3-2009

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Recommended Citation

Born, P., Viscusi, W., & Baker, T. (2009). The Effects of Tort Reform on Medical Malpractice Insurers' Ultimate Losses. *The Journal of Risk and Insurance, 76* (1), 197-219. http://dx.doi.org/10.1111/j.1539-6975.2009.01294.x

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Abstract

Whereas the literature evaluating the effect of tort reforms has focused on the impact of reforms on insurers' reported incurred losses, this article examines the ultimate effects of reforms using the developed losses from a comprehensive sample of insurers writing medical malpractice insurance from 1984 to 2003. Noneconomic damages caps are particularly influential in reducing medical malpractice losses and increasing insurer profitability. The long-run effects of these reforms are greater than insurers' expected effects; for example, 5- and 7-year developed loss ratios are below the initially reported incurred loss ratios for those years following the enactment of noneconomic damages caps. Analyses of reported losses consequently understate the ultimate effects of tort reforms. The quantile regressions show that reforms have the greatest effects for the firms that are at the high end of the loss distribution.

Disciplines

Business Administration, Management, and Operations | Business Law, Public Responsibility, and Ethics | Business Organizations Law | Health and Medical Administration | Insurance | Medical Jurisprudence

The Effects of Tort Reform on Medical Malpractice Insurers' Ultimate Losses

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December 3, 2007

Abstract

Whereas the literature evaluating the effect of tort reforms has focused on reported incurred losses, this paper examines the long run effects using a comprehensive sample by state of individual firms writing medical malpractice insurance from 1984-2003. The long run effects of reforms are greater than insurers' expected effects, as five year developed losses and ten year developed losses are below the initially reported incurred losses for those years following reform measures. The quantile regressions show the greatest effects of joint and several liability limits, noneconomic damages caps, and punitive damages reforms for the firms that are at the high end of the loss distribution. These quantile regression results show stronger, more concentrated effects of the reforms than do the OLS and fixed effects estimates for the entire sample.

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The Effects of Tort Reform on Medical Malpractice Insurers' Ultimate Losses

1. Introduction

Since the 1970s, the medical malpractice insurance industry has experienced several periods in which profits have declined rapidly, premiums have risen, and medical providers have reported problems with availability and affordability. To reduce the costs of insurance, many states have enacted a variety of tort reform measures that will reduce award and settlement amounts. There have been three distinct "rounds" of tort reform—the mid-1970s, the mid-1980s, and the late 1990s. The influence of such reforms on the medical malpractice insurance industry is of renewed interest because there are increased pressures for additional reform efforts. Medical malpractice headed the Bush administration's tort reform agenda, though no national reform legislation has been enacted.

The focus of the reform efforts has been on various measures that will reduce the amount of losses incurred by the insured. Whether such reforms are desirable from a social policy standpoint is beyond the scope of this study. We should note that a decrease in the amount of losses borne by the insurer typically implies that less money will be paid to injured parties. Tort reform is generally not strictly a zero sum game, as reduced medical malpractice losses will affect insurance premiums, the costs of care, and physician behavior. However, it is important to recognize that the "savings" from decreased losses are not necessarily efficiency gains as they may largely reflect reduced transfers to injured patients. This paper does not address the overall social desirability of specific tort reforms but is concerned with the more narrowly framed empirical issue of whether the reforms did in fact reduce losses, which was their primary intent.

The empirical novelty of our analysis is that it is the first study to assess the longer term effects of the reforms on losses. Previous studies of the effect of tort reforms on insurance

markets have focused on the effects based on initial reported losses. Insurance companies estimate the ultimate losses associated with premiums paid in given year based on the incurred and reported losses associated with these policies as well as on their expectation of the losses that will ultimately be incurred for those premiums. Over time insurers update their loss estimates as additional claims are resolved. These developed loss figures reflect greater experience with how the insurance policy has performed. If tort reforms alter the tort liability landscape so that use of previous experience as a guide will make initial projections of losses too high, then one would expect to find a greater effect of tort reforms on ultimate losses than on initial losses. The main focus of this paper is on the contrast between the effect of tort reforms on current losses rather than developed losses after five years and ten years.

By considering the effects over this "longer term," the period of time considered should be long enough for: (1) the losses have been nearly fully developed, and (2) the insurer has had time to correspondingly adjust premiums to reflect the changes in expected losses. The insurance-related studies of malpractice crises to date have mainly found effects in terms of the shorter term results of tort reform, looking at how insurer losses and loss ratios vary across states with different sets of reforms. These studies use reported losses in calculating the influence of the reform variables, and thus capture the influence of the reforms as "perceived" by the insurer (Barker, 1992; Viscusi et al, 1993; Viscusi and Born, 1995; Born and Viscusi, 1998; and Viscusi and Born, 2004). The results of these studies indicate, among other things, that the most influential malpractice reform measure is the cap on noneconomic damages, which have had significant effects on reducing incurred losses.

These findings are further substantiated by the results of a line of research that focuses on the effects of the reforms on insurance company closed claim data (Danzon, 1984; Danzon,

1986; Sloan et al, 1989; Zuckerman et al, 1990; Yoon, 2001). These studies indicate that caps on damages reduce mean payments in medical malpractice cases, which in turn should be reflected in insurer losses.

The studies in the literature of current effects on insurance markets and ultimate effects on claims have not examined the potentially differing magnitudes of the current and long run effects. Doing so across different data sets and medical malpractice samples would not provide a meaningful basis of comparison because of the different mix of claims and differences in the structure of the data. Our study tracks the performance of a set of firms' medical malpractice policies over time. The data are drawn from completed insurance forms in which the firm is required by the National Association of Insurance Commissioners to trade the loss performance of its premiums over time to justify the appropriateness of the reserve amounts.

