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# FIRST DO NO HARM?: TORT REFORM AND BIRTH OUTCOMES

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## ABSTRACT

We examine the impact of tort reforms using U.S. birth records for 1989-2001. We make four contributions: First, we develop a model that analyzes the incentives created by specific tort reforms. Second, we assemble new data on tort reform. Third, we examine a range of outcomes. Finally, we allow for differential effects by demographic/risk group. We find that reforms of the "deep pockets rule" reduce complications of labor and C-sections, while caps on noneconomic damages increase them. Our results demonstrate there are important interactions between incentives created by tort law and other incentives facing physicians.



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While most tort reforms apply to all sorts of torts, much of the literature on tort reform has focused on its effects on medical practice. In a seminal study, Kessler and McClellan (1996) explore the impact of two broad classes of tort reform on medical costs and outcomes for a population of elderly heart patients. They find that tort reforms have no significant effect on health outcomes, while significantly reducing medical costs. From this evidence they conclude that the practice of defensive medicine is reduced in response to tort reform.

We show that this does not appear to be true for at least one large and important class of cases - child births in the United States. Child birth is an interesting example to study because it is one of the most common medical procedures, and because obstetrics is thought to have been particularly hard hit by malpractice concerns. For example, Bakalar (2005) argues that the recent run up in the rate of Ceasarean sections in the U.S. (which reached 30 percent in 2004, up from approximately 20 percent in the 1980s) is driven primarily by fear of litigation.

Using data from national vital statistics natality files on millions of individual births from 1989 to 2001, we ask whether specific tort reforms affect the types of procedures that are performed, and the health outcomes of mothers and their infants. We focus on four of the most important reforms - caps on punitive damages, caps on non-economic damages (pain and suffering), reform of the rule of joint and several liability (JSL, the so called deep pockets rule), and reforms of the collateral source rule. The first two types of caps are the most important examples of what Kessler and McClellan (1996) call direct reforms, while the later two reforms correspond to what they call indirect reforms.

Our analysis is informed by a model that allows physician error rates and procedure choices to depend on the patient's condition. This is important because the right procedure will be evident in many cases – it is in the marginal cases that the incentives created by tort reform may change physician choices. In addition, we introduce a new way to model JSL. The common law rule of JSL allows patients to recover full damages from any one of several defendants. Reforms typically state that the defendants cannot be sued for the full damages unless they are responsible for at

least a given minimum fraction of the harm. We model JSL reform as an increase in the correlation between the care taken by physicians and the expected liability that they face. We show that reforms of this type lead physicians to take more care, while damage caps result in less care by the physician. Moreover, if a procedure is more risky than no procedure then caps are predicted to increase procedure use, while JSL reform is predicted to reduce procedure use.

Intuitively, if many doctors are performing procedures in marginal cases not because of fear of liability but because the procedures are more profitable and less time consuming than the alternatives, [3] then these doctors may be more likely to perform these procedures when they are less fearful of liability. On the other hand, under JSL reform doctors are held more accountable for their own actions (and are less likely to be held liable for the torts committed by others). This results in more care being taken and fewer procedures. This results in the testable prediction that the effect of damage caps upon procedure use should be the opposite of the effect of reform to JSL.

Our findings are consistent with this model. We find that reforms of JSL reduce induction and stimulation of labor, C-sections, and complications of labor and delivery, while caps on non-economic damages increase them. There is little evidence that increases in procedure use induced by damage caps affect infant health, suggesting that the marginal procedures induced or discouraged by tort reform have little impact on infant health.

These results are robust to many changes in specification. For example, we estimate models separately for high risk patients since our model implies that physicians have less discretion in high risk cases. We also attempt to distinguish a class of complications that are not preventable by physician effort, and find that tort reform has no effect on these complications, while it reduces other complications. We estimate models excluding one large state at a time (to see if results are sensitive to the inclusion of one large state), and show that if anything our results are stronger if we delete states with laws that applied only to medical practice. Finally, we estimate models with leads and lags of the law changes. Because of a peculiarity in the law, laws turning "on" do not

have the same effect as laws which are turned "off" because they are ruled unconstitutional. New laws are not retroactive, while if a law is overturned, the new regime applies to cases begun under the old regime. We exploit this asymmetry and show that leads of laws turning on have no effect, while leads of laws turning off do have effects, as we expect. Lagged changes also sometimes have effects, in a direction consistent with our model.

The rest of the paper is laid out as follows. Section II provides some necessary background regarding tort reform and infant health. A theoretical analysis of tort reform appears in Section III. Section IV describes the data, our empirical methods are described in Section V, results are presented in Section VI, and conclusions follow in Section VII.

## II. Background

In his survey of the literature on tort reform, Holtz-Eakin (2004) concludes that the most consistent finding is that caps on damages reduce the number of lawsuits, the value of awards made as a result of lawsuits, and the number of payouts made by insurers relative to premiums.[4] Mello (2006) draws similar conclusions in his review of the tort reform literature. Avraham (2006) uses a national data base of medical malpractice payments and concludes that caps on non-economic damages affect the size of observed payments. However, an important issue in all of these studies is that the probability that a tort is committed, a suit is file, and a payment is observed is likely to depend on the underlying malpractice environment.

High claims in turn are thought to lead to excessively high malpractice insurance premiums.[5] But it is not clear why a doctor's effort level or choice of procedure would be strongly affected by malpractice insurance premiums. Doctors' premiums are not experience rated, but are set at the specialty-area level. Hence, short of moving from a high premium area to another area, or leaving their specialty entirely, there is little a doctor can do to affect her premiums.[6] Claims against doctors seldom exceed the amount that they are insured for (Lawthers et al., 1992; Silver et al.

2006). Moreover, doctors can pass on the cost of malpractice insurance premiums in the form of higher prices (Danzon, Pauly, and Kington, 1990). Thus doctors generally face little financial risk from malpractice claims.

One might wonder then, why doctors apparently care so deeply about the problem of legal liability? There are many non-insurable costs involved in malpractice litigation. In addition to the psychic and time costs of a potential legal proceeding, there is a very real threat of harm to the doctor's reputation. Any payment made on behalf of a physician to settle a claim of malpractice must be registered in the federally-maintained National Practitioner's Data Base (NPDB). This data bank can be searched by hospitals, other health care professionals, and in some cases, by plaintiffs' lawyers.

These facts about the malpractice insurance market suggest that doctors should care deeply about their probability of being sued. Hence, tort reforms are likely to affect doctor behavior primarily by affecting the probability of a suit. Reforms that reduce payments in the event of a successful suit may still be important however, because they are likely to reduce the probability that suits are brought. The important implication for empirical work on this subject is that the probability of a suit can respond quickly to tort reform, while premiums will be affected by tort reforms only with a relatively long and uncertain lag. (The mean time between an injury and the settlement of a claim in the NPDB is 6 years). Hence, it is perhaps unsurprising that previous work focusing on the effects of malpractice premiums on physician behavior have shown little effect.[7]

Holtz-Eakin offers a useful summary of the most common state-level tort reforms. We focus on the four most common, which can be defined as follows (see Bryan Garner, 1999):

(1) Caps on non-economic damages: Non-economic damages cover items other than monetary losses, such as pain and suffering.

(2) Caps on punitive damages: Punitive damages are awarded in addition to compensatory (economic and non-economic) damages in order to punish defendants for willful and wanton conduct.

(3) Modifications of the collateral-source rule: Under the common law collateral-source rule (CSR), amounts that a plaintiff receives from sources other than the defendant (e.g. from their own insurance) may not be admitted as evidence in a trial.[8]

(4) Modifications of the joint-and-several liability rule: In a trial with more than one defendant, the first step is to apportion blame for the harm. Under JSL, the plaintiff can then ask the "deep pockets" defendant to pay all of the damages, even if that defendant was responsible for only a small fraction of the harm. This defendant can in turn initiate separate legal proceedings in order to get "contribution" from the other defendants. Thus, the onus is on the deep pockets defendant rather than the plaintiff to collect from the other defendants. In this paper we focus on modifications of the common law rule such that a defendant had to be liable for at least 50 percent of the tort before they could be held responsible for 100 percent of the damages.[9]

Table 1 shows information about the 25 states with changes in these tort laws between 1989 and 2001. We are particularly interested in changes given that we will include county fixed effects in our model–hence, only changes in the laws are used to identify their effects. Given the controversy surrounding tort reform, and the flurry of tort reform activity that occurred in the 1980s, it is striking that changes to the tort system during the 1990s often involved turning tort reforms "off" rather than "on". Two states (Illinois and Ohio) passed packages of tort reforms only to find that the laws violated the state constitution and had to be removed two years later. The fact that laws turn on and off is useful for identification, and helps to ensure that we will not mistake general time trends in outcomes for the effects of tort reform.[10]

Table 1 also indicates that most of the law changes were changes to general tort statutes and were not aimed specifically at medical malpractice. This point is important because it suggests that most of these law changes were not motivated by things like pre-existing trends in C-section rates or complications of labor and delivery. For example, if caps were passed in an effort to reduce C-section rates, then caps might be viewed as a result of high C-section rates rather than as a potential cause of high (or low) C-section rates. However, there is little evidence that most tort laws were passed in response to specific developments in obstetrical practice, and most of the laws apply to all torts. Indeed the movement towards tort reform gained impetus from the publicity attending the famous case of the women who was severely burned by MacDonald's coffee (Liebeck vs. MacDonald, 1992). The many laws that were turned "off" by state courts also assure the exogeneity of the law changes, since these cases tended to revolve around the constitutionality of state statutes rather than any desire on the part of courts to influence obstetrical practice.

Kessler and McLellan (2002, 2002b) extend their earlier work, with elderly heart patients and further find that managed care is a substitute for tort reform (both reduce procedure use without affecting outcomes), and that tort reform reduces malpractice risks faced by physicians and has a larger effect on diagnostic rather than therapeutic treatment decisions. Our work builds on theirs by considering the effects of specific tort reforms, rather than a composite indicator of "direct" or "indirect" tort reform, using a different medical context (child birth), and more recent data. As we will show below, different types of reforms are likely to have quite different effects, and whether tort reforms increase or decrease procedure use in any particular case is a matter to be determined empirically.

