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ACCIDENTAL DEATH AND THE RULE OF JOINT AND SEVERAL LIABILITY

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ABSTRACT

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Abstract

Reforms to the Joint and Several Liability rule (JSL) are one of the most common tort reforms and have been implemented by most US states. JSL allows plaintiffs to claim full recovery from one of the defendants, even if that defendant is only partially responsible for the tort. We develop a theoretical model that shows that the efficiency of the JSL rule depends critically on both whether the care taken by potential tortfeasors is observed, and on how the actions of the potential tortfeasors interact to cause the harm. We then provide evidence that reforms of the JSL rule have been accompanied by reductions in the accidental death rate in the U. S. This result is consistent with the hypothesis that the reform of JSL causes potential tortfeasors to take more care.

1 Introduction

A tort is an act that causes injury, for which the injured person may sue the "tortfeasor" for damages. Since the 1970s, controversy about the operation of the U. S. tort system has led most states to adopt tort reforms (Congressional Budget Office (2004)). One of the most common reforms has been modification of the common law doctrine of Joint and Several Liability (JSL). JSL applies to cases in which a tort results from the actions of multiple parties (other than the plaintiff him or herself, who may also have played a role in causing the injury). It allows the injured party to recover full damages from any of the multiple parties involved in committing a tort. JSL has been criticized for encouraging expensive lawsuits by injured parties against "deep-pocketed" parties who have been only minimally involved in creating the tort. JSL reforms generally aim to mitigate this problem by requiring that a party be responsible for some minimum fraction of the blame (commonly 50 percent) before they can be held liable for the entire damages.

However, the major purpose of tort law is to encourage potential tortfeasors to take reasonable care.[1] An efficient rule will encourage them to take care up to the point where the costs of preventing an injury start to exceed the benefits of prevention. If JSL is efficient, then "reforms" are likely to reduce the amount of care taken, leading to an increase in the number of torts.

The purpose of this paper is to explore the efficiency of the JSL rule, both theoretically and empirically. At a theoretical level, we show that the optimal rule depends critically on whether there is perfect information about the actions of potential tortfeasors and about

[1] See for example Cooter and Ulen (2004).

who the set of potential tortfeasors are, and upon the "technology" that relates the actions taken by the potential tortfeasors to the harm suffered. For example, it depends on whether the harm could have been averted by either party acting alone, or whether both parties had to act in order to avert the harm.

If the level of care is observable and parties are liable if and only if they choose care less than a unique known level of care, then JSL is efficient as Landes and Posner (1980) have shown. However, if the technology is such that both parties must exert effort to avoid a tort and the court cannot perfectly observe the amount of care taken, then the efficient liability rule is one in which each tortfeasor is liable for the *marginal* harm they have caused. We show that such a rule implements the efficient level of care. However, such a rule can result in total liability that is different from the harm suffered by the plaintiff.

In this case, as Kornhauser and Revesz (1989) have shown, it may not be possible to implement the first best. In general, JSL does not provide efficient deterrence. However, we show that under the appropriate conditions reform to the rule of JSL implements the first best. This occurs when harms are separable - essentially, the marginal harm caused by one party is independent of the actions of the other. Our analysis shows that all other cases can be divided into two classes. The first class includes torts in which precaution by the two parties are substitutes. That is, the optimal level of precaution of one party is decreasing in the level of precaution taken by the other party. For example, suppose that we have a contractor and a subcontractor on a project. If the contractor supervises carefully to ensure the site is safe, then the subcontractor will take less care, and vice versa.

The second class of cases are ones in which the levels of precaution are complements - the optimal precaution by one agent is increasing in the care taken by the other. In this case, negligence by either party can result in a large loss. For example, consider maintenance of an airplane - if any mechanic is negligent then there will be an accident and a large loss - hence if one mechanic is negligent, this reduces the incentives for the other to be careful as well.[2] We show that reform to JSL in the case of substitutes leads to a situation with too little deterrence. We show that when care levels are substitutes or complements neither JSL nor JSL reform generally lead to efficient outcomes. Moreover, whether the overall level of precaution will be increased with JSL reform (so that accidents decrease) is unpredictable, and in the end, an empirical question.

In order to address this question, we ask whether accidental deaths in the United States rise or fall with JSL reform. Between 1981 and 2004, 97,000 Americans died each year from

[2]This corresponds to the "O-Ring" effect, as discussed in Kremer (1993).

accidental injuries, and injuries were the fourth leading cause of death (U.S. Centers for Disease Control and Prevention (CDC) (2007)). The accidental death rate can be viewed as a proxy for rates of serious accidental injury. For every accidental death that occurs, many nonfatal but serious injuries also occur. For instance, in 2001, injuries resulted in 33.8 million visits to emergency departments (U.S. National Center for Health Statistics (2005)).

We examine the effect of JSL reform on accidental death rates using U. S. Vital Statistics Mortality data taken from all death certificates filed in the U. S. between 1981 and 2004. We find that in a sample of deaths that excludes automobile deaths (since many other state laws affect the probability of these deaths) and illegal drug overdoses (which generally do not result in tort suits) that JSL reform significantly reduces accidental death rates. These declines are concentrated among young children and among the elderly, suggesting that they are not related to accidents occuring in the workplace.

Moreover, we examine the dynamics of responses to JSL reform and find that the effect of the reform increases with the length of time the law has been in place. We also attempt to get at the mechanism underlying reductions in death rates by separately examining deaths in hospitals and deaths outside hospitals. If, for example, reductions in accidental deaths were driven mainly by improvements in the medical care of victims, we would expect to find greater impacts on deaths in hospitals than on deaths that occur outside hospitals. However, this is not the case, suggesting that the reductions in deaths do result from greater precaution being taken. Finally, as a robustness check, we ask whether future JSL reforms are estimated to have an impact on accidental deaths. If they did, this would suggest that the results were driven by underlying trends in accidental deaths rather than by tort reform. However, 2-year "leads" of the JSL reform indicators have no significant effects.

The rest of the paper is laid out as follows. We first provide an overview of some of the relevant literature. We next lay out the theoretical model, the data, and the empirical models. The final sections discuss the results and conclusions.

Background

Brown (1973), in a seminal contribution to the economic analysis of tort law, introduced the idea that the behavior of tortfeasors can be modeled as a non-cooperative game. He makes the point that a desirable feature for the law is that the equilibrium should be unique. Landes and Posner (1980) shows that the JSL rule induces efficient precaution under the negligence standard with observable precaution. Kornhauser and Revesz (1989) show that this result does not apply in the case of strict liability, and extend these results in Kornhauser and Revesz (1990) to the case of insolvent firms. They find that in general there is no rule that achieves the first best.

Segerson (1988), Miceli and Segerson (1991) and Cooter and Porat (2007), building on the insights of Holmström (1982), show that liability rules that are not required to sum to the total damages can enhance efficiency in the case of strict liability. More recently, Currie and MacLeod (2008) present a model of JSL reform in a medical setting with procedure choice. They show that JSL reform in a negligence regime can encourage more efficient procedure choice. In this paper, we provide a more comprehensive theoretical analysis of JSL reform.

A larger number of empirical papers examine the effects of tort reform. One strand of the literature finds that tort reform does affect awards and the incentives for physicians to obtain liability insurance (for example Avraham (2007), Sharkey (2005) and Silver et al. (2007)). Both Kessler and McClellan (1996) and Currie and MacLeod (2008) find evidence that JSL reforms reduce negative outcomes in a medical context. Kessler and McClellan look at elderly heart attack victims, and find that JSL reform (the major component of what they characterize as indirect tort reforms) reduces death rates. Currie and MacLeod examine all U. S. births from 1989 to 2001 and find that JSL reform reduces the number of Cesarean sections along with complications of labor and delivery.

Accidentals are a natural context for the study of tort reform because most torts are acts that cause bodily injuries to others unintentionally, i.e. accidentally (U.S. Bureau of Justice Statistics (1995)), and accidents often result in tort suits. Moreover, many of these suits involve multiple tortfeasors. Table 1 shows the percentage of tort suits naming multiple defendants from a survey of state courts conducted by the Bureau of Justice Statistics. In fact, Table 1 suggests that the modal tort suit over an accident is likely to involve more than one defendant, which means that the efficiency of JSL is particularly salient in this context. If JSL reform decreased the level of care being taken, then it would be expected to increase accident rates, and vice versa.

