THE FREQUENCY AND SEVERITY OF MEDICAL MALPRACTICE CLAIMS*

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I. INTRODUCTION

THE early seventies witnessed a rapid increase in the frequency and severity of medical malpractice claims.[1] In California, for example, both frequency and severity increased at an average rate of almost 20 percent per annum, cumulating to yield an increase in total claim costs per physician of roughly 40 percent per annum.[2] As striking as the growth over time is the variation among states. For example, in 1976 there was an 18-fold range in malpractice claim frequency, per capita or per physician, and a 30-fold range in severity.

At the time of the 1975 medical malpractice "crisis," the explosion of claims was attributed to many factors, including growth in the number and complexity of medical treatments; pro-plaintiff trends in common law in general, and in particular the demise of traditional malpractice defenses such as charitable immunity and the locality rule; an increase in the number of lawyers and passage of no-fault automobile legislation in some states; and such intangible factors as the erosion of physician-patient relationships.

In response to the crisis, tort "reforms" were enacted in most states during 1975 and 1976. These measures vary in detail from state to state, but their common purpose is to control claim costs by limiting the size of

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[1] "Severity" is average dollar indemnity, per paid claim, including court awards and payments in out-of-court settlement.

[2] Patricia Munch, Causes of the Medical Malpractice Insurance Crisis: Risks and Regulation, in The Economics of Medical Malpractice 125 (Simon Rottenberg ed. 1978).

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awards and the scope of liability of medical providers. After 1976, average claim frequency countrywide actually fell, but severity continued to outpace the rate of inflation. To what extent the downturn in frequency was the result of tort reforms remains an open question. However, other branches of tort law—notably product liability—have experienced trends in litigation similar to, if less extreme than, those in medical malpractice. This suggests that the determinants of malpractice litigation may lie beyond factors specific to medical care and malpractice law.

The purpose of this paper is to provide some empirical evidence on the contribution of these various factors to the diversity across states and changes over time in the frequency and severity of malpractice claims. Specifically, I attempt to measure the effect of medical and demographic characteristics, trends in litigation in other lines, and changes in common and statutory law, using data on claims closed in 1970 and 1975–78. To the extent variation in claims is due to variation in the frequency and type of medical treatments, tort reforms may be inappropriate and ineffective. On the other hand, if variation in claims is due primarily to variation in incentives created by the legal system, then tort reforms which reduce these incentives will reduce claim costs. The optimal design of such tort reforms in the context of the overall role of the liability system is a crucial issue beyond the scope of this paper. However, a brief positive analysis of the determinants of the post-1975 tort reforms is presented.

The remainder of this introductory section compares countrywide trends in medical malpractice and other lines and presents some summary statistics on differences among states and trends over time in malpractice claims. Section II presents a simple model of the determinants of frequency and severity of claims. Section III describes the data and methods of estimation. Section IV reports the empirical analysis of frequency of claims per capita, severity per claim, and claim cost per capita. Section V analyzes the determinants of the post-1975 tort reforms. Section VI summarizes the findings.

Countrywide Comparison across Lines

Figures 1 and 2 plot indices of claim frequency and severity in several liability lines, based on data reported by the Insurance Services Office (ISO). These data on claims *incurred*, by policy year, reflect ISO's estimate of the ultimate cost of claims against policies written in a 12-month period, based on claims reported to date and projections derived from past experience.[3] Estimates are therefore less reliable for lines, such as

[3] As the main rating bureau for property-casualty insurance, ISO collects data from member companies, adjusted for trends, and publishes advisory premium rates. The number of companies reporting their loss experience to ISO varies by line and by state. Although

