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Information and Externalities in Sequential Litigation

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Information and Externalities in Sequential Litigation

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The information that is created and disseminated through the litigation process can have social value. When economic agents learn about risks, they can fine-tune their future behaviors to mitigate these risks. Specifically, suppose that an injured plaintiff sues a defendant for damages sustained in an accident. In the future, the plaintiff may be harmed in similar accidents involving different defendants. The first lawsuit creates valuable information that the future defendants can use to fine-tune their investments in accident prevention. If the plaintiff and the first defendant are symmetrically uninformed about the true damages, their private incentive to litigate the first case is too small. If the plaintiff and the first defendant are asymmetrically informed, then the incentive to litigate the first case may be too large. The optimal liability rule trades off the need to provide defendants with incentives to take precautions and to provide the plaintiff with incentives to create valuable public information through litigation.

1. Introduction

In 1989, the Exxon Valdez ran aground off the coast of Alaska and spilling some 11 million gallons of crude oil into Prince William Sound. The spill affected approximately 1,500 miles of Alaska's coastline killing billions of salmon, on order of a million seabirds, thousands of otters, and hundreds of bald eagles.[2] Exxon paid about $2.5 billion to cover the two years of cleanup efforts. After investigations to assess the value of the environmental damages themselves, Exxon settled in 1991 with the state of Alaska for $1 Billion. The

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[2] Wilkinson (2002).

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settlement also included a so-called "reopener clause" that allowed the government to seek an additional $100 million in the future if new damages were discovered within a decade.[3]

This paper argues that the accurate determination of damages -- even those that may become known years later -- provides those engaging in similar risky activities with valuable information for future decision-making. This point is of course not unique to environmental damages. Manufacturer liability for product-related harms does more than simply provide manufacturers with better incentives to design safer products and disclose known product risks to consumers. Manufacturer liability is also a mechanism for creating and disseminating information about these risks. The information that is made public through litigation puts both product users and other manufacturers in a better position to take precautions to mitigate their future risks.[4]

Formally, this paper considers a simple framework where a single plaintiff faces a sequence of defendants. The first accident has already occurred, while the accidents involving future defendants have not. The accidents are similar in the sense that the plaintiff's damages from the accidents are positively correlated. Litigation is socially valuable in this setting because pretrial investigations and trials provide information about accident risks to the future defendants. The future defendants can then fine tune their precautions to avoid the second accident. We ask several questions. First, is the plaintiff's decision to litigate the first case socially desirable? Second, how should the liability rule be adjusted in light of a divergence? Finally, does the presence of asymmetric information change these answers?

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[3] Carlton (2001).

[4] Individuals who have been exposed to asbestos, for example, can reduce the chance of developing severe asbestos-related illnesses by avoiding cigarettes and dust.

We first consider a case where the plaintiff and the defendants are *symmetrically uninformed* about the damages from an accident. In the Exxon Valdez case, it was not initially clear how high the environmental damages were. Careful investigations before the trial allowed the litigants to more accurately pinpoint the damages that arise from oil spills. If there is no possibility of a similar case arising in the future then the first case will surely settle -- there is no sense spending money to determine the precise level of damages when a quick settlement can be obtained at the expected damage level. When similar cases may arise in the future, however, then settlement negotiations could fail. In particular, the long-lived plaintiff can benefit from the affect that the information from the first trial has on the future defendants' precautions. The plaintiff's incentive to generate information is not socially optimal, however, since the future defendants typically capture some of the social benefit of increased information.

The symmetric information case also gives us insights into how liability rules should be designed. Taking the plaintiff's decision to settle or litigate the first case as fixed, the best liability rule would put 100% responsibility the player who needs to be given incentives for care -- the future defendants in our example. But the plaintiff's settlement decision is endogenous and hinges on the liability rule. When the plaintiff bears no responsibility for his own damages he captures none of the information value and will therefore prefer to settle the first case. To put it somewhat differently, putting 100% responsibility on the defendants will chill the flow of information. The optimal liability rule will balance the need to provide defendants with appropriate incentives and the need to create public information and will often feature shared responsibility for accident harms.

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These results may change when the plaintiff and the first defendant are *asymmetrically informed* about the damages. Suppose that the plaintiff has private information about the damages he has sustained and the first defendant can make a single take-or-or-leave-it offer before trial. Bargaining failures arise in equilibrium: when the plaintiff's damages are sufficiently high the plaintiff will reject the defendant's offer and go to trial where litigation costs are incurred.[5] In short, value is destroyed as the litigants engage in rent seeking activities and take tough bargaining stances in an attempt to grab a greater share of the bargaining surplus. When the plaintiff's long-run value from information disclosure is small then the equilibrium level of litigation is socially excessive.

