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Liability Insurance, Joint Tortfeasors and Limited Wealth

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Abstract

This article offers a theory of optimal liability insurance and applies the theory in analyzing the impact of various liability rules. When multiple injurers have limited wealth and are subject to joint and several liability, liability insurance decisions are the outcome of a game rather than a single-agent decision problem. With endogenous insurance decisions expanded liability or a move to joint-and-several liability can have the perverse effect of reducing both compensation to accident victims and incentives for accident-avoidance. The model provides as well a demand-side theory of why liability insurance markets are so unstable. The liability insurance game yields a multiplicity of equilibria that suggests a cascading of decisions to drop liability insurance and extreme sensitivity to small shocks.

1 Introduction

The functions of the tort system are to minimize the social costs of accidents by providing incentives to avoid accidents or excessive levels of risky activities and to provide compensation or insurance to accident victims. These tasks, however, depend not only on the tort system itself but on the efficient operation of liability insurance markets. When liability insurance markets break down as they did in the 1980’s, and to a lesser extent in episodes before and

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since, potential tortfeasors are often left with little or no liability insurance coverage.\footnote{For a summary of the liability insurance crisis of the 1980’s, see Priest (1991). More recently, the popular press is reporting on rapidly increasing premiums and dropping coverage. For example, the Vancouver Courier (March 12, 2003) reports that “Small businessmen from roofers to woodworkers are seeing the premiums double, triple and sometimes quadruple in 2003. Liability coverage is being radically downsized or eliminated, and in some cases, clients are having their policies cancelled entirely.” For theories and evidence on the dynamics of insurance market pricing that account for periodic "crises", see Gron (1994) or Winter (1991).} Accident victims can then be left with little compensation and incentives for potential injurers to take care are distorted.

This paper offers a theory of optimal liability insurance and applies it to analyze the interaction of the tort system and liability insurance markets. When joint tortfeasors (injurers) have limited wealth and are subject to joint and several liability, insurance decisions are the outcome of a game rather than a single-agent decision problem. That there are interactions among tortfeasors is clear. When one tortfeasor purchases additional insurance, it "deepens its pockets", providing a source of compensation to an accident victim in states of the world where the tortfeasor would otherwise be bankrupt. This reduces the risk faced by another tortfeasor who would otherwise absorb additional damages in these states under the rule of joint and several liability. Insurance purchases convey positive externalities among potential injurers.

A second property of optimal liability insurance, beyond externalities among tortfeasors, is important. If liability risks are sufficiently high, a single economic agent with limited wealth may respond to a further increase in risk by decreasing its insurance purchases, perhaps dropping insurance altogether and relying instead on limited liability to limit its contingent losses (Huberman, Mayers and Smith (1983)). Greater risk can lead to a decrease in optimal purchase of insurance. When these two properties are combined, it is clear that the best response by one agent to a decrease in the purchase of liability insurance by another agent may be to decrease insurance as well. Multiple equilibria result in the liability insurance purchase game: in the simple model developed in this paper, all tortfeasors may be fully insured or all of them may drop insurance altogether. Greater liability can lead to less insurance and therefore less compensation to accident victims. Even a small and gradual increase in liability risk, through a shift in tort law itself or a shift in the liability risk environment, can lead to sudden and cascading episodes of "going bare" in the liability
insurance market.

The paper contributes to three areas of the law and economics literature. First, it extends the literature on optimal insurance to the case of liability insurance with joint tortfeasors and limited wealth. Liability insurance is a large fraction of all insurance purchased, yet there is relatively little literature analysing the unique aspects of optimal liability insurance. Second, an established principle in both the tort literature and cases is that the risk of an accident should be allocated to the party that is best placed to bear the risk. The theory developed here shows that it is critical to recognize the endogeneity of multiple insurance decisions in evaluating tort rules, even the simplest tort rule of how much liability to assign to an injurer. More liability can lead to less compensation for the accident victim, and less deterrence of accidents. Moreover, rules such as joint-and-several liability, which would appear to broaden the scope of an accident victim to collect damages, may in fact reduce the compensation available once the impact on insurance decisions is recognized. Previous authors have argued for ceilings on particular types of liability on the grounds that compensation for punitive damages or for pain and suffering represent from an ex ante perspective inefficient risk-bearing, or insurance for losses that are not optimally insured. A ceiling even on economic damages can emerge as optimal here because it increases the compensation to victims, while also making injurers better off. Our analysis builds on Landes and Posner (1980) who first studied the problem of multiple injurers, Summers (1983) and especially Shavell (1986) and (1987) who integrated liability insurance decisions into the economic theory of torts in the context of a single tortfeasor.

