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Ulrich Matter, Alois Stutzer

Corresponding author:

**Prof. Dr. Alois Stutzer**

University of Basel  
Faculty of Business and Economics  
Peter Merian-Weg 6  
CH-4002 Basel

Phone: +41(0)61 267 33 61

Mail: [alois.stutzer@unibas.ch](mailto:alois.stutzer@unibas.ch)

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# Politico-Economic Determinants of Tort Reforms in Medical Malpractice

Ulrich Matter                      Alois Stutzer  
(University of Basel)              (University of Basel)

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## Abstract

The U.S. tort system has experienced various reforms during the last three decades. While there is a broad literature on the consequences of these reforms, very little is known about their determinants. In this study, we investigate the politico-economic forces that were driving the reform process across U.S. states. We focus on five types of medical malpractice tort reform and apply semi-parametric proportional hazards models to assess the factors that are related to reform enactments. We find, first, that a higher fraction of Republicans in a state legislature as well as a Republican governor are the major drivers of medical malpractice tort reforms. Second, we find that a higher fraction of women in a state legislature is associated with reforms being deferred. This finding is corroborated by micro-evidence on female legislators' voting behavior on medical malpractice tort reforms, and it is consistent with the notion that women are disproportionately aggrieved by such reforms. (*JEL classification*: D72, K13)

**Keywords:** Tort reform, tort law, medical malpractice, rent-seeking, legislatures, women in politics

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Matter: University of Basel, Faculty of Business and Economics, Peter-Merian-Weg 6, 4002 Basel, Switzerland, phone: +41-(0)61 267 33 03, ulrich.matter@unibas.ch

Stutzer (corresponding author): University of Basel, Faculty of Business and Economics, Peter-Merian-Weg 6, 4002 Basel, Switzerland, phone: +41-(0)61 267 33 61, alois.stutzer@unibas.ch

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## I. INTRODUCTION

Since the 1980s the reform of tort law<sup>1</sup> has become an increasingly important political issue in the United States. Many state legislatures have passed statutes to reshape their mainly common-law-based law of torts. While the nature and extent of these reform efforts vary significantly across U.S. states, the reforms generally point in the same direction and aim at a reduction in the number of tort suits as well as the amount of damages awarded. The reform process as well as the expansion of tort liability and damages preceding it in the 1960s and 1970s are difficult to understand as an evolutionary process towards an efficient system. They rather reflect a complicated interaction of interest representation in the compensation of injured parties that has become a big business.<sup>2</sup>

In this paper, we study the politico-economic determinants of legislative tort reforms in U.S. states. It has long been argued that special interest groups shape U.S. tort law in their pursuit of economic rents (e.g., Epstein 1988, Rubin and Bailey 1994, Rubin 2005, Zywicki 2000). The legal changes that expanded tort liability were mainly brought about by litigation and judicial action that were favored and supported by organized groups of attorneys (see Rubin et al. 2001 for theoretical arguments as well as observational evidence).<sup>3</sup> In response, defense interests began to form around groups of businesses and medical doctors.<sup>4</sup> For them, the legislative process was relatively more accessible than the judicial process, and tort reform became an important issue in the political arena (Campbell et al. 1995). It has been argued that tort reforms became a highly partisan subject with Republicans taking side with the business community and being in favor of and Democrats being pro plaintiff and against reforms (Sugarman 2002), although these positions are historically and ideologically not totally clear (Sugarman 2006). The Democrats' opposition to tort reforms goes along with generous campaign contributions from trial lawyers (Zywicki 2000). The lobbying for changes in tort law led to many reform proposals over the last 30 years that were put forward and decided on in state legislatures. However, is the relative strength of these forces sufficient to explain the patchwork of tort reforms across U.S. states?

In our empirical analysis, we test a set of hypotheses that relate politico-economic determinants to changes

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<sup>1</sup>Tort law deals with situations where one party's behavior causes another party to suffer a loss or harm. The law allows the party who is harmed to recover its loss. The aims of tort law, however, are not confined to insurance and compensation but damages may also be awarded for deterrence. The economic analysis of tort law emphasizes this latter aim based on the argument of an efficient distribution of risk in order to provide optimal incentives for cost minimizing precautions in the presence of transaction or litigation costs (for the basic contributions, see Coase 1960, Calabresi 1970 and Shavell 1987).

<sup>2</sup>Estimates of the total transactions generated by the American tort law system amount to USD 265 billion in 2010; i.e., 1.82% of GDP. This indicates a decline from 2.21% of GDP (or USD 246 billion in current prices) in 2003 (Towers Watson 2012). Expenses in terms of fees and administrative costs, i.e., money not flowing as compensation to injured parties, account for more than half of the amount (U.S. Council of Economic Advisers 2004).

<sup>3</sup>The most important player is the American Association for Justice (AAJ), formerly the Association of Trial Lawyers of America (ATLA).

<sup>4</sup>From the numerous business groups involved in pushing reforms, the U.S. Chamber of Commerce is a prominent one. Many businesses support the American Tort Reform Association (ATRA).

in statutory tort law. We thereby concentrate on reforms in the area of medical malpractice.<sup>5</sup> In particular, we explore hypotheses on whether at any point in time a reform restricting tort liability in a U.S. state is earlier introduced if (i) there is a stronger representation of Republicans in the legislature, (ii) citizens hold more conservative general political attitudes, and (iii) the health industry is economically relatively more and the legal industry relatively less important in the state. Moreover, two hypotheses refer to the specific identity of legislators. We investigate whether a larger fraction of women as well as attorneys in a state legislature is related to a lower rate of reform enactments at any point in time. These hypotheses are motivated by the direct interest representation of two groups that are relatively more likely to lose from reforms; i.e., women in terms of adverse health outcomes and potentially lower compensation as well as lawyers in terms of business.

The hypotheses regarding the reform process at the macro level complement recent evidence on individual voting behavior on single tort reform proposals in various tort areas at the micro level (Matter and Stutzer 2015). Thereby Republicans are observed to vote systematically more likely in favor of reforms that restrict tort liability while legislators with a professional background as attorney and female legislators are systematically more likely to vote against restricting reforms than non-attorneys and male legislators. Whether the representation of these same groups can explain part of the overall reform process is studied here. Moreover, we refine our previous micro-analysis focusing on roll call votes on reforms in medical malpractice.

In order to understand the overall reform process, we analyze data from the Database of State Tort Law Reforms (Avraham 2011a) which contains the most prevalent medical malpractice tort reforms between 1980 and 2008. Avraham (2011a) distinguishes between eleven different types of non-wrongful death medical malpractice tort reforms. We concentrate on the five types of reforms that are most intensively discussed in the literature; i.e., caps on punitive damages, punitive evidence reform, caps on non-economic damages, reforms of the collateral source rule and reforms of the joint-and-several liability rule. We apply methods of survival analysis in order to empirically assess which of the factors described above drive the passage of medical malpractice tort reforms. Specifically, we estimate different specifications of semi-parametric proportional hazards models to calculate the effects of the politico-economic variables on the hazard of tort reform passage. This approach allows us to exploit the cross-sectional as well as the longitudinal variation in the data. In a first set of specifications, we take a broad view of the reform process and look jointly at repeated reform events across different domains of tort law in each state. From this part of the analysis, we can gain an idea of the factors that determine the reform process as a whole. With an additional set of specifications, we study each reform type individually. This offers us the opportunity to test hypotheses for specific reform types as well as for common drivers.

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<sup>5</sup>The other main areas are automobile accident law and product liability law.

The complementary micro-analyses are based on data from Project Vote Smart. Individual voting behavior can be studied for 21 roll call votes on medical malpractice tort reforms and 31 votes on tort reform bills covering other areas of tort law at the state and federal level.

We find that the fraction of women in a legislature is generally negatively associated with the hazard of reform enactment in medical malpractice law. Female legislators seem to have played an important role in the reform process overall. For the fraction of lawyers in the legislatures, we find, on average, no systematic effect on the reform process. However, for the two specific types for which our empirical model has explanatory power, we find negative effects, though imprecisely measured. Additionally, we find that the reform process overall can be well described as a partisan battle between the Republicans and the Democrats, whereby a stronger representation of Republicans by one percentage point increases the instantaneous risk of reform enactment in any given year by around two to three percent. A multiplicative effect on the hazard larger than one is also estimated for Republican governors, although the result is not statistically significant in all the specifications. These effects hold independent of differences in the liability risk in the early 1980s, the political orientation of the population, the fraction of African-American population, the population density, and a number of other explanatory and control variables. No clear pattern emerges for the relative size of the health and legal sector in a state's economy. We observe that reforms of the collateral source rule and punitive damages caps are significantly more likely in states with a larger health sector. There is no clear evidence that the professionalization of legislators or reforms in neighboring states explain the pattern in changes in medical malpractice law. Micro-evidence on female legislators' roll call votes on single medical malpractice reform proposals at the federal level (but not for the few votes at the state level) corroborates the macro findings. The same holds for legislators from the Republican party.

In related work, Klick and Sharkey (2009) examine the effect of jury awards on the passage of damage caps. They find no statistical relationship between these two factors. The research by Miceli and Stone (2013) is restricted to caps on punitive damages and focuses on parametric hazard analysis. In contrast, we look at reforms in five domains and concentrate on semi-parametric proportional hazards models, since the underlying distribution of the baseline hazard is theoretically undetermined.

