Chilling, Settlement, and the Accuracy of the Legal System

Ezra Friedman and Abraham L. Wickelgren[1]

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[1]Yale University and the Federal Trade Commission respectively. This paper does not represent the views of the Federal Trade Commission or any individual Commissioner.

Abstract

Many papers have been written analyzing whether various legal regimes promote settlement. In this paper, we ask the more basic question: Is it necessarily the case that settlement enhances social welfare? Our answer to this question is no; there are circumstances where actually prohibiting settlement generates more social welfare than allowing it. Settlement can lower social welfare because it reduces the accuracy of the legal process. Reducing this accuracy reduces the ability of the law to deter harmful activity without chilling legitimate activity that might be mistaken for harmful activity. In some cirucmstances, the welfare loss from the chilling of legitimate activity can outweigh the gains from litigation cost savings.

1 Introduction

There is widespread belief that settlement of lawsuits prior to trial enhances social welfare. There are legal rules designed to promote settlement. Rule 16 of the Federal Rules of Civil Procedure[1] provides for sanctions if parties do not participate in pretrial conferences aimed at promoting settlement. Rule 68 imposes legal costs on a party that rejects a settlement offer that turns out to be more favorable than the trial outcome. While promoting settlement is probably desirable in many cases, we show that there is an important class of cases where not only may parties have an excessive incentive to settle (even without rules that encourage it), but actually prohibiting settlement altogether can increase social welfare. This result does not depend any restrictions on the damage rule. That is, even when a social planner can set damages optimally, there are situations where prohibiting settlement increases social welfare.

The reason that settlement can lower social welfare is that it can make it impossible to maintain sufficient deterrence of harmful activities without worsening the "chilling effect". We use the term "chilling effect" to refer to situation where a party chooses not to undertake a legitimate, socially beneficial activity because of the fear it will be mistaken for a socially harmful activity. To make matters concrete, in our model we consider potentially tortious activity. There are two types of activity, one that is actually dangerous and one that is not dangerous but might appear dangerous. One can think of two different manufacturing processes. Both emit a chemical into the environment. The dangerous activity emits a cancer causing chemical. The chemical emitted by the other activity is benign. While the manufacturer in the second case knows the chemical it is emitting is benign, it also knows that a court may mistakenly find this chemical responsible for a victim's cancer. If this risk stops anyone from undertaking the second manufacturing process, then we say that this legitimate or innocent activity is chilled. Clearly, the more accurate the legal process is, the better able it will be to deter the dangerous activity without chilling the innocent activity.[2]

The problem with settlement is that it can make the legal process less accurate. Imagine that the plaintiff makes a take it or leave it settlement offer to the defendant, who knows whether or not his activity was dangerous (throughout the paper we refer to the plaintiff by the female pronoun and the defendant by the male pronoun). While courts are imperfect in our model, they are better

[1] Available at www.house.gov/judiciary/Civil2002.pdf

[2] For a general discussion of the value of accuracy in the determination of liability, see Kaplow and Shavell (1994).

than chance. The plaintiff has a better chance of prevailing at trial against a dangerous (we will also often use the term guilty for convenience, though we are not necessarily thinking of criminal activity) defendant than against a safe or innocent defendant. As a result, a guilty defendant will find any given settlement offer more attractive than will an innocent defendant. Thus, if the plaintiff makes a settlement offer and it is rejected, she believes the defendant she is facing is more likely to be innocent. We assume that the plaintiff has a choice of how much effort she invests in her lawsuit. The more effort she invests, the more likely she is to prevail. Furthermore, we assume effort increases her probability of prevailing proportionately more if she is suing a guilty defendant than if she is suing an innocent one. This assumption is crucial to our results, and can be interpreted as implying that an increase in effort increases the accuracy of the legal system. We justify this assumption by arguing that legal effort will be more likely to influence the decision when there is actual evidence to uncover. In our example, if the chemical really does cause cancer, it is more likely that the plaintiff's effort will uncover a study that proves it. If the chemical is benign, such a study probably does not exist or is not very credible, so working hard to uncover one will prove less valuable.

Given these assumptions, the plaintiff will expend less effort at trial when settlement is allowed, given that the case goes to trial. Of course, the defendant (innocent or guilty) knows this, which reduces the settlement amount the a guilty defendant is willing to accept. That is, when settlement is allowed, the guilty defendant will settle for the damages and addditional legal costs he expects to pay if he rejects the offer and goes to trial. This expectation, however, is based on the fact that if the defendant rejects the offer, the plaintiff will not work as hard at trial because she assumes the defendant is more likely to be innocent. In order to maintain an equal amount of deterrence against guilty types, then, damages must be larger when settlement is allowed because the plaintiff will expend less effort at trial. Since the plaintiff's effort is more effective against guilty types than innocent types, however, this reduction in effort benefits the guilty more than the innocent. Thus, the level of damages that maintains deterrence against the guilty will actually increase the expected liability faced by the innocent, resulting in more chilling of innocent activity.

We believe this effect to be quite pervasive. While the chilling of innocent activity is a social cost of permitting settlement, society benefits from the reduced litigation expenses incurred by both sides. Nonetheless, we can show that there are parameters where the social losses from the chilling of innocent activity exceed the benefit from the reduction in litigation expenses. We do not argue that this is always the case, there are parameter values where settlement increases social welfare and parameters where it decreases it. When the safe activity is very sensitive to deterrence, the increased chilling from allowing settlement is likely to outweigh the reduced legal costs. Likewise when the costs of litigation are very small, allowing settlement has very little benefit and is likely to be harmful.