Just as limits on liability awards can increase compensation to accident victims, so can an restriction on the scope of liability: individual liability is Pareto superior to joint and several liability in the simplest version of the model developed here. These predictions, based solely on optimal insurance responses to liability rules, offer potential support to the tort reforms enacted by states since the mid-1980’s. Between 1986 and 2004, for example, 38 states modified joint-and-several liability and 34 enacted limits on punitive damages.3

The final contribution of this paper is to a substantial literature on the instability of the

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2The literature on privately optimal liability insurance, which includes Huberman, Mayers and Smith (1983), Shavell (1982, 1986 and 1987) focusses on the case of single injurers, unlike this article. Other articles, such as Polborn (1998) and Jost (1996) consider the social value of mandated liability insurance.

3Congressional Budget Office (2004).
liability insurance market mentioned at the outset of this introduction. In 1985-86 and in 2002-03, many insurance buyers found that their premiums had tripled or more on renewal. A literature has developed on supply side explanations of this instability. The theory here points to a demand-side factor in the volatility of the market. The liability insurance market in this theory is sensitive to small shocks and may even jump between equilibria with no external shock.

2 The Model

2.1 Introduction

I consider throughout the simplest model of an accident, beginning with the limited liability insurance model of Huberman, Mayers and Smith (1983), and then extend this model to multiple tortfeasors. I examine in part the impact of changing liability rules or levels on the compensation to the accident victim. Such compensation or insurance to accident victims is one role of the tort system, because there are risks that can be allocated to (risk-neutral) insurers when assigned via liability rules to tortfeasors that could not be efficiently allocated via first-party insurance markets. Consider, for example, the purchase by consumers of a dangerous appliance. It would be difficult to write first-party insurance contracts contingent upon the ownership of the appliance (and every similar item), and as a result adverse selection and moral hazard problems would limit the scope of first-party insurance. Liability insurance would in theory be ideal for allocating this type of risk.

Given the costs of using tort liability and liability insurance for allocating risk-bearing, the more important role of the tort system is the creation of incentives for avoiding accidents. In order to focus on insurance decisions, however, I do not model care decisions. If we restrict consideration to circumstances in which liability insurers can contract fully with tortfeasors (i.e. if we set aside moral hazard in the liability insurance market) then it is clear that any increase in contingent compensation to an accident victim entails increased incentives to take care. Accordingly, throughout the discussion we can interpret the impact of liability on compensation to accident victims as the impact on incentives to take care, as well as on the allocation of risk-bearing. The simple model is a step towards a fuller theory of joint

\footnote{For example, see Priest (1991), Gron (1994), Winter (1991 and 1994) and Harrington (2004).}

\footnote{The same argument applies to activity level incentives. (We consider only strict liability rules rather}
tortfeasors and limited wealth in which care decisions are endogenous.

2.2 Accidents with a Single Tortfeasor

In this model, an accident occurs with exogenous probability $p$, and involves a loss $A$ to a victim. Initially, I consider a single tortfeasor, who is subject to the simplest of all liability rules: pay the victim $L$ if the accident occurs. $L$ is interpreted to include compensation for pain and suffering as well as economic damages. This allows us to consider the impact on the liability insurance market of an expansion in liability, such as the increase that virtually all commentators agree has occurred in the U.S. since about 1960 (Priest (1991)). In our framework, the expansion of liability is simply an increase in $L$.

The key feature of the model is that the tortfeasor has limited liability, because of the option to declare bankruptcy. I have in mind either an individual with the option of personal bankruptcy, or a risk-averse corporation. The tortfeasor’s initial wealth and utility function are $w$ and $U$. The accident victim plays no strategic role in the model beyond simply absorbing any accident cost that is not assigned by the liability rule to the tortfeasor. Given a liability rule, $L$, the tortfeasor chooses an amount of insurance, $I$, to maximize expected utility. The tortfeasor pays a fair premium $p \cdot I$ for insurance (the supply side of the insurance market is perfect). I refer to the above assumptions as the single tortfeasor model.

