Deterring Nuisance Suits through Employee Indemnification

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Abstract: Broad employee indemnification is pervasive among corporations. Indemnification covers individual sanctions, such as fines, for corporate actions. These guarantees that are not merely tolerated but indeed encouraged by public policy. We offer a new rationale for widespread indemnification. Indemnification deters meritless civil suits (as well as prosecution by non-benevolent officials) by strengthening employees' resolve to fight them.

Keywords: indemnification, litigation, settlement bargaining

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1. Introduction

Litigation against corporations and their officers and directors is a major industry. While some of these lawsuits may be useful to society, it is feared that a fraction are so called "nuisance suits." These suits are motivated solely by the prospect of extracting settlement payments. A logical strategic response by targeted corporations would be to strengthen their bargaining position against such plaintiffs in the settlement negotiations.

According to a recent survey, 98 percent of U.S. firms with over 500 shareholders had third party D&O (director and officer) insurance (Tillinghast-Towers Perrin 2002). One interpretation of broad indemnification is that the firm (or shareholders) will absorb fines and settlements ostensibly levied against officers and directors.

The most direct rationale for widespread indemnification is that it shares risk between risk neutral shareholders and risk averse officers and directors. A complicating factor for policy is whether indemnification encourages corporate crime since managers do not have adequate "skin in the game" for certain classes of crimes. Mullin and Snyder (2010) studied this case and found only very limited circumstances in which there is a social gain from sanctioning the employee and banning his indemnification. A further implication of that paper is that if the government is successful in levying employee sanctions only in the proper circumstances, then any social loss from banning indemnification can be prevented. Taken together, the results from the past literature do not yet provide a strong rationale for widespread permissiveness toward employee indemnification observed in practice.

The present paper offers such a rationale by identifying a new effect of employee indemnification. Employee indemnification bolsters their willingness to fight nuisance suits. In our model, presented in Section 2 and analyzed in Sections 3 and 4, we assume that the action against the firm is a nuisance suit undertaken by a rent-seeking party (private or government). In this

model, indemnification provides a strategic benefit to defendant firms. Absent indemnification, the firm's director or officer would have an excessive incentive to settle the case to avoid personal liability. The party making the decision to settle is not a perfect agent of the firm because he bears 100 percent of his personal liability but only a share at best of the firm's profits. This principal-agent friction is a chink in the firm's armor which the plaintiff in a nuisance suit can exploit by aggressively targeting the agent. This vulnerability would encourage the entry of further baseless suits, potentially in unlimited supply. Such nuisance suits could lead to social-welfare losses from mounting court costs and exit of productive enterprises.

The model in the present paper contributes to the literature on the credibility of nuisance suits, including Bebchuk (1988), Katz (1990), and Schwartz and Wickelgren (2009). We study how delegating negotiations affects the settlement process and how the equilibrium is affected by changes in the agent's compensation contract, including indemnification. Our paper is part of a broader literature on delegated bargaining including Jones (1989) and Fershtman, Judd, and Kalai (1991). Their applications are quite different from ours, and since their agents are not exposed to sanctions, the issue of indemnification does not arise. There is related work on agency problems in settlement, between a lawyer and a client. Most of this work, such as Miller (1987) and Hay (1997), has focused on the plaintiff side. The central focus of our paper is on the corporate defendant side, and the effect of indemnification.

We also make a contribution to the literature on strategic entry deterrence. Tirole (1988) outlines a large list of firm investments that could affect entry decisions. Fudenberg and Tirole (1984) provide a taxonomy of business strategies, indicating that firms may underinvest or overinvest in order to deter entry or to accommodate entry. Ellison and Ellison (2007) provide evidence how entry deterrence motivations can distort firm investment behavior. In our context, the firm's investment decision is whether or not to indemnify the employee. Indemnification acts

to strengthen the employee's spine in settlement negotiations with plaintiffs, leading to deterrence of the nuisance suits that were marginally profitable.

The structure of the paper is as follows. The next section presents the model. The four sections after that contain the analysis. Section 3 provides some preliminary analysis and defines perfect Bayesian equilibrium in our setting. Section 4 presents the main comparative statics results on the effect of indemnification. Section 5 assess the welfare effects of indemnification from a private and a social perspective. Section 6 compares the results from the model to a benchmark in which the firm can commit to a settlement offer ex ante, before the plaintiff's filing decision. A simple numerical example illustrating several of the general propositions is provided in Section 7. Section 8 concludes.

2. Model

We will model the lawsuit as a game of incomplete information involving three players: a plaintiff and a defendant-firm consisting of a principal and an agent. The plaintiff—who can be thought of as a rent-seeking private party or non-benevolent government prosecutor—potentially files a lawsuit against the defendant-firm. Within the firm, the principal—who can be thought of as some combination of the firm's shareholders and/or board of directors—is the residual claimant of profit and is responsible for the initial design of the agent's incentive scheme. All subsequent decisions, including importantly the conduct of settlement bargaining, must thus be delegated to the agent. The agent can be thought of as the CEO or other upper-level manager in the firm. One justification for the delegation assumption is that the agent has superior expertise or information. Another is that the principal, although modeled as a unitary actor, represents a large number of dispersed shareholders who would have difficulty coordinating on appropriate decisions. All players are risk neutral. Normalize the plaintiff's reservation payoff (from not filing a lawsuit)

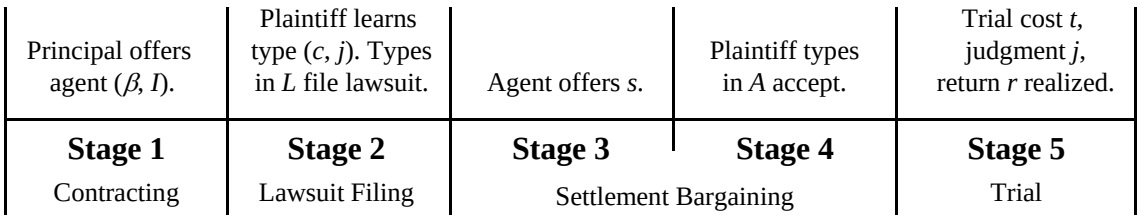


Figure 1: Timing of Model

to 0.

Figure 1 shows the stages of the game. In stage 1, the principal makes a contract offer to the agent. To leave scope for indemnification policy to have an effect on the agent's equilibrium behavior, contracts cannot be perfectly complete. We will capture contractual incompleteness in a simple way by assuming contracts can have only two basic provisions. The agent receives a share $\beta \in [0, 1]$ of the profit the firm is left with at the end of the game net of any trial costs and judgments. Thus we are restricting attention to a simple linear profit-sharing rule. The incentive scheme may also specify a simple all-or-nothing indemnification policy regarding trial costs and judgments against the agent. If the firm indemnifies the agent, the agent escapes some but not all of the burden of trial costs and judgments; the agent still faces some burden because the firm's indemnification payment reduces its net profit and thus the agent's earnings from profit sharing. Let the I be an indicator for indemnification, with $I = 0$ if the contract does not specify indemnification and $I = 1$ if it does. (A governmental bans on indemnification forces the contract to specify $I = 0$.) We assume that contractual incompleteness forces the firm to delegate all other decisions to the agent because they cannot be performed by the principal and cannot be specified in a contract. As will be seen, the important implication of this assumption is that the settlement offer will be up to the agent's discretion.

In stage 2, the plaintiff obtains private information regarding his cost $c \geq 0$ of filing the lawsuit and the judgment $j \geq 0$ that the defendant will have to pay to him as a result of the

trial. We will refer to the two-dimensional vector (c, j) as the plaintiff's "type." Let $\phi(c, j)$ be the probability density function (pdf) for the plaintiff's type. Assume ϕ is twice differentiable, strictly positive on the whole nonnegative quadrant $\mathbb{R}^2_+$, and log-concave.[1] The principal and agent only know the distribution from which the type is drawn but do not observe the actual draw. After learning his type, the plaintiff makes his decision about whether to file a lawsuit. Let $L \subseteq \mathbb{R}^2_+$ denote the subset of types that file a lawsuit. The plaintiff's filing decision provides a signal about his type which the principal and agent use to update their prior beliefs (embodied in pdf ϕ) to form posterior beliefs (embodied in a pdf which we will later label $\hat{\phi}$).

If the plaintiff does not file a lawsuit, the game ends there. The firm earns a total gross return $r > 0$, divided βr for the agent and $(1 - \beta)r$ for the principal; no trial costs or judgments have to be paid. If the plaintiff files a lawsuit, the game may continue to trial. Prior to a trial, the plaintiff and defendant engage in settlement bargaining, which spans stages 3 and 4. To capture bargaining under asymmetric information (regarding the plaintiff's type (c, j)) in a simple way, we assume that in stage 3 the party without the information (the defendant-firm) makes a take-it-or-leave-it settlement offer to the informed party (the plaintiff). Let s be the total payment to the plaintiff in return for dropping the case, made up of a payment s_a from the agent and s_p from the principal, with $s = s_a + s_p$. In stage 4 the plaintiff responds to the offer s by accepting or rejecting it. Let $A \subseteq \mathbb{R}^2_+$ be the subset of types who accept it. If the offer is accepted, the game ends there, with payments, returns, and earnings dispersed.

