The Effect of Malpractice Liability Risk on Workers' Compensation Insurance Losses

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Abstract

Evidence in prior studies indicates medical malpractice liability risk may influence medical professionals' behaviors in ways that impact healthcare costs and health insurance markets. Due to the fact that a sizeable component of workers' compensation insurance losses is payment for healthcare, we posit that the effects of the medical malpractice liability climate may also spillover into the workers' compensation insurance market. Using data from the National Association of Insurance Commissioners (NAIC) and various other sources, our initial results suggest that higher levels of medical professional liability exposure are associated with higher levels of losses incurred by workers' compensation insurers. In particular, we find that insurers in states with caps on noneconomic damages have lower levels of losses incurred. We also find insurers in states with higher numbers of medical malpractice claims have higher levels of workers' compensation insurance losses incurred. A flexible event study approach provides further evidence that incurred workers' compensation losses decline following the enactment of caps on noneconomic damages.

1. Introduction

Evidence suggests that physicians may respond to medical professional liability exposure by employing "defensive medicine" techniques. That is, in an effort to mitigate the expected cost of a medical professional liability lawsuit, medical professionals may alter the nature of care rendered to the patient (e.g. Mello et al., 2005, Currie and MacLeod, 2008). Defensive medicine practices have been found to directly influence healthcare costs, implying that the economic consequences of medical professional liability exposure extend beyond simply those direct costs incurred by medical professionals (e.g. Kessler and McClellan, 1996). However, to date, the majority of studies related to the indirect effects of liability exposure have largely examined its influence on healthcare costs and patient outcomes (e.g. Kessler and McClellan, 1996; Kessler and McClellan, 2002; Sloan and Shadle, 2009).

More recent analyses in this topic area have examined the spillover effects of malpractice liability on health insurance markets. The intuition is that, if defensive medicine practices lead to differences in healthcare costs, then the malpractice liability climate should influence the costs incurred by the private health insurance companies ultimately paying for the care rendered by the medical professionals. The works of both Avraham and Schanzenbach (2010) and Avraham, Dafny, and Schanzenbach (2013) support this supposition, and suggest that medical malpractice tort liability reforms increase insurance coverage rates and reduce group health insurance premiums. Similarly, Karl, Born, and Viscusi (2013), as well as Born, Karl, and Viscusi (2014), find evidence that medical malpractice insurance costs and reforms have a non-trivial influence on private health insurance losses. Considered in their entirety, these studies suggest that the effects of medical professional liability spill over into insurance markets that pay for the financial cost of healthcare services.

Of note is that there exists another insurance market that, in part, pays for the costs of healthcare services – workers' compensation insurance. Workers' compensation insurance provides payments for lost income and medical expenses arising out of employee injuries on the job. While indemnity payments historically accounted for the majority of workers' compensation losses incurred by insurers, medical costs now account for approximately 60 percent of total losses (NCCI, 2010). When we consider the large role

healthcare costs play in total workers' compensation losses alongside the findings of studies such as Avraham et al. (2013) and Karl et al. (2013), we believe that the medical professional liability climate may have a non-trivial influence on workers' compensation insurance losses. That is, we expect that defensive medicine costs may ultimately be borne out in workers' compensation insurance losses. While workers' compensation insurance has been extensively studied by insurance economists, we are unaware of any studies that have considered the spillover effects of malpractice liability exposure in the workers' compensation market.

The purpose of our study is to examine the influence of professional liability exposure on workers' compensation insurance losses. We hypothesize that the medical professional liability climate of a given market influences the cost of care rendered to workers' compensation claimants. As such, we expect to observe a cross sectional relation between the professional liability climate of a given market and the incurred losses of the workers' compensation insurers operating in that market. We test our hypothesis using data collected from the National Association of Insurance Commissioners (NAIC), the American Tort Reform Association (ATRA), the National Practitioner Databank (NPD), the U.S. Chamber of Commerce, the National Academy of Social Insurance (NASI), and the Bureau of Labor and Statistics (BLS) for the years 1996 through 2012. We follow the general form of Born, Viscusi, and Baker (2009) and perform our final analysis at the firm-state-year level, after initially conducting a state-year level analysis.

Our initial results indicate that workers' compensation insurers operating in states with noneconomic damage caps have lower levels of incurred losses than those in states without caps. In addition, we find that workers' compensation insurance losses are positively related to the level of medical malpractice claims (as given in the NPD). This evidence suggests that, in an effort to reduce professional liability exposure, physicians rendering services to workers' compensation claimants alter their interaction with the patient in a way that increases workers' compensation costs incurred by insurers.

The paper proceeds as follows. Section 2 contains a discussion of the workers' compensation insurance market, including a review of the literature. In Section 3 we develop our hypotheses and in

Section 4 we describe the data and methodology for our analysis. The results of our analysis are presented in Section 5 and a final section concludes.

2. Background

The costs associated with workers' compensation insurance have changed over time as a result of several factors. Butler (1994) argues that two primary forces are responsible for the rising level of workers' compensation indemnity claims: the demographics of employees and direct changes to the program itself. Butler does not consider medical costs in his analysis, but we believe his arguments apply to medical expenses, as well. Specifically, the increase of older employees in the workforce, as well as those employees actively working in manufacturing industries may be associated with higher medical costs. Likewise, as wage replacement rates increase and waiting periods decrease, we can expect higher costs.

