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W. Kip Viscusi
Patricia H. Born

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Damages Caps, Insurability, and the Performance of Medical Malpractice Insurance *

W. Kip Viscusi** and Patricia H. Born***

Abstract

This paper uses the complete property and casualty insurance files of the National Association of Insurance Commissioners from 1984-1991 to assess the effect of medical malpractice reforms pertaining to damages levels and the degree to which these damages are insurable. Limits on noneconomic damages were most influential in affecting insurance market outcomes. Several punitive damages variables specifically affected the medical malpractice insurance market, including limits on punitive damage levels, prohibitions of the insurability of punitive damages, and prohibition of punitive damages awards. Estimates for insurance losses, premiums, and loss ratios indicate effects of reform in the expected directions, where the greatest constraining effects were for losses. The quantile regression analysis of losses indicates that punitive damages reforms and limits were most consequential for firms at the high end of the loss spectrum. Tort reforms also enhanced insurer profitability during this time period.

Key Words: medical malpractice insurance, tort reform, punitive damages, noneconomic damages

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** Cogan Professor of Law and Economics, Harvard Law School, 1575 Massachusetts Avenue, Cambridge, MA 02138; phone: 617-496-0019; fax: 617-495-3010; e-mail: kip@law.harvard.edu.

*** Assistant Professor, Department of Finance, Real Estate and Insurance, California State University, Northridge, 18111 Nordhoff St., Northridge, CA 91330; phone: 818-677-4614; fax 818-677-6079; e-mail: patricia.born@csun.edu

Damages Caps, Insurability, and the Performance of Medical Malpractice Insurance *

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1. Introduction

The tort liability crisis of the mid-1980s generated a continuing interest in tort reform. One of the principal lines of insurance affected by the tort crisis was medical malpractice. Within a two-year period from 1984-1986 medical malpractice premiums nationally doubled.[1] Premiums for some other lines of insurance, such as those for product liability, were also volatile, whereas lines such as automobile insurance and homeowners' insurance were less affected.[2]

Rising medical malpractice premium costs stimulated substantial policy interest. Higher premiums raised the cost of providing medical care, and influenced physician behavior in a variety of ways, including attempts to reduce risk exposure by practicing defensive medicine.[3] Higher insurance costs imply greater payments to injured patients and their families as well, so that an increase in losses may not be undesirable unless the previous payment levels were already optimal. Insurance market volatility is more problematic to the extent that it implies ratemaking.

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[1] See the Insurance Information Institute (1992), pp. 20-29.

[2] Ward (1988) examines multiple causes of the property-casualty insurance crisis, including ineffective regulation of the insurance industry and a more litigious society.

[3] See Danzon, Pauly, and Kington (1990); Weiler (1991); and Weiler et al. (1993). Kessler and McClellan's (1996) analysis addresses such costs empirically.

In response to the rising costs and insurance market volatility, many states enacted reforms to limit the level and variability of insurance company losses.[4] While some of these measures were broad, in many instances states adopted legislation targeted specifically at medical malpractice insurance.

That tort liability reforms can influence the general performance of medical insurance is well established in numerous studies.[5] This paper uses the same data set and general approach in Born and Viscusi (1998). However, that analysis did not address the effect of limits on noneconomic damages and limits on punitive damages, which are the two most prominent reform components. In contrast, compensatory damages have been almost entirely unaffected by the wave of tort reform measures. The second novel aspect of this paper is that it explicitly addresses the role of whether damages are insurable. To the extent that states have stipulated that punitive damages are not insurable, a damages component should be eliminated as a cost concern to insurance companies. Whether the expected ramifications of those limits actually affect insurance company losses and premiums has never been answered empirically.

One category of damages reforms that continues to play a prominent role in tort reform debates is punitive damages reforms. Punitive damages are often associated with the largest and most highly publicized awards. Whereas million dollar awards used to merit headlines, there have been at least 63 punitive damages awards of at least $100 million, and in some cases punitive damages awards have been in the billions of dollars.[6]

[4] Such reforms were not unique to the 1980s. There were also reforms enacted in the 1970s, which are analyzed by Danzon (1985). Born and Viscusi (1998) found that these reforms in the 1970s did not have a continuing effect for the time period in this paper.
[5] See, among many others, Danzon (1985), Hughes and Snyder (1989), Viscusi and Born (1995), Viscusi, Zeckhauser, Born and Blackmon (1993), and Zuckerman, Bovbjerg, and Sloane (1990).
[6] For a list of these large award cases see Hersch and Viscusi (2002).

Some observers, however, might question whether punitive damages reforms will have any effect at all on medical malpractice insurance. Medical malpractice cases are responsible for a much smaller proportion of punitive awards than are cases involving product liability, fraud, and intentional torts.[7] The current low level of punitive damages in medical malpractice cases may be due in part to the enactment of reforms in the mid-1980s. Punitive awards are very infrequent and are often reduced on appeal, thus reducing their ultimate cost.[8] The prospect of these awards may, however, induce out-of-court settlements, which will be reflected in insurance losses.

A second class of tort reforms pertains to limitations on noneconomic damages, chiefly pain and suffering compensation. Jury instructions for pain and suffering typically provide little guidance to jurors that might assist them in selecting a dollar value for pain and suffering. Because of this lack of guidance, there have long been claims that jury awards for pain and suffering are random and capricious, though there is no general empirical evidence to that effect. Noneconomic damages also serve the additional function of providing funds for the plaintiff to pay the attorney's fees so that the award less these fees will be adequate to address the economic losses incurred.[9]

This article examines the implications of damages reforms for a very large sample of medical malpractice insurance losses, premiums, and loss ratios. The overall intent of our analysis is to ascertain whether there are significant effects of these reform efforts on various measures of insurance market performance. Evidence that the reforms were effective in the manner that is generally intended by the legislatures does not necessarily

[7] A breakdown of the frequency of punitive damage awards by case type appears in Hersch and Viscusi (2002), where the tabulation is for a large sample of state court cases in 1996.
[8] Ibid.
[9] However, the analysis of pain and suffering awards in Viscusi (1996) suggests that they are not as random as is often thought.

imply that such reforms are socially desirable. To explore the influence of these reforms, we utilize the complete insurance financial data files compiled by the National Association of Insurance Commissioners for 1984-1991. The comprehensive data base includes financial information for each insurance company writing medical malpractice insurance, where such data appear separately by line. These data comprise the most complete set of insurance data available and the largest data set ever used in a study of medical malpractice.[10]

Several aspects of damages reforms will be of interest. First, will states that do not permit punitive damages at all or which limit noneconomic damages fare differently with respect to insurance market performance? Second, what is the effect of imposing a cap on the level of punitive damages or noneconomic damages that can be awarded? Third, if states enact legislation that permits punitive damages to be awarded, but does not permit such damages to be insurable, will there be an observed effect on losses and premiums? While losses may be affected by the aforementioned punitive damages variables, premiums may not vary if insurance companies set their rates based on information with respect to average risks nationally. In that case, the specific states enacting the reforms would not benefit to a greater extent, as there would be an average national effect.

