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Liability rules, limited information, and the role of precedent

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Recent studies of the role of law in distributing accident costs have led to the pessimistic conclusion that because judges lack the information to discover the efficient level of care, efficiency cannot be achieved by common law tort rules. We show that judges have enough information to revise the legal standard via the mechanism of precedent so that the standard adopted tends toward efficiency. This optimistic conclusion results from changing previous models so that the level of care taken by litigants affects the information available to the court, but does not directly influence the legal standard. We model a sequence of court decisions by differential equations and show that the unique, stable equilibrium is efficient.

1. Introduction

■ Recently economists have devoted much attention to the role of the law in distributing accident costs. Calabresi (1970) outlined the problem in his book *The Costs of Accidents*, but the first formal model was presented in Brown's article "Toward an Economic Theory of Liability." Brown (1973) showed that victims and injurers will adopt the efficient level of care if the courts choose it for the legal standard. He then argued that efficiency could not be achieved by common law tort rules, unless the courts have enough information about the costs of accidents to choose the efficient level as the legal standard.[1] His con-

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[1] The four common law rules considered are negligence, negligence with contributory negligence, strict liability with contributory negligence, and strict liability with dual contributory negligence. Brown shows that when his own rule of relative negligence is in force, efficiency will be achieved when there is limited information. Brown also considers comparative negligence.

clusion is pessimistic because there is a presumption that courts will seldom know the efficient level of care. Other investigations have not succeeded in dispelling the gloom (Green, 1976; Diamond, 1974; Diamond and Mirrlees, 1976).

We contend that these pessimistic conclusions result in part from neglecting the role of precedent in the behavior of the courts. We show that legal standards of care, and the resulting care taken by victims and injurers, converge to an efficient level when the courts learn over time. The situation may be inefficient at a point in time, but it *tends towards efficiency*. We offer a formal model of the process of adjusting court standards by successive changes in precedent.

Section 2 introduces the problem and generalizes known theorems; the proofs are omitted from the text but are available upon request (Cooter, Kornhauser, and Lane, 1978). Section 3 presents our main results on precedent. Our conclusion appears in Section 4.

2. The structure of the court's problem

■ Accidents are not goods but bads, the undesirable byproduct of obtaining goods. The victims of accidents would be willing to pay the injurers to avoid them, but markets do not spontaneously arise to facilitate this transaction. One function of courts might be to induce a set of prices that accomplish what the market does not do on its own: allocate the efficient amount of resources on the part of both victims and injurers to accident avoidance.

The structure of this problem can be understood with the help of Brown's notation and formulation:

X = precaution by the injurer;
Y = precaution by the victim;
W_x = cost of precaution taken by the injurer;
W_y = cost of precaution taken by the victim;
A = cost of the accident;
P = probability of avoiding an accident.

Accidents with a fixed damage A occur with probability $1 - P(X,Y)$, where $P(X,Y)$ is the technology of accident avoidance. The efficient level of care minimizes the sum of the cost of accidents and accident avoidance:

$$\min_{X,Y} C_s(X,Y) = W_x X + W_y Y + A(1 - P(X,Y)). \tag{1}$$

However, each party does not face the full social cost $C_s(\cdot)$ of accidents. The costs faced by the parties can be formulated with the help of the functions $L_x(X,Y)$ and $L_y(X,Y)$, which describe the proportion of the accident costs that each party must pay.[2] The actual costs for injurer and victim are

$$\begin{aligned} C_x &\equiv W_x X + A[1 - P(X,Y)]L_x(X,Y) \\ C_y &\equiv W_y Y + A[1 - P(X,Y)]L_y(X,Y). \end{aligned} \tag{2}$$

We want to choose a form for the liability functions $L(\cdot)$ which models what courts actually do. Four such rules were considered by Brown; each one presup-

[2] In common law the liabilities must add to one: $1 = L_x + L_y$.

poses a legal standard of care, indicated by (X^*, Y^*), and violation of that standard is deemed negligent behavior. The rules are:

