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The Effect of Frivolous Lawsuits on the Settlement of Litigation

ABSTRACT

It is commonly alleged that a substantial proportion of lawsuits are frivolous and are filed only for their nuisance value. This paper models settlement bargaining in the presence of frivolous suits as a game of asymmetric information, where the plaintiff knows the true merits of his claim, and the defendant does not, apart from any inferences he can draw from the fact of suit. When there is free entry to the opportunity to make a frivolous claim, the profit from doing so is driven to zero, and the surplus from settlement bargaining is completely dissipated. Several policies dealing with frivolous suits are examined; it turns out that requiring a losing litigant to pay the expenses of the winner (the English rule) does not alleviate the problem, but introducing a refundable deposit does.

1. Introduction

It is commonly alleged that a substantial proportion of lawsuits are frivolous or "strike" suits, that is, lacking merit and filed only in the hopes of obtaining a favorable settlement.[1] The handling of such suits provides frequent cause for criticism of American civil procedure, on grounds both of efficiency and fairness. Indeed, in certain areas of the law such as medical malpractice, antitrust, and corporation law, the asserted prevalence of frivolous suits has commonly been cited as an argument for law reform. For example, recent critiques of treble damages in antitrust have emphasized the supposed encouragement such damages give to strike suits.

The fairness objection to frivolous suits is that such suits can result in opportunistic persons obtaining payments to which they are not entitled, at the expense of innocent defendants who may be viewed as defrauded or under a sort of duress. The efficiency objection is that the rent-seeking occasioned by frivolous suits wastes resources both directly and indirectly. The direct costs include resources used in filing and defending such suits, as well as costs of investigation and discovery as defendants attempt to distinguish frivolous from genuine claims. The indirect costs stem from the additional trials required because the presence of frivolous plaintiffs in the population of litigants interferes with the settlement of legitimate claims.

This article develops a model of litigation and settlement in the presence of frivolous suits, defined as those that have a sufficiently low chance of prevailing at trial that they would not be brought but for the

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1. See, e.g., the discussion in Rowe (1984), at p. 151.

prospect of settlement.[2] The model views the settlement process as an asymmetric information game. Specifically, the plaintiff knows the true merits of the claim, while the defendant must base decisions on an estimate of the proportion of legitimate suits in the population, updated by any inferences he can draw from the plaintiff's behavior. When there is free entry to the opportunity to bring a frivolous claim, in a sense to be defined below, the number of frivolous claims is strictly proportional to the number of genuine claims. And, among the properties of the resulting equilibrium is that frivolous suits completely dissipate the surplus from settlement bargaining.

Section 2 of the paper briefly surveys and critiques related work in the literature on litigation and settlement. Section 3 develops the basic model of the paper, solves for its equilibrium, and derives some results in comparative statics. Section 4 discusses the model's implications for a number of policy proposals for civil court procedure. Section 5 summarizes the analysis and suggests some possible extensions.

2. Related work on strike suits and settlement

The first formal analysis of frivolous suits was by Rosenberg and Shavell (1985). They develop a full information model in which a frivolous plaintiff can obtain a positive settlement even though the defendant knows

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2. The analysis here thus does not address the problem of suits in which the prospect of judicial error or confusion at trial permits a plaintiff to obtain a settlement which is undeserved according to some external objective standard. From the perspective of this paper, suits of the latter type are legitimate.

with certainty that the plaintiff would not go to trial. This result follows from the particular sequential structure of their model. First, the plaintiff decides whether to bring suit, which costs an amount c. Second, if suit is brought, the plaintiff chooses a settlement demand equal to S. Third, the defendant then decides whether to accept the settlement, to default and pay the alleged stakes A, or to defend the suit at a cost of k. Fourth and finally, if the defendant chooses to defend, the plaintiff chooses whether to drop the lawsuit or to litigate at a cost of t. The plaintiff has a probability w of winning the suit, so that his expected gains from going to trial are wA-t (where if wA-t is negative, the suit is denoted frivolous.)

The solution of the model is found by backwards programming. At the last stage, a frivolous plaintiff would withdraw, so that a defense results in payoffs (-c, -k) for plaintiff and defendant respectively. At the third stage, therefore, the defendant will accept a settlement S if and only if it is less than min [A, k]. The plaintiff thus chooses S in stage 2 so that it is infinitesimally less than min [A, k]. The payoff from bringing suit is then (min [A, k] - c, -min [A, k]), and if defense costs and the alleged stakes are both greater than the filing costs c, strike suits will be brought in equilibrium and will receive a positive settlement.

This result, however, depends critically on two particular assumptions of the Rosenberg/Shavell framework. First, they assume that the plaintiff rather than the defendant makes the settlement offer. In reality, a potential strike suitor is often a one-shot litigant, while the potential defendant is often a well-established person or business with incentives to establish a reputation. Such a defendant would seem more likely as the plaintiff to make a credible take-it-or-leave-it offer.

Second, the Rosenberg/Shavell result depends upon the assumption that

once suit has been brought, the defendant must spend the entire cost of a defense before the plaintiff faces the decision whether to continue. In reality, a defendant who knows the suit to be frivolous can respond by filing an answer consisting merely of a blanket denial of the plaintiff's allegations. This will suffice to avoid default, and the defendant can thereby shift the burden of the next expenditure to the plaintiff at little immediate cost. Since the plaintiff's ultimate threat to go to trial is not credible, the defendant may be able to ignore it. The reason that frivolous suits are not always met with blanket refusals to negotiate, of course, is that the defendant rarely knows the merits of the claim with certainty.

There has developed a substantial literature on litigation and settlement under imperfect information. Most of the contributors, however, have assumed the plaintiff's threat to go to trial to be credible, thus ruling out the possibility of strike suits. In contrast, a recent working paper by Bebchuk (1987) makes the point, developed more generally in the section below, that when defendants have incomplete information regarding injury, frivolous suitors can profit by free riding on the presence of genuinely injured persons in the pool of litigants. Bebchuk's analysis, however, is incomplete in two respects: first, it ignores the costs of filing suit, and second, it assumes a fixed number of potential strike suitors either all of whom or none of whom bring suit. These assumptions lead to a focus on what is shown below to be a special case.

More recently, a paper by Nalebuff (1987) explores a model of settlement bargaining in which it is the plaintiff rather than the defendant who is uninformed regarding the extent of injury. Because rejection of a small settlement demand can make the plaintiff's threat to litigate incredible, plaintiffs are led in Nalebuff's model to exaggerate their demands

in order to limit the bad news they learn from a rejection. He interprets such exaggerated threats as nuisance suits. While the model is undoubtedly interesting and useful, one may question whether it captures the features of strike suits that have received recent public attention, particularly in that the plaintiff does not know whether the suit is frivolous when he makes his demand. A more realistic and complicated model, which combines features of Nalebuff's model with the one developed here, will be necessary in order to explore the aspects of bilaterally assymmetric information that characterize actual disputes.[3]

3. The model and its equilibrium

3.1. Assumptions

Suppose that some event occurs that enables a plaintiff plausibly to claim an entitlement to legal compensation. Assume that the potential

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3. Several other articles shed light on various features of suits by plaintiffs who might not go to trial. Ordover and Rubenstein (1986) analyze a bargaining game which can be reinterpreted as a model of strike suits. They assume that the only way the suit can end is for one of the parties to give up, however, and are primarily interested in explaining the duration of a variable bargaining period.

