payoffs. In contrast, in the situation examined in this article, one party is assumed to have superior information about the *other party's*, and not only his own, expected payoff in case an agreement is not reached and a trial takes place.

Second, the literature on labor-management bargaining against the background of compulsory arbitration (e.g., Crawford, 1979) again assumes that the parties have private information only about their *own* preferences. No party is assumed to possess private information about the arbitrator's expected decision in case no agreement is reached.

Third, Grossman and Katz (1983) study a model of plea bargaining in which the criminal defendant has private information concerning the expected outcome of a trial. The objective function of the criminal prosecutor, however, is importantly different from that of the potential private law plaintiff. In my model of a private law dispute, the potential plaintiff would prefer to extract from the defendant as high a settlement amount as possible. In contrast, Grossman and Katz appropriately assume that the criminal prosecutor would prefer to have no penalty imposed on innocent defendants.

by various legal rules, such as those governing the allocation of litigation costs. Finally, Section 5 contains concluding remarks.

2. The model

■ **Framework of analysis.** A risk-neutral plaintiff files a suit against a risk-neutral defendant. Settlement negotiations are then conducted against the background of a possible trial. If a trial does take place, the expected litigation costs of the plaintiff and the defendant will be C_p and C_d , respectively;⁴ and, according to the prevailing rule in American law, each party will have to bear his costs regardless of the trial's outcome. If the defendant is found liable, the court will award a judgment W in favor of the plaintiff.⁵

One of the parties to the dispute has some private information about factual issues that is relevant to estimating the expected outcome of a trial. That party can thus make a better assessment of the trial's expected outcome. In developing the model it will be assumed that the defendant is the party with private information; an example to bear in mind is a tort suit in which the defendant has private information concerning whether he was negligent. As Section 5 will explain, however, the model can be easily adjusted to apply to the case in which the plaintiff is the one with private information.

On the basis of his information, the defendant estimates the likelihood of the plaintiff's prevailing in a trial to be p . A defendant with an estimate p will be referred to as being of type p . The plaintiff does not know p —the defendant's type—but only that p is distributed with a density function $f(\cdot)$ and a cumulative distribution function $F(\cdot)$.⁶ It will be assumed that $f(\cdot)$ is positive in the interval (a, b) , $0 < a < b < 1$, and zero outside this interval, that $f(\cdot)$ is continuous and differentiable throughout, and that there is some neighborhood of b where $f(\cdot)$ is nonincreasing.⁷

It will be assumed that litigation has a positive expected value for the plaintiff even if the defendant is of the lowest type, that is, $-C_p + aW > 0$. This assumption is made to rule out the possibility that the plaintiff will not actually go to trial even if he gets no payment whatsoever from the defendant.

The bargaining over the settlement amount will be assumed to take the following simple form. The plaintiff chooses a settlement amount and offers it to the defendant on a take-it-or-leave-it basis. The defendant then decides whether to accept the offer. At this point the settlement negotiations end, with or without a settlement agreement. If the defendant has turned down the plaintiff's offer, the plaintiff will have to choose whether

⁴ The parties' litigation costs should not be viewed as fixed; rather, C_p and C_d should be viewed as the levels of expenditures that the parties will find optimal to spend should a trial take place. For models of parties' decisions concerning how much to invest in litigation costs, see Posner (1973, pp. 456–458) and Braeutigam, Owen, and Panzar (1982).

⁵ It will be clear that the model can be easily extended to a case where the size of the judgment, and not only the defendant's liability, is uncertain.

⁶ If the defendant is of a low- p type, then it will be in his interest to eliminate the informational asymmetry and to have the plaintiff realize that the expected value of a trial is low. It will be assumed, however, that the defendant cannot eliminate the informational asymmetry in any way which is not prohibitively costly. A statement by the defendant about his low estimate of the plaintiff's chances will be disregarded by the plaintiff unless the defendant provides the plaintiff with a verification of his low estimate. My assumption is that the defendant cannot provide such a verification, or that he cannot provide it without jeopardizing his defense should the plaintiff elect to litigate.

