LITIGATION OF QUESTIONED SETTLEMENT CLAIMS:
A BAYESIAN NASH-EQUILIBRIUM APPROACH

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I. INTRODUCTION

It is often argued that if some bargain exists that all participants strictly prefer to a specified outcome, then surely that specified outcome will not occur. Coase (1960) makes such an argument in his analysis of bargaining over externalities. Gould (1973) and Shavell (1982) invoke the same line of reasoning in their analyses of pre-trial settlements. And yet there are many occasions when outcomes do occur that are Pareto inefficient—or at least that are revealed to be, ex post. For example peace (labor) negotiations collapse and wars (strikes) ensue which each side subsequently recognizes to be more costly than some settlement would have been. Trading on a futures contract terminates without full offsets and the shorts must incur transport costs to deliver physical goods—and the longs must likewise incur costs to reship these goods to the cash market—when both sides would have been better off with some paper settlement prior to the close of futures trading. As Arrow (1979, p. 25) has pointed out in discussing the Coase theorem, the argument that rational bargainers will always reach some Pareto efficient agreement depends on the implicit—and often unrealistic—assumption that they have complete information. If, instead, information is private, a negotiator may well reject a Pareto-dominant proposal because a rational inference from his limited information leads him to infer that some alternative—which is in fact Pareto-dominated—is the more attractive option. (Agents in our model are rational, not clairvoyant). Situations where it is common knowledge that private information exists are characterized on the one hand by bluffing, deception, and concealment and on the other by discovery, challenging, and attempted inference. In such circumstances, an offer by one side or a response by the other often becomes the basis for a revision of beliefs.

Below we consider a legal conflict in which the adversaries have incomplete information. Specifically, the severity of a prospective plaintiff's injury is unknown to a prospective defendant. We assume that—for each possible severity of injury—there exists an out-of-court settlement which both parties would prefer to trial. But since each prospective plaintiff knows that his adversary has incomplete information about the extent of his injuries, in equilibrium a plaintiff sometimes
finds it in his interest to inflate his claim. Prospective defendants are, of course, painfully aware of their limited information and know that plaintiffs sometimes exploit defendants' ignorance by making inflated claims. As a result, in equilibrium a defendant facing a high demand may well reject it in the rational (albeit possibly incorrect) expectation that the particular plaintiff he is challenging is making an inflated claim. The probability that a case goes to trial and the defendant's expectation of the verdict—given that the case proceeds to trial—are then determined endogenously in our model.

We believe that representing the legal settlement process as a noncooperative game of incomplete information contributes to a better understanding of why cases go to trial. But in our view such theorizing is also of practical importance. Periodically, proposals are made to alter legal procedures (discovery rules, filing fees, and so forth). For any such change, it is desirable to determine the consequences before the "reform" is implemented. But such procedural changes sometimes have important effects on the behavior of the legal adversaries. Without a theoretical model, there is no way to make a sensible prediction about how their behaviors will be affected if the procedural change contemplated has no historical precedent. Models like ours permit predictions of the behavioral responses which would be induced by a proposed change in legal procedures. The predictions are based on the plausible (yet testable) premise that legal adversaries act as if in a self-interested manner.

At the conclusion of Section III, we illustrate this approach by examining—within the context of our stylized model—the predicted consequences of an increase in a lower court filing fee.

Our analysis may usefully be distinguished from independent work in progress by P'ng (1982) and Samuelson (1982). Each considers legal negotiations as games where learning can occur. Each builds upon earlier models which investigate the financial incentives to litigate, such as the models of Landes (1971), Gould (1973), Posner (1977), Landes and Posner (1979), Shavell (1982), and Cooter et al. (1982).

However, in Samuelson (1982) each party to a legal dispute revises his priors about winning in court on the basis of his private research rather than on the basis of the previous moves of his opponent. In P'ng (1982), it is in principle possible for the uninformed player to make an
inference about the private information of the informed player by observing his prior moves. But because P'ng has so far arbitrarily restricted the strategies of the informed player to pure strategies, the informed player's moves in equilibrium never provide information to the uninformed player.

In contrast, honesty and deception, inference and misinference lie at the center of our model. More importantly the aim of our research is different since our goal is to develop a methodology which can be understood and utilized by those concerned with determining in advance the consequences of changes in the legal environment.