The agent is assumed to have the authority to choose what settlement offer s to make, along

[1] It can be shown (see Boyd and Vandenberghe 2004, Section 3.5) that a twice-differentiable multivariate function $g(\vec{x})$ is log-concave if and only if

$$g(\vec{x})Hg(\vec{x}) \leq Dg(\vec{x})Dg(\vec{x})'$$

for all $\vec{x}$ in the domain of g, where Hg is the Hessian (matrix of second partial derivatives), Dg is the gradient (column vector of first partial derivatives), and $\leq$ represents element-by-element inequality. As discussed in Bagnoli and Bergstrom (2005), log-concavity is a standard assumption in the literature, adopted in labor, industrial organization, auction theory, political science, as well as law and economics applications. Most standard distributions are log-concave including the uniform, beta, normal, exponential, logistic, gamma, and many others.

with all the other decisions within the firm. For most of the paper, we will assume that, owing to contractual incompleteness, the contract cannot specify the settlement offer that the agent must make.[2]

If the plaintiff rejects the settlement offer, the game proceeds to the trial in stage 5. The trial requires expenditure $t_a \geq 0$ by the agent and $t_p \geq 0$ by the plaintiff, with $t = t_a + t_p$. These expenditures reflect court costs including costs of legal representation, costs of submitting to discovery, and possible reputation losses. We will abstract from the plaintiff's trial costs for simplicity. The plaintiff wins a judgment of $j_a \geq 0$ from the agent and j_p from the principal for a total judgment of $j = j_a + j_p$. To economize on the number of random variables that need to be considered, we will assume that there is a proportional division of trial costs and judgments between the principal and agent, with proportion $\alpha \in [0, 1]$ paid by the agent and $1 - \alpha$ by the principal, implying $t_a = \alpha t$, $j_a = \alpha j$, $t_p = (1 - \alpha)t$, and $j_p = (1 - \alpha)j$. If the agent's contract specifies full indemnification, both his trial cost αt and judgment αj are covered by the firm (though as mentioned the agent will still bear some of this cost indirectly through a reduction in firm profits of which he earns a share). If the contract does not specify indemnification, the agent bears the full burden of his costs.

To summarize the role of different variables, r, α, β, and t are fixed parameters, common knowledge to all players; c and j are random variables; and s is an endogenous variable. L and A are also endogenous but are endogenous sets rather than scalars. We will normalize total trial costs to $t = 1$. This can be done without loss of generality, bearing in mind that the remaining payoff-related variables (r, c, j, and s) must then be interpreted as measured relative to total trial costs.

[2]We will show that under some conditions (in particular, under indemnification—see Proposition 4) the agent's settlement offer is the same as what the principal would have chosen ex post. In Section 6 we will investigate the possibility that the principal can specify a settlement offer in the contract and can commit not to renegotiate this provision.

3. Perfect Bayesian Equilibrium

We will look for the pure-strategy, perfect Bayesian equilibrium of this sequential game with incomplete information. We will do this by analyzing various stages shown in Figure 1 in a convenient order. Note that there is no strategic behavior in the final, trial stage, so the analysis just focuses on the first four stages.

Perfect Bayesian equilibrium requires players to behave sequentially rationally. A consequence of this requirement in the present setting to rule out the the firm's committing to an overly "tough" settlement strategy (for example, refusing to settle any cases) to deter lawsuit filings. In a different model, say with incomplete information about the firm's type or with repeated interaction, the firm may be able to maintain a reputation for "tough" behavior. Without those elements here, we can analyze the isolated impact of indemnification on settlement behavior.

3.1. Contracting Stage

The contract offered by the principal to the agent has two provisions, β and I. We will take the profit-sharing term β as given. This can be done without loss of generality because, as we will show, the results hold for any $\beta \in (0, 1)$. Another reason for taking β as given is to accommodate the influence of factors outside of the model on it. For example, β may be set in part to provide incentives for proper decisions to be made on a broad range of issues apart from the lawsuit settlement and for proper effort to be exerted for a broad range of tasks. We will avoid complicating the model by introducing these factors explicitly.

The remaining element of the contract, indemnification, will be handled by providing a complete analysis of each of the two possible cases ($I = 0$ and $I = 1$). Each of these analyses will take the indemnification policy as given.

3.2. Plaintiff's Acceptance Decision

It is straightforward to solve for the plaintiff's equilibrium acceptance decision in stage 4 because this is effectively an endgame decision made by a perfectly-informed party. Perfect Bayesian equilibrium requires the plaintiff's acceptance decision to be sequentially rational. Given settlement offer s, the plaintiff earns s from accepting it and j from rejecting it and proceeding to trial. The filing cost is sunk and there are no trial costs. Sequential rationality thus requires the plaintiff to choose the higher of the two payoffs, accepting the offer if $s > j$ and rejecting otherwise. Therefore, the subset of types who filed a lawsuit for whom, furthermore, it is a best response to accept offer s is

$$A^{BR}(s, L) = \{(c, j) \in L | j < s\}. \tag{1}$$

The set $A^{BR}(s, L)$ is a function of the set of types who file a lawsuit, L, because filing a lawsuit is a precondition for receiving a settlement offer, which in turn is a precondition for accepting a settlement offer.

3.3. Plaintiff's Filing Decision

Turning now to stage 2, involving the plaintiff's decision to file a lawsuit or not. Given the settlement offer s that he will receive in stage 3 and the acceptance decision that he will make in stage 4 (see equation (1)), we can compute his gross return from filing a lawsuit as the greater of the payoff from settling s and the payoff from proceeding to trial j. Subtracting the cost of filing c from the gross payoff gives the net payoff $\max(s, j) - c$. If the plaintiff does not file a lawsuit, recall his payoff is normalized to 0. Thus, his best response is to file if $\max(s, j) > c$ and not if $\max(s, j) < c$.

Formally, let $L^{BR}(s)$ be the set of plaintiff types for which it is a best response for him to

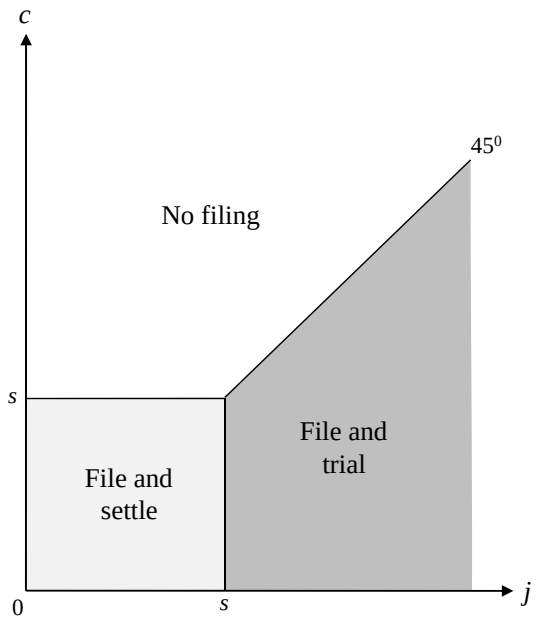


Figure 2: Plaintiff Best Responses

file a lawsuit. We have

$$L^{BR}(s) = \{(c, j) \in \mathbb{R}^2_+ | \max(s, j) > c\}. \tag{2}$$

Figure 2 depicts the plaintiff's best response in stages 2 and 4. The plaintiff's type space is the whole nonnegative quadrant, $\mathbb{R}^2_+$. The probability of a subset of this type space can be visualized as the weighted area of the region, with the weight given by the by the density function $\phi(c, j)$. The unshaded region is the set of types for which the plaintiff's best response is not to file a lawsuit. The set of plaintiff types for which it is a best response to file a lawsuit, $L^{BR}(s)$, is given by the entire shaded region. The shaded region is divided into two subregions. The light-shaded region is the set of plaintiff types who file the lawsuit but go on in stage 4 to accept the settlement offer.[3] The dark-shaded region is the set of types who file but reject the settlement offer, continuing to trial. As equation (1) implies, the dividing line between the two subregions

[3]Formally, the light-shaded region is the set $A^{BR}(s, L^{BR}(s))$.

are types for which $j = s$, i.e., types that are indifferent between the settlement offer and the judgment amount.

Figure 2 graphs the plaintiff's best response for a given value of s. The picture will change for different values of s. For example, for a higher s than the one in the figure, the light-shaded "file and settle" square would expand, taking over some of the unshaded and dark-shaded areas. More lawsuits would be filed, and more filed lawsuits would end up being settled.