P'ng (1983) considers the possibility that the plaintiff would not go to trial, in a model in which an informed defendant chooses whether to offer an exogenous settlement to an uninformed plaintiff. It is difficult to describe P'ng's plaintiff as a strike suitor, however, since like Nalebuff's he does not know whether his case is a winner.

Salant (1984) develops an model of litigation in which an informed plaintiff has already filed suit at the outset and is about to make an offer to an uninformed defendant. Although Salant does not explicitly consider the issue of strike suits, the approach is sufficiently general that a reinterpretation of the notation could yield some insights about the issue. He is concerned primarily, however, with the information transmitted by the amount of the settlement offer.

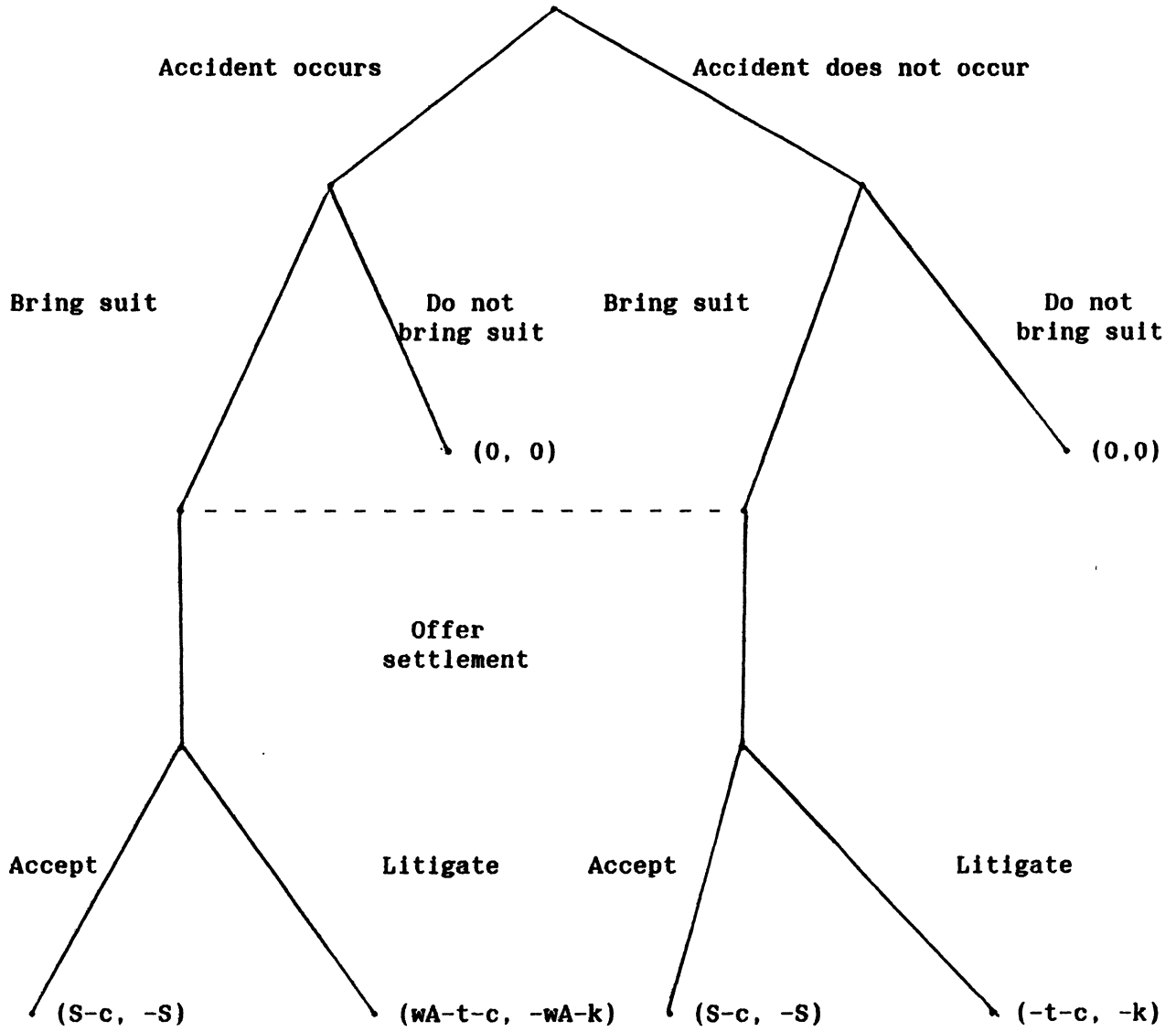
plaintiff knows with certainty whether he is actually injured. The defendant, in contrast, knows only the probability of compensable injury conditional on the initial event. To illustrate, consider a customer at a retail store who slips and falls on a wet floor that the store negligently failed to keep dry. The customer knows the true extent of his injury, but the store only knows that such falls result in injury a certain proportion of the time. A second illustration would be a products liability case in which the fact of injury is undisputed, but the plaintiff is not entitled to damages if he was contributorily negligent in using the product. The plaintiff knows whether he was negligent, but the defendant cannot know without a trial.

The litigation process of our model occurs in four stages. First, an injury either occurs or does not occur. Second, the plaintiff makes the decision whether or not to sue; this depends on both the expected settlement and the plaintiff's expected gains from trial should there be no settlement. Third, the defendant chooses a single take-it-or-leave-it settlement offer. Fourth, the plaintiff chooses whether to accept the offer, and if the offer is nonpositive, whether to drop the case or to proceed to trial. At trial the plaintiff's information is revealed, and judgment may be given for an injured plaintiff. The structure of the settlement game is shown in extensive form in Figure 1. Dotted lines indicate the defendant's inability to distinguish between two nodes of the game.

This framework involves a number of important assumptions. First, the assumption of a single offer is clearly restrictive. I abstract from this issue since my main goal is not to provide a general solution to the bargaining problem but to focus on how bargaining over just claims can induce

Figure 1

Structure of model



frivolous claims to arise. Whatever the defendant's settlement strategy, he faces a tradeoff between paying frivolous claims and risking trial against genuine claims. A more sophisticated bargaining strategy may reduce the defendant's expected losses without eliminating this essential tradeoff.

Second, the assumption that the defendant makes the offer simplifies the analysis considerably, in that information regarding the plaintiff's type is conveyed only by the fact of suit and not by the amount of the offer. Which version of the model is a better description of reality may vary according to the legal context, and may depend upon the type of claim and area of substantive law.

