ON THE CONSEQUENCES OF COSTLY LITIGATION IN THE MODEL OF SINGLE ACTIVITY ACCIDENTS: SOME NEW RESULTS

by

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I. Introduction

Theoretical legal-economic literature has devoted considerable attention to the efficacy of diverse liability rules in attenuating the external effects of risky behavior and in reducing the social costs of accidents.[1] The diversity of the analyzed models precludes at this juncture useful generalizations about the appropriate role of the tort law as an instrument for correcting externalities. It is, however, apparent, at least to me, that any discussion about the optimal structure of the tort law must pay some attention to the costs of enforcement of the tort law, and to the informational requirements of diverse liability rules.[2] The most casual empiricism confirms that both private and social costs of enforcement -- the costs of litigation -- are substantial. More importantly, theoretical conclusions regarding the efficiency properties of various liability rules depend substantially on whether or not litigation costs are present in the model of the tort law.

In my earlier paper, Ordover (1978), I showed that costly litigation implies that in equilibrium some participants in the risky activity must disobey the due care standard -- must be negligent. I then concluded that even if the litigation costs are arbitrarily small, care levels taken by negligent and nonnegligent persons cannot be arbitrarily close to each other; the equilibrium share of negligent persons is usually not very close to zero; the reduction in social welfare due to small but positive litigation costs can be, nevertheless, quite substantial when compared to the level of social welfare with zero litigation costs. Putting those results together, I adduced arguments for subsidization of civil litigation.

This paper will study further the implications of costly litigation for allocation of resources towards accident-avoidance in the regime of the negligence-contributory negligence liability rule. As in my previous paper, I analyze only single activity accidents. Section II outlines the basic model and shows that the social welfare-maximizing due care standard is a discontinuous function of the litigation cost. In particular an increase in that cost from zero to some arbitrarily small positive value causes a finite upward increase in the optimal due care standard. I also argue that any subsequent increases in the litigation cost may lead to a reduction in the standard from this initially high level. This behavior, if it does occur, can be explained by the symmetric structure of the equilibrium:

in such an equilibrium both negligent and nonnegligent persons obtain equal expected utilities.

Section III considers the welfare effects of the (partial) indemnity rule. It shows that shifting litigation costs onto a losing defendant can reduce the overall level of social welfare. Again this result is directly attributable to the symmetric nature of the equilibrium.

Sections IV and V explore the informational underpinnings of the model of single activity accidents. Section IV argues that Diamond's (1974) model can be interpreted as postulating either zero litigation costs or positive litigation costs <u>and</u> perfect post-accident information about the care levels taken by the parties to an accident. Given the latter interpretation, efficiency requires that negligent persons, if there are any, voluntarily reimburse nonnegligent ones for their accident costs. In this case, the costs of litigation become irrelevant to the analysis. However, it is to be expected that injurers will be recalcitrant and will attempt to force a settlement rather than a trial. If settlements are allowed, in some cases social welfare must be lower than the maximum level attainable when settlements are precluded.

Eschewing the polar specifications of the informational structure -- either no post-accident information, as in Ordóver (1978), or perfect post-accident information, as in Section IV -- I consider the last section the welfare implications of informative accidents. Given the posited information structure, an innocent person must decide whether to sue everyone with whom he has an accident, or whether to sue selectively. I show that if the total population can be dichotomized into those who ex-post look innocent or look guilty, improvements in the post-accident information do not invariably conduce to higher social welfare; a uniform equilibrium of the type suggested by Diamond (1974) is not usually attainable; and the level of social welfare is a discontinuous function of the quality of post-accident information. This analysis implies, therefore, that some types of post-accident information are socially more valuable than others. Whereas for some types of post-accident information small investments in the improvement in their quality leave social welfare unaffected, for others the same investment may substantially improve the level of social welfare. Section V provides a rudimentary framework within which the social value of information can be assessed.

II. A Model of Single Activity Accidents

The basic model used in this paper was developed by Diamond (1974) and was subsequently extended by Ordover (1977, 1978) to allow for the presence of litigation costs. Since I confine myself here to the most cursory description of the model, an interested reader is advised to consult those papers.

I assume that a large number of identical persons is engaged in an activity which exposes them to a risk of accident. $\pi(x,y) = \pi(y,x)$ denotes the expected number of accidents (per unit time) between two persons taking care levels x and y

respectively, where x and y both lie between zero and one. Regarding the properties of $\pi(\ )$, I assume that $\partial\pi/\partial x \equiv \pi_1 < 0$, $\partial\pi/\partial y \equiv \pi_2 < 0$, $\pi_{11} < 0$, $\pi_{22} < 0$, and $\pi_{12} > 0$. I denote by $V(x)$, $V'(x)$ and $V''(x)$ both negative, the (gross) utility from a risky activity obtained by a person who takes care level x. It is convenient to interpret x as the level of accident-avoidance expenditure which, after an accident, is compared (with perfect accuracy) by the court to the due care standard d. The value of d is known in advance to all participants in the risky activity. Each person is also fully cognizant of whether he did or did not take due care. If all persons are risk neutral, have identical utility functions, and if all accident costs are fully recognized and independent of care levels, then the expected utility of a person taking care level x is given by

$$U(x) = V(x) - c\int_0^1 \pi(x,y)h(y)dy$$

where h(y) is the number of agents taking y units of care.

In a single activity model the range of possible liability rules is fairly limited. Here I confine my analysis to the negligence-contributory negligence liability rule. Under this rule a victim can collect for damages provided that his care level, x, is at least equal to the due care standard d, and the injurer's care level, y, is less than d. It follows that if $x < d$ and $y < d$ or $x \geq d$ and $y \geq d$ neither party to an accident can collect for damages. With the liability rule in effect, expected utility of a representative nonnegligent person (victim) is

$$A(d) = V(d) - (c+s)(1-n)\pi(d,d) - sn\pi(d,x): \quad x \geq d \tag{1}$$

and expected utility of a representative negligent person (injurer)[3] is

$$B(x) = V(x) - 2c(1-n)\pi(x,d) - cn\pi(x,x): \quad x < d. \tag{2}$$

Here s is the litigation cost which is fully borne by the plaintiff and n is the share of negligent persons in the total population which was normalized at one. Equations (1) and (2) make use of the following facts:[4] i) all victims select care levels equal to the due care standard; ii) all injurers select the same level of care; iii) any nonnegligent agent sues everyone with whom he has an accident. This last fact depends on the assumption that accidents are uninformative, meaning that the prior (pre-accident) and posterior (post-accident) probabilities of winning a suit are equal. Stated differently, accidents are uninformative if they do not convey any information about the care levels of the parties involved.

From equation (2) we can derive the reaction function $x^{00} = \chi(n,d;\cdot)$ which gives the optimal level of care of injurers as a function of the two control variables n and d, and of all the parameters of the model, in particular, of the two costs c and s. Thus x^{00} is the implicit solution to the first-order condition.

$$\frac{\partial B}{\partial x} = V'(x) - 2c(1-n)\pi_1(x,d) - cn\pi_1(x,x) = 0. \tag{3}$$

The properties of the reaction function $\chi(\cdot;\cdot)$ are discussed in Ordover (1977).[5]

It is difficult to say much about the behaviors of the two expected utilities, A( ) and B( ), as functions of the due care standard, d, and of the share of injurers in the total population, n. It is difficult, that is, to sign the important derivatives A_i and B_i, i = d, n, where those derivatives also involve the indirect effects on the expected utilities through the reaction function $\chi(\ )$. In order to proceed with the analysis, I will assume that for the relevant values of d

(A.1) Assumption 1: $A_n \geq 0$;

(A.2) Assumption 2: $B_n \leq 0$;

(A.3) Assumption 3: $B_d \geq 0$.