3.4. Agent's Posterior Beliefs

In stage 3, the agent first forms posterior beliefs about the plaintiff's type, then acts on the basis of these beliefs, so we will start by examining his posterior beliefs. Given that a lawsuit has been filed, this sends a signal about the plaintiff's type which the agent must use to update his prior beliefs (embodied in the pdf $\phi(c, j)$) to form posterior beliefs. Let $\hat{\phi}(c, j, s)$ denote the pdf associated with this posterior distribution computed according to Bayes Rule based on the plaintiff's strategy, as required by perfect Bayesian equilibrium.

Some explanation is required for why s appears as the last argument of $\hat{\phi}$. Here, s represents the settlement offer that the plaintiff believes it will receive (more precisely, the offer that the agent believes the plaintiff believes he will receive). Intuitively, observing that the plaintiff has filed a lawsuit signals to the agent that the plaintiff's type is drawn from $F^{BR}(s)$ rather than from all of $\mathbb{R}^2_+$. More formally, the dependence of $\hat{\phi}$ on s is clear from the following application of Bayes Rule:

$$\hat{\phi}(c, j, s) = \begin{cases} \dfrac{\phi(c, j)}{\Pr(L^{BR}(s))} & (c, j) \in L^{BR}(s) \\ 0 & (c, j) \notin L^{BR}(s), \end{cases} \tag{3}$$

where $\Pr(L)$ is the prior probability that the plaintiff's type is in set L, i.e.,

$$\Pr(L) \equiv \iint_{(c,j)\in L} \phi(c,j)\, dc\, dj.$$

3.5. Agent's Settlement Offer

It remains to characterize the agent's equilibrium settlement offer. This offer must maximize his expected payoff given his posterior beliefs about the plaintiff's type. Let $U(\tilde{s}, s, I)$ denote this expected payoff. The first argument $\tilde{s}$ is the agent's actual settlement offer. The second argument is an index of his posterior beliefs; i.e., argument s indicates that his posterior beliefs are represented by pdf $\hat{\phi}(c, j, s)$. That is, he believes that the plaintiff's type is in $L^{BR}(s)$. The first two arguments of U will be equal ($\tilde{s} = s$) in a perfect Bayesian equilibrium, but having distinct arguments allows us to compute the expected payoff from deviating settlement offers. The last argument I will allow us to compute possibly different settlement offers in the two different indemnification regimes.

A best-response for the agent is a settlement offer maximizing his expected payoff:

$$s^{BR}(s, I) = \underset{\tilde{s}\in\mathbb{R}_+}{\operatorname{argmax}}\, U(\tilde{s}, s, I). \tag{4}$$

Most of the analysis in Section 4 will be directed toward characterizing this best response.

3.6. Equilibrium Definition

Putting the analysis from the preceding three subsections together, perfect Bayesian equilibrium in indemnification regime I has four elements: an equilibrium set of plaintiff types who file a lawsuit, $L_I^* \subseteq \mathbb{R}_+^2$, an equilibrium agent settlement offer, $s_I^* \in \mathbb{R}_+$, posterior beliefs for the

agent, and an equilibrium acceptance decision for the plaintiff.[4] The equilibrium lawsuit-filing set must be a best response to s_I^*: i.e., $L_I^* = L^{BR}(s_I^*)$. The equilibrium settlement offer must be a best response to posterior beliefs that the lawsuit-filing set is $L^{BR}(s_I^*)$: i.e., $s_I^* = s^{BR}(s_I^*, I)$. Posterior beliefs must satisfy Bayes Rule given equilibrium strategies: i.e., the pdf must be $\hat{\phi}(c, j, s_I^*)$. Finally, the equilibrium acceptance decision for the plaintiff must be a best response: i.e., the acceptance set must be $A^{BR}(s, L)$.

We have already derived explicit formulas for three of the four elements of equilibrium: $L^{BR}(s)$ in equation (2), $\hat{\phi}(c, j, s)$ in (3), and $A^{BR}(s, L)$ in (1). The remaining element is s_I^*, which can be found as the fixed point of the equation

$$s = s^{BR}(s, I). \tag{5}$$

Once we have s_I^*, the rest of the equilibrium elements can be computed by substituting s_I^* into the relevant equations.

4. Effect of Indemnification

This section characterizes the equilibrium settlement offer s_I^* under the two indemnification regimes ($I = 0$ and $I = 1$). We argued that s_I^* is a fixed point of equation (5). This fixed point does not have an explicit solution for general functional forms. We will derive a first-order necessary condition for the fixed point and apply monotone-comparative-statics methods to show how this implicit solution varies with the indemnification regime I.

We begin by deriving an expression for $U(\tilde{s}, s, I)$. Consider the case of an upward deviation,

[4] As a technical aside, note that perfect Bayesian equilibrium will generally not pin down the plaintiff's strategy for types that are indifferent (say between filing and not or accepting and not). Such types have zero measure given that the distribution of types is continuous. As we did in the preceding subsections, we will typically ignore these cases to streamline the discussion. When we refer to a unique equilibrium, we will mean unique up to specification of the plaintiff's strategy when indifferent.

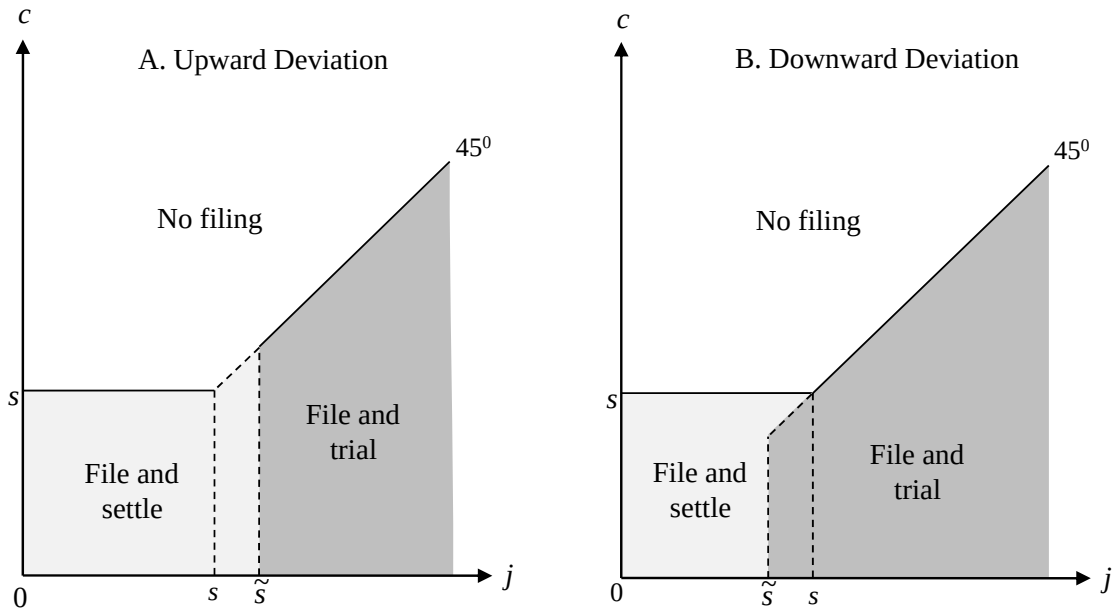


Figure 3: Deviating Settlement Offers

drawn in the first panel of Figure 3. In this panel, s is the anticipated settlement offer but $\tilde{s} \geq s$ is the actual offer. This deviation does not affect the shaded filing set, which stays the same as in Figure 2. The only changes are that (1) the payment to settling types increases and (2) a wedge of types that would have rejected s now accept $\tilde{s}$.

We will first compute the agent's payoff for plaintiff types in the light-shaded region, which accept the settlement offer. If $I = 1$, the firm bears the whole sanction $\tilde{s}$, implying that its net return is $r - \tilde{s}$ and the agent's share of this net return is

$$\beta(r - \tilde{s}). \tag{6}$$

(Notice that the amount paid is determined by the actual, not the anticipated, settlement offer.) If $I = 0$, it can be shown that the agent's payoff is also given by equation (6) in the light-shaded region. Since the agent has authority over the settlement offer, including the apportionment between himself and the principal, he would choose to apportion the entire amount of any total

settlement $\tilde{s}$ entirely to the principal and none to himself. The firm's net return is again $r - \tilde{s}$, and the agent's share of this net return is again $\beta(r - \tilde{s})$.

