Accidental Death and the Rule of Joint and Several Liability*

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Abstract

Since 1980, a majority of U.S. states have enacted reforms to the common law tort rule of joint and several liability (JSL) which allows plaintiffs to claim full recovery from any one of multiple defendants. We develop a theoretical model of this move from JSL to a regime in which defendants are held liable only for the harm they cause (JSL reform). Contrary to previous theoretical analyses, we show that JSL reform can increase precaution by giving “deep pockets” an incentive to reduce their own liability by bringing judgment-proof agents into court. The key insight is that if being involved in a tort suit is costly, then judgment-proof agents will have an incentive to increase precaution after JSL reform. Using longitudinal data on accidental deaths in the United States, we explore the impact of JSL reform and find that it reduces death rates for many types of accidents, suggesting increased precaution levels. In the context of our theoretical model, these empirical results suggest that litigation costs and judgment-proof agents play an important role in the functioning of the American tort system.
1 Introduction

A tort is an act that causes injury, and victims of torts often sue their injurers for damages. Since the 1970s, concerns about the effectiveness of the U.S. tort system have led most states to adopt tort reforms (U.S. Congressional Budget Office (CBO) (2004)). One of the most common reforms involves the common law doctrine of joint and several liability (JSL). In cases with multiple defendants, JSL allows the injured party to recover full damages from any of the “tortfeasors.” JSL has been criticized for encouraging plaintiffs to sue “deep-pocketed” defendants who were only minimally involved in causing a harm. JSL reforms aim to mitigate this problem by moving towards a regime (several liability, or SL) in which damages are apportioned as a function of the degree of responsibility for the accident. The best available data suggest that over half of tort suits over accidental bodily injuries involve more than one defendant, and that 30 percent of them involve three or more defendants.1 Hence, the case of multiple tortfeasors is an important aspect of the American tort system.

We develop a theoretical model of the effects of this move from JSL to SL (JSL reform) on precaution and show that the results depend critically on the presence of litigation costs, and on the presence or absence of judgment-proof agents (agents whose limited resources imply that they could not pay damages assessed against them). In the absence of litigation costs, JSL reform has no effect on precaution levels. The reason is that prior to JSL reform, all states (except Connecticut) had adopted the law of contribution, which allows the defendant who pays the full damages under JSL to sue other negligent tortfeasors for their share of the damages. If there were no litigation costs, and if the other tortfeasors were able to pay

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1See U.S. Bureau of Justice Statistics (1995), which describes tort suits that terminated in 1992 in state courts for the 75 largest U.S. counties. This data base also has information about third party defendants, cross-claims, counter-claims, and third party claims, and shows that about a quarter of multi-party suits involve such claims. Many of these claims may be for “contribution” as described further below. Dobbs (2000) indicates that suits for contribution are often joined to the main suit in this way rather than being filed as separate actions.
(that is, they were not judgment-proof), then each tortfeasor would ultimately pay his or her share. With JSL reform it is the responsibility of the plaintiff to recover damages from each of the negligent parties, but in a world without litigation costs, this would make no difference. With litigation costs, JSL reform reduces the amount that a plaintiff can collect from a single defendant, which in turn leads to fewer cases and less precaution. This result captures the intuition of proponents of JSL reform, who argue that it should lead to fewer suits.

With both litigation costs and judgment-proof agents the results are quite different. Under JSL, a judgment-proof agent has no incentive to take precaution because the plaintiff will attempt to recover all damages from the other defendants. Conversely, the solvent agent will have a strong incentive to take precaution, especially if she can prevent the accident. Kornhauser and Revesz (1990) argue that JSL reform lowers the solvent agent’s liability, without affecting the judgment-proof agent’s incentives, leading to less precaution.

However, there is a potentially countervailing effect, which has not previously been described in the literature. Under JSL, the “deep pocket” is likely to be held liable for all of the damages, and will have no reason to sue the other tortfeasors if they are judgment-proof because they will not be able to contribute. With JSL reform the deep pocket’s liability is restricted to the percentage of the harm that she causes. Hence, the deep pocket now has an incentive to drag judgment-proof agents into court to establish their liability, even when they cannot contribute. If she can show that the judgment-proof agents caused some of the harm, her own liability will be reduced.

This incentive is reflected in advice found in Dobbs (2000)’s textbook on tort, which explicitly exhorts lawyers to join even insolvent agents to a case:

So [under several liability] defendants have an interest in asserting that all fault be considered, including the fault of non-parties, the fault of insolvent and
immune tortfeasors, and the fault of intentional tortfeasors (p. 1088).

The classic tort reference book of Prosser and Keeton (Prosser and Keeton (1984)) (which Dobbs also worked on as an editor) makes no mention of this point, suggesting that JSL reform changed the way that lawyers think about strategy in tort cases.

If being dragged into court imposes real costs on judgment-proof agents, then JSL reform offers a way to incentivize precaution among judgment-proof agents who previously had little reason to take precaution. In the case of physicians or contractors, for example, being found liable would harm their reputations even if the damages they faced were limited. Thus, the effects of JSL reform on precaution can be either positive or negative depending on the importance of litigation costs and the incentives for precaution created for judgment-proof agents. We also show that the results vary depending on whether precautions are substitutes or complements (that is, whether one agent’s optimal level of precaution is decreasing or increasing in the level of caution exerted by the other).

This analysis shows that the impact of JSL reform is not a theoretical question, but an empirical one. The second part of the article explores the impact of JSL reform on accidental deaths using U. S. Vital Statistics Mortality data taken from all death certificates filed in the U. S. between 1981 and 2004. Each year, 97,000 Americans die from accidental injuries, and injuries are the fourth leading cause of death (U.S. Centers for Disease Control and Prevention (CDC) (2007)). 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 find that although JSL reform has no effect on automobile deaths or drug overdoses (which account for about half of accidental deaths) it significantly reduces the number of deaths from most other causes. We show that the effect of the reform increases slightly with the length of time it has been in place, and that future JSL reforms have no effect on current accidental deaths.
Given our theoretical framework, the paper’s empirical results suggest that litigation costs and judgment-proof agents play an important role in the workings of the tort system.

1.1 Background

Landes and Posner (1980) were concerned with the movement to allow defendants liable for full damages under JSL to sue other potential tortfeasors for their share of the harm. This is the legal reform known as “contribution,” a reform that had been adopted in all states except Connecticut prior to the current wave of JSL reform. For them the puzzle was that under a negligence standard, JSL without contribution induces potential tortfeasors to take an efficient level of precaution, and hence there could be no efficiency argument in favor of the contribution rule. The negligence standard requires that a party be found negligent before they can be held liable for damages. In particular, they show that if precaution is observable, then JSL in a regime with a negligence standard but no contribution is sufficient to ensure the first best.²

The intuition is straightforward. If the negligence standard is fixed at the efficient level of precaution, then both parties can avoid all liability by choosing precaution at the efficient level. If one were to deviate to a slightly lower level of precaution, she would face full liability under JSL, and hence it would never be in her interest to do so.³ However, as Craswell and

²Landes and Posner (1980) also observe that JSL is technically equivalent to the rule of contributory negligence. This is the rule that allows a tortfeasor to avoid all liability if the plaintiff is found to be negligent as well. Mirroring the move to contribution under JSL, there has been a similar move from contributory to comparative negligence. Under the latter, defendants are only liable for the percentage of the harm they caused. A number of articles, notably Haddock and Curran (1985), Cooter and Ulen (1986) and Rubinfeld (1987), have shown that under certain conditions the rule of comparative negligence is superior to contributory negligence, but that the optimal rule is a function of characteristics of the accident. Under the optimal liability rule derived below, liability is reduced by the harm that would have arisen if agent $i$ was not negligent. This is effectively the rule of comparative negligence, though with a twist. The defendant should be liable for the marginal harm they cause, and not the proportional harm. The focus of this analysis is on changes to JSL, taking the rule of comparative negligence as given. As a consequence, for most of the analysis we focus upon precaution by the two defendants.

³Brown (1973) introduced the idea that the behavior of tortfeasors can be modeled as a non-cooperative
Calfee (1986) note, precaution is rarely perfectly observed and hence such a rule cannot necessarily ensure the first best.

The form of the optimal liability rule was further explored by Segerson (1988), Kornhauser and Revesz (1989), Miceli and Segerson (1991), and Cooter and Porat (2007) in a literature that reaches the conclusion that JSL is not in general an efficient rule, and that efficiency could be enhanced by breaking the link between total harm and total liability. Kornhauser and Revesz (1990) extend these results to the case of insolvent firms, and again find that the effect of the law is sensitive to the details of the situation.

Much of the prior literature on JSL is concerned with environmental tort cases, such as those involving Superfund sites. These studies include Kornhauser and Revesz (1994a, 1994b) and Spier (1994), who look at the structure of the settlement game and deterrence; Klerman (1996) who looks at the effects of various setoff rules applicable when one or more defendants settle and others are found liable at trial after settlement; and Klee and Kornhauser (2007), who consider a situation in which tortfeasors can choose their level of output. The only available empirical evidence on these hypotheses is the work of Chang and Sigman (2000), who find that JSL may encourage settlement in environmental tort cases.

