

THE LEGAL BATTLE

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Abstract

Lawsuits are a form of conflict in which relative success depends upon two main factors: (1) the true degree of fault, and (2) the litigation efforts on each side. We assume Plaintiff commits to a level of litigation effort, to which Defendant then responds. The result depends upon a number of parameters including the costs of litigation and the weights attached to the fault and effort factors. Outcomes are evaluated in terms of two social criteria: (i) achieving 'justice' (defined as equality between degree of fault and the probability of Plaintiff victory, or latter's proportionate award) and (ii) minimizing aggregate cost. Achievement of these aims is hampered mainly by high 'decisiveness' of litigation effort, that is, when a high weight attaches to the effort factor as opposed to the fault factor. The analysis has suggestive implications for proposed litigation reforms.

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Trials are battles. In consequence, litigation shares certain family traits with wars, strikes, and other human conflicts. 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.

Despite the efforts that have gone into modelling the reasons for lawsuits and the likelihood of one or the other party prevailing, little attention has so far been devoted to the analysis of the legal battle itself. This paper takes a first step toward filling the gap.

We will be generating a detailed model of litigation-as-conflict, involving optimization on the part of each litigant (how much effort to devote to the struggle?) and the consequent equilibrium (outcome of the struggle in terms of relative success and costs incurred). The key point is that while the outcome does in part depend upon the 'truth' (upon who has the better case), who wins is also a function of the litigation efforts on the two sides.

Among the issues to be explored are:

- (1) Does the litigant with a better case tend to fight harder, or the reverse?
- (2) Under what circumstances does it pay Defendant to concede, and what are the consequences for Plaintiff strategy?
- (3) How would parametric variations -- e.g., higher or lower costs of litigation effort -- affect the outcome?
- (3) What factors make for a pro-Plaintiff bias or the reverse?
- (4) What are the consequences of the litigation system in terms of the two desiderata: achieving 'justice' and minimizing cost? To what extent is there a trade-off between the two?
- (5) Would certain proposed reforms -- for example, adoption of the English rather than the American rule for bearing the expenses of trial -- improve matters?

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I. FUNDAMENTALS AND APPROACH

In modelling the legal battle, the first issue is: why fight at all? Costly litigation is always Pareto-dominated by a range of potential settlements. Furthermore, whereas in international power struggles and certain other conflictual contexts there may be no superarching authority available to enforce agreements, here the judicial authorities stand ready to implement any negotiated settlements arrived at.

In some models, failure to settle has been explained by Plaintiff and Defendant having different estimates as to the outcome. And specifically, litigation is more likely when each side is relatively optimistic about what would happen in the event of trial. Also, as another possible explanation, while risk-aversion makes settlement more likely, conceivably one or both sides may actually prefer risk.²

Neither of these possible explanations plays any role at all in our analysis. In our model both sides are risk-neutral. And, we will always assume, Plaintiff (P) and Defendant (D) are in agreement as to the outcome measure we will call "degree of Plaintiff success" (π). There are two ways of interpreting π : either as a probability, or as a deterministic share. More specifically, π could represent the probability of Plaintiff victory as a yes/no outcome -- in which the total judgment amount is awarded to one side or the other. Or, alternatively, π could measure the Plaintiff's award as a proportionate share of the amount at stake. (Following most of the analytic literature, we will be taking the stakes as fixed and equal for the two sides.) Under our risk-neutrality assumption, both interpretations are acceptable: a litigant will be indifferent as between a given probability of full judgment in his/her favor versus a deterministic partial award with the same mathematical expectation.

The novel element in our model is that the chance or fraction of

² The roles of optimism and risk-preference in fostering litigation were first systematically developed in Gould (1973). Priest and Klein (1984) brought out an additional factor: only cases with Defendant fault sufficiently close to the legal standard of liability tend to be litigated. Differential information, which underlies the belief inconsistencies leading to both sides being optimistic, has been further analyzed by Bebchuk (1984), Shavell (1989), and Farmer and Pecorino (1994), among others.

Plaintiff success is not exogenously given but is instead an endogenous variable. Specifically, π is determined by the parties' legal efforts L_i ($i = P, D$) entering into a Litigation Success Function (LSF).³ The form of this function being known, π is computable by both sides once the legal efforts L_i are specified. And we will also be assuming that these legal efforts, and the costs thereof, are common knowledge.

So why litigate? We answer this question on two levels. (1) In the actual world we frequently observe "bargaining impasses" -- parties failing to arrive at mutually preferred settlements -- even where enforcement problems and informational discrepancies are absent.⁴ (2) But even if settlement were ultimately certain, the model could be understood as reflecting the hypothetical calculations of the contending parties as each attempts to figure out what its minimum terms ought to be.

A second modelling issue is: who are the decision-makers? Since the principal and his/her attorney never have perfectly harmonious interests,⁵ a general model of litigation struggles would have to deal with at least four parties -- principals and attorneys on each side. But here we bypass these agency questions so as to deal solely with the decisions of the two litigants.

A third issue is the protocol of interaction and the associated solution concept. Do the parties move simultaneously (the Nash-Cournot model), or does Plaintiff move first (the Stackelberg model), or perhaps some more complex protocol is appropriate?

No simple model can of course capture the full complexity of the give-and-take of filings, discovery proceedings, offers, threats and so forth

³ We have not located any earlier literature that comes close to this idea. However, in different ways Trubek et al (1983) and Ashenfelter and Bloom (1990) do show that higher investment in litigation effort -- if not matched by the opponent -- does tend to pay off.

⁴ Whether 'rational' agents should always be able to extricate themselves from bargaining impasses remains a subject of debate among mathematical game theorists. See, e.g., Rubinstein [1982] and Binmore [1992], pp. 208-209.

⁵ Among the authors addressing these issues are Miller [1987], Dana and Spier [1993], Osborne [1993], and Watts [1995].

that characterize a lawsuit. Our analysis concentrates upon the one obvious asymmetry: there is no case unless the Plaintiff brings it. The simplest way of dealing with such an asymmetry is the Stackelberg model, and that is what we will use -- with one variant.

If he brings suit at all, in our model the Plaintiff commits to a specific level of legal effort $L_P > 0$. Defendant, in her response, either concedes entirely ($L_D = 0$) or else chooses some $L_D > 0$. In the standard Stackelberg analysis, the first-mover's commitment is totally irrevocable. But in the lawsuit context, if Defendant concedes (chooses $L_D = 0$) 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 fixed proportion ρ of Plaintiff's initial commitment. For example, Plaintiff might pay his attorney a retainer up front on the understanding that, if Defendant concedes, the proportion ρ 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 only if Defendant fails to concede.

In contrast with most of the preceding literature, the judicial system is here assumed to be imperfect. (It is only because courts are imperfect that attorneys need be hired at all.) Specifically, we postulate that the true degree of Defendant fault, $0 \leq Y \leq 1$, is known to both parties but not to the court. In effect we are reversing a key assumption of Priest and Klein (1984), Cooter and Rubinfeld (1989), Farber and Bazerman (1989), and many other authors -- that while litigants have incorrect estimates of the true degree of fault Y , the judicial system always finds the correct Y . In contrast, we assume the litigants know Y but the court does not. (However, we take the judicial system to be unbiased as between Plaintiff and Defendant.)⁶

⁶ In criminal cases the judicial system is intendedly biased in favor of defendants: the prosecution must convince a jury 'beyond a reasonable doubt'. In tort litigation of the type considered here, however, an unbiased or symmetrical rule is normally followed.

II. ELEMENTS OF THE MODEL

At this point it will be convenient to provide a more systematic list of the elements of the model.

Choice variables

L_P, L_D : These index the respective real litigation efforts, for example, hours of attorney time.⁷ $L_P = 0$ corresponds to Plaintiff not filing the lawsuit, and $L_D = 0$ to Defendant conceding the case.

Exogenous parameters

J_P, J_D : These are the possible gains from litigation (the stakes at issue). J_P is positive while J_D is negative. Apart from sign, J_P and J_D might in principle numerically differ,⁸ but $J_P = -J_D$ will be a maintained assumption throughout this paper.

Y : The degree of Defendant fault, scaled from 0 to 1.

α : In the Litigation Success Function to be defined below, α measures the decisiveness attaching to the 'effort factor' L_P/L_D relative to the 'fault factor' $Y/(1-Y)$. α may range from 0 to $+\infty$.

γ : This is the coefficient of the variable-cost term in the litigation cost function, assumed identical for the two sides.

ρ : This is Plaintiff's recovery factor. Having made a prior commitment L_P , he recovers the fraction ρ of the variable costs in the event that Defendant concedes.