We see our analysis as a complement to the literature on the consequences of alternative tort regimes and specific regulations. This literature has accumulated an interesting body of empirical findings, whereby the design of tort law is considered an exogenous factor. For example, Avraham (2007) investigates the impact of six different types of tort reforms on the frequency, size and number of total settlements in medical malpractice cases between 1991 and 1998. He shows that caps on pain and suffering damages and limitations on joint and several liability reduced the number of annual damage payments, while the periodic-payment reform and again caps on pain and suffering damages reduced average awards. Paik et al. (2013), taking the

gradual phase-in of damage caps into consideration, find strong negative effects of this reform on claim rates as well as payout per claim. Moreover, they present evidence suggesting that claim rates specifically decrease in claims with larger payouts and that stricter caps are associated with larger effects. Conversely, Donohue and Ho (2007) find no evidence that caps on pain and suffering as well as on punitive damages had any effect on the number of claims, using (nonparametric) randomization inference with differences-in-differences. Viscusi and Born (2005) find that medical malpractice reforms reduced the losses and increased the profitability of insurance companies. Klick and Stratmann (2007) show, using a triple-differences design to capture potential endogeneity of the passage of medical malpractice reforms, that caps on non-economic damages positively affect the number of doctors in high-risk specialties in a state. Additionally, Helland and Showalter (2009) find evidence that an increase in expected liability costs is associated with a decrease in a physician's hours worked. Rubin and Shepherd (2007) study the impact of different types of tort reforms on non-motor-vehicle accidental death rates and present significant positive as well as negative effects depending on the type of tort reform. While non-economic damages caps, punitive evidence reform, product liability reform as well as prejudgment interest reform significantly decrease the number of accidental deaths, collateral source rule reform significantly increases the number of accidental deaths. Building on these results, Rubin and Shepherd (2008) as well as Shepherd (2008) show that the non-motor-vehicle accidental death rates of women and men are affected differently by malpractice tort reform; i.e., the death rate for women is increased, while the one for men is decreased. Carvell et al. (2012) provide evidence that joint-and-several liability tort reforms have been accompanied by reductions in the non-auto, non-overdose accidental death rate. However, Frakes and Jena (2014) find only small and statistically insignificant effects of changes in malpractice pressure (in terms of non-economic damages caps) on different measures of health care treatment quality. Similarly, Sloan and Shadle (2009) conclude, based on the analysis of eight different reform types, that neither medical decisions nor patient outcomes are systematically affected by tort reforms. Finally, Kessler and McClellan (1996) and Currie and MacLeod (2008) assess the effect of malpractice reform on the practice of defensive medicine. Kessler and McClellan (1996) find that reduced liability pressure leads providers to reduce medical expenditures in treatment of serious heart disease without substantial negative effects on the rate of mortality. In a similar vein, Currie and MacLeod (2008) investigate whether certain types of tort reform affect the choice of birth procedures and related to this the health outcomes of mothers and their infants. They find that joint-and-several liability reforms reduce the probability of cesarean delivery as well as complications of labor and delivery, while damage caps increase the probability of additional procedures and complications.

In Section 2, we develop our politico-economic hypotheses regarding the legislative reforms in medical malpractice law. Section 3 outlines the empirical strategy based on survival analysis. The data for the empirical tests is described in Section 4. Section 5 presents the results. Concluding remarks are offered in

## II. POLITICO-ECONOMIC DETERMINANTS OF REFORMS IN MEDICAL MALPRACTICE LAW

### A. The evolution of (medical malpractice) tort law

The judicial process in the United States brought about a common law tort regime during the 1960s and 1970s that strengthened the position of victims and their (plaintiff) lawyers. These legal changes allowed plaintiffs to sue for high non-compensatory (punitive) damages and lawyers to share in the awards. A large popular and scientific literature controversially discusses the merits and flaws of this system. The same holds for the assessment of the backlash that occurred when defense interests from the industry and the medical profession started lobbying in state legislatures for reforms to curb the tort system (Rubin 2005). Five types of reforms are of particular importance:

1. Caps on punitive damages: Under this reform type fall statutes that either ban punitive damages outright or limit them to a maximum amount.
2. Punitive evidence reform: Statutes of this type of reform require a higher burden of proof for recovery of punitive damages. Such statutes often require the plaintiff to present “clear and convincing” evidence that the defendant acted maliciously.
3. Caps on non-economic damages: Reforms in this domain include statutory limits to damage awards for psychological losses such as damages for pain and suffering.
4. Collateral source rule reforms: Under the collateral source rule, defendants were not allowed to present evidence at trial which proved that a plaintiff had already been compensated for a loss from another source of remuneration; e.g., her insurance. Statutes that abolish or limit this rule are subsumed in this reform type.
5. Joint-and-several liability reforms: If the harm is caused by two or more parties, the joint-and-several liability rule enables plaintiffs to sue any of these for the whole amount of damages, regardless of their relative responsibility. Reforms considered in this category usually limit the rule of joint-and-several liability in such a way that any party causing harm can only be sued for its proportion of fault.

Figure 1 illustrates the reform process in terms of the enactment of these five reform types across the U.S. states during the period of observation in our study; i.e., 1980 to 2008.<sup>6</sup> In all these law changes, reformers

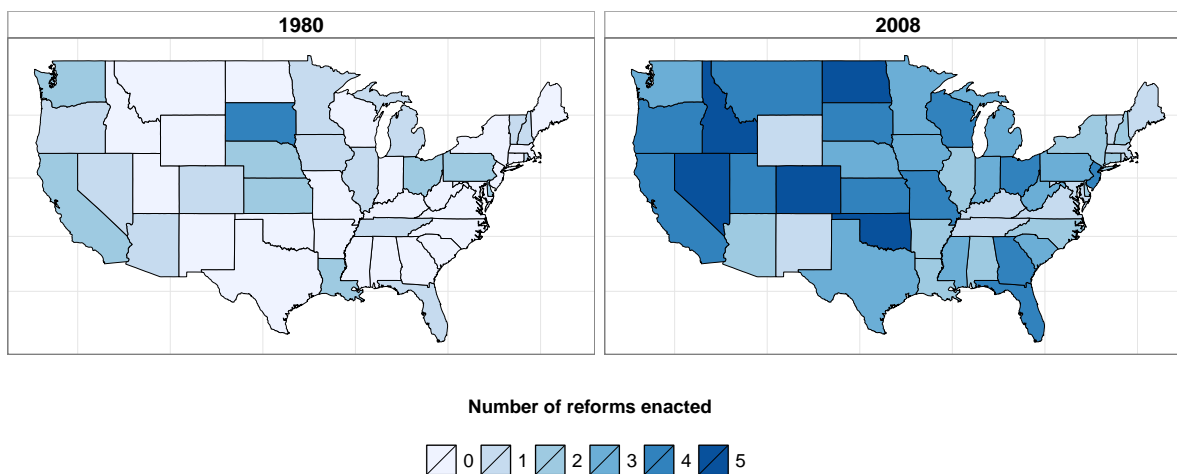
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<sup>6</sup>More descriptive details on the tort reform process are presented in Section 4.



understand that the transaction value of tort cases, and therefore liability pressure, is reduced. We do not aim at assessing the pros and cons of these reforms for the consumers and patients.<sup>7</sup> We rather want to gain a better understanding of the reform process as such, in particular the role of specific interests within state legislatures. Is there a pattern in the patchwork of legislative tort reforms that is systematically related to the political and economic conditions in the U.S. states?

FIGURE 1  
Number of reforms enacted across the U.S. states by 1980 and 2008




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*Data source:* Avraham (2011).

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## B. Basic hypotheses

The varying economic conditions across U.S. states suggest the simple presumption that tort reforms are more likely to come about where there is a particular reform pressure: In states with a higher liability risk for physicians, we expect tort reforms to be more likely at any point in time. We think of this force as one that is necessary to take into account in order to approximate to *ceteris paribus* conditions for the other factors. Regarding the political forces, we might start from the benchmark that legislative tort reforms reflect voters' preferences due to electoral competition in the democratic process. For instance, in states where more people share political attitudes that favor individual responsibility on the side of consumers, tort reforms are expected to be more likely.<sup>8</sup> However, citizens' interests are notoriously difficult to organize because of the free rider problem (Olson 1965) and a strong hypothesis is thus not warranted.

<sup>7</sup>Key references to the evaluation literature are provided in the introduction.

<sup>8</sup>This hypothesis is difficult to test directly as indicators on people's attitudes towards the tort regime in their state are rare. Instead, we rely on the general political attitudes in a state as reflected in their representatives' voting behavior in Congress. Concretely, we draw on the voting records that are summarized in the so-called (adjusted) ADA scores and reflect a conservative to liberal rating of the representatives.

Instead, tort reforms can be modeled as the result of a lobbying process involving competing well-organized interest groups. In particular, business associations and associations of physicians are expected to engage in spurring the reform process in order to reduce the likelihood and magnitude of damage awards that their members have to pay or insure against. Opposition is expected from lawyers who benefit substantially from the litigation business. The demand for tort lawyers and thus their income opportunities increase with the amount and the value of tort litigation as well as with the cost of litigation; i.e., with the complexity of the tort system. Therefore not only do the plaintiffs' lawyers benefit professionally and financially from an increased demand for their services, but also the defense lawyers (Olson 2003) and transactions lawyers.

In the context of U.S. tort reforms, the lobbying process is often described as a battle, as it has become a partisan issue with the Democrats fighting against reforms and the Republicans fighting in favor of reforms. This involves the members of the legislatures as well as the governors who play an important role in the appointment of judges in many states and who might also influence the legislative reform process with their veto right. The partisan orientation is often explained by the large financial support that the Democrats receive from trial lawyer associations (Zywicki 2000). However, this is not an obvious association, as lobby groups do not want to depend on members of one party alone, but rather rely on logrolling and gaining support across the political spectrum. Furthermore, while the Republican's idea of a *laissez-faire* economy surely agrees with product liability reforms that aim to remove the burden of potential damages from the manufacturing industry, it is not clear that the same rationale and political ideology also applies to medical malpractice; particularly, when one considers that the concept of tort law also represents the "[...] principle of personal responsibility for wrong doing, and this is normally a core conservative value" (Sugarman 2006: 1105).

The lobbying arguments lead to competing hypotheses. Based on the argument of the relative strength of pressure groups (Becker 1983), medical malpractice tort reforms are more likely if the health sector contributes more to the state's social product. They are less likely – *ceteris paribus* – if the legal services sector is economically more powerful. The partisan argument proposes that reforms are more likely if the Republicans control a larger share of seats in the legislatures.