Many studies have focused on the economic incentives provided in workers' compensation schemes. Some of these evaluate these incentives from the perspective of the employee, finding significant effects of program parameters on lost injury/work days and safety incentives (e.g. Butler, 1996; Harrington and Danzon, 2000). Butler (1996) finds that employees of firms using a tort system, rather than a no-fault system, report more frequent injuries that are less severe. Harrington and Danzon (2000) recognize that in order to achieve an optimal level of loss control within the workers' compensation insurance market, several parties must put forth effort – employees, employers, and insurers. However, they argue that if insurers are unable to charge appropriate rates, then the incentive to control losses is reduced on behalf of all three participants. As hypothesized, the authors find evidence consistent with rate suppression leading to higher levels of loss growth, and they attribute this to the fact that the incentives to control workers' compensation losses became distorted among the three parties – employees, employers, and insurers.

A few studies have evaluated how health care providers respond to changing parameters in the workers' compensation system. These studies recognize that providers have a central role in the workers' compensation system because they have the responsibility to: (1) legitimize the nature and extent of the injury, (2) provide services and/or referrals for services, and (3) make recommendations regarding

employees' ability to return to work. Providers' ability and/or incentives to meet these responsibilities can depend on a number of factors. For example, Butler et al. (1997) find that doctors in HMOs are more likely than other doctors to classify health services as compensable under workers' compensation. Wickizer et al. (2011) conduct an intervention study, motivated by the poor quality of health services received by workers' compensation claimants. They find that when providers receive a financial incentive to encourage adoption of best practices, patients experience improved outcomes.

Other studies examine various topics related to healthcare costs and workers' compensation claims (e.g. Morrison, 1990; Durbin, Corro, and Helvacian, 1996; Levy and Miller, 1996). The sentiment in this literature is that workers' compensation insurance claims and healthcare costs are inextricably related. For instance, Morrison (1990) argues that in the decade prior to his study, medical costs represented only one-third of workers' compensation losses, whereas in 1990 they represented approximately half of all paid workers' compensation losses. The author attributes both the negligible use of cost containment techniques, as well as the practice of cost shifting (where an employee files a workers' compensation claim when it should be filed elsewhere) to the rising medical costs of workers' compensation insurance.

Seminal research on medical professional liability (e.g. Danzon, 1984; Danzon, 1986) largely focused on factors that influence the frequency and severity of medical malpractice insurance claims. Additional studies specifically examine the influence of tort liability reforms (including caps on noneconomic damages, caps on punitive damages, modifications to joint and several liability, modifications to collateral sources rules, and limitations on attorney fees) and find that they have a non-trivial effect on medical malpractice award amounts (e.g. Avraham, 2007). Further studies provide substantial evidence that the enactment of these reforms ultimately reduce the levels of losses incurred by medical malpractice insurance companies (e.g. Viscusi et al, 1993; Viscusi and Born, 1995; Born and Viscusi, 1998; Viscusi and Born, 2005; Grace and Leverty 2008; Born, Viscusi, and Baker, 2009). Of particular relevance to our study is that previous studies indicate the enactment of caps on noneconomic damages have the most significant effect on medical malpractice awards and insures' incurred loss levels.

Other related studies have examined the effect that medical professional liability exposure has on the actions of medical providers, but the evidence as to how the provider-patient relationship is influenced by medical professional liability exposure is conflicting. Most notable are a series of studies that indicate higher levels of professional liability exposure induce medical professionals to prescribe additional services that are of no marginal value to the patient and therefore lead to unnecessarily higher healthcare costs. For example, Kessler and McClellan (1996) find that liability-reducing tort reforms reduce the rates of defensive medicine in a sample of Medicare beneficiaries.[1] Some studies, however, find no evidence that the practices of medical professionals are altered by the malpractice liability climate, suggesting that medical professionals do not practice "defensive medicine".[2] In support of the notion that medical professionals' actions are influenced by the professional liability climate, other studies suggest that physicians practice "negative" defensive medicine whereby physicians distance themselves from certain patient interactions or, in the extreme case, withdraw from a particular healthcare market.[3] For example, Currie and MacLeod (2008) find that the implementation of caps on non-economic damages increased the incidents of C-sections among a large sample of individual births from 1989 to 2001.

More recently in the literature, researchers have begun to examine whether the consequences of defensive medicine practices extend beyond healthcare costs and into health insurance markets. Many studies find evidence that the medical professional liability climate influences the cost of health insurance and the losses incurred by health insurers.[4] For example, Avraham and Schanzenbach (2010) provide evidence that tort reform increases insurance coverage rates. Avraham, Dafny, and Schanzenbach (2009)

[1] Other previous studies seem to support the conclusions of Kessler and McClellan (1996) that medical professionals do, in fact, practice "positive" defensive medicine. For example, using data from the Physician Insurance Association of America (PIAA), Kessler and McClellan (2002) find evidence that direct malpractice reforms reduce defensive medicine practices but do not influence health outcomes. Baicker, Fisher, and Chandra (2007) find a positive relation between Medicare spending, especially on imaging services, and malpractice awards which provides support for the hypothesis that malpractice awards drive defensive medicine rates.

