TRUTH AND THE LEGAL BATTLE*

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Abstract

In lawsuits, relative success depends upon two main factors: (1) the true degree of fault, and (2) the litigation efforts on each side. We make use of a Litigation Success Function (LSF) that displays this dependence while satisfying certain other essential properties. Under two different protocols, Nash-Cournot and (a generalized version of) Stackelberg, solutions are obtained for litigation effort, degree of success achieved, and value of the lawsuit on each side. Outcomes are evaluated in terms of two normative criteria: (i) achieving 'justice' (defined as equality between Defendant fault and relative Plaintiff success) and (ii) minimizing aggregate litigation cost. Achievement of these aims is hampered mainly by high <u>decisiveness</u> of litigation effort, that is, when the LSF attaches heavy weight to the effort factor as opposed to the truth factor.

TRUTH AND THE LEGAL BATTLE[1]

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Trials are battles. In consequence, litigation shares certain family traits with wars, strikes, and other human conflicts -- violent and non-violent. True, not all lawsuits proceed to trial, just as not all international disputes culminate in war. But the potential 'decision at arms' casts its shadow over any settlement negotiations the parties might undertake.[2]

Law and economics scholars have concentrated attention mainly upon the reasons for lawsuits, the likelihood of settlement, and the implications of alternative cost-shifting systems ("English rule" versus "American rule") and attorney payment structures (hourly rates versus contingent fees). Only quite recently have a few studies appeared that have analyzed the legal battle itself. In the small existing literature, the present paper is most closely related to Braeutigam et al [1984], Katz [1988], Hause [1989], and especially Kobayashi and Lott [1996] (hereafter sometimes K&L).[3]

We will be generating a model of litigation-as-conflict, involving optimization on the part of each litigant (how much effort to devote to the contest) and the consequent equilibrium outcome in terms of success achieved and costs incurred. Although the analysis has implications for already well-researched topics such as the likelihood of settlement and the influence of alternative fee structures, we will be concentrating upon other equally important issues that have not received so much attention. Among these are:

(1) Does the litigant with the more meritorious case tend to "fight harder", that is, to invest more in litigation effort?

(2) Taking the two litigants together, does aggregate effort tend to be greatest when Defendant fault is high, low, or middling?

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2 "The decision by arms is for all operations in war, great and small, what cash settlement is in trade." -- Clausewitz, quoted in Rothfels [1941]. "Pretrial bargaining may be described as a game played in the shadow of the law." -- Cooter, Marks, and Mnookin [1982].

3 Unlike our own and the other studies cited, the K&L analysis runs in terms of criminal rather than civil litigation, but this difference is inessential for our purposes.

(3) Under what circumstances does it pay Defendant to concede, or Plaintiff not to bring suit?

(4) What characteristics of litigation systems may make for a pro-Plaintiff bias or the reverse?

(5) As a normative matter, what criteria should be used to evaluate litigation systems?

I. FUNDAMENTALS AND APPROACH

The first issue is: why litigate at all? Going to court is always Pareto-dominated by a range of potential settlements. Furthermore, although negotiated settlements might not be enforceable in international power struggles and other conflictual contexts, when it comes to lawsuits effective procedures exist for implementing any agreements arrived at.

There are several possible explanations. (1) In the literature, failure to settle has most frequently been attributed to the adversaries having differing beliefs as to the outcome of trial. And specifically, litigation becomes more likely when each side is relatively optimistic about its prospects for success in court. Our analysis rules out this factor. We assume Plaintiff (P) and Defendant (D) have common knowledge of the underlying functions and parameters (for example, of the actual level of fault, the stakes at issue, and the cost functions on each side) and of the structural relationships set forth in the model itself. (2) Failure to settle might also be due to attitudes toward risk. While normal risk-aversion makes settlement more likely, conceivably one or the other contender might actually be characterized by risk-preference.[4] We rule out this element as well, postulating that both sides are risk-neutral.[5] (3) Scarcely ever considered in the literature, but arguably an important force, is sheer hostility or malevolence. A contender might be willing to sacrifice wealth in order to impoverish or distress the opponent. We rule out this possible explanation as well. In accordance with the existing literature, each contender is assumed to aim simply at maximizing own-income.

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[4] The roles of optimism and attitudes toward risk were explored in the early analytic works of Landes [1971] and Gould (1973), followed by many other authors.

[5] We also exclude the possibility that one or both contenders might value fighting for its own sake, as a kind of consumption good.

So why ever go to trial? Without attempting a full answer, we simply call upon the common observation that negotiation failures ("bargaining impasses") often occur, even where differences in beliefs or attitudes toward risk do not appear to be involved.[6] (The difficulty is sometimes attributed to "costs of negotiation", though that is little more than a verbal re-statement of the problem.) Furthermore, even if settlement were ultimately certain, our model could reflect the hypothetical calculations of the contending parties as each attempts to estimate its minimum terms for agreement.

A second issue is: who are the decision-makers? As a litigant and his/her attorney never have perfectly harmonious interests, a general model of litigation struggles would have to deal with at least four parties: the principals and attorneys on each side. We bypass these agency questions so as to deal solely with the decisions of two litigants who employ attorneys together with other inputs into the legal battle.[7] Thus there is a single choice variable on each side, the litigation efforts L_P for Plaintiff and L_D for Defendant.

A third modelling issue, one that has not received its due in the literature, involves the protocol of interaction and associated solution concept. No single paradigm can ever capture the full complexity of filings, discovery proceedings, offers, threats and so forth that characterize a lawsuit. For our purposes three relatively simple solution concepts suggest themselves: (i) Nash-Cournot, (ii) Stackelberg, and (iii) Threat-and-promise.

(i) Nash-Cournot:[8] The protocol underlying the familiar Nash-Cournot solution is symmetrical. Plaintiff and Defendant choose L_P and L_D respectively, in ignorance of the opponent's simultaneous choice. The condition of equilibrium is that each side's selection must be a best response to the opponent's decision, implying that neither has any motive to change.

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[6] Whether rational agents 'should' always be able to extricate themselves from bargaining impasses remains a subject of debate among game theorists. See, e.g., Aumann [1976] and Binmore [1992], pp. 208-209. And of course, real-life humans are not always fully rational.

[7] An attorney engaged on a contingent-fee basis has in effect become a partner of the litigant. This tends to reduce incentive divergences between them, but we are assuming away conflicts of interest to begin with. (Our analysis also disregards possible informational discrepancies between principals and their attorneys.)

[8] The Nash-Cournot solution corresponds to what is often termed the Nash non-cooperative solution. We say "Nash-Cournot" to avoid possible confusion with the Nash cooperative solution, which is quite different.

(ii) Stackelberg: One side (the "leader") commits to a level of effort, to which the other then makes an optimizing response. In the lawsuit process, the time-sequence of events makes it more plausible for Plaintiff to be the leader.

(iii) Threat-and-promise: Here, while Plaintiff is still the first to choose a level of litigation effort, before he can do so Defendant is permitted to make a prior commitment aimed at influencing that decision. More specifically, Defendant commits not to a specified level of litigation effort but to a reaction function. In effect Defendant says: "If your opening move is as I desire, I will reward you (promise), but if not I will punish you (threat).[9]

We would not contend that any one of these three elementary protocols is the "correct" way to represent litigation. Social interactions, whether cooperative or conflictual, are almost always too complex to be captured by any simple model. Most of the related analyses in the literature have employed the symmetrical Nash-Cournot protocol and solution concept.[10] That might be satisfactory in many contexts.[11] However, one obvious asymmetry exists: there is no lawsuit unless Plaintiff brings it.[12]

The Stackelberg and Threat-and-promise protocols make use of this asymmetry in the different ways described above. Although covering the Nash-Cournot solution for purposes of comparison, our central analysis runs mainly in terms of a (slightly generalized) Stackelberg protocol.

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[9] Threat-and-promise protocols are examined in Hirshleifer [1988], building in part upon Schelling [1960] and Thompson and Faith [1981].

[10] Kobayoshi and Lott [1986], while modelling the (criminal) trial itself as a Nash-Cournot game, allow for a prior "plea bargaining" phase in which the prosecution makes the first move.

[11] As has often been pointed out, the Nash-Cournot solution concept is rather paradoxical. An equilibrium is said to exist if each side's selection is a best response to the opponent's choice. But the Nash protocol requires simultaneity, which means that neither side knows the opponent's choice to which it is supposed to be replying optimally. Implicit therefore is a kind of unmodelled learning and mutual accommodation process which, over time, may converge to the kind of equilibrium described. (See Binmore [1992], Ch. 9.)

[12] Using the symmetrical Nash-Cournot solution concept, Katz [1988, p. 129] says: "the designation of the parties as plaintiff and defendant is arbitrary." In contrast, for the asymmetrical Stackelberg and Threat-and-promise protocols, the Plaintiff/Defendant distinction is essential.

II. BUILDING-BLOCKS

The cost function:

By assumption, Plaintiff's cost C_P depends only upon his own litigation effort L_P and Defendant's C_D only upon her own litigation effort L_D. To begin with, we make the specific assumption:

$$C_i = \gamma L_i \qquad (i = P,D) \tag{1}$$

Thus fixed costs are ruled out, and marginal cost γ is assumed constant. Furthermore, the same cost function holds for both Plaintiff and Defendant. (Justification: the same lawyers and other inputs to litigation are available for hire by both sides.) Each party is assumed responsible for its own legal costs regardless of the outcome -- the so-called 'American rule'.

The value of the lawsuit:

The value of the lawsuit to each side, which for risk-neutral litigants is the mathematical expectation of gain or loss in the event of trial, is defined as:

$$V_i \equiv \pi J_i - C_i \qquad (i = P,D) \tag{2}$$

J_P and J_D are the respective stakes. We will be assuming that, apart from litigation cost, Plaintiff stands to gain what Defendant loses. Thus J_P is positive, and J_D is numerically equal but negative in sign. (Where convenient we will sometimes simply write J for $J_P \equiv -J_D$.) Plaintiff's proportionate degree of success is symbolized by π -- or, in the interests of explicitness, sometimes by π_P. Similarly, Defendant's proportionate success $1-\pi$ will sometimes be written π_D. Thus:

$$\pi_P + \pi_D \equiv 1 \tag{3}$$

It follows that Defendant's value of the lawsuit V_D is always non-positive; the only question is how much she is going to lose. For Plaintiff V_P might be either positive or negative; if the latter, he will not bring suit at all.

There are two equally valid interpretations of these success measures π_i. (A) $\pi_P \equiv \pi$ could be regarded as a probability, that is, as the likelihood of Plaintiff victory in an all-or-nothing, yes/no situation. On this "entire fault" interpretation, the question at trial is whether Defendant has met some appropriate standard of behavior. If the answer is no, she is fully liable for the entire amount at stake (Plaintiff prevails). If the answer is yes, she is home free (Defendant prevails). (B) Under the "comparative fault" interpretation, the outcome is a proportionate division of the stakes. Here $\pi_P \equiv \pi$ would represent the deterministic fractional share awarded to Plaintiff, in response to Defendant's adjudged degree of fault.