Rubin and Shepherd (2007) study the effects of tort reforms on non-automotive accidental deaths. They do not find significant effects of JSL reform. Carvell (2009) highlights several differences between our preferred specifications and theirs, which explain the different conclusions. The most important of these is treating drug-overdoses separately. This is a large category of accidental deaths that seldom result in tort suits. The rationale for this decision is discussed further below. Second, following Bertrand et al. (2004) and our previous work, Currie and MacLeod (2008), we are careful to allow for state specific trends in death rates so that we can reliably estimate the causal impact of JSL reform upon accidental death.

2 Model of Multiple Tortfeasors

In this section, we begin with the standard model of multiple tortfeasors due to Landes and Posner (1980). Tortfeasors may face either a strict liability regime or a regime with a negligence standard. Under the former they are always liable for the damage they cause. Under the later, they are liable only if their behavior crosses some threshold for negligent behavior. Landes and Posner show that under a negligence regime with the rule of joint and several liability (the JSL rule), there exists a Nash equilibrium in which parties choose the efficient level of care. They argue that this is an efficient legal rule. We provide a more general analysis of the *ex ante* incentive effects of JSL.[3]

It is well know that under more general conditions, particularly when the negligence standard is not known with certainty, the efficiency results of Landes and Posner (1980) do not hold (see Craswell and Calfee (1986) and Kornhauser and Revesz (1989)). More generally, the provision of efficient incentives when there are several agents is known to be a hard problem. The difficulty is that the efficient level of care of one agent typically depends upon what that agent expects the other agents to do. For example, if a contractor expects a subcontractor to take appropriate precautions, then there will be less supervision. However, if the subcontractor is negligent then the contractor may face liability for not being sufficiently diligent in oversight.

We introduce a model that highlights the relationship between the actions of the two parties and the optimal liability rule. Our analysis builds upon the insights of Bulow et al. (1985), who introduce the idea of strategic substitutes and complements. They focus on how the actions of one party vary with the actions of the other. This in turn divides the set of cases into two groups for which the optimal liability rules are quite different. We begin by introducing the model and characterizing the first best. We then derive the optimal liability rule, and compare this rule to JSL and its reform.

2.1 Optimal Precaution

Suppose there are two potential tortfeasors, denoted by a and b, and one injured party. Let x_i be the investment by agent $i \in \{a, b\}$ in precaution. We consider incentives under two negligence regimes. In the first case we suppose that precaution x_i is directly observable. In the second we suppose that precaution is not directly observed, rather, only the consequences

[3]There is a significant literature on the effect of JSL upon *ex post* incentives to settle. See for example Kornhauser and Revesz (1994). See also Spier (2002) for a discussion of the problems that arise when insolvent parties negotiate a settlement.

of precaution are observed. In order to provide a unified analysis, we suppose that there is a signal that can be associated with each agent that is denoted by $n_i \in \{0,1\}$, where $n_i = 1$ implies that the courts find that agent i took an action that contributed to the accident, and $n_i = 0$ implies that the courts find that agent i did not. To distinguish between the two information cases, we say that agent i is *culpable* if and only if $n_i = 1$. When precaution is observable, the negligence standard is denoted by x_i^N, and an agent is negligent if and only if $x_i < x_i^N$. If precaution is not observed, then agent i is negligent if and only if $n_i = 1$. For example, a doctor may take appropriate precaution and still be found negligent. Similarly, in some cases a physician may provide negligent treatment yet the patient gets well in any case.[4]

Investment into precaution determines the probability, $p_i(x_i)$, that the signal $n_i = 1$. It is assumed p_i is twice differentiable and decreasing with precaution. Whether or not precaution is directly observed, the signal n_i is always correlated with the amount of harm that a victim suffers. We allow the expected harm to take the general form $H(n_a, n_b)$, and for notational convenience let $H_a = H(1,0)$ be the harm when a is negligent, $H_b = H(0,1)$ the harm when b is negligent, $H_{ab} = H(1,1)$ the harm when both are negligent, and finally $H = H(0,0)$ the harm when neither agent is found negligent. We shall suppose that culpability is correlated with an increase in the size of the harm and hence:

$$H_{ab} \geq H_a, H_b \geq H.$$

The social welfare for this model is given by:

$$\begin{aligned} SW(x_a, x_b) &= -H_{ab}p_a(x_a)p_b(x_b) - H_a p_a(x_a)(1-p_b(x_b)) - \\ &\quad -H_b(1-p_a(x_a))p_b(x_b) - H(1-p_a(x_a))(1-p_b(x_b)) \\ &\quad -x_a - x_b. \end{aligned} \tag{1}$$

Since social welfare is continuous and bounded above, then there exist precautionary investments, $\{x_a^*, x_b^*\}$, that maximize social welfare. With little loss of generality, we can assume that this solution is unique and that it is optimal for both parties to take precautions (otherwise we are in the case of a simple tort). Before characterizing the first order conditions, we define two measures of the marginal gain from precaution that play a central role in the

[4]See Arlen and MacLeod (2005) for a discussion of this point.

characterization of the first best:

$$\Delta_t = H_t - H,\ t \in \{a, b\},$$
$$\Delta_{ab} = H_{ab} - H - H_a - H_b$$

The term Δ_t is the increase in harm when agent t is found negligent, but not the other agent. This term is always non-negative. It may be zero in those situations where only one person needs to be non-negligent. For example, take the case of a substandard building foundation, discussed in Landes and Posner (1980). In that case, if the subcontractor performed correctly, or the general contractor supervised closely enough to avoid poor quality work, then there would be no harm. In that case $\Delta_t = 0$. The term Δ_{ab} is the increase in harm when both parties are culpable relative to when one or no individual is culpable. In the contractor example we would have $\Delta_{ab} > 0$. In this case, we say that the precaution of one party is a *substitute* for precaution by the other. That is, if either one or the other agent is not culpable, then this leads to a significantly lower level of harm.

In contrast, the case of strategic complements is one in which both agents play an important role in reducing harm; hence $\Delta_{ab} < 0$. This might be the case with front steps to an apartment building if one party is responsible for shoveling in snowy weather and the other is responsible for maintaining a guardrail in good condition. If the stairs aren't shoveled then someone who falls may not blame it on the guardrail. However, if the stairs are always well maintained, the owner will have a greater incentive to fix the guard rail.[5]

Finally, there is the case in which we say precaution is *separable* - namely $\Delta_{ab} = 0$. In that case, the harm caused when both are liable is simply the sum of the harm caused when either is liable ($H_{ab} - H = H_a + H_b$). We can relate this notion to the optimal level of precaution. The differentiability of the probability implies that at the optimum the first order conditions are satisfied:

$$SW_{x_a} = -\{\Delta_a + p_b(x_b^*)\Delta_{ab}\}\, p_a'(x_a^*) - 1 = 0, \tag{2}$$

$$SW_{x_b} = -\{\Delta_b + p_a(x_a^*)\Delta_{ab}\}\, p_b'(x_b^*) - 1 = 0. \tag{3}$$

The optimal level of care is the solution:

$$\{x_a^*, x_b^*\} \in argmax_{x_a, x_b \geq 0} SW(x_a, x_b).$$

[5]See McCoy v. Monroe Park West Associates, 1999, 44 F.Supp2d 910 for an example of a similar slip of fall case on an icy staircase.

Notice that the optimal precaution for agent a in general depends upon the actions of agent b. Hence, one of the goals of tort law when there are multiple defendants is to provide an incentive for parties to coordinate their actions. The extent and nature of this coordination depends upon the nature of the environment in which parties find themselves. We illustrate this by explicitly working out how one party's optimal care varies with the care taken by the other party. To keep matters as straightforward as possible suppose that the probability of negligence is a strictly convex function of care: $p_i'' > 0$.

This assumption ensures that the first order conditions uniquely fix agent $a's$ care level as a function of agent $b's$ care level, and vice versa. Let $x_a = r_a^*(x_b)$ be the optimal care level that agent a should choose if agent b chooses x_b. This function is the unique solution to the first-order conditions given by (2) and can be rewritten as follows:

$$f\left(r_a^*\left(x_b\right)\right) \equiv -\frac{1}{p_a'(r_a^*(x_b))} = \Delta_a + \Delta_{ab} p_b(x_b), \tag{4}$$

where one can verify that $f' > 0$. Observe that the term Δ_{ab} determines how $a's$ precaution should vary with $b's$ precaution. If harm is separable, $\Delta_{ab} = 0$, and agent $a's$ optimal action is independent of agent $b's$. When $\Delta_{ab} < 0$ then the levels of care taken by agents a and b are *complements,* that is most of the harm is caused when one person is negligent, with the additional harm caused by the second person's negligence being less if the first person is negligent. Hence, an increase in $b's$ precaution results in a lower probability of an accident, and hence more precaution by a. In contrast, precautions are *substitutes* when $\Delta_{ab} > 0$. In this case, an increase in precaution by b leads to *less* precaution by a. These results can be summarized as follows:

Proposition 1. *Suppose that the probability of negligence as a function of care is convex, $p_i'' > 0$, then:*

1. If care levels are separable, $\Delta_{ab} = 0$, then the optimal care levels are independent of each other: $\frac{\partial r_i}{\partial x_{-i}} = 0$ for $i \in \{a, b\}$.