This paper contributes to the large literature on settlement of litigation (see the surveys of Daughety, 1999, and Hay and Spier, 1998). Although most of the early literature focused on disputes between a single defendant and a single plaintiff -- often with asymmetric information -- more recent papers have considered externalities among multiple litigants. Even in the absence of private information, externalities can lead settlement negotiations to fail.[6] Some of the externalities come from underlying correlation among the claims. Daughety and Reinganum (1999, 2002) argue that confidential settlements are a way for the defendant to keep information about the lawsuit a secret from future plaintiffs.

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[5] Although the framework with a take-it-or-leave-it offer, based on Bebchuk (1984), seems extreme, the results are actually more general. The bargaining environment features common values and any bargaining game will lead to negotiation breakdowns with positive probability. See the mechanism-design model of Spier (1994).

[6] Spier (2003) looks at externalities between multiple plaintiffs who are suing a potentially insolvent defendant. Spier and Sykes (1998) explore the externalities between settling plaintiffs and debtholders. Kornhauser and Revesz (1994a) and (1994b) look at multiple defendant lawsuits under joint and several liability, focusing on the externalities in settlement decisions.

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Externalities also can create strong incentives for parties to consolidate their claims (Che, 1996 and 2002, Spier 2002). Public policies, such as precedent, also create externalities and lead parties to adjust their settlement strategies (Che and Yi, 1993).[7] None of these papers consider the ex post incentive effects identified here.

Second, our paper adds a new twist to the debate over the social value of accuracy in adjudication (see the survey by Kaplow, 1998). Kaplow and Shavell (1996) have argued that the accurate assessment of damages at trial can be valuable in creating better *ex ante incentives*. If an injurer knows ex ante that his actions could lead to higher social losses -- and that he will be held liable for the higher damages -- then he will take greater care to avoid the accident. If, on the other hand, if the injurer lacks the knowledge that the social harm will be unusually large (and cannot easily acquire the information) then accuracy has no social value. Since the accurate determination of damages at trial is very costly, their argument goes, society would be better served by policies where injurers are held responsible only for the damages that they could have reasonably anticipated ex ante.[8] This paper takes a different perspective: accuracy in adjudication creates social value by informing future players about the risks associated with their activities and creating better *ex post incentives*.

Finally, this paper adds to the small but growing literature on the divergence between the private and social incentives to litigate and settle lawsuits. Shavell (1997) argues that the incentives of private parties to use the legal system typically diverge from what is best for

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[7] Miller (1998) presents a survey, highlighting the conflict of interest between the plaintiffs and the (often self-appointed) attorney.

[8] Spier (1994) argues that accuracy is valuable when ex ante care levels affect the level of damages, not just the probability of an accident. Kaplow and Shavell (1994) consider the value of accuracy when the main issue at trial is liability, not damages.

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society as a whole. The resources wasted in litigation do not always have a corresponding social benefit. Costs would be saved -- and the proper ex ante incentives maintained -- if the parties settled for the "average" judgment instead.[9] In contrast to the literature, this paper takes a forward-looking perspective by arguing that early settlement can compromise the *future incentives* of the players.

The next section presents the general framework. The third section assumes that the players are symmetrically uninformed about future damages and shows that the private incentive to settle is stronger than the social incentive. The fourth section presents an example where the plaintiff is privately informed about his damages at date 1, and shows that the private incentive to settle may be either too weak or too strong. The final section concludes. The proofs that are not included in the main text are given in the technical appendix.

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[9] Disagreements over liability, on the other hand, can create incentives to settle too often in the sense that defendants will take too little care in anticipation of a future settlement (Spier, 1997).

2. The Model

There are $N+1$ players: a plaintiff (P) who has suffered harm, h, a current defendant (D_1) who has caused the harm, and a group of $N-1$ future defendants ($D_2, D_3, \ldots D_N$) who may harm the plaintiff at a future date. All players are risk-neutral. We assume that the damages caused by the N defendants are perfectly correlated; in the event of an accident the future defendants cause harm h as well.[10] The damages are drawn from distribution $f(h)$ on $[0,\infty)$ with mean $\bar{h}$. We assume that $[1-F(h)]/f(h)$ is strictly decreasing in h.[11] Although this distribution is common knowledge, the realization of h is not observed. If the plaintiff pursues litigation against the first defendant, however, then investigations will be conducted and the true value of h will be accurately verified and publicly disclosed.

In the event of an accident, the court will force the responsible defendant to pay fraction $\alpha \in [0,1]$ of the plaintiff's damages. The parameter α, the "liability rule," is a choice variable for a social planner who seeks to maximize social welfare. Trials are assumed to be costly: the plaintiff's litigation cost is k_P and the defendant's litigation cost is k_D and we let k represent the total litigation cost. The "American Rule" is in effect: each side bears its own litigation costs.[12]

The future defendants are fully aware of the existence of the first case and take careful note of its disposition, including the precise value of h if the first case goes to trial. These defendants also play an active role in preventing future accidents: Each future defendant D_i,

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[10] This simplification is not restrictive. The basic result would hold so long as the damage levels for all cases are positively correlated.
[11] This monotone hazard rate assumption is satisfied by many common distributions.
[12] Our basic results do not hinge on the cost allocation rule.