While the literature on settlement bargaining is extensive, there has been much less research on the desirability of settlement. Polinsky and Rubinfeld (1988) analyze the deterrent effect of settlement in a model where the damage rule is fixed, information is perfect, and the defendant's share of the surplus from settlement is exogenously fixed. In their model, they show that settlement can weaken deterrence, though they point out that this problem can be eliminated in their model by changing the damage rule (Shavell (1997) makes a similar point). Spier (1997) shows that there can be too much settlement under the negligence rule. Again, however, she shows that adjusting the damage rule (adding punitive damages), can eliminate this problem.[3] Shavell (1999) presents a model where parties have insufficient incentives to settle because increasing one's share of the settlement surplus also increases the probability of trial. In a footnote, however, he sketches an example where some trial might be desirable. As he points out, however, in his example only a very small probability of trial is desirable. Moreover, this example also assumes a fixed damage rule. Probably the closest paper to this one is Franzoni (1999). He models the effect of plea bargaining on a prosecutor's incentive to investigate should negotiation fail. He finds, as we do, that the possibility of settlement weakens the prosecutor's effort incentive. He finds that if the prosecutor has a fixed amount of total resources for prosecution, the additional prosecutions that are enabled by settling some cases early will lead to an increase in detterrence. When the prosecutor faces a soft budget constraint however, allowing settlement could increase or decrease social welfare. However, he does not allow the social planner to vary the damage rule according to the settlement regime, and does not consider the effects of chilling. This is the first paper to show that settlement can reduce social welfare even when the social planner can choose any damage rule.[4]

[3]There are some other papers that model settlement and ex ante incentives under the negligence rule but do not directly investigate the welfare consequences of settlement. Schrag (1999) investigates the effect of settlement bargaining on deterrence in a model with discovery. He finds that a judge can increase the probability of settlement and maintain deterrence by limiting discovery. Hylton (2002a) also considers a model of settlement bargaining and ex ante care decisions to derive testable implications about plaintiff win rates.

[4]Spier (1994) examines the optimal damage rule when settlement is allowed and the plaintiff has private information about damages. She finds that a flat damage rule is optimal when legal costs are large since this eliminates the asymmetric information about the trial outcome that impedes settlement. For smaller legal costs, however, finely tuned awards are superior since they maintain a defendant's incentive to take precautions that reduce the harm to the plaintiff. Because the plaintiff, rather than the defendant, has private information, settlement itself does not undermine the relationship between harm and liability. Hylton (2002b) examines the effect of settlement on social

2 Model

There is one potential injurer and one potential victim. In period 1 the potential injurer decides whether or not to engage in an activity. There are two types of activities: dangerous and safe. The potential injurer is one of two types: either he benefits from the dangerous activity or from the safe activity. Let $G_G(B)$ and $G_I(B)$ refer to the mass of dangerous (guilty) and safe (innocent) types respectively who receive a benefit greater than or equal to B from their activity. Let $g_G(B)$ (respectively, $g_I(B)$) be the probability that the potential injurer is a dangerous type (respectively, a safe type) with benefit B from the dangerous (respectively, safe) activity. Because of how we define $G_G(B)$ and $G_I(B)$, $g_G(B) = -G'_G(B)$ and $g_I(B) = -G'_I(B)$. We use the subscripts G and I to refer to dangerous and safe producers, respectively. While we sometimes refer to these types as guilty and innocent, we do not mean to imply that there is necessarily any criminal connotation associated with these subscripts. The potential victim can observe whether or not the injurer engaged in an activity, but cannot tell whether that activity is dangerous or safe (she can observe the emission of a chemical but does not know whether this chemical causes cancer or not). The potential injurer knows whether his activity is dangerous or safe. We assume that there is an exogenous probability $\rho < 1$ that the potential victim is injured by some cause that is not related to the activity in the model (in our example ρ could represent the rate of naturally occuring cancer) and that when the injurer engages in the dangerous activity, the likelihood of injury is increased by $1 - \rho$. Thus when the potential injurer engages in the safe activity or no activity at all the probability of injury is ρ, and that the probability of injury is one if the injurer engages in the dangerous activity. If the potential victim is injured she suffers a harm of $\frac{H}{1-\rho}$. Since ρ is fixed in our model, we are not suggesting that harm is increasing in ρ; this is just a normalization so that the expected increase in harm from the dangerous activity is H. In period 2, the potential victim files suit (and becomes the plaintiff) if she suffers any harm and if the potential injurer (who now becomes the defendant) engaged in any activity. If she is not harmed or the potential injurer did not engage in an activity, the game ends.

Period 3 is the settlement period. If settlement is allowed, then the plaintiff makes a settlement offer of z. If the defendant accepts, then he pays the plaintiff z and the game ends. If he refuses, then the game proceeds to period 4. If settlement is prohibited, then the game proceeds to period 4 immediately.

welfare under strict liability in a model with no asymmetric information. Neither consider the possibility of chilling.

In period 4, the case proceeds to trial. We assume that the trial outcome is affected by the effort the plaintiff puts into her case and whether or not the defendant engaged in the safe or dangerous activity. Specifically, the probability that the plaintiff prevails against a dangerous type is a thrice differentiable function $F_G(x)$ where $x \in (0, \infty)$ is the quanity of resources the plaintiff devotes to the lawsuit and c is the per unit cost of those resources. The probability the plaintiff prevails against a safe defendant is also thrice differentiable $F_I(x)$. We use $f_G(x)$ and $f_I(x)$ to refer to the derivatives of $F_G(x)$ and $F_I(x)$, and assume positive and decreasing returns to legal effort so that $f_G(x) > 0$, $f_I(x) > 0$ and $f'_G(x) < 0$, $f'_I(x) < 0$. We make the following additional assumptions:

A1: $F_G(x) > F_I(x)$ and

A2: $\frac{f_G(x)}{F_G(x)} > \frac{f_I(x)}{F_I(x)}$

In other words we assume that for any level of effort by the plaintiff, it is more likely that a defendant who is actually dangerous is found responsible, and that an increase in plaintiff's effort increases the ratio of the likelihood that a dangerous defendant is liable over the likelihood that a safe defendant is liable. Thus an increase in effort by the plaintiff increases leads to a more accurate outcome of the trial. Note that these two assumptions also directly imply that $f_G(x) > f_I(x)$. We assume that if the plaintiff prevails she collects damages equal to D, set by policymakers. We assume there is no cost to defending a case.[5]

2.1 Plaintiff's Effort

We begin the analysis by determining the plaintiff's optimal actions in period 4, the trial stage. If immediately prior to trial, the plaintiff places probability q on the defendant having engaged in a dangerous activity, the plaintiff chooses an effort level $\widetilde{x}$ to maximize $F_G(\widetilde{x})D + (1-q)F_I(\widetilde{x})D - c\widetilde{x}$. So if $\widetilde{x} > 0$,

$$(qf_G(\widetilde{x}) + (1-q)f_I(\widetilde{x}))D = c \tag{1}$$

Clearly $\widetilde{x}$ is increasing in q, since $f_G(\widetilde{x} > f_I(\widetilde{x})$, $\widetilde{x}$ is increasing in q, implying that the plaintiff's effort increases if she believes it is more likely that the defendant is the dangerous type. We abuse notations slightly and define $\widetilde{x}(q, D)$ as the optimal effort by the plaintiff given beliefs q and damages D.