Yet another line of research on the effects of malpractice tort reforms has focused on the effects of the reforms on award payments in court cases (Pace, 2004; Studdert et al., 2004). These studies indicate that caps on non-economic damages did, in fact, result in reduced payments to plaintiffs in medical malpractice cases in which the jury had awarded non-economic damages in excess of the maximum allowable amount. While of course this result is unsurprising, it does confirm that caps do have an impact on tried cases.[1] While examination of court awards is interesting, focusing on court awards alone ignores the effect of caps on settlements and on the selection of cases for litigation, which in turn will affect award levels. As

[1] Sharkey (2005) argues that much of the research on the impact of damages caps has ignored the unintended consequences of the caps, such as possible "anchoring" by the jury (jurors may learn of the existence of the cap from the news media), and the "crossover effect" in which plaintiffs lawyers work harder to increase economic damages in states in which non-economic damages are capped (Baker, 1998). She studied the relationship between damages caps and awards in tried cases using cross sectional data obtained from the National Center for State Courts and the Bureau of Justice Statistics. While both the mean and median award were lower in states with damage caps, when she controlled for injury severity, county characteristics, litigant characteristics, and whether judges are elected or appointed, she found that the relationship was not significant (although the direction and magnitude of the effect in her regression equation was consistent with the differences in the means).

a result, it provides an incomplete picture of tort reforms' effects that is also possibly tainted by changes over time in the selection of cases for trial. Our analysis of insurer losses will assess the full effects of tort reforms, not simply the effect on a very small component of closed medical malpractice claims.

Our longer term analysis of the effect of the tort reforms will also provide a more accurate and complete perspective on the reform effects. If tort reforms did not alter the temporal profile of losses, then analyses based on reported losses would be an accurate reflection of the reform effects. However, the reform may also alter the time path of subsequent losses associated with the policy, given the long tail of medical liability insurance and the time it takes for reforms to have their full effect on court awards. An assessment of the ultimate effects of the tort reforms on losses requires analysis of the developed losses, which capture the actual court and settlement outcomes as influenced by the reforms. Furthermore, the analysis of the reforms over a longer period of time will illustrate whether some types of reforms take longer to work their way through the system if, for example, they affect how cases are handled generally so that case law has to develop before the effects are realized.

In this article, we use a combination of OLS and quantile regression models to assess the relationships between various tort reform measures and insurer losses. To the extent that the results differ from earlier studies based on contemporaneous measures of losses and loss adjustment expenses, it is because we have additional information on (1) the true impact of the malpractice reforms on insurer underwriting performance and (2) the extent to which perceived effects of the reforms were actually borne out in the legal system. We discuss the construction of our dataset in the next section. This discussion is followed by an illustration of the substantial effect of loss development, which provides further motivation for our particular analytical

approach. Our empirical approach and results of our analysis follow, along with our discussion and conclusions. We find that considering the effect of the reforms on losses using both five year and ten year development factors shows that the long run effect of the reforms differs substantially from the short run effects. Typically the effects are greater in the long run, but the relative impact of the reforms and the distribution of the reform effects throughout the insurance market are influenced as well by our use of a longer term perspective.

2. Data and Methodology

The empirical analysis uses the financial data that insurers submit annually to the National Association of Insurance Commissioners (NAIC). These statements contain detailed information about the insurer's underwriting experience, including by-line and by-state premiums and losses, overall reserves and by-line developed losses incurred. For our analysis, we utilized information from all statements filed by insurers active in underwriting for medical malpractice liability between 1984 and 2003.

Premiums earned were drawn from the annual statements, Schedule P1 Part F. We took data on losses incurred and loss development from Schedule P2 Part F.[2] For each year in which premiums are earned, we obtained contemporaneous losses incurred and the revised estimates of losses incurred (i.e., development) in each of the next 9 years.

To avoid undue influence of small firm outliers on the results, we exclude from the analysis firms that wrote under $1 million in premiums in any given year. This exclusion did not alter the results in any appreciable manner. As indicated in the summary statistics in Table 1, the mean value of premiums earned is $33 million, while losses averaged $38 million.

[2] In the early 1990s, insurers began reporting separately their premium and loss information for two types of medical malpractice policies: claims made and occurrence. An insurer's business for the two types was simply added for this research project, but this distinction will be explored in subsequent research.

Additional variables drawn from the NAIC data include the number of states in which the insurer operates and the insurer's organizational form. Considering the number of states in which the insurer operates helps to capture the degree to which the insurer is able to diversify operations across different regulatory and legal environments. Organizational form is included in the analysis to reflect possible differentials in administrative costs and agency issues across the major forms of insurer ownership: stocks, mutuals, reciprocals, and Lloyds. The dominant insurance company form is that of stock companies, which account for 68 percent of the sample. The next largest category is that of mutual insurance companies, which account for 14 percent of the sample.

Insurer loss development data are only reported at the firm level, and cannot reasonably be allocated to state operations. This aspect of the data complicates our analysis of the influence of state differences in tort reform activity and regulation on insurer performance. Following Born (2001), we created proxy variables to capture the state differences in tort reform and rate regulation. For each individual insurer operating in one or more states, we created variables to capture the extent to which that insurer is exposed to business in states with a particular characteristic, e.g., a reform measure. Each of these variables was calculated in the same manner, using 853,048 firm/state/year-level observations on medical malpractice liability premiums written. E.g., the joint and several liability variable for firm i in year t operating in states indexed by s is given by

$$ShareJS_{it} = \frac{\sum_{i,s,t}(Premiums\,Written_{ist} * Modified\ \ JointSev_{st})}{\sum_{i,s,t}(Premiums\,Written_{ist})} \qquad (1)$$

where $ModifiedJointSev_{st} = 1$ for each state, *s*, with this reform in place in year *t*, and 0 otherwise. The average share values for the four reform measures increase through the sample period, indicating that the amount of business written in reformed environments increased, which is consistent with state reform activity. The average values for all insurer share variables in 1984, 1992, and 2003 are shown in Table 2.