The tortfeasor has realized wealth in the events of no-accident and accident, respectively, of $w - pI$ and $\max(0, w + I - pI - L)$ where the max operator in the second expression reflects the option to declare bankruptcy. The expected utility given the choice of $I$ is

$$EU = pU(\max[0, w + I - pI - L]) + (1 - p)U(w - pI)$$

The first-order condition for the optimal choice of $I$ if one were to ignore the limited liability constraint is well-known:

$$p(1 - p)U'(w + (1 - p)I - L) - p(1 - p)U'(w - pI) = 0$$

This can be expressed as the condition that the marginal (expected-utility) benefit of insurance, $p(1 - p)U'(w + (1 - p)I - L)$, must equal the marginal (expected-utility) cost, than negligence rules.)
$p(1 - p)U'(w - pI)$. When the limited liability constraint is incorporated, however, the marginal benefit of insurance is zero up to the value $I^* = (L - w)/(1 - p)$ because below $I^*$ the individual’s wealth is exhausted ex post even with the purchase of insurance. An additional dollar of liability insurance in this range is a transfer from the insurer to the accident victim in the event of an accident and has no positive impact on the wealth of the tortfeasor. The marginal benefit and marginal cost of insurance (in expected utility terms) are depicted in Figure 1. Proposition 1 characterizes the optimum.

**Proposition 1** Define $\hat{L}$ as the solution to

$$U(w - pL) = pU(0) + (1 - p)U(w)$$

(2)

If $L$ is less than $\hat{L}$ then full insurance, $I = L$, is optimal in the single tortfeasor model; if $L$ exceeds $\hat{L}$, then the optimal insurance is zero and the accident victim bears the entire accident cost. $\hat{L}$ exceeds $w$.

This characterization of the optimal purchase of liability insurance as a “bang-bang” solution is clear from Huberman, Mayers and Smith (1983). The left hand side of (2) gives the utility of being fully insured and the right hand side gives the expected utility of being uninsured. At $\hat{L}$, these two values are equal, whereas below $L$ the left hand side is greater. To compare $\hat{L}$ with $w$, apply Jensen’s inequality to the lottery $0$ with probability $p$ and $w$ with probability $(1 - p)$, to show that the utility of the expected value of this lottery exceeds the expected utility of the lottery. This then shows that when equation (2) is evaluated at $L = w$ the left hand side exceeds the right hand side, which in turn implies that the solution of (2) in $L$ exceeds $w$.

The compensation to the accident victim is improved by the availability of liability insurance only over the range $L \in (w, \hat{L})$. In this range, the compensation available to the accident victim increases from from $w$ to $L$ when liability insurance becomes available. When liability $L$ exceeds $\hat{L}$, however, the optimal liability insurance drops to zero and the accident victim is left with the same compensation as if the liability assigned were only $w$. The compensation to the accident victim for different values of $L$ is summarized in Figure 2. In short, the effect of increased legal liability even in this simplest of cases, when the increase takes $L$ from an amount in $(w, \hat{L})$ to a value exceeding $\hat{L}$, is to decrease compensation to
accident victims. The bang-bang solution has the tortfeasor giving up on liability insurance as risk protection, relying instead entirely on the protection implied by limited liability.\footnote{If multiple values were possible for losses, then a range of intermediate purchases of insurance would also be possible at the optimum (Shavell 1987: 241).}

A natural question is whether an expansion of liability standards, i.e., an expansion of the set of circumstances or states of the world in which the tortfeasor will be found liable, can have the same perverse effect – decreasing compensation – as an expansion of the amount of damages. Proposition 2 below confirms this.\footnote{This proposition is proved in an appendix.}

**Proposition 2** *In the single tortfeasor model, \(d\hat{L}/dp < 0\).*

An increase in the probability of an accident has the effect of decreasing the critical liability level, \(\hat{L}\). Thus an increase in \(p\) will cause some individuals to drop their insurance coverage completely. Of course, when liability insurance is dropped, the compensation to the accident victim in the event of an accident drops from the assigned liability amount, \(L\), to \(w\). In sum, an expansion of either damage awards or liability standards can reduce the compensation to accident victims because of the tortfeasor’s rational decision to abandon liability insurance.