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$i=2,\ldots N$, makes non-verifiable precautions, x_i, to reduce the probability of an accident.[13] Formally, the probability that D_i will cause an accident is $\pi(x_i)=1-x_i$ and $c(x_i)$ is D_i's associated cost of precautions. We assume that the cost function is strictly increasing and convex and satisfies the following conditions: $c(0)=0$, $c'(x)=0$, $\lim_{x\to 1} c'(x)=\infty$, and $c'''(x)\leq 0$.[14]

The timing of the game is as follows. At date 1, P and D_1 attempt to negotiate a settlement. If negotiations succeed then the first round ends and if negotiations fail the first case goes to trial where h is verified and publicly disclosed. D_1 is forced to pay αh to the plaintiff and the defendant and plaintiff bear litigation costs k_d and k_p, respectively. At date 2 the future defendants choose their precautions. Accidents subsequently occur as described above and the plaintiff and the responsible defendant engage in settlement negotiations. If negotiations fail the case goes to trial where the defendant pays αh to the plaintiff and litigation costs k_d and k_p are borne. Note that there may be anywhere between 0 and N new accidents. The assumption that future defendants choose precautions and cause accidents at exactly the same time is for expository convenience; the results would be unchanged if they arrived in sequence instead.[15]

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[13] Note that we do not consider the precautions taken by the first defendant. A firm selling automobiles, for example, could certainly take actions to reduce the possible damage level to buyers. If these precautions were observable, however, then firms could internalize these through ex-ante pricing or contracting. We simplify issues by ignoring the effect of court policies on the early defendant's precautions. Moreover, if the probability to become the first defendant is small enough, then each potential defendant has incentive to wait for more information so that he has little incentive to make ex-ante precaution. Or even if he has incentive ex-ante, since there is no information on real damage level yet, it could be shown that courts would take policies to induce too few trials, which reinforces our results below.

[14] The last assumption on the third derivative is a weak sufficient condition for later results.

[15] We will see that the plaintiff's incentive to litigate and release information is stronger when there are more accidents waiting to happen (N is larger). If the defendants arrive in

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Note that settlement negotiations always take place under symmetric information. The plaintiff's share of the bargaining surplus (if a positive surplus exists) is represented by a parameter θ and we make the simplifying assumption that $(1-\theta)k_p - \theta k_d = 0$. This would be satisfied if, for example, the two litigants had equal litigation costs $(k_p = k_d)$ and equal bargaining power $(\theta = .5)$. This assumption implies that the plaintiff would like to avoid future accidents. If the plaintiff had too much bargaining power, for example, then he would *benefit* from future accidents when α is very large. The plaintiff would want to stimulate additional accidents for their settlement value rather than prevent them.[16] This assumption also implies that settlement in the second round will be "accurate" -- reflecting the defendant's expected liability at trial.

Notice that although early litigation with D_1 involves a real costs, $k_p + k_d$, it also provides private and social benefits. In particular, the information that is verified in the courtroom -- and subsequently made public -- is used by the future defendants when making real economic decisions. It is also clear that the private and social incentives to litigate typically diverge. The decision to settle the first case involves only two of the players, P and D_1, while the litigation decision also affects the welfare of the future defendants.

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sequence then the plaintiff would, in equilibrium, either litigate in the first round or not at all.

[16] Relaxing this assumption would create special cases associated with extreme liability rules. The main insights of the paper would not be affected, however.

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3. Results

The plaintiff and the first defendant face an important decision at date 1: they can settle the first case or they can take the first case to trial. The plaintiff's expected payoff at trial is $\alpha\bar{h} - k_p$ while the defendant's expected payments are $\alpha\bar{h} + k_d$. There is an obvious incentive to settle the first case: settlement avoids the total cost of litigation, $k_p + k_d$. On the other hand, litigation reveals information about future dangers and influences the precautions chosen by future defendants. We will see that the plaintiff and the first defendant may opt to litigate the first case, despite the cost, if the benefit derived from informing the future defendants' effort choices is sufficiently strong.

3.1 Equilibrium Characterization

We will proceed by backwards induction. Suppose that first case has settled. If another accident occurs at date 2 involving defendant D_i then the plaintiff and D_i will remain symmetrically uninformed about the true damages, h. The most that D_i is willing to pay to settle the case is $\alpha\bar{h} + k_d$, his expected payment if the case goes to trial. The least the plaintiff is willing to accept is $\alpha\bar{h} - k_p$, his expected damage award minus his litigation costs.[17] Given our earlier assumption concerning the bargaining power of the two parties the case involving D_i would settle for $S_2 = \alpha\bar{h}$.