A. **Procedure choice and physician incentives.** Most literature on procedure use in obstetrics focuses on C-sections. There is a good deal of research showing that C-section rates are responsive to physician incentives, and that American C-section rates are "too high". A Healthy People 2010

goal is to reduce the rate of C-sections to 15 percent from the current 30 percent. This figure suggests that unnecessary C-sections contribute as much as four billion dollars a year in excessive health care costs, as well as inflicting unnecessary surgery on million of mothers.[11] Baicker, Buckles, and Chandra (2005) find that 75 percent of the geographical variation in C-section rates over the 1995 to 1998 period is not explained by differences in risk factors, and that the marginal C-section was performed on a medically less appropriate patient. They also find that higher C-section rates are not associated with improvements in infant health, a finding that is common in this literature. One reason for high rates of C-sections is that fees for C-sections are roughly double fees for normal deliveries. Keeler and Brodie (1993), Currie and Gruber (2001), Currie, Gruber and Fischer (1995) and Gruber, Kim, and Mayzlin (1998) all show that physicians are responsive to the incentives created by differentials between fees for vaginal births and Caesarean births.

It is important to stress that unnecessary C-sections do entail risks to mothers and infants. Common problems include sponges or other medical equipment left inside the patient, infections, and impairments to women's future fertility. In Meador v. Stahler and Gheridian (1993) a Massachusetts woman won a $1.53 million verdict arguing that her physicians had not obtained informed consent because they had not adequately explained the risks of the procedure. Ms. Meador was bedridden for several years as a result of complications resulting from her surgery. Infants can also be injured during C-sections. For example, in Bowen v. Hearn (1988) an infant was cut on the cheek, while in Hurst v. Dougherty (1990) part of an infant's finger was accidentally amputated.

The evidence suggests that C-sections are highly responsive to physician incentives and are a good procedure to examine for evidence regarding the effects of tort reform. There has been little attempt to look at other obstetrical procedures or maternal outcomes in the previous literature. In addition to C-sections, we will focus on induction or stimulation of labor, the incidence of complications of labor and delivery, and infant APGAR scores. Induction/stimulation of labor is an interesting procedure to look at in conjunction with C-sections because there is thought to be

a link between induction and unscheduled C-sections. Complications are a particularly interesting outcome because, as we argue below, some complications may be avoidable by greater physician effort, and because they represent real health costs. Finally, for our purposes APGAR scores are a good measure of infant health outcomes.[12] APGAR measures the state of the child at birth, and could be influenced by the choice of procedure, and the physician's actions at the time of delivery.

## III. Tort Law, Procedure Choice and Defensive Medicine

This section introduces a model of the effect of tort reform on physician care and procedure choice. The model extends the standard tort model by explicitly accounting for the fact that both physician decision making and liability are functions of a patient's condition. Our focus is on the *ex ante* effects of tort reform - namely how changes in the law affect physician choices. In contrast, much of the law and economics literature, particularly the literature on joint and several liability, explores the effect of the law on the process of litigation. This literature deals with issues such as when parties file suit, how the law affects settlements, and how juries measure damages (see Spier (2007) for a comprehensive survey). This literature shows that the process governing the way that a tort finally gets translated into a liability against a physician is extremely complex. But at the moment, the data is simply not sufficiently rich to distinguish between these complex models.

We focus instead on the effect of the law on physician choices at the time of service. We assume that physicians do take liability into account, but in a very reduced form way that depends on the net benefits and costs of treatment. For the period of interest all tort suits are based on the negligence standard. Hence, a physician faces liability if and only if her behavior is found to be negligent, that is below the community standard of care. As discussed in Arlen and MacLeod (2005), even if a physician is careful, there is always a chance that he or she will make a mistake that can give rise to liability. These error rates are a key feature of our model.

We define $\alpha$ as the probability that a physician makes an error that results in a potential tort liability. Let $H(p, law, s)$ be the *expected* liability given that the physician has made an error (hence the $H$ function also incorporates the fact that not all errors lead to liability). Liability is a function of procedure choice, $p$, the law at the time of treatment, $law$, and the condition of the patient, $s$. Procedure choice is denoted by $p = P \, or \, NP$, where $p = P$ indicates that the procedure is performed, and $p = NP$ indicates it is not performed. The procedures we observe in our data are Caesarean sections and the induction or stimulation of labor and delivery. It is assumed that patient condition is worse for higher $s$, and hence $s = 0$ is the least complicated case (i.e. a completely straightforward natural delivery, with no harm likely to mother or child). Let $G(s)$ denote the distribution of patient cases (the fraction of cases where patient condition $s'$ is less than or equal to $s$).

The physician's preferences are assumed to have the form:

$$U(s, \alpha, p, law) = B(s, \alpha, p) - H(s, p, law)\,\alpha, \tag{1}$$

where $B(\alpha, p, s)$ is the benefit from treatment. This includes the intrinsic reward from treating the patient, any pecuniary rewards from treatment, and the opportunity cost of care, $\alpha$. The physician chooses $\alpha^*(p, s, law)$, to maximize her payoff, where $\alpha^*$is uniquely characterized by:

$$0 = U_\alpha = B_\alpha(s, \alpha^*, p) - H(s, p, law). \tag{2}$$

Let $U^*(s, p, law)$ be the physician's payoff given that she chooses the optimal error rate given procedure choice, patient condition and current law. The physician chooses to do the procedure if and only if it is preferred to no procedure ($U^*(s, P, law) \geqq U^*(s, NP, law)$). The procedure is assumed to be needed for more serious cases and not needed for completely straightforward cases, and it is also assumed that utility rises more quickly with $s$ when a procedure is performed than

when it is not performed:

$$U_s^*(s, P, law) > U_s^*(s, NP, law), \tag{3}$$

for all $s \geqq 0$. Given that the procedure is unnecessary when $s = 0$, there is a unique patient condition that is a function of the current law, $\bar{s}(law)$, such that the physician is indifferent between performing the procedure and not performing:

$$U^*(\bar{s}(law), P, law) = U^*(\bar{s}(law), NP, law), \tag{4}$$

When the patient has condition $s > \bar{s}(law)$ then the physician chooses to perform the proceedure. Conversly, for $s < \bar{s}(law)$ no procedure is performed. Hence, the rate of procedure use increases with a change in the law if and only this results in a fall in $\bar{s}$.

Given this model, it is straightforward to demonstrate two propositions whose proofs are found in the Appendix.

**Proposition 1.** *Tort reform will increase the error rate if and only if the law decreases the liability the physician incurs in the event of an error.*

This result follows from two effects. First, conditional upon procedure choice, a decrease in liability leads to less care and hence a higher error rate. In addition, for marginal proceedures, a decrease in liability results in the firm making riskier proceedure choices. Together, this results in a higher over all error rate.

The effect of the law on procedure choice depends on the way that it effects the cutoff value $\bar{s}$. We make one additional assumption (a uniformity condition), which is that the effect of the law on liability is independent of procedure choice and patient condition. In other words, conditional on the state of the patient, a law that changes the liability in the event of an error has the same effect

whether the error occurred as a result of performing a procedure, or as a result of not performing a procedure. Given this assumption we have:

**Proposition 2.** *A legal change that increases physician liability will increase $\bar{s}$ (and therefore decrease procedure use) if and only if the error rate when the procedure is chosen is higher than the error rate when the procedure is not chosen.*

This result is quite intutitive. An increase in liability results in the physician making decision that lower risk. Hence, the choice between performing the proceedure or not depends upon the relative risks associated with the two choices. This result shows that by observing how physicians respond to changes in liability provides information regarding the riskiness of a procedure. We detail how this effect work for damage caps and JSL in the next two subsections.

A. **The Effect of Damage Caps.** Limits on damage caps are intended curb unnecessarily large awards. One can see this in the context of our model. Suppose that the uniformity condition is satisfied, and that conditional on an error occurring, the distribution of possible harm, $h$, is given by the density and cumulative distributions $f(\cdot)$ and $F(\cdot)$. Let $\bar{L}$ be a cap on damages, then expected liability is given by:

$$H\left(\bar{L}\right) = \int_0^{\bar{L}} l \cdot f(h)\, dh + \left(1 - F\left(\bar{L}\right)\right) \bar{L}.$$

This is the expected payment for harms less than $\bar{L}$, plus the payment $\bar{L}$ times the probability that the cap is reached. The marginal effect of the cap on liability is :

$$H_{\bar{L}} = 1 - F\left(\bar{L}\right) > 0. \tag{5}$$

This is positive, and therefore from propositions 1 and 2 it follows that reforms that reduce the liability cap should result in a *increase* in the error rate. It is reasonable to assume that the error rate

is correlated with complications of delivery, and hence we would expect complications to increase with caps.

The effect on procedure choice is more complicated because it depends on the relative error rates for each procedure choice at $\bar{s}$. Again, if procedure use is relatively more risky than no procedure for the patient with condition $\bar{s}$ then condition 5 and proposition 2 together imply that reductions in the cap on damages will increase procedure use. We illustrate these effects in figure 1.

Figure 1 Here

Suppose we begin with a level of procedure choice as illustrated by point X. Now suppose there is a decrease in liability. If this were to affect only cases with no procedure, then we have the utility from no procedure rising, as illustrated by the dotted line, resulting in a decrease in procedure use to point Y. Now, if there are also significant errors when the procedure is performed, the the decrease in liability results in the utility from carrying out the procedure rising to the dashed line in figure 1. If the increase in utility is sufficient, then we can arrive at point Z, an increase in procedure use relative to the starting point X.

B. **The Effect of Joint and Several Liability.** Under Joint and Several Liability the plaintiff can recover from any individual who shares in the blame for the accident. Kessler and McClellan (1996) call this an indirect reform because it does not directly constrain the level of damages. Rather, it affects who is liable for damages. It is believed that this reform can reduce liability by removing the incentive for plaintiffs to attempt to recover from the deep pocket when there is a medical error.

In practice, JSL means that if the physician makes a mistake during a delivery and the attending nurse has some culpability, then the patient may sue the nurse's employer, usually the hospital, for

full damages. This is because unlike the physician, the nurse is an employee of the hospital, which is the deep pocket in the case. Previous research has focused on the way JSL reform might affect the litigation process. In a seminal study, Landes and Posner (1980) argue that the common law rule of JSL approximates an efficient rule if there is contribution.[13] Contribution means that the deep pocket defendant who pays the plaintiff sues to collect from the other defendants in proportion to the harm they have caused. In the absence of any transactions costs, the Coase theorem suggests that parties would always achieve an efficient allocation of costs among themselves, and hence JSL reform should have no effect.

However, suit and settlement is a complex process, and as Kornhauser and Revesz (1989) and Kornhauser and Klee (2007) have shown, the effect of JSL reform upon the *ex ante* incentive to take care is complex. Depending on the structure of the available information, incentives to take care may increase or decrease. The problem is similar to the question of how owners can provide incentives to the managers of a firm. In the absence of transactions costs, the Coase theorem suggests that owners of the firm should be able to write an efficient contract with management. In practice, as Jensen and Meckling (1977) argue, owners cannot achieve the first best. What they can do is to reduce agency costs by more closely aligning rewards with compensation.