Endogenous variables

Each party's litigation cost C_i is a function of its own L_i :

$$C_i = \gamma L_i \quad (i = P, D) \quad (1)$$

Litigation cost is scaled in dollars. For simplicity we assume there are no fixed costs on either side and that marginal cost γ is constant. Each

⁷ Recall that we are assuming unitary actors on each side, so issues such as hourly versus contingent fees do not arise.

⁸ For example, if a judicial finding in this trial could become a precedent for similar cases in future, Defendant's potential loss might be much greater than Plaintiff's potential gain.

party is assumed responsible for its own legal costs regardless of the outcome (the 'American rule' of cost-bearing).

The value of the lawsuit to each side, that is, the expected gain or loss from trial, is given by:

$$V_i = \pi J_i - C_i \quad (i = P, D) \quad (2)$$

Since $J_D < 0$, Defendant's V_D is always negative; the only question is how much she will lose in the event of trial. Plaintiff's V_P might be positive or negative; if the latter, he will not bring suit at all.

The Litigation Success Function (LSF)

This function is the crucial and most novel element of our model. It summarizes the relevant conflict technology.⁹ 'Inputs' of fighting efforts L_P and L_D on the two sides generate the 'output' π -- Plaintiff's share of the judgment amount or, alternatively, the probability of Plaintiff victory. Defendant's relative success is of course $1 - \pi$.

The LSF determines the ratio $\pi/(1 - \pi)$:

$$\frac{\pi}{1 - \pi} = \left(\frac{L_P}{L_D} \right)^\alpha \frac{Y}{1 - Y} \quad (3)$$

The RHS of (3) is the product of an effort factor L_P/L_D and a fault factor $Y/(1 - Y)$, the former being weighted by a decisiveness exponent α . As two special cases, the judicial system will produce the 'correct' result $\pi = Y$ if either $L_P = L_D$ (if the two sides invest equal efforts) or else if $\alpha = 0$ (if comparative legal efforts do not influence the outcome at all).¹⁰

(i) The effort factor: The crucial assumption here is that the respective chances of success are a function of the ratio L_P/L_D . This is

⁹ Hirshleifer [1989, 1991].

¹⁰ In (3), to reflect possible differences in litigation competence, the L_P and L_D might have been multiplied by respective "effectiveness coefficients" e_P and e_D . We do not make this extension, on the grounds that whatever fighting technology is available to one side (e.g., hiring better lawyers) is also available to the other.

not the only conceivable formulation, but it seems appropriate for our purposes.¹¹

(ii) The fault factor $Y/(1-Y)$, where Y ranges between 0 and 1, reflects the advantage of "having truth on your side". If Y has a high value (close to 1) the facts favor the Plaintiff; if Y is close to 0, the facts favor the Defendant. In the limiting case $Y=0$, on our assumptions the Plaintiff can never prevail; at the other extreme, if $Y=1$ the Plaintiff is certain to win.

Solving for Plaintiff's chance of victory:

$$\pi = \frac{L_P^\alpha Y}{L_P^\alpha Y + L_D^\alpha (1-Y)} \quad (4)$$

Of course, a corresponding expression can be written for Defendant's relative success $1-\pi$.

The two panels of Figure 1 illustrate simulations showing how Plaintiff's success π varies as L_P ranges upward from 0, Defendant's effort being held fixed at $L_D = .5$. 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]

Evidently, Plaintiff effort L_P always has a positive influence upon his success π , as revealed by the positive slopes of all the curves. Within each panel the different curves show the effects of changing the "decisiveness parameter" α . Note that higher α raises Plaintiff success π when $L_P > L_D$ but lowers π when $L_P < L_D$. In other words, α measures sensitivity to preponderance of 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. I.e., higher levels of fault always raise Plaintiff's prospect of success.

For the Defendant's optimizing decision we need the marginal product of

¹¹ Another possibility might be to express $\pi/(1-\pi)$ as a function of the difference L_P-L_D between the litigation efforts, as discussed in Hirshleifer [1989]. However, such a formulation implies that a side could invest zero effort and still retain some chance of winning. In the litigation context, this seems unreasonable: generally speaking, a litigant who fails to present a case cannot win.

her litigation effort L_D for given Plaintiff effort L_P . Defining $mp_D \equiv d(1-\pi)/dL_D \equiv -d\pi/dL_D$, we have:

$$mp_D = \frac{\alpha L_D^{\alpha-1} L_P^\alpha Y (1-Y)}{[L_P^\alpha Y + L_D^\alpha (1-Y)]^2} \quad (5)$$

The two panels of Figure 2 show how Defendant's marginal product varies as a function of her effort L_D , Plaintiff's effort held constant at $L_P = .5$. In Figure 2a fault is held constant at the mid-value $Y = .5$; the different curves show the effect of changing α . The diagram indicates that for sufficiently low effort decisiveness ($\alpha \leq 1$) diminishing marginal returns to litigation effort govern throughout -- whereas, at higher levels of α , there is an initial range of increasing marginal returns. Figure 2b illustrates the effect of changing degree of fault Y , holding decisiveness fixed at $\alpha = 1$. Here the curves indicate that for a relatively "guilty" defendant (Y near 1), her marginal product of fighting is initially low and falls slowly. But for a relatively "innocent" defendant (Y near 0), mp_D is initially extremely high but falls off rapidly. (Explanation: once her relative success approaches 1, there's not much room for raising it further by increased legal effort.)

[Figure 2]

III. OPTIMIZATION AND EQUILIBRIUM

Under our assumption of risk-neutrality, each side will simply want to maximize its V_i -- the expected value of the lawsuit.

In our Stackelberg model, Defendant as second-mover knows the L_P she faces, hence chooses L_D as a straightforward optimization problem:

$$\text{Defendant: } \quad \text{Max } V_D \quad = \quad \pi J_D - C_D \quad (5) \\ \quad \quad \quad (L_D | L_P)$$

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

In choosing L_D , assuming an interior solution is applicable, Defendant

equates her 'value of the marginal product' of litigation effort $J_D \times mp_D$ to its marginal cost γ . This is the first-order condition:

$$J_D \frac{-\alpha L_P^\alpha L_D^{\alpha-1} Y (1-Y)}{[L_P^\alpha Y + L_D^\alpha (1-Y)]^2} = \gamma \quad (6)$$

Since the mp_D curves are not always monotonic, even setting aside corner optima there may be more than one solution satisfying the first-order condition. Being careful to choose only the best solution, i.e., an L_D also satisfying the second-order condition for a maximum, we obtain Defendant's Reaction Curve RC_D . As pictured 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 smaller for any given L_P . Figure 3b shows the effect of varying fault Y . When Defendant has a weak case (high Y), this peak occurs at low L_P -- whereas with a strong case (low Y) her peak occurs much later. Interpretation: 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 if Plaintiff on his side is putting in a big effort.

[Figure 3]

To allow for corner solutions, 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:

$$\begin{aligned} L_D &= \bar{L}_D, \text{ if } V_D(\bar{L}_D) \geq J_D \\ L_D &= 0, \text{ otherwise} \end{aligned} \quad (7)$$

IV. SOLUTIONS AND COMPARATIVE STATICS

In accordance with the Stackelberg solution concept, Plaintiff will be

choosing 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 (7) which allows for Defendant's possible choice of an interior or a corner solution.

Holding constant the stakes parameters ($J_p = 1$, $J_D = -1$) and marginal cost ($\gamma = .5$), Figure 4 illustrates a convenient "base case" where the decisiveness coefficient is set at $\alpha = 1$ and the recovery coefficient at $\rho = 0$. 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 $L_D > L_p$ up to the mid-value $Y = .5$, at which point Defendant begins to cut back her effort. It pays Plaintiff to continue increasing his effort 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 .¹²

[Figure 4]

Figure 4b shows V_p and V_D -- the values of the lawsuit for Plaintiff and Defendant. Notice that when Defendant is at her corner solution, having chosen $L_D = 0$, 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 $Y = .5$, Plaintiff shifts discontinuously to a much higher effort 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 .

Evidently, the prospect of partial recovery benefits Plaintiff and correspondingly disadvantages Defendant, when the former has a good case (high level of fault Y). And if Y is high, with $\rho > 0$ fewer lawsuits

¹² It might be thought that when Defendant sets $L_D = 0$, Plaintiff should shift to the infinitesimal L_p that would suffice to achieve $\pi = 1$. He cannot do this, however, since the Stackelberg condition requires him to move first. He has to invest the effort required to deter Defendant from choosing a positive L_D .