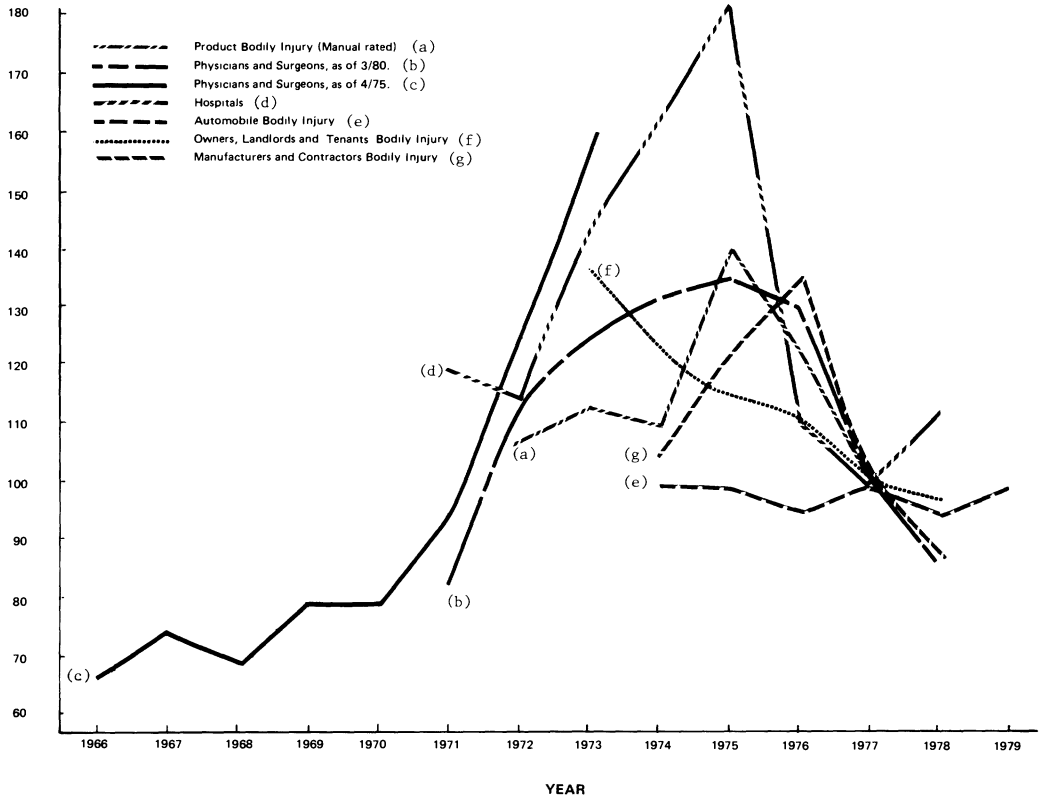

FIGURE 1.—Frequency of claims 1977 = 100

medical malpractice and product liability, with relatively long lags in filing and disposition of claims; in more immature (recent) policy years; for severity than for frequency, because of the lag in disposition; and in times of rapid change, because projections are based on past experience.

Frequency of claims against physicians and hospitals shows a sharp peak in the mid-seventies, which is mirrored to some extent by other lines, notably product liability and owners', landlords', and tenants' liability. The discrepancy between the two series for physicians—the first

these data are neither random nor comprehensive, they are probably reasonably representative of trends. Claims incurred, by policy year, include claims closed, claims reported but still open and an estimate of claims not yet filed ("incurred but not reported"), against all policies starting in a particular calendar year. Compared to claims closed, by calendar year, which are used in the subsequent analysis in this paper, incurred claims should reflect changes in filings more rapidly.