Landes and Posner (1980) introduced the idea that precautions could have the nature of joint care or alternative care. With joint care, two individuals act together to generate a harm. That is, precautions can be thought of as complementary, with each negligent action alone able to cause harm, but total harm being greater when both parties are careless. An example of a tort case in which precautions are complements is Gill v. Tamalpais Union High School Dist., Cal.App. 1 Dist., 2008. In this case, an athlete was injured when she hit a basketball goal post at a school, and further injured afterwards when she fainted and fell off a counter she was sitting on while waiting for treatment at a clinic outside the school.

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Both the pole and the counter were considered causes, and damages were allocated to both the school and the clinic. If the clinic had provided a place for the patient to lie down rather than having her sit on a counter, the extent of her injuries would have been reduced.

With alternative care, if either individual exercises precaution there is no accident; that is, the care of one person is a substitute for the care of the other person. An example of a case with substitute precaution is *Cochrane v. Pinto*, 333 Mich. 91, 52 N.W.2d 611, Mi. 1952. A customer in a shop fell through an unguarded hole in the floor of the shop where a stairway was to be constructed. Either the owner of the shop or the construction company could have covered the hole or erected barriers around it and prevented the accident. Our model builds on this distinction between substitutes or complements and explores the implications for the impact of JSL reform.

There is a significant empirical literature that explores the effects of JSL reform on medical care. In a classic article, Kessler and McClellan (1996) group JSL reform with certain other types of tort reforms that they call “indirect reforms”. They find that these reforms result in an increase in the quality of care as measured by in-hospital deaths from heart attacks. Currie and MacLeod (2008) look at the effect of tort reform upon birth outcomes. They observe that the impact of tort law is heterogeneous and depends upon the condition of the mother and child. JSL reform has no effect on deliveries that could be classified as high risk before birth. However, for other deliveries, JSL reform reduced C-sections and complications of labor and delivery without affecting birth outcomes, suggesting that it reduced harms caused by unnecessary procedure use. In contrast, caps on damages led to more C-sections and more complications. In the current article, we also find evidence of heterogeneous effects in that some types of accidents are reduced, although others are not.

The fact that JSL reform resulted in better outcomes in these cases is a puzzle because existing models suggest that JSL reform should lead to less rather than more precaution. In the context of medical malpractice, Currie and MacLeod (2008) suggested that JSL reform
causes physicians to face a greater share of the damages in an environment where hospitals are usually the deep pockets, leading to greater care on physicians’ part. That model is very reduced form, and does not explicitly deal with judgment-proof agents or litigation costs. In this article we explicitly highlight the role played by litigation costs and judgment-proof agents in explaining the impact of JSL reform.\footnote{The recent work of Rubin and Shepherd (2007) studies the effects of tort reforms on accidental deaths, and finds that noneconomic damage caps, a higher evidence standard for punitive damages, product liability reform, and prejudgment interest reform are associated with fewer accidental deaths, whereas reforms to the collateral source rule are associated with increased deaths. They do not discuss JSL reform (and report no effect in their tables). Carvell (2010) shows that these results are sensitive to their econometric specification, which can lead to changes in sign and statistical significance for the estimated effects of the different tort reforms.}

U.S. Congressional Budget Office (CBO) (2003) discusses the importance of litigation costs in designing the optimal tort law system, and Hersch and Viscusi (2007) find that litigation costs account for 75 to 83 cents of each dollar collected. Avraham (2007) finds that JSL reform reduces annual malpractice payments by physicians (payments by hospitals are not included in the data set used in his study). However, Sharkey (2005) finds that JSL reform leads to gaming in the setting of damages in court. There is little direct evidence of the importance of judgment-proof agents, though Silver et al. (2007) find that physicians purchase less medical insurance in Texas over time, which implies that they are likely more judgment-proof. Together, these studies support the hypothesis that litigation costs are significant, and can lead to behavioral responses. However, the effects of litigation costs and judgment-proof agents on precaution are relatively unexplored.

2 What is the Expected Impact of JSL Reform?

Introduction

The purpose of this section is to explore the implications of JSL reform on precaution under the negligence standard. We introduce a model that highlights the relationship be-
tween the actions of the two parties and the optimal liability rule. In our data, precaution levels are proxied for by the accidental death rates, and the law is given by the tort regime (joint and several liability with contribution, versus several liability).

There are two features of tort reform that are salient for tortfeasors. The first is litigation costs. The American Medical Association (2008) suggests that JSL reform will lower costs by reducing incentives for frivolous suits against a deep pocket. Under JSL a plaintiff can obtain full recovery from a defendant, such as a hospital, even if liability is relatively slight. We explicitly model the effect that JSL reform has upon the incentive to sue in the presence of litigation costs. We find, consistent with the intuition of the AMA, that JSL reform should reduce suits and therefore precaution.

The difficulty with this prediction is that it is inconsistent with the existing evidence. In the case of medical malpractice both Kessler and McClellan (1996) (for heart attack patients) and Currie and MacLeod (2008) (for births) find that JSL reform leads to more rather than less precaution. In the empirical section below, we also find an increase in precaution for some classes of accidental deaths. We show below that a consideration of the role of litigation costs and judgment-proof agents can resolve this puzzle. After JSL reform, wealthy defendants have an incentive to join other potential tortfeasors to a suit, even if they are judgment proof, because if a defendant can show that another individual is partially liable, then this will directly reduce her liability.

The next three subsections present the details of this argument using a simple model of precaution. We also derive the optimal damage rule in Appendix.

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6Recent work, reviewed by Spier (2007) and Kornhauser and Revesz (2009), observes that the information held by each party at the time a suit is filed can affect the outcome of the settlement. For example, Kornhauser and Revesz (1993) point out that the outcome of settlement is sensitive to the correlation between one defendant’s likelihood of being found negligent in court and another defendant’s likelihood. In order for this to affect precaution, it must be the case that parties anticipate not only the information structure, but also the impact that this information structure has upon damages. We did not find any anecdotal evidence of the structure of information affecting legal practice.
The Model

Consider the case of two potential tortfeasors, denoted by \( A \) and \( B \), and one injured party. The analysis easily extends to the case of more than two tortfeasors. Let \( x_i \) be the investment by agent \( i \in \{ A, B \} \) in precaution. In practice, precaution \( x_i \) is rarely observed. Here, we suppose that only the consequences of precaution are observed.

From the \textit{ex ante} perspective, a potential tortfeasor is only concerned with whether or not she is likely to be found negligent. When negligence is clear, there will be no court case, and parties will settle in the shadow of the law. A small number of cases will not settle, but go to court. Let \( l_i \in \{0, 1\} \) denote whether agent \( i \in \{ A, B \} \) is found liable \((l_i = 1)\) or not liable \((l_i = 0)\), where this occurs either at time of settlement or when found negligent in court. In other words, the term “liable” as used here is synonymous with having either been found negligent or having agreed to pay damages.

Both agents \( A \) and \( B \) understand that increasing precaution levels, denoted by \( x_A \) and \( x_B \), will decrease the likelihood of being held liable for damages. Moreover, it is assumed that liability is a function only of an individual’s precaution - formally:

\[
E\{l_i|x_A, x_B\} = E\{l_i|x_i\} \equiv p_i(x_i).
\]

The function \( p_i \) is the probability agent \( i \) is found liable conditional upon precaution \( x_i \). This function is assumed to be differentiable and decreasing with \( x_i \). One way to lower liability is to reduce activity levels, and in the extreme case, to shut down operations, but we assume some positive activity level in what follows.

Suppose that the negligence decision is a sufficient statistic for precaution. Namely, letting \( h \) denote the realized harm:

\[
E\{h|l_A, l_B, x_A, x_B\} = E\{h|l_A, l_B\}.
\]

(1)
In the case of an accidental death where harm is the value of life \((D)\), this corresponds to a situation in which a person died and the courts found at least one of the agents to be negligent. The issue is who was negligent.

Given these assumptions we can now define expected harm as a function of whether a court would hold one or both agents liable:

\[
H_A = E\{h|l_A = 1, l_B = 0\},
\]
\[
H_B = E\{h|l_A = 0, l_B = 1\},
\]
\[
H_{AB} = E\{h|l_A = l_B = 1\},
\]
\[
H = E\{h|l_A = l_B = 0\}.
\]

Suppose that expected harm is correlated with liability and hence:

\[
H_{AB} \geq H_A, H_B \geq H.
\]

Our goal is to understand the effect of JSL reform upon precaution under a negligence regime. We begin with a model without litigation costs and illustrate how the technology of harm production affects an individual’s incentive to take precaution.

When \(H > 0\) this implies that the plaintiff faces a harm, even if neither \(A\) nor \(B\) is found negligent. This can occur for example when the victim has been careless herself. The rule of comparative negligence allows for a reduction in damages when the victim bears some of the blame (see Cooter and Ulen (1986) Rubinfeld (1987)). This plays a role in the determination of optimal damages, as we show in Appendix . Given that JSL reform did not affect the comparative negligence rule, for simplicity we set \(H = 0\) for the rest of the analysis.

When only one person is liable, then they are responsible for all of the damage, and hence
their liability is:

\[ L_i = H_i, i \in \{A, B\}. \]

If both agents are found liable then under JSL the plaintiff can recover all of the damages from a single defendant, usually the deep pocket. However, as discussed above, when there are no litigation costs and agents are not judgment-proof then JSL with contribution is identical to several liability (SL), in which case JSL reform would have no effect. In the next section we will show how the introduction of litigation costs leads to different outcomes under joint and several liability (JSL) and several liability (SL).