After discussing the sample and the variables in Section 2, subsequent sections address the effect on losses, the subsequent influence on premiums, and the effect on insurance company loss ratios. Several of these forms of limits on punitive damages,

[10] Most previous studies of insurer performance use state-aggregated data or a more limited set of reform measures. See, for example, Barker (1992), Viscusi and Born (1995), and Viscusi et al. (1993). Medical malpractice premium levels are analyzed in Zuckerman, Bovbjerg, and Sloan (1990). The relationship between reforms and malpractice claims is explored by Hughes and Snyder (1989).

limits on noneconomic damages, and other damages reforms reduce losses, as one would predict. In a competitive insurance market one would expect lower losses to ultimately result in lower premiums. The main barometer of insurance market performance in the literature is the loss ratio, which serves as an inverse measure of profitability. If insurance markets were initially in competitive equilibrium before the reforms, loss ratios should not be affected by the reform efforts. In the long run, however, states tend to enact reforms in response to periods of liability crisis in which loss ratios tend to be high. Reforms of noneconomic damages and a more aggregative measure of other reforms prove to be particularly influential in enhancing insurer profitability.

2. The Sample and the Variables

Table 1 summarizes the principal insurance variables used for the analysis. For the 1984-1991 period, the National Association of Insurance Commissioners dataset has over 8,000 observations, where each observation pertains to a company writing medical malpractice insurance in that state in the calendar year. All states are included in the sample. Because of regulatory requirements to report insurance company financial data, these observations represent a comprehensive sample of all firms writing medical malpractice insurance. Reporting requirements also stipulate that loss and premium information be distinguished by line of insurance.

The first row of Table 1 provides premium information on the total level of medical malpractice premiums earned.[11] For the liability crisis period from 1984-1986, medical malpractice premiums rose by 36.5% in 1985 and then by an additional 40.3% in

[11] Unfortunately, the data are available by line of insurance so that the medical malpractice data file does not include information on premiums in other lines or on the share of medical malpractice insurance in the firm's overall underwriting.

1986. The rate of premium growth tapered off, as premiums reached a peak of $4.66 billion in 1988 and then exhibited a decline in 1991.

Medical malpractice losses likewise jumped by 35.5% in 1985. In the subsequent years incurred losses exhibited both modest increases and modest declines. There were, however, two years with more substantial loss fluctuations, as losses declined by 24.0% in 1989 and jumped by 28.8% in 1991.

The focal point of the empirical literature on insurance is on the loss ratio, which is usually defined as the ratio of losses incurred to premium earned.[12] The inverse of the loss ratio measures ex post insurer profitability. The average loss ratios, calculated on a calendar-year basis using losses incurred to premiums earned in medical malpractice, are presented in Table 1. These figures pertain to the average of the loss ratios of each individual insurer, without any weighting to reflect the scale of operations. This measure is useful in tracking the mean value of a key dependent variable in the analysis but is not an ideal measure of insurance market profitability.

More instructive is the value of what we term the loss ratio nationwide, which is obtained by dividing total losses incurred by total premiums earned using data from Table 1. This measure weights the loss ratio by the value of premiums and provides a less bleak picture of insurance industry health. This average is less than 1.0 in six of the eight years, suggesting underwriting profitability for the period 1986-1991. Losses are in excess of premiums for the 1984-1985 period, but in all subsequent years premiums exceed losses.

[12] We considered alternative measures of the loss ratio which include, among other things, loss adjustment expenses, but our level of analysis (by firm, by state, by line) limits the information we can include.

The striking difference between the national loss ratio and the average of individual firm loss ratios is largely due to the fact that larger firms tend to have lower loss ratios. Table 2 presents the average loss ratio for the sample firms that fall into specific ranges of premiums earned. The figures indicate that the average firm loss ratio declines as the value of premiums earned increases.

Interpreting loss ratios as a measure of insurance industry profitability requires caution. A loss ratio of 1.0 does not necessarily imply that a firm breaks even in terms of its profitability. Expenses, such as the cost of administering claims, are not included, only losses chargeable to policies written in that year. In addition, companies earn premiums before they have to pay out losses on those policies. This gap enables firms to earn interest on the premiums before making insurance payouts. Real (inflation-adjusted) Treasury bill rates declined over the period, as they were 3.7% in 1985 and 1.8% in 1991. The greater investment profitability in the earlier period in Table 1 suggests that the poor underwriting performance does not necessarily imply a high degree of unprofitability. During periods of high interest rates insurance companies compete by lowering premium levels and then subsequently raise premiums when interest rates decline. These aspects of the insurance underwriting cycle will be explicitly accounted for in the regression analysis below.

As the legal reform statistics in Table 3 indicate, reform efforts closely followed the surge in firms' loss ratios.[13] While there were some new reforms in 1985, the year in which average loss ratios hit a high of 1.6, there was an even greater wave of reforms in 1986, both as a lagged response to the 1985 market conditions and the continued low profitability in 1986. Reforms continued in 1987, particularly with respect to punitive

[13] Reform data were obtained from the Alliance of American Insurers.

damages. From 1987 through 1991 the status of the reforms for the categories listed in Table 3 remained constant as the number of states with reforms of each of the types listed in the table remained unchanged. By 1991, ten states had enacted caps on *both* noneconomic and punitive damages.