⁷ It will be clear from the proof of Proposition 1 that the assumptions concerning the behavior of the density function in the neighborhoods of a and b are sufficient—but not necessary—for the plaintiff's problem to have an interior solution. Although somewhat weaker assumptions could be used, the current assumptions were chosen for the sake of the presentation's simplicity.

to litigate the case or drop it; and since $-C_p + aW$ is assumed to be positive, the plaintiff will elect to litigate.⁸

□ **The parties' decisions.** Let us first consider the decision that the defendant will make if the plaintiff demands a settlement amount S . The defendant knows that if he rejects the demand, there will be a trial; and the expected cost that he will attach to such a trial is $C_d + pW$. Thus, the defendant will accept the settlement offer if and only if

$$S \leq C_d + pW, \tag{1}$$

or, equivalently, if and only if

$$p \geq \frac{S - C_d}{W}. \tag{2}$$

Hence, the defendant will accept an offer S if and only if his type p is equal to or higher than $q(S)$, where $q(S)$ is defined by

$$q(S) = \frac{S - C_d}{W}. \tag{3}$$

The value $q(S)$ will be referred to as the “borderline type” of an offer S . An increase in S will raise the borderline type. Notice also that, as $q(S)$ and S are linearly related, the plaintiff’s problem can be formulated either as choosing an optimal settlement demand or as choosing an optimal borderline type.

Let us now consider the plaintiff’s decision. The plaintiff knows that if he makes a demand S , the probability that the defendant will accept this demand is $1 - F[q(S)]$ and the probability that he will reject it is $F[q(S)]$. If the defendant rejects the offer, which will be the case if his type is lower than $q(S)$, then there will be a trial, and the plaintiff’s likelihood of winning will be $\int_a^{q(S)} xf(x)dx/F[q(S)]$, the average probability among defendant types lower than $q(S)$. Thus, the plaintiff’s expected position $A(S)$ will be

$$A(S) = \{1 - F[q(S)]\}S + F[q(S)] \left\{ -C_p + W \frac{\int_a^{q(S)} xf(x)dx}{F[q(S)]} \right\}, \tag{4}$$

and the plaintiff will choose S to solve

$$\max_S A(S). \tag{5}$$

Differentiating the right-hand side of (4) with respect to S and rearranging terms shows that $A'(S)$ is equal to

$$\{1 - F[q(S)]\} - \left\{ \frac{C_p + C_d}{W} f[q(S)] \right\}. \tag{6}$$

⁸ The assumed bargaining procedure—a take-it-or-leave-it offer by the plaintiff—gives the plaintiff a bargaining advantage. Indeed, if the plaintiff knew the defendant’s type, then under the assumption made here the plaintiff would be able to capture all the gains from settlement. Hence, this assumption is likely to lead to a settlement amount that is more favorable to the plaintiff (i.e., higher) than the settlement amount that would be suggested by a model with a more realistic bargaining process. My interest here, however, is not so much in the absolute level of the settlement amount as in the qualitative relations between the settlement amount (and the likelihood of settlement) and various underlying factors; and there seems to be no reason to expect the direction of these relations to be changed by an assumption that introduces an upward bias in the absolute level of the settlement amount.

⁹ It will be assumed that when a party is indifferent between a given settlement amount and a trial, he will choose to settle. All the article’s results will be the same under the opposite assumption.

The first expression in (6) represents the benefit to the plaintiff of a marginal increase in S : the plaintiff will get this marginal increase with a probability of $1 - F[q(S)]$.

The second expression in (6) represents the cost to the plaintiff of a marginal increase in S . The increase in S would raise the likelihood of litigation, since if the defendant's type is equal to (or slightly higher than) $q(S)$, he will accept a demand S but will reject a higher demand. Specifically, a marginal increase in S would raise the likelihood of litigation by $dF[q(S)]/dS = f[q(S)]/W$. And observe that litigating against a defendant of the borderline type $q(S)$ instead of settling with him for an amount S would involve a loss to the plaintiff of $C_p + C_d$; for if the defendant is of the borderline type $q(S)$, then, by definition of the borderline type, the settlement amount will give the plaintiff all of the settlement gains $C_p + C_d$.

Let S^* denote the solution to the plaintiff's problem (5), and let q^* denote $q(S^*)$. The plaintiff's choice of S^* in turn determines the likelihood that the defendant will accept the settlement offer. Denoting the likelihood of settlement by r^* , we have

$$r^* = 1 - F[q^*]. \quad (7)$$

□ **The likelihood of settlement and the settlement amount.** We begin with the following proposition.