### 2.3 Multiple Tortfeasors

When we incorporate multiple tortfeasors in the model, the insurance decisions and resulting compensation to the accident victim are the outcome of a game rather than a single-agent decision problem. To take the simplest case, suppose that there are only two tortfeasors, each involved symmetrically in the cause of an accident. Absent limited wealth, the tortfeasors would split the liability.

Consider the following liability rules:

(a) **(insurance-exclusive, individual liability)** Each individual tortfeasor is liable for a proportionate share of the costs of an accident, only up to the limit of the tortfeasor’s own wealth;

(b) **(insurance-inclusive, individual liability)** Each individual tortfeasor is liable for a proportionate share of the costs of an accident, up to the limit of wealth plus available insurance.
(c) (insurance-inclusive, joint-and-several liability) Tortfeasors are jointly and severally liable for accident costs, with the liability limit of each tortfeasor being given by the sum of the tortfeasor’s wealth and insurance purchases. Joint and several liability means that the liability that would be assigned a particular agent-insurance pair but for the limit on liability, is assigned to the other agent-insurance pair (up to that pair’s liability limit).8

Under the liability rule (a) an accident victim can collect damages only up to the limit of the injurer’s wealth, and only after a victim could demonstrate liability within such a limit would the injurer qualify for insurance payments. Rule (b) extends liability to include the amount of liability insurance; liability insurers are indeed no longer protected by the limited liability of the tortfeasor. Finally, joint and several liability is a standard rule today when there are multiple tortfeasors. As mentioned in the introduction, however, states have moved in varying degrees towards individual liability (the second rule) by imposing restrictions on joint-and-several liability since the 1980’s. The result is that some states have full joint and several liability for the same types of accidents that are governed by rules closer to individual liability in other states.9

Limited wealth can lead to a reversal in the causation between insurance and liability: greater insurance can lead to greater liability. Of the three liability rules described, rules (b) and (c) induce this feature of liability insurance: at high damage levels a marginal increase in liability insurance over some range causes a marginal increase in liability for the contracting pair, a tortfeasor and the insurer. A second, and previously unexplored, aspect of liability insurance are the externalities among tortfeasors inherent in liability insurance decisions under the joint and several liability rule, (c). When one agent increases the amount of liability insurance purchased, the liability absorbed by the other tortfeasor decreases.

I compare the rules across the range of liability levels, L. Variations in L may be interpreted as variations in the liability assigned under the rules, for a given accident cost, or as variations in the total accident costs with these costs being fully assigned by the rule

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8 For example, the Johns-Mansville asbestos litigation, every insurer that had provided coverage for Johns-Mansville was found liable for damages.

9 Interesting cases arise where the liability rules of neighboring states differ. In New Jersey, for example, if defendants in automobile accidents are less than 60% at fault then they can be held liable only for their proportion of fault, whereas in New York, full joint and several liability applies. Eddy v. Estate of Merola, 792 A.2d 1208 (M.J. 2002) addressed the question: if a New Jersey motorist is hit by a New York motorist in New Jersey, which law applies? The New Jersey Supreme Court held that the New York law on joint and several liability applied.
in question. For simplicity, I consider only the symmetric case, where the utility functions and initial wealth levels of the two tortfeasors are identical at $U$ and $w$.

The optimal liability insurance under rule (a), with a perfect (actuarially fair) insurance market is simple: each tortfeasor $i$ insures for the maximum possible liability, which is $\min(L/2, w)$. Beyond this amount, the accident victim bears the cost of the accident at the margin. To consider liability rule (b), define $\hat{L}_b$ as the solution in $L$ to

$$pU(0) + (1 - p)U(w) = U(w - \frac{L}{2})$$

(3)

Under liability rule (b), $\hat{L}_b > 2w$ is the level of total liability above which each tortfeasor will switch from full coverage to zero coverage.\(^{10}\) In sum:

**Proposition 3** Under liability rule (a), each tortfeasor fully insures, in the amount $w$. Under the rule (b) and the assumption of symmetry, any liability amount up to $\hat{L}_b$ is fully insured by the tortfeasors. If the assigned liability exceeds $\hat{L}_b$ the optimal liability insurance is zero and the accident victim bears the entire accident cost beyond the combined wealth levels of the tortfeasors.