This is exactly what JSL reform achieves. It more closely aligns the risk of liability with the tortfeasor's care level. We model this point by supposing that the common law rule causes spillover effects on liability. More precisely, we suppose that the physician's legal liability is given by:

$$H^{JSL}(\lambda) = \lambda \bar{H}^{D} \alpha^{*}(\lambda) + (1-\lambda)\bar{H}^{H}\alpha^{H}, \tag{6}$$

where $\lambda$ captures the JSL regime. When $\lambda = 1$ then the physician is liable only for her own errors, which have an expected value of $\bar{H}^{D}$. In contrast, under JSL, there is a chance that the hospital will pay for some or all of harm caused by the physician, in which case $\lambda < 1$. By symmetry, it is

also the case that the physician is liable for some of the harm caused by hospital employees. Even if a nurse is mainly responsible for an error, the physician supervising her work will usually be named in any suits arising from the error. It may also be the case that if a hospital resident is performing a procedure, the senior attending physician will be sued for inadequate supervision (see Locke v. Patchtman, 512 N.W.2dn 786 (Mich. 1994)).

One cannot, either theoretically or empirically, assign a value to $\lambda$. Rather, we suppose that JSL reform corresponds to an increase in $\lambda$, and therefore JSL reform results in $H_{law}^{JSL} > 0$. This is exactly the opposite effect of a damage cap, and hence from the analysis above we conclude that JSL reform should reduce complications of labor and delivery.

With regard to procedure choice, if it is the case that there are already excessive C-sections, then JSL reform should lead to a reduction in the C-section rate. This theory makes a clearly falsifiable prediction, namely that the effect of JSL reform should be opposite to the effect of caps. This prediction is consistent with Kessler and McClellan (1996) in that they find that direct and indirect reforms have opposite effects on expenditures, and sometimes on outcomes though this point is not highlighted in their study.[14]

While we have emphasized the incentives faced by physicians in the preceding discussion, many of our arguments also apply to hospitals. In particular, with JSL reform, hospitals have strong incentives to modify their practices in order to make it less likely that they will be judged responsible for over 50 percent of the damages (and therefore potentially held liable for paying for 100 percent of the damages). A recent Institute of Medicine report about the frequency of medical errors and the relatively few hospitals that have taken systematic steps to reduce them suggests that the scope for this type of response is large (IOM, 2006).[15]

Our simple model also leaves out the role of plaintiff's lawyers ("ambulance chasers"). It is possible that caps on damages and reforms of joint and several liability both make it less worthwhile for plaintiff's lawyers to bring a suit. So the number of suits may fall. As we discussed above, in

the case of damage caps, this will tend to reinforce the effect of the cap in reducing doctor's liability risk.[16] In the case of JSL reform, the fact that lawyers now have less incentive to bring suits is offset by the fact that if they do sue, they will now have to go after the most responsible party, which means that a suit against a physician is a more accurate indicator of competence, and hence has a greater negative effect on their reputation. This later effect is formally captured in our model because $H$ includes all costs, including losses associated with a loss in reputation (see MacLeod (2007) for a review of reputation models, and of how loss of reputation can be viewed as financial loss). Therefore, the liability risk faced by doctors may still increase, even if the number of suits falls. We illustrate this effect in figure 2.

Figure 2 Here

As in figure 2, suppose that the level of procedure choice is illustrated by point X. Now suppose there is an increase in liability, say due to JSL reform. If this were to affect only cases with no procedure, then the utility from no procedure falls, as illustrated by the dotted line, resulting in an increase in procedure use to point Y. Now, if there are also significant errors when the procedure is performed, this results in the utility from carrying out the procedure falling to the dashed line in figure 2. If the decrease in utility is sufficient, then we can arrive at point Z, a decrease in procedure use relative to the starting point X.

C. **Summary.** We have extended the standard model of deterrence created by the tort system to allow for heterogeneity in patient condition. Consistent with the standard economic theory of tort law, the theory we outline here predicts that with less liability physicians will exert less care (see Landes and Posner, 1987 ; Shavell, 1987; and Danzon 2000 for exhaustive reviews). We have also shown that if we view JSL reform from the perspective of agency theory, we can make unambiguous

predictions regarding the effect of JSL reform. We have also extended the previous literature by exploring the impact of tort reform on procedure choice. The important point is that the impact of tort reform depends on whether there is already excessive use of a procedure. Conversely, physician responses to tort reform provide some evidence about whether there is an excessive use of procedures.

Reforms reducing liability have a tendency to exacerbate an existing problem of excessive procedure use. These results are summarized in the following chart:

Chart 1: The Effect of Tort Reform on Physician Care and Cesarean Section Rates

| | Complications | Population Mean | Ceasarean Section Rate | |
|---|---|---|---|---|
| Tort Reform | Given Health Status | Complications | If excessive | If not excessive |
| Decreasing the Cap on Liability | Increase | Increase | Increases | Decreases |
| Reforming the JSL Rule | Decrease | Decrease | Decreases | Increases |

Relative to the prior literature, the theory provides some additional falsifiable predictions. Namely, the effect of caps should be the opposite of JSL reform. Also reforms that act like damage caps, such as modifying the collateral source rule, will have effects similar to caps. Previous empirical work has sometimes grouped several reforms together. This theoretical analysis suggests that such a strategy may reduce the estimated effect of the law since some reforms work in opposite directions. The results also highlight the importance of evidence. A great deal of the existing work on tort reform is based on the assumption that tort reform must either reduce unnecessary procedure use or have no effect. We show that it is also possible for tort reform to increase procedure use.

## IV. Data

Several previous studies of tort reform rely on data from the American Tort Reform Association (ATRA), which has tracked reforms enacted after 1986, when it was founded. We employed several law students to independently look up and record all state statutes that implemented tort reforms,

and any decisions that subsequently affected the status of these statutes (e.g. if the statute was subsequently ruled unconstitutional). A major issue here is to determine the pre-1986 status quo. That is, the ATRA might note that a state passed a tort reform in 1991, but not that it had passed earlier tort reform legislation in 1984. Moreover, sometimes state legislatures codified practices that were already established under common law, so that what appears to be a law change is not. The ATRA also sometimes misses laws that were over-turned. We have also compared our data with tort reform data independently collected by Ronen Avraham (2006), using Westlaw to clarify any discrepancies. One reason for the disparate findings in the literature may be that there are many errors in existing data sets regarding tort law. Further information about the construction of this data set and legal sources is available from the authors in an unpublished Appendix.

Our primary data on outcomes comes from the Vital Statistics natality data. These data come from birth certificates collected by each state and filed with the National Center for Health Statistics. Since the last revision of the standard birth certificate in 1989, Vital Statistics data has formed a very rich repository of information about pregnancy risk factors, procedures performed at the time of birth, and birth outcomes.

We define high risk using 17 different variables that indicate whether the mother suffers from conditions such as anemia, cardiac, or lung conditions; diabetes, herpes, eclampsia, or incompetent cervix; previous large or preterm deliveries; renal failure; rh problems; uterine bleeding or other medical risk factors. Generally, these risk factors would be known to medical staff before the delivery and would affect decisions about appropriate procedure use. Our models predict that doctors should have less discretion over high risk births, so that tort reforms should have smaller effects in these cases.

The birth certificate lists many possible complications of labor and delivery in a check list format. Certain types of complications including breech delivery, cephalopelvic disproportion (baby's head too big for mother's pelvis), cord prolapse (umbilical cord delivered prior to baby which may lead to

cord compression), placenta previa (placenta implanted too close to the cervical opening), abruptio placenta (premature separation of the placenta from the uterus), and premature rupture of membranes, are unlikely to be caused by the doctor's behavior at the time of delivery, while others such as excessive bleeding, fetal distress, meconium, or anesthetic complications may be preventable in many cases. We are certainly not arguing that any class of complication is always preventable, only that it is useful to distinguish between those complications that are never preventable, and those which are at least sometimes preventable. If our model is correct, tort reform should have a larger effect on potentially preventable complications while having little or no effect on complications that could never be prevented.

An additional problem is that complications could be mechanically related to C-sections, since complications might be considered indications for C-section. That is, a doctor may be unlikely to perform a C-section without indicating on the birth certificate that there was some complication that warranted such intervention. To address this concern, we examine complications for non-C-section deliveries separately (though of course, this is a selected sample).

The Vital Statistics data has a great deal of information about factors that might be expected to influence infant health. We know the infant's parity (birth order) and gender as well as the mother's education, race, age, marital status, and county of residence (which proxies for geographical differences in procedure use). We control for these variables in all of our models.

The Vital Statistics data is linked to the tort data using the state, month, and year of birth (the exact date of birth is not given in the public use Vital Statistics data). Table 2 presents means of key outcome variables, tort variables, and control variables for the years 1989 to 2001. Because the data set is very large, we use a 10 percent random sample and include only states that experienced a law change over the sample period.[17]

The first two columns of the first panel of Table 2 compare the means for the full sample to those for high risk children. As expected, high risk children have higher rates of C-sections and

complications. They are also somewhat more likely to be born to minority mothers. The remaining columns of the first panel of Table 2 indicate that C-section rates and the incidence of complications are slightly lower for births that took place in jurisdictions with a cap on non-economic damages. However, the characteristics of mothers also vary across these jurisdictions. For example, births subject to caps were less likely to be to black or Hispanic women but more likely to be to women deemed to be high risk in advance of the delivery. Hence, differences in the incidence of outcomes might reflect differences in demographic characteristics. This simple comparison of means highlights the importance of adequately controlling for other determinants of procedure use when examining the impact of tort reform.

The second panel of Table 2 shows the relationships between the different types of reforms that we consider. It is clear that the reforms tend to move together, but it is equally clear that there are no one-to-one relationships. For example, roughly 60 percent of births in jurisdictions with a cap on non-economic damages were also potentially affected by a significant reform of joint and several liability laws. (Recall, a JSL reform is coded as significant if the threshold for a defendant to be held liable for 100 percent of the damages is at least 50 percent). But only 30 percent of places with such JSL reforms had also implemented a non-economic damages cap. Whether the extent to which laws are passed as a group is too great to tease out their separate effects is an empirical matter that we will return to below.