Denote the liability of agent \( i \in \{A, B\} \) when both are liable by \( L_i^J \). The issue is exactly how one should define responsibility in this context. Let \( \alpha_i \) be agent \( i \)'s share of the damages, and hence the liability is:

\[ L_i^J = \alpha_i H_{AB}, \]

where \( \alpha_A + \alpha_B = 1 \). We have assumed that precaution is not observable, but that the parameters of the model, namely \( H_A, H_B, \) and \( H_{AB} \) are potentially knowable.

By itself, \( H_{AB} \) provides no information on proportional liability. However, the amount of harm that an agent would cause if they alone were liable provides information on their degree of responsibility. Thus, a natural rule, which we simply call the proportional liability rule, is to set:

\[ \alpha_i = \frac{H_i}{H_A + H_B}. \]

When harm occurs if and only if both agents are liable, then this implies \( H_A = H_B = 0 \). In that case we set \( \alpha_i = 1/2 \).

We suppose that the agents are risk neutral, thus their payoffs are given by:

\[
U_A(x_A, x_B) = -H_A p_A(x_A) (1 - p_B(x_B)) - \alpha_A H_{AB} p_A(x_A) p_B(x_B) - x_A, \\
U_B(x_A, x_B) = -H_B p_B(x_B) (1 - p_A(x_A)) - \alpha_B H_{AB} p_B(x_B) p_A(x_A) - x_B.
\]
Assume that each agent chooses her level of precaution given her beliefs about how the other agent will act. If these beliefs are correct, then behavior is given by the Nash equilibrium of the game with payoffs given by (3) and (4). Changes in the legal rule or litigation costs can affect the actions of each agent. The subsequent equilibrium depends upon how each agent reacts to their beliefs regarding the other agent. The reaction functions for this game, which define the optimal action given beliefs, are given by:

\[
R_A(x_B) = \argmax_{x_A \geq 0} U^P_A(x_A, x_B),
\]

\[
R_B(x_A) = \argmax_{x_B \geq 0} U^P_B(x_A, x_B).
\]

Thus \(R_A(x_B)\) is the optimal level of precaution for agent A given that she believes that agent B selects precaution level \(x_B\). The slope of this reaction function corresponds to different harm technologies. For example, take the case of a substandard building foundation, discussed in Landes and Posner (1980). In that case, if the subcontractor had performed correctly, or the general contractor had supervised closely enough to avoid poor quality work, then there would have been no harm. In other words, precautions were substitutes for each other. If either agent had been careful then there would have been no harm. Harm can only arise when both agents are careless. This possibility corresponds to the case in which \(H_A\) and \(H_B\) are zero or quite small, whereas \(H_{AB}\) is large.

In contrast, when precautions are complements, harm is avoided only when both agents take the appropriate care. In that case \(H_A\) and \(H_B\) are strictly positive, and \(H_{AB}\) is only slightly larger. 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 may fall and hurt themselves, even if the guardrail is in good condition. Similarly, if the stairs are shoveled
but the guardrail fails when somebody leans on it, then there will still be a harm.\textsuperscript{7}

Whether precautions are substitutes or complements affects the slope of each agent’s reaction curve to the other’s precaution, which in turn affects the way in which litigation costs determine precaution. The next result establishes the basic properties of the reaction curves when the probability of being found negligent is a smooth function of precaution.

**Proposition 1.** Suppose that the probability of being found liable, \( p_i \), is strictly decreasing with precaution (\( p'_i < 0 \)) and convex, (\( p''_i > 0 \)), some precaution is always efficient (\( \lim_{x \to 0} p'_i(x) = -\infty \)), and it is impossible to avoid an accident with certainty (\( p_i(x) > 0, \forall x \geq 0 \)). Then the reaction functions \( R_i(x_{-i}) \) exist, with slopes given by the following conditions:

1. If care levels are separable, \( \Delta_{AB} \equiv H_{AB} - H_A - H_B = 0 \), then the best responses are independent of each other: \( \frac{dR_i}{dx_{-i}} = 0 \) for \( i \in \{A, B\} \).

2. If care levels are substitutes, \( \Delta_{AB} > 0 \), then the best response of an agent’s precaution is decreasing with the precaution of the other agent: \( \frac{dR_i}{dx_{-i}} < 0 \) for \( i \in \{A, B\} \).

3. If care levels are complements, \( \Delta_{AB} < 0 \), then the best response of an agent is increasing with the precaution of the other agent: \( \frac{dR_i}{dx_{-i}} > 0 \) for \( i \in \{A, B\} \).

The proof is found in the appendix. In this proposition we introduce an explicit measure of the degree of substitution between precautions, \( \Delta_{AB} = H_{AB} - (H_A + H_B) \). When this is zero, then the harm caused by one party is independent of the harm caused by the other. We can obtain some intuition into how substitutability affects incentives by rewriting joint

\textsuperscript{7}See *McCoy v. Monroe Park West Associates*, 44 F.Supp.2d 910 (1999) for an example of a similar slip-and-fall involving an icy staircase.
liability for $A$ in terms of $\Delta_{AB}$ (the expression for $B$ is similar):

$$L_A^J = H_A + \alpha_A \Delta_{AB}.$$ 

The case of substitutes occurs when joint liability is greater than individual liability. Conversely, precautions are complements when joint liability is less than sole liability.

The assumptions on the liability probabilities in this proposition ensure that the reaction functions are smooth functions of the other agent’s precaution. As an example, suppose that $H_A = H_B$, and hence $R_A(x) = R_B(x)$. Suppose that in one example we have strategic substitutes, $\Delta_{AB} = d > 0$, with reaction function $R^S$, and in the second example we have strategic complements, $\Delta_{AB} = -d < 0$, defining reaction function $R^C$. Given these assumptions it follows that we can define:

$$x^m = \lim_{x \to \infty} R^S(x) = \lim_{x \to \infty} R^C(x),$$

$$\bar{x} = R^S(0) > x^m,$$

$$\underline{x} = R^C(0) < x^m.$$ 

That is, in the case of substitutes, the reaction function begins at $\bar{x}$ and decreases to $x^m$. In the case of complements, we have the reverse case and the reaction function begins at $\underline{x}$ and increases to $x^m$. This is illustrated in Figure 1.

— Figure 1 Here: Equilibrium Precaution with Substitutes and Complements —

In this figure, the reaction curves in the case of substitutes are illustrated with the long dashed curves. The intersection of the two reaction curves is the Nash equilibrium, given by
the conditions:

\[ x_A^* = R^S(x_B^*), \]
\[ x_B^* = R^S(x_A^*). \]

Similarly, we have the Nash equilibrium when precautions are complements.

Notice that the effect of a judgment-proof agent is quite different in each case. Suppose agent \( B \) is judgment-proof and believes she will incur no liability or litigation costs because of this, and hence she chooses no precaution \( (x_B = 0) \). In the case of complements, this leads agent \( A \) to lower her precaution to \( x \), whereas in the case of substitutes, agent \( A \) would increase her precaution to \( \bar{x} \). In both cases however, the presence of a judgment-proof agent would reduce overall precaution in a world without litigation costs. However in the case of substitutes the lost precaution is mitigated somewhat by the liable agent.

### Applying the Model to the Case of Accidental Death

Our data deal with accidental death, and thus we focus on how JSL reform affects the incidence of precaution in these cases. Suppose that the value of a life is \( D \). The case of pure substitutes corresponds to an accident occurring if and only if both parties are negligent. In the context of our model: \( H_{AB} = D \) and \( H_A = H_B = 0 \) and \( \Delta_{AB} = D > 0 \). The case of pure complements occurs when negligence by either party leads to death, in which case \( H_{AB} = H_A = H_B = D \); in this instance \( \Delta_{AB} = -D < 0 \). Our concern here is to explore the interplay between litigation costs and the possibility of judgment-proof agents. The model can be summarized in a simple extensive-form tree, as shown in Figure 2.
Given this model we now explore the consequences of JSL reform. When only one agent
is negligent, we suppose that the plaintiff can sue for an amount $D$. When both defendants
are negligent we wish to compare the effect of litigation costs upon liability under JSL with
their effects after JSL reform (i.e. under SL). Under JSL the plaintiff sues defendant $A$, who
in turn can sue defendant $B$ for her contribution. We assume that ex ante defendant $A$ is
the target (i.e., $A$ is the “deep pocket”), and consider the effect that litigation costs have on
her behavior.

**Effect of Litigation Costs**

Suppose each agent faces a fixed cost of dealing with a suit (but that both agents are
fully solvent nonetheless). The plaintiff’s costs are $S_P$, whereas agent $A$ faces a cost $S_D$ of
defending against the suit, as well as an additional cost $S_P$ of suing $B$ for contribution. We
can make costs more general, but this will not affect the basic qualitative conclusions. A
necessary condition for a suit is that the plaintiff would rather sue than not:

$$D > S_P.$$  \hspace{1cm} (5)

After agent $A$ pays $D$, she will sue agent $B$ if and only if the recovery is greater than costs:\footnote{Note that because $H_A = H_B = D$, then $\alpha_A = \alpha_B = 1/2$.}

$$D/2 > S_P.$$  \hspace{1cm} (6)

Consider now the effect of litigation costs after JSL reform. In this case, when both
agents are negligent, then the plaintiff must have two suits, one against each agent at a cost $S_P$. These suits will be pursued if and only if (6) is satisfied. Thus, we can characterize the liability of agents as a function of the legal regime and litigation costs.