In what follows, a game in extensive form will be described in which the following moves occur. The first move is by chance in which the prospective plaintiff is injured by the prospective defendant to some degree of severity. The second move is by the plaintiff, who knows the extent of his injury at the first move. The plaintiff must select a settlement demand. The third move is by the defendant, who knows the demand selected in the previous move by the plaintiff but not what happened by chance in the first move. The defendant must decide whether to accept the settlement demand or go to trial.
II. NONCOOPERATIVE EQUILIBRIUM OF THE SETTLEMENT GAME

PAYOFFS FROM ALTERNATIVE STRATEGIES

For ease of exposition, we consider the simplest form of the game—
with two types of injuries and two types of demands. For this case, the
extensive-form game tree is represented in Figure 1 [for the reader’s
convenience, all notation is defined in the glossary at the end of the
paper]. A slightly-injured \( (s_1) \) plaintiff who makes a low demand \( (d_1) \)
receives A if it is accepted and B if it is rejected and a trial results.
In these circumstances, the defendant would receive respectively,
the payoffs \( \hat{A} \) and \( \hat{B} \). The slightly-injured \( (s_1) \) plaintiff who makes an
inflated settlement demand \( (d_2) \) receives C if it is accepted and B
again if it results in trial. The defendant would receive respectively,
the payoffs \( \hat{C} \) and \( \hat{B} \) in these situations. It should be noted that the
payoff to each side when a slightly-injured plaintiff goes to court is
assumed to be unaffected by the demands he made prior to trial. On the
other hand, let us suppose that plaintiff was severely injured \( (s_2) \). To
simplify matters, we assume that a rational plaintiff will never demand
less than the amount corresponding to his true injuries. Therefore, the
severely-injured \( (s_2) \) plaintiff will always make a high demand \( (d_2) \). That
is, \( \pi_{22} = 1 \). If the defendant accepts, the plaintiff’s payoff is D. It
should be noted in this case that the defendant’s payoff is the same
amount \( (\hat{C}) \) regardless of whether the high settlement demand he accepts
was made by a slightly-injured or seriously-injured prospective plaintiff.
But if the defendant decides to take a plaintiff making a high demand to
court and he turns out to be severely injured, the plaintiff’s payoff
would be \( \hat{E} \), while the defendant’s payoff would be \( \hat{B} \).

We assume that—to avoid litigation costs—a plaintiff would always
prefer to have a truthful demand settled out of court \( (A>B) \), \( D>E \) and
the defendant would likewise always prefer to settle out of court if
the plaintiff was not bluffing \( (\hat{A} > \hat{B} \) and \( \hat{C} > \hat{E} \)). However, provided he goes
unchallenged, a slightly-injured plaintiff \( (s_1) \) gets a higher payoff
from pretending to be a seriously-injured \( (s_2) \) plaintiff \( (C>A) \) than from
making a truthful claim. Finally—provided the high demand he challenges
is in fact an inflated claim, the defendant would prefer trial to settle-
ment \( (\hat{B} > \hat{C}) \).
Our goal is to determine how this game would be played. We assume the strategies selected by each player form a Nash equilibrium. Moreover, we assume the defendant draws Bayesian inferences about the severity of the plaintiff's injury—and hence his own prospects in court—from observation of the settlement demand [Harsanyi, 1967].

An equilibrium is characterized by three probabilities: \( \pi_{12}, \alpha_1, \) and \( \alpha_2. \) \( \pi_{12} \) is the probability that a slightly-injured plaintiff makes an inflated claim, while \( \alpha_1 \) is the probability the defendant accepts a demand of \( d_1. \) Since it is always in a defendant's interest to accept a low settlement demand (\( \hat{A} \geq \hat{B} \)), \( \alpha_1 = 1. \) These probabilities can be interpreted either as the odds that a given individual behaves in a particular way or, alternatively, as the fraction of the population which invariably behaves in that way. The latter interpretation is discussed in more detail at the conclusion of the section (p. 8).

To determine the two remaining probabilities which characterize the equilibrium strategies \( (\alpha_2 \text{ and } \pi_{12}) \) we turn to the decision problem of each player.

**The Plaintiff's Decision Problem**

A plaintiff who is slightly injured chooses whether or not to inflate his claim. His goal is to maximize his expected payoff:

\[
(1 - \pi_{12}) \left( \alpha_1 A + (1 - \alpha_1)B \right) + \pi_{12} \left( \alpha_2 C + (1 - \alpha_2)B \right)
\]

subject to \( 0 \leq \pi_{12} \leq 1. \)

Since \( \alpha_1 = 1, \) the plaintiff's maximization problem reduces to:

Maximize \( \pi_{12} \left( \alpha_2 C + (1 - \alpha_2)B - A \right) + A \)

\{\pi_{12}\}

subject to \( 0 \leq \pi_{12} \leq 1. \)

By the Kuhn-Tucker theorem, if \( \pi_{12} \) is optimal then either

1. \( \pi_{12} = 0 \) and \( \alpha_2 C + (1 - \alpha_2)B - A < 0, \)

or 2. \( \pi_{12} = 1 \) and \( \alpha_2 C + (1 - \alpha_2)B - A > 0, \)

or 3. \( \pi_{12} \in [0,1] \) and \( \alpha_2 C + (1 - \alpha_2)B - A = 0. \)

That is, whether a slightly-injured (\( s_1 \)) plaintiff is always truthful \( (\pi_{12} = 0), \) always bluffs \( (\pi_{12} = 1) \) or is indifferent between these
strategies depends on whether the payoff from telling the truth (A) exceeds the expected payoff from bluffing \((\alpha^*_2 C + (1 - \alpha^*_2)B)\).