The risk-neutrality assumption makes it unnecessary to choose between these two interpretations. A risk-neutral litigant will be indifferent between a given probability of receiving the entire stake at issue or receiving a corresponding fractional share of the stake as a deterministic magnitude.

Fault:

Defendant fault (Y) is scaled between zero and unity: $0 \leq Y \leq 1$. Thinking in terms of comparative negligence, $Y = 1$ means that Defendant is totally in the wrong; $Y = 0$ means that Plaintiff's case is entirely without merit.

In the literature on the economics of litigation, most commonly it has been assumed that the court will infallibly ascertain the true degree of fault, whereas the litigants do not know in advance what the decision will be.[13] In effect, the litigants do not themselves know the truth, but the court will correctly ascertain it. We assume the reverse: that the true degree of fault Y is known by both litigants but is not known by the court (whose decision is therefore subject to influence by the litigation efforts on the two sides).[14]

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[13] See, e.g., Priest and Klein [1984]. More precisely, Priest and Klein assume the court will correctly determine whether the true fault lies to one or the other side of the relevant "decision standard".

[14] Though it was a criminal rather than civil proceeding, the O.J. Simpson case is an illuminating example. Was it that the defense and prosecution were unaware of where the truth lay, whereas the judge and jury were able to discover it? Or were the litigants quite aware of the true guilt or innocence of the accused, whereas the judge and jury were fallible?

III. THE LITIGATION SUCCESS FUNCTION

The Litigation Success Function (LSF) is the crucial and most novel element of our model. The LSF summarizes the relevant conflict technology.[15] As a kind of analog of the production function in standard economics, 'inputs' in the form of litigation efforts L_P and L_D generate 'outputs' π_P and π_D -- Plaintiff and Defendant success.

We now postulate certain features that a satisfactory Litigation Success Function LSF should display.

(i) The determinants of success should include the litigation efforts L_P and L_D and the degree of Defendant fault Y.

(ii) The LSF should satisfy what has been called the logit property (see Dixit [1987]). That is, the functions determining the parties' respective prospects of success must be such as to satisfy equation (3) above: π_P and π_D must sum to unity.

(iii) Given equal degrees of fault (that is, if $Y = 1\text{-}Y = 0.5$) the outcome at trial should depend only upon the litigation efforts.

(iv) And correspondingly, given equal efforts $(L_P = L_D)$, the outcome should depend only upon the degree of fault.

(v) If Defendant is totally in the wrong (if her fault is $Y = 1$), she should always lose the entire stake -- provided only that Plaintiff makes some effort (i.e., provided he chooses any $L_P > 0$). And similarly a Defendant totally without fault $(Y = 0)$ should always win, provided she makes some effort (chooses $L_D > 0$).

Perhaps the simplest Litigation Success Function meeting all these criteria can be written in the form:

$$\frac{\pi_P}{\pi_D} = \left[\frac{L_P}{L_D}\right]^{\alpha} \frac{Y}{1-Y} \tag{4}$$

[15] The Litigation Success Function is an adaptation of what has been called the Contest Success Function in the literature on the economics of conflict (Hirshleifer [1989], Skaperdas [1996]).

Or, making use of (3) to solve for the respective degrees of success:

$$\pi_P = \frac{L_P^\alpha\, Y}{L_P^\alpha\, Y + L_D^\alpha\,(1-Y)} \quad \text{and} \quad \pi_D = \frac{L_D^\alpha\,(1-Y)}{L_P^\alpha\, Y + L_D^\alpha\,(1-Y)} \tag{5}$$

The LHS of (4) shows the outcome of the legal battle as a success ratio. The RHS is the product of an effort factor L_P/L_D and a fault factor $Y/(1-Y)$, the former being weighted by what we will call a force exponent α. With this LSF, $\pi_P = Y$ -- that is, Plaintiff's proportionate success will exactly reflect Defendant's fault -- whenever either (i): $L_P = L_d$ (the two sides invest equal efforts), or (ii) $\alpha = 0$ (legal efforts are totally ineffective as compared with what might be called "the power of truth" -- the underlying merits of the case).

As for the effort factor, the assumption here is that the respective chances of success are a function of the effort ratio L_P/L_D. This is not the only conceivable formulation, but it seems appropriate for our purposes.[16] And similarly for the fault factor $Y/(1-Y)$ -- the relative advantage of "having the truth on your side".

The force exponent α weights the relative importance of effort versus fault in determining the outcome. Differing judicial systems will be characterized by different values of α. Where judges have broad leeway to instruct juries, as in British courts, the power of advocacy on each side is correspondingly diminished -- α is relatively low. In contrast, α would be comparatively high if, by law or custom, judges limit themselves to procedural issues and refrain from instructing juries on the substantive merits of the case.

It is easy to verify that all the desirable features listed above are satisfied by the Litigation Success Function of equations (4) and (5).

Various generalizations of this LSF are possible.

1. "Effectiveness coefficients" e_P and e_D could be attached to the decision variables L_P and

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[16] The two 'canonical' ways of dealing with the effort factor are as a ratio L_P/L_D or as a difference L_P-L_D (Hirshleifer [1989]). If the difference form were employed, zero effort would not necessarily entail total loss. In warfare, for example, a nation might capitulate without losing absolutely everything. (A victor might choose not to press its advantage to the limit, even against a non-resisting opponent.) But failing to contest a lawsuit generally leads to adverse judgment for the full amount.

L_D in equations (4) and (5), to reflect the possibility that one side or the other is more adept in converting legal effort into a successful judicial outcome.

2. The judicial system might be characterized by a degree of bias, intended or not, in one direction or the other. In American criminal procedure there is a traditional intended bias in favor of Defendants -- whose guilt must be established "beyond a reasonable doubt".[17] Bias could be modelled by introducing a suitable asymmetry into the form of equations (4) and (5).

3. Whereas the force exponent α in equation (5) parametrically weights the effort factor L_P/L_D relative to the fault factor $Y/(1 - Y)$, in principle there should also be a parametrically varying "truth exponent" β attaching to the fault factor as well. Whereas α measures the "decisiveness of effort", β would scale the "decisiveness of truth" in determining the outcome. Not only the relative sizes of α and β matter but their absolute magnitudes as well. If α and β were both very low, the success ratio is going to be close to unity (that is, π will be close to 0.5) regardless of both truth and effort.

Apart from the desire for simplicity, we had a particular reason for fixing the β parameter at unity. Doing so leads to a proportionality property of the LSF. Proportionality, which is somewhat stronger than property (iv) in our list above, dictates that when efforts are equal ($L_P = L_D$), Plaintiff's proportionate success should not merely "depend upon" Defendant's degree of fault but actually equal it numerically ($\pi = Y$). Alternatively, it might have been desired to reward the more successful party, and punish the loser, disproportionately. (Or, this might come about unintentionally.) For example, 70% Defendant fault could, either desirably or de facto, translate into 90% Plaintiff success (which would be disproportionately high) or only into 60% success (which would be disproportionately low). Our justification for the proportionality property is its consistency with a concept of 'justice' to be described below.

Although it would not be difficult to allow for any of the generalizations just described, for expository simplicity the present paper retains throughout the symmetry and proportionality assumptions implicit in the form of equations (4) and (5).

At this point we digress briefly in order to comment on how predecessor papers in the literature have dealt with the need for a Litigation Success Function (LSF). Braeutigam [1984], Katz [1988], Hause [1989], and K&L [1996] also allow for both effort and fault. (The

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[17] A less defensible instance of bias is the tendency of state courts to favor in-state plaintiffs against out-of-state defendants. See Tabarrok and Helland [1999].

terminology varies; e.g., where we speak of fault, some of these authors refer to the "merits" or "strengths" of the respective cases.) The formal analyses of these authors tend to be highly abstract, less keyed to a specific algebraic form of the LSF (except sometimes for purposes of illustration). Our contention is that proper modelling of litigation does call for a more specific form of the LSF, one that would meet the criteria described in the text above (plus, more arguably, the proportionality criterion). K&L, though without any particular justification, do specify a functional form (their equation (A1)) that is closer to ours. Indeed the illustrative algebraic example they employ would be identical with our LSF except for one crucial omission: it lacks the force exponent α that scales the relative importance of the 'effort factor' and the 'fault factor'. (In effect, they fix the exponents attaching to both of these factors at unity.)

These divergences do not in any way put in question the very real merits of any of these papers, all of which go beyond ours in important respects that we do not have space to cover here. But we do want to comment on the central thrust of the important paper by Katz [1988], which adopts a mainly informational approach to the legal battle. On Katz's interpretation, legal efforts take the form of search for supporting "arguments". The side producing a sufficient preponderance of arguments becomes the winner. But, we argue, locating evidence and making valid logical inferences are not the only means of influencing judicial outcomes. Litigants and their attorneys can and do use a wide range of other techniques, not excluding outright bribery and coercion. Our approach leaves open the actual tools employed. In our model, litigation is more akin to warfare than to information-gathering. Having a meritorious case helps, certainly, but only as one element in the picture.

The next section is devoted to an analysis of the ways in which the two factors, truth and effort, interact as inputs into the legal battle.

IV. THE INTERACTION OF EFFORT AND FAULT

Figure 1 is a numerical illustration showing how Plaintiff's success π varies as his litigation effort L_P ranges upward from 0 to 2, Defendant's effort being held fixed at $L_D = .5$. (The stakes are normalized throughout at $J_P = -J_D = 1$.) Figure 1a pictures a relatively low level of Defendant fault ($Y=1/3$), and Figure 1b a relatively high level ($Y=2/3$).

[Figure 1]

As expected, Plaintiff effort L_P always has a positive influence upon his success fraction π, as revealed by the positive slopes of all the curves in Figure 1. Within each panel the different curves show the effects of changing the "force parameter" α. Notice that higher α raises Plaintiff success π in the range $L_P > L_D$ but lowers π when $L_P < L_D$. In other words, α measures sensitivity of the outcome to preponderance of fighting effort. Finally, as would be expected, between the low-fault and high-fault panels there is a general upward shift of the whole set of curves: higher levels of fault always raise Plaintiff's prospect of success.