[2] For example, Sloan and Shadle (2009), using survey data as well as Medicare data, conclude that medical decisions are not significantly affected by tort reform measures.

[3] For example, Mello et al. (2005) provide evidence that suggests physicians reduce or eliminated "high risk" aspects of their practice. Kessler, Sage, and Becker (2005) provide evidence that tort reforms increase the supply of physicians.

[4] This is not a universal sentiment in the literature. For example, Morrisey, Kligore, and Nelson (2008) do not find any evidence that damage caps reduce the cost of employer sponsored health insurance.

find that the enactments of various tort reform measures reduce group self-insured health insurance premiums. Interestingly, Karl, Born, and Viscusi (2013) and Born, Karl, and Viscusi (2014) find that tort reforms – specifically a cap on noneconomic damages – are associated with higher levels of claims incurred by health insurance companies.

Despite the evidence that the liability climate has significant consequences for the health insurance market, we are unaware of any studies that track this result into the workers' compensation area. However, as prior research in workers' compensation suggests, factors that change incentives for providers have implications for workers' compensation losses. As such, if tort reforms change providers' incentives to practice defensive medicine to avoid liability, the consequences should be evident in the variation in workers' compensation losses across states with and without such reforms.

3. Development of Hypothesis

As previously discussed, a large number of studies provide evidence that malpractice liability pressure leads to changes in medical professionals' behavior in ways that ultimately influence health insurance premiums and losses incurred. The intuition is that the defensive medicine practices of the medical professional lead to higher/lower medical costs that, when paid for by health insurers, lead health insurers to incur higher/lower levels of claims. We posit that the same potential exists in workers' compensation insurance. That is, medical professionals treating workers' compensation claimants may respond to higher levels of malpractice liability pressure in ways such as prescribing services more/less frequently, prescribing more/less costly procedures, or providing care more/less often. Because workers' compensation insurance pays for medical care, it follows that workers' compensation insurance companies may incur more/less losses in markets with higher levels of medical professional liability exposure. However, since the evidence presented in the literature does not definitively indicate whether defensive medicine practices lead to higher or lower healthcare costs, the direction of the effect is ambiguous. Therefore, we hypothesize that

H_o: The medical malpractice liability climate has no effect on workers' compensation insurance claims.

Rejection of the null hypothesis would provide evidence that, via the medical professional's defensive medicine practices, the medical professional liability climate influences the levels of claims incurred by workers' compensation insurance companies. Further, the direction of the effect would provide evidence as to the type of defensive medicine practices medical professionals employ when treating workers' compensation claimants. If higher malpractice liability exposure is associated with lower levels of workers' compensation claims, this would suggest medical professionals are practicing negative defensive medicine, and providing minimal amounts of care or less costly services in an effort to reduce the expected cost of a lawsuit. If higher malpractice liability exposure is associated with higher levels of workers' compensation losses, this would indicate medical professionals are practicing positive defensive medicine, whereby they prescribe unnecessary procedures or interact with patients in other ways that increase the cost of medical care. Failure to reject the null would suggest that medical professionals may not practice defensive medicine when treating workers' compensation claimants. Failure to reject the null could also indicate that medical professionals practice different types of defensive medicine that, in the aggregate, are cancelled out.

4. Data and Methodology

To test our hypothesis, we use data from the National Association of Insurance Commissioners (NAIC) for the years 1996 – 2012. We obtain workers' compensation losses incurred and premiums earned for firm *i* in state *j* during year *t*. After applying the common filters found in the insurance literature to address non-logical values and outliers, our final sample includes 96,478 firm-state-year observations. We also obtain other firm level characteristics from the NAIC data to control for other sources of variation across insurers in our analysis. These include the insurer's organizational form, group membership, total assets, the number of states in which the insurer operates, and the insurers' share of the state workers' compensation market.

Our measures for tort reform activity were acquired from Avraham's (2007) online database and confirmed with data from the American Tort Reform Association (ATRA). We include four reform variables that have been found to be especially effective in controlling insurer losses. Our key variable of

interest is the cap on noneconomic damages, which has been widely shown to lower the liability exposure of medical professionals. This measure establishes a monetary cap on awards for noneconomic damages in medical malpractice cases. Although the caps differ in size and, in some cases, applicability, we include this as a dummy variable equal to one if the state has the cap in place, zero otherwise. Our variable for caps on punitive damages is defined similarly. Finally, we include two dummy variables to capture whether the state has modified joint and several liability or collateral source rules. Joint and several liability rules allow for individual defendants to be held responsible for the full award amount in the event that a joint claimant is insolvent. Modifications of this rule either abolished or relaxed the joint defendant's responsibility. Collateral source rules limit the disclosure or consideration of collateral sources of payment when establishing award amounts. Many states have relaxed this rule as well. State level data on the number of medical malpractice insurance claims were obtained from the National Practitioner Databank (NPD).