(1) *Negligence*. The victim is liable unless the injurer is found negligent:

$$L_x(X,Y) = \begin{cases} 1 \\ 0 \end{cases} \quad L_y(X,Y) = \begin{cases} 0 & \text{if} \quad X < X^*, \\ 1 & \text{otherwise.} \end{cases}$$

(2) *Negligence with contributory negligence*. The injurer is liable if he is negligent and the victim is not. The victim is liable otherwise:

$$L_x(X,Y) = \begin{cases} 1 \\ 0 \end{cases} \quad L_y(X,Y) = \begin{cases} 0 & \text{if} \quad X < X^* \quad \text{and} \quad Y \geq Y^*, \\ 1 & \text{otherwise.} \end{cases}$$

(3) *Strict liability with contributory negligence*. The injurer is liable unless the victim is found negligent:

$$L_x(X,Y) = \begin{cases} 0 \\ 1 \end{cases} \quad L_y(X,Y) = \begin{cases} 1 & \text{if} \quad Y < Y^*, \\ 0 & \text{otherwise.} \end{cases}$$

(4) *Strict liability with dual contributory negligence*. The victim is liable if he is negligent and the injurer is not:

$$L_x(X,Y) = \begin{cases} 0 \\ 1 \end{cases} \quad L_y(X,Y) = \begin{cases} 1 & \text{if} \quad Y < Y^* \quad \text{and} \quad X \geq X^*, \\ 0 & \text{otherwise.} \end{cases}$$

The definition of the four rules is incomplete without a characterization of the legal standard of care (X^*, Y^*). If the courts have full information about the technology for preventing accidents—in particular, if they know the value of the function $P(X,Y)$ for all values of X and Y—then they may choose the legal standard to be the efficient values:

$$(X^*, Y^*) = (X_\Omega, Y_\Omega), \text{ where } (X_\Omega, Y_\Omega) \text{ solves (1).} \tag{3}$$

An equilibrium pair of precaution levels is an X and Y such that when the victim chooses care level Y, the injurer's actual costs C_X are minimized at care level X and simultaneously, care level Y minimizes the victim's actual costs C_Y, given that the injurer has chosen care level X. The following theorem can be easily proved:

Theorem 1. Assume (i) $P(X,Y)$ is increasing and strictly concave, (ii) each of the potential litigants behaves as if his level of care does not influence the level of care taken by others, and (iii) one of the four preceding rules describes the rule of liability. Then the legal standard described in (3)—the full information incremental standard—results in an equilibrium at the efficient point (X_Ω, Y_Ω).

Brown (1973) has proved that the equilibrium is unique under the particular assumption $P_{xy}(X,Y) < 0$.[3]

Unfortunately, we cannot expect the courts to have full information about the technology for preventing accidents, in which case they may be unable to calculate (X_Ω, Y_Ω). How are they to choose the legal standard (X^*, Y^*) when

[3] This is Brown's Theorem 1. There is a small technical error in Brown's paper which leads him to formulate his theorems with a determinate sign on the cross partial P_{xy}. He claims that the full cost functions have a unique equilibrium only if the cross partial has a particular sign, but in fact concavity of $P(\cdot,\cdot)$ is the requirement.

their information is limited? Brown supposes that the courts can discover the actual level of care taken by each party in the suit and calculate the reduction in accident costs that would result from a small increase in care by either party. In brief, he supposes that the courts can determine the partial derivatives of the function $P(X,Y)$ at the actual values of X and Y. The courts may then follow an incremental approach and find that a party has failed to use due care if the expected reduction in accident costs exceeds the cost of a small increase in the care; formally, the "limited information incremental standard" is

$$X < X^* \quad \text{if and only if} \quad W_x < AP_x(X,Y)$$
$$Y < Y^* \quad \text{if and only if} \quad W_y < AP_y(X,Y). \tag{4}$$

It is easy to prove the following pessimistic proposition about this standard of care.