Third, I assume that the plaintiff faces no uncertainty regarding the defendant. When the defendant's conduct is also a major issue in the lawsuit, as in an antitrust case with allegations of conspiracy or in a suit centered on the defendant's alleged negligence, more complicated models may be needed. In such cases, however, it is more difficult to characterize the plaintiff's claim as frivolous; the problem may instead be that of frivolous defenses.

Fourth, I abstract from the fact that in an actual lawsuit the defendant may wish to spend resources to investigate the claim's validity, for example by paying for a medical examination or by engaging in civil discovery. The strike suitor's decision will be affected by the prospect of discovery, and easily disprovable claims may be deterred. Similarly, I assume that an injured plaintiff cannot credibly communicate the fact of injury (although he will have no incentive to do so if the defendant makes the final offer and gets all the gains from settlement.) For frivolous suits that are not so cheaply exposed, the analysis below will still hold. Complete information is

likely to be prohibitively costly. The defendant's probability estimate can be interpreted as that remaining after optimal investigation.

Fifth, I assume that a court can tell the merits of a claim without substantial error. For many areas of law, this is a reasonable approximation. But this assumption means that I do not address a class of lawsuits that in ordinary conversation are often referred to as frivolous; namely, cases where a plaintiff can obtain an undeserved recovery by taking advantage of judicial confusion or error. Such cases are alleged to occur in fields such as antitrust where facts and law are complex and special technical expertise is needed to decide correctly. Instead, I measure a case's merit positivistically, by how an actual court would decide it.

The preliminaries aside, suppose for that plaintiffs are either injured or not, with the prior probability of injury denoted as $p \in [0,1]$. The extent of injury is denoted as A and the likelihood of a finding of liability given that there is injury is denoted as $w \in [0,1]$; the expected award at trial for an injured plaintiff then equals wA.

The cost of trial if no settlement is reached is denoted as t for the plaintiff and as k for the defendant. In addition, a plaintiff must initially spend c to bring the lawsuit; this includes the costs of preparing and filing a complaint and making the fact of the lawsuit known to the defendant. Once suit has been brought, this cost is sunk and does not affect the decision to proceed to trial. The net expected gains for an injured plaintiff from trial, given that suit has been brought, then equals $wA - t$; the expected cost for the defendant when the injured plaintiff goes to trial is $wA + k$.[4]

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4. The defendant may also have costs prior to trial. Such costs are sunk by the time of settlement and hence do not affect the optimal settlement strategy, so I ignore them. In a model analyzing frivolous defenses as well

The analysis uses sequential equilibrium as its solution concept. Each plaintiff type chooses a strategy that is optimal given the strategies of the defendant and the other plaintiff type. The defendant chooses a strategy that is optimal given the plaintiffs' strategies and given his best estimates of the given plaintiff's type. The defendant's estimates are formed by updating his original beliefs according to Bayes' rule, through inferences drawn from the plaintiffs' behavior. Mixed strategies are admissible and indeed are necessary for the existence of equilibrium.

3.2. Solution of the game

The requirement of sequential equilibrium implies that the game is solved by reasoning backwards from its last stage, where the plaintiff must choose between accepting the defendant's offer S and going to trial. A frivolous plaintiff could obtain S by accepting the offer, could obtain -t by rejecting the offer, and could obtain zero by dropping the lawsuit. He would therefore accept any positive settlement offer, and would drop the lawsuit if faced with a zero or negative settlement offer. An injured plaintiff, by the same token, could obtain S by accepting the offer, could obtain wA-t by rejecting the offer, and could obtain zero by dropping the lawsuit. He would therefore accept a settlement if and only if it were greater than his expected gains from trial, wA-t.[5] Note that the initial complaint cost has no effect

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(continued)

as frivolous claims, such costs might become an important factor.

5. I assume without loss of generality that an injured plaintiff will always accept a settlement offer when indifferent.

on the decision to accept settlement. This is because that cost is sunk once the plaintiff brings suit.

Now when the defendant chooses S, he does not know which type of plaintiff he faces. The optimal S then depends upon his estimate of the probability that the plaintiff is injured. The defendant knows a genuinely injured plaintiff will always sue, because the net payoff from suit to such a plaintiff is the greater of s-c or wA-t-c; and I have assumed that wA-t-c is strictly positive.[6] Denote as q the probability that an uninjured plaintiff brings suit, and denote as r the defendant's posterior probability estimate that the plaintiff is injured. According to Bayes' rule:

$$(1) \quad r = \frac{p}{p + (1-p)q}$$

The value of r ranges from 1 to p as q ranges from 0 to 1.

The defendant's choice of S is simplified by observing that he should never make an offer other than S = 0 or S = wA-t. To see this, note that for $S \in [wA-t, \infty]$, both injured and frivolous plaintiffs will always accept the offer. The defendant's expected payout is therefore equal to S, which is minimized in the interval at wA-t. For $S \in [0, wA-t)$, frivolous plaintiffs accept the offer and injured plaintiffs prefer to go to trial. The defendant's expected payout is then equal to (1-r)S + r(wA+k), which is minimized in the interval at S=0. The intuition is that so long as the set of plaintiffs who accept the offer is unchanged, the defendant wants to make the

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6. This assumption is essential to the formulation of the problem. If wA-t<c, then in equilibrium neither frivolous nor injured plaintiffs will bring suit.

offer as low as possible.

The choice between offering zero or wA-t depends upon the value of r. Denote the threshold value of r as:

$$(2) \quad r^* \equiv \frac{wA-t}{wA+k}$$

The defendant's optimal settlement strategy is easily characterized. If $r > r^*$, the defendant offers $S = wA-t$. If $r < r^*$, the defendant offers $S=0$. And if $r=r^*$, the defendant is indifferent and chooses a mixed strategy, offering $S=wA-t$ with probability σ, and offering $S=0$ with probability $1-\sigma$, with $\sigma \in [0,1]$.

Note also that associated with the threshold value of r is a threshold value of q, equal to:

$$(3) \quad q^* \equiv \frac{p(1-r^*)}{(1-p)r^*} = \frac{p}{(1-p)} \frac{t+k}{wA-t}$$

If $q > q^*$, then $r < r^*$, and vice versa.

As for the frivolous plaintiff's decision whether to sue, this depends upon the value of σ. The net return to an opportunistic plaintiff is $\sigma(wA-t)-c$. Denote the threshold value of σ as:

$$(4) \quad \sigma^* \equiv \frac{c}{wA-t}$$

If $\sigma > \sigma^*$, a potential frivolous plaintiff will always bring suit. If $\sigma < \sigma^*$, no frivolous plaintiffs will bring suit. And, if $\sigma = \sigma^*$, frivolous

plaintiffs will be indifferent and will enter with some probability $q \in [0,1]$.