The empirical analysis will include several variables pertaining to punitive damages. The first of these, which is shown in Table 3, is punitive damages reforms. The number of states with such reforms was 2 in 1985, 7 in 1986, and 21 in all subsequent years. The reform variable used below will be in terms of a 0-1 dummy variable that captures the average influence of these reforms. It is not feasible to construct a quantitative measure of reform stringency because of the differing character of the reforms. In some instances, there is a specific dollar cap, whereas for some states the reform structure is more complex as it may, for example, limit punitive damages to a particular ratio with respect to the compensatory damages award.[14]

In some states punitive damages were not recoverable at all during the sample period. The states of Michigan, Nebraska, New Hampshire, and Washington did not permit punitive damages for medical malpractice. Past analysis of a much more limited sample of state level data in Viscusi (1998) failed to find any significant difference in insurance premium levels in these states.[15]

The third punitive damages variable included is a variable for states in which punitive damages are not expressly insurable. Three types of states will be grouped in this category because the empirical analysis could not distinguish significant differences

[14] For further discussion of the functions and effect of punitive damages, see Schmit, Pritchett, and Fields (1988).

[15] Because that sample of 50 observations is dwarfed by the NAIC sample used here it may nevertheless be the case that there is an influence but it could not be captured with a fairly coarse empirical analysis.

among them. In two states (Ohio and Virginia) insurance of punitive damages is prohibited. Six states (Colorado, Maine, Montana, North Dakota, Pennsylvania, and Rhode Island) prohibit the insurability of punitive damages but have left the insurability of punitive damages for vicarious liability undecided. Finally, in six states (Nevada, South Dakota, Texas, Massachusetts, Utah, and Hawaii) the insurability of direct punitive damages remains undecided throughout the sample period. In all other states, punitive damages are permitted to be insurable.

During the time period of our study, some but not all punitive damages awards were insurable in California. Ghiardi and Kircher (1988), § 7.04, observed: "The court stated

> … [It] appears that most of the cases … involve considerations similar to those expressed by the Arizona and Oregon Supreme Courts. Such insurance coverage is valid in jurisdictions where punitive damages are allowed in respect to gross negligence or reckless or wanton conduct. On the other hand, the authorities in jurisdictions where punitive damages are limited to cases involving fraud, oppression, or malice have generally involved coverage for punitive damages on public policy grounds.[16]

One can conclude from this quote that punitive damages based on gross negligence, reckless, or wanton conduct could be insured against without being against public policy and that those cases should be distinguished from those involving 'fraud, oppression, or malice.'"[17] Similarly, Launie and Jennings (1997), p. 23, observe that the minimum standard of conduct for punitive damages not to be insurable in California is malice.

To distinguish the effect of punitive damages reforms from other tort reforms, three additional tort reform variables will be included in the analysis. The first of these

[16] *City Products Corp. v. Globe Indemnity Co.*, Cal. App. 3d 31, 151 Cal Rptr 494, 500 (1979).
[17] See *Clemmer v. Hartford Ins. Co.*, 22 Cal 3d 865, 151 Cal Rptr 285, 587 P2d 1098 (1978) as to nonliability of insurer for intentional acts.

reform variables pertains to limits on noneconomic damages. Many states sought to restrict awards of damages for pain and suffering, loss of consortium, and damages items other than those that reflect the financial harm to the plaintiff. Such restrictions consequently would not affect compensation for earnings loss, medical expenses, rehabilitation expenses, and similar financial costs.[18] In 1986, 10 states enacted such limits on noneconomic damages, and an additional 5 states followed suit in 1987. The typical measures imposed a monetary cap on the amount of noneconomic damages recoverable in actions seeking damages for personal injury or death, or set restrictions on the recovery of such damages in particular actions.[19] Due to the often complex character of the limits, we do not construct a continuous measure of such reforms but focus instead on a 0-1 variable categorizing whether such noneconomic damages limits exist.[20] Whether noneconomic damages reforms would have a restraining effect on medical malpractice costs has long been questioned in tort reform circles.[21]

The second tort reform variable is a 0-1 variable capturing reforms other than those pertaining to damages levels.[22] Such reforms affect either the probability that a defendant will be found liable, or, indirectly, the size of the award. By 1987, 38 states had enacted some type of "other" reform, as shown in Table 3. At that time, 13 states

[18] Previous research by Schmit, Browne, and Lee (1997) and by Browne and Puelz (1997) indicates that limits on noneconomic damages reduce the rate of tort filings, which one would expect to influence insurance losses in the same manner.

[19] The reform passed in Montana prohibited recovery for emotional or mental distress in actions for breach of an obligation or duty arising from contract, except in those actions involving actual physical injury to the plaintiff (MT B 167, 1997).

[20] Five states enacted caps on noneconomic damages in the 1970s, prior to our sample period (CA, IN, LA, NM, and VA).

[21] In 1993 the chairman of the American Bar Association's Working Group on Health Care Reform expressed doubt regarding the efficacy of such reforms when he observed that "caps on noneconomic damages have not had the dramatic impact that supporters think." See Asseo (1993).

[22] These reforms include limits on attorney contingency fees, modifications to joint and several liability rules, establishment of requirements for structured and periodic payments, fees for frivolous suits, and modifications of the collateral source rule.

had *both* a cap on punitive damages and a cap on noneconomic damages, and 12 of these states had at least one additional reform.

In the mid-1970s, nine states (Florida, Indiana, Kansas, Louisiana, Nebraska, New Mexico, Pennsylvania, South Carolina, and Wisconsin) established patient compensation funds, designed as excess liability coverage for judgments against providers that exceed the state's statutory requirement for malpractice insurance. In these states, providers purchase malpractice coverage from private insurers and also make contributions to the state's fund. Liability losses are paid by the private insurers up to the policy limits, and judgments over these limits are covered by the fund, up to the fund's limits. The existence of these funds allows providers to insure only to the statutory requirement, and thus reduces private insurers' exposure to catastrophic malpractice losses. Only one state, Virginia established a fund during our time period.[23] To the extent that funds relieve private insurers of catastrophic risk, these may be associated with improved performance. Thus, we include in our analysis a dummy variable which equals one if the insurer operates in a state with a patient compensation fund, and zero otherwise.[24]

The earlier crisis in the 1970s spurred reform in several states.[25] The level of activity in the 1980s suggests shortcomings in the earlier reforms, many of which were later redefined or modified. With the exception of noneconomic damages caps, we control for these earlier "other" efforts by including an additional 0-1 variable to indicate prior reform activity. Our noneconomic damages cap variable, by definition, captures the implementation of these caps prior to our sample period.