A complementary view regards the legislature not only as a bargaining platform for special interest groups, but also as a selection of individuals with specific preferences or identities (Besley 2006). Legislators, thus, not only choose policies to gain (re-)election, but they choose them, because they are elected and are in the position to do so (see, e.g., Lee et al. 2004). Non-binding election promises and limited electoral control allow legislators to, at least partly, pursue their individual (e.g., gender-specific ideals) as well as their professional interests.<sup>9</sup> Special attention in the context of medical malpractice tort reform is warranted for

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<sup>9</sup>For the role of female identity for policy outcomes see, e.g., Chattopadhyay and Duflo (2004). The direct representation of

lawyer-legislators and women legislators. Lawyers are probably the most prominent and often also the most numerous representatives in U.S. state legislatures (Miller 1995). Many of them continue to practice law or consult their law firm while in the legislature. They usually return to their business after having finished their careers as politicians, endowed with a rich network. Lawyer-legislators are thus expected to benefit directly in terms of income opportunities if they oppose tort reforms. Matter and Stutzer (2015) analyze individual voting behavior on tort reforms at the federal and the state level and show that lawyer-legislators systematically engage to expand or at least maintain an extensive tort liability. We thus hypothesize that a stronger representation of lawyers in state legislatures overall reduces the likelihood of tort reforms.

The fraction of women in U.S. state legislatures during the period investigated in this study is on average about 15 percent, but ranges in some states and years to over 40 percent.<sup>10</sup> A distinct position of women on tort reform issues might therefore make a significant impact on the tort reform process. The recent literature on women in (U.S.) politics suggests that women have different political priorities and a different voting behavior in legislature than their male colleagues. Wängnerud (2009) concludes, based on a broad review of the literature, that women in legislature generally focus on issues dealing with women, children and family and thereby contribute to strengthening the position of women's interests. Swers (2001) comes to similar conclusions by specifically reviewing research on women in U.S. state legislatures. She points out that female legislators have been found to be more liberal and more committed to policy issues such as education, health and welfare. Moreover, evidence presented by Thomas (1991) suggests that, during a period with many tort reforms in the late 1980s, women in U.S. state legislatures particularly focussed on policy issues dealing with women, children and family.<sup>11</sup> It might thus be particularly relevant that the evidence on the consequences of medical malpractice tort reforms is suggestive that women benefit less than men or even experience a disproportionate and negative impact on their health (see Shepherd 2008 and Rubin and Shepherd 2008 for a review of the arguments). Other studies indicate that women are less likely to get compensated in the reformed medical malpractice system. According to Finley (2004) and Sharkey (2005), women might, due to a lower income, be awarded lower economic damages than men and therefore be more dependent on non-economic damages. With caps on non-economic damages, claims from women become less attractive for attorneys who might systematically screen out such claims, making it harder for women to get any compensation. While evidence by Studdert et al. (2004) suggests that the impact of caps on non-economic damages is equally distributed between men and women, such screening activity might still affect women adversely. We therefore hypothesize that the hazard of reform enactment is lower at the

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professional interest has, for example, been studied for business men (Gehlbach et al. 2010), and public servants (Braendle and Stutzer 2011).

<sup>10</sup>See Section 4 for details on this variable.

<sup>11</sup>Thomas (1991) finds that women in state legislatures with higher shares of female representatives introduce and pass more priority bills concerning issues relating to women, children and family than men.

aggregate level if there is a larger fraction of women in the legislature. Correspondingly at the micro level, we expect that female legislators support reforms in medical malpractice with a lower probability. This would help to better understand why women are observed to support reform proposals that restrict tort law in general less than men (Matter and Stutzer 2015).

Finally, we take into account in our robustness analyses the professionalization of legislatures, the partisan election of judges as well as possible spillover effects from neighboring states. A more professional legislature is meant to capture a possibly more intensive struggle for control in law making vis-a-vis the courts. In contrast, if the reform battle is partly fought in elections to the courts, statutory reforms might be less likely. Regarding spillover effects, we consider the possibility of policy diffusion and policy transfer effects. As citizens and legislators learn about the reforms in neighboring states (and experience the consequences of these reforms such as the migration of physicians), they might engage in policy action themselves. Alternatively, policy enactments in one state might generate transfer effects to neighboring states: If juries and courts consider the arguments in the policy debates of other states in their verdicts they reduce reform pressure.

### III. EMPIRICAL STRATEGY

As we want to study the forces accelerating the reform process (or, in other words, to investigate the factors in- or decreasing the instantaneous risk of reform enactment in a state), our empirical strategy relies on survival analysis. The focus of our analysis thus lies on the duration  $t$  a state is at risk of tort reform enactment, before the reform is actually introduced. Stated technically, we are interested in the hazard rate of tort reform enactment  $\lambda(t)$  which can be described as the instantaneous risk of reform enactment at time  $t$  given the reform has not yet been enacted. Assuming continuous time, this can be written formally as

$$\lambda(t) = \frac{f(t)}{1 - F(t)} = \frac{f(t)}{S(t)} \quad (1)$$

where  $\lambda(t)$  is the hazard rate of tort reform enactment,  $f(t)$  is the density function of durations to enactment,  $F(t)$  is the probability distribution of durations to enactment and  $S(t)$  is the survivor function of durations to enactment. To assess the effects of the explanatory variables on the hazard rate of reform enactment, we estimate different extensions of the Cox Proportional Hazards Model (Cox 1972, hereafter Cox model). Formally, our basic empirical model can be expressed as

$$\lambda(t, x(t)) = \lambda_0(t)e^{\beta'x(t)} \quad (2)$$

where  $\lambda(t, x(t))$  is the hazard rate of reform enactment;  $\lambda_0(t)$  is the underlying baseline hazard of reform

enactment;  $\beta$  is the vector of the regression coefficients, and  $x(t)$  the covariate-matrix, indicating that all covariates are allowed to be time-dependent. Since the underlying real-world distribution of durations to tort reform enactment is unknown and since the literature lacks – to our best knowledge – of any theoretical approach for approximating this distribution, we do not parametrize the underlying baseline hazard  $\lambda_0(t)$ . Instead, we rely on Cox’ partial-likelihood method (Cox 1972) to set up and maximize the log-likelihood for (2).<sup>12</sup> The advantage of this approach is that we do not need any assumption about the underlying distribution of  $t$ .<sup>13</sup> The downside of this approach is its lower efficiency, because it can only take the order of events (reform enactments) into account, but not their distribution.

In our first analysis, we take a broad view of the reform process by looking at reform events as such. A single state may thus experience the event of passing a reform several times. This allows for detection of the factors driving the overall reform process. Our empirical model is essentially the same as (2). However, the dataset is structured differently than in a standard Cox model. All states stay in the risk set for the entire observation period whether they enacted one or several reforms or no reform at all.<sup>14</sup>

We apply two distinct techniques to analyze the data in this structure. First, we estimate a model with the approach suggested by Andersen and Gill (1982), often referred to as the counting process approach or the independent increment model (IIM; Therneau and Hamilton 1997), which is probably the simplest approach to estimate a Cox-like model with repeated events. It is important to note, though, that this implies the assumption that reform enactments are independent of each other, which furthermore implies that the risk of reform enactment for any state is not affected by any earlier reform in this state. This assumption is rather problematic because, for example, the passage of one reform might reduce the pressure for additional reforms. Therefore, we also apply the ‘conditional’ approach suggested by Prentice et al. (1981) as an alternative.<sup>15</sup> The conditional model (CM) takes the sequence of events into account and is therefore considered to be more efficient and thus often preferable when analyzing repeated events data (Box-Steffensmeier and Zorn 2002). The CM approach exploits the sequence of events by using exactly the same data layout as the IIM but applies a stratified Cox model instead of a standard Cox model. The stratum variable is defined by the number of events experienced. Hence, a state is in stratum 1 when it is at risk of experiencing the first reform enactment. As soon as the first reform has been enacted, the state changes to stratum 2. A potential problem with both of these approaches with repeated events is the lack of independence of the reform events. From the same state, two or more reform enactments may be included in

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<sup>12</sup>In the case of tied events, such a model cannot be estimated directly. Since different states happen to enact some reforms in the same year, this is an issue in our study. We use the Efron method to deal with this problem (see Therneau and Grambsch 2000 for a discussion of handling tied events in a Cox model).

<sup>13</sup>In this respect, our empirical strategy diverges significantly from the one applied by Miceli and Stone (2013) who rely on the assumption that  $t$  is Weibull-distributed.

<sup>14</sup>Reform bills that included more than one issue are treated as one reform enactment in a given year.

<sup>15</sup>This method is also called the stratified counting process approach (Kleinbaum and Klein 2005).

the data set and be affected by the same unobserved factors leading to correlations among them. Therefore, the assumed correlation structure might be misspecified. In both cases, we calculate robust standard errors (clustered at the state level) to adjust for this potential misspecification.

In our second analysis, we investigate the effects of different sets of explanatory variables on the hazard of first reform enactment for different reform types individually. For each reform type, we estimate a model like (2). The datasets for each reform type, however, are structured differently than the pooled dataset in the previous analysis. A state leaves the risk set in the moment of enactment. This implies the assumption that once a reform has been enacted, it stays in place forever (or at least until the end of the observation period).<sup>16</sup>

The complementary analyses based on micro data from roll call records apply OLS and Logit estimations to capture the partial correlations between individual characteristics and voting behavior.