Proposition 1. The settlement amount S^* and the likelihood of settlement r^* are characterized by:

$$C_d + aW < S^* < C_d + bW; \quad (8)$$

$$a < q^* < b; \quad (9)$$

$$1 - F(q^*) = \frac{C_p + C_d}{W} f(q^*); \quad (10)$$

$$f(q^*) + \frac{C_p + C_d}{W} f'(q^*) > 0; \quad (11)$$

and

$$0 < r^* < 1.^{10} \quad (12)$$

Remarks. Equations (8), (9), and (12) imply that the plaintiff's offer will not be one that the defendant will either accept no matter what his private information is or reject no matter what his private information is. Rather, the plaintiff's offer will be accepted by a defendant whose private information is sufficiently unfavorable and rejected by a defendant for whom this is not the case. Thus, there is a positive probability—but no certainty—of a settlement.

Equation (10), the first-order condition, implies that at the plaintiff's optimal settlement offer the marginal cost and marginal benefit of increasing the offer (and the borderline type) are equal. Finally, equation (11) is the second-order condition.¹¹

¹⁰ A numerical example illustrates the model's results. Suppose that the judgment (W) is \$20,000, and that the plaintiff's litigation costs (C_p) and the defendant's litigation costs (C_d) are \$4,500 and \$3,500, respectively. Suppose that the defendant's type (p) is distributed in the interval (.4, .8) with a triangular distribution (the density function is a triangle). Then it can be shown (using Proposition 1, equations (10) and (11)) that the plaintiff's settlement demand (S^*) will be \$13,280, and that consequently the likelihood of settlement (r^*) will be 90.1%.

¹¹ There might be of course more than one value of S for which the first-order condition (10) and the second-order condition (11) hold. If there are two or more local optima, then the global optimum can be found by comparing the values that $A(S)$ reaches in each of these local optima. It will be assumed that there is no tie between two local optima for the highest value of $A(S)$, so that there is a unique global optimum.

Note that the first-order condition (10) can be rewritten (see (13) below) as requiring that $f(q^*)/[1 - F(q^*)]$, which is the failure rate (or hazard function) of the distribution $f(\cdot)$ at q^* , be equal to $W/(C_p + C_d)$. Thus, assuming that the distribution $f(\cdot)$ has a monotonically increasing failure rate would rule out multiplicity of local optima.

Proof. Note that for any $q(S) \leq a$ (i.e., $S \leq C_d + aW$), $A'(S)$ (see (6)) is equal to one. In that interval the defendant will certainly accept the offer and the plaintiff will thus get any increment in his settlement demand. Since the expression in (6) is equal to one at $q = a$ and $f(\cdot)$ is a continuous function, there must be some neighborhood to the right of $q = a$ where (6) is positive. This implies that $q^* > a$, and, by (3), that $S^* > C_d + aW$.

Note now that for $q(S) \geq b$, the value of (6) is equal to zero. In this interval raising the offer will not have any effect on the plaintiff's expected position since the defendant is bound to reject the offer anyway. Thus, to prove (8) and (9) it remains only to show that there is some neighborhood to the left of $q = b$ where (6) is negative.

Let $(b - \epsilon_1, b)$ denote the interval where $f(\cdot)$ is nonincreasing, and let ϵ_2 denote some positive value less than $\min(\epsilon_1, (C_p + C_d)/W)$. We shall now show that (6) is negative in the interval $b - \epsilon_2 < q < b$. Observe that in this interval, $1 - F(q) - (C_p + C_d)/Wf(q)$ is (by the definition of ϵ_2) less than $1 - F(q) - \epsilon_2 f(q)$. And note that, since f is nonincreasing in the interval, $1 - F(q) - \epsilon_2 f(q)$ is less than or equal to $1 - F(b) = 0$. This completes the proof of (8) and (9).

Next, note that since by (8) the optimal settlement demand is interior to the interval $(C_d + aW, C_d + bW)$, then $A'(S)$ (see (6)) must be equal to zero at S^* . From this (10) follows.

Next, note that since S^* is an interior solution, the second-order condition for a maximum must hold. Differentiating (6) with respect to S , rearranging terms, and requiring negativity at S^* give (11).

Finally, (12) follows immediately from (8) and from the definition of r^* (see (7)). *Q.E.D.*

Note. An informational asymmetry is responsible for the possible failure of parties to settle. If the plaintiff knew the defendant's type p , then the plaintiff would make a settlement demand that the defendant would not find in his interest to reject. The plaintiff, however, does not know p , but only the distribution from which it is drawn. Consequently, the plaintiff's optimal settlement demand will be one that the defendant will reject if his type is sufficiently low. To be sure, the defendant might tell the plaintiff that his estimate of the plaintiff's chances is low. But the plaintiff will do best to disregard such a statement by the defendant because of the adverse selection problem: the defendant will prefer to be viewed as being of a low type even if he is actually of a high type.