Define \(\alpha^*_2\) as that probability of acceptance by the defendant of a high claim that will leave a slightly-injured plaintiff indifferent between making a truthful or an inflated claim. That is,

\[
\alpha^*_2 C + (1 - \alpha^*_2)B = A
\]

or, equivalently,

\[
\alpha^*_2 = \frac{A - B}{C - B}.
\]

Since \(C > A > B\), \(0 < \alpha^*_2 < 1\).

Then a slightly-injured plaintiff would always bluff if the defendant accepts a high demand with probability greater than \(\alpha^*_2\). If the defendant accepts a high demand with probability less than \(\alpha^*_2\), a slightly-injured plaintiff would always tell the truth and make a low demand. If \(\alpha^*_2 = \alpha^*_2\) both strategies—or, for that matter, mixtures of them—result in an equal payoff. In Figure 2, we represent a slightly-injured plaintiff's best response \((\pi_{12})\) to any given probability \(\alpha^*_2\) that the defendant will accept a high demand.

To illustrate how to interpret this graph, two instances can be described more explicitly.

(a) If \(\alpha^*_2 = 0\), then \(\pi_{12} = 0\). The intuition behind this result is as follows: if the defendant never accepts a high demand, then the rational \(s_1\) plaintiff should never make one; otherwise, he would be taken to court and his payoff would be less than it would be if he had made a lower \((d_1)\) demand.

(b) If \(\alpha^*_2 = 1\), then \(\pi_{12} = 1\). The intuition behind this result is as follows: if a defendant always accepts a high demand when he sees it, then the rational \(s_1\) plaintiff should make one since he knows he can always get away with it.

Finally, we note that the reaction function of the plaintiff does not shift when the exogenous prior probability of a slight injury \((p_{11})\) is altered. We shall make use of this result in Section III when we
discuss comparative statics.

THE DEFENDANT'S DECISION PROBLEM

The defendant is looking at the situation from a different perspective. If he is confronted by a high demand, the defendant must decide whether to accept or to reject it. His goal is to maximize his expected payoff:

\[ a_2 \left( \Pr(s_1|d_2) \hat{C} + \Pr(s_2|d_2) \hat{C} \right) + (1 - a_2) \left( \Pr(s_1|d_2) \hat{B} + \Pr(s_2|d_2) \hat{E} \right) \]

subject to \( 0 \leq a_2 \leq 1 \)

Since \( \Pr(s_2|d_2) = 1 - \Pr(s_1|d_2) \), the defendant's maximization problem reduces to:

Maximize \( a_2 \left\{ \left[ \Pr(s_1|d_2) (\hat{E} - \hat{B}) \right] + \hat{C} - \hat{E} \right\} + \left[ \Pr(s_1|d_2) (\hat{B} - \hat{E}) \right] + \hat{E} \)

subject to \( 0 \leq a_2 \leq 1 \).

By the Kuhn-Tucker theorem, if \( a_2 \) is optimal then either

1. \( a_2 = 0 \) and \( \Pr(s_1|d_2) (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) < 0 \),

or 2. \( a_2 = 1 \) and \( \Pr(s_1|d_2) (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) > 0 \),

or 3. \( a_2 \in [0, 1] \) and \( \Pr(s_1|d_2) (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) = 0 \).

That is, whether a defendant facing a high demand always accepts it \((a_2 = 1)\), contests it \((a_2 = 0)\), or is indifferent between these strategies depends on whether the expected payoff from taking a bluffing plaintiff to trial \[ \Pr(s_1|d_2) (\hat{B} - \hat{E}) \] + \( \hat{E} \) exceeds the certain payoff from making a high settlement \( \hat{C} \).

Good Bayesian that he is, the defendant uses his observation of the plaintiff's settlement demand to revise his beliefs about the severity of the plaintiff's injury:

\[ \Pr(s_1|d_2) = \frac{\pi_{12} \cdot P_1}{\pi_{12} P_1 + \pi_{22} P_2} = \frac{\pi_{12} \cdot P_1}{\pi_{12} P_1 + 1 - P_1} \]
Substituting for $P(a_1|d_2)$, we can re-express the conditions necessary for the defendant's choice to be optimal. If $a_2$ is optimal, then either:

$$(1') \quad a_2 = 0 \text{ and } \frac{n_{12} p_1}{n_{12} p_1 + 1 - p_1} (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) < 0,$$

or $$(2') \quad a_2 = 1 \text{ and } \frac{n_{12} p_1}{n_{12} p_1 + 1 - p_1} (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) > 0,$$

or $$(3') \quad a_2 \in [0, 1] \text{ and } \frac{n_{12} p_1}{n_{12} p_1 + 1 - p_1} (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) = 0.$$