We move now to the third liability rule: joint and several liability, insurance inclusive. Under this rule, half of the liability is allocated to each tortfeasor-insurance pair. Table 1 summarizes the accident cost incidence, i.e. the allocation of each marginal dollar of accident costs. (In this table, the injurer with the lower insurance is labelled as 1, i.e. $I_1 \leq I_2$, and $w$ refers to wealth net of any insurance premium paid). Half of the total liability is first allocated to each insurer, and once the limit on insurance coverage $I_1$ is exhausted, the wealth of the first injurer ($a_1$) is the next source of funds for half the liability. If $I_2 > w + I_1$ then the first agent’s wealth is exhausted before $I_2$ and the full marginal accident cost above $2(w + I_1)$ is borne by the second insurer. Then once $I_2$ is exhausted, the wealth of the second agent ($a_2$) is the final source of funds before the accident victim bears the full marginal accident cost. If $I_2 < w + I_1$ then the two agents split the marginal accident cost once the combined insurance coverage is exhausted and otherwise the story is similar.

\(^{10}\)Equation (3) is derived from replacing $L$ by $L/2$ in equation (2).
If $I_2 \geq (w + I_1)$: the marginal dollar of accident cost, $C$, is:

- split between $I_1$ and $I_2$ until $C = 2I_1$ then:
- split between $a_1$ and $I_2$ until $C = 2(w + I_1)$ then:
- incurred by $I_2$ until $C = w + I_1 + I_2$ then:
- incurred by $a_2$ until $C = 2w + I_1 + I_2$ then:
- incurred by victim for $C > 2w + I_1 + I_2$

If $I_2 < (w + I_1)$: the marginal dollar of accident cost, $C$, is:

- split between $I_1$ and $I_2$ until $C = 2I_1$ then:
- split between $a_1$ and $I_2$ until $C = 2I_2$ then:
- split between $a_1$ and $a_2$ until $C = 2(w + I_1)$ then:
- incurred by $a_2$ until $C = 2w + I_1 + I_2$ then:
- incurred by victim for $C > 2w + I_1 + I_2$

Table 1: Accident Cost Incidence under Joint and Several Liability Rule following Insurance Purchases $I_1$ and $I_2$

The allocation of accident costs in Table 1 can be transformed in a conceptually straightforward way into the payoffs to the two tortfeasors as functions of strategies $I_1$ and $I_2$, taking into account both the direct exposure of each agent to the accident cost and the impact of each insurer’s exposure on the premium that each agent must pay across all (non-bankruptcy) states. This construction defines the insurance game between the two agents, and the equilibria of the game can then be derived. We take a short-cut, however, avoiding the mechanics of fully specifying the payoff functions by noting two properties of the payoffs that are clear a priori from the economics: (P1) The optimal response by each agent to any insurance choice $I$ on the part of the other agent is either full insurance or zero insurance. Thus there is no loss in generality in restricting the strategy sets to full insurance and zero insurance. This property follows from the analysis under the single-tortfeasor analysis of section 2.1; (P2) If full insurance by agent $i$ is an optimal response to zero insurance by agent $j$ then it is also an optimal response to full insurance by agent $j$; similarly if zero insurance by agent $i$ is an optimal response to full insurance by agent $j$ then it is also an optimal response to zero insurance by agent $j$.\footnote{Property (P2) can be re-stated as the following: re-define the game in terms of strategies given by the proportion of the maximum loss that is insured by each agent. Then the strategies are (weak) strategic complements in the sense of Bulow et al (1985).} Property (P2) follows from the fact that an increase in $I_j$ either decreases the contingent liability faced by agent $i$ or leaves it unchanged, as can
be confirmed from Table 1; and as illustrated in Figure 1 and the single tortfeasor model, an increase in contingent liability can only increase an agent’s incentive to “go bare”.