Simple manipulations show that if the accident production function, $\pi(\ )$, is given by $\pi(x,y) = (1-n)(1-y)$, then the relevant derivatives have the requisite signs. The ambiguities in the signs of the partial derivatives of A( ) and B( ) arise because the changes in d or n almost invariably have conflicting effects on the expected utilities. To illustrate, let us consider the derivative of A( ) with respect to n:

$$A_n = (c+s)\pi(d,d) - s\pi(d,x) - sn\pi_2(d,x)(\partial\chi/\partial n). \qquad (4)$$

A small increase in n may increase or decrease the total cost of accidents, holding care levels constant, depending on the sign of the difference $(c+s)\pi(d,d) - s\pi(d,x)$. In addition, there is the indirect effect on expected utility through change in the care level of negligent persons, *viz*. $sn\pi_2\chi_n$. It should be apparent from equation (3) that the sign of $\partial\chi/\partial n$ is indeterminate. Thus, *a priori*, little can be said regarding the sign of A_n. Unfortunately, knowledge of the signs of various derivatives of the expected utility functions is essential to study of the social welfare optimum.

II.A Social Welfare Considerations

In the model postulated here, there is essentially only one control variable -- the due care standard. Once that standard is set, all negligent persons choose the noncooperative level of care, x^{00}, given their share in the total population. This share adjusts to equalize the expected utilities of injurers and their victims. In addition, in equilibrium the expected benefit from suing cannot be less than the certain litigation cost s. Given this formulation of the problem, the decision-maker must choose d so as to maximize social welfare given by

$$W = (1-n)A + nB$$

while being mindful that all the other decisions -- those that determine the equilibrium values of n and x -- are fully decentralized. This problem can be converted into an equivalent one where n is also directly controllable and social welfare is measured by the value of A( ). Now the optimization problem is:

$$\max_{\{d,n\}} A(\ )$$

subject to

$B(\ ) - A(\ ) \geq 0$: (the equilibrium symmetry condition)

$pc - s \geq 0$: (the litigation constraint)

where p is the probability of winning the suit:

$$p = \frac{n\pi(d,x)}{n\pi(d,x) + (1-n)\pi(d,d)} \equiv \phi(d,n). \qquad (5)$$

The Lagrangian for this program is

$$\mathcal{L} = A + \lambda(B-A) + \gamma(c\phi-s) \qquad (6)$$

where λ and γ are the multipliers associated with the two constraints. λ measures the welfare effect of permitting a small positive wedge between the expected utilities of victims and injurers.[6] Consequently, λ cannot be negative. Similarly, γ measures the indirect welfare effect of a small decrease in litigation cost. Thus it also must be nonnegative.

First-order necessary conditions for the maximum of the program given by (6) are

$$\mathcal{L}_d = (1-\lambda)A_d + \lambda B_d + \gamma c\phi_d = 0 \quad (7)$$

$$\mathcal{L}_n = (1-\lambda)A_n + \lambda B_n + \gamma c\phi_n = 0 \quad (8)$$

where subscripts indicate partial derivatives.

Few results can be wrung from those first-order conditions. However, given the assumptions made above some potentially interesting observations can be made:

<u>Fact 1 (F.1)</u>: If we assume that the litigation constraint is not binding and that assumptions (A.1) through (A.3) hold, then the Lagrange multiplier λ must lie between zero and one, $0 \leq \lambda \leq 1$.

In other words, (F.1) states that, in equilibrium, the welfare effect of a small positive wedge between A( ) and B( ) is only a fraction of that wedge. More interestingly, we can use (F.1) to deduce

<u>Fact 2 (F.2)</u>: Given (F.1), the expected utility of nonnegligent persons in equilibrium is a decreasing function of the due care standard, i.e., $A_d < 0$.

Therefore, from the standpoint of nonnegligent persons, maximization of social welfare leads to a due care standard that is too high. This "overshooting" need not occur, of course, if one of the assumptions, (A.1) through (A.3), fails. Assume, for example, that $B_n > 0$ in the neighborhood of the equilibrium and that $\gamma = 0$. This implies that $\lambda > 1$ and that $A_d > 0$. Thus, in this instance, the standard is set too low from the standpoint of both nonnegligent and negligent persons. This paradoxical result arises only because an increase in the due care standard leads to a reduced share of injurers in the population. This downward shift in $\underline{n}$ is detrimental to both injurers and victims. It follows from equations (7) and (8) that almost nothing of interest can be said about λ and A_d when the litigation constraint is binding.

II.B The Optimal Level of Due Care

Does litigation cost raise or lower the socially optimal due care standard that obtains when those costs are zero? In our simplified model the latter standard, denoted by $\underline{d}^*$, is given by the solution to

$$\max_{\{x\}} V(x) - c\pi(x,x). \tag{9}$$

Thus, at the social optimum, $V'(d^*) = 2c\pi_1(d^*,d^*)$. The solution to this problem corresponds precisely to the noncooperative (Nash) equilibrium when the per accident costs are 2c, i.e., twice what they really are in the underlying model.

The usual way to answer the question above would be to use the methodology of comparative statics and analyze the sign of (dd*/ds) around s = 0. Unfortunately, this route is not available here because, as I demonstrated in my earlier paper, the required continuity properties fail us when we move from a zero litigation-costs model to a model where these costs are arbitrarily small. Thus, we must make use of somewhat imprecise methodology which, however, tends to confirm our intuition that, when litigation is costly, the due care standard ought to be set higher than when these costs are zero. This argument relies on the observation that, from the social standpoint, accidents are now more costly: as before, c per person is incurred when an accident occurs, and in addition each innocent victim now spends an extra amount, equal to s, to press his claim in court. Consequently, an increase in the due care standard is necessary to reduce the expected cost of accidents. In addition, and this part of the argument does not depend on the expected cost per accident, an increase in the due care standard above d* both lowers the expected utility of the innocent persons and raises the expected utility of the guilty persons. Thus, an upward readjustment in the due care standard may be necessary if the two expected utilities are to be equalized. This novel and important function of upward adjustments in the due care standard can be summarized in

Proposition 1 (P.1): If we let $B_d \geq 0$ and let the litigation cost, s, be positive but arbitrarily small so that each accident has a social cost virtually equal to 2c, then the socially optimal due care standard, d**, is greater than d* by a finite amount.

The proof[7] of this proposition requires two steps. The first rules out the possibility that d* can be an equilibrium due care standard by showing that if the due care standard is d* then, for any n, the maximum expected utility of nonnegligent persons exceeds by a finite amount the expected utility of negligent persons. Since in equilibrium A( ) = B( ), and since A_d and B_d are both finite and bounded, a finite adjustment, up or down, in d must be made to restore this equality. In the second step the fact that $B_d \geq 0$ rules out the possibility that the optimal due care standard, d**, is less than d*.