3. Comparative statics

■ **The amount at stake and the parties' litigation costs.** The following two propositions describe the effects of changing the amount at stake and the parties' litigation costs.

Proposition 2. An increase in the judgment to which a winning plaintiff is entitled will: (a) increase the settlement amount; and (b) decrease the likelihood of a settlement.¹²

Proposition 3. (a) An increase in the plaintiff's litigation costs will decrease the settlement amount. (b) An increase in the defendant's litigation costs might increase, decrease, or have no effect on the settlement amount. (c) An increase in the litigation costs of *either* party will increase the likelihood of a settlement.¹³

¹² In the numerical example described in footnote 9, an increase in W from \$20,000 to \$25,000 would increase S^* from \$13,280 to \$16,175 and would reduce r^* from 90.1% to 85.7%.

¹³ In the numerical example of footnote 9, a \$1,000 increase in either C_p or C_d would increase r^* from 90.1% to 91.8%. As to the settlement amount, a \$1,000 increase in C_p would reduce S^* from \$13,280 to \$13,120, while such an increase in C_d would raise S^* from \$13,280 to \$14,120.

Proofs. Propositions 2 and 3 can be proved by differentiating (10) and (7) with respect to W , C_p , and C_d , rearranging terms to get the derivatives of S^* and r^* with respect to these three variables, and then using the second-order condition (11).

The propositions can also be verified by making the following observations:

(i) *The effect on the likelihood of settlement.* The first-order condition (see (10)) can be rewritten as

$$\frac{W}{C_p + C_d} = \frac{f(q^*)}{1 - F(q^*)}. \quad (13)$$

The second-order condition (see (11)) implies that the derivative of the right-hand side of (13) with respect to q^* is positive. Thus, an increase in the value of the left-hand side of (13) will increase the optimal borderline type q^* . And an increase in q^* will in turn reduce r^* , as it will raise the likelihood that the defendant is of a type lower than q^* , and hence will reject the plaintiff's demand.

Thus, an increase in W (which will increase the value of the left-hand side of (13)) will reduce r^* , while an increase in either C_p or C_d will increase r^* . Note also that a proportionate increase in W and in $(C_p + C_d)$ will leave both q^* and r^* unchanged.

(ii) *The effect on the settlement amount.* Rewriting (3), we relate the optimal settlement demand to the optimal borderline type by

$$S^* = q^*W + C_d. \quad (14)$$

An increase in W will raise S^* for two reasons: first, as noted above, the increase will raise q^* ; and, second, even holding q^* fixed, an increase in W will raise S^* .

As to an increase in C_p , it will decrease S^* because, as noted above, it will decrease q^* .

Finally, the effect on S^* of increasing C_d is ambiguous: on the one hand, when q^* is held fixed, an increase in C_d will raise S^* ; on the other hand, an increase in C_d will decrease q^* . The total effect on S^* is ambiguous, because the magnitude of the decrease in q^* can vary greatly depending on the features of the distribution $F(\cdot)$. *Q.E.D.*

□ **The distribution of types.** Let us first study the effect of shifting (upward or downward) the range of types. To this end, let us drop the assumption that p is distributed in the interval (a, b) with a density function $f(\cdot)$. Instead let us assume that p is distributed in the interval $(a + \epsilon, b + \epsilon)$,¹⁴ with a density function $g(\cdot)$ and a cumulative distribution function $G(\cdot)$ defined by

$$g(x) \equiv f(x - \epsilon) \quad (15)$$

and

$$G(x) \equiv F(x - \epsilon). \quad (16)$$

Using different values for ϵ , we get a family of distributions that differ in their means, but are equal in all the higher moments. For a positive ϵ , $g(\cdot)$ is an upward shift of $f(\cdot)$; for $\epsilon = 0$, $g(\cdot)$ is equivalent to $f(\cdot)$; and for a negative ϵ , $g(\cdot)$ is a downward shift of $f(\cdot)$.