2. If care levels are substitutes, $\Delta_{ab} > 0$, then the optimal care level of one agent is decreasing in the care level of the other agent: $\frac{\partial r_i}{\partial x_{-i}} < 0$ for $i \in \{a, b\}$.

3. If care levels are complements, $\Delta_{ab} < 0$, then the optimal care level of one agent is increasing in the care level of the other agent: $\frac{\partial r_i}{\partial x_{-i}} > 0$ for $i \in \{a, b\}$.

Proof. The proof of this proposition follows immediately from differentiating (4). □

Bulow et al. (1985) call case 2 above "strategic substitutes" and case 3 above "strategic complements" to indicate that the optimal actions of each party depend on the actions of the other. These terms were originally applied to understanding how firms adjust their choices in the face of exogenous shocks. In our case they help us to distinguish between different classes of tort cases, and to identify how the existing law compares to the efficient law in each of these cases.

2.2 Legal Rules

In this section, we discuss three legal rules, the rule of joint and several liability (JSL), full reform or repeal of joint and several liability that results in a regime in which each person is liable for the harm they cause (full JSL reform), and the efficient legal rule (ELR). When the levels of precaution taken by the parties are observable, Landes and Posner (1980) have shown that the rule of joint and several liability results in the first best under the assumptions that the negligence standard is efficient, and that parties know this standard.

The reason the JSL rule is efficient in this situation is straightforward. If both parties choose non-negligent precaution there is no liability, while if one person deviates, then she faces the full harm. Given that this is not efficient, it is optimal for both parties to choose to be non-negligent. In equilibrium there are no cases where only one party is negligent, and certainly few cases where there is joint liability. Cases involving joint tortfeasors are quite common as discussed above, and hence the assumption of a perfect and predictable negligence standard is too strong. However, in this case neither JSL nor full JSL reform are generally efficient, and we will show below that the distortions they cause are a function of the characteristics of the accident. Note that the Landes and Posner (1980) result also assumes that the set of potential tortfeasors is known, which may not be the case. We will return to this issue below.

We begin with a benchmark efficient rule. Let L_i be the liability assessed upon agent i if she is the only person found liable, while L_i^J is the liability if both parties are found negligent. Let $Law = \left\{L_i, L_i^j\right\}_{i\in\{a,b\}}$ denote the legal rule. Under this rule, the payoffs for agent $i \in \{a, b\}$ are:

$$U_a(x_a, x_b|Law) = -L_a p_a(x_a)\left(1 - p_b(x_b)\right) - L_a^J p_a(x_a) p_b(x_b) - x_a, \tag{5}$$

$$U_b(x_a, x_b|Law) = -L_b p_b(x_b)\left(1 - p_a(x_a)\right) - L_b^J p_b(x_b) p_a(x_a) - x_b. \tag{6}$$

Following Brown (1973), it is assumed that given the law, agents choose precaution levels to form a Nash equilibrium, $\left\{x_a^N, x_b^N\right\}$. This requires each agent to choose the optimal level of precaution given that she correctly anticipates the actions of the other person. The first order conditions for the Nash equilibrium are:

$$\begin{aligned} 0 &= \frac{\partial U_a(x_a^N, x_b^N | Law)}{\partial x_a} = -L_a p_a'(x_a^N)\left(1 - p_b(x_b^N)\right) - L_a^J p_a'(x_a^N) p_b(x_b^N) - 1 \\ &= -\left\{L_a + \left(L_a^J - L_a\right) p_b(x_b^N)\right\} p_a'\left(x_a^N\right) - 1, \qquad (7) \\ 0 &= \frac{\partial U_b(x_a^N, x_b^N | LAW)}{\partial x_b} = -L_b p_b'(x_b^N)\left(1 - p_a(x_a^N)\right) - L_b^J p_b'(x_b^N) p_a(x_a^N) - 1, \\ &= -\left\{L_b + \left(L_b^J - L_b\right) p_a(x_a^N)\right\} p_b'\left(x_b^N\right) - 1. \qquad (8) \end{aligned}$$

Comparing these equations with the first order conditions for the first best given by 2 and 3, one can see that the first best would be implemented with a legal rule that set $L_t = \Delta_t$ for $t \in \{a, b\}$ and $L_a^J - L_a = L_b^J - L_b = \Delta_{ab}$. A straightforward computation leads to the following result:

Proposition 2. Suppose that ELR, the efficient joint liability rule, is given by

$$\begin{aligned} L_a^* &= H_a - H,\ L_a^{J*} = H_{ab} - H_b, \\ L_b^* &= H_b - H,\ L_b^{J*} = H_{ab} - H_a. \end{aligned}$$

Then the efficient care levels, $\{x_a^*, x_b^*\}$, form a Nash equilibrium under this rule.

This rule is quite intuitive. It requires that when only one agent is found negligent, say a, then liability for a is given by the marginal impact of her harm, $H_a - H$. When both agents are found negligent, then liability is equal to the marginal impact of negligence compared to when only the other person is liable, namely $H_{ab} - H_b$ in the case of agent a.

Note that when a single person is negligent liability is less than total harm ($L_t^* < H_t$). When both are negligent then total liability under the efficient rule depends on the substitutability of precaution:

$$L_a^{J*} + L_b^{J*} = H_{ab} + \Delta_{ab}.$$

This implies that the efficient rule may be difficult to implement in practice. First, the courts typically base awards upon the damages that occur, as opposed to damages that might or might not have occurred. In practice, it would be extremely difficult to estimate the harm H that would be caused in expectation if there were no negligence.

A related problem arises if the set of persons who could have caused some part of the tort is large, or ill defined. Segerson (1988), Miceli and Segerson (1991) and Cooter and Porat (2007) propose a solution to the joint liability problem than involves making each potentially negligent party liable for the full amount of the harm. That is party a would pay H, H_a, H_b or H_{ab} depending on who if anyone was found liable. This rule would provide a with first best incentives. However, if precaution is difficult to observe, then when accidents corresponding to H and H_b occur it may not be possible to prove that a is a potential tortfeasor. In many accidents there may be several agents present, each of whom might have contributed to the accident. However, unless one has concrete information about their actions, it will be difficult to find them liable, and hence strict liability of this form is not likely to be feasible.

Estimating possible losses in the case of no culpability is sufficiently speculative that we suppose $H = 0$ for purposes of comparing the law to the optimal rule. This would be the case if negligence occurs if and only if there is an accident that leads to real harm. In this case, the optimal legal rule is:

$$\begin{aligned} L_a^* &= H_a,\ L_a^{J*} = H_{ab} - H_b, \\ L_b^* &= H_a,\ L_b^{J*} = H_{ab} - H_a. \end{aligned}$$

When only one individual is found negligent, this corresponds to the standard legal rule of holding that person liable for total harm. When both are found negligent, then liability is equal to the marginal consequence of each person's negligence given that the other is negligent, which as we discuss above, may be greater or less than the total harm by the amount Δ_{ab}, the degree of substitutability or complementarity in precaution.

Both JSL and its reform can be viewed as special cases of the following legal rule:

$$\begin{aligned} L_a &= H_a, L_a^{\alpha} = \alpha H_{ab}, \\ L_b &= H_b, L_b^{\alpha} = (1-\alpha) H_{ab}, \end{aligned}$$

where L_t is liability to agent t when she alone is negligent, and L_t^{α} is her liability when both potential tortfeasors are negligent (with the convention that agent a faces α fraction of the costs and agent b faces $(1-\alpha)$ fraction of the costs). Let $L(\alpha)$ denote this legal rule.

Landes and Posner (1980) observe that from the *ex ante* perspective, JSL can be viewed as determining the probability that one party or the other is found liable for the full damages. Letting α^{JSL} denote this parameter, then its value is determined by who is likely to be most able to pay an award. For example, suppose there is an accident during surgery where a is the surgeon and b is the nurse/hospital.[6] In this case the hospital is the "deep pocket" and

[6] Since the nurse is a hospital employee then the hospital would be liable for harm caused by the nurse via the doctrine of vicarious liability that makes employers responsible for the torts of their employees. See

we can suppose that *ex ante* parties expect $\alpha^{JSL} = 0$. In general this rule is not efficient because a has no incentive to take care. The question then is whether or not reform to JSL would enhance efficiency?