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 decisiveness parameter from $\alpha = 1$ to $\alpha = .5$. Here both sides 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 summed values $V_P + V_D$ are generally higher, owing to the reduced fighting efforts.

With the lower decisiveness coefficient, Plaintiff now does a little better when he has a poor case (low Y) and 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 the amount of this excess is less for low α : decisiveness 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 decisiveness coefficient ($\alpha = 2$), 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 force 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 decisiveness 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]

V. 'JUSTICE' VERSUS SOCIAL COST

There are two main criteria for evaluating the social performance of a litigation system: (i) the degree of 'justice' achieved, and (ii) the aggregate costs incurred. Both of these elements are readily pictured in terms of our analysis.

An ideally just system, we contend, would meet the condition:

$$\pi = Y \tag{8}$$

That is, Plaintiff's relative success should equal Defendant's degree of fault. This is particularly clear if π is interpreted as Plaintiff's share in a deterministic division of the stakes. Thus if fault is 50%, the contenders should split the stakes equally. Of course, under risk-neutrality this is equivalent to each side having a 50% chance of winner-take-all victory.

As for cost, it would evidently be desirable to have $C_p + C_D$ as small as possible. This is equivalent to the summed valuations $V_p + V_D$ being as large as possible. However, there might be some question as to whether the cost criterion should consider only litigation costs. Ideally, a judicial system ought to minimize the overall social cost of wrongful acts, not the cost of litigation alone. However, we would argue, the legal standards determining the definition of fault Y and amount of damages J_p, J_D to be received or paid already reflect the extent to which the associated wrongful acts are intended to be deterred. So, taking the legal standards as given, our analysis concentrates upon the cost of litigation proper.

For the specific simulations considered in the preceding section, Figure 8a shows how Plaintiff's relative success π varies as a function of fault Y . Figure 8b similarly shows how total cost $C_p + C_D$ varies with Y .

[Figure 8]

On our definition of 'justice', $\pi = Y$, ideally $\pi(Y)$ would lie along the 45° line. In our model that cannot ever exactly occur since, as equation (3) shows, π depends not only upon Y but also upon the legal efforts L_p and L_D . But equation (3) indicates that the effects of the

L_i are attenuated when decisiveness α takes on low values. Correspondingly, in Figure 8a -- dealing for the moment only with the three curves for which recovery $\rho = 0$ -- the low-decisiveness curve ($\alpha = .5$) lies nearest to the 45° line while the high-decisiveness curve ($\alpha = 2$) diverges the most.

Note that $\pi(Y)$ almost always lies below the 45° line for $Y < .5$ and above the 45° line for $Y > .5$. (The only exception is associated with the range of discontinuity along the $\alpha = 2$ curve starting about $Y = .3$, where Defendant has surrendered.) In other words, allowing for legal effort tends to bias the results against whichever side has the weaker case. We might say, paradoxically, that -- owing to the interaction with the optimal legal efforts on both sides -- 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, under the Stackelberg condition there is also 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 $\alpha = 2$ curve, where Plaintiff can induce such surrender starting with a fault level as low as $Y = .3$.

Our simulations allowed for a recovery factor, specifically $\rho = .5$, only for the case where $\alpha = 1$. Comparing the two curves for $\alpha = 1$, there is of course no difference until the point of discontinuity is reached at $Y = .5$ -- at which point π jumps to unity. Of course, that the possibility of recovery favors Plaintiff is not surprising.

Figure 8b indicates that social cost $C_p + C_D$ tends to be least at the two extremes: very high fault and very low fault. 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. The picture here parallels the finding in Priest and Klein (1984) that cases where true fault is near the legal standard are more likely to be litigated.¹³

¹³ However, Priest and Klein rest their argument upon differences in beliefs as to the degree of fault relative to the legal standard, and therefore as to the outcome of litigation. In our model there are no differences in belief. The social costs of litigation are greatest for middling values of fault Y because, at $Y = .5$, the "fault factor" in the

Also in line with expectation, comparing the different curves we see that costs are least for the low decisiveness coefficient $\alpha = .5$. Since low α minimizes the effect of litigation efforts L_i , neither side wants to invest so heavily in them.

A possibly surprising feature of Figure 8b is that, in the ranges of discontinuity where Defendant concedes, the overall social cost does not fall to very low levels. In fact, costs jump sharply at these discontinuity points. The reason is that, in order to induce Defendant to set $L_D = 0$, Plaintiff has to commit to quite a high L_P .¹⁴

VI. SUMMARY AND DISCUSSION

In the previous analytic literature, the judicial system was typically assumed to be perfect, whereas litigants' beliefs as to true fault Y and the consequent outcome were subject to error. We reverse these assumptions: in our model litigants' beliefs are correct, but the judicial system is imperfect. (Both litigants know the truth, but the court does not.)

Plaintiff's relative success π , under the assumption of risk-neutrality, can be interpreted either as his probability of yes/no victory or his deterministic share of the stakes at issue. Defendant's corresponding success is of course $1-\pi$. The most novel feature of the model is the Legal Success Function (LSF), in which the relative degrees of success are a function of both a "fault factor" $Y/(1-Y)$ and an "effort factor" L_P/L_D , the L_i ($i = P, D$) being the litigation efforts on the two

Litigation Success Function (3) cancels out. Since the "effort factor" L_P/L_D then alone determines the outcome, both sides rationally choose high values of litigation effort.

¹⁴ Thus, for $\alpha = 2$, comparison with Figure 7 indicates that, at the discontinuity around $Y = .3$, Plaintiff's $V_P = \pi J_P - C_P(L_P)$ is rising smoothly rather than discontinuously. While his probability of victory π does jump when Defendant surrenders, so do the costs associated with his discontinuously higher L_P . In fact, the increase in $C_P(L_P)$ exceeds the decrease in $C_D(L_D)$ -- mainly because Defendant is in the range where her mp_D , the marginal product of her litigation effort, is still quite high. So Plaintiff does a little better but, in aggregate, higher social costs are incurred.

sides. The relative weight attaching to the effort factor relative to the fault factor is indicated by a decisiveness coefficient α . Also involved in the litigants' decisions are the cost functions $C_i(L_i)$, here assumed identical for the two sides.

We analyzed the optimal L_P, L_D choices in terms of a Stackelberg model where Plaintiff has the first move. However, we also allowed for the possibility that Plaintiff can recover some his initial L_P commitment in the event that Defendant concedes the case (chooses $L_D = 0$). Finally, we interpreted the results in terms of two welfare criteria. First, that 'justice' calls for $\pi = Y$: 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 results of our simulations:

- (1) In general, low decisiveness α leads to small litigation efforts L_P, L_D . This in turn means that the 'justice' condition $\pi = Y$ is closely approximated, and of course that $C_P + C_D$ is quite low.
- (2) The summed costs $C_P + C_D$ are low toward the extremes where $Y = 0$ or $Y = 1$, and high for middling values of fault.
- (3) "Virtue is over-rewarded." Owing to the interaction between fault levels and litigation efforts, outcomes tend to be biased excessively in favor of whichever side has the better case. This bias is least for low values of α .
- (4) The Stackelberg condition generates a pro-Plaintiff bias. Under certain windows of parameter values, Plaintiff can commit to an L_P sufficiently high to induce Defendant to concede -- to set $L_D = 0$. For our "high" decisiveness case ($\alpha = 2$), Defendant was forced to concede even at strikingly low values of fault, around $Y = .3$.
- (5) Pro-Plaintiff bias is exacerbated by possible partial recovery of his investment in the event of Defendant surrender. The recovery prospect means that Plaintiff can now threaten higher L_P values than would otherwise have been profitable.
- (6) For the ranges of parameter values where such bias induces Defendant surrender, it might have been thought that there would at least be an offsetting social benefit in the form of reduced litigation cost. Surprisingly, perhaps, this is not the case. In order to induce surrender,

Plaintiff must commit to high L_p . Even when partially recovered, the commitment to high L_p outweighed the social cost saving due to lower L_D .

We have by no means traced out all the possible implications of our underlying approach. It would have been possible to extend the model so as to consider the implications of:

- (a) varying the absolute and relative magnitudes of the stakes (J_p and J_D);
- (b) varying the size of the variable cost parameter (γ);
- (c) allowing for fixed as well as variable costs of litigation;
- (d) allowing for intended or unintended aspects of the legal system that might, for example, make it easier to sue than to defend against suit -- or the reverse.

In the light of our various "unrealistic" assumptions, we do not feel this exploratory model warrants very confident inferences about possible legal reforms. However, several implications of the analysis seem very suggestive. The overwhelming source of inefficiency -- of both (i) high costs $C_p + C_D$, and (ii) disparities between π and Y -- are large litigation efforts L_p and L_D . So reforms should plausibly aim at reducing the motivations to invest heavily in litigation effort.