There are two possible types of equilibrium. Which type obtains depends upon whether the prior probability of injury p is greater or less than the threshold conditional probability r^*. If $p > r^*$, then all plaintiffs will bring suit and all suits will result in settlement. This is because the defendant strictly prefers to offer $S=wA-t$, no matter the value of q, buying off all strike suitors. Potential strike suitors will then anticipate a positive return of $wA-t-c$ from suit, so they will all sue.[7] In sum:

Proposition 1: If the prior probability of injury is above a threshold level, the unique Bayesian-Nash equilibrium involves all potential plaintiffs bringing suit, whether injured or not, and all suits resulting in settlement.

In this first type of equilibrium, the prior probability of injury is so high that the defendant wants to settle with all the strike suitors in order to avoid having to go to trial against the injured plaintiffs. Frivolous suits are profitable because only those persons who participated in the initial event are eligible to bring suit. Since potential strike suitors are scarce, a rent attaches to their scarcity. I refer to this type of outcome as a restricted entry equilibrium.[8]

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7. If p is exactly equal to the threshold r^*, a continuum of equilibria exists, with σ taking values from the interval $[\sigma^*, 1]$. In all such equilibria, $q=1$ and $r=r^*$; if q were less than 1, the defendant would strictly prefer $\sigma=1$, leading all potential plaintiffs to enter. If σ were less than σ^*, only the injured would sue, again leading the defendant to prefer $\sigma=1$.

8. This is the special case identified by Bebchuk (1987). In his model, the degree of injury varies over a continuum, so that some injured plaintiffs reject the offer S and go to trial in equilibrium. For a more general analysis of the variable-injury model, see my 1986 dissertation.

To get a sense of the importance of this type of equilibrium, it is helpful to calculate the typical value of the threshold r*. The findings of the University of Wisconsin Civil Litigation Research Project, which provide the best available data on litigation expenditure, indicate that the total trial costs in a typical lawsuit range from one-fourth to one-half of the potential stakes A. Denoting the ratio of total trial costs to the potential stakes as $v \equiv (t+k)/A$, and assuming that t and k are approximately equal:

$$(5) \quad r^* = \frac{wA-t}{wA+k} = \frac{2w-v}{2w+v}$$

Table 1 shows the threshold value of p for various parameter values. For example, when an injured plaintiff is certain to win and where total costs are one-third the potential stakes, r*=0.71. Observe that the threshold rises with the probability of liability w and moves inversely to the stakes-cost ratio. Thus, a restricted entry equilibrium is more likely when the cost of trial is high relative to the expected stakes. But for plausible parameter values, the prior probability of injury must be substantially above 50% to support a restricted entry equilibrium.

The value of p will in general depend upon the specificity and exclusiveness of the initial event, as well as upon any additional information the defendant obtains through investigation. If the defendant is unable to identify the occurrence of the initial event or the class of persons who may have participated in it, the value of p will be small. To illustrate, in the slip and fall case, the set of potential plaintiffs may be limited to those who actually fall, and p will represent the probability that such persons are

Table 1

Simulation of value of threshold r*

Probability of liability (w)	Ratio of total costs to stakes (v)		
	0.25	0.33	0.50
w = 0.25	0.33	0.20	0.00
w = 0.50	0.60	0.50	0.33
w = 0.75	0.71	0.64	0.50
w = 1.00	0.78	0.71	0.60

Source: Equation 5 in text

injured. But if a customer can plausibly claim to have fallen without the store's knowledge at some time in the recent past, the set of potential plaintiffs may include all customers who have used the store; p would then represent the prior probability of the compound event that a fall occurred and that it resulted in injury. The more difficulty the defendant has in defining the initial event, the less likely is a restricted entry equilibrium.

When p is less than the threshold r*, the nature of the outcome is quite different. In equilibrium, the posterior probability r must exactly equal r* . If instead r>r*, the defendant's best response is σ=1, but then additional frivolous plaintiffs would wish to enter. Similarly, if r<r*, the defendant's best response is σ=0, but then no strike suitors would enter. A similar argument shows that the equilibrium probability of settlement σ must be equal to σ*. This implies:

Proposition 2: If the prior probability of injury is below a threshold level, there is a unique equilibrium such that:

i) All genuinely injured plaintiffs bring suit;

ii) Some frivolous lawsuits are brought, but not all potential strike suitors bring suit;

iii) Some strike suitors receive positive settlements while others drop their suits, and some injured plaintiffs fail to receive any settlement and consequently go to trial.

In this second type of equilibrium, competition among strike suitors reduces the profits from bringing a strike suit to zero. I refer to this outcome as free entry equilibrium. It is the more interesting and realistic case, and the major part of the discussion is devoted to its analysis.

The entries of Table 1 can also be interpreted as the free entry equilibrium proportion of suits brought by genuine plaintiffs. For example, if the total costs of litigation are one-third of the expected judgment, approximately 29% of lawsuits will be frivolous.

Some readers may be disturbed that the free entry equilibrium requires defendants and strike plaintiffs to choose a particular mixed strategy, since the parties are indifferent between their equilibrium strategies and a continuum of other mixed strategies. This is, of course, a difficulty with Nash equilibria generally. For these readers, it may be first observed that since the equilibrium is unique, no other strategy, pure or mixed, can persist. Second, the discussion above shows that if a party chooses a strategy other than his equilibrium strategy, his opponent will react in such a way that induces the party to adjust his strategy in the direction of the equilibrium strategy. Third, one can postulate a slightly more complex model in which individual defendants differ in their trial cost k and individual potential plaintiffs differ in their entry cost c. This would imply a unique equilibrium in pure strategies where (almost) every individual strictly prefers his equilibrium choice. Such a model is briefly analyzed in an appendix. As Harsanyi (1973) has demonstrated, however, the equilibrium of the variable-cost model approaches in the limit the mixed-strategy equilibrium of the simple model as the range of costs is shrunk to a single point. Analysis of the mixed-strategy equilibrium can thus be justified as an approximation.

3.3. Comparative statics

First consider the determinants of the proportion of suits that are

frivolous, denoted as f. Since f = 1-r, and r equals the maximum of r* or p, depending whether entry is free:

$$(6) \quad f = \min \left[\frac{t+k}{wA+k} , 1-p \right]$$

It immediately follows:

Proposition 3: In free entry equilibrium, the proportion of lawsuits that are frivolous:

(a) is invariant to the prior probability of injury;

(b) increases with the trial costs of the defendant;

(c) increases with the trial costs of a genuinely injured plaintiff;

(d) decreases as the size of the potential or expected judgment increases;

(e) is invariant to the cost of filing a lawsuit.

Proof: By differentiation of equation (6). When there is free entry, p and c do not appear in the expression for f or r*. When entry is restricted, f equals 1-p. Inspection also reveals:

Proposition 4: In restricted entry equilibrium, the proportion of lawsuits that are frivolous is invariant to all parameters except the prior probability that an injury occurred; and increases directly as the prior probability decreases.