When viewed from date 2, a representative defendant D_i anticipates paying $S_2 = \alpha\bar{h}$ in the event of an accident. He therefore chooses his precautions, x, to minimize his expected future liability plus his precaution costs:

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[17] For simplicity, in this paper, we assume that the threat for going to trial is always credible.

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$$Min_x \quad (1-x)\alpha\bar{h} + c(x).$$

The first-order condition is,

$$c'(x) = \alpha\bar{h}. \tag{1}$$

In other words, theh defendant invests to the point where his marginal cost of precautions is exactly offset by his marginal benefit associated with reducing the probability of an accident. We can write the representative defendant's precaution, *x*, as a function of the expected damages, $\bar{h}$, and the liability rule, α:

$$x = g(\bar{h};\alpha). \tag{2}$$

As expected, one can show that the equilibrium precautions are increasing in the expected harm, $\bar{h}$, and the defendant's share of the damages, α. Finally, conditional upon settling at date 1, the plaintiff's expected loss associated with the representative defendant is:

$$L_P(\bar{h};\alpha) = [1 - g(\bar{h};\alpha)](1-\alpha)\bar{h}, \tag{3}$$

the probability of an accident multiplied by the plaintiff's share of the damages.

Now suppose instead that the plaintiff and the first defendant take the first case to trial. The future defendants subsequently learn the true value of *h* from the investigations that are made public. When making his date 2 precaution choice, our representative defendant, D_i, anticipates settling for $S_2 = \alpha h$ in the future (should an accident arise). D_i's optimal precaution is now a function of the true damages *h* rather than the average damages $\bar{h}$:

$$x = g(h;\alpha).$$

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Conditional upon pursuing a litigation strategy at date 1, the plaintiff's expected loss associated with the representative defendant is:

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$$E(L_P(h;\alpha)) = \int_0^\infty L_P(h;\alpha) f(h) dh$$

where $L_P(h;\alpha)$ is defined above.

We can now construct the bargaining range at date 1. The plaintiff's expected payoff conditional upon going to trial is $\alpha\bar{h} - k_p - (N-1) * E(L_P(h;\alpha))$, the expected damages from trial minus his expected losses associated with the future defendants. If he settles for S_1, on the other hand, his payoff would be $S_1 - (N-1) * L_P(\bar{h};\alpha)$. Combining these expressions shows that the least that the plaintiff is willing to accept in settlement, $\underline{S_1}$, is:

$$\underline{S_1} = \alpha\bar{h} - k_p + (N-1) * [L_P(\bar{h};\alpha) - E(L_P(h;\alpha))] . \tag{4}$$

This expression reflects the fact that litigation creates and discloses public information that subsequently affects the precautions of the defendant. The upper bound on the settlement range, or the most the first defendant is willing to pay, is simply

$$\overline{S_1} = \alpha\bar{h} + k_d . \tag{5}$$

Taken together we see that settlement occurs if and only if $\underline{S_1} \le \overline{S_1}$ or:

$$k \ge (N-1) * [L_P(\bar{h};\alpha) - E(L_P(h;\alpha))] . \tag{6}$$

<u>Proposition 1:</u> Define $\hat{k} = (N-1) * [L_P(\bar{h};\alpha) - E(L_P(h;\alpha))]$. If the total litigation costs are above this cutoff, $k \ge \hat{k}$, then the plaintiff and the first defendant settle out of court at date 1. If the litigation costs are below this cutoff, $k < \hat{k}$, then the first case goes to trial. Furthermore, if

(i) $\alpha = 0$ then $\hat{k} = 0$;

(ii) $\alpha \in (0,1)$ then $\hat{k} > 0$;

(iii) $\alpha = 1$ then $\hat{k} = 0$.

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Proof: In order to prove our result we will show that $L_P(h;\alpha)$ is a strictly concave function of h for $\alpha \in (0,1)$ and is linear when $\alpha = 1$ and $\alpha = 0$. Differentiating $L_P(h;\alpha)$ with respect to h twice shows us that:

$$L_P''(h;\alpha) = -(1-\alpha)[2g'(h;\alpha) + hg''(h;\alpha)] . \tag{7}$$

We see right away that $L_P''(h;1) = 0$ for all h which implies that $L_P(\bar{h};1) - E(L_P(h;1) = 0$. Recall that the representative defendant's precaution level, $x = g(h;\alpha)$, is implicitly defined by $c'(g(h;\alpha)) = \alpha h$. Differentiating this expression gives $g'(h;\alpha) = \alpha[c''(g(h;\alpha))]^{-1}$,. Since $c''(x) > 0$ we know that this is strictly positive when $\alpha > 0$ and zero when $\alpha = 0$. Totally differentiating with respect to h again gives $g''(h;\alpha) = -\alpha^2 c'''(x)/[c''(x)]^{-3}$, which is again strictly positive when $\alpha > 0$ and $c'''(x) < 0$ and zero otherwise. We conclude that the plaintiff's continuation payoff is linear when $\alpha = 0$ and is a strictly concave function of h for all $\alpha \in (0,1)$.