These liabilities are given in Table 1. If only one party is liable, then JSL reform will have no impact. Hence, the table shows liabilities only for the case of joint liability. Similarly, if litigation costs are high, then there will be no suits, and therefore no liability.

The first two columns show that when litigation costs are low (relative to damages), then under JSL agent $A$ will be sued and will end up paying half of the damages plus the additional cost $S_P$ of suing $B$ for contribution. With JSL reform, agent $A$ will pay only their half of the damages, whereas agent $B$’s liability is unchanged. Hence, total liability falls and there is less incentive to take precaution. The next two columns show that if litigation costs exceed half the damages, then agent $A$ pays the whole damages under JSL. Under JSL reform, it is not worth the plaintiff’s while to sue and no case is brought, so neither tortfeasor pays damages. Again, liability is reduced by JSL reform, so that precaution should be reduced as well. Hence, with legal costs but no judgment-proof agents, we expect precaution to be reduced.

### Judgment-proof Agents

A common justification for the rule of JSL is that it allows harmed parties to be fully compensated even if one of the tortfeasors is judgment-proof. In this section, we develop the
consequences of JSL reform for precaution in a world where both legal costs and judgment-proof agents are important. Suppose that agent $B$ is judgment-proof.

Normally, a judgment-proof agent is unable to pay any damages and hence would take no precaution. Suppose that agent $B$ takes no precaution and that agent $A$ is the solvent tortfeasor. Under JSL a defendant has no incentive to take action against a negligent judgment-proof co-tortfeasor because she expects no recovery. After JSL reform, if a defendant can show that another party is also liable, then the damages she is liable for will be reduced as a function of the other agent’s level of responsibility regardless of whether they are judgment-proof.\footnote{For large damages this could be a significant amount.} In order to establish liability, the judgment-proof agent will be deposed and may be asked to present evidence at trial. The court would be asked to determine whether or not the judgment-proof agent is negligent, \emph{regardless} of her ability to pay. Not only does this impose costs upon this agent in terms of her time and need to get legal representation; it may also harm the agent’s reputation. For example, in medical malpractice cases, decisions finding physicians to be negligent are recorded in the National Practitioner Data Bank, a public record available to hospitals and other health care providers.\footnote{We let $R_D$ denote the additional reputational/legal costs that are borne by a judgment-proof agent after JSL reform. $R_D$ could also include a disutility associated with being found liable for damages in a court case. What is key is that these are private costs which cannot be transferred to Agent $A$. Under JSL Agent $A$ would have no incentive to sue Agent $B$ because she is judgment-proof. However, after JSL reform, Agent $A$’s liability is reduced by bringing Agent $B$ into the case, which in turn imposes a cost $R_D$ upon Agent $B$. The effects of JSL reform with these costs are illustrated in Table 2, which follows a format similar to...}
The previous Table.

As we can see, the intermediate cost case \( (D > S_P > D/2) \) is the same as before: JSL reform leads to less precaution. However, when litigation costs are low relative to damages \( (D/2 > S_P) \), the penalties for the judgment-proof agent increase after JSL reform. If this effect is sufficiently large—namely, when the reputational concerns and disutility from dealing with a court case are sufficiently large for Agent B—then JSL reform can lead to greater precaution.

The case of *Ready v. United/Goedecke Services, Inc.*, 367 Ill.App.3d 272 (2006) offers an interesting example of the incentives JSL reform creates for bringing parties who cannot be expected to pay damages into court. In this case, a carpenter was killed when scaffolding collapsed. The plaintiff sued the worker’s employer, the general contractor, and the scaffolding subcontractor. The first two defendants settled out of court, leaving only the subcontractor as a defendant at the trial. The subcontractor wanted the settling firms to be listed as co-defendants for the purposes of determining fault, and the apportioning of damages. The lower court denied this. This ruling was later overruled by the appellate court. Justice Karnezis held that the joint and several liability reform in effect in Illinois at the time of this accident required that a remaining defendant’s culpability be assessed relative to the culpability of all defendants, including settling defendants. This ruling allowed a defendant

9. Or immune from liability, or have settled with the plaintiff.
10. This data bank provides information on physicians who have been found liable in medical malpractice cases. See http://www.npdb-hipdb.hrsa.gov/ for further information.
(as opposed to a plaintiff) to bring other culpable parties into a case.

Finally, we can show that the strength of the effect of JSL reform depends on whether precautions are complements or substitutes. The accident rate in the case of pure substitutes is given by:

\[ AR^S(x_A, x_B) = p(x_A) \times p(x_B), \]

and hence the marginal impact of \( B \)'s precaution is:

\[ \frac{\partial AR^S}{\partial x_B} = p(x_A) \times p'(x_B). \]

In practice we would expect the probability of an accident to be relatively small—it is the large damages that arise from an accident that cause individuals to take precaution.

The accident rate in the case of pure complements is given by:

\[ AR^C(x_A, x_B) = p(x_A) + p(x_B) - p(x_A) \times p(x_B), \]

and the marginal effect of precaution is:

\[ \frac{\partial AR^C}{\partial x_B} = (1 - p(x_A)) \times p'(x_B) \gg \frac{\partial AR^S}{\partial x_B}. \]

Hence, when precautions are complements we expect that law changes that increase \( B \)'s precaution will have a larger effect than when precautions are substitutes.

**JSL Reform When Precaution Affects Responsibility**

A key ingredient of tort law is the allocation of fault between parties when both are found liable. Thus far we have assumed that this rule is a function of the harm caused, a function given by (2). This is a standard assumption in the tort literature. We have maintained this

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\(^{11}\)We are grateful to Judith Chevalier for suggesting the discussion of this issue.
assumption for two reasons. First, we have assumed that the main evidence before the courts is the potential damages. Second, as we show in Appendix, it is possible to implement the efficient solution using only the damage information contained in $H_{AB}, H_A$ and $H_B$.

In this section we consider the implications of making the sharing rule depend upon the \textit{probability} of an accident. That is, the courts might apportion blame using evidence of actions taken by the tortfeasors to limit the probability of an accident. Suppose Agent B is judgment proof, and Agent A’s responsibility depends upon the probability of an accident given the actions taken by A, rather than on the damages. In order to distinguish this case from the one discussed above, let us ignore the possibility that B incurs disutility if she is deposed and asked to present evidence at trial, and assume that B therefore takes no precaution. Hence $p_B = p(0)$.

Consider first an accidental death under the doctrine of JSL with contribution and in which precautions are substitutes. In that case, Agent A is liable for all of the loss, and hence her payoff is given by:

$$U_{JSL}^A(x_A) = -D \times p_A(x_A) \times p_B - x_A.$$  

The unique, optimal precaution by Agent A in this case is defined by:

$$-p_A'(x_A^*) = \frac{1}{p_B D}.$$  

(7)

The issue then is how precaution would change with JSL reform? Suppose that the sharing rule is a function of the probability of having an accident and is given by $\alpha(x_A)$. In this case, the payoff of Agent A is now:

$$U_{SL}^A(x_A) = -\alpha(x_A) D \times p_A(x_A) \times p_B - x_A.$$  

23
Suppose that there is a unique optimal precaution level that is characterized by the first order conditions. In that case we can derive the effect of JSL reform by computing \( dU^\text{SL}_A(x_A^*)/dx_A \). JSL reform leads to greater precaution by Agent A if and only if this derivative is positive. This fact combined with a straightforward computation leads to the following proposition:

**Proposition 2.** If the optimal level of precaution is uniquely defined by the first order condition, then a change from a legal regime of JSL with contribution to a regime of several liability (SL) results in more precaution if and only if

\[
\frac{\theta^*_\alpha}{\theta^*_pA} > \frac{1 - \alpha(x^*)}{\alpha(x^*)},
\]

where \( \theta^*_\alpha = \frac{d\alpha(x^*)}{dx} \frac{x^*}{\alpha(x^*)} \) and \( \theta^*_pA = \frac{dp_A(x^*)}{dx} \frac{x^*}{p_A(x^*)} \) are the elasticities of responsibility and accident probabilities with respect to A’s precaution at the optimal precaution level under JSL.

In words, if the share of responsibility assigned to agent A is sufficiently responsive to precaution relative to the effect of precaution on the accident probability then JSL reform may lead to more precaution. This would occur when there are signals of Agent A’s precaution that the courts can observe easily. The same proposition applies to the case of complements because the additional term in \( U^\text{JSL}_A(x_A^*) \) and \( U^\text{SL}_A(x_A^*) \) is not affected by whether harms are substitutes or complements.

Hence, in this sub-section we have described a second mechanism that increases precaution under certain conditions. This time it is Agent A who is encouraged to take precaution by JSL reform because if A takes more precaution, then the courts will treat her more leniently. (Above precaution increased because JSL reform gave the judgment-proof agent
an incentive to take precaution, an effect we have explicitly ruled out here). However, the conditions necessary to generate an increase in precaution by A are rather special.