To address this question we begin by deriving the efficient sharing rule under the hypothesis that each party chooses precaution to maximize their utility given the sharing rule. This can be found by maximizing social welfare subject to the constraint that each person's precaution satisfies the first order conditions for an optimal choice:

$$max_{x_a, x_b, \alpha} SW(x_a, x_b)$$

subject to:

$$\partial U_t(x_a, x_b | L(\alpha))/\partial x_t = 0 \quad , \quad t \in \{a, b\} .$$

Here we are assuming that given the legal rule $L(\alpha)$ the first order conditions characterize the Nash equilibrium. Let us further assume that there is an interior optimal choice for α. Under these assumptions the first order conditions for the optimal legal rule and level of precaution are as follows:

Proposition 3. *If the efficient legal rule $L(\alpha^*)$ is an interior solution ($\alpha \in (0,1)$) then the optimal precaution $\{x_a^{\alpha*}, x_b^{\alpha*}\}$ and sharing rule satisfy:*

$$\frac{SW_{x_a}}{-p'_a(x_a)\,p_b(x_b)} + \frac{SW_{x_b}}{-p'_b(x_b)\,p_a(x_a)} = \Delta_{ab} \tag{9}$$

Proof. Observe that we can define a new payoff for each agent in the following form that will yield the same first order conditions (7) and (8):

$$\begin{aligned} U'_a &= SW(x_a, x_b) + p_a p_b \left((1-\alpha) H_{ab} - H_b\right), \\ U'_b &= SW(x_a, x_b) + p_a p_b \left(\alpha H_{ab} - H_a\right). \end{aligned}$$

Using this definition, the Lagrangian for the optimization problem is given by:

$$L = SW + \lambda_a \left(SW_a + p'_a p_b \left((1-\alpha) H_{ab} - H_b\right)\right) + \lambda_b \left(SW_b + p_a p'_b \left(\alpha H_{ab} - H_a\right)\right).$$

Arlen and MacLeod (2005).

Under the assumption of an interior solution for α it must be the case that:

$$\lambda_a \left(-p_a' p_b\right) + \lambda_b \left(p_a p_b'\right) = 0.$$

Let $\mu = \lambda_a p_a' p_b$ and we can rewrite the Lagrangian as:

$$L = SW + \mu \left(\frac{SW_a}{p_a' p_b} + \frac{SW_b}{p_a p_b'} + \Delta_{ab} \right).$$

At the optimum the second term is zero, which gives us our result. □

Notice that in the case of separable harm, $\Delta_{ab} = 0$, and $\alpha^* = \frac{H_a}{H_{ab}} = \frac{H_{ab} - H_b}{H_{ab}}$, in which case the first best is achieved. In this case, when both defendants are found negligent then the optimal division rule, α^*, has each agent paying their share of the total harm. This rule is consistent with reform to the JSL rule. For example, in environments where α^{JSL} is 1 or 0, and both agents make similar contributions to the harm, then JSL reform enhances efficiency - it would reduce the precaution by the agent with the deep pocket, while increasing the precaution taken by the other party.

This prediction is consistent with the evidence in Currie and MacLeod (2008), who find that in the case of medical malpractice, reform to JSL results in physicians taking more precaution. In that case the hospital would normally be the deep pocket, and hence JSL reform would lead to more liability for the physicians. Under this reform the courts divide the harm when both parties are liable.

When harm is not separable, then no division rule results in the first best, and the nature of the accident determines the nature of the distortion. In the famous Hunters case (Summers v. Tice 199 P.2nd 1 (Cal. 1948)), one hunter was shot in the eye by another hunter. The problem was that the two hunters shot in the same direction, at the same time. Hence it was not clear *who* caused the damage, and whether either of them would be liable. We can view $p_i(x_i)$ as the probability that the hunter shot in the direction of the plaintiff and hence is potentially negligent. Let q be the *ex ante* probability that the plaintiff is hit by a negligent hunter, and let H^1 be the damages if hit by a single shot, and H^2 is the hypothetical harm that would have been suffered if the hunter had been hit by two shots. Under this scenario we have $H = 0$, $H_a = H_b = qH^1$ and $H_{ab} = 2q(1-q)H^1 + q^2 H^2$.

Hence, the optimal liability rule $L_i^* = qH^1$ would be implemented by having the defendant pay H^1 whenever one hunter is negligent and there is a hunting accident. Suppose now that both hunters are found negligent - namely both could have caused the accident. If harm is separable then $H^2 = 2H^1$, that is, if the injured party is shot twice the damages are twice as large. In this case, the efficient rule is:

$$\begin{aligned} L_i^{J*} &= H_{ab} - H_i \\ &= 2q(1-q)H^1 + q^2 2H^1 - qH^1 \\ &= 2q(1-q)(H^1/2) + q^2 H^1. \end{aligned}$$

This rule can be implemented by having each hunter pay $H^1/2$ if there is only one shot, and H^1 if the plaintiff is hit twice. This is exactly the ruling that was eventually reached in the US courts - namely the damages were split between the two defendants equally.

Now consider what would happen if being shot twice led to greater complications. In that case $H^2 > 2H^1$ since $\Delta_{ab} > 0$, and hence precautions are strategic substitutes. The optimal liability in the case of a joint tort would be:

$$L_i^{J*} = 2q(1-q)(H^1/2) + q^2(H^1 + \Delta_{ab}).$$

In this case, at the optimal rule each hunter would pay $H^1 + \Delta_{ab}$ if the plaintiff were shot twice. Under JSL if one agent is known to have a deep pocket, then she will face the full loss, and will therefore over invest in precaution, while the other party will under invest. However, under JSL reform the damages would be split between the two parties to yield damages to party i of $H^1 + \Delta_{ab}/2$ if the hunter is shot twice. Thus precaution will be too low under JSL reform.

In the case of strategic complements, we have $\Delta_{ab} < 0$ ($H^2 < 2H^1$). This case might correspond to harm from a small gauge shotgun, where the injuries are minor, but there is a cost of going to the hospital for treatment. In that case, JSL reform would result in damages of $H^2/2$ that are *greater* than the efficient level of damages, $H^2 - H^1$. In this case we get excessive precaution, but again JSL does not do any better, and in this symmetric case it must do strictly worse.

These results are summarized in Chart 1 for the case in which $H_a = H_b$ and $p_a(x) = p_b(x)$, and hence both parties have equal weight. We assume that under JSL party a would be responsible for the full award. In all cases, if there is a single person found negligent damages are $L^I = H_a = H_b$. Note that under JSL we have that $L_a^J = H_{ab} > H_{ab} - H_a > 0 = L_b^J$ and hence JSL always yields too high precaution for a and too low for b. All that changes in the different cases is the liability each person faces when they are both liable. The effects on the level of precaution taken can be summarized as follows.

Environment	Efficient Solution (L^J)	JSL Reform (L^J)	JSL (L^J_a, L^J_b)
Observable Precaution	efficient	efficient	efficient
Substitutes ($\Delta_{ab} > 0$)	efficient	low	excessive (a) and low (b)
Separable ($\Delta_{ab} = 0$)	efficient	efficient	excessive (a) and low (b)
Complements ($\Delta_{ab} < 0$)	efficient	high	excessive (a) and low (b)

Chart 1: Effect of Liability Rules on Precaution

In the case of substitutes, precaution by both agents falls as we go from the efficient solution to JSL reform. Under JSL person a takes an excessive amount of precaution, while person b takes less than the efficient level of precaution. In the separable case JSL reform implements the efficient solution, while under JSL either b takes too little precaution or a takes an excessive amount of precaution. Finally, in the case of complements there is excessive precaution under JSL reform, while JSL again leads to a divergence in the amount of precaution taken by the two parties.

Hence, JSL reform may result in greater precaution being taken in some cases, though this is not necessarily efficient. Efficiency does not necessarily entail more precaution - it really depends upon the accident technology. Notice that JSL tends to enhance the precaution taken by the "deep pockets" agent while lowering the other agent's incentive to take precaution. Deep pockets are typically large organizations. If they are efficient providers of precaution, then we would expect JSL reform to lead to more accidents.

However, notice that under JSL reform, a wealthy tortfeasor can reduce liability by providing evidence that other individuals were responsible as well. Even if these persons are judgment proof, they could be asked to provide evidence and possibly to appear in court. This would impose a cost upon them, and lead to more precaution by these individuals even though they are judgment proof. If tort reform is found to enhance deterrence, then this would be consistent with the hypothesis that wealthy tortfeasors do not necessarily fully internalize the costs and benefits from deterrence.