For the defendant to be indifferent between accepting and challenging the settlement demand,

$$\frac{n_{12} p_1}{n_{12} p_1 + 1 - p_1} (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) = 0,$$

or

$$n_{12} = \left(\frac{1 - p_1}{p_1}\right) \left(\frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}}\right).$$

Define the right-hand side as $\pi_{12}^*$. Since $\hat{B} > \hat{C} > \hat{E}$, $\pi_{12}^* \geq 0$. But it may exceed unity. If so, then clearly $n_{12} \leq 1 < \pi_{12}^*$. Hence,

$$\frac{n_{12} p_1}{n_{12} p_1 + 1 - p_1} (\hat{E} - \hat{B}) + (\hat{C} - \hat{E}) > 0.$$ 

In this case, the defendant would never challenge a high demand ($a_2 = 1$).

Figure 3 illustrates the reaction function of the defendant when $\pi_{12}^* < 1$. If $\pi_{12} > \pi_{12}^*$, then $a_2 = 0$. That is, if slightly-injured plaintiffs inflate their claims more frequently than $\pi_{12}^*$, the defendant would be better off refusing the plaintiff's demand and going to trial. Conversely, if $\pi_{12} < \pi_{12}^*$, the defendant should settle high demands and avoid going to trial. But when $\pi_{12} = \pi_{12}^*$, then both strategies--or mixtures of them--result in the same payoff.

Finally, in preparation for the comparative statics analysis of Section III, we consider how the reaction function of the defendant shifts when the exogenous prior probability of a slight injury ($p_1$) is altered. Define $q^*$ as that value of $p_1$ such that $\pi_{12}^* = 1$. 


Since \( \pi_{12}^* = \left(\frac{1 - p_1}{p_1}\right) \left(\frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}}\right) \), \( q^* = \frac{\hat{C} - \hat{E}}{\hat{B} - \hat{E}} \).

(note: since \( \hat{B} > \hat{C} > \hat{E} \), \( q^* \in (0, 1) \)).

Figure 4 illustrates the appearance of the defendant's reaction function for \( p_1 \) in each of the following regions:

(a) \( p_1 = 1 \).

If \( p_1 = 1 \), \( \pi_{12} = 0 \) and \( \Pr(s_1 | d_2) = 1 \) for all \( \pi_{12} \) (including \( \pi_{12} = 0 \)). This follows since

\[
\Pr(s_1 | d_2) = \frac{\pi_{12} p_1}{\pi_{12} p_1 + 1 - p_1} = \frac{\pi_{12}}{\pi_{12}} = 1.
\]

Therefore

\[
\Pr(s_1 | d_2) = \left(\hat{E} - \hat{B}\right) + \hat{C} - \hat{E} = \hat{C} - \hat{B} \text{ for } \pi_{12} \in [0, 1].
\]

Since \( \hat{C} - \hat{B} \) is negative, the defendant must set \( a_2 = 0 \) for all \( \pi_{12} \in [0, 1] \). That is, he will challenge every high demand. We sketch the defendant's reaction function for \( p_1 = 1 \) in Figure 4a.

(b) \( q^* < p_1 < 1 \).

If \( p_1 \in (q^*, 1) \), then \( \pi_{12} \in (0, 1) \). We sketch the defendant's reaction function in Figure 4b. As \( p_1 \) increases within this region, the vertical segment (with intercept \( \pi_{12}^* \)) shifts to the right.

(c) \( p_1 = q^* \).

If \( p_1 = q^* \), \( \pi_{12}^* = 1 \). We sketch the defendant's reaction function in Figure 4c.

(d) \( 0 \leq p_1 < q^* \).

If \( p_1 \in [0, q^*) \), \( \pi_{12}^* > 1 \). We sketch the defendant's reaction function for any \( p_1 \) in this region in Figure 4d.
Hence, the defendant's reaction function is horizontal if $p_1 = 1$ or $p_1 = 0$, \( q^* < p_1 < 1 \) shaped if $q^* < p_1 < 1$ and \( q_1 < p_1 \) shaped otherwise.

**BAYESIAN-NASH EQUILIBRIUM**

The intersection of the plaintiff's reaction function with the defendant's reaction function (more precisely, their reaction correspondences) determines the equilibrium values for $\alpha_2$ and $\pi_{12}$. The equilibrium always exists and depends on the exogenous data of the problem—the value of $p_1$ and the payoffs to each player. The payoffs in turn are affected by exogenous legal rules. Changes in such rules will displace the equilibrium and will alter the equilibrium strategies adopted by the adversaries.