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[23] The Virginia Birth-Related Neurological Injury Compensation Fund was established in 1987.
[24] Wyoming and Oregon established similar funds in the 1970s, but these were never implemented. Florida's fund, enacted in the 1970s, was operational during our sample period, but is currently inactive.
[25] Reform measures included caps on noneconomic damages, modifications to statutes of limitations, limitations on attorney contingency fees, and abolishment of the collateral source rule.

The regressions include three variables pertaining to the nature of the operations of the insurance company. The total national premiums written by the company captures the scale of its operations in medical malpractice. The number of states in which the insurer operates likewise will be included to reflect diversification. Finally, we constructed a measure of the four firm concentration ratio for the insurance industry in the state, which serves as an index of the competitiveness of market conditions. The real state aggregate income level potentially could be influential as well. For any given malpractice misadventure, the economic damages associated with lost earnings will be greater, the higher the income of the injured party. To the extent that jurors take economic damages into account when assigning noneconomic damages, as empirical evidence suggests,[26] the total award will be greater as well.

The next three variables will pertain to the insurance company's organizational form. Because of agency considerations, the organizational structure could potentially affect company behavior. Stock companies are the dominant form for medical malpractice insurers, as they comprise about 90 percent of the sample. The other three organizational forms—a mutual company, reciprocal, or Lloyd's—comprise the remainder of the market.[27]

Finally, each of the equations will include a dummy variable for whether the state has a prior approval regulatory regime. This restrictive form of rate regulation is

[26] Evidence in Viscusi (1988) shows that while noneconomic damages respond less than proportionally to increases in economic damages, the elasticity is still substantial.

[27] The share of premiums written by stock companies was 59% in 1985 and 55% in 1991. Mutual companies and reciprocals wrote about 20% of the total industry premiums in each year, respectively, and Lloyds organizations had about one percent of the market.

generally associated with lower underwriting performance than in states with more competitive rate setting regimes.[28]

3. Medical Malpractice Losses

If punitive damages reforms are influential in affecting insurance market performance, then the mechanism by which this will occur is by reducing the level of losses. Tort reforms potentially will affect court awards and will consequently exert a backward influence on out-of-court settlements of cases as well as payments involving claims that are not litigated. The loss equation for firm i in state j and time t that will be estimated is the general form

$$\begin{aligned}\text{Log Losses Incurred}_{ijt} = \quad & \text{(1a)}\\ \alpha + \delta_1 \text{ Log Losses Incurred}_{ijt-1} + \beta_1 \text{ Log Premiums}_{ijt} \\ + \beta_2 \text{ Punitive Damages Reform}_{jt} + \beta_3 \text{ No Punitive Damages}_{jt} \\ + \beta_4 \text{ Punitive Uninsurable}_{jt} + \beta_5 \text{ Noneconomic Damages Reform}_{jt} \\ + \beta_6 \text{ Other Reform}_{jt} + \beta_7 \text{ 1970s Reform}_{jt} + \beta_8 \text{ Patient Fund}_{jt} \\ + \beta_9 \text{ Log National Premiums}_{it} + \beta_{10} \text{ Log Number of States}_{it} \\ + \beta_{11} \text{ Log Real Income}_{jt} + \beta_{12} \text{ Log Treasury Bill Rate}_{t} + \beta_{13} \text{ Lloyds}_{i} \\ + \beta_{14} \text{ Mutual}_{i} + \beta_{15} \text{ Reciprocal}_{i} + \beta_{16} \text{ Prior Approval}_{j} + \varepsilon_{ijt}.\end{aligned}$$

The lagged value of losses is included because firms that maintain an insurance portfolio of particular riskiness are likely to continue to do so in the future. A second

[28] See Born (2001) for discussion and analysis of the relationships between various forms of insurance regulation and insurer profitability.

equation (1b) omitting the lagged value of losses will also be estimated. The long-term effect of tort reforms may include lowering the level of losses in an earlier year, which in turn will have influences on the loss level in subsequent years. Premiums are included in the loss equation because the amount of insurance sold will affect potential losses.

Table 4 presents the results from estimating the two loss equations (1a) and (1b) using the ordinary least squares regression method. Lagged losses have a positive effect on current losses, though the elasticity is only 0.21. In contrast, the elasticity of losses with respect to premiums earned is 0.73 when lagged losses are included and 0.95 when lagged losses are omitted. As expected, the dollar volume of premiums written strongly influences the loss experience.

The tort reform results are quite stable across the two different specifications. Punitive damages have a significant negative effect on insurance company losses, as does the uninsurability of punitive damages. The estimated effects suggest that punitive damages reforms lead to 6-7 percent reductions in losses incurred. The coefficient on the variable for the four states that do not allow punitive damages also has a significant negative sign, suggesting that losses in these states are about 15 percent lower, holding all else equal. The uninsurability of punitive damages also has a significant negative effect on losses. Insurer losses are reduced 6-7 percent in states that do not allow the insurability of punitive damages relative to states that permit these damages to be insured.

While it could be the case that punitive damages reforms are reflecting in part the introduction of other reform measures at the same time, the consistent character of the three punitive damages variables suggests that such reforms affect insurer performance. States that do not permit punitive damages and states that do not permit such damages to

be insurable have had this status before the enactment of punitive damages reforms and other tort reform measures so that these variables would not be reflecting the influence of these more recent reforms. The existence of a state patient compensation fund is not significantly related to insurer losses.

Of the three additional tort reform variables, the measures pertaining to other reforms and noneconomic damages reforms are clearly influential. Both variables have significant negative effects with coefficients three to four times as great as that for punitive damages reforms. The results suggest that losses in states with noneconomic damages reforms are reduced 16-17 percent compared to states without these measures. Similarly, states that enacted any other reform measure experienced losses that were about 24-25 percent lower than states that did not enact additional measures.