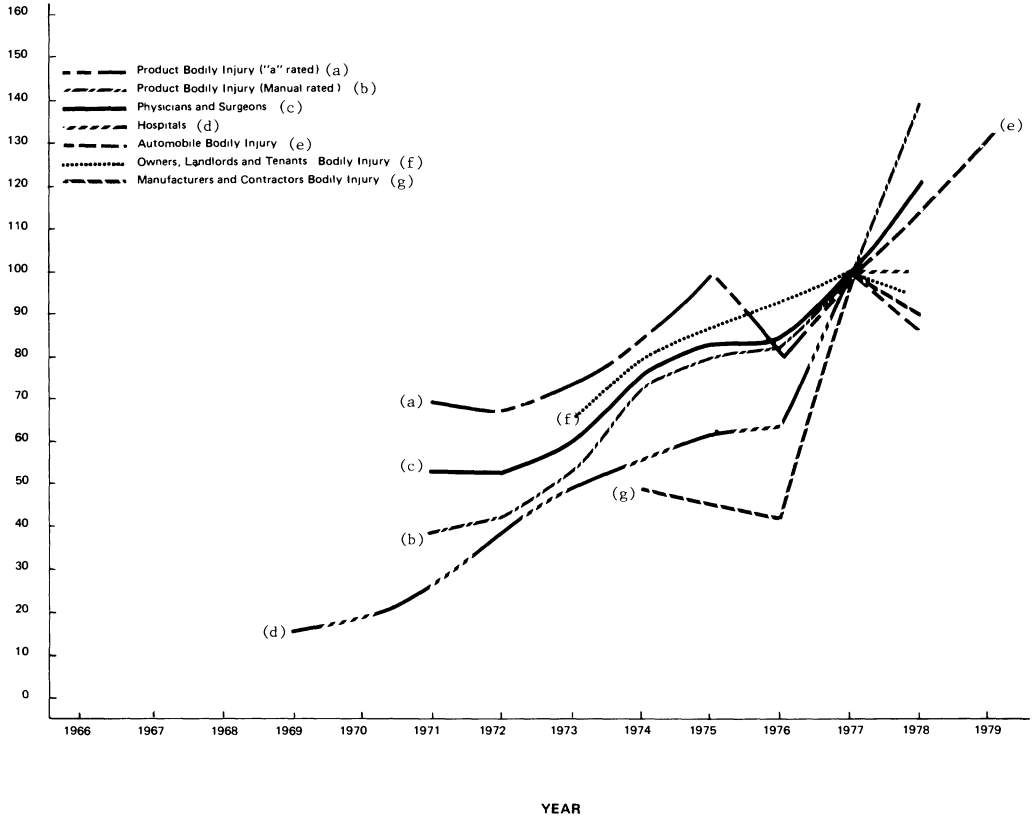

FIGURE 2.—Claim severity (total limits) 1977 = 100

reflecting information available as of April 1975, the second as of March 1980—reflects the unanticipated decrease in the latter half of the decade.

For all lines, severity has outpaced the general rate of inflation. Between 1971–78, the severity trend of 12.4 percent per annum for physicians and 18.9 percent for hospitals is comparable to the 19.4 percent and 12.1 percent for product liability bodily injury and physical damage, respectively, and 14.1 percent and 15.6 percent for automobile bodily injury and physical damage.[4]

[4] The increase in average severity tends to overstate the increase in severity for a given injury, if the decline in frequency reflects an elimination of minor claims. The average lag from filing to disposition increased from eighteen months for malpractice claims closed in 1975 to twenty-five months for claims closed in 1978. This may reflect a reduction in the filing of minor claims, which close relatively quickly, and/or longer lags in disposition, possibly due to the uncertainty created by the changes in law.

Medical Malpractice: Comparison across States

Table 1 reports summary statistics on trends in the frequency and severity of malpractice claims *closed* by calendar year.[5] The unit of observation is the mean for each state.

Between 1970 and 1975 the median rate of growth of claims closed per 100,000 population was 29 percent per annum.[6] Between 1975 and 1977 frequency fell and then leveled off in 1978. Year-to-year changes were highly erratic across states, but in general states starting at a relatively low level grew more rapidly, such that the range between the most and least litigious states narrowed, from 3.3 to 44.4 claims per 100,000 in 1975, to 1.4 to 17.4 in 1978.[7]

Between 1975 and 1978, the median rate of increase of severity is 30 percent, while the mean exceeds 60 percent, reflecting the impact of a few states with dramatic changes. This mean of the state means grew more rapidly than the countrywide mean, because the majority of small states grew more rapidly than the few states which account for most of the claims. Year-to-year changes are even more volatile for severity than for frequency, ranging from -90 percent to $+1{,}000$ percent, reflecting the small number of claims in some states and the huge potential range of awards.[8] As in the case of frequency, severity grew most rapidly in states where the initial level was low.

In general, the spread between the minimum and the twenty-fifth percentile is much smaller than the spread between the seventy-fifth percentile and the maximum, indicating highly skewed distributions, with a few states having much more adverse experience than the majority.

II. Theoretical Analysis of Claim Frequency and Severity

The relationships of major economic and policy interest—the deterrent effect of tort sanctions on quality of care and the determinants of incentives to file a claim—cannot be estimated directly because there are no

[5] Claims closed in a given calendar year include claims filed in several prior calendar years.

[6] The data underlying these estimates are described below. The growth rate between 1970 and 1975 reported in Table 1 is probably upward biased because the 1970 sample is incomplete, by as much as 30 percent. For 1975–78 claim counts in some years for some states may be incomplete. Since data were only collected for July–December 1975, the estimate used here for 1975 frequency is twice this six-month count.