Theorem 2. Assume (i) $P(X,Y)$ is increasing, strictly concave, and $P_{xy} \neq 0$, (ii) each of the potential litigants behaves as if his level of care does not influence the level of care taken by others, and (iii) one of the four preceding rules describes the rule of liability. Then the legal standard of care described in (4)—the limited information incremental standard—will not result in an equilibrium which is efficient.

Interdependence of care ($P_{xy} \neq 0$) disrupts the efficiency of the equilibria; Brown (1973) proves that no equilibrium exists when $P_{xy} < 0$.[4] Notice that condition (ii) in this theorem requires Cournot behavior on the part of the parties; we have proved a similar theorem when (ii) is replaced by the assumption of von Stackelberg behavior (Cooter, Kornhauser, and Lane, 1978). In the next section we show that these pessimistic results are a consequence of not allowing a realistic role for precedent in the model.

3. Limited information with precedent

■ Imagine a group of injurers and victims who have historically arrived at some industry standard of care. Now in year 0 a court system is introduced. At this time courts, victims, and injurers all have information about the standards of care in the industry. The courts adopt one of the rules (1)–(4) and use the industry standards of care for the initial legal standard ($X^*(0)$, $Y^*(0)$). A case will eventually arise in which a party liable under the announced standard will argue that the announced standard for him is too high or that the announced standard for the opposite party is too low. Victim and injurer will hire experts, do studies, and introduce evidence on the standards of care.

What would be a reasonable way for the court to revise its standards and to direct the inquiry into the accident prevention technology? If efficiency were the aim, one might expect them to use a method similar to Brown's incremental standard. They will seek information about the marginal effects of the current *standard*, rather than information about the parties' actual care levels which may or may not have met that standard. The courts can then adjust the standards in the direction indicated by the newly acquired information: if the cost of care to the injurer (victim) exceeds (is less than) the marginal reduction in accident costs, evaluated at the standards of care, then the injurer's (victim's) standard

[4] This is Brown's Theorem 2.

of care will be reduced (increased). The adjustment of the standard establishes a new "precedent" from which all future measurements and changes are made. The court eventually reaches the efficient standard by successive revisions.

We formalize the argument to make it precise. At each point in time a case arises challenging the legality of the current standard of care, $(X^*(t), Y^*(t))$, which is known to the court and the litigants. In the course of the trial the court discovers $P(X^*(t), Y^*(t))$ and its derivatives; that is, the court learns the effect of the current legal standards and small changes in them on the probability of accidents. The courts judge the adequacy of the prevailing standard of care according to Brown's limited information standard. Thus, if the injurers are required to take too much care, or

$$W_x > AP_x(X^*(t), Y^*(t)),$$

then X^* will be reduced. Similarly if the victims are required to take too little care, or

$$W_y < AP_y(X^*(t), Y^*(t)),$$

then Y^* will be increased. The new standard of care $(X^*(t + dt), Y^*(t + dt))$ will be announced as a precedent. This is a dynamic process which converges towards the efficient levels of care.

Theorem 3. Assume (i) $P(X, Y)$ is increasing and strictly concave and (ii) the legal rule is either negligence with contributory negligence or strict liability with dual contributory negligence. For any initial legal standards $(X^*(0), Y^*(0))$, if the courts adjust the legal standards according to the following two rules,

$$\text{(i)} \qquad \dot{X}^*(t) = AP_x(X^*(t), Y^*(t)) - W_x$$

$$\text{(ii)} \qquad \dot{Y}^*(t) = AP_y(X^*(t), Y^*(t)) - W_y,$$

the efficient point (X_Ω, Y_Ω) is the unique globally stable equilibrium of the system. That is, the legal standards will converge to the efficient levels of care.

Proof: (X_Ω, Y_Ω) is clearly an equilibrium of the system since by definition of (X_Ω, Y_Ω)

$$AP_x(X_\Omega, Y_\Omega) - W_x = 0$$

$$AP_y(X_\Omega, Y_\Omega) - W_y = 0.$$

Thus, if $X^*(t) = X_\Omega$ and $Y^*(t) = Y_\Omega$, the time derivatives are zero, and the standards $X^*(t) = X_\Omega$, $Y^*(t) = Y_\Omega$ will persist through time.