To see this, consider a natural way that responsibility might be in apportioned in terms of the probability of causing an accident. Let:

\[ \alpha (e_A) = \frac{p_A (x_A)}{p_A (x_A) + p_B}. \]

Given this definition (8) is *not* satisfied because \( \frac{\theta^*}{\theta^*_{p_A}} = \frac{p_B}{p_A + p_B} < \frac{p_B}{p_A} = \frac{1 - \alpha (x^*)}{\alpha(x^*)} \). Hence, JSL reform in the presence of a judgment proof agent would result in less precaution. It is still true however that courts could mitigate any adverse effect of JSL reform on precaution by making the degree of responsibility of the deep pocket more sensitive to evidence of precaution taken by that party.

**Summary and Empirical Implications**

JSL reform has involved a movement away from JSL with contribution to a regime of several liability in which each party is responsible for the harm that they cause. We show that the impact of JSL reform depends critically on several features of the legal environment. Without litigation costs, JSL reform should have no effect relative to a JSL regime with contribution. With litigation costs, the impact of JSL reform will depend on whether there are judgment-proof agents, to a lesser extent on whether precautions taken by potential tortfeasors are substitutes or complements, and possibly on the extent to which precautions are observed by the courts and used to determine liability. Although the standard intuition is that JSL reform should reduce precaution by reducing the liability of the deep pocket, we also show that there are circumstances in which JSL reform will increase precaution. JSL reform can do this by creating an incentive for the deep-pocketed party to bring judgment-
proof agents into court in order to reduce the deep-pocketed party’s liability. Thus JSL reform can create an incentive for judgment-proof agents to take care. This incentive is likely to have the greatest impact on accident rates when precautions are complements; by distributing liability and litigation costs between both defendants, JSL reform may enhance total precaution. In the subsequent empirical analysis we use these distinctions to help understand our findings on the impact of JSL reform.

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 LexisNexis 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. For the current project, the data base was extended by incorporating information from 1981-1984.\footnote{For use in the current project, we also collected data on state compulsory auto insurance laws from Table 1 of Cohen and Dehejia (2004), and data on state no-fault auto insurance laws from Anderson et al. (2010) and Insurance Information Institute (2010).} Errors in previous data bases about tort reform might account for some of the disparate findings in the literature (see U.S. Congressional Budget Office (CBO) (2004)).

Table 3 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 percent of the damages. We obtained results similar to those reported below when using an alternative
measure of JSL reform defined as a change in which a tortfeasor had to be responsible for at least 50 percent of the harm in order to be assessed 100 percent of the damages.\textsuperscript{13}

Table 3 shows that JSL reform was largely concentrated in the period from 1985 to 1992, and that there is considerable variation across states in whether and when JSL reforms were enacted. Other tort reforms took place over a somewhat longer period, as shown in Appendix Table 1. In what follows, we will ensure 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 look at all major categories of accidental deaths (those due to unintentional injuries). The largest single category is deaths due to automobiles, which account for 45% of all deaths. The remaining large categories are falls (11.4%), fatal overdoses on illegal drugs and abused pharmaceuticals (8%), drownings (4.5%), suffocations (4.7%), fires and burns (4.3%), transportation-related accidents not involving automobiles (2.3%), poisonings (1.3%), and accidental firearm injuries (1.3%) (U.S. Centers for Disease Control and Prevention (CDC) (2007)). These types of accidents frequently result in tort suits (with the exception of drug overdoses, as explained below). For instance, McFarland and Weissenberger (2001) state that the “slip and fall” case is the most common type of premises liability tort suit.

We find quite different effects on automobile accidents and drug overdoses than on other categories, as shown below, and we believe there may be good reasons for this. Auto accidents have been the focus of many other state laws such as those for no-fault auto insurance (which are intended specifically to remove many auto accident injury claims from the standard

\textsuperscript{13} 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 found to be 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).
negligence-based tort law system), mandatory auto insurance (which are intended specifically
to reduce the number of judgment-proof agents), and penalties for drunk driving (Landes
(1982), Chaloupka et al. (1993), and Cohen and Dehejia (2004)). Drug overdoses may be a
special case because they seldom result in tort suits, and hence are unlikely to be greatly
affected by tort law.\textsuperscript{14} Drug overdoses may also be strongly affected by drug control policies
and policing (Becker et al. (2006)).

Rates are constructed by dividing the number of deaths by the Census Bureau’s esti-
mates of state population in each year (U.S. Bureau of the Census (2009)). Figure 3 groups
accidental deaths into three categories: Those due to automobiles, those due to drug over-
doses, and all others. Figure 3 shows that the three categories of accidental deaths show
quite different trends nationally. 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 shows a continuous decline over the entire 1981-2004 period. Figure 4 illustrates
how the rate of accidental deaths in the "other" category has changed nationally over time
within different demographic groups. The figure shows the stark differences between the ac-
cident rates for the elderly and other groups, and also the increasing rates among the elderly
over time (perhaps due to the aging of this population). It will be important to control for
underlying time trends in our analyses.

Data on additional time-varying state-level control variables come from various sources.
These include: data on the fractions of the state population who are elderly and under
age 5, as well as data on the fraction of young (age 15-24) males taken from the Census;

\textsuperscript{14} A WestLaw search shows that there are in fact a few tort cases involving drug overdoses. For example,
in Cook v. Kendrick, 931 So. 2d 420 (La. App. 2nd Cir., 2006) a defendant party host was found liable
for 20 percent of the harm from an overdose because he did not make a reasonable effort to seek medical
attention for the overdose victim. 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.
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.\footnote{We use the same control variables as Rubin and Shepherd (2007) to deal with the variation in accidental death rates by demographic groups, and the relationship between accident victims’ incomes and employment status, which affects 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 alcohol often plays a role in accidents.}

We omit Connecticut from our model because Connecticut was the only state that did not allow contribution prior to the implementation of JSL reform. In practice, this makes little difference to our estimates, however.

Table 4 shows that there are about 37 accidental deaths per 100,000 persons per year, and about 17 accidental deaths per 100,000 in the “other” category. Table 4 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 is 67 per 100,000. Table 4 also breaks out death rates for state-years with and without JSL reform. A comparison 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. 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. These differences must be controlled for in an analysis of the effects 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 the extent to which the care taken is observable, on the “technology” relating care to potential harms, on the size of litigation costs and on the solvency of potential tortfeasors. Table 3 showed that there was 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 differences-in-differences framework.

Our main econometric model is the following:

\[
RATET_{st} = a + b_1 JSLR_{st} + b_2 XVAR_{st} + b_3 YEAR_t \\
+ b_4 STATE_s + b_5 STATE_s \times TIME + \epsilon_{st}, \tag{9}
\]

where \(s\) and \(t\) denote states and years, respectively. \(RATET\) denotes a rate (per 100,000 state residents) of accidental deaths. \(JSLR\) 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 \(STATE \times TIME\) 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.\(^{16}\)

We first estimate equation (9), 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 different types of accidental deaths (given the possibility of heterogeneous effects)\(^{17}\), and for

\(^{16}\) Carvell (2010) shows that estimates from models without time trends are often implausible. For example, 2-year “leads” of some tort reform variables (see below) 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.

\(^{17}\) Although it would be convenient to be able to identify types of accidents in which precautions were
different age groups in view of the large differences in accidental death rates by age.

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

\[
RATE_{st} = a + b_1JSLR\_NEW_{st} + b_2JSLR\_OLD_{st} + b_3XVAR_{st} + b_4\text{YEAR}_t + b_5\text{STATE}_{s} + b_6\text{STATE}_{s} \times \text{TIME} + \varepsilon_{st}. \tag{10}
\]

It might be the case that older reforms have more impact, because 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)). \textit{JSLR\_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, or 4. \textit{JSLR\_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 robustness check, we estimate:

\[
RATE_{st} = a + b_1\text{JSL}_{st} + b_2\text{JSL\_LEAD}_{st} + b_3XVAR_{st} + b_4\text{YEAR}_t + b_5\text{STATE}_{s} + b_6\text{STATE}_{s} \times \text{TIME} + \varepsilon_{st}. \tag{11}
\]

This regression includes an indicator equal to one in the two years preceding the enactment of a 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 generally substitutes and types of accidents in which precautions were generally complements, our reading of the case literature does not support such a simple dichotomy. For example, we cited two “falls” cases above: \textit{Cochrane v. Pinto} in which precautions were substitutes, and \textit{McCoy v. Munroe} in which precautions were complements.
In addition to these specifications, we also estimate some of our models separately for deaths that occur in the hospital and those that occur outside the hospital. The idea is that if JSL reform were acting primarily through its effects on medical care, we might see a greater effect on deaths in the hospital. We also estimate models of automobile deaths controlling separately for no fault auto insurance laws and compulsory auto insurance laws, as these have been said to have important impacts on auto accidents, and because insurance might play an important role in determining the optimal levels of precaution taken by potential tortfeasors.

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 (9) are shown in Table 5. Columns 1 and 2 of Table 5 show that none of the tort reforms are estimated to have any effect on overdoses. As we argued above, this is a reasonable finding given that overdoses seldom result in tort suits. Columns 3 and 4 show that we find no effect on auto accidents either. It is less clear what to expect in these cases. On the one hand, auto accidents often result in tort suits. On the other hand, it is not clear how much impact state-level tort reforms will have if, for example, the tort suit is filed against the auto maker (who sells autos in every state). Moreover, as discussed above, there are many other laws that might have an effect on auto accidents. In addition to the insurance market, which is likely to affect incentives to take precaution, mandatory insurance laws may reduce the number of judgment-proof agents. If there are no judgment-proof agents, then our model predicts that tort reform will have no effect. Column 7 shows estimates which control
for state-level laws on no-fault auto insurance and compulsory auto liability insurance. The no fault law is associated with a higher rates of death due to auto accidents (as found previously by Landes (1982) and by Cohen and Dehejia (2004)). However, the coefficient on JSL reform is not statistically significant with or without these controls.