#### IV. DATA

Information on tort reforms for our empirical analysis comes from the Database of State Tort Law Reforms (DSTLR 3rd, Avraham 2011a). This dataset contains the most prevalent medical malpractice reforms between 1980 and 2008. It has been updated and improved several times over the last few years.<sup>17</sup> Since a vast variety of reforms have been passed, there are many ways to code such data for analysis. In this paper, we rely mainly on the coding suggested by Avraham (2011a) who distinguishes between ten different types of malpractice reform.<sup>18</sup> In particular, we use the dataset version 'DSTLR 3rd (clever)' in our main analysis from which reforms that were identified by Avraham (2011a) as having no impact were removed. In other words, reforms that are not restrictive in practice, such as caps that are very high or only applicable in certain circumstances, are excluded from this dataset. However, we also use the standard version (DSTLR 3rd) of the data to check the robustness of our results.<sup>19</sup> Nevertheless, for all of our analyses, we diverge and adjust the coding in two directions. First, we exclude all reforms that have been enacted by a judicial decision (reforms by common law). We thus retain only the reforms that are written in the civil code or statutes of a state.<sup>20</sup> Second, we make sure that the timing of each reform is coded according to the year of actual enactment.<sup>21</sup>

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<sup>16</sup>In our context, this is not always the case, as some reforms have been held as unconstitutional by state supreme courts some years after enactment. However, this does not invalidate our approach, as we want to explain the enactment of reforms in the legislature. A possible drawback is that not all information is used. This, however, is addressed in our first analysis.

<sup>17</sup>In our dataset, we have incorporated all further improvements to DSTLR 3rd published in Avraham 2011b.

<sup>18</sup>See Avraham (2011b) for a detailed description of how the reform data was coded.

<sup>19</sup>See Section 5 for details.

<sup>20</sup>A list with the reforms identified as enacted by a judicial decision and thus excluded from the dataset can be found in the online Appendix.

<sup>21</sup>This was necessary because the original coding treats reforms that were enacted after June in year  $t$  as belonging to the next calendar year  $t + 1$  (Avraham 2011b).

The information base which we exploit thus consists of the year(s) of actual enactment of tort reforms for the five different types across all U.S. states except Nebraska.<sup>22</sup> From this information, we compute the durations to reform enactment by defining the year 1980 as the starting point of the observation period. States that already enacted a certain type of tort reform before 1980 are furthermore excluded from the analysis.<sup>23</sup> The choice of 1980 as the beginning of the observation period is somewhat arbitrary, because it implies the assumption that all states only started to be at risk of reform in that year. Making such an assumption is hardly avoidable when analyzing the passage of policies with proportional hazards models. Unlike in other applications of these methods (such as the analysis of unemployment spells), it is per se unclear when the individual (in our case a state legislature) enters the risk set. A prominent case of policy innovation by one state would be a sound reason to set the beginning of observation for other states. One could argue that the frequently cited tort reforms enacted by the California legislature in 1975 represent such a prominent case of policy innovation in the context of tort law. However, this would ignore the fact that some states' constitutions or common law contain liability limiting rules such as caps on punitive damages that date back to the 19th century (Avraham 2011b). U.S. states have thus been at risk of reforming their law of torts since they came into existence.<sup>24</sup> We count 20 reforms defining caps on punitive damages, Illinois and Wisconsin being the first states in 1985. Reforms involving punitive evidence are observed in 23 states, for the first time in Indiana in 1984. Caps on non-economic damages are coded for 21 states beginning with Colorado, Kansas, Maryland, Minnesota and Missouri in 1986. Collateral source rule reforms started in New York in 1984 and have been enacted in 19 states so far. Finally, for joint-and-several liability reforms, we observe in 31 states with Louisiana having been the first in 1980. Figure 2 shows the distribution of the five types of reforms over time. While reforms of the collateral source rule and joint-and-several liability were enacted relatively early during the first big wave of reforms in 1985/1986, the enactments of other types of tort reform are distributed more equally over time.

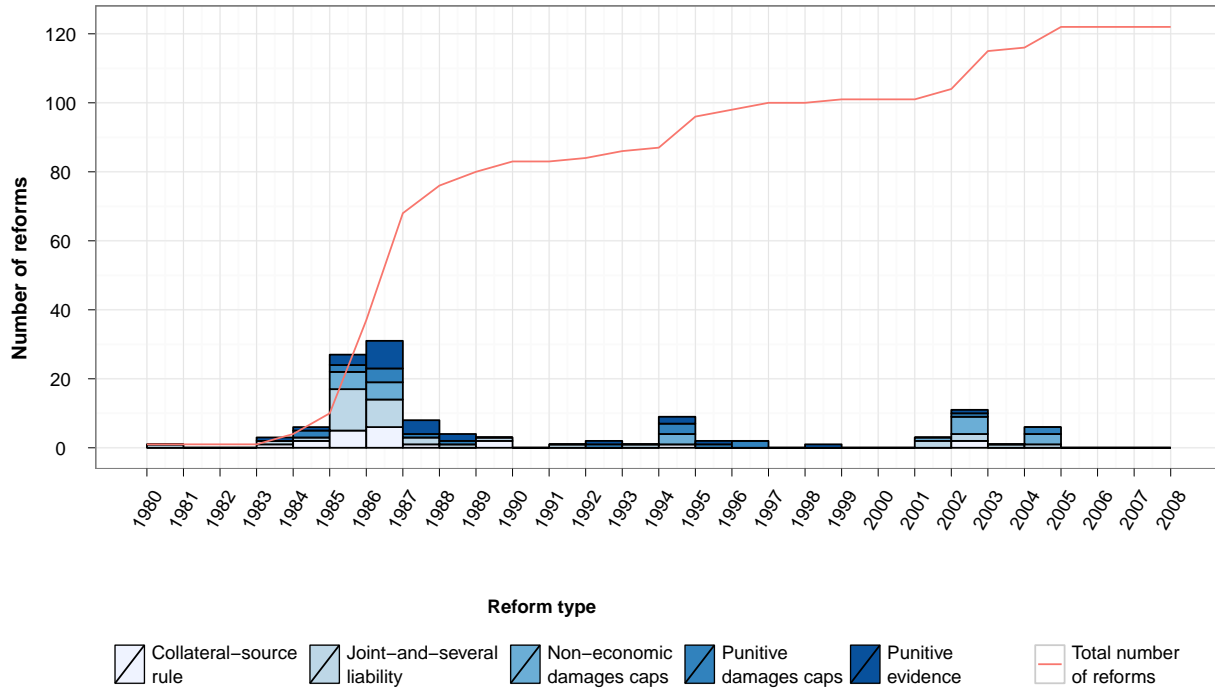
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<sup>22</sup>We exclude data on Nebraska from the analysis due to the lack of information on party strength in its nonpartisan legislature.

<sup>23</sup>For the individual analyses of different types of tort reform, the dataset thus consists of different states (depending on the previous enactment of specific types of tort reform). Table A1 in the online Appendix gives an overview of the states and reforms included in each analysis. Additionally, Table A2 in the online Appendix lists the states that are not present in the analyses of specific tort reforms as they already enacted a respective reform before 1980.

<sup>24</sup>However, there are some reasons to set 1980 as the beginning of observation in our study. First, when setting the beginning of the observation period to any year before 1980, we risk losing accuracy in the reform data. Although DSTLR also mentions reforms that were enacted before 1980, it is much more complete and accurate for the time after. The same is true for some of our explanatory variables mentioned below. Second, our approach is in agreement with Klick and Sharkey (2009:8) who argue that "there is no particularly principled way to date the beginning point of when a state could have possibly adopted a punitive damage cap" and set the beginning of observation also according to the availability of data. Miceli and Stone (2013:117) strategically choose 1981 as the starting point in their analysis "to coincide with the year in which the California Supreme Court rendered the *Grimshaw* decision". We do not follow this argumentation, because *Grimshaw* was a case of product liability tort law, while the data we use mainly contains reforms of medical malpractice tort law.

FIGURE 2  
Distribution of tort reform enactments over time



Data source: Avraham (2011a).

Based on our theoretical argumentation in Section 2, we include state-level variables on liability risk, political orientation, interest group strength, party control, legislature composition, legislative professionalism as well as several control factors. The following list gives some detailed information on each of these variables. Table 1 shows some descriptive statistics for all the explanatory variables from the data set used in our analyses.

*Liability index:* To control for the reform pressure in a state in the early 1980s we use the liability risk measure (i.e., an estimation of the expected liability costs) proposed by Helland and Showalter (2009). The liability risk measure is based on detailed liability award data in Florida, in combination with aggregate award data from all other states and is estimated by state and physicians' field of specialization in 1983 and 1988. In our specifications we include the average expected liability costs (averaged over specialties, in USD 100) by state in the year 1983.

*Liberal political orientation:* The mean of the adjusted ADA (Americans for Democratic Action) scores of members of Congress is used as a proxy for the political preferences of a state's electorate. ADA scores track how the members of U.S. Congress vote on certain key political issues. Based on these voting records,



each representative receives a rating. The ratings are based on the share of bills that a representative votes for in accordance with the ADA policies. Higher ratings reflect a more liberal attitude<sup>25</sup>. The data for this variable come from Anderson and Habel (2009).

*Percentage of Republicans in the legislature:* This variable contains the overall percentage of Republicans in a state legislature (both chambers). This data is taken from the State Politics and Policy Quarterly State Dataset (Lindquist 2007) and for recent years from the U.S. Census Bureau.

*Governor's party:* This factor is described as an indicator variable which is equal to 1 if the governor is Republican and 0 otherwise. Data is from the State Politics and Policy Quarterly State Dataset (Lindquist 2007) as well as the National Governors Association.

*Health sector share of gross state product (GSP) and legal sector share of GSP (in %):* We use the percentage of the health (legal) sectors' contribution to the state's gross domestic product as a proxy for the financial and political power of the health (legal) lobby in a state. The data comes from the U.S. Department of Commerce, Bureau of Economic Analysis.

*Real GSP per capita (in USD 1,000):* Data on this variable come from the U.S. Department of Commerce, Bureau of Economic Analysis.

*Percentage of women in the legislature:* Information on the percentage of women legislators is available for all states and comes from the Center for American Women in Politics of the Eagleton Institute of Politics, State University of New Jersey.