Interestingly, the variable capturing 1970s reform activities prior to the sample period is positively related to losses, but this effect is not significant in the model with the lagged dependent variable. A similar pattern holds for subsequent results as well. For equations without the lagged dependent variable, there is a positive effect, reflecting the fact that the high loss states were the first to enact the reforms. The inclusion of the lagged dependent variable captures the recent mix of policies written by the firm, and controlling for this influence there is no continuing effect of the 1970s reforms into the sample period.

How different damages reforms transmit their influence may vary depending on the type of reform and the nature of the insurer's loss exposure. To the extent that the reform measures take the form of limiting damages components rather than completely eliminating them, then there should be some effect across cases except for those that are

very small. However, the effect of such limits should increase with the size of the financial stakes involved in the case. These constraining influences will be greater the larger the damages component is for cases of any particular size. The character of punitive damages reforms is 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 of loss ratios. The quantile counterpart of our linear regression is

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

where β_{τ} is the vector of coefficients for the explanatory variables x at the τ^{th} percentile.[29] More specifically, the estimates will determine the differential effects of the variables x at the 10th, 25th, 50th, 75th, and 90th percentiles of the log loss ratio distribution.[30] The estimator for our quantile regression model is

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

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.

Because of the similarity of the results for the loss equations with and without the lagged loss variable, here we will present only the estimates omitting the lagged losses. Table 5 reports the quantile regression estimates for the five percentiles of interest. Consider the effect of the punitive damages reform variable. Using a 95 percent

[29] See Koenker and Bassett (1978, 1982) for a description of the approach.
[30] 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.

confidence level (either one-tailed or two-tailed test), this variable is not statistically significant at the 10th or 25th percentiles of the loss distribution. However, it is statistically significant at the higher percentiles, with coefficients rising from -0.08 at the median to -0.13 at the 75th percentile and -0.14 at the 90th percentile. These results support the hypothesis that punitive damages reforms are most effective in limiting losses for firms that are at the high end of the loss distribution.

The punitive damages variable for states that do not permit the awarding of punitive damages likewise shows a similar differential effect. Whereas this variable is not statistically significant for the first two quantiles, for the estimates at the 50th, 75th and 90th percentiles it is negative and statistically significant. The estimated magnitude of the effect suggests a striking 25 percent reduction in losses at the 90th percentile for firms in states that do not allow punitive damages.

The lack of insurability of punitive damages also does not significantly dampen losses at the 10th percentile or at the median. However, at all remaining percentiles the effects are negative and significant: -0.07 at the median, -0.10 at the 75th percentile, and -0.11 at the 90th percentile. All three punitive damages variables consequently have significant effects that are most evident at the upper loss percentiles and are less significant for firms with low levels of losses.

The noneconomic damages reform variable also exhibits a differential effect across quantiles. It is statistically significant at the 95 percent level at all percentiles, and the estimated coefficients are somewhat larger at the 75th and 90th percentiles as compared to the lower quantiles.

The other reform variable follows the same general pattern as the noneconomic damages reform variable, although the coefficients are larger at each quantile. As the results in Table 5 indicate, the estimated effects increase in magnitude from the 10^{th} to the 75^{th} percentile, then fall slightly at the 90^{th} percentile. For firms with losses above the median, other reforms led to a nearly 30 percent reduction in losses. The 1970s reform measure is positive and significant at the 25^{th}, 50^{th}, and 75^{th} percentiles. These results follow the same pattern as before when the lagged dependent variable is not included in the equation, as it is the high loss states that enacted the 1970s reforms. Once again, the existence of a patient compensation fund does not appear to have a significant effect on losses.

The general pattern exhibited by these results is that tort reforms can reduce losses, as one would expect from measures that decrease the chance that defendants will be found liable or reduce payments to medical malpractice victims. The high loss quantiles were typically the most strongly influenced by these measures, particularly in the case of punitive damage restrictions of various kinds. This pattern of influences also accords with theoretical predictions given the economic structure of the tort reforms.

4. The Effect on Premiums

The reduction of losses due to tort liability reform measures in turn should lead to a lower level of premiums if firms operate in a competitive market. How this effect occurs will depend on the scope of the insurance market and how insurers set their rates. If the individual state is the pertinent unit of analysis for the insurer, one would expect to observe effects strongly correlated with changes in that state's liability costs. If,

however, ratemaking or insurance competition occurred on a national frame of reference, measures that reduce losses would decrease premiums nationally but would not yield targeted reductions for the particular state.

To assess the effect on premiums we use an equation of the form

$$\text{Log Premium Earned}_{ijt} = \qquad (2a)$$

$$\alpha + \beta_1 \text{ Log Premiums}_{ijt-1} + \beta_2 \text{ Punitive Damages Reform}_{jt}$$

$$+ \beta_3 \text{ No Punitive Damages}_{jt} + \beta_4 \text{ Punitive Uninsurable}_{jt}$$

$$+ \beta_5 \text{ Noneconomic Damages Reform} + \beta_6 \text{ Other Reform}_{jt}$$

$$+ \beta_7 \text{ 1970s Reform}_{jt} + \beta_8 \text{ Patient Fund}_{jt}$$

$$+ \beta_9 \text{ Log National Premiums}_{it} + \beta_{10} \text{ Log Number of States}_{it}$$

$$+ \beta_{11} \text{ Log Real Income}_{jt} + \beta_{12} \text{ Log Treasury Bill Rate}_{t}$$

$$+ \beta_{13} \text{ Lloyds}_{i} + \beta_{14} \text{ Mutual}_{i} + \beta_{15} \text{ Reciprocal}_{i} + \beta_{16} \text{ Prior Approval}_{j} + \varepsilon_{ijt}.$$

As with the loss equation, we report estimates both with and without the lagged dependent variable (equations 2a and 2b), in Table 6.

The results indicate that punitive damages reforms, and the insurability of punitive damages, are not significantly related to premiums. However, if a state does not allow punitive damages, we find that premiums are significantly lower, by about 8 percent. Noneconomic damages caps and other reforms are also associated with lower premiums, but the 1970s reform measures are not statistically significant.