From properties (P1) and (P2) we can characterize the set of equilibria for various values of $L$. Let $L$ be the value for total liability at which agent $i$ is indifferent between zero insurance and full insurance given that agent $j$ has zero insurance. $L$ is given as the solution in $L$ to:

$$pU(0) + (1 - p)U(w) = U(w - p(L - w)) \tag{4}$$

The value $p(L - w)$ in equation (4) is the insurance premium for full insurance, since the loss faced by a tortfeasor in the event of an accident, if the other agent is uninsured, is the total liability minus the wealth of the other agent.\(^\text{12}\) At any value for $L \leq L$, full insurance by both agents is a unique equilibrium, since the right hand side of (4) increases as $L$ drops below $L$ and therefore full insurance is a dominant strategy: it is a best response to zero insurance (and, by (P2), a fortiori a best response to full insurance). Now consider the case $L \geq L$. Zero insurance is a best response to zero insurance in this range by the monotonicity of the right hand side of (4) in $L$. Therefore (zero insurance, zero insurance) is one equilibrium in this range. Now, let $\bar{L}$ be the value for total liability at which agent $i$ is indifferent between zero insurance and full insurance given that agent $j$ has full insurance. $\bar{L}$ is given as the solution in $L$ to:

$$pU(0) + (1 - p)U(w) = U(w - p\frac{L}{2}) \tag{5}$$

The term $p\frac{L}{2}$ in (5) is the fair premium for full insurance when the other agent is fully insured and therefore adds nothing to the risk exposure of the first agent. At any value $L \leq \bar{L}$, full insurance by both agents is one equilibrium: the monotonicity of the right hand side of (5) in $L$ shows that full insurance is a best response to full insurance in this range. For $L > \bar{L}$, however, zero insurance is a strictly dominant strategy (by analogy to the reasoning in the last paragraph) and therefore (zero insurance, zero insurance) is the unique Nash equilibrium in this range. The following lemma, proved in the appendix, orders $L$ and $\bar{L}$:

**Lemma** $\bar{L} > L > 2w$

\(^{12}\)This statement uses the fact that $L > 2w$ (Lemma 1 below).
Among the multiple equilibria in the range \((L, \bar{L})\) under joint-and-several liability, one equilibrium (full insurance) Pareto dominates the other equilibria (zero insurance) considering the utility not only of the two active players in the game but of the accident victim as well. To see this, note that the utility of each injurer in the full-insurance equilibrium is the right-hand side of (5), whereas the payoff to each injurer in the zero insurance equilibrium is \(pU(0) + (1 - p)U(w)\). This is just the left-hand-side of (5) which we have shown is less than the right hand side for \(L \in (L, \bar{L})\). Both injurers are therefore better off in the full insurance equilibrium, and of course the victim prefers the higher contingent compensation in this equilibrium. To sum up:

**Proposition 4** Under joint-and-several liability (rule (c)), below \(L\) full insurance is a unique equilibrium; above \(\bar{L}\), zero insurance is an equilibrium; and in \([L, \bar{L}]\) both zero insurance by both agents and full insurance by both agents are equilibria. The full insurance equilibrium Pareto dominates the zero insurance equilibrium.

The mapping from the exogenous variable \(L\) to the set of equilibrium is an *equilibrium correspondence*; and this correspondence is discontinuous at \(L\) and \(\bar{L}\) in the jump from full insurance (as one equilibrium) down to zero insurance as the only equilibrium.\(^{13}\) (In a more general model, the discontinuity is less extreme than from full to zero insurance.) It is this discontinuity that I suggest as – a demand-side theory – to understanding the apparent vulnerability of the liability insurance market to sudden jumps in prices and drops in transaction quantities.\(^{14}\) Previous theories of the vulnerability of the liability insurance market to this kind of behavior have focussed on the supply side of the market (Winter (1991 and 1994), Gron (1994) and Harrington (2004)).

We summarize in Figure 3 the compensation to the accident victim by the tort system under the three liability rules, and across the equilibria in the joint-and-several case, at various levels of liability. Note that equations (3) and (5) are identical, implying that \(\hat{L}_b\)

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\(^{13}\)To be more precise mathematically, the correspondence fails to have the property of *lower hemicontinuity* at \(L\) and \(\bar{L}\). Lower hemicontinuity of the equilibrium correspondence \(E\) (where \(E(L)\) is the set of equilibrium insurance purchases given \(L\)) would require that for every sequence \(L^m \to L^*\) and \(I^* \in E(L^*)\), there exists \(M\) and \(I^m\) such that for \(m > M\), \(I^m \in E(L^m)\). This fails, for example, for the choice of \(L^* = \bar{L}\) and \(L^m\) converging to \(\bar{L}\) from above.