We now turn to the defendant's decision to accept or reject the settlement demand in period 3. If the offer is $z > F_I(\widetilde{x}(q, D))D$, then under any sequential equilibrium an innocent defendant

[5]We discuss the implications of relaxing this assumption in the final section of the paper

rejects the settlement demand, likewise if $z > F_G(\widetilde{x}(q,D))D$ a guilty type must reject. Since $F_I(\widetilde{x}) < F_G(\widetilde{x})$ it is clear that if any guilty defendent rejects the offfer, all innocent defendents must also reject, so the likelihood that a defendent who rejects a settlement is guilty must be less than or equal to the prior likelihood that the defendant is guilty. One could imagine an equilibrium where all defendants accept the demand and the plaintiff assumes that anyone who rejects the demand must be guilty, but such an equilibrium would not satisfy the intuitive criterion, and we do not admit it here.

We use p to represent the prior belief that the defendant is dangerous conditional on an injury occuring. For any $z \in (F_G(\tilde{x}(0,D))D, F_G(\tilde{x}(p,D)D))$ there is an equilibrium where a safe defendant rejects the offer with probability one but a dangerous defendant accepts with probability r such that $z = F_G(\tilde{x}(\frac{p(1-r)}{1-pr},D)D$. Note that $\frac{dr}{dz} < 0$, implying that a higher settlement demand will be accepted less. We can see this since $\frac{p(1-r)}{1-pr} = \frac{p(1-r)}{(1-p)+p(1-r)}$, which is clearly decreasing in r. We can think of this equilibrium occuring when enough guilty types have accepted so that the plaintiff lowers her effort to the point where a guilty defendant is indifferent as to whether to accept the offer or go to court.

The plaintiff chooses z to maximize her expected payoff, $pz + (1-p)(F_S(\tilde{x}(\frac{p(1-r)}{1-pr},D))D - (1-rp)c\tilde{x}(\frac{p(1-r)}{1-pr},D)$. Since q decreases as z increases, it is equivalent to think of her as choosing q, the probability that the defendant who rejects the offer is guilty, to maximize her expected net recovery We use the symbol π for expected net recovery, defined by:

$\pi = pF_G(\tilde{x}(q,D))D + (1-p)(F_I(\tilde{x}(q,D))D - (1-rp)c\tilde{x}(q,D)$ where $q = \frac{p(1-r)}{1-pr}$. The first order condition for the optimal q is:

$$\frac{d\pi}{dq} = \tilde{x}_1 D(pf_G(\tilde{x}(q,D)) + (1-p)f_I(\tilde{x}q))) - (1-rp)c\tilde{x}_1 + \frac{dr}{dq}pc\tilde{x}(q,D) = 0 \tag{2}$$

Since $r = \frac{q-p}{p(q-1)}$, $\frac{dr}{dq} = \frac{p-1}{p(q-1)^2}$ and, by the definition of $\tilde{x}$, $c(1-rp) = ((1-r)pf_G(\tilde{x}(q,D)) + (1-p)f_I(\tilde{x}(q,D)))$, we can write this as:

$$\frac{d\pi}{dq} = \tilde{x}_1 D\frac{p-q}{(1-q)}f_G(\tilde{x}(q,D)) - \frac{1-p}{(1-q)^2}c\tilde{x}(q,D) = 0 \tag{3}$$

This first order condition implicitly defines the plaintiff's optimal q, and thus z, unless it is optimal for the plaintiff to choose $q = 0$ or $q = p$ The plaintiff chooses $q = 0$ when it is more profitable for the plaintiff to make a settlement offer that both types accept. By the intuitive criterion, if both types accept, the plaintiff must assume that any defendant that rejects the demand must be innocent. So the defendant will choose to make an offer all defendants will accept if and only if: $F_I(\tilde{x}0, D))D > pF_G(\widetilde{x}(q))D + (1-p)F_I(\widetilde{x}(q))D - (1-rp)c\widetilde{x}(q)$.

We are now ready to state our first result.

Lemma 1 *When settlement is allowed and $c > 0$, the plaintiff always makes an offer that some dangerous types accept, so $q < p$.*

Proof: When $q = p$, $\frac{d\pi}{dq}(q = p) = -\frac{c\widetilde{x}(q)}{(1-p)} < 0$. This implies that a decrease in q will increase the plaintiff's expected recovery from the lawsuit. *QED*

Note that we can also see that $\tilde{x}'(q, D)D\frac{p-q}{(1-q)}F'_G(\tilde{x}(q, D)) - \frac{1-p}{(1-q)^2}c\tilde{x}(q, D)$ is increasing in p, holding q constant. This implies that increasing p, the proportion of dangerous producers before settlement, will also increase q the proportion of guilty producers post settlement if damages are held constant.

The first term of (3) can be thought of as increase in the settlement amount that is due to the fact that the lawsuit effort will increase when q increases, the second term is the increase in the plaintiff's litigation costs when it q increases (fewer guilty defendant's settle). An offer that is accepted by many of the guilty types must be comparatively low, because the plaintiff cannot commit to exert high effort in trial after many guilty types settle. It can be seen that if the returns from litigation effort are very concave so that $\tilde{x}_1$ is quite small for large q, the plaintiff will make an offer small enough that many defendants will wish to settle.