*Percentage of attorneys in the legislature:* Data on the professional composition of all U.S. state legislatures is only available for the years 1986, 1993, 1995, and 2007. The data is based on surveys undertaken by the National Conference of State Legislators.<sup>26</sup> Values for unavailable years have been estimated in a first step by keeping the percentage of attorneys in the legislature over each legislative period in each state constant for which at least one year was available. The remaining missing values have been estimated using linear interpolation.

*Control variables:* For our robustness checks, we first include the percentage of the African-American population as a control factor in the estimations. Data on this variable come from the U.S. Census Bureau. Second, we include the Squire Index on legislative professionalism (Squire 1992, Squire and Moncrief 2010) as a proxy for a state legislature's level of professionalism. The data is taken from the State Politics and Policy Quarterly State Dataset (Lindquist 2007).

Additionally, we control in one specification for the partisan election of judges. This indicator variable

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<sup>25</sup>A liberal attitude in the sense of ADA scores is closely related to what is understood as modern liberalism in the United States. It includes the support of civil rights such as abortion rights, rights of homosexuals as well as government spending on education and healthcare. Unlike European or classical liberalism, it does not involve the support of a laissez-faire economy, but rather supports Keynesian government interventions.

<sup>26</sup>Data for the initial waves comes from Rosenson (2006).

is equal to 1 if the election or reelection of judges for the highest court in a state is partisan. The data for this variable come from Kang and Shepherd (2011). Finally, we control in one specification for the number of neighboring states with a reform enacted. This variable captures the prevalence of the different types of tort reform in the neighboring states. The states without direct boundaries to other states have been coded as neighbors of the states they are closest to. Hence Alaska is coded as a neighboring state of Washington, and Hawaii as a neighboring state of California.

TABLE 1  
Summary statistics for the independent variables (all reforms pooled)

	Mean	Std.dev.	Median	Min.	Max.	Range
African-American population (%)	10.19	9.45	7.32	0.23	37.50	37.27
Attorneys in legislature (%)	16.43	8.53	16.33	0.00	51.67	51.67
GSP health industry (%)	5.73	1.57	5.61	1.04	11.35	10.31
GSP legal industry (%)	1.04	0.40	0.98	0.28	3.09	2.82
Liability risk (in USD 100)	55.33	29.05	48.90	7.45	151.80	144.35
Liberal political orientation	42.21	20.64	41.28	-3.84	92.64	96.48
Real GSP p.c. (in USD 1,000)	17.89	4.57	17.18	9.96	57.26	47.30
Republican governor	0.47	0.50	0.00	0.00	1.00	1.00
Republicans in legislature (%)	43.93	17.01	45.41	1.90	89.29	87.38
Women in legislature (%)	17.83	8.38	17.14	0.82	42.35	41.53

*Notes:* N= 1421. The data consist of yearly observations for 49 U.S. states (We exclude data on Nebraska from the analysis due to the lack of information on party strength in its nonpartisan legislature.) from 1980 to 2008.

*Data source:* See main text, Section 4.

The complementary analyses for individual behavior in specific roll call votes is based on data from Project Vote Smart. We rely on the data set in Matter and Stutzer (2015) with 21 votes on medical malpractice tort reforms (13 at the state level and 8 at the federal level) and 31 votes on tort reform bills covering other areas of tort law (25 at the state level and 6 at the federal level). We additionally take into account whether the specific reform proposal is directed towards medical malpractice law or towards some other area of tort law. Moreover, in terms of professional background, we not only identify attorneys but also physicians. Table A8 in the online Appendix provides summary statistics for the fraction of legislators with specific individual characteristics separately for roll call votes on reforms in medical malpractice and in other areas of tort. On average, about 15.55% of the records are from female legislators, 29.63% from attorneys, but only 1.42% from physicians.

## V. RESULTS

We present our results in separate subsections for the overall reform process across states and the five specific types of tort reform. A third subsection documents the micro-evidence for individual legislators' voting behavior on medical malpractice tort reforms. In the fourth subsection, we present several robustness checks. As there is no straightforward interpretation of the estimated coefficients in a Cox model, the tables report exponentiated coefficients. An exponentiated coefficient from a Cox model represents the multiplicative effect of the corresponding variable on the underlying baseline hazard (i.e. an exponentiated coefficient of 1.1 indicates that an increase of one unit in the respective variable is *ceteris paribus* increasing the hazard by  $1.1 - 1 = 0.1 = 10\%$ ).

### A. General tort reform process

Table 2 presents the findings for the malpractice tort reform process as a whole. Similar results are obtained for the unconditional Cox-like model with repeated events (IIM) in columns (1), (3), and (5) and the conditional model (CM) in columns (2), (4), and (6). Strikingly, liability risk, i.e., the indicator for reform pressure, is not statistically related with the hazard of overall reform enactment. The respective multiplicative effect on the hazard is close to 1 with z-values of the underlying coefficient ranging from 0.022 to -1.084. This result echoes the finding that large individual jury awards are not systematically related to tort reforms across states (Klick and Sharkey 2009). In contrast, the political orientation in a state is systematically related to the adoption of reforms as indicated in specifications (1) and (2). For a one standard deviation more liberal orientation, the overall reform hazard is roughly 21% lower ( $= (0.99 - 1) * 20.64$ ). Specifications (3) and (4) indicate that the political orientation primarily works via the partisan composition of the state legislature and the party affiliation of the governor. If the fraction of Republicans in the legislature is higher by one percentage point, the hazard of reform is increased by 2.2%. For one standard deviation in the strength of the Republican party, the respective effect on the hazard is about 34% ( $= (1.02 - 1) * 17$ ). If a Republican governor is in charge, rather than a Democrat governor, the hazard of reform is around 46% higher. With these two party variables included, there is no independent effect of the general political orientation on the tort reform process. The evidence thus supports the hypothesis that U.S. tort reforms at the state level are a strongly partisan issue. The finding is corroborated in specifications (5) and (6) where the correlated variable political orientation is not included. A substantial effect is also found for the fraction of women. With a one percentage point stronger presence of women in a legislature the hazard of reform is lowered by 3.6% to 4.2%. This result indicates that female legislators have played an important role in opposing the ongoing malpractice tort reform process towards less liability. No systematic effects are found for the

economic importance of the health and the legal industry, the fraction of attorneys in a legislature and GSP per capita.

TABLE 2  
Determinants of the overall malpractice reform process in U.S. states between 1980 and 2008

exp(Coefficient)	(1)	(2)	(3)	(4)	(5)	(6)
Liability risk (in USD 100)	1.000 (-0.041)	1.000 (0.022)	0.996 (-1.084)	0.996 (-0.840)	0.995 (-1.316)	0.995 (-1.013)
Liberal political orientation	0.990 * (-1.930)	0.988 ** (-1.979)	0.995 (-0.525)	0.994 (-0.613)		
Republicans in legislature (%)			1.021 ** (2.429)	1.022 ** (2.214)	1.023 *** (3.480)	1.025 *** (3.143)
Republican governor			1.458 ** (1.997)	1.461 * (1.787)	1.439 ** (1.993)	1.430 * (1.800)
GSP health industry (%)			1.023 (0.158)	0.986 (-0.095)	0.974 (-0.220)	0.928 (-0.547)
GSP legal industry (%)			1.535 (1.318)	1.680 (1.251)	1.563 (1.412)	1.677 (1.285)
Attorneys in legislature (%)			0.999 (-0.087)	1.002 (0.099)	0.998 (-0.154)	1.001 (0.045)
Women in legislature (%)			0.960 *** (-2.843)	0.964 ** (-2.056)	0.958 *** (-2.767)	0.961 ** (-2.142)
Real GSP p.c. (USD 1,000)	0.956 (-1.382)	0.970 (-0.929)	0.979 (-0.478)	0.980 (-0.412)	0.971 (-0.631)	0.971 (-0.590)
No. of observations	1421	1421	1421	1421	1421	1421
No. of events	92	92	92	92	92	92
Logrank test (p)	0.091	0.124	0.005	0.009	0.008	0.013
Approach	IIM	CM	IIM	CM	IIM	CM

*Notes:* Cox-like proportional hazards models with repeated events. Specifications (1), (3), and (5) are based on an independent increment model. Specifications (2), (4), and (6) are based on a conditional model. Standard errors are clustered at the state level. Z-values of the coefficients are in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . No. of observations reflects total state-year observations at risk (49 states over 29 years).

*Data sources:* Avraham (2011a) for data on tort reforms (only restrictive reforms). For data on independent variables, see main text, Section 4.

In a supplementary analysis (see Table A4 in the online Appendix), party politics is considered in a more flexible way in the empirical models. It is hypothesized that party control of both legislative chambers is particularly relevant for the reform process. Specifically, we include for both Republican and Democratic control two indicator variables. One indicating whether the party controls both chambers with a large majority and one indicating whether the party controls both chambers with a small majority.<sup>27</sup> The reference category contains legislatures in which control over the two chambers is divided between the two parties.

<sup>27</sup>Parties are coded as having control with a large majority if the share of Republicans (Democrats) in the legislature is larger than the median average share of all legislatures/years where Republicans (Democrats) control both chambers. If it is smaller than the median average share, we code it as small majority.

The results for this alternative specification of party control are qualitatively similar to the results presented in Table 2. If both chambers are controlled by the Republicans with a large majority, the hazard of reform is around 2.7 times higher than when control over the chambers is divided (with a z-value of 1.706). For legislatures under Republican control with a small majority, the multiplicative effect on the hazard is only slightly smaller and amounts to 2.4 (z-value=1.657). No statistically significant difference is found between Democratic control and divided control.