The prevalence of the tort reform regimes differs across states. As indicated in Table 1, the average share of the business in states with modified joint and several liability is 73 percent, and the percentage with modified collateral source rules is 71 percent. The prevalence of caps on noneconomic damages or punitive damages is only 38 percent.

Of these various tort reform variables, it is likely that caps on noneconomic damages will be most influential. That has been the pattern found in most previous studies of medical malpractice. Moreover, noneconomic damages comprise the largest component of compensation in medical malpractice cases. Based on closed claims data from Florida and Texas, the noneconomic damages share of medical malpractice payments for claims involving adults age 18 and over is 0.84 for nonfatal cases and 0.75 for fatal cases (Hersch, O'Connell, and Viscusi, 2007). Given the prominence of noneconomic damages and reforms that cap these damages, this tort reform measure will be the main matter of interest.

The temporal shifts in the reform variables vary as well, as reflected in Table 2. In 1984 there were few of these limitations in place, whereas by 1992 over one third of the insurer share of business was in states with modified joint and several liability and modified collateral source rules. By 2003, the average share of business in states with punitive damages caps was just over one-third the 1992 level. The effect these various measures will have on losses will depend not

only on their prevalence but also on the extent to which these various reforms impinge on the levels of damages that plaintiffs would otherwise receive.

Table 2 also provides information on the within-year variation in the tort reform and regulatory share variables. For noneconomic damages and punitive damages caps, the standard deviations exceed the mean values, while for the other variables the standard deviations within years fall just short of the level of the means. This substantial value of the within-year standard deviations relative to their mean effects indicates that the estimation of the effect of tort reforms is indentified not only through the temporal variation in these values but also through the variation across firms.

It should be noted that medical malpractice reforms will give rise to a complex set of effects, which may affect the estimated values and the interpretation of the results. We discuss these below. However, it should be emphasized that our focus is not on these various mechanisms per se but on whether the effects of tort reform on the developed losses associated with premiums written in a given year are greater than the reported loss values for that year. This contrast should not be greatly altered by such influences.

Some of the responses induced by tort reform will be in terms of changes in the behavior of physicians. Following standard economic reasoning and empirical work on defensive medicine (Kessler and McClelland, 2002), one would expect malpractice reforms that limit damages to lead doctors to take fewer precautions. There might also be entry into the tort reform states by higher risk physicians from other states. Consequently, the effects observed for reforms will be less than would be in the absence of behavioral responses or doctor selection effects. Alternatively, if good doctors are attracted to lower liability states, the effect of tort reforms per se might be overstated. Insurance data do not permit resolution of this issue.

An alternative possibility is that insurers exit high loss states and select into more favorable states. However, our data indicate very little movement of this type. Patty?

3. Loss Development

Earlier studies of the effects of tort reform on insurer performance made use of current year reported loss information. Reported incurred losses include losses paid and an estimate of losses incurred but not yet reported. The reported figure represents, to some extent, an insurer's expectations of the ultimate payout for policies in that year. This expectation is formed by past experience, whereby the insurer can use past payout history to estimate the ultimate losses if the book of business and types of risks borne by the insurer have not changed markedly.

Insurers use a variety of methods to evaluate the development of losses over time. Reported losses are adjusted to correct for errors in the estimation of loss reserves. These errors arise from two primary factors: (1) delays in the reporting of claims, and (2) misjudgments in calculating the value of claims. As time passes, the number and value of claims for a particular policy year become more evident. The pattern of loss development can be estimated using past experience, and this projection is essential to the insurer's reserving for future losses.

The relationship between reported and developed losses has been the focus of several different veins of research. Several studies offer a behavioral perspective, suggesting that insurance company managers may intentionally misreport losses to achieve corporate or even personal objectives.[3] Unintentional misreporting results from unforeseen exogenous influences, such as a higher than expected inflation rate which causes higher than expected claims payments

[3] These errors have direct effects on the insurer's reported financial results, allowing managers to justify price increases (Nelson, 2000), manipulate tax payments, and smooth earnings over time (Grace, 2000). Over-estimating reduces reported earnings, decreases reported capital surpluses, reduces tax liabilities, and can ward off regulatory scrutiny (Petroni, 1992; Gaver and Paterson,1999).

(Weiss, 1985). Others have suggested that during periods in which insurance markets are soft that firms tend to underprice insurance (Harrington and Danzon, 1994). Significant errors in loss estimates make it difficult to evaluate an insurer's true financial performance. The implications of misreported losses are especially important to reinsurers, who rely greatly on the insurer's estimates of loss development patterns. A recent study suggests that from 1983-1993 property-casualty insurers were systematically overstating their loss reserves (Bierens and Bradford, 2005). By including year fixed effects in the regression analyses, we will seek to control for such market-wide influences with a temporal component.

In the period we analyze, medical malpractice insurers' loss expectations must take into account the largely unknown effects of state tort reform activity on the legal outcomes for which the insurer may be liable. To the extent that past experience does not prove helpful in estimating reserves given the shift in the tort liability landscape, we expect that the level of incurred losses reported in a given year may be significantly different than the level reported for that same year of policies in subsequent years.