Next we will compute the agent's payoff for plaintiff types in the dark-shaded region, which reject the settlement offer. If $I = 1$, the firm's net return is $r - t - j$ because it bears all trial costs and judgments. The agent's share of this net return is $\beta(r - t - j)$. If $I = 0$, the firm's net return is $r - t_p - j_p$, and the agent's share of this is $\beta(r - t_p - j_p)$. The agent also directly bears his own trial costs and judgment, so his endgame wealth is $\beta(r - t_p - j_p) - t_a - j_a$, or upon substituting, $\beta(r - t - j) - \alpha(t + j)(1 - \beta)$. Nesting the results for the two indemnification regimes together, noting the normalization $t = 1$, and rearranging, the agent's payoff in the dark-shaded region can be written

$$\beta \left[r - 1 - j - (1 - I)\alpha(1 + j) \left(\frac{1 - \beta}{\beta} \right) \right]. \tag{7}$$

Integrating the payoffs from equations (6) and (7) over the shaded regions in the first panel of Figure **??** using pdf $\hat{\phi}(c, j, s)$ for likelihood weights, we have the following expression for the agent's expected continuation payoff following the filing of a lawsuit, defined for $\tilde{s} \geq s$:

$$\begin{aligned} U(\tilde{s}, s, I) = & \frac{\beta}{\Pr(L^{BR}(s))} \left\{ \int_0^s \int_0^s (r - \tilde{s})\, \phi(c, j)\, dc\, dj \right. \\ & + \int_s^{\tilde{s}} \int_0^j (r - \tilde{s})\, \phi(c, j)\, dc\, dj \\ & \left. + \int_{\tilde{s}}^{\infty} \int_0^j \left[r - 1 - j - (1 - I)\alpha(1 + j) \left(\frac{1 - \beta}{\beta} \right) \right] \phi(c, j)\, dc\, dj \right\}. \end{aligned} \tag{8}$$

To be a fixed point of the best-response relation (5), equilibrium settlement offer s_I^* must maximize the agent's expected payoff over all possible settlement offers. A first-order necessary condition for the solution to this maximization problem is $U_1(s_I^*, s_I^*, I) = 0$. Differentiating equation (8) with respect to its first argument gives the version of the first-order condition stated in the following lemma.

Lemma 1. *An equilibrium settlement offer s_I^* must satisfy the first-order condition $F(s_I^*, I) = 0$, where*

$$F(s, I) \equiv \left[1 + (1 - I)\alpha(1 + s)\left(\frac{1 - \beta}{\beta}\right)\right] \int_0^s \phi(c, s)\, dc - \int_0^s \int_0^s \phi(c, j)\, dc\, dj. \tag{9}$$

The equilibrium settlement offer must also satisfy $s_I^* > 0$.

The proof of the lemma, provided in the appendix, fills in some of the technical details. Equation (8) only defines $U(\tilde{s}, s, I)$ for upward deviations ($\tilde{s} \geq s$). The proof provides an analogous expression for downward deviations ($\tilde{s} \leq s$), which can be pictured with the help of the second panel of Figure 3. The proof goes on to show that the derivative $U_1(s_I^*, s_I^*, I)$ exists because the relevant left- and right-hand derivatives are equal. Condition (9) is shown to be equivalent to $U_1(s_I^*, s_I^*, I) = 0$, which in turn is shown to be necessary for equilibrium by showing that it is sandwiched between two inequalities ensuring that upward and downward deviations are unprofitable. The proof is completed by showing that the equilibrium settlement offer cannot equal 0, because $U_{11}(0, 0, I) > 0$, and this local strict convexity violates a second-order necessary condition that the objective function be locally concave.

To gain some intuition for the equation (9), consider each term on the right-hand side in turn. The first term can be interpreted as the marginal benefit of deviating to a settlement offer that is higher than anticipated. This higher offer induces new plaintiff types to accept the settlement offer. Since these types are near their margin of indifference, the settlement payment is about equal to the judgment expense to a first-order approximation ($s \approx j$). However, there is a first-order savings on trial costs that benefits the agent whether or not there is indemnification. With no indemnification ($I = 0$), an upward deviation provides the agent with the additional benefit because he bears a smaller share of the settlement offer (which he can choose to apportion fully to the firm) than he does his own trial and judgment expenses (which he directly bears and cannot apportion to the firm). These benefits from an upward deviation are scaled by the probability

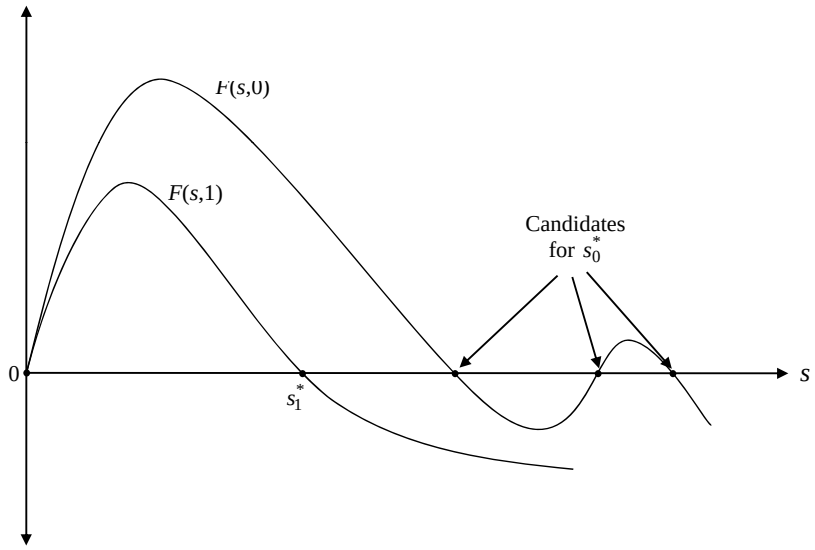


Figure 4: Visualizing Lemma 2

that a type near the margin of indifference (i.e., with $j \approx s$) had a low enough c that it filed a lawsuit ($c \leq s$). The second term on the right-hand side of (9) is the marginal cost of an upward deviation. Inframarginal types (in the light-shaded square) receive a higher settlement offer than before, a cost that is scaled by the mass of inframarginal types.

The next lemma provides some facts about the shape of $F(s, I)$ which will help us visualize the comparative-static properties of equilibrium.

Lemma 2. *$F(s, I)$ has the following properties:*

(a) $F(0, I) = 0$ *for* $I = 0, 1$,

(b) $F_1(0, I) > 0$ *for* $I = 0, 1$,

(c) $\lim_{s\uparrow\infty} F(s, I) < 0$ *for* $I = 0, 1$,

(d) $F(s, I)$ *is differentiable in* s *for all* $I = 0, 1$ *and* $s \geq 0$,

(e) $F(s, 0) > F(s, 1)$ *for all* $s > 0$.

Figure 4 exhibits the properties listed in the lemma. Both curves $F(s, 1)$ and $F(s, 0)$ begin at the origin (property (a)), slope upwards initially (property (b)), but eventually dip below the horizontal axis, (property (c)). The curves are smooth (property (d)), and except for the initial point where they are equal, $F(s, 0)$ lies everywhere above $F(s, 1)$ (property (e)).

To be a candidate for an equilibrium settlement offer, s must satisfy first-order condition $F(s, I) = 0$, corresponding to an intersection between $F(s, I)$ and the horizontal axis in Figure 4. In the figure, there are two candidates for equilibrium under indemnification (0 and s_1^*) and two under no indemnification (0 and s_0^*). Lemma 1 states that, although 0 satisfies the first-order condition, 0 cannot be an equilibrium settlement offer. The only remaining candidates for equilibrium are additional intersections to the right of 0. The properties listed in Lemma 2 ensure there is at least one additional intersection for each indemnification regime. In particular, properties (a) and (b) imply that $F(s, I)$ initially rises above the horizontal axis; property (c) implies that $F(s, I)$ eventually falls below the horizontal axis. Since, by property (d), $F(s, I)$ is differentiable—and therefore continuous—in s, by the Intermediate Value Theorem it must intersect the horizontal axis for some $s > 0$. Since $F(s, 1)$ is below $F(s, 0)$ for all $s > 0$, intersection point s_1^* must be to the left of s_0^*.

At an intuitive level, Figure 4 suggests that our main result holds—indemnification strictly decreases the equilibrium settlement offer. Several loose ends need to be tied up before this conclusion is formal. First, although the curves are drawn so that they only intersect the horizontal axis once to the right of 0, Lemma 2 does not rule out the possibility of multiple intersections and thus multiple equilibria. Second, points where $F(s, I)$ intersect the horizontal axis are candidates for equilibrium, but they are not guaranteed to be equilibria because first-order condition $F(s, I) = 0$ is necessary but not sufficient for equilibrium.

Proposition 1 ties up these loose ends for the indemnification ($I = 1$) case. The proof shows that the agent's objective function $U(\tilde{s}, s_1^*, 1)$ to be quasiconcave in the actual settlement offer $\tilde{s}$. Quasiconcavity is sufficient for a solution to a first-order condition to be a maximum and thus in the present context for a solution s_1^* to the first-order condition $F(s_1^*, 1) = 0$ to satisfy the best-response relation (5). This establishes the existence of equilibrium under indemnification.