The same parameters correspondingly affect the marginal products, Plaintiff's $mp_P \equiv d\pi/dL_P$ and Defendant's $mp_D \equiv d(1-\pi)/dL_D \equiv -d\pi/dL_D$. Writing out the latter, standard steps lead to:

$$mp_D = \frac{\alpha\, L_D^{\alpha-1}\, L_P^{\alpha}\, Y\,(1-Y)}{[L_P^{\alpha}\, Y + L_D^{\alpha}\,(1-Y)]^2} \tag{6}$$

In Figure 2, the two panels show how Defendant's marginal product varies as a function of her effort L_D. In Figure 2a fault is fixed at the mid-value $Y = .5$; for sufficiently low decisiveness ($\alpha \leq 1$), diminishing marginal returns govern throughout -- whereas, at higher levels of α, there is an initial range of increasing marginal returns. Figure 2b illustrates the effect of parametrically changing the degree of fault Y, holding decisiveness fixed at $\alpha = 1$. For a relatively "guilty" defendant ($Y = .75$ here), the marginal product of fighting is low to begin with and thereafter declines slowly as her effort increases. In contrast, for a relatively "innocent" defendant ($Y = .25$ here), mp_D is initially extremely high but falls off rapidly. Explanation: for such an "innocent" Defendant, relative success approaches 100% quite rapidly, so there's not much room for raising it further by increased legal effort.

[Figure 2]

V. OPTIMIZATION AND EQUILIBRIUM -- NASH-COURNOT SOLUTION

In the symmetrical Nash-Cournot analysis, each side makes a best response to the opponent's chosen level of litigation effort. Under risk-neutrality, the best responses maximize the expected value of the lawsuit -- V_P and V_D respectively:

$$\begin{aligned} &\text{Plaintiff:} \quad \max_{(L_P|L_D)} V_P \equiv \pi J_P - C_P \\ &\text{Defendant:} \quad \max_{(L_D|L_P)} V_D \equiv \pi J_D - C_D \end{aligned} \tag{7}$$

(Defendant's V_D being negative, in ordinary parlance we would say she is minimizing loss rather than maximizing her gain.)

Setting aside possible corner solutions, each litigant equates the 'value of the marginal product' -- $J_P \times mp_P$ for Plaintiff and $-J_D \times mp_D$ for Defendant -- to marginal cost γ. Omitting the technical details, this first-order condition generates a pair of Reaction Curves RC_P and RC_D for the two contenders.[18] The Nash-Cournot solution occurs at the intersection of the paired RC_i curves.

Owing to the symmetry of the two contenders' situations, it suffices to explore one set of Reaction Curves. Specifically, Figure 3 illustrates Defendant's RC_D, that is, her optimal L_D in response to any given L_P on Plaintiff's part. In Figure 3 notice that L_D at first rises in response to increasing Plaintiff effort L_P but then eventually falls off, owing to diminishing returns and escalating costs. Figure 3a shows the effect of varying marginal cost: at higher γ, Defendant's optimal L_D is always smaller for any given L_P. Figure 3b shows the effect of varying fault Y. When Defendant has a weak case (high Y) her peak L_D occurs at low L_P -- whereas with a strong case (low Y) her peak L_D occurs much later. Explanation: A Defendant with a weak case will put in a big effort only if Plaintiff is not fighting very hard, but with a strong case it pays her to remain in contention even when Plaintiff is putting in a big effort.

[Figure 3]

Making use of equation (6) for Defendant's marginal product mp_D and the corresponding equation for Plaintiff's mp_P, the Nash-Cournot protocol permits an analytic solution for the

[18] Since the mp_i curves are not always monotonic, there may be more than one solution satisfying the first-order condition. So in constructing the Reaction Curves we were careful to choose only the best solution, i.e., an L_i also satisfying the second-order condition for a maximum.

decision variables L_P and L_D. Owing to the various assumed symmetries, in particular identical cost functions and equal stakes ($J_P \equiv -J_D$), the only possible reason for unequal litigation efforts has to do with the level of fault Y. In particular, we may wonder, if Defendant is relatively "guilty" (Y near 1), who will fight harder -- Plaintiff or Defendant? And similarly, what if Defendant is relatively "innocent" (Y is near 0)? (Recall that we are considering interior solutions only.)

The answer is summarized in Proposition 1:

Proposition 1: Under the Nash-Cournot protocol and our other assumptions, the respective litigation efforts L_P and L_D will always be equal regardless of the level of fault Y.[19]

Corollary: $\pi = Y$

As follows immediately from equation (4), Plaintiff's proportionate success (whether as probability of victory in a yes/no contest, or as his awarded fractional share of the stakes) equals Defendant's degree of guilt. This is of course the proportionality property referred to above.

Using L for the common equilibrium value of $L_P = L_D$, correspondingly simple steps lead to Proposition 2:

Proposition 2: In equilibrium:

$$L = \alpha \frac{J}{\gamma} Y(1-Y) \qquad (8)^{20}$$

[19] The very simple proof starts with the first-order conditions:

$$J \times mp_i = \gamma \qquad (i = P,D)$$

Since only interior solutions are relevant here, at equilibrium $mp_P/mp_D = 1$. Defendant's mp_D is given in equation (6), and it is easy to verify that Plaintiff's mp_P is identical except that the exponents of L_P and L_D are interchanged in the numerator. Taking the ratio mp_P/mp_D and cancelling:

$$\frac{mp_P}{mp_D} = \frac{L_D}{L_P}$$

Since both marginal products equal γ/J, it follows that $L_P = L_D$.

[20] In (6), substituting L for L_P and L_D:

$$mp_D = \frac{\alpha\, Y(1-Y)}{L}$$

Then solving $J \times mp_D = \gamma$ leads to the equation in the text.

Thus the litigation efforts rise in proportion to the stakes J, the decisiveness coefficient α, and to $Y(1-Y)$ but are inversely proportional to marginal cost γ.

The dependence of L upon the stakes J and marginal cost γ is straightforward and has been arrived at by previous analysts (though not always in this exact form). But, so far as we know, the roles of the product $Y(1-Y)$ and especially of the force parameter α in determining the levels of legal effort has not previously been noted, at least not explicitly.

As background for our comparison with the Stackelberg protocol to come, we can summarize the answers offered by our Nash-Cournot analysis to the first two of the questions posed in our introductory discussion:

(1) Does the litigant with the more meritorious case fight harder?

Answer: No. Given that Plaintiff and Defendant have equal stakes and identical cost functions, then their litigation efforts $L_P = L_D$ are always equal regardless of the level of fault Y.

(2) At what level of fault is aggregate effort greatest?

Answer: The sum $L_P + L_D$ is maximized at middling levels of fault, specifically when $Y = 0.5$.

However, recall that we have explored only interior solutions, excluding corner outcomes (in which the optimal L_P and/or L_D is zero). One of the main possible sources of corner solutions, fixed costs, has been ruled out for this Nash-Cournot analysis, and we will do the same for the Stackelberg analysis to come. But even setting aside fixed costs, under certain conditions -- e.g., if marginal product is rising over an initial range as occurs for values of the decisiveness parameter $\alpha > 1$ -- it might be more advantageous for a contestant to concede (set litigation effort at zero) rather than equate value of the marginal product to marginal cost. In the interests of brevity,[21] and since our analysis of the Nash-Cournot protocol is mainly to provide background for the more novel Stackelberg analysis, we have excluded these other possible sources of corner solutions as

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[21] There are some technical difficulties associated with corner solutions due to an initial range of rising marginal product. If one side were to choose $L_i = 0$, then the other contender can win the entire prize by setting L_j equal to some tiny epsilon. This consideration indicates that the Nash equilibrium will involve mixed strategies on both sides.

well.[22] (But when we take up the Stackelberg protocol in the sections to come, possible corner solutions will play an important role.)

VI. OPTIMIZATION AND EQUILIBRIUM -- STACKELBERG SOLUTION

In the Stackelberg protocol and solution concept, Plaintiff as first-mover commits to a level of litigation effort L_P to which Defendant responds with L_D. As just indicated, we are going to allow for possible non-interior solutions, in which Plaintiff as leader commits to so high a level of L_P as to force Defendant to concede (to choose $L_D = 0$). Since analytic solutions are not generally obtainable, we will mainly be using numerical simulations to portray the results achieved.

In the interests of realism, one significant extension will be taken into account. On the standard Stackelberg assumption, the first-mover's commitment is totally irrevocable. But in an actual lawsuit, if Defendant concedes the Plaintiff can usually escape some of the expenses he would otherwise have been committed to. To capture this idea, our model allows for recovery of some (exogenously fixed) proportion ρ of Plaintiff's initial commitment. (This might correspond to Plaintiff paying his attorney a retainer up front on the understanding that, if Defendant concedes, some fraction thereof will be refunded.) So in choosing to file a lawsuit, in effect the Plaintiff initially makes only a "down payment" consisting of the fraction $1-\rho$ of the cost of his L_P commitment -- the remainder becoming payable if and only if Defendant fails to concede. (Of course, setting $\rho = 0$ reduces to the standard Stackelberg model.)

Under our assumption of risk-neutrality, as before each side will simply want to maximize its V_i -- the expected value of the lawsuit. Since Defendant as second-mover knows the Plaintiff's L_P, she chooses her L_D as a straightforward optimization problem just as in equation (7) above.

To allow for corner optima, denote as $\bar{L}_D$ Defendant's legal effort meeting the first-order condition (6) together with the second-order condition. If choice of $\bar{L}_D$ means that Defendant would lose more than J_D by fighting, she does better by conceding immediately. Taking this

[22] Corner solutions play a crucial role in the K&L analysis. They address the circumstances in which the prosecutor, in a "plea bargaining" session prior to the legal battle itself, can make an offer that criminal defendants might accept rather than go to trial.

possibility into account, her best choice of legal effort becomes:

$$L_D = \bar{L}_D, \text{ \underline{if} } V_D(\bar{L}_D) \geq J_D$$
$$L_D = 0, \text{ otherwise.} \tag{9}$$

In accordance with the Stackelberg solution concept, Plaintiff will then choose his optimal L_P in the light of Defendant's anticipated reaction. That is, he maximizes his value of the lawsuit V_P, subject to Defendant's best response as shown in equation (9).

Setting the stakes parameters at $J_P = 1$, $J_D = -1$ and marginal cost at $\gamma = .5$, Figure 4 illustrates a convenient "base case" in which the force exponent is $\alpha = 1$ and the recovery coefficient is $\rho = 0$. The pictured results are solutions for comparative-static variation of the parameter Y -- the degree of Defendant fault. In Figure 4a, L_P and L_D are both initially rising functions of Y. Notice that L_D exceeds L_P up to the mid-value $Y = .5$, after which $L_P > L_D$. Thus, in contrast with the Nash-Cournot result obtained above, here the side with a better case fights harder. In absolute terms, once fault exceeds $Y = .5$ Defendant effort begins to fall off, while Plaintiff effort continues to increase somewhat longer -- specifically, up to about $Y = .67$, at which point Defendant hits her corner solution at $L_D = 0$. From that point on, Plaintiff is able to start reducing his L_P as well.[23]

[Figure 4]

Figure 4b shows the corresponding values of the lawsuit V_P and V_D. Notice that when Defendant is at her corner solution (when she chooses $L_D = 0$), her $V_D = -1$ throughout. This is the maximum she can ever lose.