Figure 1 shows the pattern of industry losses based on initial reports and subsequent development for the time period we analyze. The figure indicates the reported losses in each year as well as the developed losses after five and ten years. Although the loss statistics follow a similar pattern of increases and decreases over time, the gap between reported and developed losses is quite different. In the early 1980s developed losses are higher than initially reported, which suggests that the long run loss experience during that period was worse than insurers had predicted. The reverse is true from 1986-1997: developed losses are lower than amounts initially reported, and further development, i.e., from 5 years to 10 years, results in additional reductions

in the loss amounts. Although development of losses since 1997 is not complete, the developed losses appear to be greater than reported losses.

4. Empirical Analysis

If the malpractice tort reforms are influential in affecting insurer performance, then these effects will be evident in the level of losses. Insurer losses are reduced if these reforms have the intended effect of decreasing award and settlement amounts and the number of claims that are litigated. Analysis of the effect on losses consequently provides a more direct test of the effect of the reforms than would analysis of the effect on loss ratios, which is an inverse measure of insurance profitability. Indeed, the more rapidly the effects of tort reforms are passed through to insurance purchasers through lower premiums, the more one will understate the actual consequences of the tort reform. In addition, the central focus of the analysis is on the contrast between the effect of tort reforms on current losses and the effect on developed losses. The premium levels are the same in each instance. Our analysis of loss ratios effects yielded results similar to those found for losses.

We begin by presenting a baseline ordinary least squares (OLS) regression equation to obtain estimates of the reform effects on reported losses, using the following loss equation for firm *i* at time *t*:

$$\begin{aligned} \textit{Log Losses Incurred}_{it} = \quad & (1) \\ & \alpha_t + \beta_1 \textit{ Log Premiums Earned}_{it} \\ & + \beta_2 \textit{ ShareJS}_{it} + \beta_3 \textit{ ShareCS}_{it} + \beta_4 \textit{ SharePD}_{it} + \beta_5 \textit{ ShareND}_{it} \\ & + \beta_6 \textit{ Sharereg}_{it} + \beta_7 \textit{ Log Number of States}_{it} \end{aligned}$$

$$+\beta_8 \, Lloyds_i + \beta_9 \, Mutual_i + \beta_{10} \, Reciprocal_i + \beta_{11} \, TBill_i + \varepsilon_{ijt}.$$

Equation 1 and all subsequent equations allow for time-specific fixed effects α_t. Influences common to specific years, such as effects of the underwriting cycle, consequently will be reflected in this set of year-specific fixed effects.

Following the approach in most previous analyses of tort reform, we assume that endogeneity of tort reforms and losses is not a major problem. As our analysis will indicate, the current period losses do not reflect the ultimate value of the losses associated with these premiums but will be governed to a large extend by expectations based on past loss performance. Our analysis of the effect of logged values of the tort reform measures rather than contemporaneous values yields similar results to those found because there is not a great deal of temporal variation in the presence of the tort reforms. Including the one-period logged value of the tort reform measures the elimination of one year of data. In a similar vein, tort liability reform doesn't typically affect contemporaneous premium levels, as values are set based on the previous years' lost experience. California's recent efforts to couple workers' compensation reform with lower premium levels is a rare exception. More common is the Texas medical malpractice experience in which the damages cap legislation enacted in 2003 led to a legislative proposal in 2005 (HR 1665) to commission a state insurance commission study of the effect of the noneconomic damages caps on premiums. Such effects involve policy responses that are not contemporaneous with tort reform.

To allow for the influence of omitted insurer characteristics, we also estimate the OLS equation using a firm-specific fixed effects model as well. The model takes the form:

$$\begin{aligned} \textit{Log Losses Incurred}_{it} = \quad & (2) \\ & \alpha_t + \sum \alpha_i \textit{Firm}_i + \beta_1 \textit{ Log Premiums Earned}_{it} \\ & + \beta_2 \textit{ ShareJS}_{it} + \beta_3 \textit{ ShareCS}_{it} + \beta_4 \textit{ SharePD}_{it} + \beta_5 \textit{ ShareND}_{it} \\ & + \beta_6 \textit{ Sharereg}_{it} + \beta_7 \textit{ Log Number of States}_{it} \\ & + \beta_8 \textit{ Lloyds}_i + \beta_9 \textit{ Mutual}_i + \beta_{10} \textit{ Reciprocal}_i + \beta_{11} \textit{ TBill}_i + \varepsilon_{ijt}. \end{aligned}$$

where $\textit{Firm}_i$ is a 0-1 dummy variable for firm i ($i = 2,...N$), and the estimates of α_i capture the presence of any statistically significant group effects. The firm-specific fixed effects model is only feasible with OLS, not the subsequent quantile regressions.

The influence of the tort reforms may vary depending on the type of reform and the nature of the insurer's loss exposure. If the reforms work to limit award amounts, rather than completely eliminating them, then the effects of such measures should increase with the size of the financial stakes involved in the case. Likewise, we would expect little effect on cases that are very small. The reforms are therefore likely to be particularly influential in dampening the losses of firms that are at the high end of the loss distribution. To evaluate the potential differential influence on loss levels of the reform measures we utilize a quantile regression analysis. Equation (3) is the quantile regression counterpart of the modified version of our linear regression (1):

$$\text{Quant}_\tau \text{ (Log Losses} \mid x) = \beta_\tau' x, \qquad (3)$$

where β_τ is the vector of coefficients for the explanatory variables x at the τ^{th} percentile.[4] More specifically, the estimates will determine the differential effects of the variables x at the 10^{th},

[4] See Koenker and Bassett (1978, 1982) for a description of the approach.