State workers' compensation markets differ widely due to regulations and other state employment characteristics. To control for these differences we include nine state level workers' compensation market characteristics collected from the National Academy of Social Insurance (NASI) and the U.S. Chamber of Commerce. These include five continuous variables: (1) the required waiting period for benefits, (2) the percent of payments that are indemnity based, (3) the indemnity benefits per worker, (4) the percent of manufacturing employees in the state, and (5) the percent of private insurance coverage. The remaining four measures are dummy variables that indicate (1) whether workers' compensation insurance is elective within the state, (2) whether the employee has the choice of their own physician, (3) whether the state pays a relatively high percentage of employee wages as benefits, and (4) whether the state offers full occupational disease coverage. Each of these variables is defined further below.

Waiting periods are common within workers' compensation insurance, affecting employee compensation. The variable, *Waiting Period*, captures the number of days employees must be disabled before they may receive income benefits. Workers' compensation benefit payments are categorized as either medical care or from cash payments to disabled workers (or the surviving families of deceased workers). *Percent Indemnity Payments* is the percentage of indemnity payments made by a given state

relative to the total payments, and *Indemnity Benefits per Worker* is calculated as the total workers' compensation benefits paid in the state divided by the number of covered workers within that state where the total benefits paid is measured as calendar year paid benefits. Thus, it captures benefits paid to employees during a given year, regardless of when their illness began or their injuries occurred. A measure of risky employment, *Percent Manufacturing Employees* is the percentage of workers within a state that are employed in the manufacturing industry. Benefits may be paid by several different sources – private carriers, state funds, self-insureds, and the federal government. *Percent Private* captures the percentage of total workers' compensation benefits paid by the private insurance market within a particular state.

Workers' compensation laws are either compulsory or elective. Employers operating in states with a compulsory law must accept the provisions and provide for the specified benefits. The variable, *Elective*, is in indicator variable equal to one if the state has an elective workers' compensation law. If a state allows injured employees to select their own provider, the variable *Choice* is equal to one. If an employee receives income benefits, the amount received is calculated using a formula that is expressed as a percentage of wages. Because the majority of states pay 66 2/3%, we include an indicator variable, *High Percent Wages*, that equals one if the state pays more than 66 2/3% of wages. All states now recognize a responsibility for occupational diseases. However, states differ in terms of the restrictions they place on the coverage of these diseases. If the particular state has no restriction on the coverage of occupational diseases, then *Full Occupational Disease Coverage* is equal to one. If the state does place limitations on this coverage, the variable is equal to zero for that particular state.

We begin our investigation with a state-year-level analysis to examine how the medical malpractice liability climate of a given state is related to the aggregate losses incurred by workers' compensation insurers operating in that market. To answer this question, we estimate an ordinary least squares regression where the dependent variable is measured as the total dollar amount paid for workers' compensation benefits by state *j* in year *t*. This is calculated by summing the workers' compensation losses for all insurers operating in each state for each year, denoted by *WCLI*. The key independent variable, *Noneconomic Damage Cap (NDCap)*, is a dummy variable equal to 1 if state *j* has a cap on noneconomic damages in year

t. Our controls include all state characteristics described above, as well as the state total premiums earned to control for volume of business. Finally, we include state and year effects to capture omitted variables. Specifically, we estimate:

$$WCLI_{jt} = \alpha + \beta WCPE_{jt} + \rho NDCap_{jt} + \gamma' Controls_{jt} + \delta' State_j + \mu' Year_t + \varepsilon_{jt} \quad (1)$$

where:

WCLI = The natural logarithm of the dollar amount of workers' compensation losses incurred during year *t* in state *j*.

WCPE = The natural logarithm of the dollar amount of workers' compensation premiums earned during year *t* in state *j*.

NDCap = One if state *j* has a cap on noneconomic damages in year *t*, 0 otherwise.

Controls = A vector of state-level controls for year *t* in state *j*, defined above.

State = A vector of state fixed effects.

Year = A vector of year dummies.

ε = an error term.

Table 1 presents the summary statistics for the sample used in estimating equation 1. Due to missing state variables for some years, we exclude ND and WY from the analysis, resulting in a sample of 784 state-year observations.

Next, we explore the consequences of the medical malpractice tort reforms on the individual insurers directly. We conduct a firm-state-year analysis where we employ two separate proxies to reflect the climate of a given state's medical malpractice insurance market. The first proxy is the cap on noneconomic damages, which is discussed above. The second proxy is the number of medical malpractice claims against all categories of medical professionals, in state *j* during year *t*, scaled by the state's total population. We believe that higher levels of medical malpractice claims per capita are indicative of higher levels of medical professional liability exposure. Similar to Born et al. (2009), our measure of losses is the dollar amount of workers' compensation losses incurred by firm *i* in state *j* during year *t*. In each case, we include firm-state fixed effects and our estimation equation takes the form:

$$WCLI_{ijt} = \alpha + \beta WCPE_{ijt} + \rho MM_{ijt} + \gamma' Controls_{ijt} + \delta' Firm_i + \mu' Year_t + \varepsilon_{ijt} \quad (2)$$

where:

WCLI = The natural logarithm of the dollar amount of workers' compensation losses incurred in year *t* by firm *i* in state *j*.