Figure 5 illustrates the effect of allowing Plaintiff a non-zero recovery coefficient, specifically $\rho = .5$. Since recovery only becomes operative when $L_D = 0$, for low values of fault Y the two panels here are identical with those in Figure 4. But Figure 5a shows that when fault reaches about $Y = .5$, Plaintiff's effort jumps discontinuously to a much higher level ($L_P \approx 2$) which induces Defendant to concede (to set $L_D = 0$). Plaintiff then recovers half the cost of his L_P commitment. Figure 5b shows the corresponding values of the lawsuit V_P and V_D.

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[23] It might be thought that when Defendant sets $L_D = 0$, Plaintiff should shift to the infinitesimal L_P that would suffice to achieve $\pi = 1$. But as Stackelberg leader he must move <u>first</u>, investing the effort required to deter Defendant from choosing a positive L_D.

Evidently, the prospect of partial recovery benefits Plaintiff and correspondingly disadvantages Defendant, when the former has a good case (at high levels of fault Y). And if Y is high, with $\rho > 0$ fewer lawsuits will go to trial, since Defendant is more likely to concede. In contrast, when Plaintiff has a poor case (low value of Y), the prospect of recovery will make no difference.

[Figure 5]

Returning to the zero-recovery ($\rho = 0$) condition, Figure 6 now shows the effect of reducing the force exponent from $\alpha = 1$ to $\alpha = .5$. As can be seen, both sides now invest substantially less in litigation effort. Also, L_P being lower, Defendant does not hit her corner solution anywhere within the open interval $0 < Y < 1$. And the respective lawsuit values V_P and V_D are generally higher, owing to the reduced fighting efforts.

With the lower force exponent, Plaintiff does a little better than before when he has a poor case (low Y) but not quite so well when he has a good case (high Y). And similarly Defendant does a little worse with a good case (low Y) and a little better with a poor case (high Y). Explanation: when Plaintiff has a poor case, L_D tends to exceed L_P. But when α is low, the amount of this excess is less; the decisiveness of effort being lower, it doesn't pay Defendant to overtop Plaintiff's commitment so heavily. Consequently, Plaintiff ends up a bit better off. The reverse of course holds in the range where Plaintiff has a good case (high Y).

[Figure 6]

Finally, Figure 7 illustrates a high value for the force exponent ($\alpha = 2$), still holding the recovery coefficient at $\rho = 0$. Here the overwhelming feature is how much earlier on the scale of fault, around $Y = .3$, the Plaintiff can compel Defendant to concede (to set $L_D = 0$). So long as he has not too hopeless a case, Plaintiff, by choosing a sufficiently high L_P, can make resistance a losing proposition for Defendant. So in this important respect, high α works strongly to the advantage of Plaintiff. Within the interior range, however, the opposite holds: higher α benefits Defendant. Since Defendant moves last, she can and will overtop Plaintiff's L_P, and the ratio $L_P/L_D > 1$ now has a heavily amplified effect in reducing Plaintiff's success fraction π. Also, as a secondary consideration, Plaintiff, knowing this, will tend to choose quite a small L_P to begin with, so even a high ratio L_D/L_P need not involve Defendant in heavy legal costs.

[Figure 7]

VII. 'JUSTICE' VERSUS SOCIAL COST

Turning now to normative evaluation, textbooks generally say that social performance ought to be evaluated in terms of both efficiency and distributive considerations. Roughly speaking, we want to maximize the size of the pie and then divide it up fairly.

For calculating the efficiency of legal systems, ideally we would want to go beyond the actual cost of lawsuits. Usually more important than the cost of litigation (even counting in pre-trial expenditures for exploration of the facts and the law) are the costs and benefits of the behaviors outside the courtroom influenced by the fear or prospect of litigation. Thinking in terms of auto accidents, a litigation system should aim at offering proper incentives for careful driving. Unfortunately, just what is the appropriate degree of careful driving and how the judicial process might help bring it about are huge and difficult issues. We will have to set this ideal criterion aside -- commenting only that the legal standards defining fault Y and determining the stakes J_P and J_D at issue may possibly reflect a social estimate of the rewards and penalties needed.[24] Instead we will only take account of a limited efficiency criterion, to wit, minimizing the cost of the litigation process itself.

Turning to distribution effects, on this score mainline economics usually offers no guidance. Absent a generally accepted standard of "equity", the distributive criterion is almost always regarded as outside the range of analysis. Yet litigation systems clearly employ such a criterion in the concept of 'justice'. What does justice signify? Without attempting to enter into philosophical debate, we will bite the bullet and define a system as just if it meets the proportionality condition described above:

$$\pi = Y \tag{10}$$

According to this criterion, Plaintiff's relative success should equal Defendant's degree of fault. Thus in a deterministic division of the stakes, if fault is 50% the contenders would split the stakes equally. (Under risk-neutrality this is equivalent to each side having a 50% chance of winner-take-all victory.)

For the Nash-Cournot protocol, the Corollary to Proposition 1 above told us that the 'justice' condition is exactly met: since equilibrium litigation efforts are always equal, Plaintiff's

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[24] For example, in order to reinforce deterrent effects upon careless driving, the laws may permit or even require punitive damages over and above actual loss suffered.

proportionate success will always equal Defendant's proportionate degree of fault. This does not in general occur in the Stackelberg analysis, and it will be of interest to explore the direction of divergence.

Under the Stackelberg protocol, Figure 8a shows π as a function of Y under the various parametric conditions considered. For any specified set of conditions, the 'justice' condition would be exactly met if the associated curve were to exactly overlie the 45° line, as occurs under the Nash-Cournot protocol (owing to the litigation efforts on the two sides always being equal). But under the Stackelberg protocol the litigation efforts L_P and L_D are almost always unequal. However, the discussion of equation (5) indicated that the effects of an L_p/L_D ratio diverging from unity are attenuated when the force exponent α takes on low values. Correspondingly, in Figure 8a -- dealing for the moment only with the three curves for which the recovery factor is absent ($\rho = 0$) -- the curve for $\alpha = .5$ lies very close to the 45° line whereas the curve for $\alpha = 2$ diverges the most.

[Figure 8]

Note also that $\pi(Y)$ would almost always lie below the 45° line for $Y < .5$ and above the 45° line for $Y > .5$, consistent with the previous observation that the side with the better case tends to fight harder. (The only exception is associated with the range of discontinuity along the $\alpha = 2$ curve starting about $Y = .3$, the fault level at which Defendant surrenders.) Thus, we might say, under the Stackelberg protocol virtue is "excessively" rewarded! The bias is of course smallest for $\alpha = .5$, where the decisiveness of legal effort is least.

On the other hand, we have also noted an element of pro-Plaintiff bias in the range where a high L_P commitment can force a Defendant to surrender entirely. In Figure 8a this is most conspicuously evident for the high force exponent ($\alpha = 2$) curve, where Plaintiff can induce surrender starting at a fault level as low as $Y = .3$.

And, of course, allowing for a recovery factor also strongly favors Plaintiff, as can be seen by comparing the with-recovery and without-recovery curves for the intermediate level of the force exponent ($\alpha = 1$).

Figure 8b indicates that, in line with expectation, aggregate cost $C_P + C_D$ is least when the force exponent is low ($\alpha = .5$). Since low α weakens the power of litigation efforts L_i, neither side wants to invest so heavily in them.

We see also that social cost tends to be minimized at the extremes of very high fault and very low fault, as of course also occurred in the Nash-Cournot analysis. (A side with a very poor case will not want to spend very much on it. And, knowing this, the opponent need not make a large commitment either.)[25] However, whereas under the Nash-Cournot protocol the legal efforts (and therefore the aggregate costs) were greatest exactly at $Y = .5$, inspection of Figure 8b indicates that -- setting aside the curves where maxima occur at points of discontinuity -- highest aggregate costs are incurred at fault levels somewhat greater than $Y = 0.5$. Explanation: Although Plaintiff has the more meritorious case for $Y > 0.5$, under the Stackelberg protocol Defendant has the advantage of being able to make a maximizing response to the opponent's commitment. To overcome this handicap, Plaintiff must invest more litigation effort than would otherwise be ideal. This handicap is attenuated, of course, where Plaintiff benefits from a recovery factor $\rho > 0$. Indeed, in Figure 8b, the handicap disappears completely, since Defendant is forced to concede for any $Y > 0.5$.

Setting aside the single pictured curve reflecting this recovery factor, a possibly surprising feature of Figure 8b is that, in the ranges of discontinuity where Defendant concedes, the overall litigation cost does not fall immediately to very low levels. In fact, for the $\alpha = 2$ curve, aggregate cost jumps sharply at the discontinuity point. The reason is that, in order to induce Defendant to set $L_D = 0$, Plaintiff has to commit to quite a high L_P.

VIII. THOUGHTS ON EMPIRICAL IMPLICATIONS

Time and space limitations rule out pursuing empirical implications at this point, but some preliminary thoughts as to how the model might potentially be confirmed or disconfirmed may be in order. To begin with, all sensible models of the litigation process would make a number of similar predictions: for example that (other things equal) litigation efforts will be greater the larger are the stakes and the smaller the costs, that the size and/or likelihood of verdicts for the Plaintiff will be positively correlated with Defendant fault, that the party investing greater litigation effort is more likely to win. Setting aside such more or less 'universal' forecasts, we will concentrate on

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[25] There is a certain qualitative parallel with the finding in Priest and Klein (1984) that cases where true fault is near the legal standard are more likely to be litigated. (We assume that litigation always takes place, but the intensity of litigation effort is greatest toward the middling fault levels which would presumably be in the neighborhood of Priest and Klein's 'legal standard'.)

actual or potential observations stemming from the more novel features of our analysis.

First, while all models employ some concept of fault ("the merits of the case"), we emphasize the balance between fault and the other major determinant of judicial outcomes -- the chosen litigation efforts. And in particular, our analysis highlighted the force exponent parameter α that scales the relative decisiveness of fault versus effort. Second, our analysis deals with the Stackelberg as well as the more usual Nash-Cournot protocol, with emphasis upon the former. Even the Stackelberg paradigm hardly captures the complex processes of negotiation that may precede, accompany, or even (by settlement) preclude courtroom trials. But of the two very rough approximations, Nash-Cournot and Stackelberg, it would be of interest to test our contention that the latter represents a closer fit. Third, our model derives a number of more specific implications from the interaction of protocol, fault, decisiveness, and so forth -- for example, circumstances leading to pro-Plaintiff bias.

As so often happens, several of the model's parameters and variables are not measurable in any simple direct way. This is notably true of fault[26] Y and of the force exponent α. And although the stakes J_i, the costs Ci, and the litigation efforts L_i are somewhat more visible, even they raise serious problems of measurement. So we mainly limit ourselves here to describing a few indirect implications of the analysis.