Proposition 5: A restricted entry equilibrium is more likely to obtain when (1) the prior probability of injury is higher; (2) the defendant's trial costs are higher; (3) the trial costs of an injured plaintiff are higher; (4) the expected or potential stakes are lower.

One surprising aspect of Proposition 3 is that in free entry equilibrium, we can expect the same fraction of suits to be frivolous in a

freak accident case as in a common slip and fall, so long as the amount of damages and the costs of the trial are the same. Equivalently, the number of frivolous lawsuits, (1-p)q, is strictly proportional to the prior probability p. The intuition is that it is just this proportion that makes a defendant indifferent between settling and going to trial.

As p continues to rise, of course, it will eventually reach r*, and the equilibrium will switch to restricted entry. In the case of restricted entry, an increase in p leads directly to a decrease in the proportion of frivolous suits. This follows trivially from the fact that all potential plaintiffs, frivolous and genuine, are bringing suit.

Next, it is also apparent that the cost of initiating suit, c, does not affect the number or proportion of frivolous suits, nor does it affect which type of equilibrium obtains. While changes in the entry cost do have effects in equilibrium, such effects are entirely concentrated on the frequency of settlement. This is because when the genuinely injured plaintiff's return from suit is positive, it always pays strike suitors to enter until r reaches the level where the defendant is indifferent between settlement and trial.

This result is perhaps surprising; it implies that policies that aim to discourage strike suits by increasing the complaint costs will not work. More accurately, they will not work so long as c is kept below wA-t. Raising c above wA-t will discourage strike suits, but only at the cost of discouraging meritorious suits as well.

The effect of an increase in the defendant's trial costs, k, is to increase the relative frequency of strike suits. Thus, the popular claims that strike suits are an especially severe problem in the fields of antitrust and medical malpractice may be explained by the complexity and high costs of

mounting a defense to such claims. The intuition here is similar to the argument of Rosenberg and Shavell. Larger defense costs make trial more unattractive for the defendant and increase his willingness to settle; accordingly, more strike suitors enter. In the Rosenberg-Shavell model, however, high defense costs make a defendant more willing to accept a settlement offer from a plaintiff whom he knows to be frivolous. Here, where it is the defendant who makes the settlement offer, high defense costs make a settling defendant willing to tolerate a higher proportion of strike suitors.

An increase in the trial costs of an injured plaintiff, t, also increases the relative frequency of strike suits in free entry equilibrium. Thus, the alleged prevalence of strike suits in antitrust and medical malpractice may also be explained by high plaintiff's costs in such suits; similar reasons may also explain assertions that strike suits are common in the areas of securities law and products liability, and for class actions generally. The reasoning underlying this result is somewhat more complicated: higher plaintiff's trial costs imply that the amount needed to induce a genuinely injured plaintiff to settle is reduced. The defendant will therefore be more willing to settle and will tolerate a higher proportion of frivolous suits in order to do so. Indeed, by a similar argument one may see that any policy that reduces a genuinely injured plaintiff's return from trial will increase the frequency of strike suits.

Finally, an increase in the expected judgment will reduce the frequency of frivolous lawsuits. This is because an increase in the stakes reduces the relative importance of the trial costs, and it is the relative costs of trial that determine the frequency of strike suits. The defendant will thus be more willing to risk the defense costs at trial, and will tolerate fewer frivolous suitors in equilibrium.[9] This result has at least

one striking policy implication: detrebling antitrust damages should increase the frequency of frivolous suits, contrary to the common casual assertions of antitrust policy analysts.

If the result seems counterintuitive, consider an example of two claims that might be made against a grocery store: injury from a slip and fall, and an overcharge. A customer claiming to have been overcharged is more likely to be indulged, because contesting such claims is too expensive to be worthwhile. The grocery is more likely to contest a slip and fall case, because the amount of alleged damages justifies the defense. We should therefore expect a higher proportion of claims of being overcharged.

Now consider the comparative statics for the probability of settlement. If there is a restricted entry outcome, then $\sigma=1$ and local changes in the parameters have no effect. Therefore consider the case of free entry equilibrium, where $\sigma=\sigma^*$.

Proposition 6: In free entry equilibrium, the proportion of lawsuits that settle:

(a) is invariant to the prior probability that an injury occurred;

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9. This argument, as well as the mathematical derivations, is based on a partial derivative analysis and assumes that as the expected judgment rises the costs of trial will be unchanged. In general, parties will find it worthwhile to increase trial expenditures in cases with higher stakes. Whether an increase in the expected judgment will increase or reduce the frequency of frivolous suits depends on the elasticity of expenditure with respect to the expected stakes. If, for instance, expenditure is exactly proportional to the stakes (the case of unit elasticity), a change in the expected judgment will have no effect on the equilibrium proportion of frivolous suits. If trial expenditure is inelastic with respect to the stakes, however, as the CLRP evidence suggests, the result in the text and its underlying reasoning are still valid.

(b) is invariant to the trial costs of the defendant;

(c) increases with the trial costs of a genuinely injured plaintiff;

(d) decreases as the size of the potential or expected judgment increases;

(e) increases with the cost of filing a lawsuit.

Proof: By differentiation of equation (4). The underlying intuition is that the equilibrium settlement frequency must leave the marginal frivolous plaintiff indifferent whether to bring suit. A marginal increase in the initial cost c, then, will make suit less attractive, requiring an increase in the frequency of settlement. Note that if c=0, so that it costs nothing to bring suit, strike suitors will prevent all settlement, forcing all genuinely injured plaintiffs to trial. This does not make the injured plaintiffs worse off, however, because the defendant gets all the gains from bargaining by virtue of his ability to make the offer.

An increase in the trial cost of a genuine plaintiff will also make suit less attractive by reducing the settlement level. Therefore it also requires an increase in the equilibrium settlement frequency. An increase in the expected award makes suit more attractive and decreases the equilibrium settlement frequency; this result is consistent with a number of other models of settlement.

Now from a social welfare standpoint, we care not about the frequency of suits or of settlement, but about total legal expenditure. This total cost, denoted as L, is the sum of total initial costs and total expenditure on trials. We should also care how changes in the parameters or in legal rules affect the welfare of the various parties. Payments received by legitimate plaintiffs reflect the system's effectiveness in achieving compensation for injury; while payments made by defendants reflect the level of deterrence

provided by litigation.