Premium effects are often difficult to predict because they capture a variety of influences other than simply the riskiness of the state's legal arenas. To the extent that firms and insurance purchasers responded to the liability crisis by reducing the amount of coverage, limiting the circumstances in which there would be an insurance payoff, or

choosing to self-insure rather than purchasing insurance, there will be effects on premiums that may mask the passthrough of lower liability costs. The basic difficulty is that premiums do not reflect unit prices of insurance but rather the combined influence of both price and quantity concerns, making it difficult to assess the effect of the reforms on unit prices.

5. The Response of Loss Ratios

Although ex ante unit insurance pricing information is not available, one can view the loss ratio as a measure of the inverse of the ex post unit price of insurance. Competition will lead to equalization of loss ratios across states with different tort liability costs so that in the long run there should be a passthrough of the loss reductions. An important caveat is that it may be that the reforms addressed unanticipated increases in liability costs that were not reflected in the earlier premium structure. Firms may have experienced temporary losses and the reforms could be viewed as a mechanism for reducing the unanticipated costs of the liability system. The structure of the loss ratio equation will parallel that for losses and premiums, or

$$\begin{aligned}\text{Log Loss Ratio}_{ijt} = \quad & \alpha + \beta_1 \text{ Log Loss Ratio}_{ijt-1} + \beta_2 \text{ Punitive Damages Reform}_{jt} \\ & + \beta_3 \text{ No Punitive Damages}_{jt} + \beta_4 \text{ Punitive Uninsurable}_{jt} \\ & + \beta_5 \text{ Noneconomic Damages Reform}_{jt} + \beta_6 \text{ Other Reform}_{jt} \\ & + \beta_7 \text{ 1970s Reform}_{jt} + \beta_8 \text{ Patient Fund} \\ & + \beta_9 \text{ Log National Premiums}_{it} + \beta_{10} \text{ Log Number of States}_{it} \\ & + \beta_{11} \text{ Log Real Income}_{jt} + \beta_{12} \text{ Log Treasury Bill Rate}_{t} \\ & + \beta_{13} \text{ Lloyds}_{i} + \beta_{14} \text{ Mutual}_{i} + \beta_{15} \text{ Reciprocal}_{i} + \beta_{16} \text{ Prior Approval}_{j} + \varepsilon_{ijt},\end{aligned} \tag{3a}$$

where this equation is estimated with and without the lagged dependent variable (equations 3a and 3b). The autoregressive structure captures the possibility that firms with an unprofitable portfolio of insurance in any given year may continue to experience the same level of profitability unless it alters the mix or character of policies it writes.

The regression results reported in Table 7 indicate that some tort reforms improve insurer profitability. States that do not permit punitive damages have medical malpractice insurance with observed loss ratios that are 10-13 percent lower. With loss ratios around 1.20, on average, during this time period, these results imply a reduction in loss ratios to about 1.04-1.08 due to the absence of punitive damages. The only other tort regime variables that have a statistically significant negative effect on the loss ratio are noneconomic damages reforms and the other reform variable. Noneconomic damages reforms enhance insurer profitability by lowering the loss ratio by 10-13 percent.

While one would expect tort reforms to improve profitability by lowering losses in the affected states, the greater profitability of insurance in reform states should not persist. Other firms should enter these markets or existing firms should lower their prices so that loss ratios are equilibrated across different insurance regimes. How long this adjustment takes is not clear, and there have been no previous estimates of this adjustment process. Analyzing this process is a target of future research using a longer time period of analysis.

6. Sensitivity Tests

The results thus far used pooled time series and cross section data for the 1984-1991 period to assess the effect of the reforms. The analysis thus took into account how the effect of the reforms alter the performance of the state relative to both the pre-reform period and how reform differences across states influence the performance of insurers in those states. To assess the relative influence of each of these comparisons, we estimate our losses equations (1a and 1b) for the post-reform period as well as for only those states

that have reforms in place. Doing so reduces the information used to estimate the incremental effect of reforms but helps highlight the structure of the influence. Thus, the first set of estimates restricting the sample to the time period in which reforms had been enacted focuses on whether there are differences across states during the reform period that account for the earlier estimated effects, while the second set of estimates focusing on the entire sample period but only for the states that undertook reforms examines whether it is primarily the shift across time in the performance of the states that accounts for the observed effect.

Panel A of Table 8 presents results for 1987-1991, which is after all states enacted the tort reforms. The only tort regime variables that exhibit significant effects are for states that do not permit punitive damages, states in which punitive damages are not insurable, and noneconomic damages reforms. With one exception, these measures are all associated with reduced losses, while punitive damages reforms, other reforms and the 1970s reforms are all insignificant.

The two significant punitive damages regime variables did not undergo any changes in 1984-1986. They were not targets of the reform efforts, yet they have significant bearing on insurer performance for the 1987-1991 period. In contrast, of all the tort reform measures enacted prior to 1987, only the noneconomic damages reform variable has any significant effect on insurer performance. Comparison of these results with the earlier findings indicates the main effect of tort reforms was to shift the performance of these states between the pre-reform and post-reform period.

The estimates in Panel B of Table 8 focus on only those states that enacted reforms, but include the pre-reform years in the analysis. There are significant effects of

the no punitive damages variable and the punitive damages uninsurable variable, as in Panel A. The estimated coefficients for the noneconomic damages reform measure are significant, and somewhat larger in magnitude than the results reported in tables 4-7. Including the pre-reform period in the analysis greatly enhances the estimated affect of the newly introduced reforms. Thus, the estimated effect of the reforms in the full sample analysis stems more from the contrast across time for the states that enacted the reforms rather than the contrast across states of their performance within the reform period.

7. Conclusion

Many states enacted tort liability reforms for medical malpractice to lower liability costs. Whether doing so is socially desirable or enhances insurance market efficiency requires a judgment involving broader concerns than those examined here. Our focus has been on whether these reforms do in fact alter the performance of medical malpractice insurance markets.

The three classes of measures that were the primary focus of this study were limits on noneconomic damages, limits on punitive damages, and limitations on the insurability of punitive damages. Each of these measures exhibited some significant efforts, though the locus and magnitudes of the effects differed. These results extend previous analysis, which either have not specifically analyzed these measures or else failed to find significant effects because of reliance on state average data rather than the more detailed individual firm.