Since high decisiveness α is the most powerful influence pressing the parties toward large litigation efforts, we are led to ask: How can the decisiveness parameter α be reduced? To the extent that judges are more likely than juries to see through the noise, increasing the allowable scope of non-jury trials may be indicated. If a second implication of our model is also accepted, namely a tendency toward a pro-Plaintiff bias over a wide range of parameter values, then perhaps Defendant should always have the right to call for a non-jury trial.¹⁵

Higher court fees, proportioned to the "size" of the trial (in terms of days spent in the courtroom, pages of documentation, etc.) would raise the marginal cost γ of litigation effort, and thus also evidently reduce the equilibrium levels of L_p and L_D . A tax on judgment awards -- whether in

¹⁵ In American civil litigation, broadly speaking, a non-jury trial is permitted only if both sides waive the right to jury. In contrast, in the English system Defendant has the option proposed here.

favor of Plaintiff or Defendant -- would similarly lead to smaller equilibrium investments in litigation on both sides. So far as we know, the suggestions in this paragraph have never been seriously proposed.

One reform that has been proposed is shifting from the 'American rule' of cost-bearing to the 'English rule' (loser pays). While we have not modelled this explicitly, it seems a reasonable conjecture that the effect would be to increase the litigation effort of the side with the better case -- the Plaintiff if $Y > .5$, and the Defendant otherwise -- and thus improve the correlation between Y and π . One other proposed reform, caps on judgment amounts in the event of Plaintiff victory, has serious flaws. There would be no effect upon judgments falling below the cap, and beyond that (i.e., for cases possibly involving genuinely large losses) there is an obvious bias against Plaintiffs.

However, to repeat the general caveat above, the gaps between the simplified world of our model and the intricacies of real-world litigation mean that these suggestions must be treated with considerable reserve. One feature worth mentioning: the seeming pro-Plaintiff bias indicated by our simulations is exclusively due to our assumption that Plaintiff can commit in advance to a specified degree of litigation effort. (And that bias is exacerbated to the extent that Plaintiff can recover a fraction of his commitment should Defendant concede.) Using a more symmetrical protocol of interaction, or a fortiori if Defendant were regarded as in a position to commit first, the indicated bias would be quite different.

Whatever the best assumption about commitment might be, we hope our analysis will be illuminating in underlining the significance of that assumption. And similarly for the other implications of our model, crucial among which is the dependence of relative success upon both relative fault and relative effort, as weighted by the decisiveness coefficient α . While the specific form of the Litigation Success Function that best pictures the litigation process may not be quite as postulated here, we believe that a useful first step has been taken in analyzing the legal battle.

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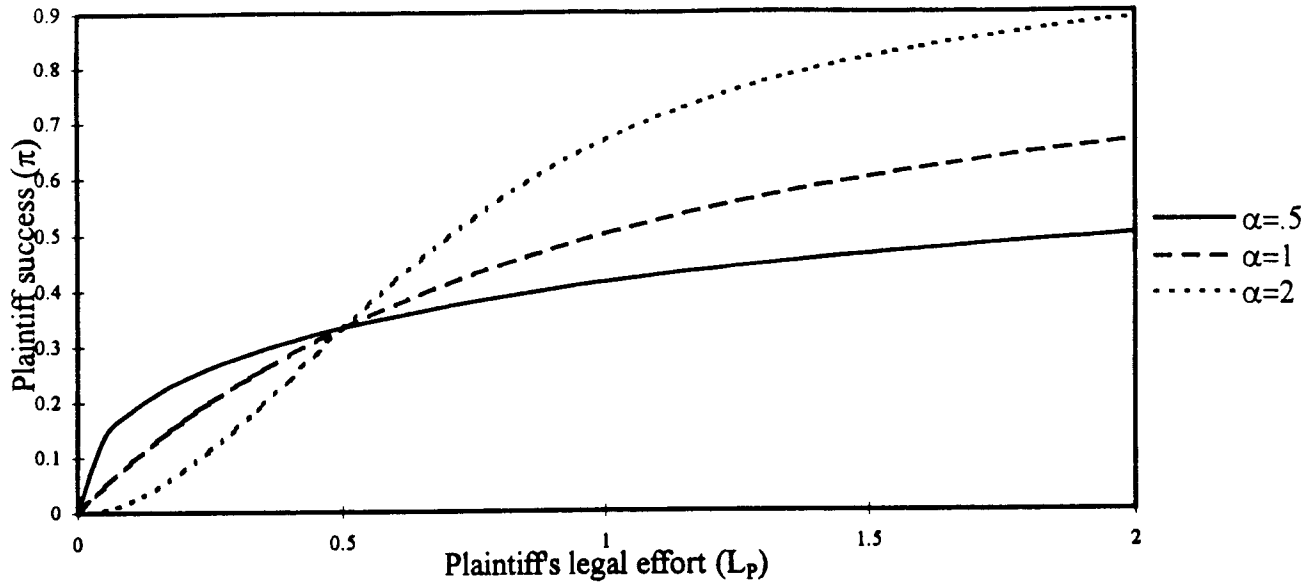
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Figure 1
Plaintiff Success as Function of Legal Effort

Panel (a) - Low fault
 $L_D = .5$, $Y = 1/3$, Varying α



Panel (b) - High fault
 $L_D = .5$, $Y = 2/3$, Varying α

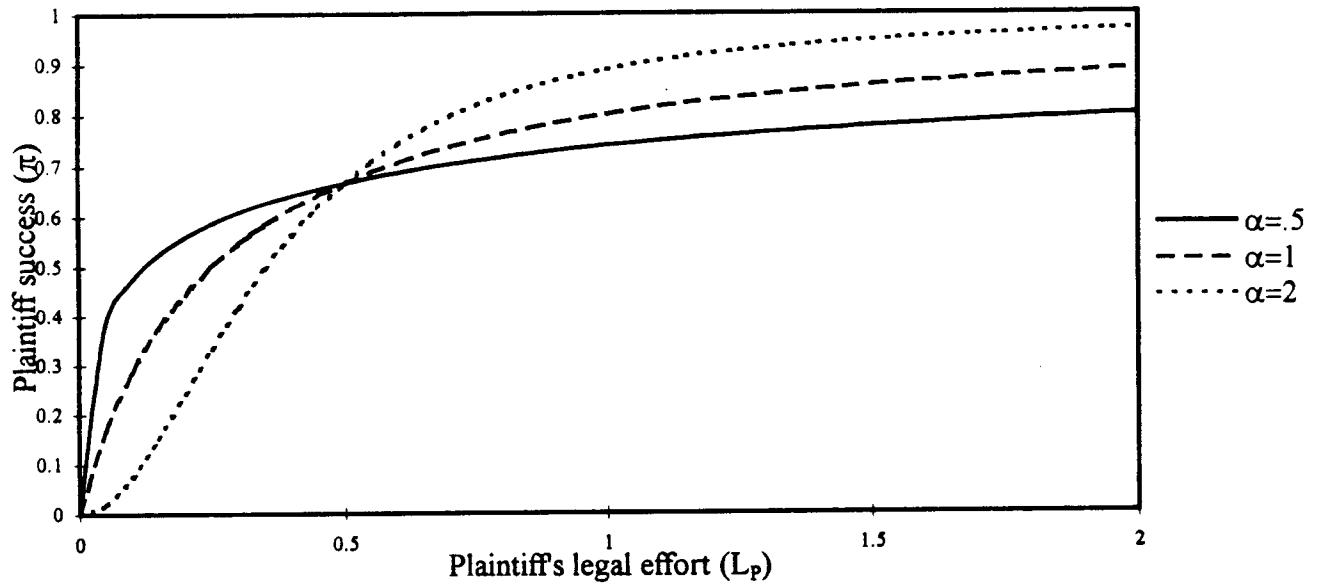
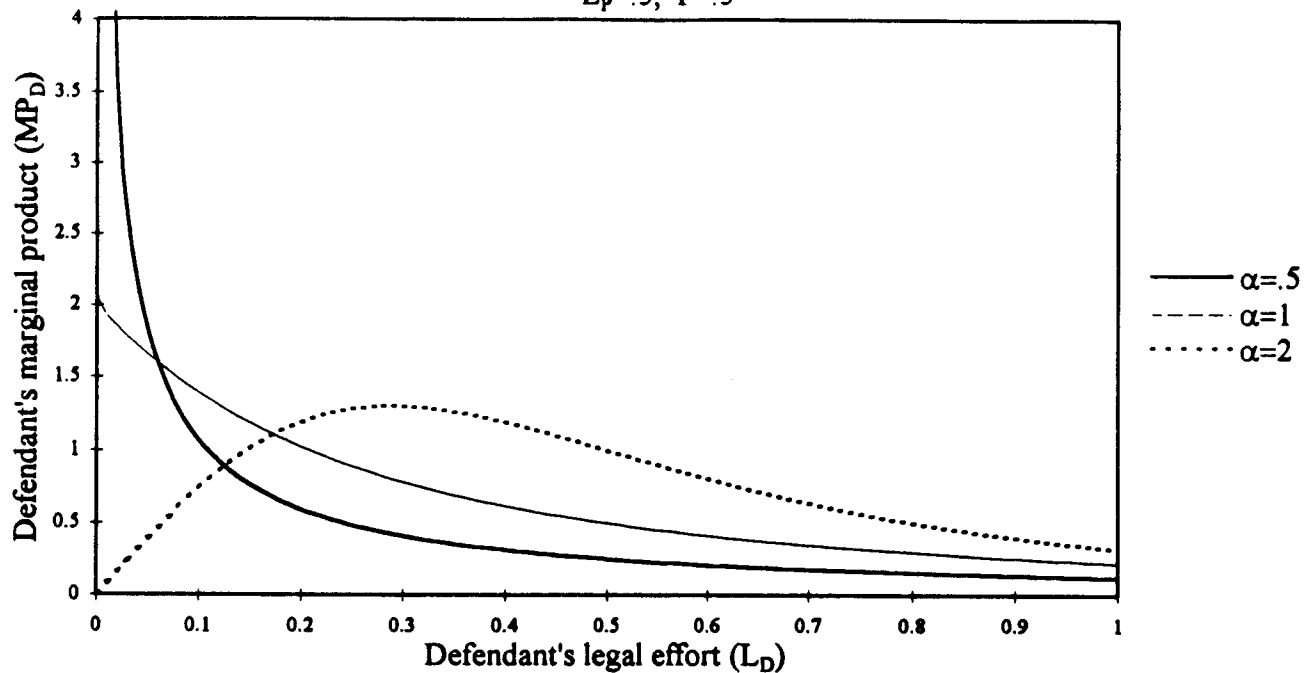