Q.E.D.

These results may be understood intuitively. When $\alpha = 0$ the plaintiff bears all of the damages from the accident. Since the defendants bear no responsibility for the accidents they cause they take no precautions to avoid accidents *(x = 0)*. At this extreme, the plaintiff gains nothing from early litigation and so the first case always settles. At the other extreme, when $\alpha = 1$ the defendant bears 100% responsibility for the plaintiff's damages. The plaintiff again gains nothing from litigating the first case because his continuation losses are zero: $L_P(\bar{h};1) = E(L_P(h;1) = 0$. In the intermediate range, $\alpha \in (0,1)$, however, the early case may go to trial in equilibrium. The future defendants respond to information by

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fine-tuning investments and the plaintiff captures some social value through his share, $1-\alpha$, of the damages.

3.2 The Divergence Between the Private and Social Incentive to Settle

The decision of the plaintiff and the first defendant to litigate or settle at date 1 does not necessarily correspond to the best decision from a social welfare perspective. If the first cases settles out of court, then the future defendants choose precautions based on the average damages, $\bar{h}$. The representative defendant's expected future losses may be written as:

$$L_D(\bar{h};\alpha) = (1-g(\bar{h};\alpha))\alpha\bar{h} + c(g(\bar{h};\alpha)). \tag{8}$$

If the first case went to trial instead, the future defendants would fine-tune their precautions to the actual damage level, *h*. A representative defendant's expected loss would be:

$$E(L_D(h;\alpha)) = \int_0^\infty L_D(h;\alpha) f(h) dh .$$

The next lemma states that, for all liability regimes where $\alpha > 0$ (so the defendants bear some responsibility for the damages), the future defendants benefit from more information about damage levels. In short, the decision to settle the first case before investigations are conducted imposes a negative externality on future defendants.

<u>Lemma 1:</u> When $\alpha > 0$ then $L_D(\bar{h};\alpha) > E(L_D(h;\alpha))$; future defendants strictly benefit from early litigation. When $\alpha = 0$ then $L_D(\bar{h};\alpha) = E(L_D(h;\alpha)) = 0$; future defendants derive no value from early litigation.

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<u>Proof</u>: To show that $L_D(h;\alpha)$ is concave we take the derivative with respect to *h*. By

envelope theorem we may ignore the effect of h on precautions and so we have $L_D'(h;\alpha)=(1-g(h;\alpha))\alpha$ and $L_D''(h;\alpha)=-\alpha g'(h;\alpha)$. As in the proof of Proposition 1 we have that $g'(h;\alpha)=\alpha[c''(g(h;\alpha))]^{-1}>0$ for all $\alpha>0$. Therefore $V_D''(h;\alpha)<0$. When $\alpha=0$, however, the future defendants take no precautions and so $V_D(\bar{h};\alpha)=E(V_D(h;\alpha))=0$.

Q.E.D.

The plaintiff and the first defendant, as shown above, will choose to settle the first case when $k\geq\hat{k}$. The future defendants, on the other hand, benefit from the information revealed through early litigation. Since the plaintiff and the first defendant do not internalize the benefit that accrues to the future defendant, there is a divergence in the direction of "too few trials".

The next proposition characterizes the optimal litigation decision from a social welfare perspective. The social planner would take into account the payoffs of all players, including the future defendants, when determining whether settlement or litigation is appropriate.

<u>Proposition 2:</u> Define

$$\tilde{k}=(N-1)*[L_P(\bar{h};\alpha))-E(L_P(h;\alpha))]+(N-1)*[L_D(\bar{h};\alpha))-E(L_D(h;\alpha))]. \quad (9)$$

If $k\geq\tilde{k}$ then social welfare is highest if the first case settles at date 1 and if $k<\hat{k}$ then social welfare is highest if the first case goes to trial. Furthermore, if

(i) $\alpha=0$ then $\tilde{k}=\hat{k}=0$;

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(ii) $\alpha \in (0,1)$ then $\tilde{k} > \hat{k} > 0$;

(iii) $\alpha = 1$ then $\tilde{k} > \hat{k} = 0$.

<u>Proof:</u> Social welfare is higher with date 1 settlement when $(N-1)*[L_P(\bar{h};\alpha)+L_D(\bar{h};\alpha)] \leq (N-1)*[E(L_P(h;\alpha))+E(L_D(h;\alpha))]+k$ which gives the expression for $\tilde{k}$ in the proposition. The results follow immediately from definition of $\hat{k}$ and the previous results.

Q.E.D.