25th, 50th, 75th, and 90th percentiles of the log loss ratio distribution.[5] The estimator for our quantile regression model is

$$\underset{\beta}{\text{Min}} \quad \frac{1}{n}\sum_{i=1}^{n}[\tau\rho(LR_i \geq \beta'\chi_i) + (1-\tau)\rho(LR_i \geq \beta'\chi_i)]\left|LR_i - \beta'\chi_i\right|,$$

where the sample size is *n* and ρ is an indicator function that assumes a value of 1 when the inequality holds; otherwise, it is zero. To estimate the asymptotic standard errors we use a bootstrapping technique.

Results of estimating equations (1) - (3) for reported losses are shown in Table 3. All standard errors reported are robust with respect to heteroskedasticity. As expected, the contemporaneous value of premiums earned is strongly related to the insurer's reported loss experience for every set of results.[6] For the initial OLS specification, a 1 percent increase in premiums has an almost identical percentage effect on losses. In the first OLS model including year-specific effects but not firm-specific fixed effects, two of the four tort reform variables have a significant negative effect on losses: noneconomic damages reforms and punitive damages reforms. Somewhat surprisingly, joint and several liability reform has a positive effect, which is consistent with the mixed performance of this reform type in previous studies. Prior approval rate regulation raises the value of losses, which one would expect if regulatory stringency boasts the expected level of losses for any given value of premiums.

[5] The quantile regression at, for example, the 90th percentile will fit an equation such that 90 percent of the sum of the absolute value of the residuals will involve negative errors and 10 percent will be positive. The large loss firms will tend to be captured at this high quantile. Because we include a measure of earned premiums in the equation, the "large loss" firms are those firms with high losses given their premiums; they are not necessarily the large firms.

[6] Since the reform effects are evaluated using firm-level data, the estimated effects are not directly comparable to those obtained earlier using firm-state-level data. Nevertheless, the significant results are consistent with earlier findings (See Born & Viscusi, 1998).

The second OLS equation in Table 3 includes both firm-specific fixed effects and year-specific fixed effects, thus capturing much of the variation in the tort reform measures. Only the joint and several liability tort reform measure is statistically significant.

The quantile regression effects results in Table 3 provide a different perspective in that these results make it possible for us to analyze the incidence of the reform effects across different percentiles of the loss distribution. Consider the effect of noneconomic damages cap limits. Those firms with losses at the upper end of the loss distribution benefit the most from tort reforms, as this variable has an increasingly negative effect beginning at the median loss quantile and peaking at the 90^{th} percentile. Punitive damages camps likewise are not statistically significant at the 10^{th} percentile but begin to have an effect at the 25^{th} percentile, which becomes increasingly great at the 90^{th} percentile. The effects of joint and several liability and collateral damages reforms are more mixed across the quantiles. Overall, any restraining effect of the reforms appears to be largely concentrated at the upper tail.

Similarly, the role of regulatory restrictions in terms of prior approval state insurance regulatory regimes is also greatest for the high loss quantiles. At the 75^{th} and 90^{th} percentiles, rate regulation of this type significantly raises losses.

The largest effects of the reforms directed at limiting damages are consistently for firms that would otherwise have experienced the largest losses. To the extent that these firms are the same firms from year to year, tort reforms benefit the firms with the highest risk portfolios, which perhaps are also the most inefficient firms. However, if the large losses stem from unreasonably high outlier medical malpractice awards, which is an assumption upon which much tort reform is based, then the effects of tort reform across the distribution of losses have a more favorable interpretation. More simply, to the extent that many tort reform measures are

structured to eliminate very large losses by capping the noneconomic damages component of awards, almost tautologically there will be an effect in reducing the awards that otherwise would have been much larger.

The reported losses that are the basis for the estimates in Table 3 are largely estimated, so that it is useful to assess whether the performance of actual loss experiences accord with what insurers expected their losses to be. By evaluating the effects of the reforms on developed losses, we can assess whether their expectations were correct. Moreover, analysis of developed losses provides a more accurate picture of the ultimate effects of the reform measures. Tables 4 and 5 present the results of estimating equations (1) - (3), where the dependent variables are losses developed to the 5^{th} year and losses developed to the 10^{th} year, respectively. While Table 3 contains all insurers writing medical malpractice insurance between 1984 and 2003, the time periods covered in Table 4 (1984-1998) and Table 5 (1984-1993) are necessarily reduced.

The effects of the tort reforms on losses tend to be greater in the developed loss estimates in Tables 4 and 5, as one might expect if the reforms reduced not only initial reported losses but also the subsequent temporal distribution of losses. One would also expect the influence of loss development to diminish over time as the resolution of claims by the fifth year as compared to the first year will embody a greater contrast than a comparison of the tenth year with the fifth year.

The most pronounced effect of considering developed losses is with respect to the key noneconomic damages reform variable. For quantile regressions for fifth year and tenth year developed losses, reported in Tables 4 and 5, the noneconomic damages cap begins to have a statistically significant negative effect on losses. The largest effects of this variable are at the 90^{th} percentile, with the largest point estimate observed for tenth year developed losses.

Analysis of the developed loss experience as analyzed using quantile regressions indicates an effect of reforms on the distribution of losses that is quite different from reported loss regressions. The main effect of the reform efforts is concentrated among the firms that would otherwise have exhibited the worst loss experience. The estimates for the tenth year developed losses indicate that a 10 percent increase in the share of business in states with noneconomic damages caps is associated with loss reductions of x percent at the 90^{th} percentile.

The other tort reform variables are less consistently significant for the fifth year and tenth year developed loss equations, which suggests that the effects observed for reported losses are spurious. The observed effects largely are the result of initial loss reports and insurer expectations rather than the actual loss experience. Punitive damages are awarded in under 3 percent of all medical malpractice cases that plaintiffs win after a jury trial (Hersch and Viscusi, 2004), so that the absence of any significant effect of the punitive damages cap variable on losses accords with the legal structure. Joint and several liability reforms have a significant effect only at the 10^{th} percentile for fifth year losses, which consequently appears to be spurious. The collateral source reform variable is more consistently significant in both the fifth year developed loss quantile equations and the twelfth year developed loss equations. Apparently collateral source reforms have a restraining effect on large stakes claims but not on very large firm losses.