The proof then shows that log-concavity of ϕ is sufficient for $F(s,1)$ to intersect the horizontal axis for exactly one $s > 0$. This establishes uniqueness of equilibrium under indemnification.

Proposition 1. *A unique perfect Bayesian equilibrium exists under indemnification. A settlement offer s_1^* constitutes an equilibrium in this case if and only if it satisfies $s_1^* > 0$ and $F(s_1^*, 1) = 0$.*

We are now ready to state the main results of the paper, comparing equilibrium under indemnification to no indemnification.

Proposition 2. *The equilibrium settlement offer under indemnification, s_1^*, is strictly lower than any equilibrium offer under no indemnification, s_0^*.*

The proposition follows from Strict Monotonicity Theorem 1 of Edlin and Shannon (1998). The first-order condition $F(s,1) = 0$ has a unique interior solution by Proposition 1. Property (e) of Lemma 2 ensures that $F(s,0)$ lies strictly above $F(s,1)$. Thus any $s_0^* > 0$ satisfying $F(s_0^*, 0) = 0$ must be strictly greater than s_1^*. Figure 4 provides graphical intuition for the result.

Indemnification makes the agent a more aggressive settlement bargainer. This reduces the plaintiff's net gain from filing a lawsuit, thus reducing the size of the filing set.

Proposition 3. *Let L_1^* be the set of types that file a lawsuit in equilibrium under indemnification. L_1^* is strictly contained within L_0^*, the set of types that file a lawsuit in equilibrium in the no-indemnification case (if an equilibrium exists). The probability that a lawsuit is filed falls by*

$$\int_0^{s_1^*} \int_0^{s_1^*} \phi(c,j)\, dc\, dj + \int_{s_1^*}^{s_0^*} \int_j^{s_0^*} \phi(c,j)\, dc\, dj. \tag{10}$$

Once we have from Proposition 2 that $s_1^* < s_0^*$, it is immediate from the formula for $L^{BR}(s)$ in (2) that fewer plaintiff types will find it profitable to file lawsuit. The set of plaintiff types who no longer file is shown in Figure 6, and the formula for the probability of this set is given in equation (10). Types in this set have marginally profitable cases in the absence of indemnification. Their judgment amounts were sufficiently low that they only filed because of the prospect of a high settlement offer. The lower settlement offer under indemnification is not sufficient to cover their filing cost, so they do not file.

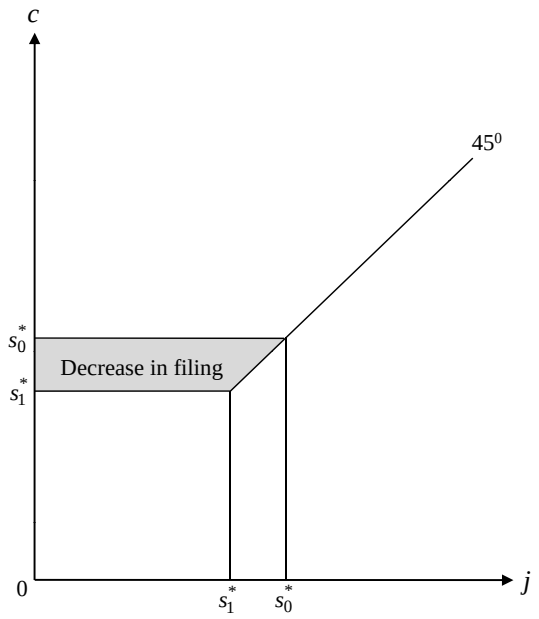


Figure 5: Indemnification Reduces Lawsuit Filing

5. Welfare Implications

In this section we turn from a descriptive analysis of indemnification to a normative analysis. The effect of indemnification on the firm's private surplus is studied in Section 5.1; the effect on social welfare is studied in Section 5.2.

5.1. Firm Surplus

In this section we analyze the effect of indemnification on the firm's total surplus (i.e., the joint surplus of principal and agent). Indemnification has two beneficial effects for the firm. First, indemnification has the ex post benefit of aligning the interests of the agent with the principal, leading the agent to make a more efficient settlement offer (in terms of firm surplus). Second, indemnification has the ex ante benefit of committing the firm to tougher settlement bargaining, reducing the profitability of filing suits, thereby reducing the number of suits that are filed. As the next proposition states, the ex post and ex ante benefits work in the same direction

to make indemnification better for the principal and agent than no indemnification. Indeed, indemnification is a powerful enough tool in the model that it allows the principal and agent to attain the same surplus as in the integrated outcome in which the firm consists of a single entity. The proof is provided in the appendix.

Proposition 4. *The principal's and agent's joint surplus in equilibrium under indemnification is as high as an integrated firm's equilibrium surplus. This joint surplus is strictly higher than the in any equilibrium without indemnification.*

The stark result in Proposition 4—that indemnification can replicate the integrated outcome for the firm—depends on the assumption that the agent is risk neutral. If the agent were risk averse, he would tend to make higher settlement offers than the principal would prefer because of the effective insurance that settlement provides. Whereas trial exposes the agent to the variation in j, settlement offers the prospect of a sure expenditure, s. So risk aversion tends to drive the agent toward more settlement at the margin.

The principal, being the player to make contract offers, would choose to indemnify or not based on his own private payoff rather than the ventures, so it is worth inquiring into the principal's payoff from indemnification. If lump-sum transfers are allowed at the contracting stage, then the principal would choose the indemnification regime that would maximize the joint "pie" to be shared by the principal and agent, extracting any surplus gains by adjusting the lump sum. By Proposition 4, joint surplus is higher with indemnification, so the principal would offer indemnification in the contract. The same conclusion would follow if the principal were free to reduce β to extract the additional rent from the agent provided by indemnification.

If lump-sum payments are not allowed at the contracting stage, and β cannot be freely adjusted (say because its level is chosen to achieve goals for the principal outside of the model such as effort incentives), then the principal faces a tradeoff in making the indemnification decision. Indemnification increases the "pie" he divides with the agent but involves an additional

payment $\alpha(1+j)$ to the agent if the lawsuit goes to trial. According to the next proposition, for some parameters the principal prefers the contract to specify indemnification and for others, not. The principal certainly prefers indemnification when α is sufficiently small. The benefit of indemnification—in terms of making the agent a tougher bargaining and reducing the probability of a lawsuit—is independent of α. However, the indemnification payment $\alpha(1+j)$ approaches 0 as α approaches 0. On the other hand, for β close to 1, the agent—as the residual claimant of most of the firm's net return—already has the incentive to make a tough settlement offer. Indemnification merely adds a payment that the principal has to make to the agent. The proof of the next proposition is provided in the appendix.

Proposition 5. *Holding constant all the other parameters, for α sufficiently close to 0, the principal prefers the contract to specify indemnification. Holding constant all the other parameters, for β sufficiently close to 1, the principal prefers the contract to specify no indemnification.*

5.2. Social Welfare

Most of the action in the model regards transfers between parties, which do not factor into social welfare. The only social-welfare considerations are the two sources of social costs: filing cases involves a social cost c and trials involve a social cost $t=1$. Expected social cost equals

$$SC(s_I^*) = \int_0^{s_I^*}\int_0^{s_I^*} c\phi(c,j)dc\,dj + \int_{s_I^*}^{\infty}\int_0^{j}(c+1)\phi(c,j)dc\,dj. \tag{11}$$

Indemnification, which leads to a lower value s_I^*, has two effects on $SC(s_I^*)$. Fewer suits are filed, reducing the first term in (11). Conditional on filing, however, there is less settlement and more trial costs are expended. We suspect that the net effect is ambiguous. In Section 7 we provide concrete cases in which indemnification reduces social cost.

Beyond our specific model, the reduction in the number of suits filed may be good or bad

for social welfare depending on whether there tend to be too many or too few suits relative to the social optimum. Textbook treatments such as Miceli (2009) suggest that suits perform the function of disciplining defendants to correct externalities such as choosing the right amount of precaution to avoid accidents. There will tend to be too few suits, for example, if filing costs are not included in the judgment and if judgments are biased below plaintiff damages. There will tend to be too many suits if judgments are biased upwards or if the defendant faces relatively higher trial costs than the plaintiff, so that the lawsuit can serve as a tool of rent redistribution. The latter is in a sense the factor our model focuses on since we have not modeled an economic benefit of suits, so indeed they are just a tool for rent extraction here.

6. Commitment to Settlement Offer

The model has assumed that the plaintiff moves first with his filing decision. In this section, we explore the alternative possibility that the firm moves first, committing to a settlement that if would offer if a lawsuit is filed. The firm would benefit from moving first because it could distort its offer below the equilibrium in which it is a second mover, thereby deterring additional lawsuits. In Fudenberg and Tirole's (1984) taxonomy, this sort of strategy could be categorized as the "lean and hungry look" (interpreting a higher settlement offer as an increase in "investment").