Proposition (P.1) clearly brings out the dual role of the due care standard which not only influences the expected number of accidents in the population, but also assures that the equilibrium symmetry condition is satisfied. When the litigation cost s is small, this second role of the due care standard predominates. When s is large, however, this by itself helps to reduce the gap between the two expected utilities because the expected utility of negligent persons does not depend on s whereas $\partial A/\partial s$ is always negative. The foregoing discussion suggests that for $s > 0$ the socially optimal due care standard, $d^{**}(s)$, may be a decreasing function of the litigation cost, and certainly need not be a monotonically increasing function. This is true because, with s large, the due care standard need not be very strict for the two utilities to be equalized. Unfortunately, rigorous comparative statics, even in the case where $\pi(\ ) = (1-x)(1-y)$, failed to provide unambiguous information about the sign of $dd^*(s)/ds$.

III. Shifting of Litigation Costs

It may be argued that fairness requires that a successful plaintiff be relieved of some of the litigation costs incurred in pressing his just claim. Equity considerations aside, one would still like to know what the efficiency implications are of indemnifying the winning plaintiff for his litigation costs. This section shows that efficiency consequences of the indemnity rule are uncertain.[8] The obvious benefit of shifting litigation costs is that it induces greater expenditures on care by negligent persons. This effect, plus the fact that the nonnegligent person now bears lower litigation cost, raises the expected utility of each nonnegligent person. However, for any given value of n, the expected utility of negligent persons is reduced as their share of the litigation cost is increased. Thus, a new equilibrium with some shifting of litigation costs may yield a lower level of overall utility than if there were no shifting, no indemnity.

We can formalize the notion of shifting litigation costs by assuming that the negligent person pays share $\underline{t}$ of the litigation cost. Now the expected utilities of nonnegligent and negligent persons are given by

$$A(\ ) = V(d) - c(1-n)\pi(d,d) - s(1-t)n\pi(d,x) \tag{10}$$

and

$$B(\ ) = V(x) - (2c+st)(1-n)\pi(x,d) - cn\pi(x,x), \tag{11}$$

respectively. Using the first-order condition for the noncooperative optimal value of care by negligent persons, $\underline{x}^{00}$, as in equation (3), we can calculate

$$\frac{\partial x^{00}}{\partial t} = \frac{s(1-n)\pi_1(x,d)}{V''(x) - (2c+st)\pi_{11}(x,d) - 2cn\pi_{11}(x,x)} > 0 \tag{12}$$

Thus an increase in $\underline{t}$ raises the level of care of nonnegligent persons. This is reasonable: since the (partial) indemnity rule raises the cost of an accident with a nonnegligent person, each negligent person desires to reduce the number of those costly accidents and therefore raises his level of care.

The effect of changing $\underline{t}$ on the respective expected utilities is

$$\frac{\partial A}{\partial t} = sn\left[\pi(d,x) - (1-t)\pi_2(d,x)\frac{\partial x^{00}}{\partial t}\right] > 0 \tag{13}$$

and

$$\frac{\partial B}{\partial t} = -s(1-n)\pi(x,d) - cn\pi_2(x,x)\frac{\partial x^{00}}{\partial t} \qquad (14)$$

As equation (14) shows, the sign of $\partial B/\partial t$ is indeterminate: the first term is negative and the second positive. We note, however, that as _n_ tends to zero $\partial B/\partial t$ is almost surely negative. At the other end, as _n_ tends to one, both the first and the second term go to zero since from equation (12) we know that $\partial x^{00}/\partial t$ tends to zero as the share of negligent persons in the population becomes larger.

Let us denote by $A^*(t)$ the socially optimal level of utility when negligent persons bear _t_ percent of the litigation cost. Let us also assume initially that the litigation constraint is not binding. Application of the envelope theorem yields

$$\frac{dA^*(t)}{dt} = (1-\lambda)\frac{\partial A}{\partial t} + \lambda\frac{\partial B}{\partial t} \qquad (15)$$

From equation (15) it follows trivially that

Proposition 2 (P.2): If $\partial B/\partial t < 0$, as is most likely, then $dA^*/dt < 0$ whenever $\lambda \geq 1$.

This result indicates that the indemnity rule can be a mixed blessing: As the shifting of litigation costs to negligent persons reduces their expected utility, it reduces the share of negligent persons in the total population. This, in turn, negatively affects the expected utilities of both types of persons. I do not wish to intimate, however, that an indemnity rule is always undesirable. Indeed,

> <u>Proposition 3 (P.3)</u>: If $n \geq \lambda$ and the litigation constraint is not binding, indemnity raises the level of social welfare.

To prove this proposition we need only to substitute equations (13) and (14) into equation (15) to obtain

$$\frac{dA^*(t)}{dt} = (n-\lambda)\pi(d,x)s - \left[sn(1-t)\pi_2(d,x)\,\frac{\partial x^{00}}{\partial t}\right](1-\lambda) - \lambda\, cn\pi_2(x,x)\,\frac{\partial x^{00}}{\partial t}\,. \tag{16}$$

Since the last two terms are positive, a sufficient condition for dA^*/dt to be positive is that $n \geq \lambda$. In particular we can deduce from equation (16) that, if the equilibrium share of negligent persons approaches zero, the indemnity rule will lower welfare; on the other hand, when <u>n</u> is close to one, welfare is likely to increase.

The assumption that the litigation constraint is not binding is not particularly important. If the constraint is binding, another positive effect on $A^*(t)$ is likely to result from raising <u>t</u> above zero. To see this, let us rewrite the litigation constraint as

$$g(t) \equiv pc - s(1-t) \geq 0. \tag{17}$$

Differentiating equation (17) with respect to <u>t</u> and using the fact that if the litigation constraint is binding then $pc = s(1-t)$ is positive as long as the elasticity $\partial \log p/\partial \log(1-t)$ is less than one. Simple manipulations reveal that this elasticity tends to zero as $\underline{n}$ approaches one. Therefore, for large values of $\underline{n}$, there is additional positive effect on maximized welfare, an effect approximately equal to $(\gamma s)dt$. At the other extreme, when $\underline{n}$ is close to zero, the situation is less clear, and the possibility arises that

$$\frac{dA^*(t)}{dt} \cong s\{\gamma-\lambda\pi(d,x)\}$$

will be negative.

The results reported in this section accord well with our intuition. When the share of negligent persons in the population is small, a nonnegligent person rarely encounters a guilty defendent -- most of the suits involve two nonnegligent parties. Thus, to a representative nonnegligent person expected benefit from the indemnity rule is small since only rarely is he able to shift a share of the litigation costs. For a negligent person, on the contrary, the indemnity rule is particularly costly (in terms of expected utility) when $\underline{n}$ is small: his accidents are mostly with nonnegligent persons, and thus he will almost always have to bear a share of the litigation costs. That he will have fewer accidents with other negligent persons -- recall that $\partial x^{00}/\partial t > 0$ -- is hardly a consolation since the number of those encounters is very small. Similar arguments can be offered to show that maximized welfare will tend to increase in t when n is large. However, instances when the equilibrium value of n is small will usually arise when the litigation cost is small. Consequently, the absolute value of dA^*/dt will most likely be small, as well.