Some readers may find troublesome the idea that an individual player randomizes his strategies. Therefore, the following alternative interpretation of the equilibrium may be more appealing. Since players are indifferent about their choices in equilibrium, assume that some fraction of defendants facing high claims invariably challenge them, while the remainder accept them; similarly assume that some fraction of slightly-injured plaintiffs invariably inflate their claims, while the remainder are truthful. Then under this interpretation, the equilibrium value of $\alpha_2$ represents the fraction of defendants faced with high claims who accept them. Similarly, $\pi_{12}$ represents the fraction of slightly-injured plaintiffs who inflate their claims.

An analysis of the stability of equilibrium requires explicit specification of a dynamic adjustment process. We do not attempt such an analysis here but call the reader's attention to one stabilizing characteristic of the equilibrium. If more (less) than the equilibrium fraction of plaintiffs inflate their claims, forces arise which reduce (increase) this fraction. Specifically, a larger (smaller) fraction of defendants will be motivated by self-interest to challenge such claims. Similarly, if more (less) than the equilibrium fraction of defendants facing high claims accept them, forces arise which will reduce (increase) this fraction. Specifically, a larger (smaller) fraction of plaintiffs would find inflating their claims to be in their self-interest.
III. COMPARATIVE STATICS

VARIATIONS IN $p_1$

Recall that the plaintiff's reaction function does not shift when $p_1$ changes, while the defendant's reaction function does depend on $p_1$. Hence, as $p_1$ changes, the defendant's reaction function shifts against the fixed reaction function of the plaintiff and the intersection point changes.

The different equilibrium values for $a_2$ and $\pi_{12}$ corresponding to $p_1$ in each of the four regions defined above are shown in Figure 5. Note that in redrawing the plaintiff's fixed reaction function, we have reversed the axes used in Figure 2. The intersection of the plaintiff's and defendant's reaction functions determines the equilibrium values of $a_2$ and $\pi_{12}$. In all cases except panel c, each intersection is a single point, so the equilibrium values of $a_2$ and $\pi_{12}$ are unique. In panel c, where $p_1 = q^*$, the intersection is an interval. In this case, $\pi_{12} = 1$ in conjunction with any value of $a_2 \epsilon [a_2^*, 1]$ form a Nash equilibrium.

The equilibrium values of $a_2$ which are associated with different values of $p_1$ are sketched in Figure 6. Figure 7 summarizes the corresponding equilibrium values of $\pi_{12}$ associated with different values of $p_1$. It should be noted that $a_2$ is discontinuous at $p_1 = 1$. To show that $\pi_{12}$ is decreasing and convex for $q^* < p \leq 1$, note that in this region $\pi_{12} = \pi_{12}^*$.

$$\pi_{12}^* = \left(1 - \frac{p_1}{\hat{p}}\right) \left(\hat{C} - \hat{E}\right)$$

$$\pi_{12} = \frac{1}{p_1} \left(\frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}} - \left(\frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}}\right)\right).$$

This is simply the equation of a rectangular hyperbola which has been shifted vertically downward.

Next, we consider how the likelihood of a trial depends on $p_1$. The general equation representing the likelihood that a case will go to trial is

$$L = p_1 (1 - a_1) \pi_{11} + p_1 (1 - a_2) \pi_{12} + p_2 (1 - a_2) \pi_{22}.$$
Since $\alpha_1 = 1$, $\alpha_{22} = 1$ and $p_2 = 1 - p_1$, 

\[ L = p_1 [(\alpha_{12} - 1) (1 - \alpha_2)] + 1 - \alpha_2 = (1 - \alpha_2) [1 + p_1 (\alpha_{12} - 1)]. \]

The value of $L$ corresponding to any given value of $p_1$ is shown in Figure 8.

(a) For $p_1 = 1$, $\alpha_2 = \alpha_{12} = 0$. Hence, 

\[ L = (1 - \alpha_2) \left(1 + p_1 (\alpha_{12} - 1)\right) = 0. \]

(b) For $q^* < p_1 < 1$, 

\[ \alpha_2 = \alpha_{2}^* = \frac{A - B}{C - B} \quad \text{and} \quad \alpha_{12} = \frac{1 - p_1}{p_1} \left(\frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}}\right). \]

Hence, 

\[ L = \left(1 - \frac{A - B}{C - B}\right) (1 + (1 - p_1) \left(\frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}}\right) - p_1) \]

or equivalently 

\[ L = \left(1 - \frac{C - A}{C - B}\right) \left(\frac{\hat{B} - \hat{E}}{\hat{B} - \hat{C}}\right) (1 - p_1). \]

Therefore $L$ is a decreasing linear function of $p_1$ in this interval.