Given that we find no effect of JSL reform on categories accounting for half of all accidental deaths, it is perhaps unsurprising that we do not find a significant effect on accidental deaths as a whole. However, it appears that this result masks considerable heterogeneity in the effects of JSL reform on different categories of accidents.

The fifth column of Table 5 shows that JSL reform reduces the non-auto, non-overdose accidental death rate by .43 deaths per 100,000 persons on a baseline of 17.01 deaths per 100,000 persons. The numbers imply that in the U.S. population of 310 million, JSL reform would avert approximately 1,300 deaths per year. The estimates shown in column 6 show that controlling for other prominent tort reforms only increases the estimated effect of JSL reform. For example, the column 6 estimate of -.54 implies that approximately 1,700 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"), caps on non-economic damages that are specific to medical malpractice (i.e., that only apply in medical malpractice claims, rather than in all or most types of tort suits in general as with other caps on non-economic damages), and changes to punitive-damages rules.18

Of these other tort reforms, only changes to CSR have an impact. Most reforms to 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 from third-party "collateral" sources, such

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18Changes 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 generally used is that there must be clear and convincing evidence, rather than merely a preponderance of evidence, that the defendant’s conduct justifies punitive damages.
as payments from insurance companies. Thus, these reforms directly reduce the amount a potential tortfeasor can expect to pay and should reduce precaution. Table 5 suggests that reforms to CSR do encourage potential tortfeasors to take less care, with a resulting increase in fatal accidents.

Caps on non-economic damages (whether they are general caps or only applicable in cases of medical malpractice) are also intended to limit payouts by tortfeasors, but have little impact on accidental deaths. Some states have separate laws pertaining to non-economic damage caps for medical malpractice, and we included indicators for these laws separately. Tort reforms might affect death rates not by preventing accidents but by improving the medical 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 these separate damage caps had this effect.

Column 7 focuses on accidental deaths where the victim was pronounced dead outside of a hospital. The coefficient on JSL reform is very similar to the one in column 6, indicating that JSL reform reduces accidental deaths even among those who never make it to a hospital. Hence, it is unlikely that the effect is driven entirely by changes in the behavior and/or supply of medical providers who care for accident victims.19 Our interpretation is that instead, JSL reform is affecting accidental death rates by preventing some classes of accidents that would otherwise lead to death.

Table 6 presents estimates of equation (9) by age. We find significant effects of JSL reform on the very young (children aged zero to five) and on those age 65 or over. The point estimate for working-aged people 18 to 64 is similar to that for preschool children, but is not quite significant at the 95% level of confidence. Estimates for school-aged children are much smaller, and not precisely estimated. Among the elderly, the estimates suggest that

19Note that if deaths were being prevented mainly by improvements in medical care made in response to tort reform, one might expect this to also impact deaths due to auto accidents.
2.4 per 100,000 fewer elderly people suffer accidental deaths after reform, which implies a reduction of about 854 deaths per year. However, because the elderly have much higher rates of “other” fatal accidents than others, the percentage reduction in fatal accidents (3.5%) is actually lower than in the other age groups. For example, the estimates imply a 9% reduction in “other” fatal accidents among young children and an 8.1% decline in fatal accidents among working aged adults. Still, given the preponderance of accidental deaths among the elderly, our estimates imply that over half of the deaths averted due to JSL reform occur in this age group.

Turning to other tort reforms, 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 for medical treatment of injuries sustained in accidents have to be set against any damages that victims and their families could collect from tortfeasors when a CSR reform is in place.

Estimates of equation (10) are shown in Table 7. 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 4 years in column 3. Table 7 suggests that people respond rapidly to a JSL reform. For example, column 1 shows that JSL reforms enacted within the last two years reduce accidental deaths by .43 per 100,000, whereas those that have been in place for more than two years decrease them by .58 deaths per 100,000. The next column suggests, however, that the effect of a reform passed within the last 3 years is virtually identical to the effect of a reform that has been in effect for more than 3 years. The estimated effect of .52 per 100,000 is very similar to the baseline full sample estimate of .53 per 100,000 shown in Table 5. Once again, CSR reform is the only other tort reform that has a consistently significant effect, and as discussed above, it increases accidental death.

Table 8 shows our estimates of equation (11). An indicator for the two year “lead” of the JSL reform is added to these regressions; the estimates shown in column (2) of Table
8 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.

Finally, Table 9 shows separate estimates for the largest categories of accidental deaths (other than automobile accidents and drug overdoses). Together, these categories account for 66 percent of non-automobile, non-overdose deaths. It is remarkable that all of the estimated coefficients besides that on non-overdose poisonings are negative, and all but the coefficient on drownings are statistically significant.

6 Discussion

Our theoretical model implies that under the negligence standard, JSL reform will only have a significant effect on accident rates if litigation costs are important. Moreover, even when litigation costs are important, our model implies that we will see negative effects of JSL reform on accident rates if judgment-proof agents play an important role in causing and preventing accidents. The intuition for our result is that JSL reform can only encourage judgment-proof agents to take care by imposing costs on them in the event that they are negligent. This occurs because under JSL reform, solvent parties who are sued have an incentive to bring all the other tortfeasors into court in order to show that they are responsible for some of the harm.

The empirical section of our article finds that JSL reforms are associated with significant decreases in some categories of fatal accidents. Thus, our empirical results provide evidence for the importance of litigation costs and judgment-proof agents in understanding the functioning of the tort system. Our empirical results justify the theoretical focus on JSL reform, with its complex implications for the incentives of multiple parties.
Our estimates suggest that in many cases, JSL reform increases the level of care taken, so that the incidence of important categories of fatal accidents is reduced. The primary beneficiaries of JSL reforms are the elderly, because they are disproportionately likely to suffer from non-automotive and non-drug overdose accidental deaths. Our estimates suggest that 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 deaths due to accidents, whereas overall social efficiency will also depend on what happens to non-fatal accidents, court costs (Shavell (1982)), and on uncertainty about expected court costs (Craswell and Calfee, 1986). In addition, 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.

References


Appendix A Proof of Proposition 1

Under the assumption of strong uncertainty, agent A’s best response to agent B’s precaution satisfies:

\[- p'_A(R(x_B)) = \frac{1}{H_A(1 - p_B(x_B)) + \alpha_A H_{AB} p_B(x_B)},\]

\[= \frac{1}{H_A + \alpha_A \Delta_{AB} p_B(x_B)} \equiv g_A(x_B, \Delta_{AB}).\]  

Notice that \(g(x_B, \Delta_{AB}) \geq \frac{1}{\min(H_A + H_B, H_{AB})} > 0\). From the strong uncertainty condition we can conclude that \(\lim_{x \to \infty} p'_A(x) = 0\), and hence there always exists a solution \(R_A(x_B)\) for every \(x_B\). The fact that \(p''_A > 0\) ensures that the solution is unique. A similar argument applies to \(R_B\). Furthermore, the fact that expected harm is bounded implies that there is an \(\bar{x}\) such that \(R_A, R_B \leq \bar{x}\), from which we conclude that the mapping \(H : [0, \bar{x}]^2 \to [0, \bar{x}]^2\) defined by \(H(x_A, x_B) = (R_A(x_B), R_B(x_A))\) is well-defined and continuous. From this we conclude by Brouwer’s fixed point theorem that there exist \(\{x^N_A, x^N_B\}\) satisfying

\[H(x^N_A, x^N_B) = (x^N_A, x^N_B),\]

and hence a Nash equilibrium exists.

Notice that \(\text{sign} \{\partial g_A/\partial x_B\} = \text{sign} \{\Delta_{AB}\}\), and similarly for \(g_B\). This, combined with the fact that \(p_A\) and \(p_B\) have continuous second derivatives implies conditions 1-3 of the proposition.

Appendix B Optimal Liability Rule

The purpose of this section is to derive the optimal liability rule, as opposed to exploring the effect of a change in legal regime from joint and several liability to several liability.
This analysis illustrates the effect of the precaution technology (i.e., whether precautions are substitutes or complements) upon the form of the optimal liability rule, and shows that in general neither of these rules are efficient. For this model social welfare is:

\[
SW(x_A, x_B) = -H_{AB}p_A(x_A)p_B(x_B) - H_A p_A(x_A)(1 - p_B(x_B)) \\
- H_B(1 - p_A(x_A))p_B(x_B) - H(1 - p_A(x_A))(1 - p_B(x_B)) \\
- x_A - x_B.
\] (13)

This is the expected loss from accidents, less the total cost of precautions. The question we pose here is what is the liability rule that results in agents choosing the efficient level of compliance? The first order conditions for the optimal level of precaution are given by:

\[
SW_{x_A} = -\{\Delta_A + p_B(x_B^*)\Delta_{AB}\} p'_A(x_A^*) - 1 = 0, \tag{14}
\]

\[
SW_{x_B} = -\{\Delta_B + p_A(x_A^*)\Delta_{AB}\} p'_B(x_B^*) - 1 = 0. \tag{15}
\]

where \(\Delta_i = H_i - H, i \in \{A, B\}\), and \(\Delta_{AB} = H_{AB} + H - H_A - H_B\). Let \(L_A^*, L_B^*\) be the optimal liability when either \(A\) or \(B\) is found solely liable, and let \(L_A^{J*}\) and \(L_B^{J*}\) be \(A\) and \(B\)'s liability when they are found jointly liable. The first order conditions for precaution by agents \(A\) and \(B\) are correspondingly:

\[
0 = \frac{\partial U_A(x_A^*, x_B^*)}{\partial x_B} = -\{L_A^* + (L_B^{J*} - L_B^*) p_B(x_B^*)\} p'_A(x_A^*) - 1, \tag{16}
\]

\[
0 = \frac{\partial U_B(x_A^*, x_B^*)}{\partial x_B} = -\{L_B^* + (L_A^{J*} - L_A^*) p_A(x_A^*)\} p'_B(x_B^*) - 1. \tag{17}
\]

If one compares (14) and (15) with (16) and (17) one has the following proposition:
Proposition 3. The liability rule that achieves efficient precaution is given by:

\[
L^*_i = H_i - H, \\
L^*_i = H_{AB} + H - H_i,
\]

for \( i \in \{A, B\} \).