Liability reforms reduce losses, lower premiums, and enhance insurer profitability. These liability reforms were especially likely to benefit firms at the high end of the loss distribution. While many of the reform variables reduced losses at the high end of the distribution, those pertaining to punitive damages were especially influential, as one might expect.

Fewer effects were apparent for premiums or loss ratios, in part because of market pressures that will tend to equalize loss ratios in the reform and non-reform states in the long run. However, it was apparent that reforms of noneconomic damages and other reforms that limit the potential liability of the defendant did enhance profitability during the sample period.

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Table 1
Medical Malpractice Insurance Sample Statistics by Year

Insurance Variable	1984	1985	1986	1987	1988	1989	1990	1991
Number of Firm-State Observations	1091	1091	925	906	915	1032	1023	1119
Premiums ($ billions)	1.68	2.63	3.69	4.31	4.66	4.43	4.05	3.93
Percentage Change in Premiums		36.5	40.3	16.8	8.1	-4.9	-8.6	-3.0
Losses ($ billions)	2.20	2.98	3.04	2.74	2.67	2.03	2.26	2.91
Percentage Change in Losses		35.5	2.0	-9.9	-2.6	-24.0	11.1	28.8
Average Loss Ratio [a]	1.28	1.60	1.47	1.17	1.03	1.03	1.01	1.03
Loss Ratio Nationwide [a]	1.31	1.13	0.82	0.64	0.57	0.46	0.56	0.74

[a] The average loss ratio is the unweighted average of the loss ratio for all firms in the sample whereas the loss ratio nationwide is the ratio of total losses to total premiums for the sample in that year.

Table 2
Average Loss Ratios across Distribution of Premiums Earned, 1985-1991

Quantile Range	10-25%	25-50%	50-75%	75-90%
Range of Premiums Earned	$7,180 – 40,041	$40,041 - $239,143	$239,143 - $1,336,270	$1,336,270 - $8,044,682
Average Value of Loss Ratio in Range	1.542 (2.876)	1.383 (2.642)	0.991 (1.392)	0.822 (0.705)
Number of Firms	1,050	1,752	1,752	1,050

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Table 3
Reform Activity by Year

Insurance Variable	1984	1985	1986	1987	1988	1989	1990	1991
Number of States with Punitive Damages Reform	0	2	7	21	21	21	21	21
Number of States with Noneconomic Damages Reform	0	0	10	15	15	15	15	15
Number of States with Any Other Reform Affecting Medical Malpractice	0	8	26	38	38	38	38	38
States with a Patient Compensation Fund	9	9	9	10	10	10	10	10

Table 4
Regression Results for Log Losses Incurred

Explanatory Variable	Coefficient (Standard Error)	Coefficient (Standard Error)
	1	2
Log Losses Incurred $_{t-1}$	0.214*	--
	(0.008)	
Log Premiums	0.734*	0.952*
	(0.011)	(0.008)
Punitive Damages Reform	-0.066*	-0.074*
	(0.028)	(0.030)
No Punitive Damages	-0.161*	-0.154*
	(0.044)	(0.046)
Punitive Damages Uninsurable	-0.058*	-0.071*
	(0.027)	(0.028)
Noneconomic Damages Reform	-0.162*	-0.172*
	(0.029)	(0.030)
Other Reform	-0.243*	-0.251*
	(0.025)	(0.026)
1970s Reform	0.045	0.065*
	(0.026)	(0.027)
Patient Compensation Fund	0.004	-0.001
	(0.031)	(0.033)
Log National Premiums	0.042*	0.041*
	(0.009)	(0.010)
Log Number of States	-0.090*	-0.110*
	(0.014)	(0.014)
Log Concentration Ratio	-0.207*	-0.162*
	(0.078)	(0.081)
Log Real Income	0.040*	0.043*
	(0.015)	(0.015)
Log Treasury Bill Rate	-0.028	0.024
	(0.046)	(0.048)
Lloyds	0.328	0.413
	(0.253)	(0.265)
Mutual	-0.202*	-0.252*
	(0.040)	(0.042)
Reciprocal	-0.140*	-0.194*
	(0.062)	(0.065)
Prior Approval	0.019	0.015
	(0.027)	(0.029)
Constant	-0.368*	-0.626*
	(0.187)	(0.195)
Adj. R^2	0.888	0.878

* Coefficient is statistically significant at the 95 percent level, two-tailed test.

Table 5
Quantile Regression Results for Log Losses Incurred

Explanatory Variable	Quantile Coefficient (Bootstrap Standard Error)				
	0.10	0.25	0.50	0.75	0.90
Log Premiums	1.019*	1.008*	0.988*	0.920*	0.805*
	(0.015)	(0.008)	(0.006)	(0.016)	(0.018)
Punitive Damages Reform	-0.057	0.021	-0.079*	-0.133*	-0.135*
	(0.049)	(0.038)	(0.029)	(0.030)	(0.061)
No Punitive Damages	-0.158	-0.112	-0.094*	-0.163*	-0.249*
	(0.102)	(0.072)	(0.038)	(0.057)	(0.080)
Punitive Damages Uninsurable	-0.055	-0.067*	-0.028	-0.097*	-0.115*
	(0.038)	(0.024)	(0.032)	(0.030)	(0.061)
Noneconomic Damages Reform	-0.167*	-0.196*	-0.161*	-0.189*	-0.208*
	(0.057)	(0.033)	(0.025)	(0.026)	(0.056)
Other Reform	-0.196*	-0.248*	-0.278*	-0.281*	-0.269*
	(0.057)	(0.043)	(0.023)	(0.030)	(0.040)
1970s Reform	0.039	0.119*	0.089*	0.049	0.101*
	(0.067)	(0.033)	(0.023)	(0.034)	(0.048)
Patient Compensation Fund	0.010	0.006	0.000	0.000	0.005
	(0.056)	(0.047)	(0.037)	(0.033)	(0.055)
Log National Premiums	0.066*	0.047*	0.030*	0.047*	0.063*
	(0.019)	(0.013)	(0.011)	(0.019)	(0.023)
Log Number of States	-0.054*	-0.040*	-0.050*	-0.131*	-0.229*
	(0.028)	(0.015)	(0.008)	(0.024)	(0.029)
Log Concentration Ratio	-0.217	-0.066	-0.094	-0.092	-0.228
	(0.134)	(0.092)	(0.078)	(0.119)	(0.202)
Log Real Income	0.049	0.025	0.015	0.073*	0.104*
	(0.031)	(0.018)	(0.014)	(0.016)	(0.022)
Log Treasury Bill Rate	0.016	-0.103*	-0.033	0.139*	0.043
	(0.086)	(0.062)	(0.027)	(0.053)	(0.093)
Lloyds	-0.036	0.372	0.404	0.895	0.851*
	(0.482)	(0.330)	(0.238)	(0.748)	(0.382)
Mutual	-0.185*	-0.247*	-0.272*	-0.231*	-0.219*
	(0.076)	(0.050)	(0.038)	(0.066)	(0.098)
Reciprocal	-0.211	-0.180*	-0.185*	-0.228*	-0.264*
	(0.149)	(0.056)	(0.061)	(0.080)	(0.085)
Prior Approval	-0.006	0.024	0.017	0.047	0.091*
	(0.059)	(0.040)	(0.026)	(0.034)	(0.046)
Constant	-3.308*	-1.903*	-0.713*	-0.124	1.704*
	(0.344)	(0.253)	(0.202)	(0.258)	(0.400)
Pseudo R^2	0.681	0.683	0.674	0.644	0.610