\(^{14}\)The model does not discuss insurance premiums. It is clear, however, that in the model when the quantity of insurance purchased by the set of other (joint) tortfeasors has dropped discontinuously, the actuarially-fair premium facing a given tortfeasor will rise discontinuously.
and \( L \) are identical. Figure 3 summarizes both the impact of an expansion of damages on compensation under a single tort rule and in the impact of a change in tort rules. As depicted in the Figure, tort rule (a) provides compensation with a ceiling given by the combined wealth of the agents. Compensation never decreases with an expansion of liability under this rule. Tort rule (b) provides full coverage up to \( \hat{L}_b = L \), at which point the coverage drops discontinuously down to the total wealth of the agents because of the endogeneity of the liability insurance decisions. Finally, under the joint and several liability rule (c), a wide range of compensation schedules are possible. At any \( L \) in \([L, \bar{L}]\) either full compensation or compensation limited to tortfeasors’ wealth is possible.

The Pareto optimum among these joint and several liability equilibrium compensation schedules – the schedule that the most optimistic forecaster would predict – is identical to the schedule under liability rule (b). Clearly the equilibrium under (b) as \( L \) varies is payoff equivalent to the best (in the Pareto sense) selection from the multiple equilibria under joint-and-several liability, this selection being full insurance whereever it is an equilibrium. Summarizing the comparison of tort rules (b) and (c), we have:

**Proposition 5** When liability insurance purchases are endogenous and tortfeasors are symmetric, insurance-inclusive individual liability Pareto dominates all equilibria under joint-and-several liability except one, to which it is equivalent.

This is a striking result, and underscores our theme that to understand tort law as a means of compensating accident victims or providing incentives for care, we must incorporate injurers’ choices of insurance coverage. The impact of endogenizing liability insurance is most pronounced in two propositions. First, the effect of increasing liability, given any rule that includes insurers within the set of liable parties, can be to reduce compensation to accident victims and welfare for all participants. Second, in the context of symmetric tortfeasors, a switch from individual liability to joint and several liability – a trend that was clearly aimed at increasing compensation to accident victims – can only have the effect of reducing compensation schedules.

### 3 Conclusion

Building on the economic literature on torts and insurance, especially Shavell (1986), this paper shows that incorporating multiple injurers is essential to a theory of how tort rules and
liability insurance decisions interact. The multiplicity of equilibria that emerges when joint tortfeasors have limited wealth suggests a cascading across individuals in decisions to reduce or eliminate liability insurance.\textsuperscript{15} It also yields discontinuities in the response of the tort-liability system to even small shocks. The paper shows that the theory of optimal insurance contracts must be fundamentally altered in the extension to optimal liability insurance. Liability insurance decisions can only be seen as the outcome of a game, rather than through the traditional lens of individual decision theory. It contributes to the normative analysis of tort rules, showing that endogenizing liability insurance decisions can sharply reverse the conventional wisdom that expanded tort liability provides more protection for accident victims. Finally, it offers a demand side complement to the supply side theories of liability insurance dynamics.

Our results derive from the externalities inherent in liability insurance decisions when injurers have limited wealth and the tort rule is joint and several liability. But the argument extends directly to a model where victims incur costs in launching lawsuits and must limit the set of targets in their lawsuits to those who are not only liable with high probability but who are able to pay. Externalities arise in this setting because “deep pockets” are relative: a reduction in liability insurance by other injurers makes it more likely that a particular injurer will be sued. Multiple equilibria and inefficiencies in liability insurance decisions would again arise in this model.