Proposition 4. An upward shift in the range of types will: (a) increase the settlement amount; and (b) have no effect on the likelihood of a settlement.¹⁵

Remarks. (a) An upward shift in the range of types will raise the settlement amount because it will increase the expected value to the plaintiff of a trial and thus will reduce

¹⁴ It is assumed that ϵ is such that $0 < a + \epsilon < b + \epsilon < 1$ and $-C_p + (a + \epsilon)W > 0$.

¹⁵ In the numerical example of footnote 9, an upward shift by $\epsilon = .1$ in the range of types (from (.4, .8) to (.5, .9)) would increase S^* from \$13,280 to \$15,280, and leave r^* unchanged at 90.1%.

the cost to him of a given increase in his settlement demand. (b) An upward shift in the range of types will not affect the likelihood of a settlement because, even though it will increase the absolute levels of the expected judgment for all defendant types, it will not change the difference in these levels between any two given types.

Proof. The proposition can be proved by differentiating both (10) and (7) (using the defined g and G instead of f and F) with respect to ϵ , and then rearranging terms to get $\partial S^*/\partial \epsilon$ and $\partial r^*/\partial \epsilon$.

The proposition can also be verified by using the following observations. Substituting g and G (as defined in (15) and (16)) for f and F in (13), the first-order condition becomes:

$$\frac{W}{C_p + C_d} = \frac{f(q^* - \epsilon)}{1 - F(q^* - \epsilon)}. \quad (17)$$

The second-order condition (11) (with g and g' replacing f and f') implies that the derivative of the right-hand side of (17) with respect to $(q^* - \epsilon)$ is positive. Thus, an increment in ϵ will require that q^* increase by the same amount so that $(q^* - \epsilon)$ will remain the same and the first-order condition continue to hold. Consequently, the likelihood of settlement, which is equal to $1 - F(q^* - \epsilon)$, will be unaffected by an increment in ϵ . At the same time, however, an increment in ϵ will raise the settlement amount S^* because the increment in ϵ will raise q^* , and the settlement amount is equal (see (14)) to $q^*W + C_d$. *Q.E.D.*

Let us now study the effect of expanding or contracting the range of types without changing the mean of the distribution of types. To this end, denote by c the mean of the distribution $f(\cdot)$, and assume that p is distributed in the interval $(c - \theta(c - a), c + \theta(b - c))$,¹⁶ with a density function $h(\cdot)$ and a cumulative distribution function $H(\cdot)$ defined by

$$h(x) \equiv \frac{1}{\theta} f\left[c + \frac{x - c}{\theta}\right] \quad (18)$$

and

$$H(x) \equiv F\left[c + \frac{x - c}{\theta}\right]. \quad (19)$$

Using different values for θ gives us a family of distributions all with the same mean, but with different higher moments. For $\theta = 1$, $h(\cdot)$ is equivalent to $f(\cdot)$; for $\theta > 1$, $h(\cdot)$ is an “expanded” version of $f(\cdot)$; and for $\theta < 1$, $h(\cdot)$ is a “contracted” version of $f(\cdot)$.

Proposition 5. An expansion of the range of types: (a) might increase, decrease, or have no effect on the settlement amount; and (b) will decrease the likelihood of settlement.¹⁷

Remark. “Spreading out” the distribution will decrease the likelihood of a settlement because it will increase the differences among types in the expected outcome of a trial.

Proof. The proposition can be proved by differentiating both (10) and (7) (by using the defined h and H instead of f and F) with respect to θ , rearranging terms to get $\partial S^*/\partial \theta$ and $\partial r^*/\partial \theta$, and using the second-order condition.

The proposition can also be verified by using the following observations. Substituting

¹⁶ It is assumed that θ satisfies $0 < c - \theta(c - a) < c + \theta(b - c) < 1$ and $-C_p + [c - \theta(c - a)]W > 0$.

¹⁷ In the numerical example of footnote 9, an expansion of the range of types from (.4, .8) to (.35, .85) would decrease r^* from 90.1% to 85.8%, and slightly reduce S^* from \$13,280 to \$13,160.

h and H (as defined in (18) and (19)) with f and F in (13), and multiplying by θ , the first-order condition becomes

$$\theta \frac{W}{C_p + C_d} = \frac{f\left(c + \frac{q^* - c}{\theta}\right)}{1 - F\left(c + \frac{q^* - c}{\theta}\right)}. \quad (20)$$