[7] Washington, D.C., is an extreme outlier in 1975, with claim frequency twice that of the second ranked state, California. Correlation coefficients between year-to-year growth rates and level in the initial year range from $-.2$ to $-.4$ for frequency, and $-.3$ to $-.5$ for severity.

[8] In 1976, thirty-five states had fewer than 100 paid claims.

TABLE 1
MEDICAL MALPRACTICE FREQUENCY AND SEVERITY: STATE MEANS, LEVELS, AND GROWTH RATES

	Mean	Median	25th Percentile	75th Percentile	Minimum	Maximum
Claims per 100,000 population						
1970*	2.76	2.56	1.99	3.27	.35	8.86
1975	10.04	8.98	6.42	12.14	3.34	44.38
1976	7.17	6.47	4.78	8.39	1.24	21.99
1977	6.09	5.81	3.92	7.52	1.72	13.76
1978	6.23	5.81	3.96	7.89	1.40	17.44
Growth rate:†						
75 ÷ 70‡	33.2	28.7	20.8	38.4	8.1	79.7
76 ÷ 75	−26.3	−27.4	−42.6	−8.7	−70.8	31.1
77 ÷ 76	−8.9	−9.3	−21.3	3.3	−57.6	121.0
78 ÷ 77	7.8	2.0	−15.0	26.2	−59.5	124.4
Paid claims per 100,000:						
1975	3.64	3.10	2.12	4.58	.96	18.59
1976	2.81	2.67	1.73	3.62	.37	8.16
1977	2.51	2.37	1.47	3.26	.43	6.18
1978	2.68	2.37	1.51	3.44	.52	6.57
Severity ($)						
1975	19,793	16,719	11,186	25,429	2,789	62,120
1976	24,505	21,612	14,640	29,643	3,427	89,147
1977	29,945	25,335	19,525	39,101	3,816	102,317
1978	36,766	32,550	16,961	49,096	5,267	160,161
Growth rate						
76 ÷ 75	67.4	33.8	−12.2	83.3	−92.6	575.0
77 ÷ 76	60.8	33.6	−23.5	78.0	−75.0	1,053.0
78 ÷ 77	67.9	25.0	−30.6	76.5	−80.0	1,534.0

* 1970 sample incomplete.
† Growth rate = $[(\text{claims}_t/\text{claim}_{t-1}) - 1] \times 100$.
‡ $[(\text{claims}_{75}/\text{claims}_{70})^{1/5} - 1] \times 100$.

data on injuries and claims *filed*. The only data are claims *closed*, which reflect injuries indirectly and claims filed with a lag. This section outlines the structural model underlying the reduced-form equations which are estimated from these closed claim data. The frequency of claims closed per capita, the severity per paid claim and changes in statutory law are viewed as a simultaneously determined system of equations.

Overview of the Model

Frequency of Claims. In order to establish a claim for medical malpractice, a plaintiff must show that he sustained damages during the course of medical treatment; that the treatment violated the standard of due care; and that the injury was causally related to the negligent treatment. The frequency of claims filed therefore depends on the frequency of injury, the standard of care, and the incentives to file.

Exposure to iatrogenic injury (adverse outcomes related to medical care) in any period depends on the frequency of medical treatments, although a strictly proportional relationship is not expected, since the mix of treatments changes with the quantity. The actual frequency of injuries depends on the normal risk of the procedures performed and on the incentives of medical providers to practice with care, which incentives in turn depend on expected sanctions through the tort system, if negligent.[9]

Given the flow of injuries, the stock of potential claims at any point depends on the standard of care being applied by the courts and the statute of limitations. Although in general the standard of due care is defined by the customary practice of the profession, the courts have expanded the scope of liability of medical providers in recent years by rejecting traditional defenses and recognizing new grounds for action. For example, abolition of the locality rule substitutes a statewide or national standard for a local standard of acceptable practice; the abolition of charitable and government immunity has exposed voluntary and government hospitals to suit; the doctrine of respondeat superior extends the liability of hospitals for the actions of their employees; the doctrine of informed consent set new standards for disclosure of risk. Courts have also occasionally asserted the right to override medical custom and apply a cost-benefit calculus to individual cases.[10]

[9] The word "injuries" denotes all adverse medical outcomes, including those attributable to negligent care and those within the normal risk of acceptable care. A study of iatrogenic injuries in twenty-three California hospitals estimated that 17 percent were potentially actionable under the negligence system. California Medical Association and California Hospital Association, Report on the Medical Insurance Feasibility Study (1977).