(c) For $p_1 = q^*$, $\alpha_{12} = 1$ and $\alpha_2 \in [\alpha_{2}^*, 1]$.

Hence, 

\[ L = (1 - \alpha_2) (1 + q^* - 0) = (1 - \alpha_2) \in [0, 1 - \alpha_{2}^*]. \]

(d) For $0 \leq p_1 < q^*$, $\alpha_2 = 1$ and $\alpha_{12} = 1$. Hence, $L = 0$.

Note that in the extreme cases often assumed—where there is no uncertainty about the condition of the prospective defendant ($p_1 = 1$ or $p_1 = 0$)—the probability of going to trial is zero.

Further insight into the defendant's behavior in equilibrium can be gained by studying the payoff he expects (EV) if he refuses to settle a high demand:

\[
EV = \Pr(s_1|d_2) \cdot \hat{B} + (1 - \Pr(s_1|d_2)) \hat{E} \\
= \Pr(s_1|d_2) \cdot (\hat{B} - \hat{E}) + \hat{E}.
\]
Since the defendant is a Bayesian,

\[
\Pr(s_1|d_2) = \frac{\pi_{12} P_1}{\pi_{12} P_1 + (1 - P_1)}. 
\]

Therefore

\[
EV = \frac{\pi_{12} P_1 (\hat{B} - \hat{E})}{\pi_{12} P_1 + (1 - P_1)} + \hat{E}. 
\]

To plot EV as a function of \( P_1 \), we must take account of how \( P_1 \) affects \( \pi_{12} \).

(a) For \( P_1 = 0 \), it was already shown that \( \pi_{12} = 0 \) and \( \Pr(s_1|d_2) = 1 \).

Therefore \( EV = \hat{B} - \hat{E} + \hat{E} = \hat{B} \).

(b) For \( 1 > P_1 > P_0 \),

\[
\pi_{12} = \left( \frac{\hat{C} - \hat{E}}{\hat{B} - \hat{C}} \right) \left( \frac{1 - P_1}{P_1} \right). 
\]

Therefore

\[
EV = \frac{P_1 (\hat{B} - \hat{E})}{P_1 + (1 - P_1)} + \hat{E} = \frac{\hat{B} - \hat{E}}{\hat{B} - \hat{E}} (\hat{C} - \hat{E}) + \hat{E} = \hat{C}; 
\]

(c) For \( P_1 = P_0 \),

\[
EV = \hat{E} + P_0 (\hat{B} - \hat{E}) \text{ where } P_0 = \frac{\hat{C}}{\hat{B} - \hat{E}}. 
\]

Therefore \( EV = \hat{C} \).

(d) For \( 0 < P_1 < P_0 \), it has been shown that \( \pi_{12} = 1 \).

Therefore

\[
EV = \frac{P_1 (\hat{B} - \hat{E})}{P_1 + (1 - P_1)} + \hat{E} = \hat{E}(1 - P_1) + P_1 \hat{B} = \hat{E} + (\hat{B} - \hat{E})P_1. 
\]

For \( P_1 \) in this region, EV linearly increases at slope \( B - \hat{E} > 0 \), from a value of \( \hat{E} \) (when \( P_1 = 0 \)).

These relationships are summarized in Figure 9. For \( P_1 < P_0 \), the prospective defendant is better off settling a high demand. For \( 1 > P_1 > P_0 \), he is no better off settling than he is going to court. The reason why the defendant's expected payoff from challenging a high demand remains constant as \( P_1 \) increases (for \( 1 > P_1 > P_0 \)) is as follows:
as slightly-injured plaintiffs come to predominate, they are forced in equilibrium to reduce the frequency with which they make inflated claims. As a result, the probability that a prospective plaintiff is slightly injured given that his demand is high does not change as \( p_1 \) increases. Finally, for \( p_1 = 1 \), the prospective defendant is better off challenging any high demand.

**EFFECTS OF CHANGING LEGAL RULES**

To predict the consequences of a change in legal rules, we need to be able to forecast how legal adversaries will adapt to the new environment in which they find themselves. The difficulty of this task should not be underestimated. But failure to accomplish it will result in unrealistic expectations about the consequences of legal reforms. Brazil [1978] for example, contrasts what was expected from the discovery rules first introduced in 1938 in the Federal Rules of Civil Procedure to their actual effects. He argues that designers of the rules failed to take account of how lawyers would adapt their adversarial tactics to take advantage of ["abuse"] the new rules.