3 Data

Data on tort reforms come from the data base described in Currie and MacLeod (2008). This data base incorporates information from the American Tort Reform Association Record, McCullough, Campbell and Lane's "Summary of U. S. Medical Malpractice Law," and Ronen

Avraham's "Database of State Tort Law Reforms" (Avraham (2006)). The text of each statute and court case enacting, modifying, repealing, or striking down a tort reform was located and examined using Westlaw and Lexis-Nexis in order to either verify or correct the information on the presence and characteristics of tort reforms in U.S. states from these previously existing data bases of state tort reforms. For the current project, the data base was extended by incorporating information from 1981-1984. Errors in previous data bases about tort reform might account for some of the disparate findings in the literature (see Congressional Budget Office (2004)).

Table 2 shows which states and years had any JSL reform. The indicator is equal to one if there is any new rule stating that a party had to be responsible for a certain minimum fraction of the harm suffered before he or she could be held liable for 100% of the damages. We obtained similar results to those reported below if we used an alternative measure of JSL reform defined as a change in which a tortfeasor had to be responsible for at least 50% of the harm in order to be assessed 100% of the damages.[7]

Table 2 shows that JSL reform was largely concentrated in the period from 1985 to 1992, and that there is considerable variation across states. Other tort reforms took place over a somewhat longer period, as shown in Appendix Table 1. In what follows, we will insure that the estimated effects of JSL are not driven by other tort reforms that occurred at roughly the same time period.

Data on accidental deaths come from the National Vital Statistics Mortality files for 1981-2004. These files include data collected from all death certificates filed in the United States. We divide data on accidental deaths (those due to unintentional injuries) into three groups: automotive deaths, fatal overdoses on illegal drugs and abused pharmaceuticals, and all others.

Our main focus is on the third category. Automotive accidents have been the focus of many other state laws such as those for no-fault auto insurance, mandatory auto insurance, and penalties for drunk driving (Landes (1982), Chaloupka et al. (1993), and Cohen and Dehejia (2004)). Drug overdoses are treated separately because they seldom result in tort suits, and hence may not be greatly affected by tort law.[8] Drug overdoses may also be

[7] The lowest cutoff was a reform Texas enacted in 1988, which had a cutoff of only 10%, although Texas raised its cutoff point to 50% in 1995, strengthening the earlier reform. Minnesota is the only other state that had a cutoff below 25% (a threshold of 15% was adopted in 1989 and raised to 50% in 2004). Hawaii (1987) and Illinois (1987-1994, 1998-present) are the only states with a 25% cutoff. Four states adopted rules eliminating JSL in cases in which the plaintiff is partially responsible for the harm, but not otherwise: Georgia(1988), Michigan (1987, changed to a full repeal of JSL in 1996), Nevada (1988), and Washington (1987).

[8] A careful search of Westlaw shows that there are in fact a few tort cases involving drug overdoses. For

strongly affected by drug control policies and policing (Becker et al. (2006)).

Rates are constructed by dividing the number of deaths with the U.S. Census Bureau's estimates of state population in each year (U.S. Bureau of the Census (2009)). Figure 1 shows that the three categories of accidental deaths show quite different trends. In particular, drug overdoses have been rising over time, which tends to drive the rate for all accidents upwards after 1992. In contrast, the "other" category we focus on shows a continuous decline over the entire 1981-2004 period. The consquence of excluding drug overdoses is illustrated in figure 2.

The most common types of accidents in the "other" category are falls (25.1%), drownings (10.0%), suffocations (10.4%), fires and burns (9.4%), other transportation related accidents (5.1%), poisonings (2.8%), and accidental firearm injuries (2.8%) (U.S. Centers for Disease Control and Prevention (CDC) (2007)). These types of accidents frequently result in tort suits. For instance, McFarland and Weissenberger (2001) state that the "slip and fall" case is the most common type of premises liability tort suit (page 177).

Data on additional time varying state-level control variables come from various sources. These include: data on the fraction elderly and under 5 as well as data on the fraction of young males taken from the Census; unemployment rates (U.S. Bureau of Labor Statistics (2009b)); per capita real personal income (U.S. Department of Commerce (2009); U.S. Bureau of Labor Statistics (2009a)); per capita alcohol consumption (U.S. National Institutes of Health (2009)); and hospital beds per capita (U.S. Department of Health and Human Resources (2006)). These variables were chosen as controls because they might affect accidental death rates independently of tort laws.[9]

Table 3 shows that there are about 20 accidental deaths per 100,000 persons in the first two categories, and about 17 accidental deaths per 100,000 in the third category. Table 3 also shows that deaths in this latter category are quite concentrated in the very young, and especially, in the elderly. Among individuals 65 and above, the "other accidents" death rate

example, in Cook v. Kendrick (931 So. 2d 420, LA. App. 2 Cir. , 2006) a defendant host was found liable for 20% of the harm from an overdose because they did not make a reasonable effort to seek medical attention. However, the number of such cases is very small relative to the number of reported cases for accidents such as falls and drownings. Moreover, for other types of accidental deaths, there exist numerous reports, such as a number of reports from the American Law Reports series, summarizing lawsuits over these types of accidents. No such report exists for drug overdoses, probably because these deaths are so rarely the subject of tort suits.

[9] We use the same control variables as Rubin and Shepherd (2007) to deal with the variation in accidental death rates by demographic groups, the relationship between accident victims' incomes and employment status and the size of any economic damages from accidents, and possibly the willingness to bring tort suits (Burstin et al. (1993)). The alcohol variable is included because it often plays a role in accidents.

is 67 per 100,000. Table 3 also breaks out death rates for state-years with and without JSL reform. A comparisons of columns 2 and 3 shows that states and years with JSL reform tended to have lower death rates, particularly when auto accidents and drug overdoses are excluded. Moreover, death rates are particularly lower for the elderly, who account for a large share of accidental deaths. However, state-years with JSL reform also tend to have higher per capita personal income, a lower percentage of African-Americans, and lower per capita alcohol consumption, characteristics that would be expected to be associated with lower death rates in the absence of JSL reform.

4 Econometric Model

The theoretical model developed above suggests that the effect of JSL reform on accident rates is very much an empirical matter. The answer depends on both the extent to which the care taken is observable, and on the "technology" relating care to potential harms. Table 2 showed that there is considerable variation in the adoption of JSL reform across U.S. states and years. Our empirical model uses this variation to identify the effect of JSL reform on accident rates in a difference-in-differences framework.

Our main econometric model is the following:

$$\begin{aligned} ln(RATE_{st}) &= a + b_1 JSL_{st} + b_2 xVAR_{st} + b_3 YEAR_t \\ &\quad + b_4 STATE_s + b_5 STATE_s * TIME + \epsilon_{st}, \end{aligned} \tag{10}$$

where s and t denote states and years, respectively. RATE denotes a rate (per 100,000 state residents) of accidental deaths. Taking the natural logarithm of the RATE allows us to interpret the effects of the right hand side variables as percentage changes. JSL is an indicator for any JSL reform, XVAR is the vector of other state characteristics described above, STATE is a vector of state indicators, and STATE*TIME indicates that we are allowing a separate time trend for each state. State-specific time trends control for possible gradual changes in omitted factors within states, such as changes in awareness about safety issues.[10]

[10] Carvell (2009) shows that estimates from models without time trends are often implausible. For example, 2-year "leads" of some tort reform variables are statistically significant in models that exclude the time trends, but not in models that include them, suggesting that time trends really do provide a correction for omitted variables.

We first estimate equation (10), and then test the robustness of our estimates to including controls for the other tort reforms shown in Appendix Table 1. We estimate the model for the three categories of accidental deaths (auto, drug overdoses, and other) separately. We predict that state-level JSL reform should have no impact on deaths due to auto accidents or drug overdoses, so if we found an "effect" of JSL reform on these deaths, it might suggest that an omitted variable correlated with JSL reform was driving the estimates. Alternatively, if we found an effect of JSL reform on all accidental death rates, it might suggest that the reform acted by causing medical practitioners to treat accident victims with more care, rather than by preventing accidents. We also estimate (10) separately by age in view of the large differences in death rates across age groups.

We estimate a second model that asks whether the effects of JSL reforms change as time passes:

$$\begin{aligned} ln(RATE_{st}) &= a + b_1 JSL\_NEW_{st} + b_2 JSL\_OLD_{st} + b_3 XVAR_{st} + \\ & \quad b_4 YEAR_t + b_5 STATE_s + b_6 STATE_s * TIME + \varepsilon_{st}. \end{aligned} \tag{11}$$

It might be the case that older reforms have more impact, since parties will have had more opportunity to learn about the law and to adjust their behaviors in response to the legal change (Kessler and McClellan (1996)). JSL_NEW is an indicator equal to one if the reform was enacted within the last N years, where, in successive models, N takes on the values 2, 3, 4, or 5. JSL_OLD is an indicator equal to one if the law has been in place for more than N years. Kessler and McClellan (1996), Kessler and McClellan (2002b), Kessler and McClellan (2002a), Kessler et al. (2005), and Born et al. (2009) adopt a similar approach to investigating the dynamic effects of tort reforms.