WCPE = The natural logarithm of the dollar amount of workers' compensation premiums earned in year *t* by firm *i* in state *j*.

MedMal = The medical malpractice proxy described previously for firm *i* at year *t* in state *j*.

Controls = A vector of firm-level and state-level controls for firm *i* at year *t* in state *j*.

Firm = A vector of firm-state fixed effects.

Year = A vector of year dummies.

ε = an error term.

In this model, we include the state-level controls and tort reform measures described previously. We also add firm-level characteristics that are commonly included in analyses of insurer performance. The insurer's organizational form is represented by a dummy variable, *Stock*, that equals one if the insurer is organized as a stock entity, zero otherwise. We also include a dummy variable for whether the firm is a member of an insurance group, *Group*. These two variables capture differences across insurers in access to capital, which may influence capacity and subsequent underwriting performance. *Residual Market* is a dummy variable that equals one if the insurer also operates in the state's residual market, which may afford different opportunities for cost shifting or pose other operational risks than for insurers not participating. We include the insurer's total assets as well as the number of states that the insurer operates in to control for variations in scale. These two variables, *Size* and *NumStates*, are included in log form. Finally, we include the insurer's workers' compensation market share in the state, *WCShare*, calculated as the insurer's total premiums earned in the state divided by the state total premiums earned for all insurers. Firms with a larger market share may have distinct advantages in terms of negotiating medical reimbursements over smaller insurers.

The model specification above is designed to estimate the relationship of an existing tort reform – with specific emphasis on a cap on noneconomic damages – without regard to how long the reform has been in place. Because a reform's effectiveness may not be immediate – especially as the reforms targeted medical malpractice and not workers' compensation – we take another approach at estimating the relationship using a flexible event study methodology. In this approach, we include a series of dummy variables that indicate the year of the reform, the previous two years, as well as the following three years and beyond. The coefficients on these variables shed light on the timing of the effect of the reform on workers' compensation losses. Table 2 presents the summary statistics for all variables in our firm-state-year sample.

5. Results

Table 3 presents the results of estimating equation 1, our state-level regression. Three variants of our model are presented: one in which the dependent variable is total insured losses and two in which we scale our dependent variable by population. We restrict our discussion to the first model.[5] Here, we find that the cap on noneconomic damages is significantly related to workers' compensation losses at the state level, even as we have controlled for state total premiums. Specifically, states with an existing cap on noneconomic damages reform experience workers' compensation losses that are almost 6 percent lower, on average, than states without a cap, holding premiums constant. This result refutes our null hypothesis and suggests that, in markets with higher liability exposure, medical professionals interact with workers' compensation claimants in a manner that results in higher costs of claims paid by workers' compensation insurers. We note that several of our state-level characteristics are also significantly related to the level of losses, but we do not find any significant relationships among the other three tort reform measures. The results of this analysis – suggesting that tort reforms had at least some real effect on the workers' compensation market – further motivate our exploration of firm-level results that follows.

[5] In a future draft will elaborate on the differences between models and results. It will also include a more detailed discussion of the results.

Tables 4a and 4b present the results from estimating equation 2 with our two medical malpractice risk proxies. For each, we present three models, this time with varying sets of fixed effects and assumptions on our standard errors. In every model we find that our medical malpractice proxy variable is statistically significant, and in the direction we would expect. In Table 4a, the noneconomic damages cap measure is significant and negative, suggesting that as malpractice risk is reduced, workers' compensation losses decrease. This result again refutes our null hypothesis and suggests that, in markets with higher liability exposure, medical professionals interact with workers' compensation claimants in a manner that results in higher costs of claims paid by workers' compensation insurers. This result is, however, consistent with our finding in the state-level analysis and supports the arguments that providers practice defensive medicine to reduce malpractice risk. In Table 4b, where we include a measure of the volume of medical malpractice claims, thereby reflecting malpractice risk through a measure of litigiousness, we find a positive relationship that confirms our finding in Table 4a, i.e., of defensive behavior.[6]

The results in Tables 4a and 4b provide evidence of a cross sectional relation between workers' compensation claims and the medical malpractice liability climate. In an effort to provide more dynamic evidence on the effect of changes in the liability climate on workers' compensation insurance losses, we employ a flexible event study framework that estimates the casual effect that the enactment of tort reforms have on workers' compensation insurance losses. Therefore, we estimate the following equation:

$$WCLI_{ijt} = \alpha_{ij} + \sum_{t=T-2}^{T3+} \beta_t WTORT_{ijt} + \beta_n Controls_{ijt} + \varepsilon_{ijt} \quad (3)$$

In this model we are interested in the estimated values of β_t, which track the year of a tort reform and the years immediately preceding and following it for each firm within a given state in a given year. The variable $WTORT_{ij0}$ is equal to one if firm *i* is operating in a state, *j*, that enacted tort reforms in that calendar year. Similarly, $WTORT_{ijT+1}$ is equal to one if firm *i* is operating in a state *j* that enacted tort reforms in

[6] The differences across models and the consequential results will be discussed further in a later draft.

the next calendar year. By omitting time period *t*-1, the model allows us to track how workers' compensation losses changed in the years following the enactment of a reform relative to the years prior to the reform. All other variables are as previously defined.