[10] Helling v. Carey, 83 Wash. 2d. 514, 519 P.2d 981 (1974).

Changes in legal rules that reduce costs or increase the payoff to suit tend to increase the stock of potential claims. Changes which expand the scope of liability have a similar effect, to the extent the changes are applied retroactively. Incidents previously considered not worth filing or within normal risk become potentially actionable under the new standards. The increment to the stock of potential claims depends on the statute of limitations, which determines how many years of prior practice may be affected by current changes.[11]

Incentives to file from the stock of potential claims depend on the expected payoff to filing, net of costs. The expected payoff is the product of the probability of winning, which depends on the standard of care applied by the courts, and the expected award, which depends on the damages incurred and the law defining compensation (see below). The costs of filing a claim are determined by the wage rate of attorneys, the opportunity cost of the plaintiff's time, and the expected (optimized) input of effort, which depends on the rules of procedure and evidence. Recent rule changes which have effectively reduced plaintiffs' litigation costs include abolition or modification of the locality rule;[12] allowing medical texts as evidence of customary practice, and expansion of the doctrine of res ipsa loquitur, which shifts the burden of proof to the defendant. In an attempt to contain this trend, since 1975 many states have reinstated some form of locality rule and limited the application of res ipsa. Other states have introduced arbitration or pretrial screening panels, which may lower costs and hence raise the net payoff to filing.[13]

The frequency of claims closed in any year reflects the rate of filings in several prior years and the lag in disposition, which may exceed ten years but averages around two years.

Average Severity. The *potential* award per paid claim (potential se-

[11] Even with static standards, the long-run equilibrium frequency of actionable injuries could be nonzero for several reasons. First, if physicians pay less than the full cost of negligent injuries, because some injured patients do not sue or because liability insurance premiums are not experience rated, then incentives are insufficient to eliminate all negligence. Very crude estimates suggest that at most one in ten potentially actionable injuries give rise to a claim. Second, if the courts set standards above the efficient level, it is cheaper for a physician to pay damages than to comply. Third, if standards are set at the efficient level for the average physician, it may be cheaper for the below average physician to pay damages than comply. The contribution of these factors to claim frequency cannot be tested with the data available.

[12] If local physicians are unwilling to testify against each other—the alleged "conspiracy of silence"—abolition of the locality rule reduces the cost to the plaintiff of obtaining expert testimony.

[13] The net effect of these alternative forums is highly uncertain a priori, since they may change expected recoveries as well as costs. See Patricia A. Ebener, with the assistance of Jane Wilson-Adler, Molly Selvin, & Michael S. Yesley, Court Efforts to Reduce Pretrial Delay, Institute for Civil Justice, R-2732-1CJ, Rand Corporation (1981).

verity) depends on the "true" damages incurred on claims closed with payment and the valuation of these damages by the courts. For nonfatal claims, "true" damages depend on the severity of the injury, the plaintiff's actual or potential wage level, and his life expectancy. Rules of compensable damages determine the valuation of these damages by the courts. The trend over time at common law has been to extend the categories of compensable damages from tangible "economic loss" (forgone wages and medical expense) to less tangible items, such as loss of consortium and pain and suffering. Since 1975, many states have modified basic tort damage rules for cases of medical malpractice by such measures as: dollar ceilings, either on the total award or on some component; modification of the collateral source rule, to admit evidence and, in some states, mandate offset of compensation from other sources against the tort recovery; elimination of the plaintiff's ad damnum (the dollar amount claimed as damages); and periodic payment of future damages.

The predicted effects of explanatory variables on *potential* awards do not carry over immediately to *observed* severity per paid claim. For example, let r denote the implicit value per unit of true damages defined by the legal rules governing compensation. Observed average severity per paid claim could rise or fall in response to an increase in r. This is because an increase in r not only raises actual awards on inframarginal claims but also raises the expected net payoff on all potential claims and therefore induces filing of claims with true damages or probability of winning too low to have been worth filing prior to the increase in r. Differences in average severity across states or changes over time understate differences in r to the extent the composition of the claim universe changes in response to a change in r. Observed severity therefore depends on the fraction of claims filed from the potential stock.