To calculate the total number of suits brought, denoted as N_s, recall that the number of genuine suits is equal to p (all the injured plaintiffs bring suit) and the number of frivolous suits equals (1-p)q. From equation (3), we can see that

$$(7) \quad N_s = p\left[1 + \frac{t+k}{wA-t}\right] = p\left[\frac{wA+k}{wA-t}\right] = \frac{p}{1-f}$$

The total number of cases going to trial is $N_t = p(1-\sigma)$, or:

$$(8) \quad N_t = p\left[\frac{wA-t-c}{wA-t}\right]$$

Since the social cost of a suit is c and the social cost of a trial is (t+k), the total social loss from litigation is:

$$(9) \quad L = pc\left[\frac{wA+k}{wA-t}\right] + p(t+k)\left[\frac{wA-t-c}{wA-t}\right]$$

$$= p(c+t+k)$$

Equation (9) has an interesting interpretation. The social loss from litigation in the presence of strike suits is precisely equal to the social loss that would occur if there were no frivolous suits and also no settlement. Indeed, since the absence of settlement would remove all incentive to bring a frivolous suit, actually forbidding settlement would have absolutely no effect on social welfare! Rent-seeking by strike suitors completely exhausts the surplus from settlement bargaining.[10]

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10. This result depends upon the assumption that all plaintiffs face

The distributional effects of litigation are easily calculated. Since there is perfect competition in bringing suit, frivolous plaintiffs earn zero expected profits in equilibrium. Since the defendant chooses the offer so as to leave an injured plaintiff indifferent between settlement and trial, net gains to injured plaintiffs are p(wA-t-c). Total losses to defendants are just $N_s S\sigma + p(1-\sigma)(wA+k) = p(wA+k)$.

This implies it would not be desirable to increase the initial cost c, even though doing so would increase the frequency of settlement. The extra costs incurred per suit would more than outweigh the decrease in trials, so that total litigation costs would increase. Moreover, all the increased cost would be concentrated on injured plaintiffs, undercutting the goal of compensation. Increasing trial costs for the plaintiff would similarly increase total cost while undercutting compensation; an increase in defense costs would also increase total costs but would at least raise the deterrent value of litigation. In sum:

Proposition 7: In free entry equilibrium, the social cost of litigation would be increased by an increase in either entry costs or trial costs. Social welfare would be unaffected if settlement were forbidden.

4. Applications to policy issues in civil procedure

This section applies the foregoing analysis to a number of policies

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(continued)

the same initial cost in bringing suit; i.e., that rent-seeking is perfectly competitive. If potential plaintiffs differed in their values of c, those with lower c would earn positive rents in equilibrium, and not all the gains from bargaining would be dissipated. In the general case, then, forbidding settlement could still decrease social welfare.

that have been proposed to deal with the strike suit phenomenon.

Stricter proof and pleading requirements

Some analysts have favored stricter pleading and proof requirements on the grounds that they will raise the cost of bringing suits and thereby improve their average merit. To model this, suppose plaintiffs were required to engage in a higher degree of preparation before initiating a suit. For genuine plaintiffs, this would reduce the amount of preparation needed at trial, and so would not necessarily mean a change in the total costs of litigation. In our notation, c would be increased and t reduced by an equivalent amount; the total plaintiff's costs, t+c, would be unchanged. The increase in c would not affect the equilibrium frequency of strike suits, and the decrease in t would decrease the frequency of strike suits; the net result would be a reduction in strike suits.

To consider the effect on the equilibrium settlement frequency, define the variable z as the amount of trial cost that is shifted to initial cost by the stricter requirements. The initial entry cost is c+z while the plaintiff's trial cost becomes t-z. The settlement frequency is then:

$$(4')\quad \sigma = \frac{c+z}{wA-t+z}$$

Differentiating, we find $\delta\sigma/\delta z > 0$, so that settlement becomes more frequent as the initial cost increases proportionately more than the settlement offer. Despite this, equation (9) shows a stricter pleading rule would have no net effect on social welfare. While it would reduce both the number of strike suits and the number of trials, it would increase costs incurred in those

lawsuits which settle. This last effect precisely balances the first two. Furthermore, the welfare of each type of litigant would be unchanged, so there would be no net effect on compensation or deterrence.

English rule of litigation finance

Some legal writers have recommended that we adopt the English rule of cost allocation, under which the losing party must indemnify the winner for his costs. Under our American rule, in contrast, each party bears his own costs regardless of the outcome of trial. Proponents of the English rule have conjectured that its adoption would reduce both the general level of legal expenditure and the number of strike suits in particular. I have elsewhere attempted to cast doubt on the former claim, and our model here implies little support for the latter claim as well.

Under the English rule, a prevailing plaintiff not only recovers the stakes A but is also reimbursed for his costs in the amount (t+c). Should an injured plaintiff lose at trial, conversely, he must pay the defense cost k. The expected gains from trial for an injured plaintiff, given that initial costs of suit are sunk, then equal:

$$(10) \quad G_t = wA-t + w(c+t) - (1-w)k$$

Note that this differs from expected gains under the American rule by the amount w(c+t)-(1-w)k. The English rule increases the required settlement if and only if w is greater than k/(c+t+k). To illustrate, suppose that the total costs of litigation are approximately equal for plaintiff and defendant, so that c+t = k. Then the English rule improves the welfare of plaintiffs who have a greater than 50% chance of winning at trial, and reduces the welfare of

plaintiffs with less than a 50% chance of winning at trial.[11]

Denote the difference between a genuine plaintiff's expected gains under the two rules as $u \equiv w(c+t)-(1-w)k$. If u is positive, the English rule benefits the plaintiff. Furthermore, consider cost shifting rules intermediate to the English and American rules by introducing the parameter $b \in [0,1]$, which is the proportion of costs that a winning party is entitled to recover at trial. Then b ranges from a value of 0 for the American rule to 1 for the English rule.

With this notation, an injured plaintiff would expect to gain wA-t+bu at trial, and a defendant would expect to pay wA+k+bu if brought to trial by an injured plaintiff. The initial cost of bringing suit is still equal to c. By the same reasoning as section 3.2 above, the equilibrium proportion of frivolous suits is:

$$(11) \quad f = \frac{t+k}{wA+k+bu}$$

The equilibrium frequency of settlement is:

$$(12) \quad \sigma = \frac{c}{wA-t+bu}$$

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11. I assume that the adoption of the English rule will not affect the genuine plaintiff's decision whether to sue. As Shavell (1982) has demonstrated, for suitable parameter values the English rule can deter some genuine claims that the American rule would have encouraged. On the other hand, if the defendant's costs are small relative to those of the plaintiff, or if total costs are large relative to the stakes, the English rule can encourage some genuine claims that the American rule would have deterred. Since I am primarily concerned here with the effect of the English rule on frivolous suits, I abstract from such effects.

Thus, the proportion of frivolous suits is decreased by a move toward the English rule if and only if u is positive, that is, if and only if the English rule increases the expected gains of an injured plaintiff. The equilibrium frequency of settlement decreases if and only if $u > 0$.