1. Without directly measuring the force exponent α that scales the relative decisiveness of litigation effort as against Defendant fault, it is possible to distinguish settings associated with higher or lower α. First, α can plausibly be assumed to be lower for the European inquisitorial system (in which lawyers play a distinctly secondary role) than for the Anglo-American adversarial system. And similarly α is presumably lower in British courts, where judges keep a tight rein upon what lawyers are permitted to do, than in American courts. And once again, the force parameter α is presumably lower in courts of appeal, where authentic facts and valid forms of reasoning (the "power of truth") are likely to carry more weight. Finally, since arbitration and

[26] Priest and Klein [1984] and a number of other studies assume that courts always correctly ascertain the truth, implying that the distribution of verdicts can be taken to reflect the underlying distribution of fault (for cases brought to trial). But our model of an imperfect litigation process cannot draw inferences as to fault from data on judgments -- in fact, that association would be the central empirical question. However, proxies for fault independent of actual court judgments have been used by, e.g., Farber and White [1991] for medical malpractice cases and Wittman [1985] for auto accident liability litigation.

other forms of alternative dispute resolution have come into existence mainly owing to complaints about high expenses and long delays in courts of law, it seems at least plausible that they will be characterized by a lower force exponent α.[27]

For all these comparisons, the model predicts that, other things equal, litigation efforts L_i on both sides should tend to be smaller in the lower-α type of forum. The econometric problem is how to "hold other things equal". While by no means a controlled experiment, a study by the British accounting firm Tillinghast has reported that gross tort costs are -- in terms of percent of GNP -- three to nine times as high in the U.S. as in the other twelve other economically advanced countries surveyed (Tillinghast [1989], as cited in Litan [1991]).[28]

A related implication is that appeals should be more prevalent in the U.S. than the U.K. The presumably higher force exponent α characterizing lower courts means that the "power of truth" is less, so reversible errors are more likely to occur.[29]

A number of other possible implications are connected with differences between the Nash-Cournot and Stackelberg protocols. Under Nash-Cournot, other things equal, litigation investments

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[27] Some consequences of the introduction of lawyers into arbitration proceedings are described in Ashenfelter and Bloom [1990].

[28] The 1987 Tillinghast estimate cited for the U.S. is 2.6% of GNP, whereas the other countries range from 0.3% (Australia) to 0.8% (Switzerland). The U.K. figure is 0.5%. However, these "gross" tort costs include amounts paid out as judgments, which are of course only transfers. Litan cites Tillinghast as estimating that only about 25% of U.S. tort costs are paid out to cover victims' economic losses, leaving some 75% of the 2.6% U.S. figure as a "net" magnitude comparable to our $C_P + C_D$ (which covers attorney fees, clerical expenses, administrative charges, etc.) But even this reduced U.S. amount remains far higher than the gross tort costs in any of the other countries listed. While not immediately relevant for our purpose here, we perhaps ought to mention that these high costs might arguably have proportionately favorable effects in deterring wrongful actions. Conceivably, the U.S. physical and social environment requires an extraordinarily high level of litigation costs to keep reckless driving, environmental destruction, and other damage-inflicting actions within proper bounds.

[29] However, even if appellate courts were not expected (on average) to come to more correct judgments, a side defeated in the lower court might still find it profitable to take the proceeding to a higher forum. An appeal might be just another means of escalating investment in litigation effort L_i so as to put the opponent at a disadvantage. (Note that whichever is the losing party at trial would become the Stackelberg leader in the appeal phase.)

should be greatest for the middling degree of fault -- $Y = 0.5$. Under the Stackelberg protocol, however, we found a tendency for aggregate costs $C_1 + C_2$ to be maximized at somewhat higher fault levels, though the shift away from $Y = 0.5$ tended to be only moderate. Also, because the Stackelberg protocol requires the first-mover (Plaintiff) to convey commitment and not recede from it, a predictable psychological difference between Plaintiff lawyers and Defendant lawyers might be anticipated. Although attorneys on both sides will probably all pretend to stubbornness and determination, having a reputation for actually being unyielding should be relatively more important for representatives of the Plaintiff.

Finally, one further implication stemming from the Stackelberg protocol is that Plaintiff ability to commit may often induce even low-fault Defendants to concede. That such "nuisance suits" often succeed is of course widely believed, but a rigorous demonstration would require independent estimates of true fault.[30]

IX. SUMMARY AND FURTHER DISCUSSION

Although settlement is always Pareto-preferred to litigation, for reasons not modelled here the parties nevertheless fail to come to an agreement. (Or, on an alternative interpretation, the analysis could reflect the hypothetical calculations of litigants as to minimum acceptable terms in an ultimately successful negotiation process.)

Plaintiff's relative success π, under our maintained assumption of risk-neutrality, can be interpreted either as his probability of yes/no victory ("entire fault") or as his deterministic share of the stakes at issue ("comparative fault"), and correspondingly for Defendant's relative success $1-\pi$. Certain very reasonable criteria lead to a specific form of Litigation Success Function in which the relative degrees of success $\pi, 1-\pi$ depend upon two ratios: an effort factor L_P/L_D and a fault factor $Y/(1-Y)$. In principle both factors might be weighted (exponentiated) by decisiveness parameters α and β to reflect the respective influences of effort and fault upon the judicial outcome. But consistency with a "proportionality" property -- that with equal efforts, Plaintiff's

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[30] Other authors such as Rosenberg and Shavell [1985] and Bebchuk [1996] have explained successful nuisance suits as due to differences between the parties in litigation costs or magnitudes of the stakes. The Stackelberg model, in contrast, predicts that nuisance suits will sometimes be successful even when such differentials are ruled out.

proportionate success should equal Defendant's degree of fault -- dictates fixing $\beta = 1$. Also involved in the litigants' decisions are the cost functions $C_i(L_i)$, here assumed identical for the two sides.

The paper emphasized the importance of different possible interaction protocols and associated solution concepts. In particular, we compared symmetrical Nash-Cournot solutions with asymmetrical Stackelberg solutions in which Plaintiff moves first. We also considered a variation of the Stackelberg protocol, allowing Plaintiff partial recovery of his cost commitment in the event that Defendant concedes (if she sets $L_D = 0$).

For the Nash-Cournot protocol, on our maintained assumptions as to identical cost functions and numerically equal stakes, and ruling out corner equilibria, we obtained very simple analytic solutions. But the Stackelberg protocol, which was the main thrust of the paper, required undertaking a number of simulations. The results were interpreted in terms of two normative criteria. First, that 'justice' calls for the proportionality property $\pi = Y$: that is, Plaintiff's relative success should equal Defendant's degree of fault. Second, that the social total of costs, $C_P + C_D$, should be as low as possible.

Summarizing some of the specific results (compare the questions listed in our introductory discussion):

(1) Under the Nash-Cournot protocol, in equilibrium the litigation efforts L_P and L_D will be equal regardless of the level of fault Y. It follows as a corollary that the 'justice' condition $\pi = Y$ is always met: Plaintiff's proportionate success will equal Defendant's proportionate fault. In contrast, these results almost never exactly hold for the Stackelberg protocol.

(2) A low force exponent α (lesser weight attaching to the effort ratio) always leads to small litigation efforts L_P and L_D. This in turn means that the 'justice' condition $\pi = Y$ is closely approximated, even under the Stackelberg protocol, and of course that aggregate costs $C_P + C_D$ are quite low.

(3) The summed costs $C_P + C_D$ are always low toward the extremes of fault (where Y is close to 0 or 1) and are high for middling values of fault.

(4) In contrast with the Nash-Cournot result, under the Stackelberg protocol the side with the more meritorious case ordinarily fights harder: merit and effort are complements.

(5) For the Stackelberg protocol, again in contrast with Nash-Cournot, "virtue is over-rewarded." Owing to the positive interaction between fault levels and litigation efforts, outcomes tilt <u>disproportionately</u> in favor of the side with the more meritorious case.

(6) Under certain conditions the Stackelberg protocol involves a pro-Plaintiff bias: over a range of parameter values, Plaintiff can commit to an L_P sufficiently high to induce even a relatively "innocent" Defendant to concede -- to set $L_D = 0$.

(7) Pro-Plaintiff bias is exacerbated if Plaintiff can recover part of his investment in the event of Defendant surrender.

(8) When Defendant concedes, it might have been thought there would at least be a social benefit in the form of reduced litigation cost. This is generally not the case since, in order to induce surrender, Plaintiff must commit to high L_P. Even if partially recovered, the commitment to high L_P generally outweighs the social cost saving due to lower L_D.

A number of possible extensions of the model suggest themselves. Particularly important would be to study protocols of interaction that better approximate the complexities of the negotiation process, for example the Threat-and-promise protocol mentioned earlier. And even within the Nash-Cournot and modified-Stackelberg protocols it would be of interest to consider the implications of:

(a) varying the absolute and relative magnitudes of the stakes J_P and J_D and the marginal cost parameter γ;

(b) allowing for fixed as well as variable litigation costs;

(c) taking account of the principal-agent interaction between litigant and attorney on each side;

(d) allowing for Litigation Success Functions not meeting the 'proportionality' condition, so that the absolute weights attaching to effort and truth (exponents α and β) can be varied independently;

(e) weakening the common-knowledge assumptions.

Although an exploratory model like ours does not warrant drawing confident inferences about possible legal reforms, at least one normative implication seems very robust, to wit, the adverse implications of a high force exponent α in terms of both 'justice' and cost. How might α be reduced? Judges are presumably more likely than juries to see through the noise represented by lawyers' clamor, which suggests possibly extending the range of disputes for which non-jury trials are permitted or required. Even for jury trials, the ability of judges to control the proceedings could be expanded. And alternative modes of dispute resolution, particularly those involving self-representation, might in some contexts be encouraged in place of representation by attorneys.

In addition, it is straightforward (as follows from almost all models of litigation) that higher court fees -- especially if proportioned to the "size" of the trial in terms of days spent in the courtroom, pages of documentation, etc. -- would reduce the equilibrium levels of litigation efforts. A tax on judgment awards would have similar effects. (Yet, it must be remembered, cost reduction would have to be weighed against possible adverse effects in terms of the distributive criterion associated with the achievement of 'justice'.)

Overall, we regard the main contributions of the paper to be:

(1) underlining the significance of selecting the correct protocol for modelling litigation contests;

(2) proposing a specific form of Litigation Success Function that identifies and parametrizes the relative weights of the two crucial factors -- the degree of fault ("truth") versus the contenders' litigation efforts;

(3) on the assumption that each side aims solely to maximize its own value of the lawsuit, analytic solutions for the Nash-Cournot model and simulation results for the Stackelberg model were obtained that illustrate the influence of the several parameters upon the outcome;

(4) in particular, we found, systems of law that attach relatively high weight to the effort factor relative to the fault factor are associated with high litigation costs and failures of 'justice' (in the sense of proportionality).