Figure 2
 Marginal Product of Defendant's Legal Effort

Panel (a) - As decisiveness (α) varies
 $L_p = .5, Y = .5$



Panel (b) - As fault (Y) varies
 $L_p = .5, \alpha = 1$

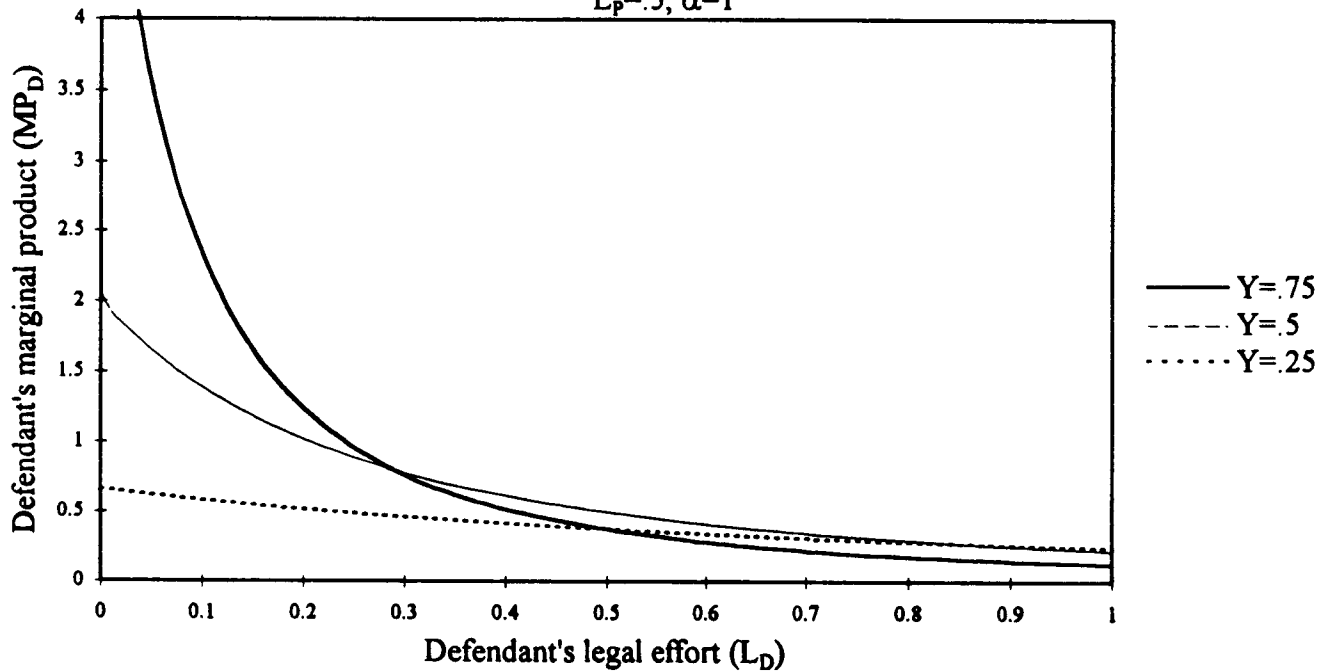
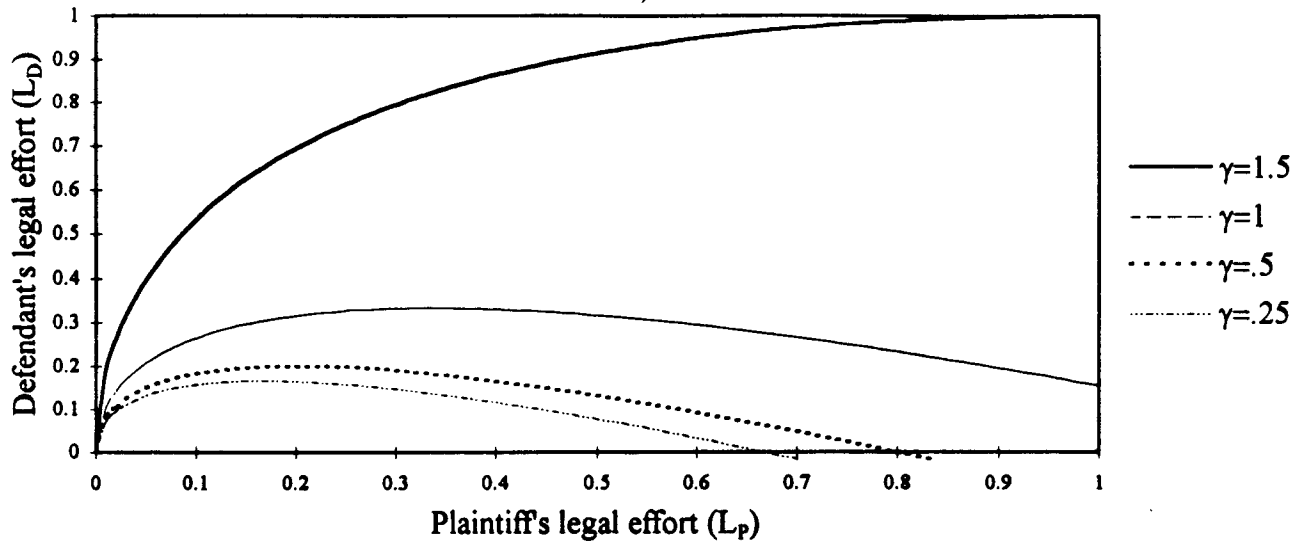