What is the effect of the English rule on social welfare? The number of suits is still $N_S = p/(1-f)$, and the number of trials is still $N_t = p(1-\sigma)$. The total social cost, L, then equals $cN_S + (t+k)N_t$, or:

$$(13) \quad L = pc\left[\frac{wA+k+bu}{wA-t+bu}\right] + p(t+k)\left[\frac{wA-t+bu-c}{wA-t+bu}\right]$$

$$= p(c+t+k)$$

So total social cost is unaffected by the choice of financing rule; the effects on the number of suits and on the number of trials cancel out. The underlying reasoning is that strike suitors will enter until all the gains from bargaining have been dissipated.

The financing rule can, however, affect the welfare of the individual parties. The expected profits of injured plaintiffs are wA-t-bu, and the expected losses of defendants are wA+k+bu. The English rule redistributes income between defendants and injured plaintiffs depending on the sign of u. If u>0, a shift to the English rule will benefit injured plaintiffs and hurt defendants. In sum:

Proposition 8: A shift toward the English rule of litigation finance will increase the welfare of an injured plaintiff if and only if his probability of winning at trial is above a certain threshold. The level of the threshold varies directly with the size of the defendant's legal costs, and varies inversely with the size of the plaintiff's legal costs.

Proposition 9: In free entry equilibrium, a shift toward the English rule of litigation finance will:

(a) decrease the frequency of frivolous suits if and only if an injured plaintiff would benefit from the English rule;

(b) increase the frequency of trials if and only if an injured plaintiff would benefit from the English rule;

(c) leave unchanged the total social costs of litigation.

Why, contrary to the apparent intuition of its proponents, isn't the English rule a remedy to the problem of strike suits? The reason is that since strike suitors always drop out before a trial, they never have to pay any defense costs, so the rule provides no direct deterrent. The only effect is indirect: the English rule changes the expectation of injured plaintiffs, thus changing the equilibrium settlement amount.

Indeed, the problem is not one of an inability to collect defense costs from strike suitors; since they never go to trial, there are no defense costs in their cases. The externality arising from strike suits, rather, is that they interfere with the settlement of genuine claims. They cause both defendants and injured plaintiffs to incur increased trial costs in other cases. A simple indemnification remedy, therefore, does not work to remove the externality.

Refundable deposits

Now consider a rule which requires all plaintiffs to file a deposit upon bringing suit. The deposit is refundable if and only if the plaintiff's injury is established at trial or if the defendant consents to its return through a settlement. Otherwise, the deposit is paid into the court system.[12]

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12. A deposit payable to the defendant works similarly.

Assume that even if a genuine plaintiff can lose, the good faith nature of his claim can be established at trial, entitling him to the return of his deposit.

Denote the amount of the deposit as D. At the last stage before trial, a genuine plaintiff stands to gain either wA-t+D from going to trial or S+D from accepting settlement. He will accept settlement if and only if S > wA-t, just as before. For a frivolous plaintiff, in contrast, the deposit allows the defendant to capture some rents. At the last stage, a strike suitor can gain -t by going to trial, can gain zero by dropping the suit, or can gain S+D by accepting the settlement offer. It follows that he will pay up to the amount of the deposit in order to settle.

An offer of wA-t will be accepted by all plaintiffs; an offer of -D will be accepted only by a strike suitor and will have an expected payout for the defendant of r(wA+k) - (1-r)D. The defendant will be indifferent between the two offers when r equals:

$$(14) \quad r^* = \frac{wA-t+D}{wA+k+D}$$

Note that this threshold is larger the higher is the deposit. The opportunity to extort the value of the deposit from the strike suitor encourages tougher bargaining. The equilibrium proportion of suits which are frivolous then equals:

$$(15) \quad f = \frac{t+k}{wA+k+D}$$

A higher deposit reduces the frequency of strike suits.

Now a potential strike suitor will enter if and only if $\sigma(wA-t+D) > c+D$. The equilibrium settlement probability therefore equals:

$$(16) \quad \sigma^* = \frac{c+D}{wA-t+D}$$

A higher deposit increases the settlement probability, reducing the frequency of trials. It does so by increasing the ratio of entry cost to potential settlement, making strike suits less attractive. A higher probability of settlement can thus be sustained in equilibrium.

Finally, the number of suits is equal to $N_S = p/r$, and the number of trials is $N_S = p(1-\sigma)$. So total litigation costs are:

$$(17) \quad L = cN_S + (t+k)N_t$$

$$= p \left[c + (t+k) \frac{wA-t}{wA-t+D} \right]$$

The deposit scheme improves social welfare. Moreover, the higher the deposit the better. As D approaches infinity, σ and r approach 1 and L approaches pc. A sufficiently large deposit allows us to come arbitrarily close to the first-best outcome, in which only injured plaintiffs bring suit and all suits are settled.

In theory, perfect capital markets would lend an injured plaintiff the amount of any deposit. In practice, plaintiffs will be liquidity constrained. The most obvious defect in the capital market is that lenders would find it at least as difficult as the defendant to tell genuine from frivolous plaintiffs. If borrowing is difficult, a deposit may deter genuine plaintiffs from suit.

If the assets of injured plaintiffs place an upper limit on the feasible deposit, the first-best outcome cannot be reached. The model suggests, however, that the deposit should be as large as can feasibly be required.

Taxes and subsidies

The equilibrium is inefficient because externalities arise from the choices of both frivolous plaintiffs and defendants. The strike suitor does not take into account the cost of the trials which are caused because of his interference with settlement. The defendant does not take into account his offer's effect on the incentive to bring suit. This suggests that taxing either entry or settlement will improve welfare. Surprisingly, a subsidy on settlement can also improve welfare, if the subsidy is large enough to induce the defendant to buy off all potential suitors. Both results are demonstrated in my dissertation (Katz, 1986).

5. Conclusions

This article analyzes the settlement strategies of parties to a lawsuit when there is a possibility that the suit is frivolous. A frivolous suit is interpreted as one which does not merit going to trial and which is brought only in the hopes of obtaining settlement. Because the defendant does not know whether a given lawsuit is frivolous or genuine, he may choose a strategy which leads to the settlement of frivolous claims or the trial of genuine ones. It turns out that a bargaining situation in which it is common

knowledge that the plaintiff may drop the suit looks very different from one in which the plaintiff will always go to trial. A number of conclusions follow from the analysis.

First, so long as the defendant has imperfect information regarding the merits of the plaintiff's claim and cannot commit not to settle, a certain proportion of suits will be frivolous. The reason for this is that if there were no frivolous suits brought, defendants would find it in their interest to offer large amounts in settlement. Such high levels of settlement, however, will encourage the entry of strike suitors. Moreover, the number of frivolous suits as a proportion of all suits is constant with respect to the frequency of genuine claims in the population of potential plaintiffs.

Second, the proportion of frivolous suits is directly related to both sides' costs of trial. The prospect of an expensive trial will make the defendant a softer bargainer. Similarly, the proportion of strike suits is inversely related to the size of the potential judgment, since the higher stakes reduces the relative importance of trial costs and makes the defendant a harder bargainer. This suggests, for instance, that proposals to reduce the number of frivolous suits by detrebling antitrust damages may be misplaced.