## V. Methods

We explore the relationship between tort reform and outcomes using standard panel data methods. Since our outcomes are relatively common and we include a large number of county fixed effects in our models, we rely on linear probability models. Our base model is specified as follows:

$$OUTCOME_{it} = a + b_1 TORT_{st} + b_2 XVAR_{it} + b_3 YEAR$$

$$+ b_4 STATE * TIME + b_5 COUNTY + e_{it}, \quad (7)$$

where OUTCOME represents a procedure or health outcome; TORT is a vector of indicators for the tort reforms; XVAR is a vector of personal characteristics; YEAR is a vector of YEAR indicators; STATE*TIME is a vector of state specific linear time trends; and COUNTY is a vector of indicators for all of the counties that are identified in the Vital Statistics data (generally counties with over 100,000 population, with balance of each state is treated as an additional "county" ); and e is a random error term. The subscript i indicates that the variable is defined at the individual level, while the subscript s indicates that it is defined at the state level, and t indicates that the variable is time varying.

XVAR includes controls for the child's gender and multiple births, indicators for whether the mother is Hispanic, African American or other race, dummies for each parity from 1 to 4 and for parity 5 or greater, dummies for the mother's education (<12, 12, 13-15, or 16+ years), dummies for mother's age (19-24, 25-34, 35+), and mother's marital status. As discussed above, there are large differences in outcomes between demographic groups. Variables such as race may also interact with tort reform, if for example, blacks and whites have different propensities to sue. Hence, it is important to control for the variables in XVAR.

The year indicators allow there to[18] be systematic differences over time, while the state-specific time trends allow different states to be on different trajectories with respect to outcomes. In fact, these state-specific time trends turn out to be quite significant in models of C-sections, indicating that there is wide variation in the growth of C-section rates across states. Finally, the county indicators help to account for well-known geographic differences in factors such as access to medical

care and physician practice patterns. Although this is a simple innovation, most previous studies have not controlled for county fixed effects. We estimate our models clustering the standard errors by state.

While (7) is a simple model, there are many possible permutations of the vector TORT. We estimate the model including each tort reform separately (as some previous work has done) as well as estimating a base model that includes all four major tort reforms together. We estimate the model separately for different risk groups as discussed above.

Finally, we have conducted a number of additional specification checks. These include estimating models that systematically exclude data from each of the largest states in order to see if our results are driven by a few large states, and estimating models that exclude data from states that passed reforms that deal only with medical malpractice. The latter models are identified using only data from states that passed general tort reforms that also happen to apply to malpractice cases. The idea is that these law changes are most likely to be exogenous to medical practice.

## VI. Results

A. **Effects on Procedures and Health Outcomes.** Our main estimation results are shown in the first panel of Table 3. All coefficients and standard errors are multiplied by 100. Caps on damages increase the incidence of C-sections, while JSL reform reduces C-sections. The coefficients represent roughly 5 and 7% increases/decreases in the probability of C-section, respectively. The second column shows that the estimated effects on the probability that labor was induced or stimulated are almost identical. This suggests that many of the additional C-sections induced by law changes were not scheduled C-sections but occurred as a result of problems in deliveries where natural labor had been hurried along.

In addition to its effects on C-sections, JSL reform reduces the incidence of preventable complications of labor and delivery. The estimated effects are large, suggesting that caps on non economic

damages increase preventable complications by 6% while JSL reform reduces them by 13%. The effects are there even in non-C-section births, but are not there when we look at complications such as breech birth, which are unlikely to be prevented by physician effort. This pattern of results provides support for our contention that complications may be prevented by physician effort, which in turn, is influenced by the incentives created by the tort system.

We find no effects of tort law changes on the probability of low APGAR scores. This finding suggests that increases in effort levels and procedure use induced by tort reforms such as damage caps are not having an effect on infant health.

The second panel of Table 3 shows estimates from models that include each tort reform separately. That is, every coefficient estimate in the table is from a separate regression. The estimated effects of JSL reform on complications are quite robust, as are the estimated effects of caps on punitive damages on C-sections. However, the estimates for caps on non-economic damages suggest that it can be quite misleading to consider these caps separately, perhaps because JSL and NE caps are often implemented at the same time and tend to have off-setting effects. Given the correlations between some of the tort reforms shown in Table 2, an alternative interpretation is that the estimates in the first panel of Table 3 are afflicted by multicollinearity. However, if this were the case, we would see a large drop in standard errors between panel 1 and panel 2, which we do not see.

B. **Specification Checks.** Table 4 shows estimates of models including leads and lags of law changes. While one might expect laws that turn "on" to have effects equal and opposite to laws that turn "off", there is an important reason why this may not be the case. In most cases, the law governing the resolution of a tort is the one that was in effect at the time when the tort occurred. Thus, even if a doctor foresees that a new law limiting damage caps will be adopted, there is no reason for her to change her behavior until the law actually passes. However, if the law that was in effect at the time a tort occurred is subsequently ruled unconstitutional, then doctors will be subject

to the new law even if the tort occurred under the old (unconstitutional) regime. For example, if a doctor foresees that a damage cap that is in effect is about to be ruled unconstitutional, the doctor has an incentive to change her behavior right away, because any cases arising from torts committed today will be judged under the new law.

The first three columns of Table 4 show models that include 12 month leads of the law changes. These models do not include CSR reforms, since these were never statistically significant. The estimated effects of contemporaneous law changes are much the same as those shown in Table 3. Leads of new laws (laws turning on) are never statistically significant. Leads of laws turning off, however, are sometimes significant. The estimates suggest that a doctor who anticipates that a cap on non-economic damages will be ruled unconstitutional reduces C-sections in the 12 months before the law change. This is consistent with the evidence presented earlier that non-economic damage caps increase C-section rates. On the other hand, doctors who anticipate that a JSL reform will be ruled unconstitutional in the next 12 months, appear to reduce effort such that there is an increase in preventable complications 12 months before the law change. These changes are consistent with our theory, given the asymmetry in the retro-activity of laws that turn "on" and laws that turn "off".

The next three columns of Table 4 show models that include lags of the law changes. The lags on laws that turn "on" suggest that these laws become effective quickly, since none of the lags are statistically significant. Lags on laws that turn "off" suggest some lingering effects. When caps on punitive damages turn off there is a negative effect on C-sections and on preventable complications. When caps on non-economic damages are removed, the estimates suggest that the effects on C-section rates are immediate (i.e. lags are not statistically significant), but that there is a lingering positive effect of having had a cap on the incidence of complications.

Table 5 shows results for high risk and non-high risk groups. Our model implies that doctors have less discretion in high-risk cases, so that we expect to see smaller effects of tort law changes on procedure use in this group. While the standard errors are large enough that we cannot conclusively reject equality of the coefficients across columns, Table 5 shows that the point estimates are generally larger for high risk patients as predicted.

We have also done some additional exploration of caps on non-economic damages, including interactions of the dummies for the existence of caps with their amounts. The idea was that if a cap had an effect, then a lower (more binding) cap should be associated with a stronger effect, while a higher cap should have a weaker effect. We found that the interaction term did tend to have a sign opposite to the sign of the cap dummy, but it was only (marginally) significant in the model of C-sections, suggesting that higher caps produce fewer C-sections. The estimates suggested that a cap of $1,600,000 or more (which can be compared to the mean cap of $473,803 in our data) would have a negligible effect on C-sections.

As an additional specification check, we re-estimated the models in the first panel of Table 3 after systematically excluding each large state with a law change. This is a demanding specification check since large states account for the majority of births. Our results regarding the effects of JSL and non-economic damage caps on C-sections were remarkably robust. Results regarding the effects of JSL reform on preventable complications were also robust. The effect of non-economic damage caps on preventable complications was less robust, mostly because the standard error increased when we excluded Pennsylvania, Illinois, or Texas.

Table 6 shows the effect of excluding states that passed laws which pertained only to medical malpractice, rather than to torts more generally. As discussed above, laws that were passed to deal with malpractice might have been passed in response to specific incidents of malpractice, and thus might be regarded as effects rather than causes of changes in physician behavior. Excluding states

that passed such laws has little qualitative effect on our estimates, though the effect of non-economic damages caps on preventive complications is now significant only at the 10% level of confidence.

## VII. Conclusions

We develop a model that analyzes the incentives created by specific tort reforms and explores the effect of tort reform on both the level of care and procedure use during child birth. Our model shows that contrary to popular belief, reducing the threat of malpractice can increase the use of unnecessary procedures and may reduce the effort made by doctors in realistic scenarios. Second, we have assembled very detailed data on tort reform in an effort to accurately identify changes in the laws. We apply this data to a large national panel data set covering an important population, newborns and their mothers, and examine a range of outcomes representing procedure use, care taken by physicians, and maternal and infant health. Finally, we show that our results are robust to many specification checks.

Our strongest and most robust finding is that JSL reform reduces C-sections, and complications of labor and delivery. By aligning malpractice risk more closely with the physician's own actions, JSL reform causes physicians to take more care and avoid unnecessary and potentially harmful procedures. In addition, JSL reform may cause hospitals to undertake systematic reforms that are beneficial to patients generally in order to avoid being held responsible for a large share of the damages in medical malpractice cases. In contrast, caps on damages are found to increase unnecessary procedure use. They also increase complications of labor and delivery in some specifications.

Hence, in one important example, tort reform that reduces the malpractice risk facing doctors appears to increase rather than decrease unnecessary procedure use, with harmful effects on patients. Much of the public and academic discussion of tort reform on medical malpractice is premised on the idea that reforms must either reduce unnecessary procedure use or have no effect. Our results demonstrate that the incentives created by the tort system are complex, and interact in important

ways with other incentives facing physicians. Without knowing more about the specific incentives faced by physicians it is hazardous to predict that a specific tort reform will either reduce unnecessary procedure use or have beneficial impacts on health.

## VIII. Appendix A

**Proposition 1.** *Tort reform will increase the error rate if and only if the law decreases the liability the physician incurs in the event of an error:*

$$sign\left\{\frac{\partial \alpha^*(s,p,law)}{\partial law}\right\} = -sign\left\{H_{law}(s,p,law)\right\} \tag{8}$$

Proof of Proposition 1. The first order condition for the optimal error rate is:

$$0 = U_\alpha = B_\alpha(s,\alpha^*,p) - H(s,p,law). \tag{9}$$

If we differentiate with respect to law we get:

$$\frac{\partial \alpha^*(s,p,law)}{\partial law} = \frac{H_{law}(s,p,law)}{U_{\alpha\alpha}}.$$

The second order conditions for an optimum imply that $U_{\alpha\alpha} < 0$, from which the result follows. □

**Assumption 1.** *A tort reform satisfies the* uniformity condition *if the marginal effect of the law on liability is independent of the procedure choice or the condition of the patient. In other words, a law that changes the liability in the event of an error has the same effect whether the error occurred as a result of performing a procedure, or as a result of not performing a procedure. That is, for every* $s, s' > 0$ *then* $H_{law}(s,P,law) = H_{law}(s',NP,law) \equiv H_{law}(law)$.