The second-order condition (11) (with h and h' replacing f and f') implies that the derivative of the right-hand side of (20) with respect to $c + (q^* - c)/\theta$ is positive. Thus, an increment in θ , which will raise the left-hand side of (20), will increase $c + (q^* - c)/\theta$; hence it will decrease the likelihood of settlement, which is equal to $1 - F[c + (q^* - c)/\theta]$. As to the effect of an increment in θ on q^* and S^* , note that the increase will directly change the value of $c + (q^* - c)/\theta$. In light of this change, it is indeterminate whether the necessary overall increase in the value of $c + (q^* - c)/\theta$ will require an increase, a decrease, or no change in q^* : this will depend on the value of $(q^* - c)$ and on the features of $f(\cdot)$ in the neighborhood of $c + (q^* - c)/\theta$. Consequently, the effect of an increment in θ on q^* and hence on S^* is ambiguous. *Q.E.D.*

4. The effects of legal rules on the likelihood of settlement

■ **Rules governing the allocation of litigation costs.** Thus far it has been assumed that in case of a trial, each party will have to bear his own litigation costs, regardless of the trial's outcome. This legal arrangement will be referred to as the *American rule* since it is the one prevailing in the United States. I shall compare the likelihood of settlement under the American rule with the likelihood of settlement under three alternative arrangements: (1) the *British rule* (prevailing in Britain), whereby the losing party bears all the litigation costs; (2) the *proplaintiff rule*, whereby the plaintiff bears no litigation costs if he wins, and only his own litigation costs if he loses; and (3) the *prodefendant rule*, whereby the defendant bears no litigation costs if he wins, and only his own litigation costs if he loses.¹⁸

The model developed above can be used to examine settlement decisions under these alternative rules. A change from the American rule to one of the alternatives is equivalent to retaining the American rule and redefining the size of the judgment and the magnitudes of the parties' litigation costs. For example, adopting the British rule is equivalent to retaining the American rule and changing the judgment to $W + C_p + C_d$, the plaintiff's litigation costs to $C_p + C_d$, and the defendant's litigation costs to 0. Such changes imply that the plaintiff will suffer a loss of $C_p + C_d$ if he loses and will make a net gain of W if he wins; and that the defendant will suffer a loss of $W + C_p + C_d$ if the plaintiff wins and will bear no cost if the plaintiff loses. These are exactly the results that will obtain if the British rule is adopted.

On the basis of similar reasoning, adopting the proplaintiff rule is equivalent to changing the judgment to $W + C_p$. And adopting the prodefendant rule is equivalent to changing the judgment to $W + C_d$, the plaintiff's litigation costs to $C_p + C_d$, and the defendant's litigation costs to 0.

Proposition 6. (a) The likelihood of settlement is greatest under the American rule and lowest under the British rule. (b) The likelihood of settlement under the proplaintiff rule may be greater or smaller than that under the prodefendant rule as the plaintiff's litigation costs are smaller or greater than the defendant's litigation costs.

¹⁸ For references to instances where these rules are applied, see Shavell (1982, note 2).

Remark. The proof of Proposition 6 is given in Bebchuk (1983) and is omitted here for brevity.¹⁹ The intuition behind the proposition, however, may be briefly described as follows. The greater the amount that depends on the trial's outcome, the greater the difference between any two given defendant types in terms of the expected outcome of litigating against them, and consequently the more severe the adverse selection problem, and the greater the likelihood of litigation. The amount that depends on the trial's outcome is smallest under the American rule, where it is W , and it is largest under the British rule, where it is $W + C_p + C_d$. Under the proplaintiff rule and the prodefendant rule this amount is $W + C_p$ and $W + C_d$, respectively, and whether the former value exceeds the latter one obviously depends on whether C_p exceeds C_d .

Note. The strong conclusions of the preceding analysis should be qualified because it has abstracted from two relevant considerations. First, in the model considered the gains from settlement are equal to the sum of the parties' litigation costs, and they are the same under all of the four rules considered. This results from the assumption that the parties are risk neutral. If one or both of the parties were risk averse, the settlement gains would be enhanced as they would also include the saving of risk-bearing costs. Since replacing the American rule by one of the alternative rules would increase these risk-bearing costs, the change would increase the potential gains from settlement.