The role of the prior approval regulation follows the opposite pattern of the noneconomic damages variable. Prior approval regulation leads to higher losses, where these losses are concentrated at the median and above in Tables 4 and 5. The greatest effects of prior approval regulation are at the 90^{th} percentile.

Conclusion

Earlier work suggested that certain malpractice tort reforms have the intended effect in reducing malpractice losses reported by insurance companies. Examination of initial reported losses provides a mixed picture with respect to the influence of tort reform. Noneconomic damages and punitive damages reforms have a negative effect on losses, but joint and several liability reforms have a positive effect. The effects of the reforms on the reported loss distribution is also mixed.

By shifting the focus of the analysis to the effect on developed losses, the patterns on influence become much more narrowly focused. The only consistently influential tort reform of consequence is that of noneconomic damages caps. The effect of these caps is greatest at the higher loss quantiles, with the greatest effect at the 90^{th} percentile. Developed losses after five and ten years embody the actual loss experience to a much greater extent than do reported losses. Thus, they provide a much more accurate reflection of the actual consequences of tort reforms on paid losses as opposed to insurers' expectations of what these losses may be.

In much the same manner, insurance regulation has a differential effect as well, with the greatest effect being a boosting of loss levels for the upper loss quantiles. However, unlike the tort reform measures, this effect of prior approval regulation is consistent whether one examines reported losses or developed losses. This similarity is not surprising because there is little change across the sample period in the fraction of business subject to prior approval regulation, as it increased from 0.32 to 0.34 from 1984 to 2003. In the absence of changes with respect to the insurance regulation regime, insurers' historically based expectations as embodied in reported loss levels should be more in line with actual loss patterns. In contrast, the fraction of business affected by noneconomic damages caps rose from 0.11 to 0.47. Expectations regarding

losses that are governed by experiences before the presence of the caps will understate the effect that the caps will have. Developed losses show a greater effect of noneconomic damages caps on the upper end of the loss distribution than does the analysis of reported losses. Actual developed loss patterns provide a more accurate and in many respects more narrowly focused and quite different perspective on the effects of tort liability reforms on medical malpractice insurance markets.

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Table 1. Sample means, 1984-2003 (N=2177)

Variable		Mean (Standard Deviation)
Premiums Earned (in millions)		33.828 (71.261)
Losses Incurred – Current Year (in millions)		37.941 (85.408)
Share of Business in States with:	Modified Joint & Several Liability	0.726 (0.355)
	Modified Collateral Sources Rule	0.708 (0.349)
	Noneconomic Damages Cap	0.382 (0.371)
	Punitive Damages Cap	0.307 (0.355)
	Prior Approval Rate Regulations	0.529 (0.360)
Number of States in which Insurer Writes Med Mal		14.775 (17.903)
Organizational Form	Stock	0.675 (0.468)
	Mutual	0.138 (0.345)
	Reciprocal Exchange	0.114 (0.318)
	Lloyds	<0.001 (0.021)

Source: National Association of Insurance Commissioners. The sample includes only insurers that write more than $1 million in premiums. The number of insurers in the sample ranges from 33 to 162 per year.

Table 2. Average share of insurer business in states with tort reforms and prior approval rate regulation

Share variable	Mean 1984	Mean 1992	Mean 2003
Modified Joint & Several Liability	0.000 (0.000)	0.642 (0.414)	0.540 (0.435)
Modified Collateral Source Rule	0.113 (0.212)	0.619 (0.406)	0.590 (0.425)
Noneconomic Damages Cap	0.080 (0.179)	0.294 (0.377)	0.262 (0.340)
Punitive Damages Cap	0.000 (0.000)	0.187 (0.311)	0.340 (0.385)
Prior Approval Rate Regulation	0.307 (0.320)	0.461 (0.390	0.418 (0.395)

* Sources include the American Medical Association (2004), the American Tort Reform Association, and individual state statutes.

Figure 1. Industry Losses using Reported, 5-year and 10-year Developed Losses, 1980-2003