**Proposition 2.** *Suppose that the uniformity condition holds. Then a legal change that increases physician liability will increase* $\bar{s}$ *(and therefore decrease procedure use) if and only if the error rate when the procedure is chosen is higher than the error rate when the procedure is not chosen:*

$$sign\left\{\frac{dG(\bar{s}(law))}{dlaw}\right\} = sign\left\{H_{law}(law)\cdot(\alpha^*(\bar{s}(law),P,law) - \alpha^*(\bar{s}(law),NP,law)\right\}, \tag{10}$$

*and the average error rate satisfies:*

$$sign\left\{\frac{d\alpha^*(law)}{dlaw}\right\} = -sign\left\{H_{law}(law)\right\}. \tag{11}$$

Proof of Proposition 2. The the physician is indifferent between performing or not performing the procedure when:

$$U^*(\bar{s}(law), P, law) = U^*(\bar{s}(law), NP, law). \tag{12}$$

Differentiating this expression with respect to the law we obtain:

$$\begin{aligned}\frac{d\bar{s}(law))}{dlaw} &= \frac{\{H_{law}(\bar{s}(law), P, law)\cdot\alpha^*(\bar{s}(law), P, law) - H_{law}(\bar{s}(law), NP, law)\cdot\alpha^*(\bar{s}(law), NP, law)\}}{U_s(P, \bar{s}(law), law) - U_s(P, \bar{s}(law), law)},\\ &= \frac{\{H_{law}(law)\cdot(\alpha^*(\bar{s}(law), P, law) - \alpha^*(\bar{s}(law), NP, law))\}}{U_s(\bar{s}(law), P, law) - U_s(\bar{s}(law), NP, law)}.\end{aligned}$$

The second line follows from the uniformity condition. The fact that physician utility rises faster with patient condition when a procedure is performed implies that the denominator is positive. This result combined with the fact that $G' > 0$ implies the first expression of the proposition.

For the second expression we differentiate the expression for the average error rate to get:

$$\begin{aligned}d\alpha^*(law)/dlaw \quad &= \quad \int_0^{\bar{s}(law)}\{H_{law}(law)/U_{\alpha\alpha}(s, NP, law)\}g(s)ds\\ &+\int_{\bar{s}(law)}^{\infty}\{H_{law}(law)/U_{\alpha\alpha}(s, P, law)\}g(s)ds\\ &+ \quad (\alpha^*(\bar{s}(law), NP, law) - \alpha^*(\bar{s}(law), P, law))g(\bar{s})\frac{d\bar{s}(law))}{dlaw}.\end{aligned}$$

Note that this include two individual effects for patient who do and not not receive the procedure, plus a third effect arising from changes in treatment for the marginal patient. This third expression

can be rewritten as:

$$-H_{law}(law) \cdot (\alpha^*(\bar{s}(law), NP, law) - \alpha^*(\bar{s}(law), P, law))^2 g(\bar{s}).$$

This, combined with the fact that $U_{\alpha\alpha} < 0$ implies the second expression 11. $\square$

Expression 11 shows that average error rates rise if tort reform reduces liability. This result is the consequence of two effects. The first is the direct effect of the reform on a patient conditional upon health status and procedure choice. The second works via the changes in procedure choice that occur for patients whose health condition is near the cutoff $\bar{s}$. As shown above, this effect has the same sign as the direct effect, regardless of the relative error rates for the procedure choices.

## IX. Appendix B - Source of Law Data (Not Intended for Publication)

The database of state tort reforms, containing descriptions of and citation information for tort reforms in place in each U.S. state at different times between 1985 and 2004, was created using both law and economics students who were employed as research assistants. The database's information about tort reforms was constructed from the text of state legislation using Westlaw and Lexis-Nexis, on-line databases containing the information used by the legal profession for both litigation and advising clients, as well as micro-fiches of early state legislation when the text of the early legislation was not available on line. We also consulted key cases that determined the common law rules that were in effect before legislation was enacted. Finding the relevant statues and case law is difficult. To guide the search for this information we used:

(1) American Tort Reform Association's Tort Reform Record ("ATRA Record" available at http://www.atra.org/files.cgi/8140_Record07-07_3.pdf), which lists reforms enacted since 1986, the year it was founded. The ATRA Record contains the name or number of the legislative bill that enacted the tort reform, the year the bill was passed, and a description of the details of each of the tort reforms, although the Record does not give the citation information of the statutes that the bills enact (the "name" of the statutes, which is a number such as California Civil Code § 3333.2 that shows where the statute is to be found in the state's statutory code).

(2) Westlaw's 50 State Surveys of Tort reform and Medical Malpractice (http://www.westlaw.com, database "surveys" with search for "tort reform"), lists tort reforms that are currently included in a state's statutory code and provides the citation information for the reforms and a link to the text of the current version of the reform.

(3) The law firm McCullough, Campbell & Lane LLP publishes on their website a summary of United States Medical Malpractice Law (Available at http://www.mcandl.com/introduction.html).

We corrected a number of deficiencies in the ATRA Record. For example, it focuses on the enactment of laws and does not always note whether the enacted reforms are struck down by a state's Supreme Court as unconstitutional. The ATRA Record also does not indicate if reforms enacted prior to 1986 are struck down after 1986. The ATRA Record is not always clear on whether the law changes it lists enact new tort reforms or modify existing tort reform statutes enacted before 1986. Furthermore, the ATRA Record does not make note of when statutes enacted by state legislatures are codifying tort reforms that were already part of a state's common law (the set of laws that were created by the Supreme Court of that state). For instance, the ATRA Record lists New Mexico as passing a statute adopting a reform to joint and several liability in 1987, although this reform had already been adopted by the New Mexico appellate courts in 1982. (See N.M. Stat. Ann. § 41-3A-1 and Bartlett v. New Mexico Welding Supply, Inc., 98 N.M. 152, 646 P.2d 579, N.M.App., March 2, 1982, Certiorari Denied by the Supreme Court of New Mexico, June 17, 1982.)

We corresponded with Ronen Avraham, and cross validated our data with a similar data set that he has constructed. This resulted in the correction of several errors in both of our data sets. Avraham (2006) provides a comprehensive data set on enacted tort reform that resulted from this collaboration. The data set we used for our regressions extend this data by including information on whether legislation codified existing common law.

However, coding of the tort reform variables occasionally involves some difficult issues of legal interpretation. For example, in a few states, caps apply only to payments in wrongful death claims, and not more generally to medical malpractice claims for nonfatal personal injury. We have treated these states as if caps did not apply. A second issue is that some states have caps on total damages, rather than caps on non-economic or punitive damages only, that can be awarded in a medical malpractice claims. We have coded states with total damages caps as having caps on both non-economic damages and punitive damages (unless punitive damages are specifically excluded).

## X. References


Almond, Douglas, Kenneth Chay and David Lee. "The Costs of Low Birth Weight," *The Quarterly Journal of Economics*, August 2005.

Arlen, Jennifer and MacLeod, W. Bentley. "Torts, Expertise and Authority: Liability of Physicians and Managed Care Organizations." *Rand Journal of Economics*, 2005, 36(3).

Avraham, Ronen, "Database of State Tort Law Reforms (DSTLR 2nd)" (November, 2006). Northwestern Law & Econ Research Paper No. 06-08. Available at SSRN: http://ssrn.com/abstract = 902711.

Avraham, Ronen, "An Empirical Study of the Impact of Tort Law on Medical Malpractice Payments" Northwestern Law School, 2006.

Bakalar, Nicholas. "Premature Births Increase Along with C-Sections," *The New York Times*, Nov. 22, 2005, page f8.

Baldwin, L.M. et al., "Defensive Medicine and Obstetrics," *Journal of the American Medical Association*, 274, 1995, 1606-1610.

Baicker, Katherine and Amitabh Chandra. "Defensive Medicine and Disappearing Doctors?" Regulation, 28 #3, Fall 2005, 24-31.

Baicker, Katherine, Kasey Buckles, Amitabh Chandra. "Geographic Variation in the Use and Appropriateness of Caesarean Delivery," UCLA School of Public Affairs working paper, August 24, 2005.

Brown, Mark and Robert Puelz. "The Effect of Legal Rules on the Value of Economic and noneconomic Damages and the Decision to File," Journal of Risk and Uncertainty, v18 #2, 1999, 189-213.

Burstin, H.R., W.G. Johnson, S.R. Lipsitz, and T.A. Brennan. "Do the Poor Sue More? A Case-Control Study of Malpractice Claims and Socioeconomic Status," Journal of the American Medical Association, 270 #14, 1993, 1697-701.

Congressional Budget Office. "Limiting Tort Liability for Medical Malpractice," Economic and Budget Issue Brief (Washington D.C.: CBO) Jan. 8 2004.

Currie, Janet and Jonathan Gruber. "Public Health Insurance and Medical Treatment: The Equalizing Impact of the Medicaid Expansions," Journal of Public Economics, v82 #1, October 2001, 63-90.

_____ , _____ , and Michael Fischer, "Physician Payments and Infant Mortality: Evidence from Medicaid Fee Policy," The American Economic Review, May 1995, 85 #2, 106-111.

_____ and Enrico Moretti. "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings," Quarterly Journal of Economics, VCXVIII #4, Nov. 2003, 1495-1532.

Dranove, David. "Demand Inducement and the Physician/Patient Relationship," Economic Inquiry, 26, April, 1988, 281-299.

Dubay, Lisa, Robert Kaestner, and Timothy Waidmann. "The Impact of Malpractice Fears on Caesarean Section Rates," Journal of Health Economics, 18 1999, 491-522.

Danzon, Patricia, Mark Pauly, and Raynard Kington. "The Effects of Malpractice Litigation on Physician's Fees and Incomes," The American Economic Review, 80 #2, May 1990, 122-127.

_____. "Liability for Medical Malpractice," Handbook of Health Economics, 1B (Amsterdam: North Holland) v1b, 2000, 1339-1404.

Elias, Marilyn. "Obstetricians Dwindle Amid High Malpractice Costs," USA Today, May 6, 2002.

Garner, Bryan (ed). Black's Law Dictionary, $7^{th}$ edition (St. Paul MI: West Group) 1999, p 971.

General Accounting Office, Medical Malpractice Insurance: Multiple Factors Have Contributed to Increased Premium Rates, GAO-03-702 (June 2003), p. 27.