In the proposition, $(N-1)*[L_P(\bar{h};\alpha))-E(L_P(h;\alpha))]$ is the plaintiff and the first defendant's additional joint private benefit from litigating the first case rather than settling while $(N-1)*[L_D(\bar{h};\alpha))-E(L_D(h;\alpha))]$ is the joint benefit of the future defendants. When $\alpha = 0$ there is no benefit from having information revealed, so it is both privately and socially optimal for all cases to settle: $\tilde{k} = \hat{k} = 0$. When $\alpha > 0$, then the later defendants gain surplus from early litigation, $L_D(\bar{h};\alpha))-E(L_D(h;\alpha)) > 0$, and so the socially planner would choose to go to trial more often than arises in the private equilibrium. We have the following corollary.

<u>Corollary 1:</u> For litigation costs in the range $k \in (\hat{k},\tilde{k})$ the plaintiff and the first defendant choose to settle the first case even though it is in the best interest of society for the first case to go to trial. For litigation costs outside this range the private and social incentives to litigate are aligned.

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3.3 The Optimal Liability Rule

The preceding analysis took α, the proportion of damages borne by defendants, as exogenous. What if a social planner could choose the liability rule optimally instead? On the one hand, setting $\alpha = 1$ will have a positive effect on the second defendant's incentives to take precautions. Taking the decision of the defendant to litigate or settle the first case as given, $\alpha = 1$ better aligns the incentives of the future defendants with the incentives of society more broadly. But the social planner's choice of liability rule also affects the plaintiff's and the first defendant's decision to settle the case at date 1. When $\alpha = 1$, as shown in proposition 1, the first case would settle out of court. The information about *h* would remain hidden, preventing the future defendants from fine-tuning their precautions.

Take instead the liability rule where $\alpha = 0$, so the plaintiff and the first defendant *strictly* prefer to settle rather than litigate the first case. This α cannot be an optimal liability rule: by increasing α slightly while keeping the private incentive for settlement, the social planner enhances the future defendants' incentives to take precautions. Similarly, suppose that the liability rule is $\alpha < 1$ such that $k < \hat{k}$, the plaintiff and the first defendant *strictly* prefer to litigate rather than settle the first case. This α cannot be an optimal liability rule: by increasing α slightly while keeping the incentive for litigation, we could give the future defendants stronger incentives to invest in precautions. Indeed, the optimal liability rule α^* must have the property that it is either one (so the first case settles) or it is the largest positive number that makes the plaintiff and the first defendant indifferent between litigating and settling the first case.

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Proposition 3: The optimal liability parameter is either $\alpha^* = 1$ or the largest value of α that satisfies $(N-1)*[L_P(\bar{h};\alpha) - E(L_P(h;\alpha)] \geq k$.[18] In the former case the first suit settles; no information is released but the future defendants are optimally deterred. In the latter case the first suit goes to trial; information is released but the future defendants take too few precautions.

This result also suggests circumstances where the private and social incentives to litigate diverge, even when the liability rule is chosen optimally. For example, if $\alpha^* = 1$ and $k < \tilde{k}$ then the plaintiff and the first defendant may choose to settle the first case even though it is in society's interest for the first case to go to trial. The next example illustrates that this latter situation can indeed arise for a certain range of parameter values.

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[18] When $(N-1)*[L_P(\bar{h};\alpha) - E(L_P(h;\alpha)] = k$, the plaintiff and the first defendant are actually indifferent between settlement and litigation. We assume that the defendant will choose litigation in this knife-edged case.

3.4 Example.

Suppose that $N = 2$, so there is exactly one future defendant. Suppose further that $c(x) = (1/2)x^2$ and that $f(h)$ is uniformly distributed on the unit interval *[0,1]* so $\bar{h} = 1/2$. Also for simplicity, suppose $\theta = 1$ so that the plaintiff always requests the settlement offer, and that $k_D = 0$ and $k_P = k$. D_2's precaution choice takes a simple form: $x = g(h;\alpha) = \alpha h$. P's expected future losses are $L_P(h;\alpha) = [(1-\alpha)h - (N-1)(1-\alpha)h^2$ and P and D_2's joint expected losses are $L(h;\alpha) = L_P(h;\alpha) + L_D(h;\alpha) = h - \alpha(1-\alpha/2)h^2$. Note that both are concave functions of *h*. We have $\hat{k} = (E(h^2) - \bar{h}^2)\alpha(1-\alpha) = (1/12)\alpha(1-\alpha)$. We also find that $\tilde{k} = (E(h^2) - \bar{h}^2)\alpha(1-\alpha/2) = (1/12)a(1-\alpha/2)$. Note that $\tilde{k} > \hat{k} \geq 0$ for all $\alpha \in (0,1]$ and $\tilde{k} = \hat{k} = 0$ when $\alpha = 0$.