Having solved the final stages of the model, we now turn our focus to finding sequential equilibria of the entire game, with a focus on whether prohibiting settlement can ever increase social welfare, and if so, under what cirucumstantces. If settlement is not permitted, the social planner wishes to choose a D that maximizes the following social welfare function.

$$\int_{DF_G(\tilde{x}(p,D))}^{\infty} g_G(b)(b - H - c\tilde{x}(p, D))db + \int_{D\rho F_I(\tilde{x}(p,D))}^{\infty} g_I(b)(b - \rho c\tilde{x}(p, D))db \tag{4}$$

The first term is the social welfare from dangerous types. A dangerous type only does the activity if his benefit, b, exceeds his expected liability, $DF_G(\tilde{x}(p, D))$. The probability that the potential injurer is a dangerous type with benefit b from the dangerous activtity is $g_G(b)$. The dangerous activity produces a social welfare gain of b and a social cost of H due to the harm from the activity and a cost of $c\widetilde{x}(p, D)$ due to litigation costs. The second term is the social welfare from safe types. It has a similar interpretation, only these types only face suit with probability

ρ and their activity causes no harm. Since p is the probability that a defendant facing suit is a dangerous type,

$$p = \frac{G_G(DF_G(\tilde{x}(p,D)))}{G_G(DF_G(\tilde{x}(p,D))) + G_I(D\rho F_I(\tilde{x}(p,D)))} \tag{5}$$

If settlement is allowed the planner chooses a D that maximizes social welfare when settlement is allowed.

$$\int_z^\infty g_G(b)(b - H - (1-r)c\tilde{x}(q,D))db + \int_{D\rho F_I(\tilde{x}(q,D))}^\infty g_I(b)(b - c\rho\tilde{x}(q,D))db \tag{6}$$

Welfare differs from the no settlement case in that a dangerous type only does the act if his benefit exceeds the settlement offer. The welfare cost of the dangerous act act is now also smaller since there are legal costs only when the case does not settle, which happens with probability $(1-r)$. And the magnitude of legal effort also differs since it depends on q, the probability that the defendant at trial is a dangerous type, rather than on p, the probability that the defendant being sued is a dangerous type. Having presented the model and defined our criteria for social welfare, we are now ready to examine the welfare results of permitting or prohibiting settlement.

2.2 Welfare Consequences of Settlement

We first show that settlement will never be a free lunch for the social planner. That is, there is always some sacrifice involved in allowing settlement: either the amount of the dangerous activity is increased, or more of the safe activity is chilled, even when the social planner chooses the optimal damage rule in each case. We then present a special case where allowing settlement will always decrease social welfare. This occurs where there is no heterogeneity among the dangerous or safe producers. In this case allowing settlement is unambiguously bad, because it results in more entry of dangerous types, but does not reduce legal costs.

Proposition 1 *(***NO FREE LUNCH***) If the expected penalty for the dangerous types is held constant, either the expected penalty for the safe type increases, or the probability that a dangerous type engages in the activity increases.*

Proof. Say that without settlement damages are set at D_0 and the cutoff dangerous type is B_G^0 and the cutoff innocent type is B_I^0. That is, a dangerous type whose benefit from the activity is $B \geq B_G^0$ does the activity, but if $B < B_G^0$, then he is deterred; a safe type whose benefit from the activity is $B \geq B_I^0$ does the activity, but if $B < B_G^0$, then he is chilled. The probability that a defendant is a dangerous type is then given by:

$$\frac{G_G(B_G^0)}{G_G(B_G^0) + \rho G_I(B_I^0)} \equiv p_0 \tag{7}$$

Now, imagine that settlement is allowed and the damage measure is adjusted to D_S so that the level of deterrence of the dangerous activity is unchanged, the cutoff type is $B_G^S = B_G^0$. We now show that the new cutoff for safe types, B_I^S, must increase, $B_I^S > B_I^0$ so that more innocent activity is chilled. We know from Lemma 1, that the plaintiff either makes a settlement offer that both types accept with probability one or an offer that dangerous types accept with positive probability less than one and safe types reject with probability one.

In the first case, the both the dangerous and the safe type's expected liability is z. Because the dangerous type's expected liability does not change by assumption, we know that $z = F_G(\widetilde{x}(p_0, D_0))D_0$. The safe type's expected liability without settlement was $F_I(\widetilde{x}(p_0, D_0))D_0 < F_G(\widetilde{x}(p_0, D_0))D_0$.

In the second case, let r be the probability that the dangerous type accepts the offer, then the probability that defendant facing trial (who rejected the settlement offer) is dangerous under settlement is

$$\frac{(1-r)G_G(B_G^S)}{(1-r)G_G(B_G^S) + \rho G_I(B_I^S)} \equiv q_S \tag{8}$$

If expected liability for safe types does not increase, which implies that $B_I^S \leq B_I^0$, and the probability that a dangerous type engages in the activity does not increase, then $q_S < p_0$. Thus, by (1), either $\widetilde{x}(q_S, D_S) < \widetilde{x}(p_0, D_0)$ or $D_S > D_0$ or both. If $\widetilde{x}(q_S, D_S) < \widetilde{x}p_0, D_0)$ and $D_S \leq D_0$, then expected penalty for a dangerous type must decrease, contradicting the hypothesis of equal expected penalty. If $\widetilde{x}(q_S, D_S) \geq \widetilde{x}(p_0, D_0)$ and $D_S > D_0$, then again the expected penalty for a dangerous type must increase. Thus, the only remaining alternative is that $\widetilde{x}(q_S, D_S) < \widetilde{x}(p_0, D_0)$ and $D_S > D_0$ so that the expected penalty for dangerous types is constant. That is, expected penalty for a dangerous type is:

$$F_G(\widetilde{x}(q_S, D_S))D^S = F_G(\widetilde{x}p_0, D_0))D^0 \tag{9}$$

By assumption A2, however, this implies that:

$$\rho F_I(\widetilde{x}(q_S, D_S))D^S > \rho F_I(\widetilde{x}(p_0, D_0))D^0 \tag{10}$$

That is, the expected penalty for a safe type increases. *Q.E.D.*

It should be noted that unless $g_I(B_I^0) = 0$, an increase in the expected penalty for a safe type implies a decrease in the amount of safe activity. Morever, the level of damages that lead to B_I^0 where $_I(B_I^0) = 0$ can only be socially optimal if this level of damages is $D_0 = \frac{H+c\widetilde{x}(p_0,D_0)}{F_G(\widetilde{x}(p_0,D_0))}$. Otherwise, if there is over- or under-deterrence of the dangerous types, then it would be optimal to slightly decrease or increase damages to improve deterrence of dangerous types without affecting the chilling of safe types. Since these level of damages is defined without reference to the distribution of benefits of the safe types, $g_I(B_I^0) = 0$ will only hold at the optimal level of damages by chance Except where this chance even occurs, it is impossible to allow settlement and hold deterrence of dangerous producers constant without chilling more safe producers.