IV. Perfectly Informative Accidents: A Reinterpretation of Diamond's Model

In the last two sections, I have reviewed the standard model of single activity accidents with costly litigation and offered some new results regarding the efficiency implications of the tort law. I have not, however, clarified the important question whether the results reported in my earlier paper (Ordover, 1978), and in Sections II and III of this paper, depended on the assumption that litigation is costly, or on the assumption that accidents are uninformative. The reader will recall that an accident is *uninformative* if it does not convey any information about the guilt or innocence of the parties to the accident. Analogously, an accident is *perfectly informative* if it fully reveals the care levels taken by the parties to the accident. Most likely the informational content of an accident is somewhere between the two extremes. When the informational content is very low, my earlier model appears appropriate; when that content is high, however, the Diamond model is perhaps more relevant to the study of the liability rules. In fact we have the following result:

Proposition 4 (P.4): If accidents are perfectly informative, litigation costs are irrelevant to analysis of the efficiency properties of the tort law, provided nonnegligent persons are always willing to sue negligent ones.

This proposition states that the canonical Diamond (1974) model can be interpreted as postulating either uninformative accidents and zero litigation costs, or perfectly informative accidents and positive litigation costs. Under the first interpretation, equilibrium is enforced by actual suits which always result in a loss to the plaintiff: he does not recover his accident costs since, in equilibrium, everyone is nonnegligent. Under the second interpretation, equilibrium in enforced by threat of a suit provided that, in the present notation, $c > s$. If this inequality holds, every nonnegligent person will always sue if he is involved in an accident with a negligent person. To see this, let us assume that (almost) everyone is nonnegligent. Thus, the expected utility of a representative nonnegligent person is

$$A(\ ) = V(d) - c\pi(d,d). \tag{18}$$

A person who violates the due care standard can anticipate an expected utility of

$$B(\ ) = V(x) - 2c\pi(x,d): \quad x < d.$$

Diamond (1974) demonstrated that $A(\ ) > B(\ )$ for at least some values of $\underline{d}$. For our purposes the most important is the fact that

Proposition 5 (P.5): If litigation is costly, accidents are perfectly informative, and nonnegligent persons are willing to litigate, then the socially efficient due care standard is equal to the socially efficient standard, $\underline{d}^*$, calculated on the assumption that litigation costs are zero.

Observe that the efficient standard $\underline{d}^*$ is the solution to

$$V'(d) - 2c\pi_1(d,d) = 0. \tag{20}$$

Given $\underline{d}^*$, the efficient level of care for a negligent person, $\chi(0,d^*)$, is given by the solution to

$$V'(x) - 2c\pi_1(x,d^*) = 0. \tag{21}$$

Thus $x^{00} \equiv \chi(0,d^*) = d^*$. Substituting $\chi(0,d^*)$ for $\underline{x}$ in equation (19) reveals that $A(d^*) >> B(x) = V(d^*) - 2c\pi(d^*,d^*)$, and that $A(d^*) > B(x)$, for all $\underline{x} < d^*$.

Propositions (P.4) and (P.5) depend crucially on the assumption that nonnegligent persons are always prepared to sue negligent persons, or that a negligent person voluntarily reimburses his victims for the costs of accidents. But this may not be true: First, since $c > s$, victims have a strong incentive to settle. Second, the two parties know precisely the outcome of a prospective suit, and it is the divergence of opinions about the outcome that (often) makes the parties opt for litigation and not settlement.[9] Knowing that victims prefer to settle, injurers may resist compensating the victim, hoping for a more favorable settlement. Thus, settlements are quite likely.

We would expect that settling a dispute is not only individually rational but also socially desirable because it saves resources. Unfortunately, this conjecture is not universally valid even if the costs of settlement are equal to zero, as I shall assume from now on. Our intuition fails because the possibility of a settlement can make it optimal for some subset of the population to violate the due care standard. In order to prove this assertion, let us make an implausible assumption that if a settlement occurs, the guilty person pays the amount equal to (c-s), which is precisely the net amount that the plaintiff would have collected had he taken his claim to court. More realistically, we would expect the injurer to pay, on the average, a quantity $c - s + \Delta$, with Δ perhaps equal to 1/2s. The analysis that follows is unaffected by the assumption that $\Delta = 0$ as long as the "true" Δ is lower, by a finite amount, than $\underline{s}$. Let us assume in addition that, initially, the due care standard is at a socially efficient level $\underline{d}^*$. Given those assumptions, we can establish[10]

<u>Proposition 6 (P.6)</u>: There exists some level of litigation cost, and some rule Δ for dividing the gains from avoiding the litigation, such that a subset of participants in the activity will prefer violating the socially optimal due care standard to obeying it. Consequently, since in

equilibrium the expected utility of all persons must be the same, the level of utility will be lower if settlements are permitted than it will be if settlements are disallowed.

As Diamond observed in a similar context, (see Diamond 1974), it is dangerous to draw strong policy conclusions from overly simple models. Nevertheless, my analysis tends to indicate that settlements are a mixed blessing. They may indeed conserve scarce resources by minimizing costly litigation, but they may also weaken incentives to obey the law. It is paradoxical that when litigation is very costly, as compared to the size of the award and to the costs of settling, this socially undesirable feature of settlements tends to be most pronounced.

V. Informative Accidents

In the preceding section, I considered the efficiency implications of perfectly informative accidents in the presence of litigation costs. However, most accidents do not perfectly reveal the guilt or innocence of the parties involved. Indubitably, some margin of error will persist after an accident, and the innocent person will have to make a decision whether or not to sue.

Perhaps the simplest way to model the concept of informative accidents is to assume that a victim can observe a costless signal which permits him to form an "opinion" about the guilt or innocence of the other party. The signal takes only two values. Consequently, the victim can label the other party as someone who looks guilty or looks innocent.[11] The informational content of the signal can be summarized, therefore, by two conditional probabilities: the probability that an innocent person looks innocent, denoted by $p(i|I)$, and the probability that a guilty person looks innocent, denoted by $p(i|G)$. (The complements of those two probabilities are $p(g|I)$ and $p(g|G)$, respectively.) Naturally, for the signal to have any prospective value $p(i|I)$ must exceed $p(i|G)$. Given this model of post-accident information, we have the following

<u>Definition 1 (D.1)</u>: Accidents are informative if $p(i|I) > 1/2$, or $p(i|G) < 1/2$, or both.

Thus, according to this definition, accidents are informative if the test which generates the requisite signal reveals some information about the care of at least one of the two groups in the population. Using this definition, it also follows that an accident is uniformative if $p(i|I) = p(i|G)$; whereas, if $p(i|I) = 1$ and $p(i|G) = 0$, an accident is perfectly informative.