Figure 3
Defendant's Reaction Curves

Panel (a) - As marginal cost (γ) varies
 $\alpha=1, Y=5$



Panel (b) - As fault (Y) varies
 $\alpha=1, \gamma=5$

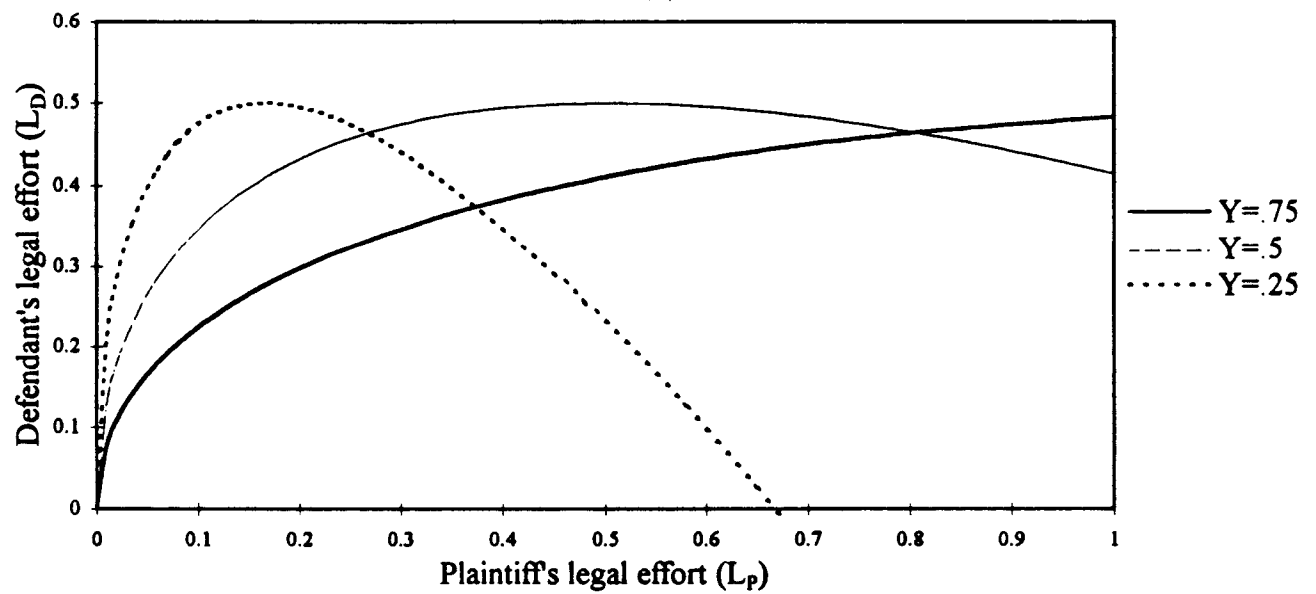


Figure 4
Effort Levels and Values of the Lawsuit, as Functions of Fault Y
(Base case)

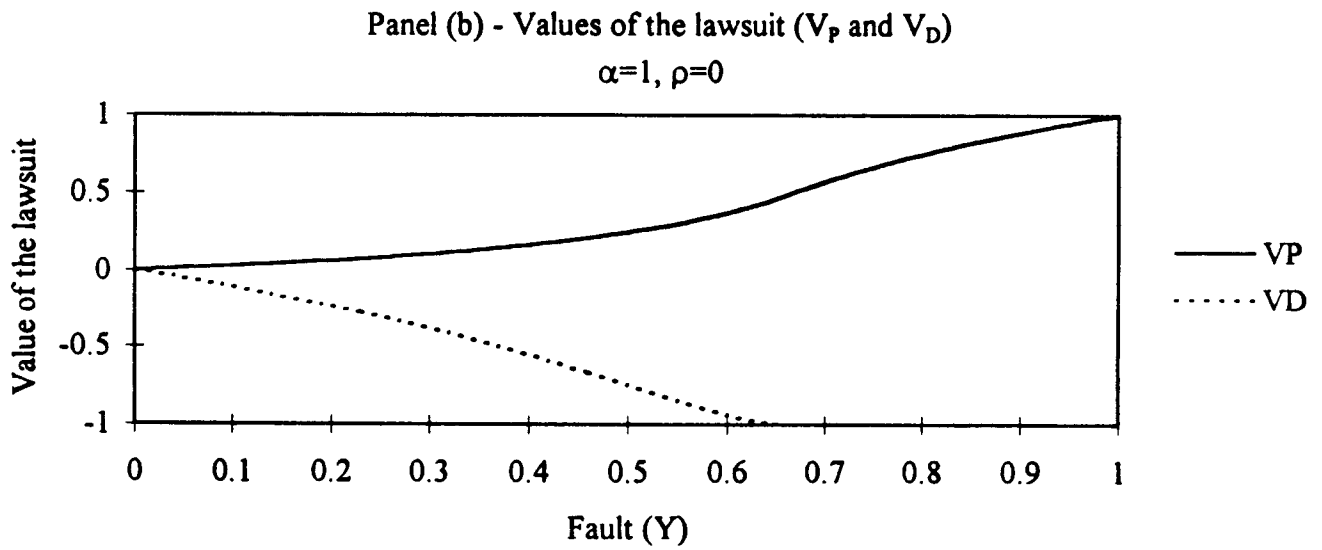
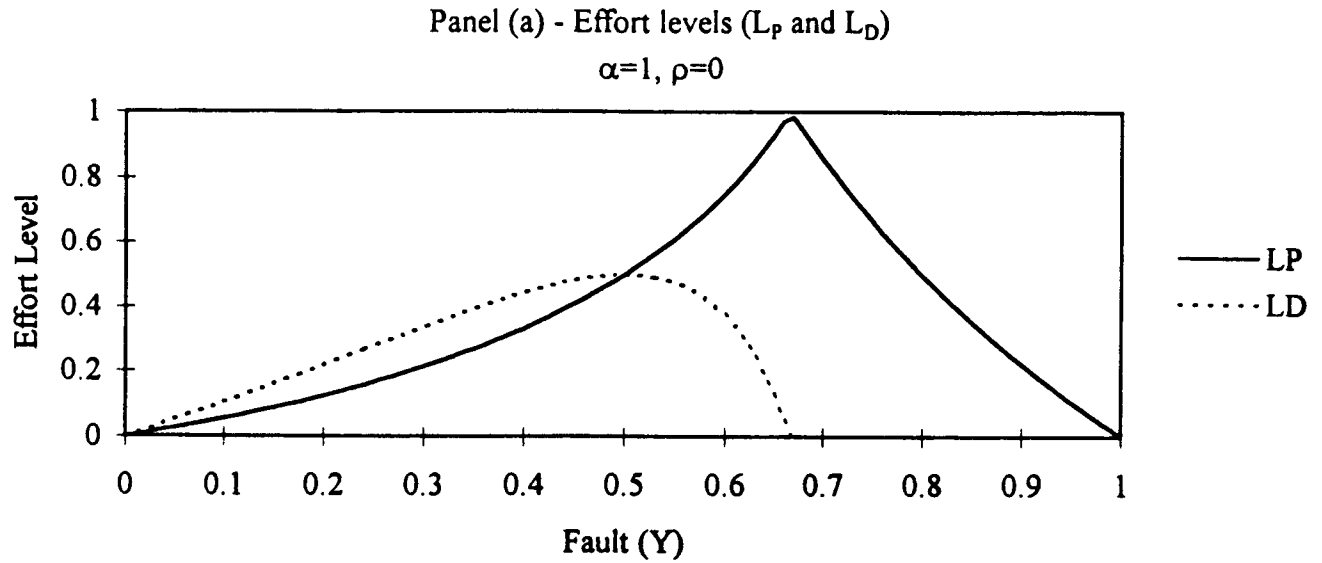


Figure 5
Effort Levels and Values of the Lawsuit, as Functions of Fault Y
(Allowing for recovery factor)