Now given k, define the optimal liability rule be $\alpha^*(k)$. From earlier result on the optimal liability rule, we must have either $\alpha^*(k) = 1$ or $(1/12)\alpha^*(1-\alpha^*) = k$. If $\alpha^*(k) = 1$, there is settlement and the future losses are $L(\bar{h};1) = 3/8$. If $(1/12)\alpha^*(1-\alpha^*) = k$, there is litigation and the loss is $E[L(h;\alpha^*) + k] = 1/2 - \alpha^*/3 + \alpha^{*2}/6 + k = 1/2 - \alpha^*/4 + \alpha^{*2}/12$, which is smaller than 3/8 when $\alpha^* \leq (3-\sqrt{3})/2$. Therefore, if $k \leq (2\sqrt{3}-3)/24$, the optimal liability rule is $\alpha^*(k)$ satisfying $(1/12)\alpha^*(1-\alpha^*) = k$; if $k > (2\sqrt{3}-3)/24$, the optimal liability rule is $\alpha^*(k) = 0$. Finally notice there is divergence if $(2\sqrt{3}-3)/24 < k < 1/24$: $\alpha^*(k) = 1$ so that defendant would settle with P1, but litigation is socially optimal since $k < \tilde{k} = 1/24$.

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4. A Simple Example with Asymmetric Information

The previous section focused on a setting where private parties tend to settle *too often*. They choose to settle to avoid their private litigation costs, not internalizing the social benefits of the information made public through trial. This result may be reversed, however, when other factors are introduced. In particular, when the early litigants are privately informed they will engage in rent-seeking activities and take tough bargaining stances in an attempt to extract a greater share of the bargaining surplus. This will lead to bargaining failures and costly trials. The rent-seeking motive is purely redistributive and is not aligned with the motives of a social planner.

We modify the previous model in several ways to explore the role of asymmetric information. First, we change the information structure. Suppose that the plaintiff has private information about his harm level, *h*, when negotiating with the first defendant at date 1 and the first defendant knows that the plaintiff has this information. At date 2, the $N-1$ future defendants update their beliefs based on the disposition of the earlier case and choose their precautions accordingly. At date 3 we assume that the future defendants observe the plaintiff's damages should an accident occur so there is symmetric information at date 3. We also assume that *h* is uniformly distributed on the unit interval *[0,1]*, that the defendants' cost of precautions is quadratic, $c(x) = .5x^2$, and that the defendants have the power to make take-it-or-leave-it settlement offers, so $\theta = 0$. In this way, the negotiations at date 2 resemble the screening model in Bebchuk (1984). The property that $(1-\theta)k_p - \theta k_d = 0$ is maintained by assuming that the plaintiff's litigation cost is zero or, alternatively, that the English Rule for allocating the litigation costs is in effect. In all other respects, however, the

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model here is the same as before.

<u>Lemma 2:</u> Suppose that the uninformed defendant, D_1, has offered to settle with the privately informed plaintiff for S_1. The continuation equilibrium features a cutoff, h_1, implicitly defined by $\alpha h_1 + [\alpha(1-\alpha)(N-1)/2]h_1^2 = S_1$ if $S_1 < \alpha + \alpha(1-\alpha)(N-1)/2$ and $h_1 = 1$ otherwise.

i. If $h \le h_1$ then P accepts S_1 at date 1. Each of the $N-1$ future defendants take precautions $ah_1/2$ each and subsequently settle out of court for $S_2 = ah$.

ii. If $h > h_1$ then P rejects S_1 at date 1 and goes to trial. Each of the $N-1$ future defendants take precautions ah and subsequently settle out of court for $S_2 = ah$.

<u>Proof:</u> We will begin at date 3 and work backwards. At date 3 the plaintiff and the defendants become symmetrically informed about damages so the defendants who caused accidents will settled out of court for $S_2 = ah$, regardless of the outcome of the earlier case. The outcome of the earlier case will affect the defendants' precautions at date 2, however. If the first case went to trial then the representative defendant learns the true damages and sets $c'(x) = ah$, giving $x = ah$. If the first case settled then the representative defendant knows that the plaintiff's damages are in the truncated uniform distribution on $[0, h_1]$, so the expected harm is $h_1/2$. The defendant therefore takes precautions $x = ah_1/2$.

Now let's consider the plaintiff's decision about whether to accept an offer at date 1. In general, a plaintiff of type h has an expected future loss $(N-1)(1-x)(1-\alpha)h$, the number of future defendants multiplied by the probability of an accident multiplied by the

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plaintiff's share of the damages. These losses influence the plaintiff's decision to accept a settlement offer, S_1. If the plaintiff accepts S_1 he gets $S_1-(N-1)(1-ah_1/2)(1-\alpha)h$ and if he rejects S_1 and goes to trial he gets $\alpha h-(N-1)(1-ah)(1-\alpha)h$. Setting these two expressions equal to each other we find the interior value for h_1 as defined in the lemma (if an interior solution exists); otherwise, $h_1=1$ and all plaintiff types settle out of court.

Q.E.D.