Observe that optimal individual liability, \( H_i - H \), entails reducing damages by the amount of harm if neither \( A \) nor \( B \) is found negligent. This formally captures the doctrine of comparative liability, where a harmed party’s damages are reduced by the amount of harm their own actions created (see for example Cooter and Ulen (1986)). Second, observe that the optimal total liability when both parties are found negligent is given by:

\[
L^*_A + L^*_B = H_{AB} + \Delta_{AB}.
\]

Thus, when precaution are complements, \( \Delta_{AB} < 0 \), and so total liability is less than expected harm, \( H_{AB} \). This implies that for damage rules that entail a division of the harm between the negligent parties there may be over-deterrence. In the case of substitutes, \( \Delta_{AB} > 0 \), we have the opposite - total liability is greater than total harm as \( L^*_A + L^*_B > H_{AB} \). In this case we may get under-deterrence with a damage rule like SL that sets total liability equal to total harm and then apportions the total harm between the negligent parties. Segerson (1988) has pointed out the under-deterrence effect in the case of environmental tort where precautions are substitutes. Cooter and Porat (2007) provide a solution to this problem based upon the total harm that does not entail apportioning negligence. Our result shows that the extent to which there is over- or under-deterrence depends upon the extent to which precautions are complements or substitutes.
Figure 1: Equilibrium Precaution with Substitutes and Complements
Figure 2: Effect of Harm in the Cases of Pure Substitutes and Pure Complements ($x_A, x_B \in \{L, H\}$)
Figure 3: Accidental Death Rates, U.S., 1981-2004

- Rate Including Auto Accidents and Drug Overdoses
- Rate Excluding Auto Accidents and Drug Overdoses
- Rate of Drug Overdoses Only

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<tr>
<th>Year</th>
<th>Death Rate, per 100,000 People</th>
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<td>2001</td>
<td>5</td>
</tr>
<tr>
<td>2003</td>
<td>10</td>
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Figure 4: Accidental Death Rates by Demographic Group
Rates Exclude Overdoses and Auto Accidents
Table 3: Summary of Enactment Dates of State JSL Reforms, 1981–2004

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<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>1981</td>
<td>MN</td>
</tr>
<tr>
<td>1982</td>
<td>NM</td>
</tr>
<tr>
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<td>IN, IA</td>
</tr>
<tr>
<td>1984</td>
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<td>CO, CT, FL, HI, IL, MI, NY, SD, WA</td>
</tr>
<tr>
<td>1986</td>
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</tr>
<tr>
<td>1987</td>
<td>MN</td>
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<td>1988</td>
<td>MS, NH</td>
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<td>NE, TN</td>
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<td>2003</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
</tr>
</tbody>
</table>

The law is entered as turning on during the first year in which it is in place for at least half the year.
Table 4: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Sample</th>
<th>State-Year Obs. without a JSL Reform</th>
<th>State-Year Obs. with a JSL Reform</th>
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<td>Accidental death rates, per 100,000:</td>
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<td>- drug overdoses only</td>
<td>3.07</td>
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<td>[1.78]</td>
<td>[2.38]</td>
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<td>- auto accidents only</td>
<td>17.36</td>
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<td>- excluding auto accidents and drug overdoses</td>
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<td>- pronounced dead outside of hospital</td>
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<td>10.39</td>
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<td>9.75</td>
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<td>Accidental death rates, per 100,000, by demographic group excluding overdoses and auto</td>
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<td>- Ages 0 to 5</td>
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<td>[3.14]</td>
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<td>State-Year Level Controls:</td>
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<td>Real per Capital Personal Income ($2004)</td>
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<td>Percent African-American</td>
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<td>Percent Other Minority</td>
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<td>Percent Age 4 and Under</td>
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<td>Percent Age 65 and Over</td>
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<td>Percent Males Age 15 to 24</td>
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<td>Per Capita Alcohol Consumption</td>
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Notes: All values are for annual state-level observations from 1981 to 2004, weighted by state-year populations. The standard deviation is below the mean in brackets.
Table 5: Effects of JSL Reform on Accidental Deaths

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<td>Other Accidents</td>
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<td>JSL Reform</td>
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<td>-0.0054</td>
<td>-0.4291*</td>
<td>-0.5348**</td>
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<td>0.7535**</td>
<td>0.5656**</td>
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<td>Non-Economic Damages (NED) Cap Reform</td>
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<td>Punitive Damages</td>
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<td>[0.2071]</td>
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<td>NED Cap, Specific To Medical Malpractice</td>
<td>-0.2827</td>
<td>0.4402</td>
<td>0.0881</td>
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<td>Compulsory Auto</td>
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<td>0.91</td>
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</table>

Notes: Standard errors in brackets. They are clustered at the state level. A + indicates statistical significance at 10%; * significance at 5%; ** significance at 1%.

The "Other Accidents" category includes all types of accidents other than drug overdoses and automobile accidents. 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 6: Estimated Effects of JSL Reform, by Age

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<tr>
<th>Dependent Variable</th>
<th>Aged 0 to 5</th>
<th>Aged 6 to 17</th>
<th>Aged 18 to 64</th>
<th>Aged 65 and Up</th>
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<tr>
<td>JSL Reform</td>
<td>-0.9729*</td>
<td>-0.2398</td>
<td>-0.9171</td>
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<td>[0.1929]</td>
<td>[0.5766]</td>
<td>[0.8928]</td>
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<td>Collateral Source Rule</td>
<td>0.8427</td>
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<td>[0.5091]</td>
<td>[0.1982]</td>
<td>[0.3303]</td>
<td>[0.9948]</td>
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<tr>
<td>Non-Economic Damages</td>
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<td>-0.1284</td>
<td>0.4375</td>
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<td>(NED) Cap</td>
<td>[0.3197]</td>
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<td>[0.3880]</td>
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<td>[0.1475]</td>
<td>[0.4514]</td>
<td>[1.1384]</td>
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<tr>
<td>NED Cap, Specific To</td>
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<td>0.1319</td>
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</tr>
<tr>
<td>Medical Malpractice</td>
<td>[0.5547]</td>
<td>[0.1345]</td>
<td>[0.2927]</td>
<td>[0.7810]</td>
</tr>
<tr>
<td>Observations</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.82</td>
<td>0.86</td>
<td>0.98</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Notes: See Table 5. Auto accidents and overdoses are excluded.
Table 7: Estimates Comparing the Effects of "New" and "Old" JSL Reforms on the Rate of Accidental Death