Using the structural description of the test, we can calculate expressions for the probabilities of winning when the population is dichotomized into mutually exclusive groups of those who look innocent and those who look guilty. From the vantage point of an innocent person, the number of those who look innocent is given by

$$m^i = p(i|I)[(1-n)\pi(d,d)] + p(i|G)[n\pi(d,x)]. \tag{21}$$

The first term of this expression is the share of all accidents between an innocent person and other innocent persons that the test correctly reveals as being accidents between two innocent persons; the second term is the share of the incorrectly labeled accidents between an innocent person and a guilty person. Similar calculation gives the number of those who look guilty as being equal to

$$m^g = p(g|I)[(1-n)\pi(d,d)] + p(g|G)[n\pi(d,x)] \tag{22}$$

$$= (\text{total number of accidents}) - m^i.$$

Using (21) and (22) we can calculate the probabilities of winning a suit. If a person in the class of those who look guilty is sued, the probability of winning is

$$p^g = \frac{p(g|G)[n\pi(d,x)]}{m^g} . \tag{23}$$

The probability of winning when suing a person who looks innocent is

$$p^i = \frac{p(i|G)[n\pi(d,x)]}{m^i} . \tag{24}$$

Thus, we have the following alternative definition of informative accidents:

<u>Definition 2 (D.2)</u>: Accidents are informative if

$$p^g > p > p^i \tag{25}$$

where p is the weighted average of the two pool-specific probabilities, p^g and p^i.

Inequality (25) is satisfied whenever the condition $p(i|I) > p(i|G)$ is satisfied. In what follows I shall assume that this condition is met.

One important implication of inequality (25) is that an innocent person will either sue everyone or only those who look guilty. The former case obtains if $p^g c \geq s$ <u>and</u> $p^i c \geq s$; the latter, if the second inequality is reversed. This observation is sufficient for

<u>Proposition 7 (P.7)</u>: If in a mixed equilibrium with uninformative accidents the litigation constraint is not binding, so that $pc > s$, then there exists post-accident information of such low quality that it does not improve social welfare.

Phrased differently, the shadow-price of (improved) post-accident information is zero if in the initial equilibrium the expected gain from suing everyone is strictly greater than the cost of a suit. The policy implication of this proposition is that it may be socially wasteful to invest resources in devising post-accident tests which, speaking loosely, convey only minimal amounts of additional information about the guilt or innocence of a person involved in an accident.

Another important question is whether the nature of the equilibrium changes when we posit that some additional information becomes available after an accident. We would like to know, in particular, whether a uniform equilibrium with everyone taking the socially optimal level of care, $\underline{d}^*$, is possible when accidents are informative.[12] I have already given a partial answer to this question. The corollary of Propositions (P.4), (P.5), and (P.7) is

<u>Corollary 1 (C.1)</u>: Whereas perfect information, absent settlements, guarantees that a uniform equilibrium exists, some improvements in post-accident information do not ensure the existence of such an equilibrium.

Thus we must inquire how much post-accident information, and of what type, is necessary for the existence of a uniform equilibrium. First I report this negative result:

<u>Proposition 8 (P.8)</u>: If litigation costs are positive and if the conditional probability that an innocent person is classified as being innocent, $p(i|I)$, is not equal to one, then a uniform equilibrium does not exist even if the other conditional probability, $p(i|G)$, is zero.

The proof of (P.7) follows the strategy of the proof of the nonexistence of a uniform equilibrium when accidents are uninformative. (The details of the proof are in Ordover (1978).) Let us observe that, given the assumptions made in (P.8), an innocent person will either sue everyone, which requires that $p(i|G) > 0$, or will sue only those who look guilty. The former situation obtains if the post-accident signal is very noisy; the latter if, for example, $p(i|G)$ equals zero. If an innocent person sues everyone, then the model with informative accidents becomes analogous to that with uninformative accidents in which, as we know, uniform equilibrium does not exist, and (P.8) holds. Hence, let us assume that $p(i|G) = 0$. Thus $p^i = 0$ and it is not worthwhile to sue those who look innocent. For an innocent person to sue those who look guilty it must be true that $p^g c \geq s$. But this implies that there are some guilty persons, which again establishes (P.8). Of course, there remains the possibility that an innocent person sues no one. In this instance his expected utility is

$$A(d) = V(d) - c\pi(d,d)$$

provided (almost) everyone is innocent. However, the expected utility of a guilty person is

$$B(\tilde{x}) = V(\tilde{x}) - c\pi(\tilde{x},d) > A(d): \quad d > x^* > \tilde{x} \qquad (26)$$

where $\underline{x}^*$ is the noncooperative level of care in non-liability equilibrium and $\underline{\tilde{x}}$ is the optimal level of care. Given that the inequality in (26) holds, each innocent person desires to violate the standard. Consequently, the only equilibrium is a mixed equilibrium.

The above Proposition re-establishes the crucial role of private incentives to sue in improving resource allocation in the presence of externalities resulting from risky activities. As I have demonstrated, the fact that post-accident information may enable the nonnegligent person to classify the negligent agent correctly, does not necessarily provide the requisite incentives to sue. The lack of these incentives is directly attributable to the inability to classify nonnegligent persons precisely. It may be information about nonnegligent persons that is crucial in providing necessary conditions for the existence of a uniform equilibrium. Indeed, it is possible to show

Proposition 9 (P.9): If $\underline{s} > 0$, the necessary, though not sufficient, condition for the existence of a uniform equilibrium is that $p(i|I) = 1$.

We have seen already, [see (P.8)], that if $p(i|I) \neq 1$ then a uniform equilibrium does not exist. Hence, it remains to show that even if $p(i|I) = 1$ a uniform equilibrium may or may not exist. The existence of a uniform equilibrium can be frustrated because if $p(g|G) \neq 1$ some nonnegligent persons may prefer to become negligent. Whether they do depends on the direction of the inequality

$$B(x) = V(x) - 2c\pi(x,d)[1-p(i|G)] - c\pi(x,d)p(i|G)$$

$$\lesseqgtr V(d) - c\pi(d,d) = A(d),$$

where the two expected utilities are evaluated with $n \cong 0$ and $s \cong 0$. Furthermore, $B(x)$ is calculated with the plausible assumption that a negligent person is not sued if he looks innocent; $A(d)$ equals the expected utility of an innocent person if everyone is also innocent. When $\underline{n}$ and $\underline{s}$ both tend to zero, the expected utility of an innocent person who sues selectively approaches $A(d)$.

We already know that if $p(i|G) = 0$ then $B(x)$ is less than $A(d)$, whenever $p(i|I) = 1$. However, as $p(i|G)$ approaches 1/2, indicating that the test poorly identifies negligent persons, their expected utility may exceed that of representative non-negligent persons. Hence, at least for some values of the parameters, there exist $\overline{p}(i|G)$ such that if $\overline{p}(i|G) \gtreqless p(i|G)$ then $A(d) \gtreqless B(x)$. This establishes the Proposition.

By comparing the last two propositions, we can better understand the role of the conditional probability $p(i|I)$ in securing the existence of a uniform equilibrium. We note that, if $p(i|I) = 1$, then $p^g = 1$; there are no innocent persons among those who look guilty. Consequently, the latter will always be sued. This may be a sufficient deterrent against breaking the due care standard: even if $p^i c < s$, so that those who look innocent are not sued, setting $x < d^*$ may not be optimal if $p(i|G)$ is also very small so that the chances of avoiding the punishment are slight indeed. However, if $p(i|I) < 1$, the sole person who violates the due care standard always escapes punishment, inasmuch as both $p^i c < s$ and $p^g c < s$, and his expected utility exceeds the expected utility of all of those who set $x = d^*$. Thus, in this instance, there is an incentive to break the standard.