Third, frivolous suits lead to at least two major sorts of social costs. The first is the real resource cost involved in filing such suits. The second is the cost of increased trials required because the presence of strike suitors in the pool of plaintiffs prevents many genuine claims from being settled. If there is free entry to bringing a frivolous suit, rent-seeking can dissipate the entire surplus from the settlement of genuine claims. In the simple model of section 3, the increased costs resulting from

frivolous claims is equivalent to the costs that would be suffered if settlement were actually prohibited.

Fourth, policies proposed to remedy the problem of frivolous lawsuits often have undesirable effects on the disposition of genuine claims that may make them undesirable as a whole. For example, the English rule of litigation finance, in which the loser must indemnify the winner, may reduce the frequency of frivolous suits. It does so, however, only by interfering with the settlement of meritorious suits and reducing the amount received by genuine plaintiffs. Moreover, it is on balance no cheaper than the American rule in which each party must pay his own costs. Similarly, requiring each plaintiff to put up a refundable deposit which is forfeited if the suit is dropped will reduce total litigation costs, but is likely to prevent genuine liquidity-constrained plaintiffs from obtaining just compensation.

Obviously, settlement negotiation in lawsuits is an extremely complicated problem, and the results warrant further investigation to check their robustness. An obvious extension would be to consider the situation where the plaintiff makes the settlement offer. This would complicate matters by allowing the defendant to draw inferences not just from the fact of suit but also from the settlement amount. As is well-known, equilibrium in such situations can vary depending on hypothetical disequilibrium beliefs. Such issues are the subject of work in progress.

The analysis above also abstracts from a number of interesting aspects of settlement bargaining, which should provide fertile ground for further research. For example, we have omitted any mention of civil discovery, the process whereby a party can compel his adversary to turn over private

information regarding the merits of the case. The opportunity to engage in discovery, at a cost, may further enrich the strategic possibilities for the litigants. Second, it would be useful to incorporate into the analysis the contingent fee, where the plaintiff's attorney agrees to be compensated by a percentage of the verdict or settlement as opposed to a fixed or hourly fee. While the contingent fee has been criticized for its supposed contribution to the increase in litigation, the true story may be more complicated. The fact that an attorney is willing to take a percentage of a case as his compensation may be a good signal that the case has merit; accordingly, contingent fees may help to channel meritorious cases toward settlement, while screening out some frivolous claims.[13]

In summary, the reality of the court system is complex, and our results and recommendations should be taken as tentative. On the other hand, recent critics of the American civil litigation system have been quite willing to make their own recommendations for its reform on efficiency grounds. Our results also suggest that we should be even more cautious in applying "common sense" prescriptions for the judicial process which are not carefully based on an explicit theoretical model. This paper is intended as a step toward that goal.

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13. In a prominent dissent based on this conjecture, Judge Richard Posner argued for the denial of state-appointed counsel to an indigent prisoner who wished to bring a civil suit against the prison physician for medical malpractice, on the grounds that the suit would have been accepted by a private attorney on a contingent fee basis had it been meritorious. See Merritt v. Faulkner (1983), 697 F.2d 761.

Appendix

In this appendix I briefly analyze a variation of the strike suit model in which the costs of filing suit of defending suit can vary. Let all of the notation be the same as in the text except that the cost of filing suit is $c+\gamma u$ and the cost of defending suit is $k+\theta v$ where γ and θ are both positive and where u and v are independent random variables distributed continuously over the interval [-1, 1]. Let f(u) and g(v) be the density functions of u and v respectively, and let F(u) and G(v) be the respective distribution functions. Also, reinterpret σ as the proportion of defendants who offer settlement and q as the proportion of frivolous plaintiffs who bring suit.

The only settlement offers are still wa-t and 0. A defendant of type v will strictly prefer the higher offer iff $wA-t < r(wA+k-\theta v)$. It follows:

$$(A1) \quad \sigma = G\left[\frac{t+k-(1-p/p)(wA-t)q}{\theta}\right]$$

Also, a frivolous plaintiff of type u can expect a return of $\sigma(wA-t)$ from entry and will enter if and only if $c+\gamma u < \sigma(wA-t)$, implying that:

$$(A2) \quad q = F\left[\frac{\sigma(wA-t)-c}{\gamma}\right]$$

Since both $\sigma(q)$ and $q(\sigma)$ are continuous, existence of an equilibrium follows trivially from the fact that all continuous functions from the unit interval to itself have a fixed point. Moreover, since $\sigma'(q) \leq 0$ and $q'(\sigma) \geq 0$, the equilibrium is necessarily unique.

Assuming an interior solution, let v^* denote the argument of G in (A1)

and u* denote the argument of F in (A2). Differentiating (A1) and (A2) and solving out through the method of linear equations, we get:

$$(A3)\quad \frac{\partial\sigma}{\partial t} = \frac{1 + (1-p/p)q}{\Delta\theta f(u^*)} + \frac{f(u^*)\sigma(wA-t)(1-p/p)}{\Delta\theta\gamma} > 0$$

$$(A4)\quad \frac{\partial\sigma}{\partial k} = \frac{1}{\Delta\theta f(u^*)} > 0$$

$$(A5)\quad \frac{\partial\sigma}{\partial c} = \frac{(wA-t)(1-p/p)}{\Delta\theta\gamma} > 0$$

$$(A6)\quad \frac{\partial\sigma}{\partial p} = \frac{(wA-t)q}{\Delta\theta f(u^*)p^2} > 0$$

$$(A7)\quad \frac{\partial\sigma}{\partial A} = \frac{-(1-p/p)w}{\Delta\theta\gamma f(u^*)}\left[q\gamma + f(u^*)\sigma(wA-t) \right] < 0$$

$$(A8)\quad \frac{\partial q}{\partial t} = \frac{(1/r)(wA-t)g(v^*) - \sigma\theta}{\Delta\theta\gamma g(v^*)}$$

$$(A9)\quad \frac{\partial q}{\partial k} = \frac{wA-t}{\Delta\theta\gamma} > 0$$

$$(A10)\quad \frac{\partial q}{\partial c} = \frac{-1}{\Delta\gamma g(v^*)} < 0$$

$$(A11)\quad \frac{\partial q}{\partial p} = \frac{q(wA-t)^2}{\Delta\theta\gamma p^2} > 0$$

$$(A12)\quad \frac{\partial q}{\partial A} = \frac{w}{\Delta\theta\gamma g(v^*)}\left[\sigma\theta - g(v^*)(1-p/p)q(wA-t) \right]$$

where $\Delta \equiv 1/g(v^*)f(u^*) + (1-p/p)(wA-t)^2/\theta\gamma > 0$.

For θ and γ near zero, the right-hand side of (A8) is positive and the right-hand side of (A12) is negative, confirming the comparative statics results of the constant-cost model in the text.

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