As a final robustness check, we estimate:

$$\begin{aligned} ln(RATE_{st}) &= a + b_1 JSL_{st} + b_2 JSL\_LEAD_{st} + b_3 XVAR_{st} \\ & \quad + b_4 YEAR_t + b_5 STATE_s + b_6 STATE_s * TIME + \epsilon_{st}. \end{aligned} \tag{12}$$

This regression includes an indicator equal to one in the two years preceding JSL reform. If JSL reform reflects underlying trends in the state, and these trends also influence the accidental death rate, then we may find that these "leads" are statistically significant.

All of the regressions are weighted by population in each state and year. Standard errors are clustered by state, which allows for arbitrary forms of serial correlation and heteroscedasticity in the error terms.

5 Empirical Results

Estimates of equation (10) are shown in Table 4. The first column shows that JSL reform reduces the non-auto, non-overdose accidental death rate by 2.8%. The numbers in Table 2 imply that there are 51,721 deaths per year of this type, so universal JSL reform would avert 1,433 deaths per year. The estimates shown in columns 2 and 3 show that controlling for other prominent tort reforms only increases the estimated effect of JSL reform. For example, the column 3 estimate of -0.0336 implies that 1,738 deaths per year could be averted. The other tort reforms considered include reform of the Collateral Source Rule (CSR), caps on non-economic damages ("pain and suffering"), and changes to punitive damage rules.[11]

Of these other tort reforms, only changes to CSR have an impact. Most reforms to the CSR state that the damages a tortfeasor pays to the victim must be reduced by the amount of any payments the victim has already received, such as payments from insurance companies. Thus, these reforms directly reduce the amount a potential tortfeasor can expect to pay. Table 4 suggests that reforms to CSR encourage potential tortfeasors to take less care, with a resulting increase in fatal accidents. The magnitude of the effect is large enough to largely offset the positive effect of JSL reforms.

Caps on non-economic damages (whether they are general caps or only applicable to cases of medical malpractice) are also intended to limit payouts by tortfeasors, but have little impact on accidental deaths. We included caps on non-economic damages applying in medical malpractice cases only separately because tort reforms might affect death rates not by preventing accidents but by increasing the supply of physicians and/or other medical care providers who provide treatment of accident victims, thereby enabling more accident victims to survive their injuries (Rubin and Shepherd (2007) and Kessler et al. (2005)). However, we find little evidence that this is the case.

This conclusion is strengthened by the estimates for accidental deaths due to overdoses and auto accidents which are shown in columns 4 through 7. We find no effects of JSL or any other tort reform on deaths due to these causes. Hence, it is unlikely that the effect of

[11]Changes to punitive damages rules can take the form either of caps on punitive damages, or adoption of a higher evidence standard in punitive damages cases. The higher standard is that there must be clear and convincing evidence, rather than merely a preponderance of evidence, that the defendant's conduct justifies punitive damages.

tort reform is being driven by changes in the behavior and/or supply of medical providers who care for accident victims. Rather, it appears that JSL reform is affecting accidental death rates by preventing accidents that would otherwise lead to death. As an additional check on this hypothesis, we estimate models for deaths that occur outside hospitals only. These account for about 40% of deaths over our sample period. Column 8 of Table 4 shows that the effects of JSL reform are similar for deaths that occur outside of hospitals, which presumably are little influenced by changes in medical practice within hospitals.

Table 5 presents estimates of equation (10) by age. While it is difficult to get at the effects of tort reform on underlying causes of accidental death, these estimates are highly suggestive. We find significant effects of JSL reform only on the very young (children aged zero to five) and on those 65 or over. The point estimates for school-aged children are non-negligible, but they are not precisely estimated. However, the point estimate for working-aged people is very small and insignificant. Hence, there is little evidence that JSL reform causes employers to take more care in order to avoid employee injury. Perhaps incentives provided by the Workman's Compensation System, direct regulation of workplace safety, and/or by the difficulty of replacing injured employees are more important than the tort system when it comes to accidents on the job.

It is also suggestive that we find effects of CSR reform only for the elderly. This group may be the most likely to have alternative payers such as Medicare and other insurance companies whose payouts would have to be set against any damages that could be collected by the victim's families.

The estimates suggest that JSL reform in every state would prevent between 127 and 135 accidental deaths per year in young children, but as many as 1033 to 1146 deaths per year among the elderly. Conversely, CSR reform increases deaths among the elderly by an offsetting amount. This concentration of effects among the elderly suggests that on average tort reforms reduce accidental deaths by encouraging people like landlords to take more care to prevent accidents (like falls) that may have fatal consequences among the elderly.

Estimates of equation (11) are shown in Table 6. These estimates contrast the effects of recently enacted reforms to those that have been in place for some time. The time window for a new reform varies from 2 years in column 1 to 5 years in column 4. Table 6 demonstrates that a new JSL reform has a larger effect when it has been in place longer. For example, reforms that have been enacted within the last two years reduce accident rates by 2.09% while those enacted within the last 5 years reduce accident rates by 2.94%. The second row of the table shows that JSL reforms that have been in place for longer periods have larger effects. For example, reforms that have been in place for more than 5 years reduce accident rates by 4.57%.

In contrast, estimates shown in Appendix Table 2 show once again that CSR is the only other tort reform that has a consistently significant effect. In contrast to the dynamic pattern for JSL reform, the estimates indicate that recent CSR reforms have larger effects, but that reforms that have been in place for more than four or five years no longer have an impact.

Finally, Table 7 shows our estimates of equation (12). An indicator for the two year "lead" of the JSL reform is included in addition to the JSL reform variable in these regressions; the estimates shown in column (2) of Table 7 also include the leads of the other tort reform variables as well as the other tort reform variables themselves. These lead terms are never statistically significant, which suggests that the estimated effects of JSL (and CSR) reform are not driven by underlying trends in unobserved variables.

6 Discussion

We present a theoretical model showing that the legal rule that implements the socially efficient outcome in the case of multiple tortfeasors depends on whether there is uncertainty about whether a tortfeasor is likely to be judged negligent, and on how the actions of the tortfeasors combine to produce the harm. We show that in general, JSL is not efficient when there is uncertainty about negligence. Whether the optimal rule imposes more or less liability than JSL depends on whether the actions of the tortfeasors are substitutes or complements in the production of the harm. We argue that in many cases, JSL reform may improve outcomes by giving parties who were previously unlikely to be sued greater incentive to take care. This occurs because under JSL reform, parties who are sued have an incentive to bring the other tortfeasors into court in order to show that these others are responsible for some of the harm.

Our empirical results justify the theoretical focus on JSL reform, with its complex implications for the incentives of multiple parties. Certainly, in the case of fatal accidents, the effects of JSL reform are more consistent across specifications, and seemingly more persistent over time, than those of other prominent tort reforms, such as damage caps, which have received more attention in the literature.

Our estimates suggest that JSL reform increases the level of care taken, so that the incidence of fatal accidents is reduced. It is striking that we find no effects on deaths due to overdoses or car accidents, two classes of accidental death that are less likely than others to be driven by developments in the tort system. The failure to find an effect in these two classes of cases also indicates that accidental deaths are not declining because of better medical care caused by JSL reforms, but because parties take more care to avoid accidents. This is consistent with our result that the location of death (in or out of hospital) does not significantly change the estimated effect of tort reform.

The primary beneficiaries of JSL reforms are the elderly, and many deaths are (or could be) averted by JSL reform in this age group. A limitation of our empirical analysis is that we look only at accident rates, whereas overall social efficiency will also depend on what happens to court costs (Shavell (1982)), and uncertainty about expected court costs (Craswell and Calfee, 1986). However, one aim of JSL reform is to reduce the incidence of frivolous lawsuits against deep-pocketed defendants who have minimal responsibility for the harms suffered by plaintiffs. To the extent that the law is successful in meeting this goal, our estimates understate the potential gains to society from adopting JSL reforms.