The results of estimating equation 3 are presented in Table 5. Three model variants are shown, which employ different fixed effects or assumptions on the standard errors. First, we note that the results confirm our findings of a negative relationship between the cap on noneconomic damages and workers' compensation losses. More specifically, we note that the estimated effects are highest not in the year of the reform, but in two or three years following. This suggests there may be some lag before the effects of the reform flow to the workers' compensation market. In summary, these results confirm the evidence against our null hypothesis and suggest that lower physicians' liability exposure is associated with reductions in workers' compensation insurance losses, all else equal.[7]

6. Conclusion

While the specific reasons for enacting tort reforms, and the particular measures enacted vary from state to state, their primary target in most cases was the medical malpractice insurance market. Crises in the availability and affordability of coverage prompted legislators to consider ways to restore a smooth-functioning insurance market, which required changes to the legal environment for medical malpractice claims. The workers' compensation insurance market was not a primary target, but was a likely indirect beneficiary to any reforms that relaxed physicians' perception of malpractice risk. Our analysis suggests that changes in the medical professional liability climate did, in fact, spillover into the workers' compensation insurance market in a significant way. Workers' compensation insurers operating in states with caps on noneconomic damages reported lower losses, all else equal, than those operating in states without such caps. While our data do not allow us to evaluate how physicians change their behavior, we propose one theory: relaxing medical malpractice risk prompted physicians to perform less defensive medicine – i.e., provide fewer unnecessary services – when treating patients with workers' compensation

[7] We will elaborate on the model and results in a later draft.

claims. Further study of the health care services provided to workers' compensation claimants could provide more insight to the actual cause behind our results.

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Table 1: Summary Statistics for State-level Sample (N=784)

Variable	Mean	Std. Dev.
Ln (WCLI)	12.5072	1.2632
WC Losses Per Capita	91.1781	45.2928
Ln (WC Losses Per Capita)	4.2752	0.9699
Ln (WC Direct Premiums Earned)	12.8144	1.3171
WC DPE Per Capita	126.6501	66.7562
Ln (WC DPE Per Capita)	4.5824	1.0380
Waiting Period	5.0179	1.9271
Indemnity Benefits Per Worker	181.2313	75.2019
Percent Indemnity Payments	48.5603	10.7400
Choice	0.2449	0.4303
High Percent Wages	0.1084	0.3111
Elective	0.0510	0.2202
Full Occupational Disease Coverage	0.6977	0.4595
Percent Manufacturing Employees	10.8676	4.5734
Percent Private	0.6030	0.2270
Noneconomic Damages Cap	0.3125	0.4638
Punitive Damages Cap	0.4171	0.4934
Joint and Several Liability Reform	0.7258	0.4464
Collateral Source Reform	0.6390	0.4806

Table 2: Summary Statistics for Firm-level Sample (N=96,478)

Variable	Mean	Std. Dev.
Ln (WC Losses)	7.1279	1.4466
Numb. MedMal Claims Per Capita	52.3266	25.7989
LN (WC DPE)	7.4481	1.4593
Stock	0.8570	0.3500
Group	0.9282	0.2581
Residual Market	0.0015	0.0383
Ln (Number of States)	2.8827	0.9357
Size	13.1432	1.8931
State WC Business Percentage	0.0081	0.0254
Waiting Period	5.2548	1.9285
Percent Indemnity Payments	48.9903	10.3102
Indemnity Benefits Per Worker	174.8815	66.1448
Choice	0.1796	0.3838
High Percent Wages	0.0915	0.2883
Elective	0.0653	0.2471
Full Occupational Disease Coverage	0.7296	0.4442
Percent Manufacturing Employees	11.4313	4.4288
Percent Private	0.6622	0.1703
Noneconomic Damages Cap	0.2980	0.4574
Punitive Damages Cap	0.4635	0.4987
Joint and Several Liability Reform	0.6984	0.4589
Collateral Source Reform	0.6116	0.4874

Table 3: Results of State-level Analysis

	Dependent Variable		
Variables	LN (WC Losses)	WC Losses Per Capita	Ln (WC Losses Per Capita)
Ln (WC Direct Premiums Earned)	0.8988***		
	[0.040]		
WC DPE Per Capita		0.4955***	
		[0.079]	
Ln (WC DPE Per Capita)			0.8491***
			[0.042]
Waiting Period	0.0043	-1.1898	-0.0085
	[0.009]	[0.814]	[0.008]
Indemnity Benefits Per Worker	0.0010***	0.0961***	0.0009***
	[0.000]	[0.027]	[0.000]
Percent Indemnity Payments	-0.0036**	-0.1952	-0.0024*
	[0.002]	[0.132]	[0.001]
Choice	-0.0031	-3.0517	-0.0114
	[0.042]	[2.419]	[0.043]
High Percent Wages	0.0717	-15.8410**	-0.0095
	[0.063]	[6.494]	[0.078]
Elective	0.0589	18.1483***	0.0428
	[0.067]	[4.119]	[0.086]
Full Occupational Disease Coverage	-0.0254	3.1671	-0.0160
	[0.029]	[2.355]	[0.028]
Percent Manufacturing Employees	0.0093*	-0.1304	0.0030
	[0.005]	[0.418]	[0.006]
Percent Private	0.2497**	24.2514**	0.3870***
	[0.110]	[12.124]	[0.123]
Noneconomic Damages Cap	-0.0589*	-8.6493*	-0.0492
	[0.034]	[4.782]	[0.033]
Punitive Damages Cap	0.0214	1.8335	-0.0030
	[0.041]	[2.859]	[0.037]
Joint and Several Liability Reform	0.0835	3.2053	0.0780
	[0.058]	[2.845]	[0.056]
Collateral Source reform	-0.0048	2.5731	0.0053
	[0.041]	[3.172]	[0.038]
Constant	0.4836	0.6745	-0.0958
	[0.462]	[11.304]	[0.232]
Year Fixed Effects	Yes	Yes	Yes
Cluster by State	No	No	No
Observations	784	784	784
R-squared	0.9776	0.8658	0.8658