<u>Lemma 3:</u> D_1's optimal cutoff, $\hat{h}$, is the positive root of the following quadratic expression $\alpha\hat{h}+(3/2)(N-1)\alpha(1-\alpha)\hat{h}^2-k=0$ when that root is smaller than 1 and $\hat{h}=1$ otherwise. The social planner's optimal cutoff, $\tilde{h}$, is the positive root of $(1/4)(N-1)\alpha(1-\alpha/2)\tilde{h}^2-k=0$ when that root is smaller than 1 and $\tilde{h}=1$ otherwise.

<u>Proof:</u> The first defendant chooses h_1 to minimize his expected payments to the plaintiff.

$$\underset{h_1}{Min} \int_0^{h_1}\{ah_1+[\alpha(1-\alpha)(N-1)/2]h_1^2\}dh+\int_{h_1}^{1}[\alpha h+k]dh.$$

The first term captures the settlement payments to the plaintiff types below the cutoff and the second term are the defendant's payments at trial associated with the plaintiff types above the cutoff. Differentiating this expression once gives the first-order condition defining $\hat{h}$ in the Lemma and it is easy to see that the second-order condition holds. The social planner, on the other hand, would choose the cutoff h_1 to minimize the social losses, which include the litigation costs at date 1, the precautions at date 2, and the accident losses at date 3:

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$$\underset{h_1}{Min} \quad [1-h_1]k \tag{10}$$

$$+(N-1)\left\{\int_0^{h_1}[(1-ah_1/2)h+(1/2)(\alpha h_1/2)^2]dh+\int_{h_1}^{1}[(1-ah)h+(1/2)(\alpha h)^2]dh\right\}$$

Differentiating this expression gives the social planner's optimal cutoff, $\tilde{h}$, as in the lemma. The second-order condition holds.

Q.E.D.

<u>Proposition 4:</u> If $a<10/11$ then there are too many trials in equilibrium ($\hat{h}<\tilde{h}$). If $a>10/11$ then there exists a finite and positive cutoff, $\gamma^*(\alpha)=2\alpha(2-\alpha)/(11\alpha-10)^2$. If $(N-1)k>\gamma^*(\alpha)$ then there are too few trials in equilibrium ($\hat{h}>\tilde{h}$) and if $(N-1)k<\gamma^*(\alpha)$ then there are too many trials in equilibrium ($\hat{h}<\tilde{h}$).

Proof: Consider the first order conditions in the previous lemma, and define $\hat{g}(h)=\alpha h+(3/2)(N-1)\alpha(1-\alpha)h^2-k$ and $\tilde{g}(h)=(1/4)(N-1)\alpha(1-\alpha/2)h^2-k$. These are increasing functions of h and take on the value 0 at the values $\hat{h}$ and $\tilde{h}$, respectively. They cross at two points, zero and $h'=\left(\frac{8}{N-1}\right)\left(\frac{1}{11a-10}\right)$. If $a<10/11$ then $h'<0$ and, since $\hat{g}(0)=\tilde{g}(0)=-k$ and $\hat{g}'(0)>\tilde{g}'(0)$ we know that $\hat{g}(h)>\tilde{g}(h)$ for all h > 0. We therefore conclude that $\hat{h}<\tilde{h}$. If $a>10/11$ then $h'>0$ and so $\hat{g}(h)>\tilde{g}(h)$ for all $0<h<h'$ and $\hat{g}(h)<\tilde{g}(h)$ for all $h>h'$. Using the definition of $\tilde{h}$ in the lemma we see that when $(N-1)k>\gamma^*(\alpha)$ then $\tilde{h}>h'$ and so $\hat{h}>\tilde{h}$. If $(N-1)k>\gamma^*(\alpha)$, on the other hand, then $\tilde{h}<h'$ and so $\hat{h}<\tilde{h}$.

Q.E.D.

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5. Conclusion

This paper has explored a new efficiency rationale for litigation. The public information created by legal investigations creates economic value when future actors fine-tune their decisions in response to the information revealed through litigation activities. In contrast, when early cases settle before thorough investigations are conducted then a negative externality is imposed on the future actors. This rationale suggests an important tradeoff in the design of liability rules. First, imposing liability on long-run players (the defendant in our model) provides those players with greater incentives to litigate early claims. When held liable for future harms, the long-run players benefits from the improvement in public information that results from their litigation activities. On the other hand, shifting liability to the long-run players dampens the incentives of future players (plaintiffs in our model) to mitigate their risks.

Our basic framework may be extended in a number of ways. First, one could generalize the liability rule to consider decoupled damages (see Polinsky and Che, 1991). Assuming that plaintiffs pursue all claims, making the defendant in our model responsible for 100% of all future damages would align the private and social incentives to litigate rather than settle, while making the plaintiffs 100% responsible for their harms creates the right accident avoidance activities. This scheme may be implemented with a 100% tax on the plaintiffs' award. Our model has also abstracted from accident avoidance activities of the plaintiff. The plaintiff may be able to take precautions to reduce the risk of future accidents as well. These, and other issues, remain topics for future research.

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