Our discussion thus far reveals that unless accidents are perfectly informative, a uniform equilibrium is highly unlikely. It is unreasonable to expect that the crucial conditional probability $p(i|I)$ is equal to one. If it is not, then no matter how precise the test is in characterizing negligent persons, a uniform equilibrium will not exist. This should not be necessarily a worrisome finding if we can establish that, when accidents are (partly) informative, the level of utility realized is close to that which would have been realized in an economy with fully informative accidents, or zero litigation costs. I now turn, therefore, to analysis of the welfare effects of changes in the precision of post-accident information.

The simplest case to consider is the one instanced in (P.9) where I assume that $p(i|I) = 1$. It is then possible to show[13]

Proposition 10 (P.10): When litigation costs are arbitrarily small, and when $p(i|I) = 1$, the only possible equilibria are either uniform with everyone taking care level $\underline{d}^*$, or mixed with nonnegligent persons suing everyone with whom they have accidents. Furthermore, in a mixed equilibrium social welfare is finitely lower than in a uniform equilibrium.

This proposition shows that as the test's precision worsens -- $p(i|G)$ becoming higher -- social welfare is initially unaffected, remaining at the maximum level equal to $A^*(d^*)$. Once $p(i|G)$ exceeds the value $\overline{p}(i|G)$ defined above, there is a finite drop in the level of social welfare because the uniform equilibrium is no longer feasible. In other words, social welfare is a discontinuous function of $p(i|G)$, holding $p(i|I) = 1$, with a discontinuity occurring at $p(i|G) = \overline{p}(i|G)$. The difficult aspect of the proof is to show that in a mixed equilibrium the expected utilities are not arbitrarily close to $A^*(d^*)$.

As (P.10) indicates, the critical difference between models in which accidents are even partly informative and those in which accidents are uninformative is that the former admit of a possibility of uniform equilibria whereas the latter do not. The reason for this difference should be obvious: when accidents are informative, a certain amount of information can be obtained for nothing, even if litigation costs <u>are</u> positive. In the case instanced in (P.10), for example, the information that all those who "look guilty" are in fact negligent is freely available. Consequently, a nonnegligent person does not have to expend $\underline{s}$ to ascertain the legal status of those who "look guilty". But this is simply another way of saying that information is truly costless. (Of course, if a negligent person is recalcitrant, an innocent person may still have to bring the case to court in order to induce payment. But I abstract in this section from the role of courts as enforcement or collection agencies and concentrate on provision of information through court proceedings. See, however, Section III where I discuss settlements.)

There is no need to dwell on the case where the conditional probability $p(i|I)$ is less than one. We already know that this precludes the possibility of a uniform equilibrium. Consequently, a reduction in the precision of information from $p(i|I) = 1$ to $p(i|I) < 1$ causes a finite drop in maximized social welfare. Thus if the due care standard were to be kept at $\underline{d}^*$, the expected utility of negligent persons would be lower by a finite amount than the expected utility of nonnegligent persons. In particular, let us set $p(i|G) = 0$ so that a negligent person is always sued. Hence his utility is given by

$$B(x) = V(x) - 2c(1-n)\pi(x,d) - cn\pi(x,d).$$

If we now let both $\underline{s}$ and $\underline{n}$ go to zero, we see that $A(d) >> B(\ )$ when both are evaluated with the due care standard set at $\underline{d}^*$.

Perhaps the most succinct way to summarize our discussion in this section is

<u>Proposition 11 (P.11)</u>: When litigation costs are positive, even if they are arbitrarily small, social welfare is discontinuous in the quality of ex-post information, i.e., information that is generated by an accident itself.

VI. <u>Concluding Remark</u>

I have shown in this and the preceding section the crucial influence of available information, and of the costs of obtaining that information, on the tort law as an instrument for correcting externalities. The major finding from the policy standpoint is that small imperfections in the available information, even when the costs of obtaining perfect information are very small, may result in significant losses in social welfare. Consequently, efforts to improve the quality of post-accident information, as well as to reduce the private costs of obtaining it, may be conducive to substantial improvements in social welfare. However, a contrary policy implication is also present here: if information is imperfect, small improvements in information have in some circumstances no social value. It is essential, therefore, that the policy-maker posesses a framework within which to assess the social value of diverse types of information. I have attempted to provide the rudiments of one such plausible framework. As far as the theoretical research in law and economics is concerned, my analysis indicates, that the properties of the models of the tort law may be quite sensitive to the informational structure that is posited in the model.

APPENDIX

1. Proof of Proposition 1.

Assume first, contrary to (P.1), that $d^{**} = d^*$. Assume next that $\underline{n}^{**}$ -- the equilibrium share when $\underline{s}$ is arbitrarily small -- is arbitrarily close to zero. Note from equation (3) that in this instance $x^{00} = \chi(0,d^*) = d^*$. Hence

$$A(\ ) = V(d^*) - c\pi(d^*,d^*) >> V[\chi(0,d^*)] \tag{A.1}$$

$$- 2c\pi[\chi(0,d^*),d^*] = B(\ ).$$

Thus, if by assumption $d^{**} = d^*$ then $n^{**} >> 0$ because both A_n and B_n are bounded. In other words if $d^{**} = d^*$ then the equilibrium share of negligent persons cannot be arbitrarily close to zero, i.e., n^{**} is bounded away from zero. It is also apparent that when $\underline{n}^{**}$ approaches one A( ) exceeds B( ) by a finite amount. Thus it is necessary to rule out the possibility of any $n^{**} \varepsilon (0,1)$.

Observe that $\partial A/\partial n = c\pi(d,\chi(n,d)) > 0$ if $s \cong 0$. Thus, in the hypothetical equilibrium, $A(\ ) = B(\ ) > V(d^*) - c\pi(d^*,d^*) \equiv A^*(\ )$. This is equivalent to the statement that, if litigation costs were zero, social welfare would be higher if some persons were negligent while others were nonnegligent, the optimal share of negligent persons being n^{**}. This cannot be the case, however, since by definition A^* is the maximum social welfare attainable when litigation costs are zero.

Indeed, the number of accidents that a negligent person can expect is

$$(1-n)\pi(x,d) + n\pi(x,x) > \pi(x,\bar{x}) \qquad (A.2)$$

where $\bar{x} = (1-n)d + nx$, since $\pi(x,y)$ is strictly convex in y. Also π_{ii} is bounded away from zero and plus infinity. Thus the expected number of accidents would decrease if, given that one person takes care level $\underline{x}$, all other persons were to take care level $\bar{x} = (1-n)d^* + nx$. Similarly for a representative nonnegligent person

$$(1-n)\pi(d,d) + n\pi(d,x) > \pi(d,\bar{x}). \qquad (A.3)$$

Using (A.2) and (A.3), we observe that the social cost of accidents would be lower if all persons took care level $\underline{\bar{x}}$. In addition, in view of the strict concavity of V(x), the total avoidance costs would be lower if everyone were at $\underline{\bar{x}}$, i.e., $V(\bar{x}) < (1-n)V(d^*) + n\,V(x)$.