The important intuiton behind the above result is that if settelement is permitted the plaintiff's effort will tend to decrease. This decrease in effort means that the legal process is less accurate, leading to either an increase in chilling of the safe activity or a decrease in deterrence of the dangerous activity.

We have so far simply shown that allowing settlement entails some social costs (it is not a free lunch). It is still possible that this cost of settlement is always less than the its benefits in terms of smaller legal costs. We now focus on a specific distribution of benefits to show that this is not generally true.

Consider the following special case. There is a mass N_I of producers for whom there is a private benefit B_I in engaging in the non-dangerous activity. Assume there is a very large mass of actors who N_G receive B_G in benefit from the dangerous activity . We assume that N_G is sufficiently large so that $N_G(B_G - H) + N_I B_I < 0$; it is better to have no activity than to have all the dangerous types engage in their activity.

Proposition 2 *Define $x^\dagger$ such that $x^\dagger = \widetilde{x}(\frac{N_G}{N_G+\rho N_I}, \frac{B_G}{F_G(x^\dagger)})$. If $\frac{F_G(\tilde{x}(0,0))}{\rho F_I(\tilde{x}(0,0))} B_I < B_G < \frac{F_G(x^\dagger)}{\rho F_I(x^\dagger)}$ and the damage award is set to the optimal level, either it is optimal to have no activity, or social welfare is lower when settlement is allowed.*

Proof: First we examine the optimal level of punishment when settlement is not permitted. We define x^* such that $\frac{F_G(x^*)}{\rho F_I(x^*)} B_I = B_G$. We know that a unique x^*exists from A2.

Lemma 2 *Under the optimal policy when settlement is prohibited, either damages will be set to $D_0 = \frac{B_G}{F_G(x^*)}$, and dangerous and safe types will enter such that the probability that a defendant* *is dangerous is p_0 such that $\widetilde{x}(p_0, D_0) = x^*$, or damages will be set sufficiently high that no one enters.*

Proof. If $D_0 = \frac{B_G}{F_G(x^*)}$, then, by the definition of x^*, both safe and dangerous types are indifferent about entry when $\widetilde{x}(p_0, D_0) = x^*$. Thus, it is rational for entry to be such that the probability that a defendant is dangerous is p_0. First, we note that if $p_0(B_G - H) + \frac{1-p_0}{\rho} B_I - c\,\widetilde{x}(p_0, D_0) < 0$ an equilibrium with no activity whatsoever is preferable to the equilibrium where the fraction of defendants that are dangerous types is p_0 and damages are $D_0 = \frac{B_G}{F_G(x^*)}$. Since $F_G(0) \geq F_I(0) > 0$, it is always possible to set damages high enough to deter any activity. Next, we show that if $D > D_0$ and some entry is optimal, neither the dangerous nor safe producers will enter. If any dangerous producers enter, then $F_G(x)D \leq B_G$. Since $D > D_0$, $F_G(x) < F_G(x^*)$ and $x < x^*$. However if $F_G(x)D < B_G$ then all the dangerous producers will enter, which is not optimal even if all safe producers enter as well, by assumption. If $F_G(x)D = B_D$ then $x < x^*$ and $\rho F_I(x)D > B_I$ since $\frac{F_G(x)}{F_I(x)}$ is increasing in x so $\frac{F_G(x)}{F_I(x)} < \frac{F_G(x^*)}{F_I(x^*)} = \frac{\rho B_G}{B_I}$. This implies that no safe producers enter, which is sub-optimal.

Now we show that $D < D_0$ is not optimal. Define $p^*(D)$ such that if damages are set to D, $F_G(\widetilde{x}(p^*, D))D = B_G$. Note that $p^*$is decreasing in D, so $p_0 < p^*$. If $p > p^*$, $F_G(\widetilde{x}(p, D))D > B_G$ implying that no dangerous types enter. This can only be an equilibrium if no safe types enter, otherwise $p = 0$, implying a contradiction. If $p < p^*$, $F_G(\widetilde{x}(p, D))D < B_G$, implying that all dangerous types wish to enter, which is not optimal.

Now say $p = p^*(D)$. Note that if $D < D_0$ and $F_G(\widetilde{x}(p^*, D))D = B_G$, $\widetilde{x}(p^*, D) > x^*$, implying that $\rho F_I(\widetilde{x}(p^*, D))D < B_I$, implying that all safe types enter. Let us compare an equilibrium with $D < D_0$ to the best equilibrium with D_0 (where all safe types enter). Under $D < D_0$, social welfare is $N_I B_I + \frac{p^*}{1-p^*}\rho N_I(B_G - H) - \rho N_I(1 + \frac{p^*}{1-p^*})\widetilde{x}(p^*, D)$. Under D_0 welfare is $N_I B_I + \frac{p_0}{1-p_0}\rho N_I(B_G - H) - \rho N_I(1 + \frac{p_0}{1-p_0})x^*$. We can see that

$\frac{p^*}{1-p^*}\rho N_I(B_G - H) - \rho N_I(1 + \frac{p^*}{1-p^*})\widetilde{x}(p^*, D) < \frac{p_0}{1-p_0}\rho N_I(B_G - H) - \rho N_I(1 + \frac{p_0}{1-p_0})x^*$ because $B_G - H < 0, p^* > p_0$ and $x^* < \widetilde{x}(p^*, D)$, implying that social welfare is decreased in any equilibrium where there is entry and $D < D_0$. Q.E.D.

We now show that when settlement is allowed it is not possible to reach the same level of social welfare. If settlement is allowed we have seen above that the plaintiff will always wish to make an offer that some guilty defendents wish to accept. In other words, in equilibrium $r > 0$, so $q < p$, furthermore we have seen that $\frac{dq}{dp} > 0$, implying that an increase of dangerous types before settlement will lead to a higher proportion of dangerous types among those going to trial.

We will now show that when settlement is allowed, the optimal penalty will be D_0 as when settlement is not permitted, but that the proportion of producers who are dangerous will be $p_s > p_0$ and social welfare will be lower than when settlement is prohibited.