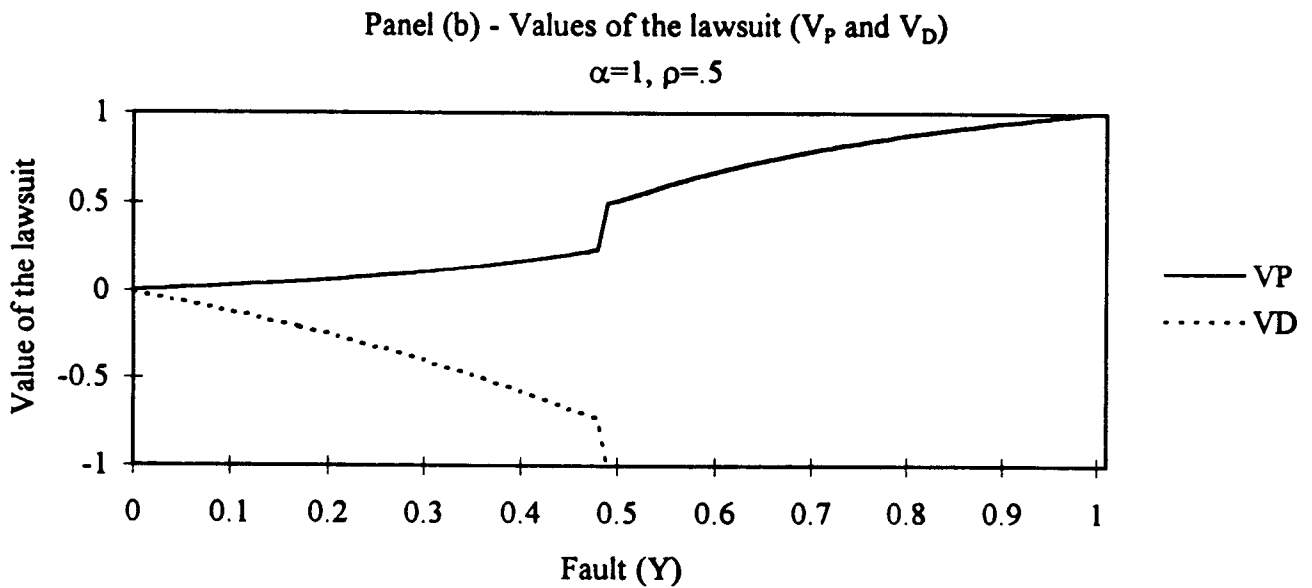
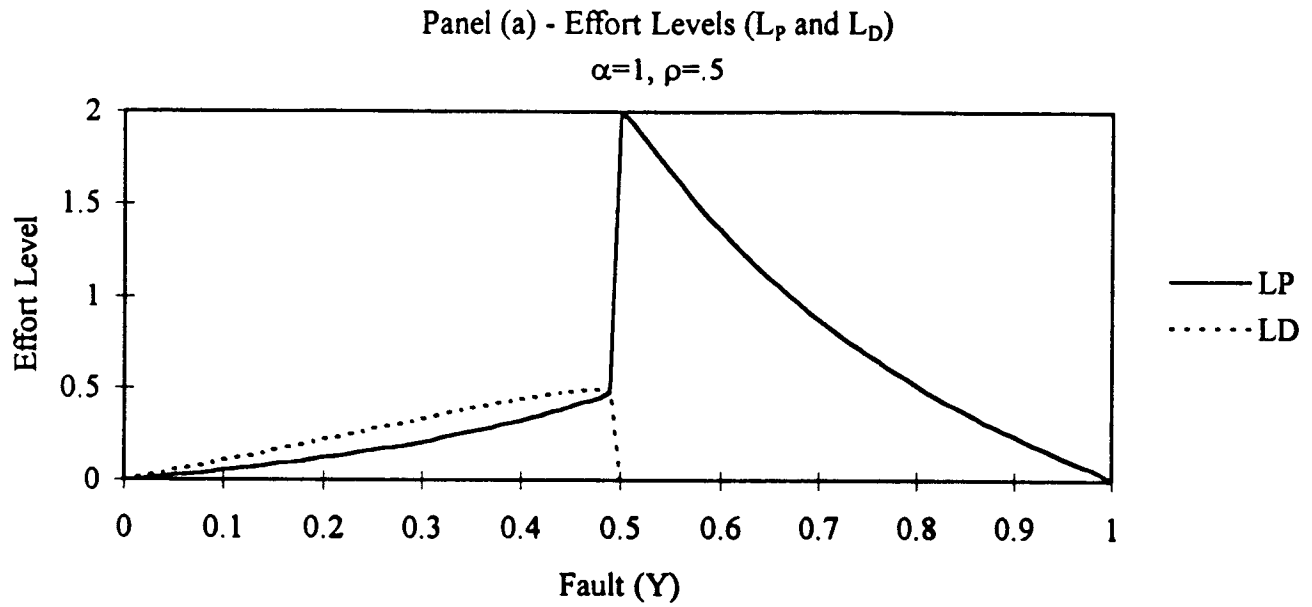
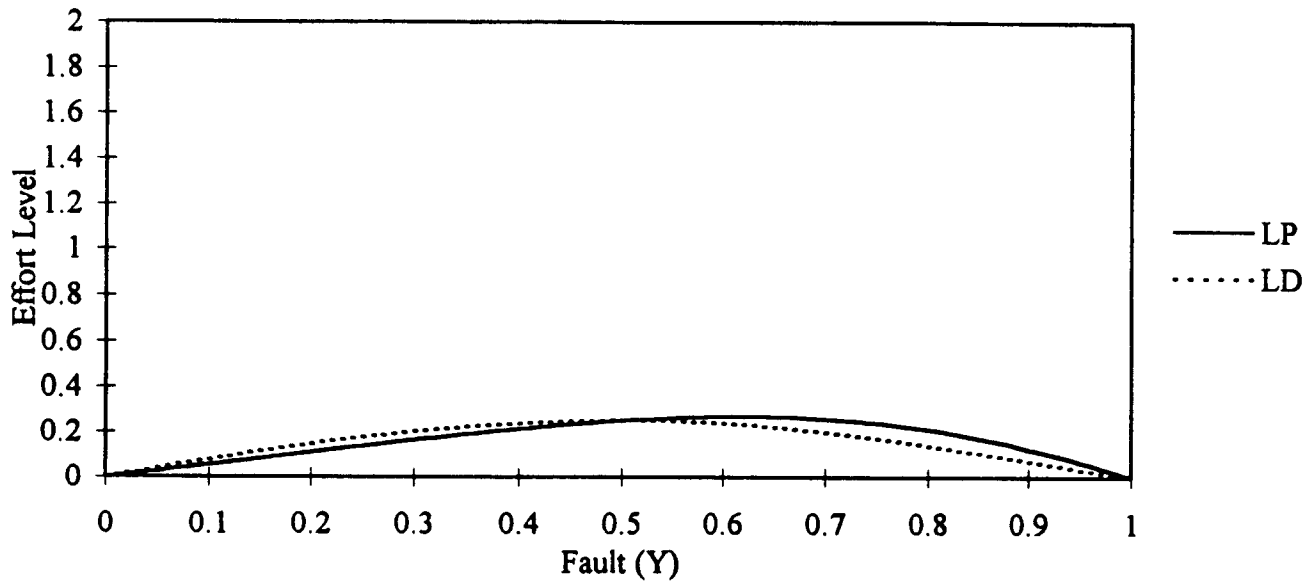


Figure 6
Effort Levels and Values of the Lawsuit, as Functions of Fault Y
(Low decisiveness)

Panel (a) - Effort levels (L_P and L_D)
 $\alpha=.5, \rho=0$



Panel (b) - Values of the lawsuit (V_P and V_D)
 $\alpha=.5, \rho=0$

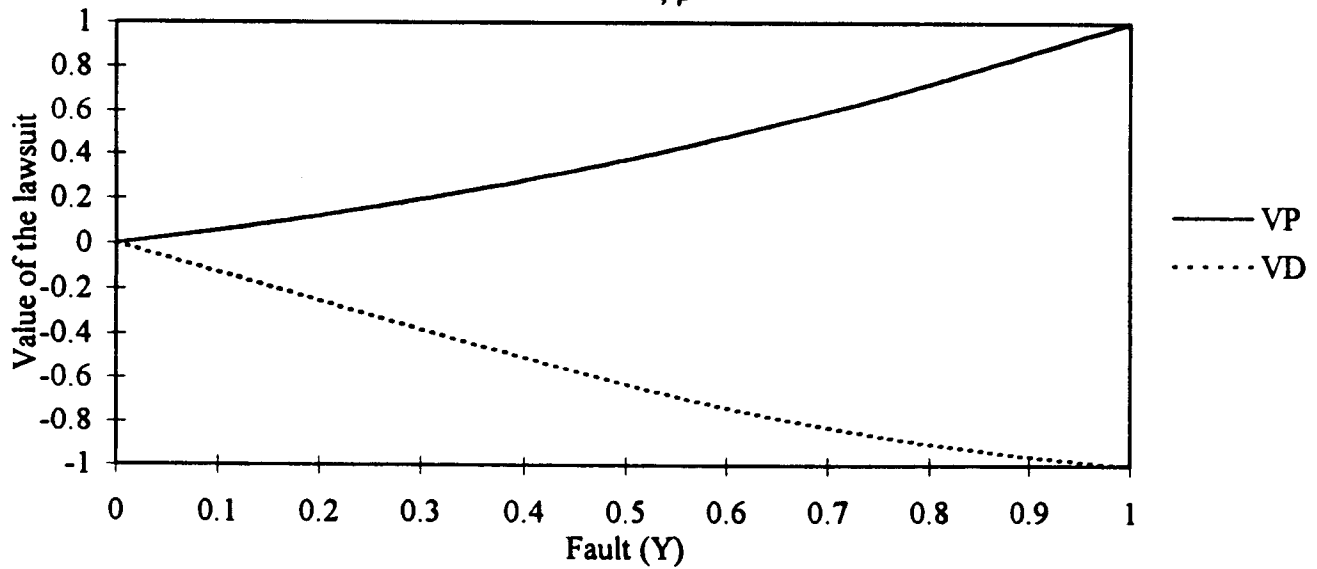


Figure 7
Effort Levels and Values of the Lawsuit, as Functions of Fault Y
(High decisiveness)