Gruber, Jonathan, and Maria Owings. "Physician Financial Incentives and Caesarean Section Delivery," RAND Journal of Economics, 27 #1, Spring 1996, 99-123.

———————— , John Kim, Dina Mayzlin. "Physician Fees and Procedure Intensity: The Case of Caesarean Delivery," Journal of Health Economics, 18 #4, 1999, 473-490.

Harvard Medical Practice Study. Patients, Doctors, and Lawyers: Medical Injury, Malpractice Litigtion, and Patient Compensation in New York, the report of the Harvard Medical Practice Study to the state of New York (Cambridge MA: President and Fellows of Harvard University) 1990.

Hotz-Eakin, Douglas. The Effects of Tort Reform: Evidence from the States, Congress of the United States, Congressional Budget Office, June 2004.

Institute of Medicine. Preventing Medication Errors (Washington D.C.: National Academy Press) July 2006.

Jensen, Michael and Willam Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics* , 3(6), 305-60, 1976.

Kahneman, Daniel, David Schkade, and Cass Sunstein. "Assessing Punitive Damages," Yale Law Journal, v107, May 1998, 2071-2153.

Keeler, Emmett B, M. Brodie. "Economics Incentives in the Choice Between Vaginal Delivery and Caesarean Section," Millbank Quarterly, 71 #3, 1993, 365-404.

Kessler, Daniel and Mark McClellan. "Do Doctors Practice Defensive Medicine?" Quarterly Journal of Economics, v 111 #2, May 1996, 353-390.

———— and ———— , "Malpractice Law and Health Care Reform: Optimal Liability Policy in an Era of Managed Care," Journal of Public Economics, 2002, 84, 175-197.

———— and ———— , "How Liability Reform Affects Medical Productivity," Journal of Health Economics, 2002, 21, 931-955.

———— , W.M. Sage, and D.J. Becker. "Impact of Malpractice Reforms on the Supply of Physician Services," Journal of the American Medical Association, 293 #21, June 1, 2005.

Kim, Beomsoo. "The Impact of Malpractice Risk on the Use of Obstetrics Procedures," Xerox, Dept. of Economics, University of Maryland, November 2005.

Kornhauser, Lewis A. and Revesz, Richard L. "Sharing Damages Among Multiple Tortfeasors," *Yale Law Journal*, 98 (5), March, 831-884 1989.

———— and Klee, Elizabeth, "Comparisons of the incentive to Insolvency under Different Legal Regimes," *Journal Of Legal Studies*, 36(1), January, 141-170, 2007.

Landes, William M. and Posner, Richard A., "Joint And Multiple Tortfeasors - An Economic-Analysis," *Journal Of Legal Studies*, 1980, 9, 517-555.

———— and ———— , *The Economic Structure of Tort Law* (Cambridge MA: Harvard University Press) 1987.

Lawthers, A.G., A.R. Localio, N.M. Laird, S. Lipsitz, L. Hebert and T.A. Brennan. "Physicians' Perceptions of the Risk of Being Sued," *Journal of Health Politics, Policy and Law*, 17 #3, 1992, 463-482.

Localio, A.R. A.G. Lawthers, J.M. Bengtson, L.E. Hebert, S.L. Weaver, T.A. Brennan, J.R. Landis. "Relationship Between Malpractice Claims and Caesarean Delivery," *Journal of the American Medical Association*, 269, 1993, 366-373.

MacLeod, W. Bentley, "Reputations, Relationships, and Contract Enforcement," *Journal of Economic Literature*, XLV, September, 597-630, 2007.

Matsa, David. "Does Malpractice Liability Keep the Doctor Away? Evidence from Tort Reform Damage Caps," Xerox, Dept. of Economics, Massachusetts Institute of Technology, March 2, 2005.

Mello, Michelle. "Medical Malpractice: Impact of the Crisis and Effect of State Tort Reforms" (New Brunswick NJ: Robert Wood Johnson Foundation) Research Synthesis Report #10, May 2006.

Pauly, Mark. *Doctors and Their Workshops* (Chicago: University of Chicago Press) 1980.

Priest, George L. "The Current Insurance Crisis and Modern Tort Law," *Yale Law Journal*, 96, 1987, 1521-1589.

Shavell, Steven. *Economic Analysis of Accident Law* (Cambridge M.A.: Harvard University Press), 1987.

Silver, Charles, Kathryn Zeiler, Bernard Black, David Hyman, William Sage. "Physician's Insurance Limits and Malpractice Payments: Evidence From Texas Closed Claims,1990-2003", paper presented at the American Law and Economics Associations, San Francisco, May 2006.

Sloan, Frank, K. Whetten-Goldstein, P.B. Githens, S.S. Entman. "Effects of the Threat of Medical Malpractice Litigation and Other Factors on Birth Outcomes," *Medical Care*, 33, 1995, 700-714.

———————, S.S. Entman, B.A. Reilly, C.A. Glass, G.B. Hickson, H.H. Zhang. "Tort Liability and Obstetricians' Care Levels," *International Review of Law and Economics*, 17, 1997, 245-260.

Spier, Kathryn E. "Litigation," A. M. Polinsky and S. Shavell, *Handbook of Law and Economics*. Amsterdam: North-Holland, 2006,

Viscusi, Kep and Patricia Born. "Damages Caps, Insurability, and the Peformance of Medical Malpractice Insurance," *The Journal of Risk and Insurance*, v 72 #1, 2005, 23-43.

Yoon, Albert. "Damage Caps and Civil Litigation: An Empirical Study of Medical Malpractice Litigation in the South," *American Law and Economics Review*, v3 #2, 2001, 199-227.

## Notes

[1]See Nightingale F, Notes on hospitals; being two papers read before the National Association for the Promotion of Social Science, at Liverpool, in October, 1858; with evidence given to the Royal Commissioners on the state of the Army in 1857. London: Parker; 1859.

[2]Some legal scholars argue that the tort system also exists to provide insurance. The idea is that it is easier for providers than patients to purchase insurance, especially since providers can pass the costs of premiums on by setting higher fees. Priest (1987) points out that higher prices will disproportionately impact the poor, and that higher premiums may cause insurance markets to fail as lower risk providers pull out (self insure) causing premiums to go still higher.

[3]See Dranove (1988) and Pauly (1980) for a discussion of physician induced demand.

[4]Even more recently, Viscusi and Born (2005) examine data at the insurance company and state-level from 1984 to 1991 and find that limits on non-economic damages and punitive damages reduced insurance payouts and premiums, and increased the profits of insurance companies

[5]However, increases in payouts are not necessarily the driving force behind increases in premiums. On average claims are settled 6 years after the premiums used to pay for them were collected. Insurers typically invest the premiums during that interval, and their profits are sensitive to the returns on these investments. A reduction in returns can drive up premiums sharply, as apparently occurred in the early 2000s (Baicker and Chandra, 2005; General Accounting Office, 2003; Congressional Budget Office, 2004).

[6]There have been repeated claims that malpractice premiums are driving ob-gyns out of high premium states, or out of practice (Elias, 2002). However, Mello (2006, page 4) concludes that the best studies show "only small or no effects" of the malpractice environment on physician supply (See

Baicker and Chandra, 2005, Kessler et al. 2005, and Matsa 2005). In one of the few papers to look at several tort reforms in the same framework, Klick and Stratmann (2005) argue that caps increase physician supply while the abolition of joint and several liability reduces it. Their OLS estimates are small (in line with other studies surveyed by Mello) while their instrumental variables estimates are very large.

[7]Several previous studies use cross sections of data from single states to examine the effect of malpractice premiums on obstetrical procedures and infant health outcomes, with mixed results. These include: Baldwin et al. 1995, Localio et al. 1993, Sloan et al. 1997, and Sloan et al. 1995. Baicker and Chandra (2005) look at the effect of malpractice premiums on the use of C-sections and several procedures for Medicare patients using state-level data. They find no effect. Dubay, Kaestner, and Waidmann (1999) and Kim (2005) use panels of national vital statistics data and look at the effects of malpractice premiums on C-sections, finding little effect.

[8]Some reforms specify that only payments from public sources can be admitted as evidence. In this paper, we use only reforms that allow payments from private sources to be admitted, but it did not change our results to use a more liberal definition of reform (i.e. reform =1 if either public or private payments are admitted).

[9]We coded JSL=1 if either the rule covering economic damages OR the rule covering non-economic damages specified that parties had to be responsible for 50% of the harm before they could be held liable for 100% of the damages. This coding captures most of the changes in JSL rules over our sample period. For example, prior to 1989, Texas had enacted a reform that set the liability threshold at 10%, which they raised to 50% in 1995. New Hampshire, Wisconsin, and Ohio all adopted the 50% threshold. Illinois, Mississippi, and Tennessee all abolished the common law JSL rule (meaning that people could only be liable for damage they caused). A few changes that are not captured by our simple algorithm are that Alaska had a 50% threshold that they raised to

100% in 1989. New Jersey had a 60% threshold for non-economic damages over the whole period, and raised the threshold for economic damages from 20% to 60% in 1995. In both cases, we take the view that the states had already enacted significant JSL reforms before these further changes.

[10]For example, in Alabama, a cap implemented before the beginning of our sample period was declared unconstitutional and removed in 1991. Yoon (2001) exploits this feature of the data in his study of the effects of caps on malpractice awards in Alabama.

[11]The estimate of four billion is based on the assumption that 15 percent of current C-sections are unnecessary and that the difference in cost between a C-section and a normal delivery is about $6,000.

[12]APGAR stands for activity, pulse, grimace, appearance, and respiration. The infant is given a maximum score of 2 for each attribute for a maximum score of 10. Most children receive a nine or higher. We code a score of 8 or lower as low APGAR. Almond, Chay, and Lee (2005) also argue that APGAR is a better predictor of infant mortality than low birth weight.

[13]As they point out on page 533, in the absence of transactions costs the Coase theorem implies that one should get the first best, regardless of the liability rule.

[14]For example, in Table 5 which examines effects on ischemic heart disease they find that indirect reforms increase 1 year hospital expenditures by 3.4 percent and reduce one year mortality by .4 percent. In contrast, direct reforms reduce spending by 9 percent but have no significant effect on mortality.

[15]The report noted that although 1.5 million people are harmed annually by medication errors in the U.S., only 6 percent of U.S. hospitals have adopted drug computer-entry systems, which have been proven to reduce such errors.

[16] An additional complication is that a cap could act as a focal point, and hence increase liability in cases with small damages. Kahneman, Schkade, and Sunstein (1998) discuss the importance of such focal points to juries.

[17] We have verified that we obtain the same results for Table 3 if we use all of the states.