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Figure 1
Probability of Plaintiff Success

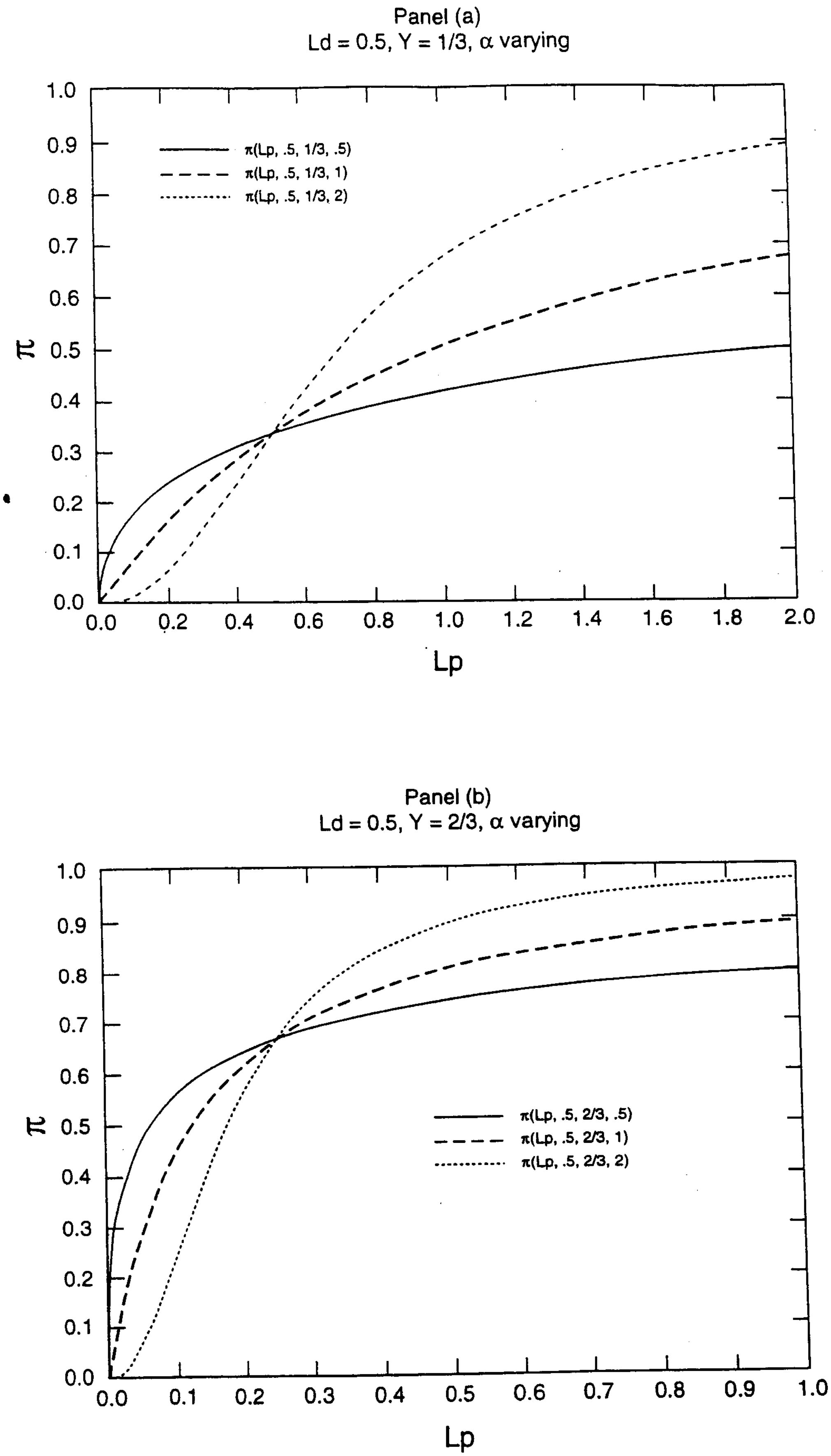
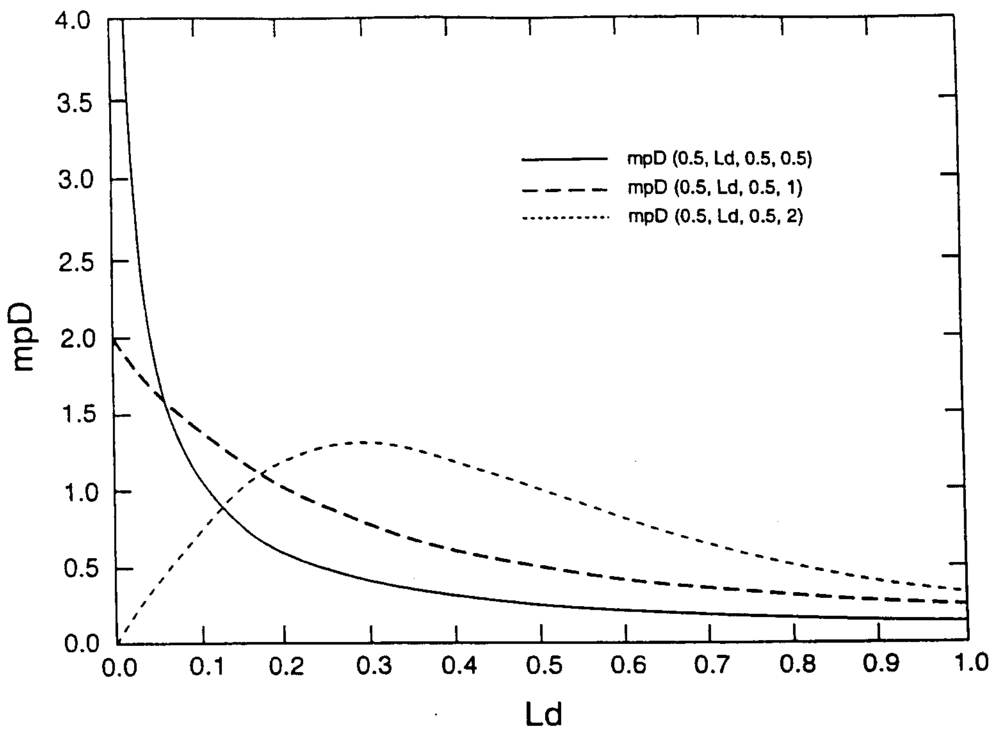


Figure 2
Defendant's Marginal Product

Panel (a)
Lp = 0.5, Y = 0.5, α varying



Panel (b)
Lp = 0.5, α = 1, Y varying

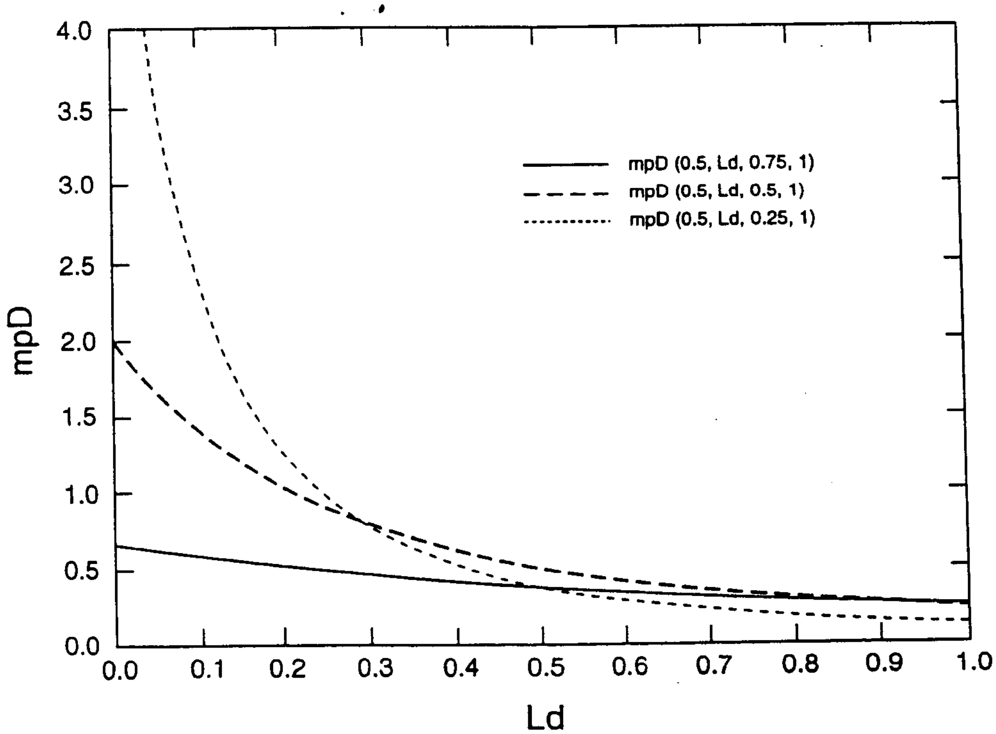
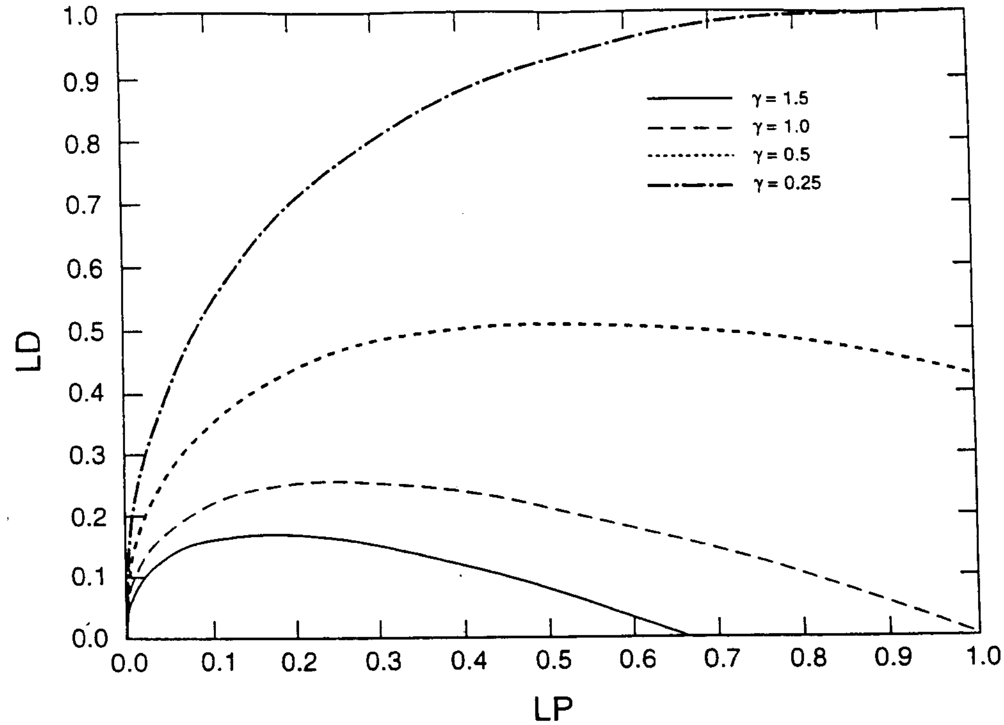