Label the optimal commitment offer chosen by the integrated firm the "Stackelberg" offer. The result that the indemnified agent would make the same offer as the integrated firm (see Proposition 4) applies in the commitment setting as well. Thus if the indemnified agent could commit to a settlement offer, he would choose the Stackelberg offer as well.[5] To streamline the presentation, we will frame the analysis around the case of the integrated firm.

[5]The remark from Section 5.1—that for indemnification to replicate the integrated outcome, the agent must be risk neutral—applies to the commitment setting as well. As before, if the agent were risk averse, he would tend to make higher settlement offers than the principal would prefer because of the effective insurance that settlement provides.

We will show (Proposition 6) that the Stackelberg settlement offer (denoted s_S^*) is strictly lower offer than the equilibrium offer when it cannot commit (s_1^*). Combining this insight with the result in Proposition 1, indemnification can be viewed as a sort of partial commitment device, reducing the firm's offer in the direction of the Stackelberg offer but not all the way there.

The commitment case can be thought of as a short-hand for the outcome from a repeated game in which the firm attempts to establish a reputation for tough settlement bargaining when facing a sequence of plaintiffs. In a model with a patient long-run player facing a sequence of short-run players having incomplete information about the long-run player's payoffs (in particular, a type of long-run player may prefer the Stackelberg outcome even if he moves second), Fudenberg and Maskin (1989) show that the long-run player's payoff converges to the Stackelberg outcome every period if he is patient enough.[6]

The expected payoff to the integrated firm from committing to a settlement offer s is

$$r - \int_0^s \int_0^s s\phi(c,j)\,dc\,dj - \int_s^\infty \int_0^j (1+j)\phi(c,j)\,dc\,dj. \tag{12}$$

The first-order condition necessary for the Stackelberg offer s_S^* is $G(s_S^*) = 0$, where

$$G(s) = \int_0^s \phi(c,s)\,dc - \int_0^s \int_0^s s\phi(c,j)\,dc\,dj - s\int_0^s \phi(s,j)\,dj. \tag{13}$$

It can be shown that $G(s)$ exhibits the same properties (a)–(d) from Lemma 2 as $F(s,I)$. That is, $G(0) = 0$, $G'(0) > 0$, $\lim_{s\uparrow\infty} G(s) < 0$, and $G(s)$ is differentiable for all s. It can be further shown that, except for the initial point where the functions are equal ($G(0) = F(0,I) = 0$), $G(s)$

[6]This result applies to both infinitely repeated games and finitely repeated games with sufficiently many periods. Our model is slightly different than Fudenberg and Maskin's in that our short-run players have private information about their types as well. We conjecture that this case strengthens Fudenberg and Maskin's result because a positive measure of plaintiff types will file suit regardless of the settlement offer, allowing the firm to demonstrate its commitment strategy along the equilibrium path with positive probability.

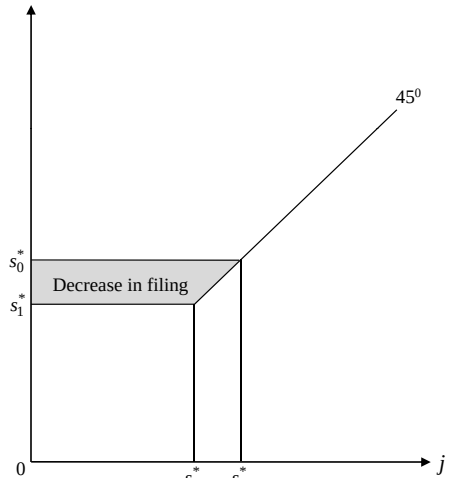


Figure 6: Visualizing Proposition 6

is strictly below $F(s, I)$ for $I = 0, 1$. Indeed, the Stackelberg first-order condition $G(s) = 0$ differs from the first-order condition under indemnification $F(s, 1) = 0$ only in the last term of (13), which represents the strategic benefit of distorting the settlement offer downward: for the measure of types $\int_0^s \phi(s, j)\, dj$ whose filing cost is high enough that they are on the margin of filing and not, the distorted settlement offer induces them not to file, saving the firm from having to pay s to them. Thus the first-order conditions are arranged as shown in Figure **??**. It is immediate from the figure that, regardless of which intersection point between $G(s)$ and the horizontal axis ends up being the Stackelberg offer s_S^*, it will still lie to the left of s_1^*.

Proposition 6. *The Stackelberg offer is strictly less than the integrated firm's equilibrium offer without commitment:* $s_S^* < s_1^*$. *Commitment thus ends up reducing the set of types who file suit:* $L_S^* \subset L_1^*$.

7. Numerical Example

To make some of the ideas above more concrete, consider an example in which c and j are independent exponential random variables with means μ_c and μ_j respectively, implying

$$\phi(c,j) = \left(\frac{e^{-c/\mu_c}}{\mu_c}\right)\left(\frac{e^{-j/\mu_j}}{\mu_j}\right)$$

Assume $\beta = 0.1$, and $\alpha = 0.5$. The agent obtains what in the real world would be a substantial share of the firm return (10%), but the principal still retains most of his return. The agent's share of the judgment is even larger. Given that the allocation of the judgment between agent and principal is in part the choice of the plaintiff, allocating such a large share to the agent could be a good strategy to extract rent from the firm by inducing settlement. Given that the agent bears half the judgment, it might not be unreasonable to suppose that he expends an equal amount in trial costs for his defense.

Further assuming $\mu_c = \mu_j = 3$, and recalling the normalization $t = 1$, one can show that the equilibrium settlement offer under indemnification is $s_1^* = 0.86$ and under no indemnification is $s_0^* = 1.75$. Indemnification reduces the probability that a lawsuit is filed from 20% to 6%. Indemnification reduces total social costs by 2%.

More generally, maintaining all of the parametric assumptions but allowing μ_c to vary yields the graphs of total social costs in Figure 7 . For low values of μ_c, the savings of filing costs under indemnification is dominated by the increase in trial costs, leading to higher total social costs under indemnification. For higher values of μ_c, the savings of filing costs begins to dominate, leading to lower social costs under indemnification. The figure proves by example that the effect of indemnification on total social welfare is ambiguous in general.

To examine the effect of commitment on equilibrium, returning to the baseline parameters $\mu_c =$

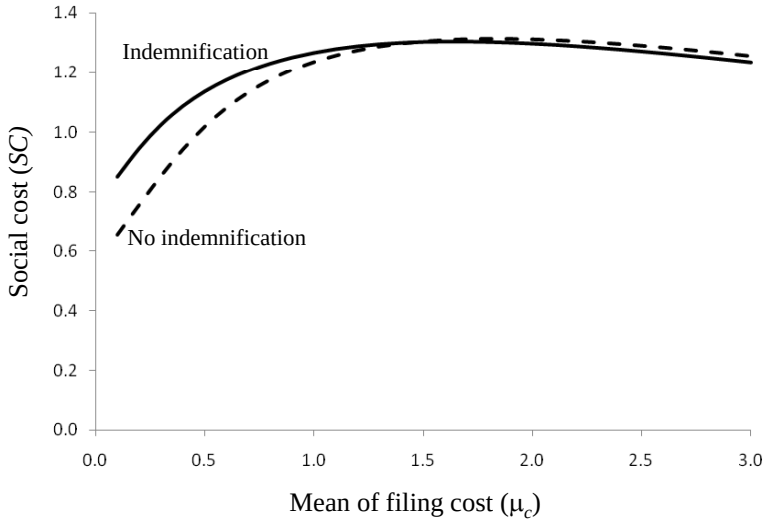


Figure 7: Total Social Cost in Numerical Example

$\mu_j = 3$. Compared to the offer the integrated firm would make in equilibrium without commitment ($s_1^* = 0.86$), the Stackelberg offer is considerably lower ($s_S^* = 0.49$). The Stackelberg offer reduces the probability a suit is filed from 6% to 2%.

8. Conclusion

Justice Souter, in the U.S. Supreme Court's opinion in *Bell Atlantic Corp. vs. Twombly* (2007), highlighted some of the salient features of the litigation environment captured in our model. The case concerned whether an antitrust complaint should proceed to discovery or be dismissed. The Court cited reports that "(. . . discovery accounts for as much of 90 percent of litigation costs when discovery is actively employed). That potential expense is obvious enough in the present case: plaintiffs represent a putative class of at least 90 percent of all subscribers to local telephone or high-speed Internet service in the continental United States, in an action against America's largest telecommunications firms (with many thousands of employees generating reams and gigabytes of business records) for unspecified (if any) instances of antitrust violations that allegedly occurred

over a period of seven years."[7]

The discovery costs are what we model as trial costs; costs the defendant employee bears regardless of whether the plaintiff prevails at trial. The Court identifies the implications for settlement behavior: "And it is self-evident that the problem of discovery abuse cannot be solved by 'careful scrutiny of evidence at the summary judgment stage,' much less 'lucid instructions to juries,' *post*, at 4; the threat of discovery expense will push cost cost-conscious defendants to settle even anemic cases before reaching those proceedings."[8]

The present paper has focused on the strategic benefits of indemnifying employee defendants. But there are natural implications for legal questions, such as rules of standing, rules of evidence, and possibly requiring the loser of a civil suit to pay the costs of both parties. Considering the broader costs and benefits of any of these rules requires a richer environment that we hope to explore in future work. Spier (2007) outlines the formal models of litigation and how these activities are affected by the legal environment.