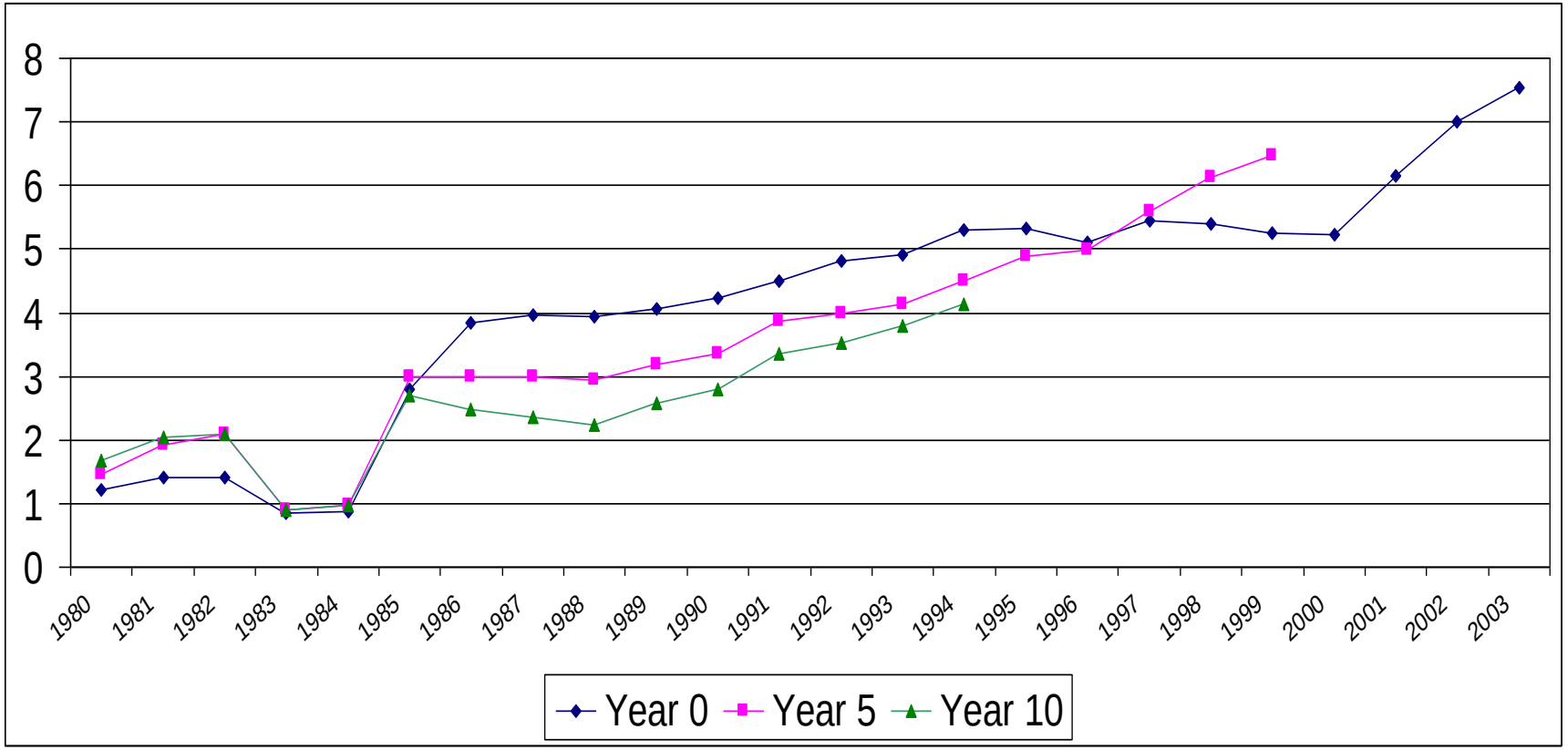

Table 3. OLS and Quantile Regression Results. Dependent Variable = Reported Losses

	OLS (with robust std errs)	OLS w/fixed effects	10%	25%	50%	75%	90%
Ln(Premiums Earned)	1.079***	0.835***	1.117***	1.091***	1.082***	1.061***	1.023***
	(0.009)	(0.022)	(0.011)	(0.006)	(0.004)	(0.007)	(0.009)
Ln(Share PW in States w/ Noneconomic damages cap)	-0.171***	0.099	-0.075	-0.028	-0.059*	-0.105***	-0.179***
	(0.048)	(0.075)	(0.078)	(0.029)	(0.030)	(0.032)	(0.040)
Ln(Share PW in States w/ Punitive damages cap)	-0.114***	-0.076	-0.052	-0.102***	-0.080***	-0.098**	-0.203***
	(0.043)	(0.077)	(0.053)	(0.035)	(0.031)	(0.040)	(0.051)
Ln(Share PW in Joint/Several Reformed States)	0.201***	0.166*	0.056	0.039	0.069**	0.060	0.076*
	(0.067)	(0.090)	(0.076)	(0.027)	(0.035)	(0.062)	(0.040)
Ln(Share PW in Collateral Source Reformed States)	-0.117	-0.073	-0.122*	-0.053	-0.047*	-0.031	-0.066
	(0.073)	(0.083)	(0.074)	(0.040)	(0.030)	(0.056)	(0.062)
Ln(Share PW in States with Prior Approval)	0.097*	0.049	-0.025	0.037	0.023	0.067*	0.184***
	(0.050)	(0.098)	(0.046)	(0.030)	(0.031)	(0.034)	(0.062)
Ln(Number of States)	-0.034***	0.077***	-0.025***	-0.034***	-0.041***	-0.037	-0.031***
	(0.008)	(0.018)	(0.009)	(0.004)	(0.007)	(0.007)	(0.008)
Mutual	0.059		-0.013	0.103***	0.028	-0.030	-0.020
	(0.042)		(0.065)	(0.021)	(0.024)	(0.026)	(0.046)
Lloyds	-4.685***		-1.144	-3.218*	-5.264**	-6.602**	-6.762*
	(0.415)		(1.161)	(1.771)	(2.592)	(3.345)	(3.497)
Reciprocal	-0.024		0.003	0.089***	0.043**	-0.027	-0.079***
	(0.045)		(0.056)	(0.032)	(0.020)	(0.023)	(0.029)
Intercept	-1.406***	0.168	-5.259***	-2.971***	-0.853	0.655***	1.126***
	(0.424)	(0.215)	(0.874)	(0.613)	(0.623)	(0.121)	(0.337)
Adjusted $R^{2\dagger}$	0.888	0.864	0.683	0.752	0.774	0.768	0.742

†Overall R^2 for fixed effects model and pseudo R^2 for quantile regressions

***, ** and * indicate estimated coefficients that are significant at the 99%, 95%, and 90% significance levels, respectively.

Note: all equations include dummy variables for years 1985-2003.