First, we note that no equilbrium that induced the plaintiff to offer $z < B_G$ can be optimal, because such an equilibrium would involve entry by all the dangerous types. If the equilibrium induced $z > B_G$, then, because a dangerous defendant wants to accept the settlement with positive probability if sued, $z = DF_G(x_S) > B_G$; no dangerous types enter. If safe types accept the settlement with positive probability once sued, then they will not enter since $B_G > B_I$. If safe types reject the settlement, then, since $B_I = F_I(x^*)D_0$, by $A2$ if $x_S \leq x^*$, $DF_I(x_S) > B_I$ and safe types would not enter. However, if $x_S > x^*$ then, by (1) either $D > D_0$ or $q > p_0$. But, $q > p_0$ is not possible if no dangerous types enter. If $x_S > x^*$ and $D > D_0$, then clearly $DF_I(x_S) > B_I$ so safe types do not enter. Thus, $z > B_G$ implies no entry by either type.

Thus, if there is an optimal settlement equilbirum with any entry, then it must induce $z = B_{G.}$ By Proposition 1, this implies either that $p_S > p_{0,}$ or $B_I^S > B_I$. If $B_I^S > B_I$ then there will be no entry by the safe types, and this will clearly not be optimal. Thus, the only candidate is an equilibirum with $B_I^S \leq B_I$ and $p_S > p_0$. Since $z = B_G = F_G(x_S)D_S$ and $B_I \geq B_I^S = \rho F_I(x_S)D_S$, we know that $\frac{F_G(x_S)}{\rho F_I(x_S)} \geq \frac{B_G}{B_I}$. By A2 and the definition of x^*, this can be true only if $x_S \geq x^*$. Since $z = B_G$, this implies that $D_S \leq D_0$. Since $x^* = \tilde{x}(p_0, D_0)$ and $x_S = \tilde{x}(q_S, D_S)$, $q_S \geq p_0$. Now let $N_I^S \leq N_I$ be the number of safe types who enter in the settlement equilibrium social welfare will be $N_I^S B_I + \rho N_I^S \frac{p_S}{1-p_S}(B_G - H) - \rho N_I^S \frac{1}{1-q_s}\tilde{x}(q_s, D_0)$. But, since $r > 0$, $p_S > q_S \geq p_0$ and $\tilde{x}(q, D_0) = x^*$ and $N_I \geq N_I^S$ this is smaller than $N_I B_I + \rho N_I \frac{p_0}{(1-p_0)}(B_G - H) - \rho N_I \frac{1}{1-p_0} x^*$, the best social welfare when there is no settlement[6]. QED

In the case where there is no heterogeneity within types of producers, allowing settlement actually does not reduce legal costs. In equilibrium at least a certain number of dangerous producers must go to trial so that the plaintiff exerts sufficient effort to deter dangerous producers without chilling all safe producers. If the plaintiff does not exert sufficient effort, the trial is less accurate, so either all safe producers are chilled or all guilty producers enter. When settlement is allowed, the optimal equilibrium occurs with the same proportion of innocent and guilty types going to trial, and the optimal penalty is actually the same as when settlement is not allowed[7]. However, since

[6]By logic similar to the lemma above we can show that the optimal no settlement equilibrium occurs when $D_S = D_0$, $q_S = p_{0,}$ and $x_s = x^*$

[7]The exception to this will be cases where it is optimal to have production when there is no settlement, but it is not optimal for there to be any production when settlement is allowed.

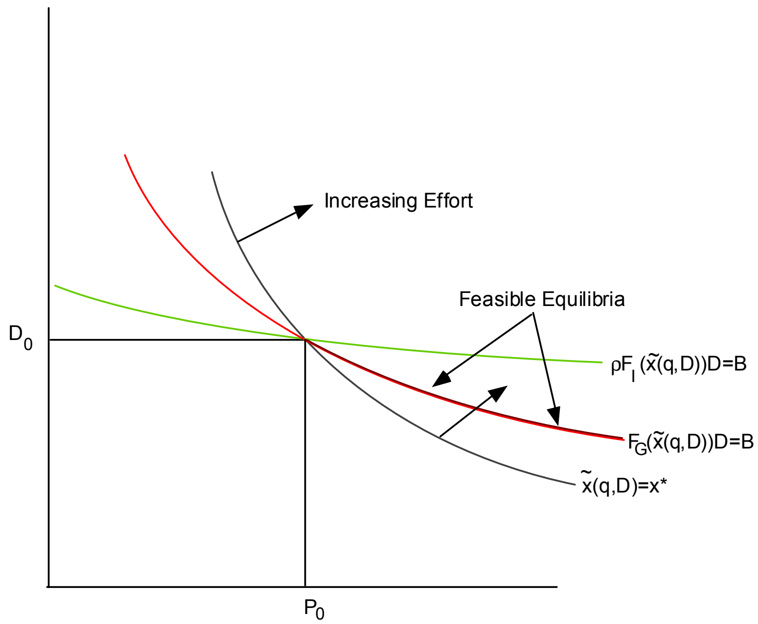

Figure 1

Figure 1:

the plaintiff always makes an offer that some guilty types accept, the proportion of guilty types among producers must be greater. Thus when settlement is allowed, the same number of guilty and innocent producers go to trial, and trial effort is the same, so the legal costs are the same, however, some guilty producers enter and settle out of court, so there will be more production of the dangerous good.