* Coefficient is statistically significant at the 95 percent level, two-tailed test.

Table 6
Regression Results for Log Premiums Earned

Explanatory Variable	Coefficient (Standard Error)	Coefficient (Standard Error)
	1	2
Log Premiums $_{t-1}$	0.686*	--
	(0.005)	
Punitive Damages Reform	-0.039	-0.036
	(0.025)	(0.046)
No Punitive Damages	-0.081*	0.084
	(0.039)	(0.072)
Punitive Damages Uninsurable	0.007	-0.007
	(0.023)	(0.044)
Noneconomic Damages Reform	-0.062*	-0.049
	(0.025)	(0.047)
Other Reform	-0.140*	-0.056
	(0.022)	(0.041)
1970s Reform	-0.010	0.026
	(0.023)	(0.042)
Patient Compensation Fund	-0.049	-0.140*
	(0.027)	(0.050)
Log National Premiums	0.313*	0.988*
	(0.007)	(0.009)
Log Number of States	-0.280*	-0.984*
	(0.011)	(0.019)
Log Concentration Ratio	-0.150*	-0.479*
	(0.068)	(0.126)
Log Real Income	0.235*	0.735*
	(0.012)	(0.022)
Log Treasury Bill Rate	0.136*	0.083
	(0.040)	(0.075)
Lloyds	0.041	0.477
	(0.221)	(0.411)
Mutual	0.011	0.185*
	(0.035)	(0.065)
Reciprocal	0.005	-0.013
	(0.054)	(0.101)
Prior Approval	0.015	-0.038
	(0.024)	(0.044)
Constant	-2.787*	-9.231*
	(0.160)	(0.282)
Adj. R^2	0.905	0.672

* Coefficient is statistically significant at the 95 percent level, two-tailed test.

Table 7
Regression Results for Log Loss Ratio

Explanatory Variable	Coefficient (Standard Error)	Coefficient (Standard Error)
	1	2
Log Loss Ratio $_{t-1}$	0.337*	--
	(0.012)	
Punitive Damages Reform	-0.041	-0.047
	(0.028)	(0.029)
No Punitive Damages	-0.105*	-0.130*
	(0.044)	(0.046)
Punitive Damages Uninsurable	-0.034	-0.050
	(0.026)	(0.028)
Noneconomic Damages Reform	-0.107*	-0.127*
	(0.029)	(0.030)
Other Reform	-0.141*	-0.164*
	(0.025)	(0.026)
1970s Reform	0.044	0.059*
	(0.026)	(0.027)
Patient Compensation Fund	0.015	0.006
	(0.030)	(0.032)
Log National Premiums	-0.010	-0.002
	(0.006)	(0.006)
Log Number of States	-0.042*	-0.069*
	(0.011)	(0.012)
Log Concentration Ratio	-0.013	0.072
	(0.076)	(0.080)
Log Real Income	0.006	0.018
	(0.013)	(0.014)
Log Treasury Bill Rate	0.062	0.190*
	(0.045)	(0.048)
Lloyds	0.339	0.422
	(0.248)	(0.262)
Mutual	-0.151*	-0.248*
	(0.039)	(0.041)
Reciprocal	-0.121*	-0.119*
	(0.061)	(0.064)
Prior Approval	0.018	0.024
	(0.027)	(0.028)
Constant	0.018	-0.423*
	(0.171)	(0.179)
Adj. R^2	0.124	0.029

* Coefficient is statistically significant at the 95 percent level, two-tailed test.

Table 8
Key Results of Sensitivity Analysis: Losses Incurred Equations
Coefficients and Standard Errors from OLS Regressions

Explanatory Variable	(1a) w/lag	(1b) w/o lag
Panel A: Models 1a and 1b: for years 1987-1991 only (N=4970)		
Punitive Damages Reform	0.013 (0.034)	0.012 (0.035)
No Punitive Damages	-0.088 (0.053)	-0.096* (0.055)
Punitive Damages Uninsurable	-0.092* (0.032)	-0.107* (0.033)
Noneconomic Damages Reform	-0.083* (0.034)	-0.091* (0.035)
Other Reform	-0.030 (0.046)	-0.015 (0.047)
1970s Reform	-0.030 (0.031)	0.041 (0.032)
Panel B: Models 1a and 1b: only firms in states that reformed (N=5418)		
Punitive Damages Reform	-0.047 (0.031)	-0.064* (0.032)
No Punitive Damages	-0.132* (0.050)	-0.141* (0.052)
Punitive Damages Uninsurable	-0.108* (0.032)	-0.118* (0.034)
Noneconomic Damages Reform	-0.114* (0.031)	-0.124* (0.033)
Other Reform	-0.116 (0.088)	-0.096 (0.093)
1970s Reform	-0.007 (0.029)	0.004 (0.031)

* Coefficient is statistically significant at the 95 percent level, two-tailed test.