[18] Our results for C-sections are not robust to the exclusion of the state-specific time trends, though our other results are.

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**Table 1: Summary of Changes in State Tort Laws, 1989-2001**

| | Law "on" | Law "off" | Law both "on" & "off" |
|---|---|---|---|
| **Cap Punitive Damages** | AK (8/7/1997), IN (6/30/1995), NJ (10/27/1995), NC (1/1/1996), ND (4/30/1993), NV (5/30/1989), **PA (1/25/1997), WI* (7/5/1995)** | **SD* (1/31/1996)** | AL* (off 6/25/1993, on 6/7/1999), OH* (on 1/27/1997, off 2/25/1998) |
| **Cap Non-Economic Damages** | **MT (10/1/1995), ND (8/1/1995)** | **AL* (9/27/1991)**, NH* (3/13/1991), OR* (7/15/1999), WA* (4/27/1989) | IL* (on 3/9/1995, off 12/18/1997), OH* (off 8/27/1991, on 1/27/1997, off 2/25/1998) |
| **Limit Joint and Several Liability** | MS (7/1/1989), NH (1/1/1990), TX (9/1/1995), WI (5/17/1995), TN* (5/4/1992) | | IL* (on 3/9/1995, off 12/18/1997), OH* (on 1/27/1997, off 2/25/1998) |
| **Modify the Collateral Source Rule** | ID (3/23/1990), **ME (4/24/1990), WI (5/25/1995)** | GA* (3/15/1991), KS* (4/16/1993), KY* (1/19/1995) | AL* (off 7/12/1996, on 9/22/2000) |

Notes: An asterisk indicates that the law was found unconstitutional, or reversed through a court's decision. Bold face indicates that the law applied only to medical malpractice rather than to all torts. Sources for the laws include Westlaw's 50 State Statutory Surveys on Tort Reform and Medical Malpractice, McCullough, Campbell, and Lane LLP's Summary of United States Medical Malpractice Law, Ronen Avraham's Data Base of State Tort Law Reforms (1st Edition), the American Tort Reform Association Tort Reform Record (1st Edition), and Lexus-Nexus. For a more complete description, please see the unpublished law data appendix.

**Table 2: Means of Key Variables by Law in Effect at Time of Birth or Risk Group**

| *OUTCOMES* | *All Births* | *High Risk* | *State has NE Cap* | *State has JSL Reform* | *State has CSR refrom* | *State has PD cap* |
|---|---|---|---|---|---|---|
| C-section | 0.217 | 0.297 | 0.196 | 0.222 | 0.217 | 0.216 |
| Complications | 0.335 | 0.450 | 0.331 | 0.325 | 0.351 | 0.324 |
| Preventable Compl. | 0.265 | 0.358 | 0.259 | 0.255 | 0.279 | 0.261 |
| 5-minute APGAR < 8 | 0.031 | 0.051 | 0.035 | 0.030 | 0.028 | 0.031 |
| Low Birth Weight | 0.077 | 0.157 | 0.069 | 0.077 | 0.077 | 0.076 |
| ***DEMOGRAPHIC VARIABLES*** | | | | | | |
| Male | 0.512 | 0.514 | 0.512 | 0.512 | 0.512 | 0.512 |
| Multiple Birth | 0.027 | 0.097 | 0.027 | 0.027 | 0.029 | 0.028 |
| High Risk | 0.280 | 1 | 0.297 | 0.280 | 0.279 | 0.283 |
| Mother Hispanic | 0.133 | 0.117 | 0.062 | 0.154 | 0.119 | 0.194 |
| Mother African-American | 0.167 | 0.190 | 0.106 | 0.172 | 0.178 | 0.161 |
| Mother Other Race | 0.033 | 0.032 | 0.040 | 0.038 | 0.044 | 0.037 |
| First Birth | 0.406 | 0.387 | 0.395 | 0.408 | 0.404 | 0.401 |
| Mother HS Dropout | 0.218 | 0.221 | 0.190 | 0.225 | 0.196 | 0.233 |
| Mother College or More | 0.203 | 0.197 | 0.207 | 0.213 | 0.228 | 0.208 |
| Teen Mother | 0.135 | 0.134 | 0.127 | 0.137 | 0.121 | 0.134 |
| Mother Married | 0.697 | 0.665 | 0.711 | 0.691 | 0.698 | 0.701 |
| **Observations** | 2,392,793 | 671,176 | 496,794 | 1,040,245 | 673,423 | 1,483,207 |

| *TORT REFORM MEASURES* | *All Births* | *State has NE Cap* | *State has JSL Reform* | *State has CSR refrom* | *State has PD cap* |
|---|---|---|---|---|---|
| State has NE Cap | 0.208 | 1 | 0.264 | 0.260 | 0.205 |
| Amount if Cap | 439264 | 439264 | 370977 | 354072 | 371471 |
| State has JSL Reform | 0.435 | 0.552 | 1 | 0.557 | 0.473 |
| State has CSR Reform | 0.281 | 0.352 | 0.361 | 1 | 0.320 |
| State has PD Cap ($) | 0.590 | 0.613 | 0.674 | 0.705 | 0.953 |
| Amount if Cap ($) | 293086 | 257264 | 388291 | 353572 | 293086 |
| State has PD Cap (multip | 0.523 | 0.477 | 0.479 | 0.602 | 0.844 |
| Amount if Cap (multiple) | 3.073 | 2.938 | 2.728 | 4.230 | 3.073 |

Notes: The sample is drawn from the National Vital Statistics Natality Files for 1989-2001 and consists of a 10% random sample of births from states that experienced a law change. (These states are listed in Table 1). NE Cap indicates a cap on non-economic damages, while PD cap indicates a cap on punitive damages. Caps on punitive damages may be specified in either dollar terms or as a multiple of the economic damages. Births are considered to be high risk if they have one of the risk factors listed in the text. Non-preventable complications include: breech delivery, cephalopelvic disproportion, cord prolapse, placenta previa, abruptio placenta, and premature rupture of membranes. All other complications are considered preventable and include: maternal fever, meconium (moderate/heavy), excessive bleeding not from abruptio placenta or placenta previa, maternal seizures, precipitous labor, prolonged labor, dysfunctional labor, anesthetic complications, fand etal distress.

**Table 3: Effects of Tort Reforms**

***a) Overall Effects, Four Laws Entered***

| Procedures: | C-sections | Induction/ Stimulation Labor | Preventable Compli-cations | Other Compli-cations | No-C sect. Compli-cations | Low Apgar |
|---|---|---|---|---|---|---|
| **Any PD Cap** | 0.86* | 0.61 | 1.17 | 0.19 | 0.85 | 0.05 |
| | [0.32] | [.65] | [2.21] | [0.20] | [2.20] | [0.05] |
| **Any NE Cap** | 1.20** | 1.2 | 1.59* | -0.35 | 0.62 | 0.07 |
| | [0.37] | [.62] | [0.73] | [0.30] | [0.57] | [0.09] |
| **JSL Reform** | -1.74** | -1.76** | -3.49** | 0.35 | -2.20* | -0.09 |
| | [0.50] | [.72] | [1.03] | [0.27] | [0.90] | [0.12] |
| **CSR Reform** | 0.43 | 1.02 | 1.06 | 0.06 | 0.77 | 0.04 |
| | [0.54] | [.56] | [0.82] | [0.21] | [0.81] | [0.12] |
| **Observations** | 2,392,793 | 2,392,793 | 2,392,793 | 2,392,793 | 1,852,997 | 1,942,247 |
| **R-squared** | 0.04 | 0.04 | 0.04 | 0.03 | 0.04 | 0.01 |

***b) Effects with Tort Laws Entered Separately (Each Cell From a Separate Regression Model)***

| Procedures: | C-sections | Induction/ Stimulation Labor | Preventable Compli-cations | Other Compli-cations | No-C sect. Compli-cations | Low Apgar |
|---|---|---|---|---|---|---|
| **Any PD Cap** | 0.83 | 0.48 | 1.00 | 0.19 | 0.67 | 0.01 |
| | [0.41] | [.64] | [2.14] | [0.20] | [2.08] | [0.08] |
| **Any NE Cap** | 0.40 | 0.36 | -0.09 | -0.14 | -0.44 | -0.02 |
| | [0.26] | [.59] | [0.66] | [0.22] | [0.60] | [0.04] |
| **JSL Reform** | -0.94 | -1.06 | -2.38* | 0.19 | -1.67* | -0.08 |
| | [0.64] | [.58] | [1.05] | [0.27] | [0.78] | [0.07] |
| **CSR Reform** | 0.27 | -0.54 | 0.64 | 0.17 | 0.52 | -0.12 |
| | [0.45] | [.59] | [0.71] | [0.21] | [0.67] | [0.14] |

Notes: Coefficients and standard errors multiplied by 100. Linear probability models include dummy variables for county, state-specific time trends, month, and year dummies, in addition to controls for child gender, multiple births, indicators for mother Hispanic, African American or other race, dummies for each parity from 1 to 4 and for parity 5+, dummies for mother's education (<12, 12, 13-15, 16+ years), mother's age (19-24, 25-34, 35+) and marital status. Complications that are not considered preventable are breech position, cephalopelvic disproportion, cord prolapse, premature rupture of membrane, abruptio placenta, and placenta previa.
Other complications are considered to be preventable.
Standard errors are clustered at the state level. A ** or * indicates statistical significance at 99 or 95%, respectively.