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Table 1: Percentage of Tort Suits Terminating in State Courts Naming Multiple Defendants (for the 75 Largest Counties in the United States, 1992)

Premises Liability Suits:	
Percentage naming 1 defendant:	47.8%
Percentage naming 2 defendants:	24.8%
Percentage naming 3 or more defendants:	27.4%
Product Liability Suits:	
Percentage naming 1 defendant:	32.2%
Percentage naming 2 defendants:	24.9%
Percentage naming 3 or more defendants:	42.9%
"Miscellaneous" Tort Suits: Tort suits over accidental bodily injuries not sustained in automobile accidents, excluding premises liability, product liability, or medical malpractice.	
Percentage naming 1 defendant:	40.7%
Percentage naming 2 defendants:	32.1%
Percentage naming 3 or more defendants:	27.1%
Premises Liability, Product Liability, and Miscellaneous Tort Suits Together:	
Percentage naming 1 defendant:	45.3%
Percentage naming 2 defendants:	25.9%
Percentage naming 3 or more defendants:	28.8%

Source: U.S. Bureau of Justice Statistics, 1995, "Tort Cases in Large Counties".
Note: The top 75 counties account for about half of all civil filings.

Table 2: Summary of Enactment Dates of State JSL Reforms, 1981-2004

	Law: JSL Reform
1981	
1982	NM
1983	
1984	
1985	IN, IA
1986	AK, CA, UT, WY
1987	CO, CT, FL, HI, IL, MI, NY, SD, WA
1988	AZ, GA, ID, LA, MT, NV, NJ, ND, OR, TX
1989	MN
1990	MS, NH
1991	
1992	NE, TN
1993	
1994	
1995	WI
1996	
1997	
1998	
1999	
2000	
2001	
2002	
2003	AR, PA
2004	

The law is entered as turning on during the first year in which it is in place for at least half the year.

Table 3: Summary Statistics

Variable	Mean	Standard Deviation
Accidental death rates, per 100,000:		
-all types of accidents	37.44	7.96
-drug overdoses only	3.07	2.33
-auto accidents only	17.36	5.17
-excluding auto accidents and drug overdoses	17.01	3.90
- pronounced dead outside of hospital	6.60	2.50
- persons pronounced dead at hospitals,	10.39	2.32
Accidental death rates, per 100,000, by demographic group excluding overdoses and auto		
-Ages 0 to 5	10.84	4.20
-Ages 6 to 17	4.84	2.22
-Ages 18 to 64	11.38	3.78
-Ages 65 and Above	67.23	16.75
State-Year Level Controls:		
Unemployment Rate	6.17	1.95
Real per Capital Personal Income ($2004)	28742	4741
Percent African-American	12.34	8.01
Percent Other Minority:	4.11	5.12
Percent Age 4 and Under	7.27	0.79
Percent Age 65 and Over	12.37	2.03
Percent Males Age 15 to 24	7.64	0.85
Per Capita Alcohol Consumption	2.35	0.43
Hospital Beds Per Capita	0.0045	0.0013

Note: All values are for annual state-level observations from 1981 to 2004, weighted by state-year populations.

Table 4: Effects of JSL reform on Accidental Deaths

Dependent Variable:	[1] Excludes Auto Accidents and Overdoses	[2] Excludes Auto Accidents and Overdoses	[3] Excludes Auto Accidents and Overdoses	[4] Overdoses Only	[5] Overdoses Only	[6] Auto Accidents Only	[7] Auto Accidents Only	[8] Deaths Outside Hospital, excluding Auto and Overdose
Variable								
JSL Reform	-0.0277**	-0.0341**	-0.0336**	-0.0049	-0.0098	0.0157	0.022	-0.0440*
	[0.0096]	[0.0085]	[0.0088]	[0.0960]	[0.0799]	[0.0134]	[0.0157]	[0.0182]
Collateral Source Rule Reform		0.0451**	0.0440**		0.0403		0.0271	0.0566**
		[0.0081]	[0.0089]		[0.0700]		[0.0166]	[0.0158]
Non-Economic Damages (NED) Cap		-0.0027	-0.0024		-0.086		-0.0211	0.0011
		[0.0123]	[0.0124]		[0.1300]		[0.0159]	[0.0143]
Punitive Damages Reform		-0.0162	-0.0155		-0.0617		-0.013	-0.0177
		[0.0102]	[0.0107]		[0.0755]		[0.0182]	[0.0183]
NED Cap, Specific To Medical Malpractice			0.0046		-0.1529		0.0334	0.0023
			[0.0089]		[0.1037]		[0.0209]	[0.0145]
Observations	1224	1224	1224	1223	1223	1224	1224	1224
R-squared	0.95	0.95	0.95	0.9	0.91	0.97	0.97	0.92

Notes: Standard errors in brackets. They are clustered at the state level. A + indicates statistical significance at 10%; * significance at 5%; ** significance at 1%.
All regressions also included the following control variables: % of state population <=4; % of state population >=65;
% state population who are males >14 and <25; % African-American; %other racial minorities; unemployment rate;
real per capita personal income; hospital beds per capita; per capita alcohol consumption; state-specific linear time trends; state-specific fixed effects; year effects.

Table 5: Estimates for Non-Auto, Non-Overdose Death Rates for Different Age Groups

Dependent Variable:	Accident Victims Aged 0 to 5	Accident Victims Aged 0 to 5	Accident Victims Aged 6 to 17	Accident Victims Aged 6 to 17	Accident Victims Aged 18 to 64	Accident Victims Aged 18 to 64	Accident Victims Aged 65 and Up	Accident Victims Aged 65 and Up
Variable								
JSL Reform	-0.0585*	-0.0624*	-0.0403	-0.0293	-0.0091	-0.0123	-0.0439**	-0.0487**
	[0.0263]	[0.0308]	[0.0326]	[0.0369]	[0.0124]	[0.0136]	[0.0124]	[0.0139]
Collateral Source Rule Reform		0.0452		0.0026		0.0193		0.0488*
		[0.0405]		[0.0459]		[0.0120]		[0.0219]
Non-Economic Damages (NED) Cap		-0.0188		-0.0125		-0.031		0.012
		[0.0309]		[0.0342]		[0.0201]		[0.0201]
Punitive Damages Reform		-0.0166		-0.0386		0.014		-0.0288
		[0.0272]		[0.0291]		[0.0160]		[0.0191]
NED Cap, Specific To Medical Malpractice		-0.004		0.0215		0.0109		-0.0112
		[0.0549]		[0.0357]		[0.0090]		[0.0134]
Observations	1224	1224	1224	1224	1224	1224	1224	1224
R-squared	0.83	0.83	0.85	0.85	0.94	0.94	0.92	0.92

Notes: See Table 4.

Table 6: Estimates Comparing the Effects of "New" and "Old" JSL Reforms

Dependent Variable:	Log of Rate of Non-Auto Accidental Deaths, Omitting Overdoses.			
	X=2	X=3	X=4	X=5
Variable				
JSL Reform,	-0.0209+	-0.0258*	-0.0276**	-0.0294**
Enacted Within the Last _X_ Years	[0.0117]	[0.0100]	[0.0095]	[0.0093]
JSL Reform,	-0.0419**	-0.0380*	-0.0395*	-0.0457**
In Place for More than _X_ Years	[0.0152]	[0.0171]	[0.0152]	[0.0133]
Observations	1224	1224	1224	1224
R-squared	0.95	0.95	0.95	0.95

Notes: See Table 4.
A tort reform enacted within the last _X_ years was enacted in the current year t, year t-x+1, or any year in between t and t-x+1.
A tort reform in place for more than _X_ years was enacted prior to year t-x+1.

Table 7: Estimated Effects of Leads of Tort Reform Variables

Dependent Variable:	Log of Rate of Non-Auto Accidental Deaths, Omitting Overdoses	
Variable		
JSL Reform	-0.0304*	-0.0370**
	[0.0136]	[0.0133]
2-Year Lead of Above	-0.0046	-0.0076
Tort Reform Variable	[0.0115]	[0.0124]
Collateral Source Rule		0.0496**
Reform		[0.0146]
2-Year Lead of Above		0.0141
Tort Reform Variable		[0.0187]
Non-Economic Damages		-0.0015
(NED) Cap		[0.0108]
2-Year Lead of Above		0.0016
Tort Reform Variable		[0.0174]
Punitive Damages		-0.0176
Reform		[0.0112]
2-Year Lead of Above		-0.0035
Tort Reform Variable		[0.0095]
NED Cap, Specific To		0.0033
Medical Malpractice		[0.0120]
2-Year Lead of Above		0.0023
Tort Reform Variable		[0.0185]
Observations	1224	1224
R-squared	0.95	0.95

Notes: See Table 4.
A 2-year lead of a tort reform variable is an indicator equal to 1 in the two years preceding the enactment of that type of tort reform and 0 otherwise.