Table 4. OLS and Quantile Regression Results. Dependent Variable = Developed Losses, fifth year

	OLS w/robust std errs	OLS w/fixed effects	10%	25%	50%	75%	90%
Ln(Premiums Earned)	1.093***	0.844***	1.200***	1.115***	1.074***	1.022***	0.981***
	(0.016)	(0.034)	(0.022)	(0.012)	(0.008)	(0.014)	(0.017)
Ln(Share PW in States w/ Noneconomic damages cap)	-0.247***	0.029	-0.123	-0.207***	-0.211***	-0.242***	-0.371***
	(0.066)	(0.101)	(0.104)	(0.051)	(0.033)	(0.053)	(0.077)
Ln(Share PW in States w/ Punitive damages cap)	-0.004	0.002	-0.040	-0.049	0.005	0.024	0.146
	(0.064)	(0.109)	(0.073)	(0.075)	(0.056)	(0.081)	(0.104)
Ln(Share PW in Joint/Several Reformed States)	-0.308***	0.308***	0.407***	0.119	0.099	0.008	0.205
	(0.107)	(0.123)	(0.150)	(0.082)	(0.062)	(0.096)	(0.175)
Ln(Share PW in Collateral Source Reformed States)	-0.288***	-0.129	-0.515***	-0.174***	-0.079	0.002	-0.181
	(0.106)	(0.118)	(0.149)	(0.051)	(0.067)	(0.099)	(0.131)
Ln(Share PW in States with Prior Approval)	0.211***	0.086	0.125*	0.121	0.175***	0.209***	0.403***
	(0.066)	(0.140)	(0.072)	(0.049)	(0.045)	(0.059)	(0.093)
Ln(Number of States)	-0.010	0.078***	-0.029	-0.006	-0.004	0.005	0.034*
	(0.015)	(0.027)	(0.025)	(0.013)	(0.010)	(0.013)	(0.018)
Mutual	0.002		-0.103	0.073	0.083*	0.017	0.119
	(0.091)		(0.099)	(0.048)	(0.045)	(0.055)	(0.090)
Lloyds	-1.500***		2.016	0.063	-1.697*	-3.353**	-3.411**
	(0.417)		(1.309)	(0.312)	(1.009)	(1.629)	(1.714)
Reciprocal	-0.029		0.050	0.109**	0.036	-0.002	-0.031
	(0.060)		(0.081)	(0.047)	(0.029)	(0.052)	(0.050)
Intercept	-1.454***	0.288***	-5.838***	-3.197***	-1.110	0.969***	1.359***
	(0.438)	(0.1318)	(1.540)	(0.588)	(0.705)	(0.190)	(0.266)
Adjusted $R^{2\dagger}$	0.825	0.806	0.606	0.659	0.684	0.689	0.670

†Overall R^2 for fixed effects model and pseudo R^2 for quantile regressions

***, ** and * indicate estimated coefficients that are significant at the 99%, 95%, and 90% significance levels, respectively.

Note: all equations include dummy variables for the years 1985-1998.

Table 5. OLS and Quantile Regression Results. Dependent Variable = Developed Losses, tenth year

	OLS w/robust std errs	OLS w/fixed effects	10%	25%	50%	75%	90%
Ln(Premiums Earned)	1.087***	0.778***	1.201***	1.133***	1.063***	0.989***	0.937***
	(0.021)	(0.052)	(0.036)	(0.021)	(0.009)	(0.017)	(0.024)
Ln(Share PW in States w/ Noneconomic damages cap)	-0.174**	0.045	-0.019	-0.195**	-0.121**	-0.292***	-0.414***
	(0.088)	(0.168)	(0.108)	(0.086)	(0.052)	(0.095)	(0.098)
Ln(Share PW in States w/ Punitive damages cap)	0.044	0.061	0.074	0.044	-0.064	-0.066	-0.033
	(0.089)	(0.184)	(0.144)	(0.115)	(0.086)	(0.115)	(0.131)
Ln(Share PW in Joint/Several Reformed States)	0.244***	0.266	0.350	0.104	0.066	-0.089	0.104
	(0.119)	(0.196)	(0.224)	(0.106)	(0.091)	(0.105)	(0.144)
Ln(Share PW in Collateral Source Reformed States)	-0.340***	-0.137	-0.511***	-0.311***	-0.186**	-0.011	-0.232
	(0.128)	(0.184)	(0.167)	(0.080)	(0.078)	(0.069)	(0.150)
Ln(Share PW in States with Prior Approval)	0.152*	0.150	0.090	0.103	0.127**	0.200**	0.268**
	(0.091)	(0.227)	(0.166)	(0.078)	(0.064)	(0.080)	(0.129)
Ln(Number of States)	-0.002	0.257***	-0.030	0.018	0.007	0.001	0.008
	(0.018)	(0.044)	(0.034)	(0.018)	(0.015)	(0.013)	(0.015)
Mutual	0.035		-0.008	0.120**	0.063	-0.003	-0.008
	(0.097)		(0.153)	(0.060)	(0.066)	(0.069)	(0.079)
Lloyds	-1.519***		1.069	0.276	-2.120*	-3.329**	-3.495**
	(0.413)		(0.730)	(0.637)	(1.156)	(1.367)	(1.664)
Reciprocal	0.066		0.214**	0.183***	0.143***	0.099**	0.023
	(0.082)		(0.100)	(0.069)	(0.045)	(0.046)	(0.076)
Intercept	-1.283***	0.716***	-4.799***	-3.451***	-0.497	1.318***	1.901***
	(0.453)	(0.478)	(0.787)	(0.854)	(0.625)	(0.133)	(0.270)
Adjusted $R^{2\dagger}$	0.786	0.680	0.562	0.607	0.634	0.650	0.638

†Overall R^2 for fixed effects model and pseudo R^2 for quantile regressions

***, ** and * indicate estimated coefficients that are significant at the 99%, 95%, and 90% significance levels, respectively.

Note: all equations include dummy variables for the years 1984-1993.