<table>
<thead>
<tr>
<th></th>
<th>X=2</th>
<th>X=3</th>
<th>X=4</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSL Reform</td>
<td>-0.4331*</td>
<td>-0.4960**</td>
<td>-0.5182**</td>
</tr>
<tr>
<td>Enacted Within the Last <em>X</em> Years</td>
<td>[0.1863]</td>
<td>[0.1783]</td>
<td>[0.1759]</td>
</tr>
<tr>
<td>JSL Reform</td>
<td>-0.5755*</td>
<td>-0.5286*</td>
<td>-0.5341*</td>
</tr>
<tr>
<td>In Place for More than <em>X</em> Years</td>
<td>[0.2488]</td>
<td>[0.2624]</td>
<td>[0.2617]</td>
</tr>
<tr>
<td>Collateral Source Rule Reform</td>
<td>0.7943*</td>
<td>0.7956**</td>
<td>0.8145**</td>
</tr>
<tr>
<td>Enacted Within the Last <em>X</em> Years</td>
<td>[0.3064]</td>
<td>[0.2468]</td>
<td>[0.1895]</td>
</tr>
<tr>
<td>Collateral Source Rule Reform</td>
<td>0.6459*</td>
<td>0.6360*</td>
<td>0.5120+</td>
</tr>
<tr>
<td>In Place for More than <em>X</em> Years</td>
<td>[0.2497]</td>
<td>[0.3036]</td>
<td>[0.2809]</td>
</tr>
<tr>
<td>Cap on Non-Economic Damages (NED)</td>
<td>-0.1130</td>
<td>-0.3019+</td>
<td>-0.2125</td>
</tr>
<tr>
<td>Enacted Within the Last <em>X</em> Years</td>
<td>[0.2100]</td>
<td>[0.1776]</td>
<td>[0.1799]</td>
</tr>
<tr>
<td>Cap on Non-Economic Damages</td>
<td>-0.1452</td>
<td>0.5360</td>
<td>0.4781+</td>
</tr>
<tr>
<td>In Place for More than <em>X</em> Years</td>
<td>[0.3226]</td>
<td>[0.3329]</td>
<td>[0.2552]</td>
</tr>
<tr>
<td>Punitive Damages Reform</td>
<td>-0.1950</td>
<td>-0.2094</td>
<td>-0.2186</td>
</tr>
<tr>
<td>Enacted Within the Last <em>X</em> Years</td>
<td>[0.2082]</td>
<td>[0.2027]</td>
<td>[0.1904]</td>
</tr>
<tr>
<td>Punitive Damages Reform</td>
<td>-0.1419</td>
<td>-0.1753</td>
<td>-0.2194</td>
</tr>
<tr>
<td>In Place for More than <em>X</em> Years</td>
<td>[0.3009]</td>
<td>[0.3097]</td>
<td>[0.3006]</td>
</tr>
<tr>
<td>Cap on NED, Specific to Malpractice</td>
<td>-0.2720</td>
<td>-0.1547</td>
<td>-0.0664</td>
</tr>
<tr>
<td>Enacted Within the Last <em>X</em> Years</td>
<td>[0.1911]</td>
<td>[0.1729]</td>
<td>[0.1708]</td>
</tr>
<tr>
<td>Cap on NED, Specific to Malpractice</td>
<td>0.4433+</td>
<td>0.3640</td>
<td>0.2906</td>
</tr>
<tr>
<td>In Place for More than <em>X</em> Years</td>
<td>[0.2571]</td>
<td>[0.2677]</td>
<td>[0.2119]</td>
</tr>
</tbody>
</table>

Observations 1200 1200 1200
R-squared 0.95 0.95 0.95

Notes: See Table 5. Auto accidents and overdoses are excluded.
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 8: Estimated Effects of Leads of Tort Reform Variables

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Rate of Accidental Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSL Reform</td>
<td>-0.4859+</td>
</tr>
<tr>
<td></td>
<td>[-0.4859]</td>
</tr>
<tr>
<td>2-Year Lead of JSL Reform</td>
<td>-0.0977</td>
</tr>
<tr>
<td></td>
<td>[0.2051]</td>
</tr>
<tr>
<td>Collateral Source Rule Reform</td>
<td>0.8383**</td>
</tr>
<tr>
<td>2-Year Lead of CSR Reform</td>
<td>0.3407</td>
</tr>
<tr>
<td></td>
<td>[0.3182]</td>
</tr>
<tr>
<td>Non-Economic Damages (NED) Cap</td>
<td>-0.1123</td>
</tr>
<tr>
<td>2-Year Lead of NED Cap</td>
<td>0.0090</td>
</tr>
<tr>
<td></td>
<td>[0.2765]</td>
</tr>
<tr>
<td>Punitive Damages Reform</td>
<td>-0.3030</td>
</tr>
<tr>
<td>2-Year Lead of Punitive Damages Reform</td>
<td>-0.2017</td>
</tr>
<tr>
<td></td>
<td>[0.2159]</td>
</tr>
<tr>
<td>NED Cap, Specific To Medical Malpractice</td>
<td>0.0390</td>
</tr>
<tr>
<td>2-Year Lead of Med-Mal NED Cap reform</td>
<td>0.0227</td>
</tr>
<tr>
<td></td>
<td>[0.3358]</td>
</tr>
</tbody>
</table>

Observations: 1200
R-squared: 0.95

Notes: See Table 5. Auto accidents and overdoses are excluded. 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.
<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Falls</th>
<th>Drownings</th>
<th>Suffocation</th>
<th>Fires &amp; Burns</th>
<th>Other Transport</th>
<th>Non-OD Poisonings</th>
<th>Accidental Firearm</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSL Reform</td>
<td>-0.1870*</td>
<td>-0.0109</td>
<td>-0.1201*</td>
<td>-0.0995*</td>
<td>-0.1847*</td>
<td>0.0595*</td>
<td>-0.0593*</td>
</tr>
<tr>
<td></td>
<td>[0.1068]</td>
<td>[0.0394]</td>
<td>[0.0582]</td>
<td>[0.0451]</td>
<td>[0.0791]</td>
<td>[0.0245]</td>
<td>[0.0256]</td>
</tr>
<tr>
<td>Collateral Source Rule Reform</td>
<td>0.3260*</td>
<td>0.0012</td>
<td>0.0785</td>
<td>0.1441**</td>
<td>0.0759</td>
<td>-0.0063</td>
<td>-0.0248</td>
</tr>
<tr>
<td></td>
<td>[0.1230]</td>
<td>[0.0651]</td>
<td>[0.0688]</td>
<td>[0.0530]</td>
<td>[0.0542]</td>
<td>[0.0255]</td>
<td>[0.0288]</td>
</tr>
<tr>
<td>Non-Economic Damages (NED) Cap</td>
<td>0.0662</td>
<td>-0.0268</td>
<td>-0.004</td>
<td>-0.0153</td>
<td>-0.1192*</td>
<td>0.0062</td>
<td>0.0122</td>
</tr>
<tr>
<td></td>
<td>[0.1093]</td>
<td>[0.0619]</td>
<td>[0.0577]</td>
<td>[0.0338]</td>
<td>[0.0551]</td>
<td>[0.0323]</td>
<td>[0.0250]</td>
</tr>
<tr>
<td>Punitive Damages</td>
<td>-0.1423</td>
<td>-0.0397</td>
<td>0.0488</td>
<td>-0.0004</td>
<td>-0.0633</td>
<td>-0.0025</td>
<td>0.0367</td>
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<tr>
<td>Reform</td>
<td>[0.1238]</td>
<td>[0.0385]</td>
<td>[0.0624]</td>
<td>[0.0385]</td>
<td>[0.0682]</td>
<td>[0.0250]</td>
<td>[0.0318]</td>
</tr>
<tr>
<td>NED Cap, Specific To Medical Malpractice</td>
<td>-0.2997*</td>
<td>-0.0168</td>
<td>0.0181</td>
<td>0.0452</td>
<td>-0.0780+</td>
<td>0.006</td>
<td>-0.0121</td>
</tr>
<tr>
<td></td>
<td>[0.1356]</td>
<td>[0.0403]</td>
<td>[0.0527]</td>
<td>[0.0418]</td>
<td>[0.0430]</td>
<td>[0.0181]</td>
<td>[0.0417]</td>
</tr>
</tbody>
</table>

| Observations | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 |
| R-squared    | 0.90 | 0.91 | 0.82 | 0.91 | 0.84 | 0.81 | 0.89 |

Notes: See Table 5. Auto accidents and overdoses are excluded.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>IN* (+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td></td>
<td></td>
<td></td>
<td>ME* (+), MT (+)</td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td></td>
<td></td>
<td>SD (+)</td>
</tr>
<tr>
<td>1986</td>
<td>AK (+)</td>
<td>AK (+), WA (+)</td>
<td>MO (+), WV (+), WI (+)</td>
<td>ME* (+), MT (+)</td>
</tr>
<tr>
<td>1987</td>
<td>AL (+), CO* (+), FL (+), IL (+), MI (+), MN (+), NY (+)</td>
<td>CO (+), HI (+), MD (+), NH (+)</td>
<td>AL (+), KS (+), MI (+)</td>
<td>AK (+), AZ* (+), FL (+), OK (+)</td>
</tr>
<tr>
<td>1988</td>
<td>CT (+), GA (+), IA (+), MT (+), NJ (+), OH (+), ID (+), KS (+), OR (+)</td>
<td>FL (+), KS (-), TX* (-), UT (+)</td>
<td>AL (+), CA (+), GA (+), IA (+), KS (+), ND (+), OH (+), OR (+), SC (+), TX (+)</td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>KS (+), KY (+)</td>
<td>WA* (-)</td>
<td>KY (+), NV (+), UT (+), VA (+)</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>ID (+)</td>
<td></td>
<td>HI* (+)</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>GA* (-)</td>
<td>NH* (-)</td>
<td>AL* (-), OH* (-)</td>
<td>MD* (+), TN* (+)</td>
</tr>
<tr>
<td>1992</td>
<td>KS* (-)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>AZ (+), OH* (-)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td>IL (+)</td>
<td></td>
<td>MS (+)</td>
</tr>
<tr>
<td>1995</td>
<td>AZ (-), KY* (-)</td>
<td></td>
<td></td>
<td>IL (+)</td>
</tr>
<tr>
<td>1996</td>
<td>AL* (-)</td>
<td>OH (+)</td>
<td>MT (+), ND (+)</td>
<td>DC* (+), NJ (+), NC (+)</td>
</tr>
<tr>
<td>1997</td>
<td></td>
<td></td>
<td></td>
<td>MO* (+)</td>
</tr>
<tr>
<td>1998</td>
<td>IL* (-), OH* (-)</td>
<td></td>
<td></td>
<td>IL* (-)</td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>AL* (+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td></td>
<td>NV (+), MS (+), OH (+)</td>
<td>AR (+)</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td>OK (+), TX (+)</td>
<td>ID (+)</td>
<td></td>
</tr>
</tbody>
</table>

*+* 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 unconstitutional 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.