Appendix Table 1: Summary of Changes in Other Major State Tort Reforms, 1981-2004

	Law: CSR Reforms	Law: NED Cap, General	Law: NED Cap, Medmal-Specific	Law: PD Reform
1981				
1982				
1983				IN* (+)
1984				
1985				ME* (+) , MT (+)
1986	AK (+)	AK (+) , WA (+)	MO (+) , WV (+) , WI (+)	SD (+)
1987	AL (+) , CO^ (+) , FL (+) , IL (+) , MI (+) , MN (+) , NY (+)	CO (+), HI (+), MD (+), NH (+)	AL (+), KS (+), MI (+)	AK (+) , AZ* (+) , FL (+) , OK (+)
1988	CT (+) , GA (+) , IA (+) , MT (+) , NJ (+) , OH (+)	ID (+), KS (+) , OR (+)	FL (+), KS (-) , TX* (-) , UT (+)	AL (+) , CA (+) , GA (+) , IA (+) , KS (+) , ND (+) , OH (+) , OR (+) , SC (+), TX (+)
1989	KS (+) , KY (+)	WA* (-)		KY (+) , NV (+) , UT (+) , VA (+)
1990	ID (+)			HI* (+)
1991	GA* (-)	NH* (-)		
1992			AL* (-), OH* (-)	MD* (+) , TN* (+)
1993	KS* (-)			
1994	AZ (+) , OH* (-)			MS (+)
1995	AZ (-) , KY* (-)	IL (+)		IL (+)
1996			MT (+) , ND (+)	DC* (+) , NJ (+) , NC (+)
1997	AL* (-)	OH (+)		MO* (+)
1998		IL* (-) , OH* (-)		IL* (-)
1999				
2000		OR* (-)		
2001	AL* (+)			
2002				
2003			NV (+) , MS (+) , OH (+)	AR (+)
2004			OK (+) , TX (+)	ID (+)

"+" indicates that the law was turned on (was enacted), and "-" indicates that the law was turned off (struck down or repealed).

"^" indicates that the CSR reform does not allow offsets of payments from private sources of collateral insurance

"*" along with "-" indicates that the law was found unconsitutional and reversed by the state Supreme Court.

"*" along with "+" indicates that the law was enacted by a state Supreme Court's decision, rather than a state legislature's decision.

The law is entered as turning on during the first year in which it is in place for at least half the year.

The law is entered as turning off for the first year in which it is no longer in place for at least half the year.

Appendix Table 2: Estimates Comparing "New" and "Old" Tort Reforms

Dependent Variable:	Log of Rate of Non-Auto Accidental Deaths, Omitting Overdoses			
	X=2	X=3	X=4	X=5
Variable				
JSL Reform	-0.0241*	-0.0296**	-0.0321**	-0.0358**
Enacted Within the Last _X_ Years	[0.0104]	[0.0095]	[0.0089]	[0.0089]
JSL Reform	-0.0422**	-0.0408**	-0.0443**	-0.0512**
In Place for More than _X_ Years	[0.0134]	[0.0152]	[0.0145]	[0.0141]
Collateral Source Rule Reform	0.0444*	0.0470**	0.0474**	0.0487**
Enacted Within the Last _X_ Years	[0.0189]	[0.0157]	[0.0120]	[0.0095]
Collateral Source Rule Reform	0.0382*	0.0352+	0.0321+	0.0207
In Place for More than _X_ Years	[0.0148]	[0.0193]	[0.0184]	[0.0159]
Cap on Non-Economic Damages (NED)	-0.001	-0.0132	-0.0082	-0.0065
Enacted Within the Last _X_ Years	[0.0103]	[0.0097]	[0.0106]	[0.0097]
Cap on Non-Economic Damages	-0.0078	0.0338*	0.0316*	0.0526*
In Place for More than _X_ Years	[0.0215]	[0.0163]	[0.0133]	[0.0254]
Punitive Damages Reform	-0.0117	-0.0131	-0.0136	-0.0163
Enacted Within the Last _X_ Years	[0.0106]	[0.0107]	[0.0103]	[0.0101]
Punitive Damages Reform	-0.0108	-0.0127	-0.0166	-0.0271+
In Place for More than _X_ Years	[0.0169]	[0.0175]	[0.0164]	[0.0157]
Cap on NED, Specific to Malpractice	-0.0179	-0.012	-0.0064	-0.002
Enacted Within the Last _X_ Years	[0.0126]	[0.0106]	[0.0093]	[0.0078]
Cap on NED, Specific to Malpractice	0.0272+	0.0244	0.0206+	0.0139
In Place for More than _X_ Years	[0.0139]	[0.0147]	[0.0111]	[0.0131]
Observations	1224	1224	1224	1224
R-squared	0.95	0.95	0.95	0.95

Notes: See Table 4.
A tort reform enacted within the last _X_ years was enacted in the current year t, year t-x+1, or any year in between t and t-x+1.
A tort reform in place for more than _X_ years was enacted prior to year t-x+1.

Figure 1: Accidental Death Rates, U.S., 1981-2004

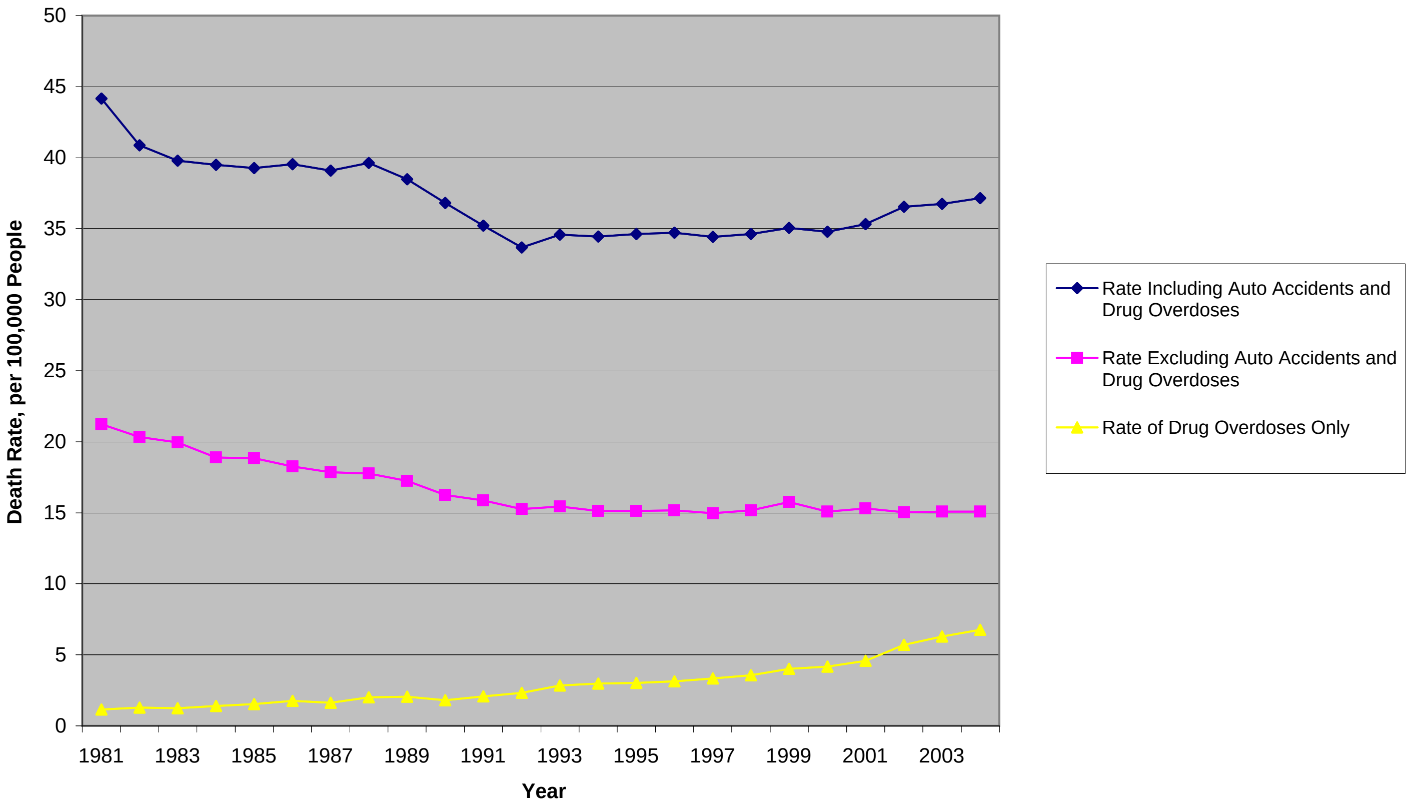

Figure 2: Accidental Death Rates by Demographic Group Excluding Overdoses and Auto Accidents