## B. Specific tort reforms

In a refined analysis, we explore how the various factors are correlated with the hazard of five major types of medical malpractice tort reforms. Table 3 shows the results that are to a large extent similar to the ones for the overall reform process.<sup>28</sup> There are, however, also a few differences. They should be considered with care though, as random deviations are statistically more likely with five separate estimations. A higher liability risk does not increase the hazard of specific reforms (as observed for the overall reform process). If anything, and counter to our hypothesis, the hazard of punitive evidence reform is lower in states with an initially higher risk. The political orientation of the electorate has generally no statistically significant influence on the hazard of reform enactment beyond the partisan composition of the legislature and the party affiliation of the governor. A larger fraction of Republicans in the two chambers is associated with a higher hazard of reform for all the five types of tort reform. The same holds for Republican governors (with the exception of collateral source rule reform). The levels of statistical significance are generally lower than for the overall reform process in Table 2 and below the 10% level in the case of a Republican governor. The estimated coefficients are difficult to compare in terms of size across reform types, as they refer to separate baseline hazards in each specification. In contrast to the partisan hypotheses, there is less systematic evidence for the lobbying hypothesis based on the economic strength of industries. While we expect the size of the health industry to be positively related to the reform hazard in all the five areas, this is only the case for two, i.e. reforms on punitive damage caps and the collateral source rule. For the other areas, the estimated coefficient is even smaller than 1 (though not statistically significant). Counter to our hypothesis, a larger legal service industry is weakly positively related to reforms, and in the case of reforms of the collateral source rule even statistically significantly so.

With regard to the identity of politicians, we find that for four out of five types of reform the hazard is smaller for legislatures with a larger fraction of lawyers. However, these multiplicative effects on the hazard are not statistically significant. For the fraction of female legislators, there are exponentiated coefficients

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<sup>28</sup>We estimated the models in Table 3 also without including the variable for political orientation. The results are qualitatively the same (they are presented in Table A7 in the online Appendix)

TABLE 3  
Determinants of specific medical malpractice tort reforms in U.S. states between 1980 and 2008

exp(Coefficient)	Punitive damages caps	Punitive evidence	Non-economic damages caps	Collateral-source rule	Joint-and-several liability
Liability risk (in USD 100)	0.997 (-0.240)	0.981 ** (-2.262)	0.992 (-0.837)	1.001 (0.109)	1.002 (0.309)
Liberal political orientation	0.973 (-1.458)	1.015 (0.912)	1.014 (0.902)	0.987 (-0.576)	0.999 (-0.034)
Republicans in legislature (%)	1.028 (1.139)	1.027 (1.290)	1.036 * (1.688)	1.055 *** (2.769)	1.022 * (1.652)
Republican governor	1.001 (0.002)	1.692 (0.954)	1.364 (0.668)	0.578 (-1.170)	1.261 (0.640)
GSP health industry (%)	1.544 * (1.719)	0.891 (-0.423)	0.726 (-1.349)	3.031 ** (2.146)	0.767 (-1.141)
GSP legal industry (%)	0.679 (-0.545)	1.229 (0.237)	1.962 (1.024)	12.433 ** (2.502)	1.843 (0.764)
Attorneys in legislature (%)	1.030 (0.753)	0.939 (-1.575)	0.975 (-0.688)	0.954 (-0.899)	0.984 (-0.525)
Women in legislature (%)	0.996 (-0.098)	0.880 *** (-3.217)	0.980 (-0.560)	0.940 * (-1.653)	0.977 (-0.711)
Real GSP p.c. (USD 1,000)	1.059 (1.339)	1.035 (0.336)	0.823 (-1.524)	1.425 ** (2.485)	0.974 (-0.324)
No. of observations	996	763	1016	559	667
No. of events	20	25	22	20	34
No. of states without reform	26	19	25	13	11
Likelihood ratio test (p)	0.383	0.036	0.23	0	0.518

Notes: Cox proportional hazards models. Z-values of the coefficients in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . No. of observations reflects total state-year observations at risk. Data sources: Avraham (2011a) for data on tort reforms (only restrictive reforms). For data on independent variables, see main text in Section 4.

smaller than 1 in all five types of reforms. For punitive evidence reforms, the effect is strongest in terms of statistical significance.

Overall, the likelihood ratio tests indicate that a statistical analysis of determinants of specific malpractice reforms is difficult. In two out of five cases, the null hypothesis of no joint correlation cannot be rejected at the 10% statistical significance level. It is important to note, though, that our inference has to rely on a rather limited number of events ranging from 20 collateral source rule reforms and punitive damages caps to 34 joint-and-several liability reforms.

### C. Micro-evidence from roll call records

The findings for the role of Republicans and female legislators in the reform process of medical malpractice law in the Tables 2 and 3 are based on aggregate data. We thus face the problem of falling prey to an ecological fallacy when interpreting the results of the survival analyses. Therefore, we complement them with micro-evidence on individual behavior in roll call votes on reform bills. Table 4 presents the results for reform bills at the state level, Table 5 for bills at the federal level. Consistent with the aggregate analysis, Republicans are more likely to support medical malpractice reforms than Democrats. The difference amounts to around 60 percentage points at the state and almost 90 percentage points at the federal level.<sup>29</sup> The partisan differences for medical malpractice reforms are more pronounced than for reforms in other areas of tort. Regarding female legislators, they seem to be equally likely as male legislators to support reforms in medical malpractice in the few bills for which data is available at the state level. In other areas of tort, a generally higher support of reform bills at the state level is observed for female legislators though. More importantly, for the larger sample at the federal level, female legislators are statistically significantly less likely to support medical malpractice reforms. No such effect is observed for reforms in other areas of tort. Overall, the individual level evidence for female legislators corroborates the results for the aggregate reform process. In line with the general results in Matter and Stutzer (2015), attorneys are less likely to support reform bills that are directed towards medical malpractice. For physicians generally a negative partial correlation with support of tort reforms is measured. However, the small number of observations in the sample prevents strong conclusions.

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<sup>29</sup>For the state level the exact differences are 74.5 percentage points based on the OLS estimation and 74 percentage points based on calculations of the average discrete effect in the Logit model. The respective differences at the federal level are 89.2 and 89 percentage points.

TABLE 4  
Voting behavior in state-level medical malpractice tort reform bills

<i>Dependent variable: Vote in support of reform=1</i>				
	Medical malpractice reforms		Other tort reform bills	
Coefficients	(1)	(2)	(3)	(4)
Intercept	0.311 *** (6.258)	-0.266 (-0.487)	0.071 *** (4.528)	-3.223 *** (-5.644)
Republican	0.745 *** (33.598)	6.417 *** (12.856)	0.880 *** (71.054)	6.960 *** (20.144)
Female	-0.020 (-0.823)	-0.397 (-1.212)	0.016 (0.978)	0.306 (1.118)
Attorney	-0.122 *** (-3.987)	-1.715 *** (-4.189)	-0.047 *** (-2.791)	-0.935 *** (-3.133)
Physician	-0.017 (-0.284)	0.336 (0.296)	-0.039 (-1.049)	-0.803 (-0.891)
Higher education	0.012 (0.607)	0.288 (0.927)	0.012 (0.898)	0.287 (1.124)
N	873	873	1869	1869
(McFadden) R-squared	0.66	0.669	0.784	0.731
Method	OLS	Logit	OLS	Logit

*Notes:* OLS specification with standard errors clustered at the individual level. T-values (OLS) or z-values (logit) are in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . All specifications include bill fixed effects. Information on the age of legislators is not available on the state level.

*Data source:* Project Vote Smart.



TABLE 5  
Voting behavior in medical malpractice tort reform bills in the U.S. Congress

<i>Dependent variable: Vote in support of reform=1</i>				
	Medical malpractice reforms		Other tort reform bills	
Coefficients	(1)	(2)	(3)	(4)
Intercept	0.117 ** (2.557)	-2.651 *** (-3.455)	0.326 *** (3.987)	0.171 (0.243)
Republican	0.892 *** (69.570)	7.344 *** (28.448)	0.772 *** (33.284)	5.608 *** (22.460)
Female	-0.039 *** (-2.831)	-0.939 *** (-3.015)	-0.022 (-0.742)	-0.188 (-0.669)
Age	-0.000 (-0.814)	-0.012 (-1.212)	-0.001 (-1.126)	-0.016 * (-1.703)
Attorney	-0.050 *** (-4.236)	-1.251 *** (-5.809)	-0.117 *** (-5.127)	-1.486 *** (-7.129)
Physician	-0.069 (-1.443)	-1.645 *** (-3.021)	-0.106 ** (-2.171)	-1.586 ** (-2.135)
Higher education	0.000 (0.017)	0.028 (0.089)	-0.010 (-0.342)	-0.230 (-0.812)
N	3394	3394	1841	1841
(McFadden) R-squared	0.828	0.798	0.672	0.652
Method	OLS	Logit	OLS	Logit

*Notes:* OLS specification with standard errors clustered at the individual level. The logit models are estimated with the method suggested by Gelman et al. (2008). T-values (OLS) or z-values (logit) are in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . All specifications include bill fixed effects and state fixed effects. Information on the age of legislators is not available on the state level.

*Data source:* Project Vote Smart.

#### D. Robustness checks

We explore the sensitivity of our macro findings in three directions. First, we extend the analysis of the overall reform process with additional control variables. Second, the tort reform process is studied based on an extended sample including all reforms (not only restrictive ones). Third, the analysis for two specific areas of reform (for which the null hypothesis of no joint correlation cannot be rejected at the 10% statistical significance level) is extended to take into account possible additional drivers.

**Possible additional drivers of the overall reform process.** Previous work on tort reforms has dealt with further socio-economic variables which affect the tort system and the application of tort law, such as the fraction of the African-American population (Helland and Tabarrok 2003). In counties with a higher fraction of this population segment, larger jury awards are observed, and this might motivate the enactment of reforms. The legislature has developed as a forum for tort reforms. However, in some states the reform

battle is partly fought in connection with the election of judges, making statutory reforms less likely. We thus take into account whether a state has a partisan election of judges. Finally, we consider potential effects of policy diffusion and policy transfer. Legislatures might learn from neighboring states about policy alternatives and as a reaction engage in reforms. In the case of transfer, however, reform pressure is found to be lower because juries and courts forestall reforms in their verdicts by taking the legal amendments of neighboring states into account.

The results of the robustness analysis with the additional control variables is presented in Table 6. The estimations are extensions of the conditional model specification (4) in Table 2. The results for the main politico-economic variables of interest are robust. The additional factors do not seem to be systematically related to the overall reform process.