Let us note that $\underline{\bar{x}}$ is finitely lower than $\underline{d}^*$ because $\underline{n}$ is bounded away from zero, and as shown in Ordover (1978), Proposition (P.4), $\chi(n,d^*)$ is not arbitrarily close to $\underline{d}^*$. Thus the level of social welfare attainable when everyone is at $\bar{x} \equiv (1-n)d^* + n\chi(n,d^*)$ is not arbitrarily close to A*.[14] And the level of social welfare when (1-n) are at $\underline{d}^*$ and $\underline{n}$ at $\chi(n,d^*)$ is lower still. Since $V(d^*) - (1-n)c\pi(d^*,d^*) > A^*$ this implies that B( ) is finitely below $A(\ ) = V(d^*) - (1-n)c\pi(d^*,d^*)$.

Given a finite gap between A( ) and B( ) when $d = d^*$, a finite adjustment in $\underline{d}$ is necessary because both A_d and B_d are bounded. Assume that $\hat{d} < d^*$ is the optimal due care standard and that $\hat{n}$ is the optimal share. (Regarding $\hat{n}$ there are two possibilities: either n is small and the litigation constraint is binding, or $\hat{n}$ is not close to zero and the litigation constraint is not binding.) Since A( ) is a uniformly decreasing function of d for $d \geq d^*$, there exists $d' > d^*$ such that $A(d',\hat{n}) = A(\hat{d},\hat{n})$. Also, because $B_d > 0$ by assumption, (for n close to zero $B_d > 0$ always), it follows that $B(d',\hat{n}) > B(\hat{d},\hat{n})$. Recalling that $A_n > 0$, $\forall$ n, there must exist some n' such that $A(d',n') = B(d',n')$. It is important to note that the litigation constraint is not violated -- in fact it need not be binding -- for this new set of values of control variables $\{d',n'\}$. The argument is that if $\hat{n}$ were feasible then $n' > \hat{n}$ because $B_d > 0$ and, consequently, when the due care standard is raised from $\hat{d}$ to d', the equality between A( ) and B( ) occurs for $n > \hat{n}$. This assures that $\{d',n'\}$ is not only feasible but also yields a higher level of social welfare. The foregoing analysis is illustrated in Figure 1. □

2. Proof of Proposition 6.

In proving (P.5), we established that

$$A(d^*) = V(d^*) - c\pi(d^*,d^*) >> V(\chi(0,d^*)) - 2c\pi(\chi(0,d^*),d^*) = B(x)$$

when it is impossible to settle. If it is possible to settle, a person who violates the due care standard has the expected utility equal to

$$B^S = V(x^S) - [c+(c-s)]\pi(x^S,d^*) \tag{A.4}$$

where $\underline{x}^s$ is the optimal level of care; that is, $\underline{x}^s$ maximizes $B^s(\ )$. Of course, $dx^s/ds < 0$. Let $\underline{s}$ tend to $\underline{c}$. Hence, $B^s(\ )$ tends to $B^s_{max} \equiv V(x^2) - c\pi(x^s, d^*)$. Note that if $d = d^*$, $B^s_{max} > A(d^*)$ because $\underline{d^*}$ is not the solution to

$$\max_x V(x) - c\pi(x, d^*).$$

In fact, the solution to this problem is given by $\tilde{x} \ll d^*$. Since B^s is continuously increasing in $\underline{s}$ for a given $\underline{d}$, and since for $s \cong 0$ and $d = d^*$, B^s is less than $A(d^*)$, there must exist $\underline{\bar{s}}$, $c > \bar{s} > 0$ such that the two expected utilities, $B^s(\ )$ and $A(\ )$, are equal. Thus,

$$B^s(\ ) \gtreqless A(\ ) \quad \text{as} \quad s \gtreqless \bar{s}.$$

If $s > \bar{s}$ then $B^s > A$ and the share of negligent persons will exceed zero. The expected utility of a victim is now

$$A(d) - c\pi(d,d) + n[c\pi(d,d) - s\pi(d,x)]. \tag{A.5}$$

If $s \to c$ the expression in square bracket becomes negative implying that, with settlements, social welfare is below what it would have been had settlements not been allowed. □

3. <u>Proof of Proposition 10</u>.

(P.10) is satisfied if the equilibrium share of negligent persons, $\underline{n}^*$, is not arbitrarily close to zero. Indeed, for any finite $\underline{n}^*$, cp^i, as given by equation (24), must exceed $\underline{s}$ which, by assumption, is arbitrarily close to zero. But this implies that the expected utility of a negligent person is no longer equal to B(x) as calculated in equation (27); instead it is equal to $V(x) - 2c\pi(x,d)$, which is less than A(d) at $d = d^*$.

We shall now analyze the possibility of an equilibrium with selective suits if in the putative equilibrium $\underline{n}^*$ is close to zero. For any value of $\underline{s}$, not necessarily close to zero, there exists some value of $\underline{n}$ such that $p^i c < s$ and the expected utility of an innocent person is higher if suits are selective than if everyone is being sued. Let us compare the accident costs in the two regimes, viz.

$$c(1-n)\pi(d,d) + cn\pi(d,x')p(i|G) + sn\pi(d,x')(1-p(i|G)) \lessgtr (c+s)(1-n)\pi(d,d) + cn\pi(d,x''). \qquad (A.6)$$

In this inequality, x' and x" are the levels of care with selective and with indiscriminate suits, respectively. After some manipulations we can rewrite (A.6) as

$$cm^i p^i + sn\pi(d,x')(1-p(i|G)) \lessgtr s\bar{m} \qquad (A.7)$$

where m^i and p^i are given by eqs. (21) and (24) respectively, and $\bar{m} = (1-n)\pi(d,d) + n\pi(d,x'')$. Let $\delta(\cdot) = s - cp^i$, with $\delta > 0$ if it is not optimal to sue those who look innocent. If for all $n \in (0,1]$, $\delta < 0$ so that everyone is sued, there is no equilibrium for $d = d^*$ and (P.10) holds. So let us assume that for some $0 > n = n(s)$, $\delta > 0$. If we now let $\underline{n}$ tend to zero,

$n \varepsilon (0,n(s)]$, the left-hand side of (A.7) will tend to $(s-\delta)\pi(d,d)$ and the right hand side will tend to $s\pi(d,d)$. Thus the inequality is satisfied in the posited direction. From this we can conclude that for $n \varepsilon (0,n(s)]$ the expected utility of a representative nonnegligent person is higher with selective suits than it would be if all nonnegligent persons were to sue indiscriminately.

Now let s tend to zero as well. We would expect the interval $(0,n(s)]$ to shrink. More importantly we can also find that $dA(\ )/dn > 0$ around $n = 0$ because if everyone were being sued and if s were arbitrarily close to zero then $dA/dn > 0$ for sure. But we already know that for $n \varepsilon (0,n(s)]$ it is preferable to sue selectively, i.e. only those who look guilty. As a last step, let us assume that there exists an equilibrium share $n^* \varepsilon (0,n(s)]$. This implies that in this equilibrium the expected utilities exceed $A^*(d^*)$ which is the level attainable.when there are no litigation costs. This, however, cannot be true since d* maximizes social welfare. (This assertion is discussed extensively in the proof of (P.1), Appendix, pp. A1-A3, supra.) We must conclude, therefore, that there is no equilibrium in the interval $(0,n(s)]$. This can be translated into the proposition that if $n \varepsilon (0,n(s))$ then the expected utility of negligent persons exceeds that of nonnegligent ones.

FOOTNOTES

[1] See Shavell (1977a), (1979b) and Simon (1979) for important recent contributions. Other references can be found in Ordover (1978), n. 3, at 244.