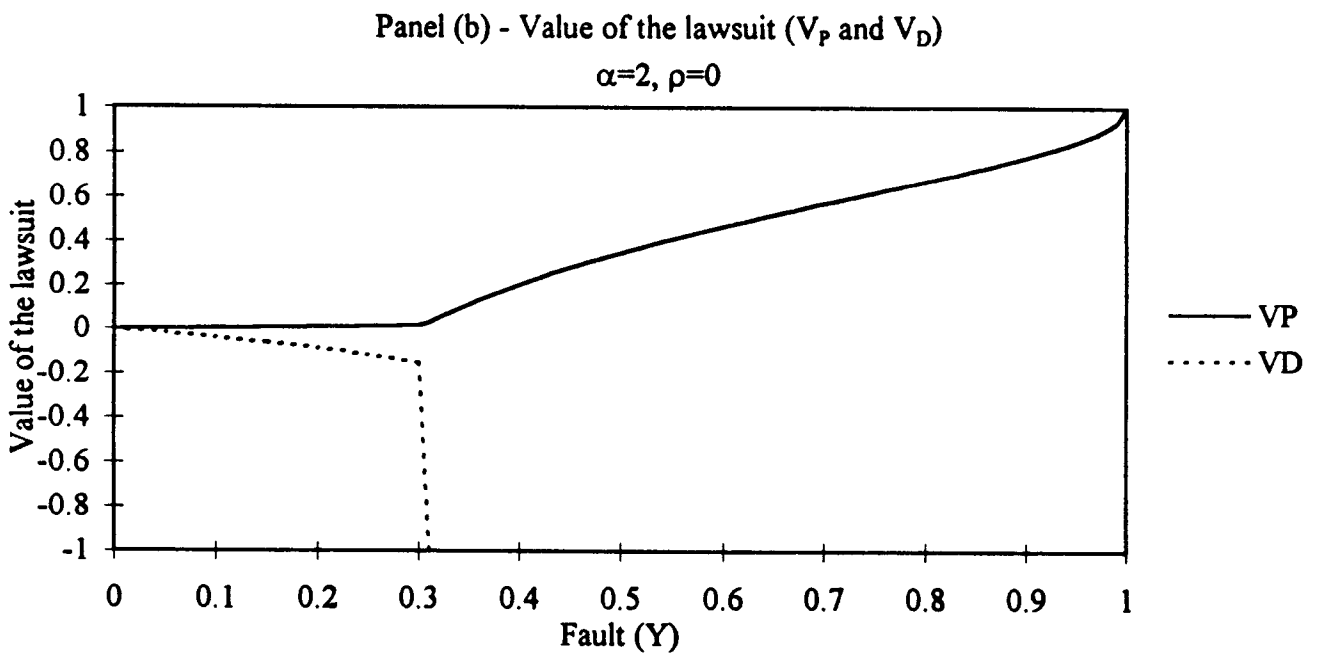
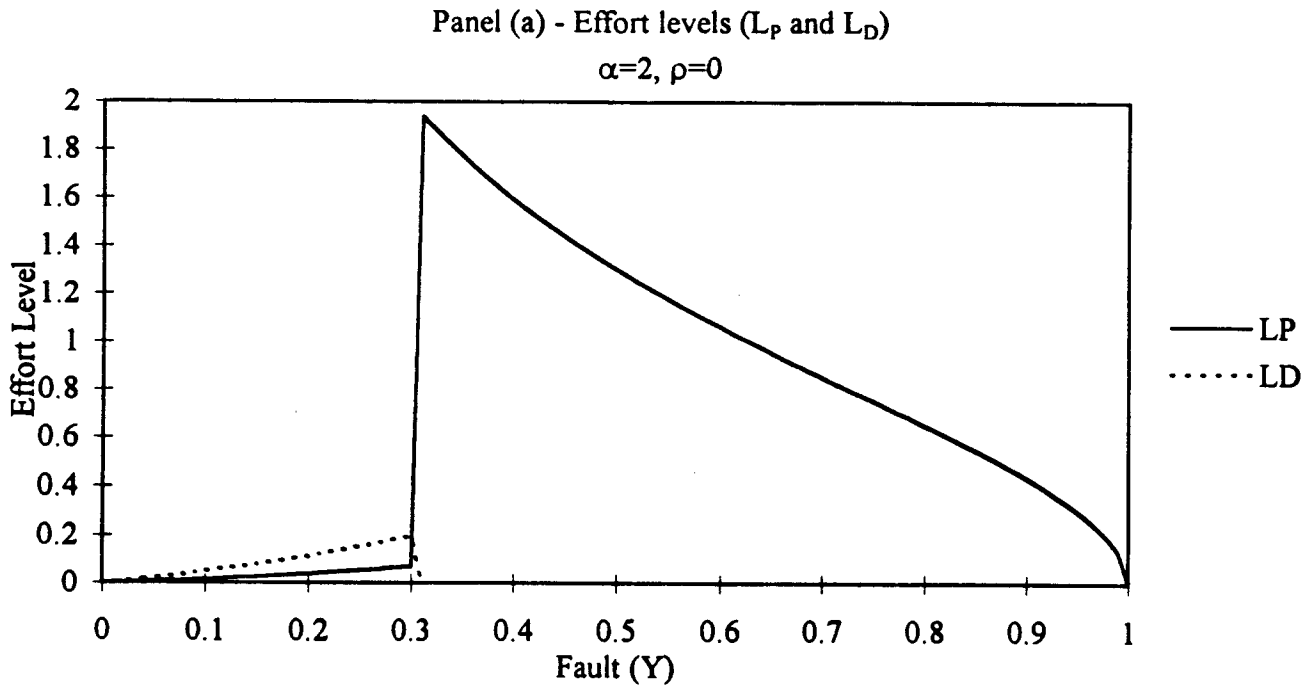
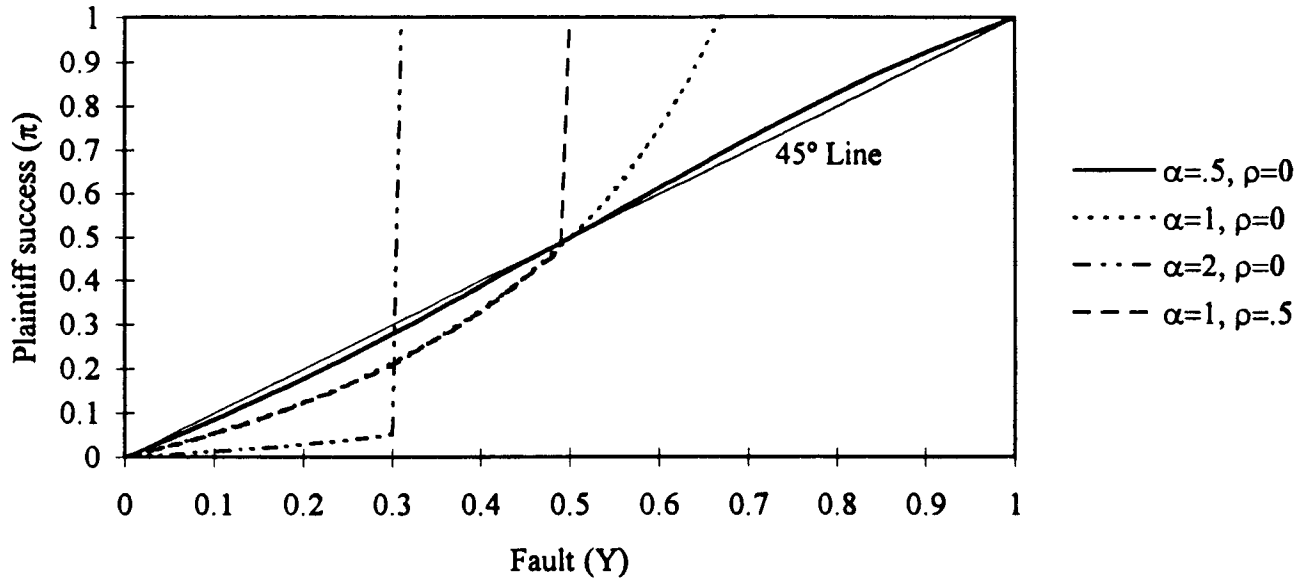


Figure 8
"Justice" versus Social Cost

Panel (a) - Plaintiff success (π) as a function of fault (Y)



Panel (b) - Social Cost ($C_p + C_D$) as a function of fault (Y)