One might suppose as well that mandatory liability insurance would completely resolve the inefficiencies that we have uncovered in the liability insurance equilibrium. This is true as a matter of theory in our model, with its assumption of a perfectly competitive supply side. Mandatory liability insurance is imposed in reality for some risks, such as automobile risks. The prices and availability of liability insurance in other areas, however, are so unstable as to make this policy solution untenable.\textsuperscript{16} Limits on liability, another policy instrument,

\textsuperscript{15}This point is analogous to a well-known result in the economics of crime. Crime rates can cascade when police and prosecutorial resources are limited: when other potential criminals commit crimes, a particular individual will match their strategy because the probability of detection has decreased. The point extends to private sanctions such as stigma (Rasmussen (1996)). A closer parallel to our multiple equilibria result is Smith and Wright (1992). These authors argued that dramatic \textit{regional} variation in automobile insurance premiums can be explained by the multiplicity of equilibria in decisions to purchase automobile insurance and the positive insurance externality across drivers operating through the collision-with-uninsured-driver clause.

\textsuperscript{16}Priest (1987) at 1577 describes cases where enterprises paid premiums of more than 50 percent of face value (maximum payout) of insurance policies. In one case this ratio reached 92 percent.
can lead to greater insurance purchases, greater equilibrium liability, and therefore greater potential compensation to accident victims.

Practically, the policy of mandatory liability insurance is limited by the fluctuations in the supply of liability insurance.
Appendix

Proof of Proposition 2: Re-write equation (2), defining \( \hat{L} \), as

\[
\Psi(p, \hat{L}) \equiv U(w - p\hat{L}) - pU(0) - (1 - p)U(w) = 0
\]  
(6)

(I omit "\(^{-}\)" in the following.) From this equation, \( \partial \Psi / \partial L = -pU'(w - pL) < 0 \); and

\[
\partial \Psi / \partial p = -LU'(w - pL) + [U(w) - U(0)]
\]  
(7)

Re-writing (6) as \( U(w) - U(0) = [U(w) - U(w - pL)]/p \) and using this to substitute for the last term of (7) yields

\[
\partial \Psi / \partial p = -LU'(w - pL) + [U(w) - U(w - pL)]/p
\]

which has the same sign as

\[
-pLU'(w - pL) + [U(w) - U(w - pL)] = -pLU'(w - pL) + \int_{w-pL}^{w} U'(x)dx
\]

\[
< -pLU'(w - pL) + \int_{w-pL}^{w} U'(w - pL)dx = -pLU'(w - pL) + pLU'(w - pL) = 0
\]

where the inequality follows from the fact that \( U'(x) \) is monotonically declining (\( U \) is concave). Therefore \( \partial \Psi / \partial p < 0 \). From (6),

\[
\frac{d\hat{L}}{dp} = -\frac{\partial \Psi / \partial p}{\partial \Psi / \partial L}
\]

Since both the numerator and denominator are negative, \( d\hat{L}/dp < 0 \).

Proof of the Lemma: Assume without loss of generality that \( U(0) = 0 \). Jensen’s inequality and the strict concavity of \( U \) imply that

\[
pU(0) + (1 - p)U(w) < U((1 - p)w)
\]  
(8)

Equations (8) and (4) imply that

\[
U(w - p(L - w)) < U((1 - p)w)
\]
From the monotonicity of $U$ this implies directly that $w - p(L - w) < (1 - p)w$ which simplifies to

$$L > 2w$$

(9)

proving the first part of the lemma. Next, note that equations (4) and (5) characterizing $L$ and $\overline{L}$ respectively, imply that

$$U(w - p(L - w)) = U(w - p\frac{L}{2})$$

From the monotonicity (and hence invertibility) of $U$ this implies that

$$w - p(L - w) = w - p\frac{L}{2}$$

which can be re-written as $\overline{L} - L = L - 2w$. This is positive from (9), proving $\overline{L} > L$. 
References


Congressional Budget Office, The Effects of Tort Reform: *Evidence from the States* (June 2004)


Marginal (expected utility) cost and benefit of liability insurance $I$ when Liability $L$ exceeds wealth $w$.
Figure 2: Compensation to Accident Victim as $L$ varies: The Case of a Single Tortfeasor
Figure 3: Compensation to Accident Victim as Liability, L, varies Under Various Liability Rules

(a) insurance-exclusive, individual liability: OAF
(b) insurance-inclusive, individual liability: OCEF
(c) insurance-inclusive, joint-and-several liability: multiple equilibria, including OBDF and OCEF