[2] Informational aspects of policies towards externalities are discussed, albeit in a different context, in Ordover and Willig (1979).

[3] The terms "victim" and "injurer" chosen to describe nonnegligent and negligent persons are used solely as shorthand expressions. Indeed, as I argued in my earlier paper (Ordover, 1978), the presence of negligent persons is essential for the private enforcement of the tort law.

[4] All those facts are established in Ordover (1978).

[5] It should be apparent from equation (3) that the negligence-contributory negligence liability rule need not induce injurers to take the socially optimal level of care. The reason for this is that negligent persons do not internalize the accident costs that are incured by other negligent persons. I should remark, however, that if injurers were to take a higher level of care, private incentives to sue would be weakened since the *ex ante* probability of winning a suit decreases as the level of care of negligent persons increases, see equation (5) *infra*. Thus by inducing injurers to internalize all accident costs we may undermine the existing equilibrium in the activity.

[6] Of course, in a decentralized economy such a wedge would not persist. But we are now concerned with a centralized economy because the decision-maker can choose the share of injurers in the total population.

[7] The details of this and other lengthy proofs are contained in the Appendix.

[8] The indemnity rule is discussed in a partial equilibrium setting in Posner (1977).

[9] The incentives to settle are discussed in Gould (1973) and Posner (1977).

[10] See the Appendix.

[11] More complex formulations of post-accident information are also possible. See Simon (1979), for example.

[12] Our interest in the existence of a uniform equilibrium stems from the fact that the first-best allocation of resources to accident-avoidance obtains in scale are equilibrium. See Diamond (1974).

[13] See the Appendix.

[14] Note that social welfare as a function of the due care standard may be constant over some interval $[\hat{d},\hat{\hat{d}}]$. If $d^* \in [\hat{d},\hat{\hat{d}}]$, then $d^* \equiv d$. Consequently for all $\underline{d}$ in $[\tilde{d},d^*)$, social welfare must be an increasing function of $\underline{d}$.

BIBLIOGRAPHY

P. A. Diamond, "Single Activity Accidents", 3 J. Leg. Studies 107 (1974).

J. P. Gould, "The Economics of Legal Conflicts", 2 J. Leg. Studies 279 (1973).

J. A. Ordover, "Costly Litigation in the Model of Single Activity Accidents", Bell Laboratories Economic Discussion Paper No. 99 (1977).

J. A. Ordover, "Costly Litigation in the Model of Single Activity Accidents", 7 J. Leg. Studies 73 (1978).

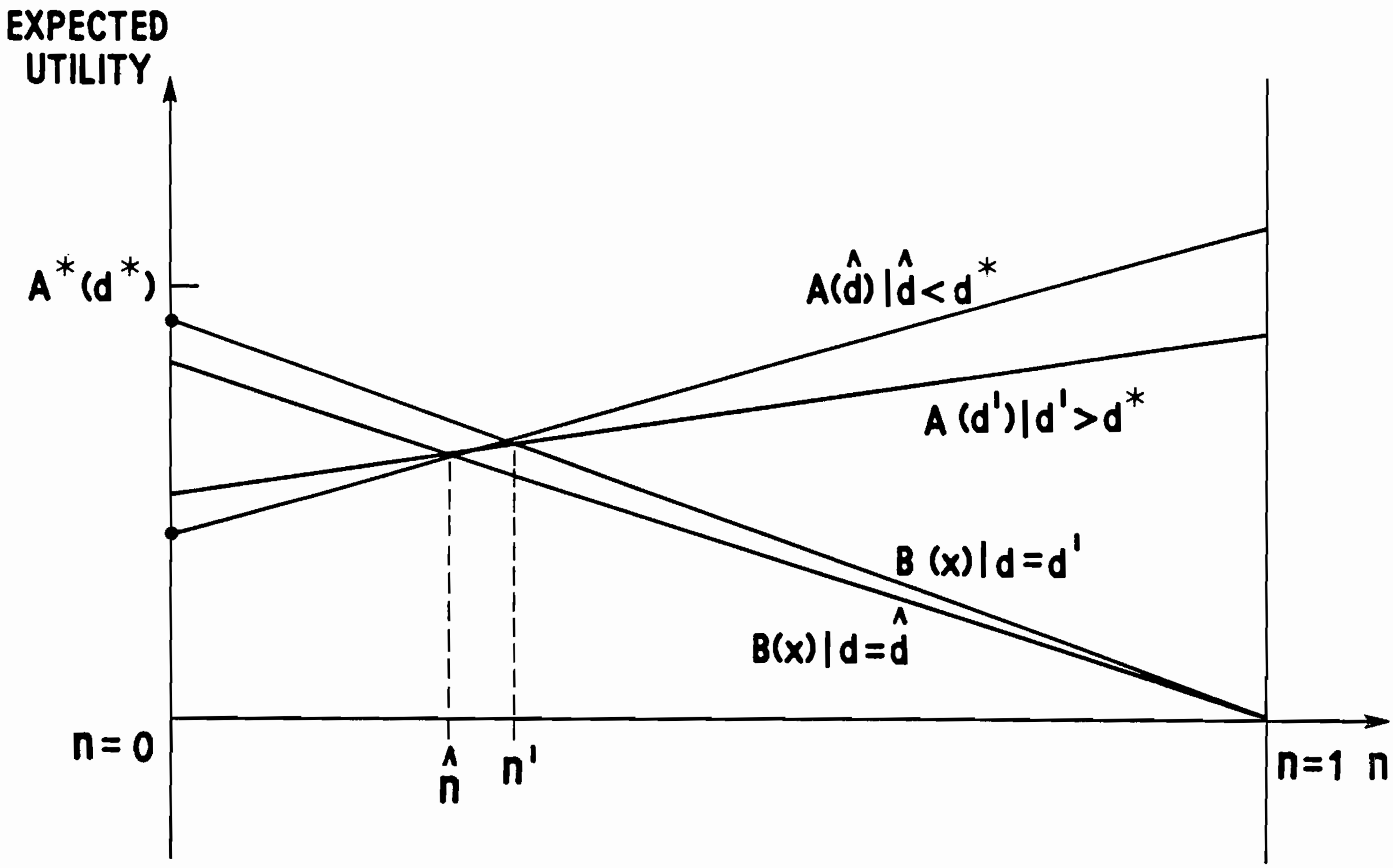
J. A. Ordover and R. D. Willig, "The Role of Information in Designing Social Policy Towards Externalities", C. V. Starr Center for Applied Economics Discussion Paper No. 79-12, New York University (1978), forthcoming in the J. Pub. Economics.

R. A. Posner, Economic Analysis of Law, 2nd ed (1977).

S. Shavell, "Accidents, Liability, and Insurance", Harvard Institute of Economic Research (February 1979) (a).

S. Shavell, "Strict Liability vs. Negligence", Harvard Univ. (February 1979) (b).

M. Simon, "Imperfect Information, Costly Litigation and Product Quality", Massachusetts Institute of Technology Working Paper (February 1979).


EXPECTED UTILITY
A*(d*)
A(d̂) | d̂ < d*
A (d') | d' > d*
B (x) | d = d'
B(x) | d = d̂
n = 0
n̂
n'
n=1
n