Figure 1 is an illustration of the case where there is no heterogeneity in (q, D) space. The steepest curve represents the beliefs and damage levels where optimal effort is exactly x^*, effort is increasing to the northeast and decreasing towards the origin. Along the curve labeled $\rho F_I(\tilde{x}(q, D))D = B_I$ the expected payment for a safe producer is exactly equal to the private benefit and safe producers are indifferent about entering. The curve labeled $F_G(\tilde{x}(q, D))D = B_D$ represents points where a dangerous producer is indifferent regarding entry. By the definition of x^*, p_0 and D_0 all three curves intersect at (p_0, D_0). Both of the indifference curves must be shallower than the $\tilde{x}(q, D) = x^*$ line, because as the proportion guilty increases, damages must decrease to keep expected penalty constant, but as damages decrease, effort must increase, implying that when these lines are to the right of the instersection they will be above the $\tilde{x}(q, D) = x^*$. It can also be seen that the indifference curve for the safe producer will be shallower. To the southeast of the intersection point, the dangerous producer's indifference curves will be at lower damage levels and higher effort levels. Since higher effort represents a proportionately higher payments for the guilty type, the guilty type will be indifferent at a lower damage level than the innocent type, so the guilty types indifference curve will be steeper. Any equilibrium with entry by the innocent type must occur to the southwest of the safe producers' indifferent line, but any point that is to the southwest of the safe producers' indifference line and to the left of the intersection would entail entry by all bad types, and would imply $p > p_0$. Thus any equilibrium must occur at or to the right of the intersection of all three lines. To the right of intersection, any point below the guilty type's indifference curve is clearly not an equilibrium, since if the guilty type does not wish to enter, then $p = 0$. There are feasible equilibria along the indifference curve of the dangerous producer, but compared to (p_0, D_0) these equilibria entail more production by the dangerous type and more effort by the plaintiff, thus they are not optimal

When settlement is allowed, the graph still describes the trial stage, with q representing the proportion of producers who reject settlement who are guilty. Since the settlement offer is equal to the expected payment of the dangerous types, and the innocent types reject settlement, the expected payment for both types is equal to their expected payment from trial, so equilibria can occur at the same points on the graph. However, we know that the proportion of all producers who are guilty will be higher, since only guilty types accept the settlement. This implies that the only effect of allowing settlement is to increase the number of dangerous types who produce. These extra dangerous types will all settle, so that exactly the same number of dangerous and safe types go to trial and no legal costs are saved.

When there is some heterogeneity among we can still use a graph in (q, D) space to illustrate outcomes as shown in figure 2. We replace the single line $B_I = \rho F_I(\tilde{x}(q, D))D$ with a region bounded above by the line $B_{I_{Max}} = \rho F_I(\tilde{x}(q, D))D$ and below by $B_{I_{Min}} = \rho F_I(\tilde{x}(q, D))D$. In this region, some, but not all of the safe producers will enter, with the proportion who enter rising towards the lower border of the region. Likewise we can replace the line $B_G = F_G(\tilde{x}q, D))D$ line with the region bounded by $B_{G_{Max}} = F_G(\tilde{x}(q, D))D$ and below by $B_{G_{Min}} = F_G(\tilde{x}(q, D))D$. If the heterogeneity of the safe type is small enough so it is optimal to set the penalty such that all safe types enter, the best equilibrium will occur along the line $B_{I_{Min}} = \rho F_I(\tilde{x}(q, D))$, the lower border of the safe type's region. As we follow that line accross the dangerous type's region, from the bottom to the top of the region, this represents a decreasing proportion of dangerous potential producers who are entering. There is only one point on that line that corresponds to an equilibrium, and that is where the proportion

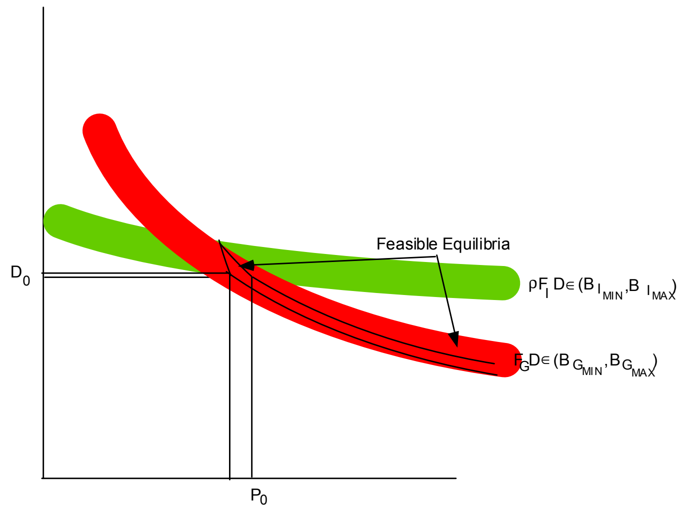

Figure 2: Feasible Equilibria with Heterogeneity

Figure 2:

of dangerous types who enter is such that the proportion of entrants who enter are dangerous is $p_{0.}$ In other words $\frac{G_G(B_0)}{G_G(B_0)+N_I} = p_0$, and $F_G(\tilde{x}p_0, D_0)) = B_0$. However, in this case there is a difference in the equilibrium when settlement is allowed. Because we know that some guilty types will accept the settlement, a given indifference curve now represents a lower proportion of guilty types among those going to trial. The new equilibrium will now occur with a greater proportion of the guilty types entering, so it will occur at a point closer to the bottom of the dangerous type's region, but still on the lower border of the safe type's region. As we can see, this will be on a point above and to the left of the original equilibrium, implying that the guilty types will be a lower proportion of those going to trial, although they will be a larger fraction of those producing. If the heterogeneity within types is reduced arbitrarily, the regions become thinner and the new equilibrium will be arbitrarily close to the old one, this implies that the savings in trial costs will become arbitrarily small. However we can rewrite **??** as $\tilde{x}'(q)Drpf_G(\tilde{x}(q)) - \frac{1-p}{(1-q)^2}c\tilde{x}(q) = 0$ and solving for r we obtain $r = \frac{(1-p)c\tilde{x}(q)}{(1-q)^2 p\tilde{x}'(q)Df_G}$, which is bounded away from zero. Hence a substantial number of dangerous types will enter and settle, suggesting that welfare will be decreased. Consequently allowing a small amount of heterogeneity will not alter the conclusion that allowing settlement is socially harmful. However, as heterogeneity within the types increases, the difference between p_S and p_0 increases, and more is saved in legal costs, and it becomes more likely that allowing settlement is socially beneficial.