Robust standard errors are reported in brackets.
Statistical significance is represented as ***, **, and * for $p < 0.01$, 0.05, and 0.1, respectively.

Table 4A: Results of Firm-State Analysis – Dependent Variable = WC Losses

	Coefficient		
Variable	[Std. Error]		
Noneconomic Damages Cap	-0.0539***	-0.0360***	-0.0360***
	[0.009]	[0.009]	[0.008]
Ln (Direct Premiums Earned)	0.7801***	0.7837***	0.7837***
	[0.003]	[0.003]	[0.008]
Stock	0.0641***	0.0786***	0.0786***
	[0.011]	[0.010]	[0.029]
Group	0.0632***	0.0520***	0.0520
	[0.014]	[0.013]	[0.033]
Residual Market	0.1378	0.1277	0.1277
	[0.128]	[0.123]	[0.150]
Ln(NumStates)	0.0001	-0.0050	-0.0050
	[0.005]	[0.005]	[0.010]
Size	0.0258***	0.0301***	0.0301***
	[0.003]	[0.002]	[0.008]
State WC Business Percentage	2.1001***	2.0543***	2.0543***
	[0.276]	[0.272]	[0.381]
Waiting Period	0.0031	0.0049**	0.0049**
	[0.002]	[0.002]	[0.002]
Percent Indemnity Payments	-0.0043***	-0.0054***	-0.0054***
	[0.000]	[0.000]	[0.000]
Indemnity Benefits Per Worker	0.0014***	0.0015***	0.0015***
	[0.000]	[0.000]	[0.000]
Choice	-0.0609***	-0.0571***	-0.0571***
	[0.010]	[0.010]	[0.010]
High Percent Wages	-0.0199	-0.0349*	-0.0349**
	[0.018]	[0.018]	[0.017]
Elective	0.1182***	0.1358***	0.1358***
	[0.024]	[0.024]	[0.023]
Full Occupational Disease Coverage	-0.0016	-0.0102	-0.0102
	[0.009]	[0.009]	[0.008]
Percent Manufacturing Employees	0.0036***	0.0039***	0.0039***
	[0.001]	[0.001]	[0.001]
Percent Private	0.1607***	0.1659***	0.1659***
	[0.022]	[0.022]	[0.022]
Punitive Damages	-0.0247***	-0.0184**	-0.0184**
	[0.008]	[0.008]	[0.007]
Joint and Several	-0.0174**	-0.0228***	-0.0228***
	[0.009]	[0.009]	[0.008]
Collateral Source	-0.0010	-0.0021	-0.0021
	[0.008]	[0.008]	[0.007]
Constant	0.6834***	0.4652***	0.4652***
	[0.043]	[0.043]	[0.100]
Year Fixed Effects	No	Yes	Yes
Cluster by firm	No	No	Yes
Observations	96,478	96,478	96,478
R-squared	0.7498	0.7524	0.7524

Robust standard errors are reported in brackets.

Statistical significance is represented as ***, **, and * for $p < 0.01$, 0.05, and 0.1, respectively.