TABLE 6  
Overall malpractice reform process: robustness analysis

exp(Coefficient)	(1)	(2)	(3)	(4)
Liability risk (in USD 100)	0.996 (-0.923)	0.996 (-0.797)	0.995 (-0.953)	0.997 (-0.571)
Liberal political orientation	0.991 (-0.714)	0.994 (-0.610)	0.993 (-0.679)	0.993 (-0.709)
Republicans in legislature (%)	1.022 ** (2.143)	1.021 * (1.694)	1.020 ** (2.033)	1.024 ** (2.398)
Republican governor	1.478 * (1.816)	1.466 * (1.796)	1.499 * (1.889)	1.432 * (1.715)
GSP health industry (%)	0.995 (-0.034)	0.977 (-0.156)	0.990 (-0.064)	1.001 (0.008)
GSP legal industry (%)	1.411 (0.793)	1.707 (1.250)	1.872 (1.549)	1.561 (1.124)
Attorneys in legislature (%)	1.002 (0.129)	1.002 (0.134)	1.000 (0.004)	1.002 (0.087)
Women in legislature (%)	0.969 * (-1.725)	0.963 ** (-2.108)	0.958 ** (-2.504)	0.963 ** (-2.186)
Real GSP p.c. (USD 1,000)	0.971 (-0.643)	0.979 (-0.437)	0.980 (-0.416)	0.971 (-0.611)
Legislative professionalism	1.010 (0.965)			
African-American population (%)		0.997 (-0.170)		
Partisan election of judges			0.659 (-1.300)	
Neighbours with reform				0.885 (-1.206)
No. of observations	1421	1421	1421	1421
No. of events	92	92	92	92
Logrank test (p)	0.017	0.022	0.012	0.012

*Notes:* Cox-like proportional hazards models with repeated events. All specifications are based on a conditional model. Standard errors are clustered at the state level. Z-values of the coefficients are in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . No. of observations reflects total state-year observations at risk (49 states over 29 years).

*Data sources:* Avraham (2011a) for data on tort reforms (only restrictive reforms). For data on independent variables, see main text in Section 4.

**Extended sample of reforms.** The standard version of the database of state law reforms not only includes the restrictive reforms studied in Table 2, but also aims at including all reforms, i.e., also rather symbolic ones. Table A5 in the online Appendix shows the results when the specifications in Table 2 are re-estimated based on the full sample. An interesting pattern emerges: The effect of a Republican governor becomes relatively smaller (and loses statistical significance), while the effect for the fraction of Republicans becomes

relatively larger. This might indicate, on the one hand, that governors from the Democratic Party only take action to stop restrictive reforms (and thus the party affiliation of the governor matters less overall). Republican legislators, on the other hand, seem to also boost less restrictive reforms. The fraction of women legislators is also related to a lower hazard of reform enactment in the extended dataset. Counter to the lobbying hypothesis, a larger legal services sector is found to be associated with a higher hazard of reform.

**Additional determinants of specific tort reforms.** The robustness analysis for specific tort reforms concentrates on the two areas of reform for which the null hypothesis of no joint correlation cannot be rejected (at the 10% statistical significance level, see Table 3). These are the punitive evidence reform and the reform of the collateral source rule. Table A6 in the online Appendix presents the results when the same set of additional controls is considered as for the overall reform process. The results for the variables capturing the main hypotheses remain qualitatively similar. The effect of the share of female legislators is slightly less statistically significant in the case of the collateral source rule reform. The additional variables which were taken into account are not statistically related to the hazard of reform enactment, except for legislative professionalism in the case of collateral source rule reforms.

## VI. CONCLUDING REMARKS

U.S. tort reform is not only a controversial issue in terms of substantive law, but also in terms of understanding its drivers and institutionalized mechanism. There are many reports which emphasize the predominant role that special interest politics play in shaping the reform process rather than a process of trial and error towards a tort law that is most beneficial for citizens. In order to better understand the reform process, we formulate a series of hypotheses on the politico-economic determinants of tort reforms and test them with regard to medical malpractice tort law at state level for the United States. We find supporting evidence that relative party strength in the legislature and governors' party affiliations affect the enactment of tort reforms. The stronger that Republican representation is in politics, the more likely is that a reform will be passed at any point in time. There is limited evidence for the influence of interest groups, other than through political parties. However, this might well be due to data limitations. A specific challenge for future research is to devise better measures for capturing the strength of interest groups in the area of tort law. The second major driving force of the reform process is the presence of women in state legislatures. The hazard of reform is found to be systematically lower when there is a larger fraction of female legislators. Evidence from micro-data on female legislators' voting behavior on medical malpractice reforms at the federal level corroborates this finding. Overall, this is consistent with gender-specific consequences of tort reforms being less beneficial

or even harmful to women. No evidence is found for either a functional or a learning explanation of the reform process: There is neither a higher hazard of reform in states where physicians faced a higher liability risk in the early 1980s, nor did there appear to be any diffusion of policy reforms between neighboring states. The insights on the reform process have implications for the evaluation of the consequences of tort reforms. Reform enactments should no longer be considered discrete random events, but should, instead, be expected to entail further policy changes that are related to the political orientation of a state's governor and legislators. In other words, the validity of the common trend assumption in difference-in-differences analyses needs to be carefully studied. We are convinced that further joint analyses of the tort reform process and its consequences will help to provide a better understanding of its costs and benefits.

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APPENDIX

A.I Reforms in medical malpractice tort law by state

TABLE A1  
Reforms and states included in individual reform analyses

State	Punitive damages caps	Punitive evidence	Non-economic damages caps	Collateral-source rule	Joint-and-several liability
Alaska	1997	1986	2005		1986
Alabama	1987	1987	1987	1987	
Arkansas		2003			2003
Arizona					1987
California		1988			1986
Colorado	1986		1986	1986	1986
Connecticut				1985	1986
Delaware					
Florida		1999	2003		1986
Georgia	1987	1987	2005		1987
Hawaii			1987	1987	1987
Iowa		1986			1984
Idaho	2003	1987	1987	1990	1987
Illinois	1985				
Indiana	1995	1984		1986	
Kansas	1987	1987	1986		
Kentucky		1988		1988	1988
Louisiana					1980
Massachusetts				1986	
Maryland			1986		
Maine				1990	
Michigan				1986	1986
Minnesota			1986	1985	1988
Missouri	2005	1986	1986		1986
Mississippi		1993	2003		1989
Montana		1985	1995	1987	1987
North Carolina	1996	1996			
North Dakota	1993	1987	1995	1987	1987
New Hampshire	1986				1990
New Jersey	1995	1995		1987	1987
New Mexico					1987
Nevada	1989	1989	2002		2002
New York				1984	1986
Ohio	2005	1988			2003
Oklahoma	1995	1987	2003	2003	2004
Oregon	1987	1987	1987	1987	
Pennsylvania	1997				2002
Rhode Island					
South Carolina		1988	2005		2005
South Dakota					

— Continued on next page —

TABLE A1 – continued from previous page

State	Punitive damages caps	Punitive evidence	Non-economic damages caps	Collateral-source rule	Joint-and-several liability
Tennessee					
Texas		1987	2003		1985
Utah		1989	1987	1986	1986
Virginia	1988				
Vermont					
Washington					1986
Wisconsin	1985	1995	1995	1995	1994
West Virginia			2003	2003	1986
Wyoming					1986
No. of reforms	20	25	22	20	34

*Note:* The indicated years refer to the first enactment (after 1979) of the respective reform in the respective state.

*Data source:* Avraham (2011a).

A.II States with first reforms before 1980

TABLE A2  
States not present in analysis of individual reforms

Punitive damages caps	Punitive evidence	Non-economic damages caps	Collateral-source rule	Joint-and-several liability
Louisiana, Michigan, Washington	Colorado, Delaware, Hawaii, Minnesota, Pennsylvania, South Dakota	California, Ohio, South Dakota	Alaska, Arizona, California, Delaware, Florida, Illinois, Iowa, Kansas, Nevada, New Hampshire, Ohio, Pennsylvania, Rhode Island, South Dakota, Tennessee, Washington	Kansas, Oregon, South Dakota, Vermont

*Note:* The listed states enacted specific tort reforms before 1980 and are thus not present in the respective analyses presented in Table 3.

*Data source:* Avraham (2011a).

### A.III Excluded reforms

TABLE A3  
Common law reforms (excluded)

State	Reform	Citation	Effective date
Arizona	Punitive damages (evidence)	Linthicum v. Nationwide Life Ins. Co., 723 P.2d 675, 680 (Ariz. 1986)	July 23, 1986
Maine	Punitive damages (evidence)	Tuttel v. Raymond , 494 A.2d 1353 (Me. 1985)	June 21, 1985
Maryland	Punitive damages (evidence)	Owens-Illinois v. Zenobia, 601 A.2d 633 (Md. 1992)	February 14, 1992
Tennessee	Joint and several liability	McIntyre v. Balentine, 833 S.W.2d 52	May 4, 1992
Tennessee	Punitive damages (evidence)	Hodges v. S.C. Toof & Co., 833 S.W.2d 896	April 20, 1992

*Notes:* Reforms that have been identified as enacted by a judicial decision and have consequently been excluded from the dataset used in our analyses. All information on the reforms mentioned in this table is cited as written in Avraham (2011b).