The model described above can be used to forecast the consequences of changes in legal rules and court policies. The predicted changes in behavior rules are based on the plausible assumption that the players will adapt their strategies in whatever way best serves their self-interest in the new environment. To illustrate how the policy analysis can be conducted, consider the following scenario. Suppose that in a state court system, cases where the plaintiff demands less than some minimal amount (such as $5000.00) must be filed in a lower court, (i.e., a court of limited jurisdiction), while a plaintiff demanding $5000.00 or more must file his case in a higher court (i.e., a court of general jurisdiction). Furthermore, let us assume that a low \( (d_1) \) demand is below the cutoff, while a high \( (d_2) \) demand is above it. In other words, low demands must be filed in a lower court, while high demands must be filed in a higher court. Next, suppose that the lower court judge increases by \( f \) the fee which must be paid for filing a \( d_1 \) claim. This fee must be paid whether the case is settled out of court or goes to trial.\(^1\) Hence the defendant's payoffs are the same as they were previously. However, the plaintiff now receives \( A - f \) if his low demand is settled out of court and \( B - f \) if it goes to trial,
where $f < A - B$. The plaintiff is assumed to receive the same payoffs as before in all other situations. It is a simple matter to determine how legal adversaries would adapt their behavior given this exogenous change in the rules. We need only review our previous analysis. Reviewing the formulas for $\pi_{12}^*$ and $q^*$ on p. 7, it is clear that neither of these variables will change since each depends only on the defendant's payoffs which have not changed. On the other hand, $a_2^*(p_1)$, $L(p_1)$, and $a_2(p_1)$ will be affected by the increase in the filing fee in the lower courts.

In the new situation the plaintiff's revised decision problem is to maximize his expected payoff:

$$(1 - \pi_{12}) (\alpha_1 A + (1 - \alpha_1) B) - (1 - \pi_{12}) f + \pi_{12} (\alpha_2 C + (1 - \alpha_2) B)$$

subject to $0 \leq \pi_{12} \leq 1$.

Since $\alpha_1 \equiv 1$, the plaintiff's revised maximization problem reduces to:

Maximize $\pi_{12} (\alpha_2 C + (1 - \alpha_2) B + f - A) + A - f$

subject to $0 \leq \pi_{12} \leq 1$ and $0 < f < (A - B)$.

This problem should be compared to its counterpart on p. 3. Proceeding as before, we conclude that

$$\pi_{12} = 0 \text{ if } \alpha_2 > \alpha_2^*$$

$$\pi_{12} = 1 \text{ if } \alpha_2 < \alpha_2^*$$

and $\pi_{12} \in [0, 1]$ if $\alpha_2 = \alpha_2^*$

where $\alpha_2^* = \frac{A - B - f}{C - B} > 0$.

Hence $\alpha_2^* < \alpha_2^*$. In terms of Figure 5, the horizontal component of the plaintiff's reaction function is lowered, while the defendant's reaction function is unchanged. The shift in the plaintiff's reaction function alters the equilibrium value of $\alpha_2$ but leaves $\pi_{12}$ unchanged. The change in $\alpha_2$ for $p_1$ in the various regions can be determined from Figure 5. The new $a_2^*(p_1)$ function differs from the curve in Figure 6 because the horizontal portion at $a_2^*$ is
shifted down to $a_2^*$. Finally, the $L(p_1)$ function plotted in Figure 8 shifts up because of the increase in the filing fee. The new function continues to equal zero for $p_1 = 0$, $q^*$ and $p_1 = 1$ but reaches up to $1 - a_2^* > 1 - a_2^*$ at

$p_1 = q^*$ and lies above the original $L(p_1)$ for all $p_1$ in $(q^*, 1)$.

In other words, an increase in the filing fee of the lower court would have the following effect. If the odds of having a high claim challenged were not to increase, then every slightly-injured plaintiff previously indifferent as to the court in which to file would inflate his claim and would file in the higher court. This, of course, would not be an equilibrium because defendants would then want to increase their challenges to such claims. In equilibrium, the fraction of high demands which defendants challenge must increase by exactly enough that slightly-injured plaintiffs do not wish to inflate their claims any more than they did previously. As a result, in equilibrium, the increase in the filing fee has no effect whatsoever on the fraction of the cases filed in the lower court or their disposition.

The entire impact of the increase in the filing fee of the lower court is felt in the higher court. If the proportion of injuries which are severe exceeds $q^*$, defendants would continue to settle all cases filed in the high court before trial. But if such injuries are less common, defendants will change their behavior and refuse to settle a larger fraction of the cases filed in the higher court.

Hence, our analysis suggests that when a lower court attempts to rid itself of minor cases by increasing its filing fee, it may cause a higher proportion of cases in the higher court to be contested and taken to trial, thereby causing the higher court to suffer from a greater workload.
CONCLUSION

The present model has been kept simple in order to demonstrate, in the least complicated way, an approach we think useful. The model can be extended to include discovery moves, multiple party suits, and intra-party differences (such as client interests versus lawyer or insurance company interests). Such realistic features have been omitted at this point to simplify analysis and clarify the exposition. If a more elaborate and realistic model based on the same methodology is desired, the solution might require computerized analysis. In that case, the algebraic formulae would be replaced by numerical calculations of the endogenous variables. Such a model might constitute a useful tool for assessing the impacts of various proposed legal reforms.