Figure 3
Defendant's Reaction Curves

Panel (a)
Y = 0.5, γ varying



Panel (b)
γ = 0.5, Y varying

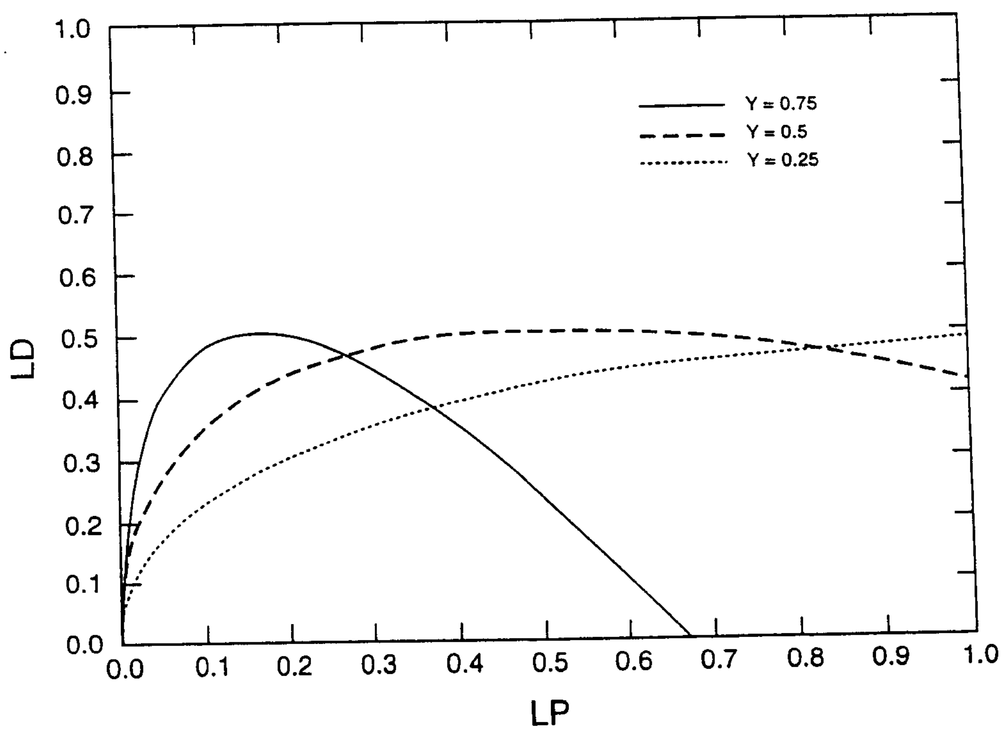


Figure 4

Effort Levels and Values of the Lawsuit, as Functions of Fault Y

(Base case)

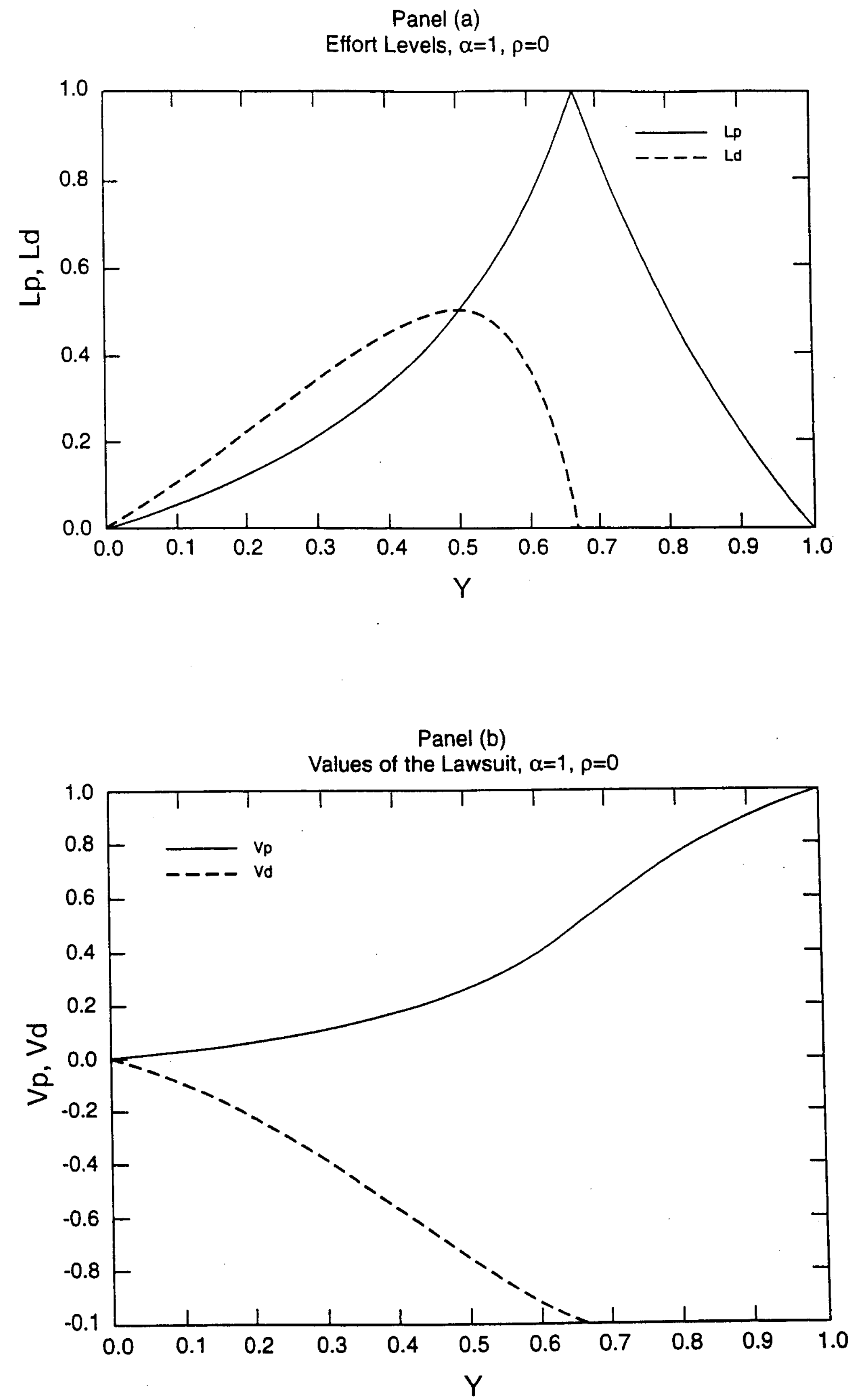
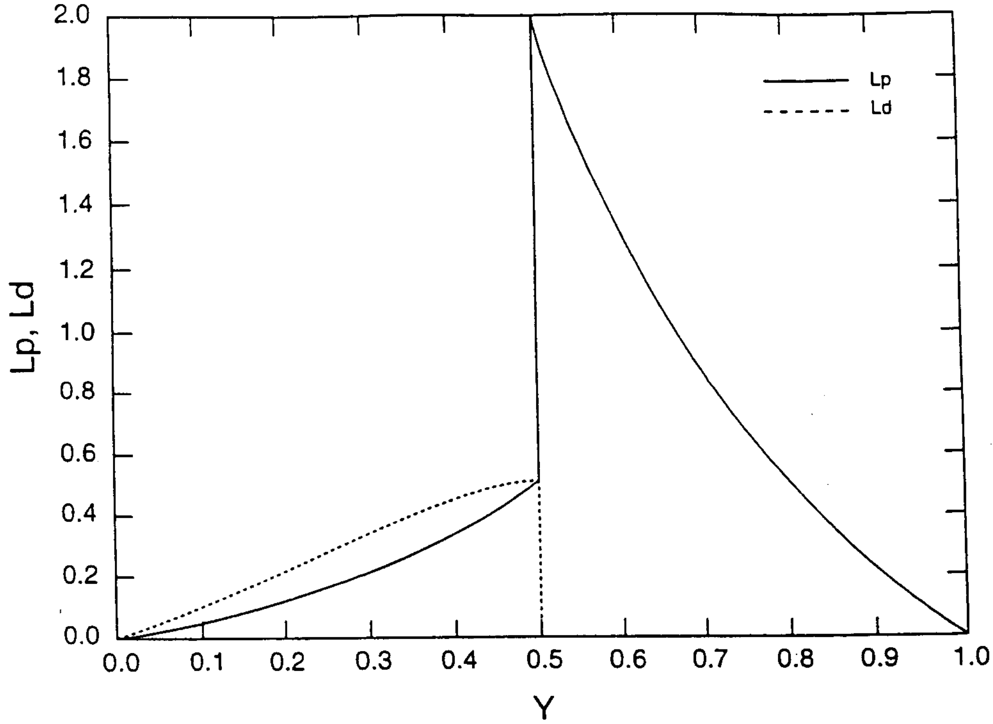


Figure 5

Effort Levels and Values of the Lawsuit, as Functions of Fault Y

(Allowing for Recovery Factor)