3 Conclusion and Extensions

We have shown that when legal effort by the plaintiff improves the accuracy of the legal system, then allowing settlement is never a free lunch, and it will lead to either more chilling of legitimate activity or less deterrence of dangerous activity. Under a range of parameters, this loss of legal accuracy outweighs the savings from increased settlement, and if the entry of both desirable and undesirable producers is very elastic with regard to expected penalty, there may be very little savings from increased settlement. We do not believe that the results of this paper should be taken to suggest that pre-trial settlements should be outlawed in all cases. Specifically, in cases where there is little doubt as to whether the harmful activity actually occurred, it would be possible to set damages such that settlements do not dilute deterrence and do not lead to significant chilling of beneficial activities. However, in cases in which a beneficial activity is likely to be confused for a tortious activity, and chilling is an important concern, allowing settlement is likely to lead to excessive chilling. One area in which chilling is a matter of vital concern is in the area of medical malpractice. The AMA claims that more than 18 states are in "full blown medical malpractice insurance crises" and that "more than 50 percent of Arkansas physicians reported in a recent survey that they have been forced to reduce or discontinue one or more medical services in the last two years due to rapidly increasing medical liability premiums"[8]. Chilling is also a major concern in the enforcement of antitrust laws, especially restrictions on predatory pricing, or illegal vertical combinations. In these cases, allowing for settlement may make it more difficult for the government to maintain adequate deterrence against illegal activities without excessively chilling efficient legal activities.

The paper is written using a model of civil litigation, but could easily apply to a model of criminal prosecution .One might question whether a prosecutor would have the exact same objective as a plaintiff in the civil case. For example, the prosecutor might wish to maximize recovery from guilty plaintiffs, rather than total recovery. However, as long as the prosecutor does not place more weight on recovery from innocent defendants than she places on recovery from guilty defendants, the prosecutorial effort will still be increasing in likelihood of guilt, and all the results of the model

[8]http://www.ama-assn.org/ama/pub/article/9255-7341.html

would carry through.[9] This would suggest that where criminal sanctions have the potential to chill legal activities, plea bargaining might increase chilling.

In the model presented in the paper we do not consider legal costs faced by the defendant. One immediate effect of considering such damages would be that settlement would be more attractive for the plaintiff, since the plaintiff would be able to extract the legal costs that would be faced by the defendant, so the settlement payment would be higher. The addition of legal costs, would not necessarily change the other important results of our model. For example if guilty and innocent defendants faced respective fixed legal costs, l_G and l_I the results would not change significantly. Allowing defendants to choose an effort level would complicate analysis significantly. Our conjecture is that our results would continue to hold as long as increasing effort by the plaintiff always increased expected damages and legal costs relatively more for the guilty.[10]

We also assume the plaintiff makes a take it or leave it settlement offer. One might wonder how robust the results are to alternate forms of the settlement bargaining game. Consider the case where the defendant makes a take it or leave it offer. There can either be separating equilibria where dangerous defendants make different offers from safe defendants or their can be pooling equilibria where both types make the same offer. In a pooling equilibria, expected liability will be independent of type, making the legal system incapable of distinguishing between dangerous and safe types. In this case, the chilling/deterrence tradeoff is clearly worse than when the plaintiff makes the offer. Now consider separating equilibria. Any separating equilibrium has to have the property that safe types go to trial more than dangerous types or else the dangerous types would mimick the safe types. Thus, the the probability that a defendant at trial is safe is greater than at the time of suit, just as in the case where the plaintiff makes the offer. This leads to reduced plaintiff effort, which reduces the difference between safe and dangerous offers since it reduces the difference in expected liability. This is what drives our results about settlement reducing accuracy. In fact, when the defendant makes the offer and there is a separating equilibria, the accuracy effect is compounded by the fact that more dangerous types settle and the defendant's expected liability is lower when he settles. So, allowing the defendant to make the settlement offer should not change

[9] Suppose the prosecutor placed weight $\beta \in [0,1]$ on recovery from innocent defendants. The prosecutor's first order condition will be $f_G(x)D + \beta(1-q)f_I(x)D = c$. The prosecutor's choice of x will clearly be increasing in D and q.

[10] The exact condition would be that $\frac{F^1_{Gx,}(x,e_G(x,D))}{F^1_I(x,e_I(x,D))} > \frac{F_{Gx,}(x,e_G(x,D))D+e_G(x,D)}{F_I(x,e_I(x,D))D+e_I(x,D)}$ where $e_G(x,D)$ and $e_I(x,d)$ are the optimal effort as a function of damages and prosecutorial effort for the guilty and innocent defendants respectively. In this case, increasing the effort of the plaintiff will always be good for discriminating between guilty and innocent plaintiffs.

the main result that settlement worsens the chilling/deterrence tradeoff.

In summary, we have shown that permitting settlement can negatively affect the accuracy of the legal system. Under a range of parameters where chilling is a concern, this effect is sufficient to outweigh the social benefits of reduced legal costs. Although we would not advocate prohibiting settlement in all circumstances, this finding calls into question the wisdom of policies to encourage settlement, particularly in areas where chilling is a major concern.

References

[1] Luigi A. Franzoni. Negotiated enforcement and credible deterrence. *The Economic Journal*, 109:509–535, October 1999.

[2] Keith N. Hylton. An asymmetric-information model of litigation. *International Review of Law and Economics*, 22(2):153–175, 2002.

[3] Keith N. Hylton. Welfare implications of costly litigation under strict liability. *American Law and Economics Review*, 4(1):18–43, Spring 2002.

[4] Louis Kaplow and Steven Shavell. Accuracy in the determination of liability. *Journal of Law and Economics*, 37(1):1–15, April 1994.

[5] A. Mitchell Polinsky and Daniel L. Rubinfeld. The deterrent effects of settlements and trials. *International Review of Law and Economics*, 8:109–116, 1988.

[6] Joel L. Schrag. Managerial judges: An economic analysis of the judicial management of legal discovery. *The RAND Journal of Economics*, 30(2):305–323, Summer 1999.

[7] Steven Shavell. The fundamental divergence between the private and the social motive to use the legal system. *The Journal of Legal Studies*, 26(2):575–614, June 1997.

[8] Steven Shavell. The level of litigation: Private versus social optimality of suit and settlement. *International Review of Law and Economics*, 19(1):99–115, March 1999.

[9] Kathryn E. Spier. Settlement bargaining and the design of damage awards. *Journal of Law, Economics and Organization*, 10(1):84–95, April 1994.

[10] Kathryn E. Spier. A note on the divergence between the private and the social motive to settle under a negligence rule. *The Journal of Legal Studies*, 26(2):613–622, June 1997.