Even in its simplest form, the approach provides a framework for policy analysis—as illustrated by our example where plaintiff attorneys must choose the jurisdiction in which to file their claims. Such strategic interactions undoubtedly make the impact of policy changes more difficult to predict. Nevertheless, as the present model illustrates, games with incomplete information may provide a means of analyzing how such interactions may vary in response to procedural and other policy changes.

Since reactive changes in legal strategies are not the only reason for incorrect predictions, use of an approach such as the present model will not prevent legal analysts from being misled in the future about the effects of proposed policy changes. Nevertheless, ignoring the effects of changes in procedures on strategic interactions can be a source of faulty analysis. The approach used in the present model is offered as one means of characterizing strategic interactions, so that reactive changes in legal strategies and their effects may be incorporated, along with other variables more commonly found in legal analysis, into future policy evaluations.
GLOSSARY OF NOTATION

1. Exogenous parameters

\[ s_i \]
Severities of injury to prospective plaintiff. More severe injuries are denoted by larger subscripts.

\[ p_i \]
Prior probability belief of defendant that plaintiff has injury \( i \). Plaintiff knows what distribution of \( p_i \) the defendant has in mind.

\[ d_j \]
\( \{d_j\} \) is the exogenous set of pure strategies from which the plaintiff can select his settlement demand. Higher demands are denoted by larger subscripts. The demand \( d_1 \) is the settlement demand a plaintiff with injury \( i \) would make if he knew that his injury were known to the defendant.

\[ A, \hat{A}, B, \hat{B}, C, \hat{C}, D, E, \hat{E} \]
Payoffs (hats go to defendant)

2. Endogenous strategies

\[ \pi_{ij} \geq 0 \]
The probability that a plaintiff makes demand \( d_j \) given he has injury \( i \).

\[ (\sum_j \pi_{ij} = 1 \text{ for all } i) \]

\[ [\pi_{ij} = \Pr(d_j|s_i)] \]

\[ \alpha_i \geq 0 \]
The probability a defendant facing demand \( d_1 \) accepts it.
3. Other endogenous variables

$\alpha_2^*$

Threshold probability of the defendant accepting a high ($d_2$) claim that will leave a slightly-injured ($s_1$) plaintiff indifferent between making a truthful ($d_1$) or an inflated ($d_2$) claim.

$\pi_{12}^*$

Threshold probability of the slightly-injured ($s_1$) plaintiff making an inflated demand which would leave the defendant indifferent between accepting the demand and going to trial.

$q^*$

The value of $p_1$ such that $\pi_{12}^* = 1$.

$L$

Likelihood that a case will go to trial.

$EV$

Expected payoff to defendant if he challenges a high ($d_2$) demand.
Footnotes

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1/ In the text, the effects of a marginal increase in the filing fee of the lower court are assessed under the assumption that the fees of the two courts are initially equal. The same results would also hold, however, if the initial fees were unequal.

2/ This condition is imposed as a matter of realism. If the condition were violated (f > A - B), then the worst a slightly-injured plaintiff could do in the higher court (gain B at trial) would exceed the best he could do in lower court (gain A - f by settling). Under such circumstances, the model's prediction is intuitively obvious: every settlement demand would be filed in higher court. Presumably, the lower court's filing fee would never be set so high.
REFERENCES


Samuelson, W., "Negotiation vs. Litigation," School of Management, Boston University, revised November 1982.

Fig. 1 — The game tree

Plaintiff's Strategy
- Claim $d_2$ whenever injury is severe
- Claim $d_2$ with probability $\pi_{12}$ if injury is slight
- Claim $d_1$ with probability $(1 - \pi_{12})$ if injury is slight

 Defendant's Strategy
- Accept $d_1$ with probability $\alpha_1$
- Accept $d_2$ with probability $\alpha_2$
Fig. 2 — Best response of slightly-injured plaintiff to any given probability that defendant will accept a high demand.

Fig. 3 — Best response of defendant to high demand for any given frequency of bluffing by slightly-injured plaintiff.
Fig. 4 — Best response of defendant for $p_1$ in specified regions
Fig. 5 - Equilibrium strategies (indicated by arrows) for $p_1$ in specified regions:

(a) $p_1 = 1$

(b) $q^* < p_1 < 1$

(c) $p_1 = q^*$

(d) $0 \leq p_1 < q^*$
Fig. 6 — Equilibrium strategy of defendant as function of $p_1$

Fig. 7 — Equilibrium strategy of plaintiff as function of $p_1$
Fig. 8 — The likelihood that a case will go to trial as a function of $p_1$
Fig. 9 — Expected payoff of Bayesian defendant if a high demand is refused and trial ensues.