Further, the social cost function $C_s(X, Y) = W_x X + W_y Y + A(1 - P(X, Y))$ is a Lyapunov function for the system (i) and (ii), because $C_s(X, Y)$ reaches its minimum at (X_Ω, Y_Ω), and

$$\begin{aligned} \dot{C}_s(X^*(t), Y^*(t)) &= (W_x - AP_x)\dot{X}^*(t) + (W_y - AP_y)\dot{Y}^*(t) \\ &= -(W_x - AP_x)^2 - (W_y - AP_y)^2 \\ &< 0. \end{aligned}$$

Hence, by Lyapunov's second method (Hirsch and Smale, 1978, pp. 192–198), the minimum of $C_s(X, Y)$, (X_Ω, Y_Ω), is a globally stable equilibrium of the system.

For convenience, we shall refer to the rule given in Theorem 3 for adjusting the legal standards as "incremental precedent." There is a corollary to Theorem 3 for the rules of negligence and strict liability with contributory negligence. The

liability rules in Theorem 3 specify legal standards for both injurer X^* and victim Y^*, but under the rules of negligence and strict liability with contributory negligence there is a legal standard of care for only one party. The rule for evolution of the legal standard must be revised accordingly. Following Brown (1973), we define the "full cost function" for each party:

$$X^f(Y) = \min_X W_x X + A(1 - P(X,Y))$$

$$Y^f(X) = \min_Y W_y Y + A(1 - P(X,Y)).$$

$X^f(Y)$ describes the level of care by the injurer which minimizes his costs under the rule of strict liability, Y being taken as given. $Y^f(X)$ describes the level of care by the victim which minimizes his costs when the courts allow costs to remain where they fall, X being taken as given. Ordinarily, we expect that either injurers or victims will be on their full-cost functions because the other party escapes liability by adhering to the legal standard. At any point in time, the courts should be able to determine the derivatives of $P(\cdot)$ when one party adheres to the legal standard and the other minimizes full costs. If the courts can gather this information, we can apply the following result:

Corollary 1. Assume (i) $P(X,Y)$ is increasing and strictly concave and (ii) the legal rule is either negligence or strict liability with contributory negligence. For any initial legal standards $(X^*(0), Y^*(0))$, if the courts adjust the legal standards according to the rules:

(iii) $\dot{X}^*(t) = AP_x(X^*(t), Y^f(X^*(t)) - W_x$ under the negligence rule and

(iv) $\dot{Y}^*(t) = AP_y(X^f(Y^*(t)), Y^*(t)) - W_y$ under strict liability with contributory negligence,

then the efficient point (X_Ω, Y_Ω) is the unique globally stable equilibrium of the system.

(The proof of Corollary 1 is almost identical to the proof of Theorem 3.)

The preceding theorem makes no particular assumptions about how potential litigants choose their care levels. Some specific assumptions about this choice are required to prove that litigants will adopt the efficient levels of care once the court announces them as the legal standard. We already know that this will be the case under Cournot behavior because of Theorem 1. Hence, we have:

Corollary 2. Assume that $P(X,Y)$ is increasing and strictly concave. If the injurer and victim adopt Cournot behavior and the court adopts "incremental precedent," then the actual levels of care will tend towards the efficient levels.

It is easy to check that this corollary is true for von Stackelberg behavior; it seems plausible to think that it is true for other kinds as well.

The reader may wonder why theories so similar as Brown's and ours produce such different results. In Brown's model, the problem with the efficiency of the legal rules arises because the court adopts a rule of liability in which the choice of care level of each litigant directly affects the legal standard of care by which that choice is evaluated. A change in X or Y changes the magnitude of the derivatives of $P(X,Y)$. Hence, the finding of negligence depends critically on what care the other party takes. In particular at (X_Ω, Y_Ω), one party has an incentive to change his care level. In our model, the choice of care levels of the

litigants does not directly affect the legal standard of care; rather, their choices coupled with the legal procedure permit the courts to *learn* about the technology of accident avoidance. Under our proposal the courts examine $P(\cdot,\cdot)$. A change in X or Y obviously cannot influence the derivatives of $P(X^*, Y^*)$, which determine the legal standard, since $(X^*(t), Y^*(t))$ are beyond the control of the litigants before the court. Our model seems more accurate as an account of what courts do, because we recognize that litigants alter the legal standard of care by their arguments in court, not by their choices of levels of precaution.