## A.IV Overall reform process: alternative specification of party control

TABLE A4  
Party control and malpractice reforms in U.S. states between 1980 and 2008

exp(Coefficient)	(1)	(2)	(3)	(4)
Liability risk (in USD 100)	1.000	1.000	0.998	0.998
	(-0.041)	(0.022)	(-0.506)	(-0.369)
Liberal political orientation	0.990 *	0.988 **	0.992	0.990
	(-1.930)	(-1.979)	(-0.905)	(-1.019)
Republican control (large majority)			2.190	2.740 *
			(1.448)	(1.706)
Republican control (small majority)			2.126	2.350 *
			(1.517)	(1.657)
Democratic control (small majority)			1.003	1.249
			(0.006)	(0.460)
Democratic control (large majority)			0.974	1.016
			(-0.052)	(0.028)
Republican governor			1.549 **	1.469 *
			(2.114)	(1.769)
GSP health industry (%)			1.087	1.076
			(0.561)	(0.456)
GSP legal industry (%)			1.549	1.725
			(1.386)	(1.403)
Attorneys in legislature (%)			1.002	1.008
			(0.135)	(0.388)
Women in legislature (%)			0.963 **	0.966 *
			(-2.375)	(-1.853)
Real GSP p.c. (USD 1,000)	0.956	0.970	0.983	0.990
	(-1.382)	(-0.929)	(-0.345)	(-0.189)
No. of observations	1421	1421	1421	1421
No. of events	92	92	92	92
Logrank test (p)	0.091	0.124	0.016	0.028
Approach	IIM	CM	IIM	CM

*Notes:* Cox-like proportional hazards models with repeated events. Specifications (1) and (3) are based on an independent increment model. Specifications (2) and (4) are based on a conditional model. Standard errors are clustered at the state level. Z-values of the coefficients are in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . No. of observations reflects total state-year observations at risk (49 states over 29 years).

*Data sources:* Avraham (2011a) for data on tort reforms (only restrictive reforms). For data on independent variables, see main text, Section 4.

## A.V Overall reform process including all reforms

TABLE A5  
Determinants of overall malpractice reform process in U.S. states (all reforms)

exp(Coefficient)	(1)	(2)	(3)	(4)
Liability risk (in USD 100)	0.991 *	0.989 **	1.001	1.000
	(-1.914)	(-1.972)	(0.114)	(-0.014)
Liberal political orientation	1.000	1.001	0.994	0.995
	(0.090)	(0.244)	(-1.419)	(-1.068)
Republicans in legislature (%)			1.030 ***	1.030 ***
			(3.944)	(3.447)
Republican governor			1.141	1.166
			(0.701)	(0.732)
GSP health industry (%)			0.973	0.918
			(-0.223)	(-0.643)
GSP legal industry (%)			1.770 **	1.807 *
			(2.069)	(1.800)
Attorneys in legislature (%)			0.998	0.999
			(-0.143)	(-0.053)
Women in legislature (%)			0.964 **	0.967 *
			(-2.255)	(-1.904)
Real GSP p.c. (USD 1,000)	0.956	0.966	0.964	0.966
	(-1.273)	(-0.996)	(-0.662)	(-0.650)
No. of observations	1421	1421	1421	1421
No. of events	101	101	101	101
Logrank test (p)	0.105	0.157	0.002	0.007
Approach	IIM	CM	IIM	CM

*Notes:* Cox-like proportional hazards models with repeated events. Specifications (1) and (3) are based on an independent increment model. Specifications (2) and (4) are based on a conditional model. Standard errors are clustered at the state level. Z-values of the coefficients are in parentheses. Statistical significance: \*  $0.1 > p > 0.05$ , \*\*  $0.05 > p > 0.01$  and \*\*\*  $p < 0.01$ . No. of observations reflects total state-year observations at risk (49 states over 29 years).

*Data sources:* Avraham (2011a) for data on tort reforms (all reforms in data set). For data on independent variables, see main text in Section 4.

## A.VI Specific reforms: robustness checks

TABLE A6  
Specific medical malpractice tort reforms: robustness analysis I

	Punitive evidence			Collateral-source rule				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
exp(Coefficient)	0.981 **	0.974 **	0.980 **	0.981 **	1.001	1.006	1.001	1.002
Liability risk (in USD 100)	(-2.276)	(-2.479)	(-2.342)	(-2.166)	(0.092)	(0.750)	(0.087)	(0.169)
Liberal political orientation	1.015	1.022	1.014	1.015	0.988	0.979	0.988	0.972
Republicans in legislature (%)	(0.859)	(1.160)	(0.847)	(0.938)	(-0.540)	(-0.916)	(-0.567)	(-1.392)
Republican governor	1.027	1.050 *	1.019	1.027	1.063 ***	1.038 **	1.055 ***	1.053 **
	(1.292)	(1.823)	(0.866)	(1.306)	(2.846)	(2.229)	(2.790)	(2.569)
	1.693	1.771	1.753	1.692	0.526	0.564	0.576	0.628
	(0.956)	(1.122)	(1.000)	(0.956)	(-1.304)	(-1.202)	(-1.178)	(-0.955)
GSP health industry (%)	0.889	0.996	0.846	0.888	2.937 **	3.215 **	2.966 **	4.199 ***
	(-0.412)	(-0.015)	(-0.657)	(-0.458)	(2.087)	(2.074)	(2.268)	(2.858)
GSP legal industry (%)	1.246	1.250	1.275	1.214	5.959 *	13.408 ***	12.752 ***	12.207 **
	(0.222)	(0.254)	(0.259)	(0.211)	(1.930)	(2.960)	(2.627)	(2.062)
Attorneys in legislature (%)	0.938	0.909 *	0.933 *	0.939	0.976	0.978	0.957	0.928
	(-1.515)	(-1.770)	(-1.683)	(-1.572)	(-0.466)	(-0.379)	(-0.779)	(-1.150)
Women in legislature (%)	0.880 ***	0.882 ***	0.872 ***	0.880 ***	0.950	0.923 **	0.938 *	0.936
	(-3.142)	(-3.086)	(-3.165)	(-3.084)	(-1.289)	(-2.257)	(-1.728)	(-1.631)
Real GSP p.c. (USD 1,000)	1.035	1.057	1.018	1.034	1.280 *	1.516 **	1.406 **	1.652 ***
	(0.343)	(0.547)	(0.144)	(0.339)	(1.646)	(2.516)	(2.509)	(2.577)
Legislative professionalism	0.999				1.038 ***			
	(-0.038)				(2.600)			
African-American pop.(%)		1.065				0.925		
		(1.293)				(-1.084)		
Partisan election of judges			0.443				0.826	
			(-1.404)				(-0.185)	
Neighbours with reform				0.989				0.781
				(-0.058)				(-1.132)
No. of obs./events	763/25	763/25	763/25	763/25	559/20	559/20	559/20	559/20
No. of states without reform	19	19	19	19	13	13	13	13
Likelihood ratio test (p)	0.057	0.057	0.057	0.057	0	0	0.001	0.001

Notes: Cox proportional hazards models. Z-values of the coefficients are in parentheses. Statistical significance: \* 0.1 > p > 0.05, \*\* 0.05 > p > 0.01 and \*\*\* p < 0.01. No. of observations reflects total state-year observations at risk.  
Data sources: Avraham (2011a) for data on tort reforms (only restrictive reforms). For data on independent variables, see main text in Section 4.



TABLE A7  
Specific medical malpractice tort reforms: robustness analysis II

exp(Coefficient)	Punitive damages caps	Punitive evidence	Non-economic damages caps	Collateral-source rule	Joint-and-several liability
Liability risk (in USD 100)	0.997 (-0.284)	0.984 ** (-2.131)	0.994 (-0.642)	1.000 (0.033)	1.002 (0.297)
Republicans in legislature (%)	1.041 ** (2.070)	1.019 (1.074)	1.027 (1.582)	1.060 *** (3.162)	1.022 * (1.951)
Republican governor	0.921 (-0.142)	1.734 (0.994)	1.399 (0.740)	0.605 (-1.034)	1.260 (0.636)
GSP health industry (%)	1.175 (0.783)	1.046 (0.193)	0.813 (-1.019)	2.367 *** (3.283)	0.763 * (-1.664)
GSP legal industry (%)	0.595 (-0.769)	1.125 (0.144)	1.845 (0.956)	15.686 ** (2.521)	1.840 (0.772)
Attorneys in legislature (%)	1.033 (0.807)	0.944 (-1.547)	0.980 (-0.538)	0.946 (-0.955)	0.983 (-0.546)
Women in legislature (%)	0.989 (-0.242)	0.889 *** (-3.129)	0.986 (-0.384)	0.929 (-1.549)	0.977 (-0.704)
Real GSP p.c. (USD 1,000)	1.022 (0.537)	1.055 (0.780)	0.834 (-1.474)	1.363 *** (2.989)	0.973 (-0.402)
No. of observations	1022	781	1040	572	678
No. of events	20	25	22	20	34
No. of states without reform	26	19	25	13	11
Likelihood ratio test (p)	0.504	0.029	0.201	0	0.418

Notes: Cox proportional hazards models. Z-values of the coefficients in parentheses. Statistical significance: \* 0.1 > p > 0.05, \*\* 0.05 > p > 0.01 and \*\*\* p < 0.01. No. of observations reflects total state-year observations at risk. Data sources: Avraham (2011a) for data on tort reforms (only restrictive reforms). For data on independent variables, see main text in Section 4.

TABLE A8

Summary statistics for the explanatory variables in the analyses of voting behavior

<i>Federal votes</i>						
Variable	Medical malpractice bills			Other tort reform bills		
	N Obs. = 0	N Obs. = 1	Mean	N Obs. = 0	N Obs. = 1	Mean
Republican	1536	1631	0.51	694	784	0.53
Female	2739	428	0.14	1305	173	0.12
Age	-	-	54.26	0	0	54.39
Attorney	2052	1115	0.35	919	559	0.38
Physician	3095	72	0.02	1450	28	0.02
Higher education	332	2835	0.90	181	1297	0.88
<i>State-level votes</i>						
Variable	Medical malpractice bills			Other tort reform bills		
	N Obs. = 0	N Obs. = 1	Mean	N Obs. = 0	N Obs. = 1	Mean
Republican	315	531	0.63	423	713	0.63
Female	652	194	0.23	897	239	0.21
Attorney	724	122	0.14	934	202	0.18
Physician	831	15	0.02	1120	16	0.01
Higher education	299	547	0.65	305	831	0.73

*Data source:* Project Vote Smart