Panel (a)
Effort Levels, α=1, ρ=0.5



Panel (b)
Profits, α=1, ρ=0.5

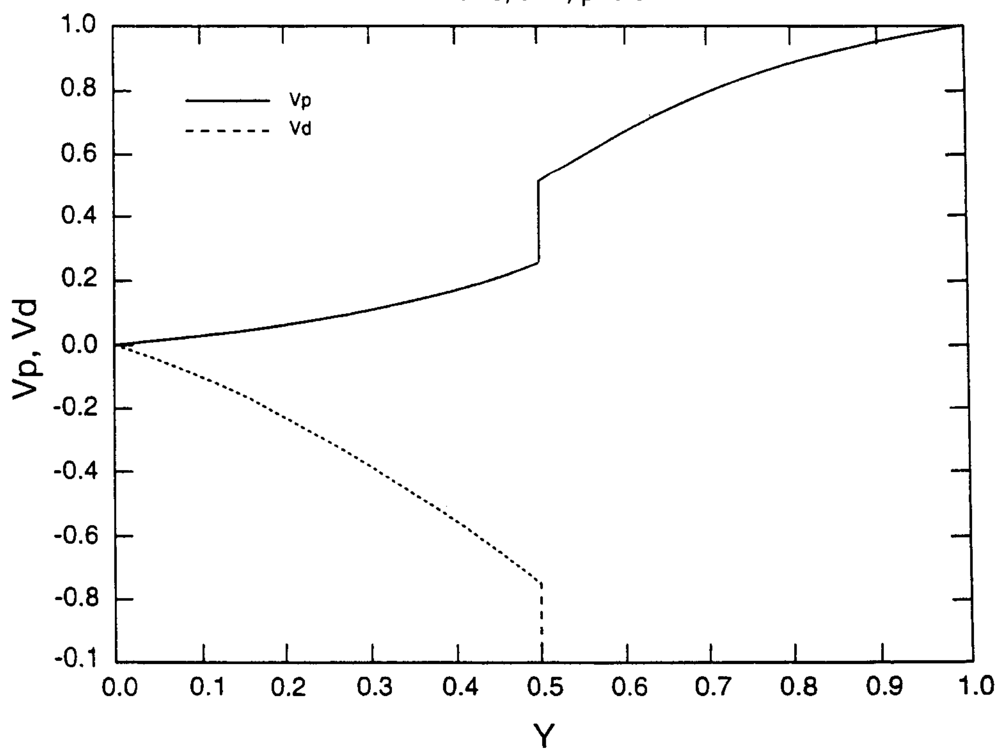


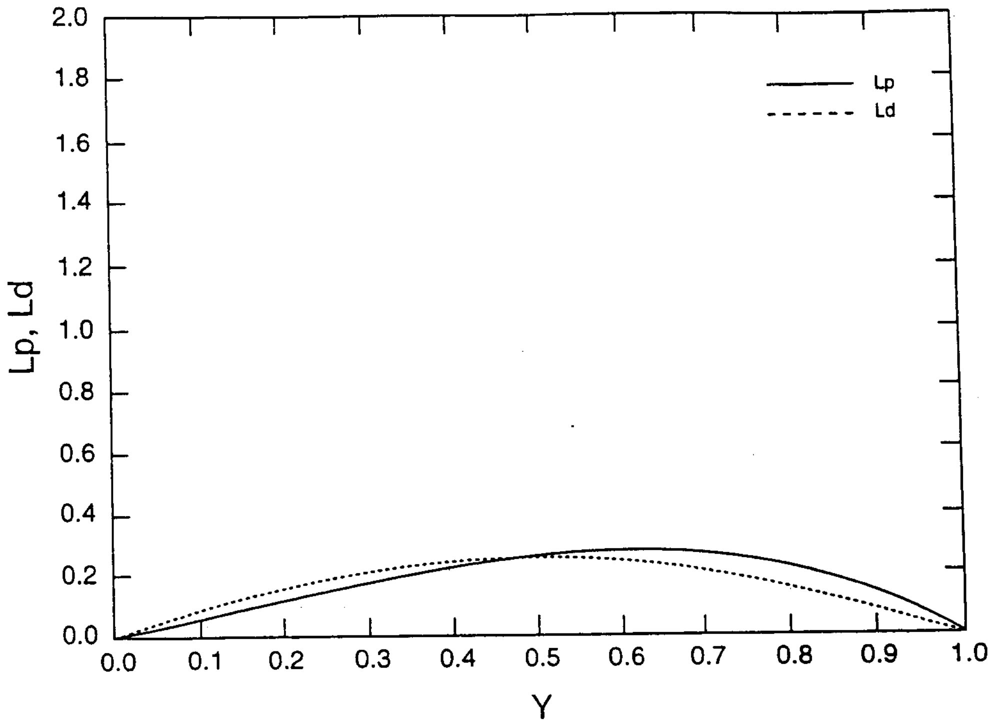
Figure 6

Effort Levels and Values of the Lawsuit, as Functions of Fault Y

(Low Decisiveness)

Panel (a)

Effort Levels, α=0.5, ρ=0



Panel (b)

Profits, α=0.5, ρ=0

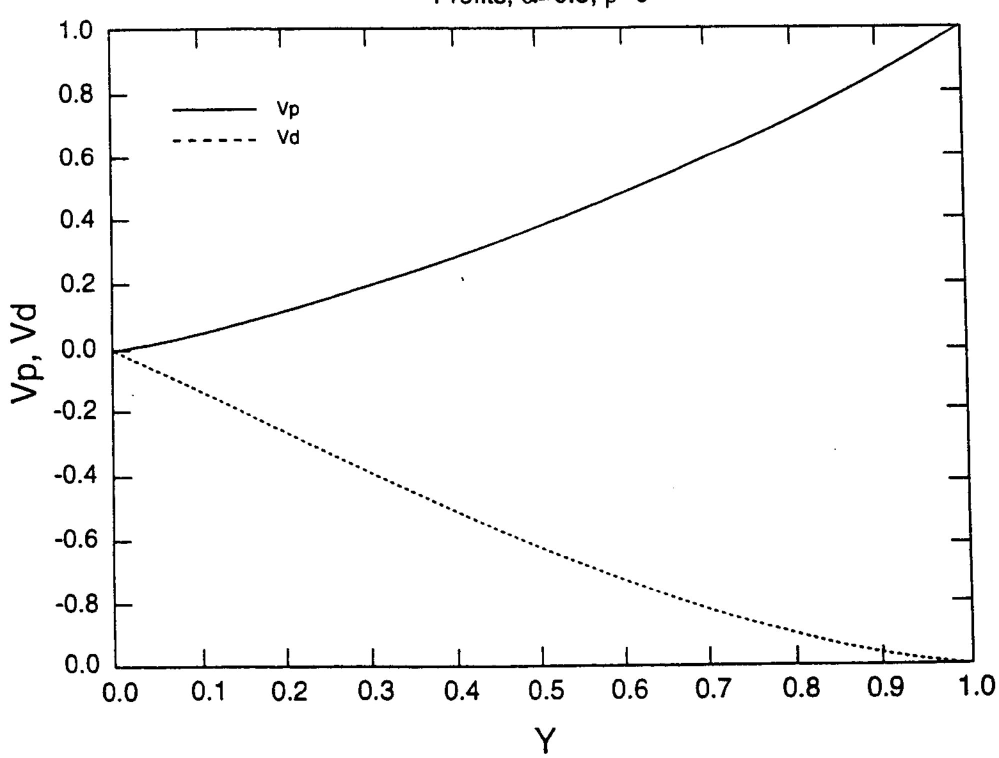


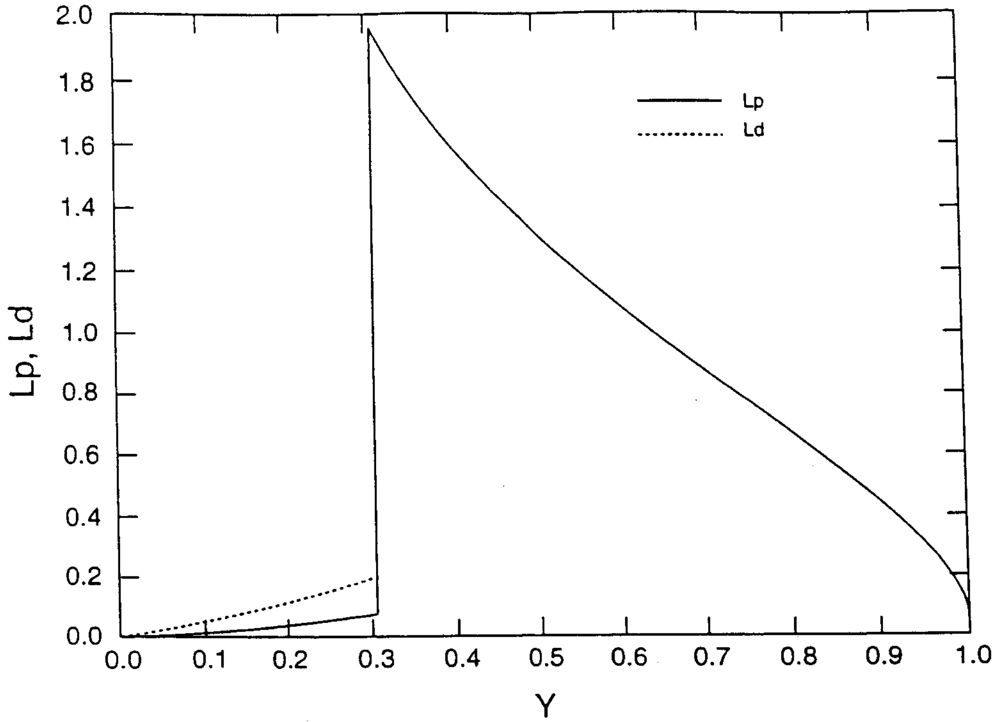
Figure 7

Effort Levels and Values of the Lawsuit, as Functions of Fault Y

(High Decisiveness)

Panel (a)

Effort Levels, α=2,ρ = 0



Panel (b)

Profits, α=2, ρ = 0

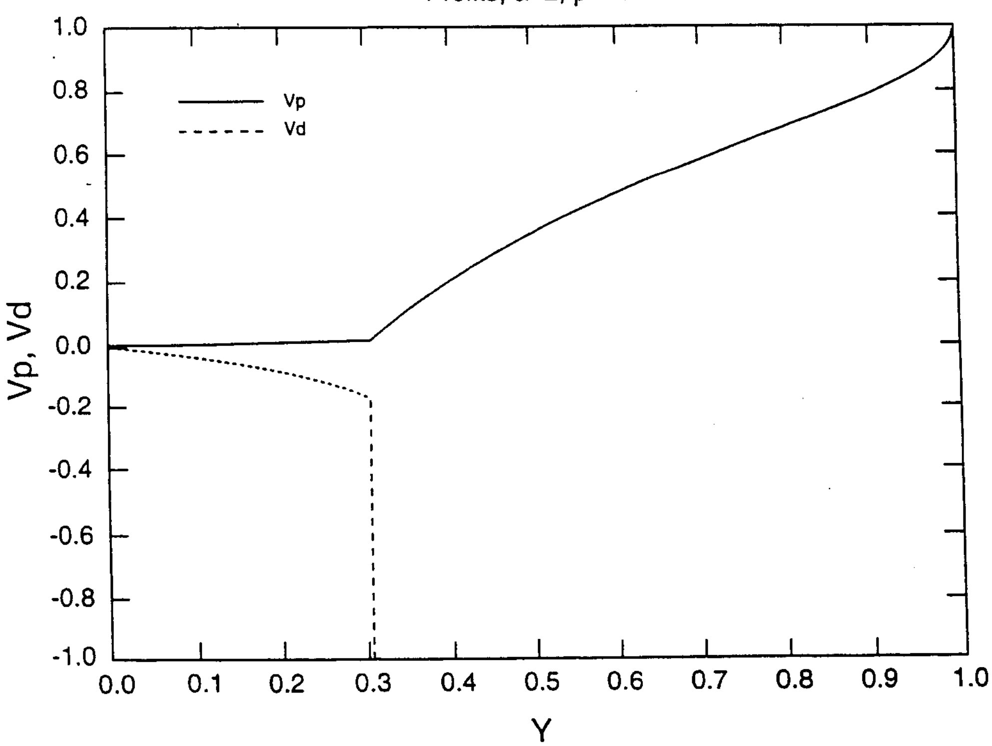


Figure 8
Justice and Social Cost