**Table 4: Leads and Lagged Effects of Tort Reforms**

| | Leads | | | Lags | | |
|---|---|---|---|---|---|---|
| **Procedures:** | **Leads C-sections** | **Leads Preventable Compli-cations** | **Low APGAR** | **Lags C-sections** | **Lags Preventable Compli-cations** | **Low APGAR** |
| Any PD Cap | 0.96* | 1.84 | 0.06 | 0.89* | 1.56 | 0.01 |
| | [0.39] | [2.45] | [0.07] | [0.38] | [2.73] | [0.06] |
| 12 month lead/lag law ON | 0.25 | -0.32 | 0.18 | -0.35 | -2.25 | 0.20** |
| | [0.57] | [0.82] | [0.15] | [0.43] | [2.69] | [0.06] |
| 12 month lead/lag law OFF | -0.35 | -3.47 | 0.01 | -0.27* | -1.81* | -0.01 |
| | [0.64] | [1.80] | [0.10] | [0.10] | [0.85] | [0.04] |
| Any NE Cap | 1.23** | 1.29 | 0.09 | 1.26** | 1.92** | 0.05 |
| | [0.39] | [0.68] | [0.10] | [0.40] | [0.65] | [0.08] |
| 12 month lead/lag law ON | -0.4 | -0.83 | 3.51 | 0.19 | -0.58 | 0.72** |
| | [3.56] | [5.98] | [3.33] | [0.23] | [0.32] | [0.09] |
| 12 month lead/lag law OFF | -0.73* | -0.76 | -0.08 | 0.48 | 1.16** | -0.02 |
| | [0.32] | [0.64] | [0.09] | [0.25] | [0.37] | [0.09] |
| JSL Reform | -1.73** | -3.41** | -0.1 | -1.77** | -3.30** | -0.11 |
| | [0.47] | [0.97] | [0.15] | [0.48] | [1.07] | [0.15] |
| 12 month lead/lag law ON | 0.24 | -1.2 | -3.5 | -0.01 | 0.58 | -0.66** |
| | [3.52] | [5.96] | [3.33] | [0.27] | [0.97] | [0.12] |
| 12 month lead/lag law OFF | 0.88 | 2.45** | 0.12 | -0.48 | 0.13 | -0.04 |
| | [0.45] | [0.80] | [0.15] | [0.24] | [0.58] | [0.07] |
| Observations | 2,392,793 | 2,392,793 | 1,942,247 | 2,392,793 | 2,392,793 | 1,942,247 |
| R-squared | 0.04 | 0.04 | 0.01 | 0.04 | 0.04 | 0.01 |

See notes to Table 3.
A 12 month lead is a dummy that is equal to one in the 12 months before a law changes.
A 12 month lag is a dummy that is equal to one in the 12 months after a law changes.

**Table 5: Effects of Tort Reform on Subgroups**

| | *Non High Risk C-section* | *High Risk C-section* | *Non High Risk Preventable Complications* | *High Risk Preventable Complications* |
|---|---|---|---|---|
| **Any PD Cap** | 0.90** | 0.46 | 0.96 | 1.37 |
| | [0.28] | [0.45] | [2.14] | [2.00] |
| **Any NE Cap** | 1.13** | 1.14* | 1.90* | 0.69 |
| | [0.34] | [0.41] | [0.78] | [0.59] |
| **JSL Reform** | -1.67** | -1.26** | -3.37** | -3.15** |
| | [0.51] | [0.39] | [1.08] | [0.92] |
| **CSR Reform** | 0.65 | -0.27 | 0.86 | 1.38 |
| | [0.60] | [0.42] | [0.83] | [0.97] |
| **Observations** | 1,721,617 | 671,176 | 1,721,617 | 671,176 |
| **R-squared** | 0.02 | 0.06 | 0.04 | 0.04 |

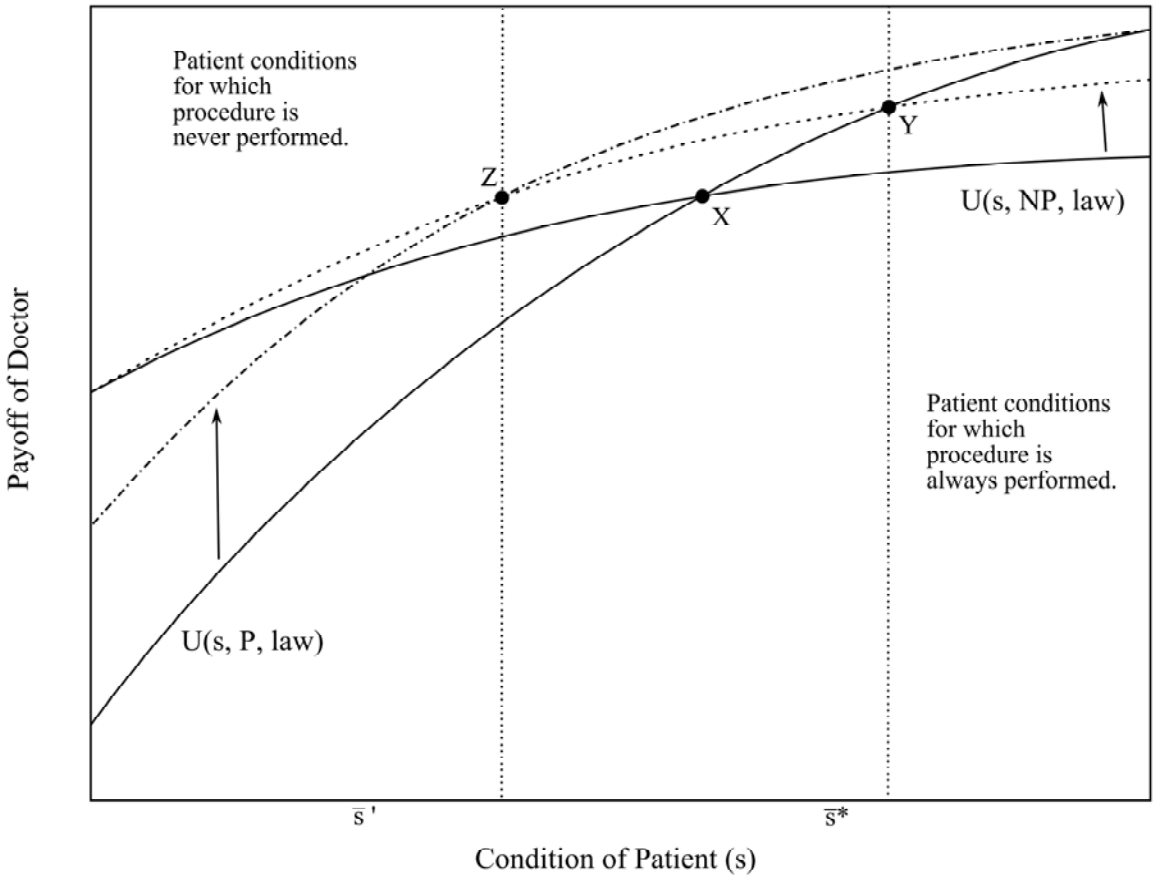
**Notes: See Table 3.**

**Table 6: Effect of Excluding Law Changes Pertaining Only to Malpractice**

| | *(1)* | *(3)* |
|---|---|---|
| | **C-section** | **Preventable Compli-cations** |
| **Any PD Cap** | 0.97 | 6.22 |
| | [0.85] | [5.28] |
| **Any NE Cap** | 1.41* | 1.79 |
| | [0.50] | [0.91] |
| **JSL Reform** | -1.92** | -2.76* |
| | [0.44] | [1.08] |
| **CSR Reform** | 1.14 | 1.31 |
| | [0.73] | [0.83] |
| **Observations** | 1,760,142 | 1,760,142 |
| **R-squared** | 0.04 | 0.04 |

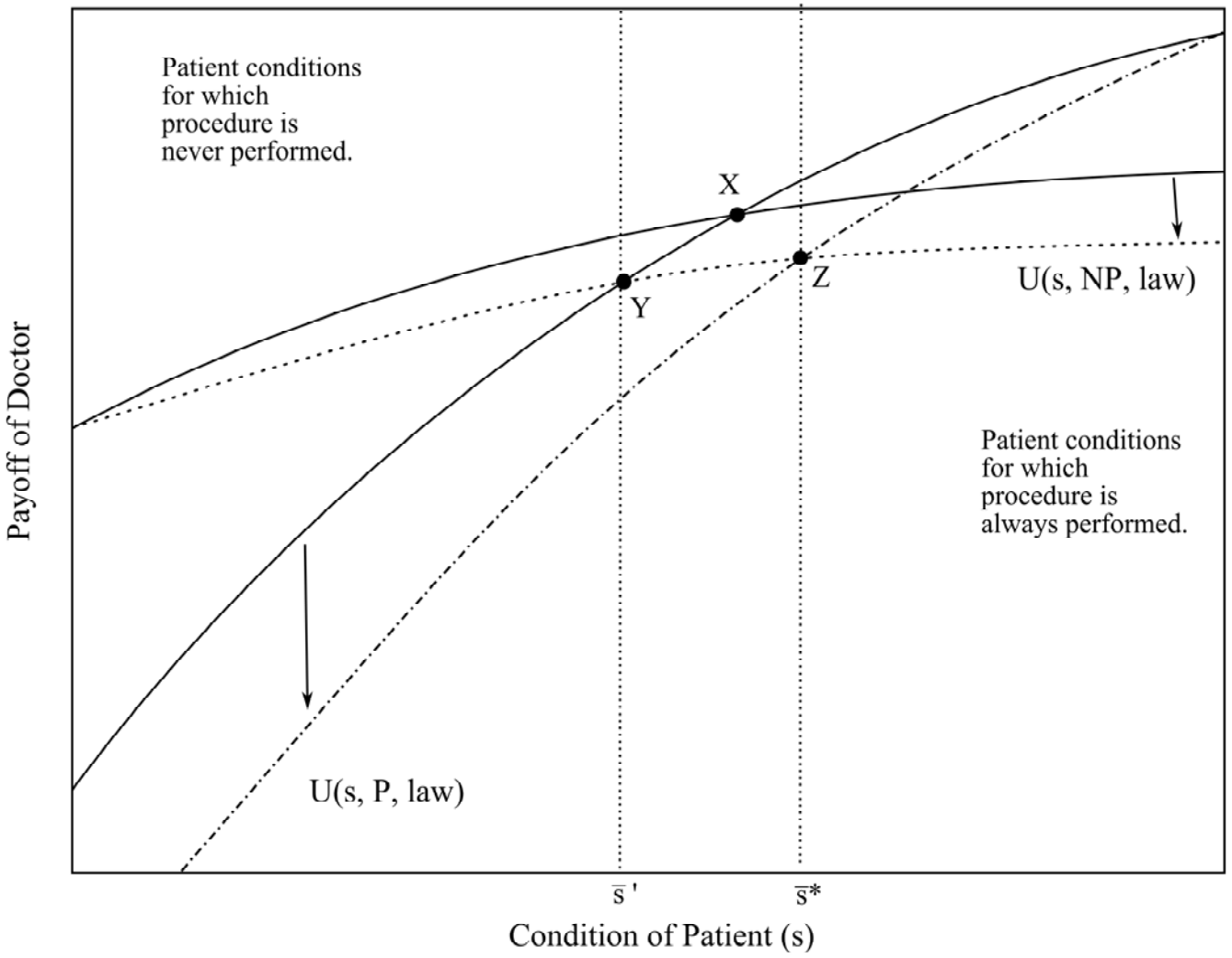
**Notes: Deleted States include AL, ME, MT, OH, ND, PA, RI, SD and WI.**

Figure 1




Doctor's Procedure Choice
When Legal Regime Reduces Liability

Figure 2




Doctor's Procedure Choice
When Legal Regime Increases Liability