Table 4B: Results of Firm-State Analysis – Dependent Variable = WC Losses

Variable	Coefficient [Std. Error]		
# MedMal Claims Per Capita	0.0019***	0.0009***	0.0009***
	[0.000]	[0.000]	[0.000]
Ln (Direct Premiums Earned)	0.7791***	0.7827***	0.7827***
	[0.003]	[0.003]	[0.008]
Stock	0.0649***	0.0780***	0.0780***
	[0.010]	[0.010]	[0.029]
Group	0.0598***	0.0516***	0.0516
	[0.014]	[0.013]	[0.033]
Residual Market	0.1203	0.1119	0.1119
	[0.129]	[0.124]	[0.151]
Ln(NumStates)	0.0022	-0.0042	-0.0042
	[0.005]	[0.005]	[0.010]
Size	0.0265***	0.0301***	0.0301***
	[0.002]	[0.002]	[0.008]
MktShare	2.1741***	2.1220***	2.1220***
	[0.281]	[0.277]	[0.386]
Waiting Period	-0.0003	0.0031	0.0031
	[0.002]	[0.002]	[0.002]
Percent Indemnity Payments	-0.0026***	-0.0047***	-0.0047***
	[0.000]	[0.000]	[0.000]
Indemnity Benefits Per Worker	0.0014***	0.0014***	0.0014***
	[0.000]	[0.000]	[0.000]
Choice	-0.0775***	-0.0662***	-0.0662***
	[0.010]	[0.010]	[0.010]
High Percent Wages	-0.0043	-0.0233	-0.0233
	[0.018]	[0.018]	[0.017]
Elective	0.0910***	0.1204***	0.1204***
	[0.024]	[0.024]	[0.023]
Full Occupational Disease Coverage	-0.0043	-0.0127	-0.0127
	[0.009]	[0.009]	[0.008]
Percent Manufacturing Employees	0.0059***	0.0063***	0.0063***
	[0.001]	[0.001]	[0.001]
Percent Private	0.1857***	0.1807***	0.1807***
	[0.022]	[0.022]	[0.022]
Punitive Damages Cap	-0.0284***	-0.0225***	-0.0225***
	[0.008]	[0.008]	[0.007]
Joint and Several Liability Reform	-0.0453***	-0.0381***	-0.0381***
	[0.008]	[0.008]	[0.008]
Collateral Source Reform	0.0020	0.0007	0.0007
	[0.007]	[0.007]	[0.007]
Constant	0.4777***	0.3656***	0.3656***
	[0.044]	[0.045]	[0.099]
Year Fixed Effects	No	Yes	Yes
Cluster by firm	No	No	Yes
Observations	96,478	96,478	96,478
R-squared	0.750	0.753	0.753

Robust standard errors are reported in brackets.
Statistical significance is represented as ***, **, and * for $p < 0.01$, 0.05, and 0.1, respectively.

Table 5. Flexible Event Study Results: Dependent Variable = Workers' Compensation Losses Incurred

Variable	Coefficient [Std. Error]		
Ln (Direct Premiums Earned)	0.7803***	0.7837***	0.7837***
	[0.003]	[0.003]	[0.008]
Stock	0.0659***	0.0789***	0.0789***
	[0.010]	[0.010]	[0.029]
Group	0.0608***	0.0513***	0.0513
	[0.014]	[0.013]	[0.033]
Residual Market	0.1299	0.1186	0.1186
	[0.127]	[0.123]	[0.150]
Ln (Number of States)	0.0010	-0.0047	-0.0047
	[0.005]	[0.005]	[0.010]
Size	0.0263***	0.0300***	0.0300***
	[0.002]	[0.002]	[0.008]
State WC Business Percentage	2.0984***	2.0631***	2.0631***
	[0.273]	[0.269]	[0.380]
Waiting Period	0.0072***	0.0075***	0.0075***
	[0.002]	[0.002]	[0.002]
Percent Indemnity Payments	-0.0043***	-0.0054***	-0.0054***
	[0.000]	[0.000]	[0.000]
Indemnity Benefits Per Worker	0.0014***	0.0014***	0.0014***
	[0.000]	[0.000]	[0.000]
Choice	-0.0720***	-0.0642***	-0.0642***
	[0.010]	[0.010]	[0.010]
High Percent Wages	0.0012	-0.0095	-0.0095
	[0.018]	[0.018]	[0.017]
Elective	0.0987***	0.1181***	0.1181***
	[0.024]	[0.024]	[0.023]
Full Occupational Disease Coverage	-0.0097	-0.0141	-0.0141*
	[0.009]	[0.009]	[0.008]
Percent Manufacturing Employees	0.0031***	0.0043***	0.0043***
	[0.001]	[0.001]	[0.001]
Percent Private	0.1790***	0.1785***	0.1785***
	[0.022]	[0.022]	[0.022]
Punitive Damages	-0.0302***	-0.0253***	-0.0253***
	[0.008]	[0.008]	[0.007]
Joint and Several	-0.0254***	-0.0268***	-0.0268***
	[0.008]	[0.008]	[0.008]
Collateral Source	0.0042	-0.0006	-0.0006
	[0.008]	[0.007]	[0.007]
WTort T-3	0.0792***	-0.0015	-0.0015
	[0.020]	[0.020]	[0.020]
WTort T-2	0.0361*	-0.0458**	-0.0458**
	[0.021]	[0.021]	[0.021]
WTort T	-0.0138	-0.0604***	-0.0604***
	[0.023]	[0.023]	[0.020]
WTort T+1	-0.0052	-0.0148	-0.0148
	[0.024]	[0.024]	[0.023]
WTort T+2	-0.0594***	-0.0427*	-0.0427*
	[0.022]	[0.022]	[0.022]
WTort T3+	-0.1269***	-0.0933***	-0.0933***
	[0.013]	[0.013]	[0.014]

Constant	0.6496***	0.4466***	0.4466***
	[0.042]	[0.043]	[0.100]
Year Fixed Effects	No	Yes	Yes
Cluster by Firm	No	No	Yes
Observations	96,478	96,478	96,478
R-squared	0.7504	0.7527	0.7527

Robust standard errors are reported in brackets.

Statistical significance is represented as ***, **, and * for $p < 0.01$, 0.05, and 0.1, respectively.