A final issue for future work concerns the objective function of government litigants. It is natural to think that private rent seeking litigants care only for dollars. But a government litigant, as a political actor, may have broader motivations. Recently New York Attorney General Andrew Cuomo filed suit against Intel for antitrust violations. To date this suit has not been joined by the U.S. Department of Justice. Abstracting from the merits of this particular suit one wonders whether New York seeks changes in Intel's business practices rather than just a settlement amount.

[7]Supreme Court of the United States, *Bell Atlantic Corp. v. Twombly*, 550 U.S. 544 (2007), (page 12..from pdf opinion of the court).

[8]Supreme Court of the United States, *Bell Atlantic Corp. v. Twombly*, 550 U.S. 544 (2007), (page 12-13..from pdf opinion of the court).

Appendix

Proof of Lemma 1: Equation (8) provides an expression for the agent's expected payoff $U(\tilde{s}, s, I)$ for an upward deviation $\tilde{s} \geq s$. Expected utility for a downward deviation ($\tilde{s} \leq s$) can be shown with the help of the second panel of Figure 3 to be

$$\begin{aligned} U(\tilde{s}, s, I) = & \frac{\beta}{\Pr(L^{BR}(s))} \left\{ \int_0^{\tilde{s}} \int_0^{s} (r - \tilde{s})\, \phi(c, j)\, dc\, dj \right. \\ & + \int_{\tilde{s}}^{s} \int_{j}^{s} (r - \tilde{s})\, \phi(c, j)\, dc\, dj \\ & \left. + \int_{\tilde{s}}^{\infty} \int_0^{j} \left[r - 1 - j - (1 - I)\alpha(1 + j) \left(\frac{1 - \beta}{\beta} \right) \right] \phi(c, j)\, dc\, dj \right\}. \end{aligned} \tag{A1}$$

A small upward deviation cannot be profitable, implying that the following condition on the right-hand derivative must hold:

$$\lim_{s \downarrow s_I^*} \frac{U(s, s_I^*, I) - U(s_I^*, s_I^*, I)}{s - s_I^*} \leq 0. \tag{A2}$$

Equation (A2) together with the definition of $U(\tilde{s}, s, I)$ in the case $\tilde{s} \geq s$ from equation (8) implies

$$\left[1 + (1 - I)\alpha(1 + s_I^*) \left(\frac{1 - \beta}{\beta} \right) \right] \int_0^{s_I^*} \phi(c, s)\, dc - \int_0^{s_I^*} \int_0^{s_I^*} \phi(c, j)\, dc\, dj \geq 0. \tag{A3}$$

A small downward deviation cannot be profitable, either, implying that the following condition on the left-hand derivative must hold:

$$\lim_{s \uparrow s_I^*} \frac{U(s_I^*, s_I^*, I) - U(s, s_I^*, I)}{s_I^* - s} \geq 0. \tag{A4}$$

Equation (A4) together with the definition of $U(\tilde{s}, s, I)$ in the case $\tilde{s} \leq s$ from equation (A1) implies the reverse inequality from (A3). Two opposite weak inequalities only hold if they are equalities. Since the left- and right-hand derivatives are equal, $U_1(s_I^*, s_I^*, I)$ exists. Treating (A3) as an equality gives equation (9).

The proof is completed by showing that, while $s = 0$ satisfies the first-order condition $F(0, I) = 0$, 0 cannot be an equilibrium. We do this by showing that $U_{11}(0, 0, I) > 0$, violating the necessary condition that the objective function be locally concave at a maximum. We have

$$U_{11}(0, 0, I) = \frac{\beta\phi(0, 0)}{\Pr(L^{BR}(0))} = \frac{\beta\phi(0, 0)}{\int_0^{\infty} \int_0^{j} \phi(c, j)\, dc\, dj},$$

a positive expression. *Q.E.D.*

Proof of Lemma 2: Property (a) follows from substituting $s = 0$ into the upper limits of integration in equation (9), implying $F(0, I) = 0$.

To establish property (b), note

$$F_1(0, I) = t[\beta + (1 - I)(1 - \beta)\alpha]\phi(0, 0). \tag{A5}$$

Equation (A5) is positive because ϕ is positive on $\mathbb{R}^2_+$.

To establish property (c),

$$\begin{aligned}
&\lim_{s\uparrow\infty} F(s, I) \\
&\leq \left[1 + (1 - I)\alpha\left(\frac{1 - \beta}{\beta}\right)\right]\left[\lim_{s\uparrow\infty} \phi_j(s)\right] + (1 - I)\alpha\left(\frac{1 - \beta}{\beta}\right)\left[\lim_{s\uparrow\infty} s\phi_j(s)\right] - 1 \qquad \text{(A6)} \\
&= -1. \qquad \text{(A7)}
\end{aligned}$$

Condition (A6) holds because

$$\int_0^s \phi(c, s)\, dc < \int_0^\infty \phi(c, s)\, dc \equiv \phi_j(s),$$

where $\phi_j(s)$ is the marginal pdf of j. Condition (A6) also uses the fact that $\phi(c, j)$ is a pdf, so the integral over its entire support equals 1. Verifying equation (A7) requires several steps. By Proposition 4(ii) of An (1998), the log-concavity of ϕ implies the log-concavity of the marginal density ϕ_j. By Corollary 1(ii) of An (1998), the right tail of a log-concave density is at most exponential. Hence $\lim_{s\uparrow\infty} \phi_j(s) = \lim_{s\uparrow\infty} s\phi_j(s) = 0$.

Property (d) follows from the Fundamental Theorem of Calculus, together with the assumption that ϕ is differentiable.

To establish property (e), note

$$F_2(s, I) = -\alpha(1 + s)\left(\frac{1 - \beta}{\beta}\right)\int_0^s \phi(c, s)\, ds, \tag{A8}$$

which is positive for $s > 0$. *Q.E.D.*

Proof of Proposition 1: We will first prove existence of equilibrium. Let $s_1^* > 0$ satisfy the first-order condition $F(s_1^*, 1) = 0$. We will prove that the agent's objective function $U(\tilde{s}, s_1^*, 1)$ is quasiconcave in its first argument. Since U is differentiable, quasiconcavity is equivalent to the following two conditions:

$$U_1(\tilde{s}, s_1^*, 1) \leq 0 \text{ for } \tilde{s} > s_1^* \tag{A9}$$

$$U_1(\tilde{s}, s_1^*, 1) \geq 0 \text{ for } \tilde{s} < s_1^*. \tag{A10}$$

For brevity, we will provide a necessary and sufficient condition for (A9) only. Proving that this same condition is necessary and sufficient for (A10) involves similar arguments and is omitted.

Consider $\tilde{s} > s_1^*$. We have

$$U_1(\tilde{s}, s_1^*, 1)$$
$$= \frac{\beta}{\Pr(L^{BR}(s_1^*))} \left[\int_0^{\tilde{s}} \phi(c, \tilde{s})\, dc - \int_0^{s_1^*} \int_0^{s_1^*} \phi(c, j)\, dc\, dj - \int_{s_1^*}^{\tilde{s}} \int_0^{j} \phi(c, j)\, dc\, dj \right] \tag{A11}$$
$$= \frac{\beta}{\Pr(L^{BR}(s_1^*))} \left[\int_0^{\tilde{s}} \phi(c, \tilde{s})\, dc - \int_0^{s_1^*} \phi(c, s_1^*)\, dc - \int_{s_1^*}^{\tilde{s}} \int_0^{j} \phi(c, j)\, dc\, dj \right]. \tag{A12}$$

Equation (A11) follows from differentiating expression (8). Equation (A12) follows because s_1^* satisfies the first-order condition $F(s_1^*, 1) = 0$, which implies, after rearranging equation (9),

$$\int_0^{s_1^*} \int_0^{s_1^*} \phi(c, j)\, dc\, dj = \int_0^{s_1^*} \phi(c, s_1^*)\, dc. \tag{A13}$$

By the Fundamental Theorem of Calculus,

$$\int_0^{\tilde{s}} \phi(c, \tilde{s})\, dc - \int_0^{s_1^*} \phi(c, s_1^*)\, dc = \int_{s_1^*}^{\tilde{s}} \int_0^{j} \phi(c, j)\, dc\, dj \tag{A14}$$

Substituting (A14) into (A12) implies $U_1(\tilde{s}, s_1^*, 1) = 0$ for all $\tilde{s} > s_1^*$, in turn implying that (A9) is satisfied. Similarly, it can be proved that (A10) is satisfied, establishing the quasiconcavity of U and existence of equilibrium.