Second, my analysis has been limited to cases where the expected value of litigation to the plaintiff is positive (even if the defendant is of the lowest type). In such cases the plaintiff is bound to file a suit, and Proposition 6 concerns the likelihood that such cases will be litigated rather than settled out of court. But there are, of course, cases where the expected value of litigation to the plaintiff is negative for all or some defendant types. Proposition 6 has no bearing on the likelihood that the potential plaintiff in these cases will choose to file a suit (and on the likelihood that such a suit, once brought, will end up in litigation). The British and prodefendant rules might well have a chilling effect on the bringing of such suits.

□ **Other legal rules.** Turn now to the model's implications for the effects that discovery requirements have on the likelihood of settlement. The law often enables a party to a legal dispute to compel the other party to disclose some pertinent facts in his possession. Assume that the plaintiff in our model can compel the defendant to disclose certain information in his possession. Assume further that this is information that the defendant would not voluntarily disclose out of concern that it might hurt him in a trial. (Otherwise the discovery requirement would have no impact.) Thus, the discovery requirement will likely reduce the informational asymmetry between the parties, and consequently contract the range of the distribution of types. We have seen that a contraction of this distribution will raise the likelihood of settlement (Proposition 5). It thus follows that the discovery requirement will likely increase the probability of settlement.

Finally, the model has implications concerning the effects that changes in substantive legal rules will have on the likelihood of settlement. The model suggests that to assess the impact of a change in substantive law on the likelihood of settlement it is necessary to

¹⁹ The proof utilizes the above observation that the model can be applied to each of the alternative rules if the sizes of the judgment and the parties' litigation costs are appropriately redefined. The proof's first step is to make the appropriate adjustments in (6) so as to get—for each of the alternative rules—the marginal benefit to the plaintiff from an increment in his settlement demand. Comparing these expressions enables us to show that the plaintiff's optimal borderline type is highest under the British rule and lowest under the American rule; and that it is higher under the proplaintiff rule than under the prodefendant rule if and only if the plaintiff's litigation costs exceed the defendant's litigation costs. From this the claims of the proposition follow.

consider the effect that the change would have on the existence and magnitude of informational asymmetries. Consider, for example, a shift in a certain tort from a rule of strict liability to a rule of negligence; and assume that the only difference between the two rules is that the latter rule requires the plaintiff to prove an additional element—the defendant's negligence. Adopting the negligence rule would thus make the outcome of the trial depend on an additional element concerning which the defendant is likely to have some private information; hence, adopting the negligence rule might well increase the informational asymmetry between the parties, and consequently reduce the likelihood of settlement.

5. Concluding remarks

■ The main concern of this article has been the effects of an informational asymmetry on the likelihood of settlement and on the settlement amount. We have shown how the presence of such an asymmetry might influence parties' litigation and settlement decisions, and how it might lead to a failure to settle. Furthermore, legal rules and institutions that magnify the extent to which an informational asymmetry is present might well increase the likelihood of litigation.

In the course of the analysis, we have assumed that the defendant is the party who possesses private information. The model can be adapted, however, to apply to the case where the plaintiff is the one who has the private information—that is, the case in which the plaintiff knows p and the defendant only knows the distribution $f(\cdot)$ from which p is drawn. For this purpose it would be necessary to make one important change in the model's assumptions: the defendant should now be assumed to be the one who offers a settlement amount on a take-it-or-leave-it basis. The analysis can then proceed in a way similar to that of Sections 2–4, and the model's results would be essentially the same.²⁰ Thus, the model can apply to cases where either the defendant or the plaintiff has superior information.

An important issue of interest that the model leaves unexamined is information transmission. The assumption that the settlement offer is made by the party that lacks private information is used in the model to rule out the possibility of parties' learning from their adversaries' offers: when an offer is made by a party that has no private information, the offer will never result in the other party's revising his estimate of the trial's outcome. In contrast, if a party with private information makes a settlement offer, the other party might infer from it some information concerning his adversary's type, and the informational asymmetry might be reduced. This possible signalling role of settlement offers is an important issue that should be treated in a complete model of settlement decisions under imperfect information.

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²⁰ Propositions 1–6 will hold with only two changes. First, the first- and second-order conditions, which are part of the statement of Proposition 1, will become, respectively,

$$F(q^*) = (C_p + C_d)/Wf(q^*) \quad \text{and} \quad f(q^*) - (C_p + C_d)/Wf'(q^*) > 0.$$

Second, Proposition 3 parts (b) and (c) will change: the effect of increasing C_p on S^* will become ambiguous, while the effect of increasing C_d on S^* will become unambiguous (the effect will be to increase S^*).

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