The legal process can plausibly be interpreted to correspond to some, if not all, of the model's requirements. For instance, under a negligence-contributory negligence rule the plaintiff-victim will first attempt to show that the defendant-injurer failed to adhere to the legal standard of care $X^*(t)$. Should the victim succeed, the defendant must argue either that the legal standard is too high or that the plaintiff was contributorily negligent. To establish that the standard is too high, the injurer will introduce evidence on the technology of accident avoidance at the prevailing standard of care. Similarly, if the plaintiff cannot prove that the injurer failed to meet the legal standard, the plaintiff will seek to establish that the legal standard is too low by introducing evidence on the care technology.

Theorem 3 and its corollaries require (a) that trials generate the information which the court needs to adjust the standard, and (b) that there be sufficient number of litigious persons to initiate the court activity. Litigants have an incentive to distort the facts, but the legal system is designed to unmask these deceptions and to verify complex factual claims through the adversary process, which permits extensive cross examination and the opportunity to present rebuttal witnesses. As noted, our model also requires an aggressive litigant at every instant in time, and we do in fact observe constant litigation over common torts. The efficiency of court rules apparently rests upon the adversary system and a sufficiently dense population of recalcitrant parties to accidents.[5]

In our model the judicial system evolves towards efficiency through constant litigation and judicial insight. Two recent articles have proposed that the law might evolve towards efficiency by differential rates of litigation without judicial insight. Rubin (1977), followed by Priest (1977), suggests that the prospect of future gain under a more efficient rule will motivate more frequent litigation of inefficient rules and that efficient rules will never be litigated. Thus the common law will evolve towards efficiency.[6] However, neither Rubin nor Priest offers any evidence as to why bargaining breaks down and the parties land in court when the rule of law is inefficient, and why the parties cooperate successfully and reach an out-of-court settlement when the rule of law is efficient. The surplus from out-of-court settlement is greater for less efficient rules, so the conclusion apparently rests upon an unproved hypothesis: the likelihood of breakdown in bargaining games decreases towards zero as the surplus from cooperation decreases towards zero. Unfortunately, game theory offers no basis

[5] In our model the courts announce a specific level of care for the legal standard—e.g., the frequency with which a test must be applied, the prohibition of a certain device, etc. In reality, on the other hand, courts generally announce some rule for determining whether sufficient care is taken. The modeling of this latter system would require changes from the approach taken by Brown and us.

[6] A much more extensive treatment of the possibilities for blind legal evolution through differential litigation appears in Cooter and Kornhauser (1978).

for this conclusion, so a strength of our model is that it does not require such differential rates of litigation for efficient and inefficient legal rules (Cooter, 1978).

4. Conclusion

■ Brown's economic theory of liability (1973) reached the pessimistic conclusion that extant rules of liability could not induce efficient levels of care if realistic restrictions are placed upon the court's ability to obtain information on the technology of avoiding accidents. We have made a change in Brown's assumption about court behavior. In Brown's model the courts permit variations in the level of care by litigants to influence the legal standard; by contrast, we allow these variations to affect the information available to the court when reviewing the legal standard. The standard itself is not directly affected by the litigants, but the information which they provide is used to calculate it. This change in Brown's model produces a system which tends toward efficiency; the path of convergence is interpreted as a sequence of precedents. Incremental precedent leads to efficiency.[7]

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[7] This optimistic conclusion assumes concavity in the technology of accident prevention, whereas nonconcavity is common in externalities. For example, see Baumol (1972); a legal example of nonconvexity appears in Cooter, Kornhauser, and Lane (1978).