We next turn to proving uniqueness of equilibrium. A sufficient condition for uniqueness is $F_1(s_1^*, 1) \leq 0$ for all s_1^* satisfying first-order condition $F(s_1^*, 1) = 0$. This can be explained intuitively with reference to Figure 4. Tracing $F(s, 1)$ as one moves away from the origin, the curve initially rises above the horizontal axis and then falls, intersects the horizontal axis from above. If there were another intersection, it must be from below. But if $F_1(s_1^*, 1) \leq 0$, there can be no intersections from below.

Now

$$F_1(s_1^*, 1) = \phi(s_1^*, s_1^*) + \int_0^{s_1^*} \phi_2(c, s_1^*)\, dc - \int_0^{s_1^*} \phi(c, s_1^*)\, dc - \int_0^{s_1^*} \phi(s_1^*, j)\, dj. \tag{A15}$$

To sign (A15) requires us to derive some implications from the log-concavity of ϕ. By Proposition 4(i) of An (1998), log-concavity of the density $\phi(c, j)$ implies log-concavity of the distribution $\Phi(c, j) \equiv \int_0^j \int_0^c \phi(x, y)\, dc\, dj$. Log-concavity of $\Phi(c, j)$ implies, by the displayed equation in footnote 1,

$$\Phi(s_1^*, s_1^*) H\Phi(s_1^*, s_1^*) \leq D\Phi(s_1^*, s_1^*) D\Phi(s_1^*, s_1^*)', \tag{A16}$$

where $H\Phi$ is the Hessian matrix and $D\Phi$ is the gradient vector for Φ. The inequality in (A15) applies element by element to the 2×2 matrix on each side of the inequality. Two of these

individual inequalities are

$$\left[\int_0^{s_1^*}\int_0^{s_1^*}\phi(c,j)\,dc\,dj\right]\phi(s_1^*,s_1^*) \leq \int_0^{s_1^*}\phi(s_1^*,j)\,dj\int_0^{s_1^*}\phi(c,s_1^*)\,dc \tag{A17}$$

$$\int_0^{s_1^*}\int_0^{s_1^*}\phi(c,j)\,dc\,dj\int_0^{s_1^*}\phi_2(c,s_1^*)\,dc \leq \left[\int_0^{s_1^*}\phi(c,s_1^*)\,dc\right]^2. \tag{A18}$$

Substituting (A13) into (A17) and (A18) implies

$$\phi(s_1^*,s_1^*) \leq \int_0^{s_1^*}\phi(s_1^*,j)\,dj \tag{A19}$$

$$\int_0^{s_1^*}\phi_2(c,s_1^*)\,dc \leq \int_0^{s_1^*}\phi(c,s_1^*)\,dc. \tag{A20}$$

Substituting (A19) and (A20) into (A15) implies $F_1(s_1^*,1) \leq 0$. This proves uniqueness of equilibrium. *Q.E.D.*

Proofs of Propositions 4: Let $V(\tilde{s},s)$ be the expected continuation payoff for the integrated firm following a lawsuit being filed. The first argument, $\tilde{s}$, is the firm's actual settlement offer and the second, s, indicates that the firm's posterior beliefs are $\hat{\phi}(c,j,s)$. We have

$$\begin{aligned} V(\tilde{s},s) =& \frac{1}{\Pr(L^{BR}(s))}\left\{(r-\tilde{s})\left[\int_0^{\tilde{s}}\int_0^{s}\phi(c,j)\,dc\,dj+\int_{\tilde{s}}^{s}\int_{j}^{s}\phi(c,j)\,dc\,dj\right]\right. \\ &\left.+\int_{\tilde{s}}^{\infty}\int_0^{j}(r-1-j)\,\phi(c,j)\,dc\,dj\right\}. \end{aligned} \tag{A21}$$

This objective function is equal to a constant ($1/\beta$) times the objective function for the agent under indemnification, which can be seen by substituting $I=1$ into equation (8). Hence the equilibrium settlement offer will be the same in both cases, proving the first statement of Proposition 4.

Next we prove that joint surplus is strictly higher under indemnification than no indemnification. The principal and agent's joint surplus given equilibrium settlement offer s_0^* under no indemnification is

$$r - s_0^*\int_0^{s_0^*}\int_0^{s_0^*}\phi(c,j)\,dc\,dj - \int_{s_0^*}^{\infty}\int_0^{j}(1+j)\,\phi(c,j)\,dc\,dj \tag{A22}$$

$$< r - s_0^*\left[\int_0^{s_1^*}\int_0^{s_1^*}\phi(c,j)\,dc\,dj+\int_{s_1^*}^{s_0^*}\int_0^{j}\phi(c,j)\,dc\,dj\right] - \int_{s_0^*}^{\infty}\int_0^{j}(1+j)\,\phi(c,j)\,dc\,dj \tag{A23}$$

$$\leq r - s_1^*\int_0^{s_1^*}\int_0^{s_1^*}\phi(c,j)\,dc\,dj - \int_{s_1^*}^{\infty}\int_0^{j}(1+j)\,\phi(c,j)\,dc\,dj. \tag{A24}$$

Expression (A23) is the same as (A22) except that a region (the shaded area in Figure 6) has

been removed from the first integral . Since this positive integral is being subtracted, (A23) strictly exceeds (A22). To see that (A24) exceeds (A23), note that both expressions are expected continuation payoffs for the integrated firm given posterior beliefs $\hat{\phi}(c, j, s_1^*)$. The actual offers are different in the two expressions: s_0^* in (A23) and s_1^* in (A24). We proved above that s_1^* maximizes the integrated firm's expected payoff given these beliefs, so (A23) can be no greater than (A24). *Q.E.D.*

Proof of Proposition 5: The principal's equilibrium expected surplus under indemnification is

$$(1-\beta)\left[r - s_1^* \int_0^{s_1^*}\int_0^{s_1^*} \phi(c,j)\,dc\,dj - \int_{s_1^*}^{\infty}\int_0^{j}(1+j)\phi(c,j)\,dc\,dj\right] \tag{A25}$$

and under no indemnification is

$$(1-\beta)\left[r - s_0^* \int_0^{s_0^*}\int_0^{s_0^*} \phi(c,j)\,dc\,dj - \int_{s_0^*}^{\infty}\int_0^{j}(1-\alpha)(1+j)\phi(c,j)\,dc\,dj\right]. \tag{A26}$$

In the limit as $\alpha \downarrow 0$, expression (A26) takes on the same form as (A25), the only difference being the value of s involved: $s = s_1^*$ in (A25) and $s = s_0^*$ in (A26). It is easy to see that (A25) is increasing in s_1^*. Therefore, because $s_1^* < s_0^*$ by Proposition 2), expression (A26) is strictly greater than (A25) for sufficiently high α.

One can see from an inspection of equation (9) that $\lim_{\beta\uparrow 1} F(s,0) = F(s,1)$. Hence $\lim_{\beta\uparrow 1} s_0^* = s_1^*$. Therefore, in the limit as $\beta \uparrow 1$, expression (A25) exceeds (A26) by

$$\int_{s_1^*}^{\infty}\int_0^{j}(1-\alpha)(1+j)\phi(c,j)\,dc\,dj.$$

Q.E.D.

Proof of Proposition 6: We begin by proving that $G(s) < F(s,1)$ for all $s > 0$. We have

$$F(s,1) - G(s) = s\int_0^s \phi(s,j)\,dj > 0.$$

We next establish that $G(s)$ exhibits the same properties (a)–(d) as $F(s,I)$ in Lemma 2. It is immediate that $G(0) = 0$, establishing property (a). We have $G'(0) = \phi(0,0) > 0$, establishing property (b). We have $\lim_{s\uparrow\infty} G(s) \leq \lim_{s\uparrow\infty} F(s,I) < 0$, where the first inequality holds because $G(s) < F(s,1)$ for all $s > 0$ and the second holds by property (c) of Lemma 2, establishing that property (c) is also inherited by $G(s)$. Finally the differentiability of $G(s)$ follows from the Fundamental Theorem of Calculus and the differentiability of ϕ.

Just as we invoked Strict Monotonicity Theorem 1 of Edlin and Shannon (1998) to establish Proposition 2, we can invoke it here, using the results in the proof so far (in particular that $G(s) < F(s,1)$ for all $s > 0$) to establish that $s_S^* < s_1^*$. *Q.E.D.*

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