Changes in Law. In principle, both common and statutory law are endogenous. They are influenced by some of the same demographic characteristics that affect the frequency and severity of claims, and by the frequency and severity of claims themselves. Only the post-1975 tort reforms are explicitly modeled here. Standard public choice theory predicts that tort reforms would be more comprehensive and/or passed earlier in states which experienced a high level or rate of increase of insurance premiums, in which the medical profession and insurance industry were relatively powerful and the legal profession relatively weak. This is discussed in more detail below.

Structural Model

The analysis of the previous section may be described formally by a system of equations in which the frequency of claims per capita, the

severity per paid claim, and the post-1975 statutory changes in law are simultaneously determined. The following notation is used: K^* = stock of potential claims; K = claims filed per capita; A = average severity per paid claim; F = claims closed per capita; T = total claim cost per capita; L = common-law and statutory rules of liability, evidence, and compensable damages; Y = characteristics of medical providers; Z = characteristics of patient population; X = characteristics of lawyer population; S = term of statute of limitations; Q = quality of medical care; r = compensation per unit of damages; C = litigation costs; D = cost of negligence borne by physicians (deterrent effect); I = flow of iatrogenic injuries; P = malpractice insurance premiums; δ_i = fraction of claims closed in ith year after filing; τ = maximum lag in disposition.

The rate of iatrogenic injury in year t depends on characteristics of the medical provider (Y) and patient (Z) populations, and on the quality of care (Q) which in turn is influenced by the perceived cost of negligence (D) to medical providers:

$$I_t = I[Y_t, Z_t, Q_t(D_t)]. \tag{1}$$

The stock of potential claims in year t is a function of the injury rate in prior years for which the statute of limitations (S) has not yet run, and the standards applied by the courts (L_t):

$$K_t^* = \sum_{i=t}^{t-S} K^*[I_i, L_t]. \tag{2}$$

The frequency of claims filed from the stock of potential claims depends on the expected net payoff, which is determined by legal rules (which affect the probability and cost of proving negligence and define compensable damages), the cost of legal services, and demographic factors which affect true damages and plaintiff time costs:

$$K_t = K[K_t^*, r(L_t), C(L_t), X_t, Z_t]. \tag{3}$$

Frequency of claims closed in year t, F_t, is some fraction, δ, of claims filed in several prior years, depending on delays in disposition:

$$F_t = \sum_{i=t}^{t-\tau} \delta_i K_i \tag{4}$$

or, in reduced form,

$$F_t = F[Y, Z, D, L, X], \tag{4'}$$

where τ, the maximum lag in disposition, may exceed ten years.[14] Thus coefficients of demographic characteristics in the reduced form claim frequency equation compound effects from the structural equations for injuries and incentives to file. In particular, old people have higher exposure to medical treatment and higher risk of injury but lower time costs and lower expected payoff to filing. Income is positively related to the frequency and complexity of medical treatments, compensable damages, and the time costs of filing. Thus the net effects of age and income on claim frequency are ambiguous a priori.

Potential severity depends on the types of injuries and hence, indirectly, on medical characteristics. Potential severity is positively related to number of medical treatments per capita if marginal visits are for more minor ailments, and positively related to surgery rates if surgical procedures typically involve more severe injuries. Potential severity is negatively related to the proportion of elderly people and positively related to per capita income; negatively related to tort reforms which reduce compensation per unit damages, $r(L)$; and positively (negatively) related to the cost and hence the input of legal services, if the marginal return to additional legal effort falls less (more) for the plaintiff than the defense. These implications for potential severity should apply to observed severity controlling for the fraction of claims filed from the potential stock, which may be approximated by claim frequency:

$$A_t = A[I, Z, r(L), F] \tag{5}$$

or, in reduced form,

$$A_t = A[Y, D, Z, X, L]. \tag{5'}$$

Total claim cost per capita is simply the product of frequency and severity and therefore depends on the same variables:

$$T_t = T[Y, D, Z, X, L]. \tag{6}$$

The propensity to enact tort reforms early and/or be more restrictive of plaintiff interests depends on frequency and severity of claims in 1975, the level of malpractice insurance premiums, and on medical, legal, and demographic characteristics:[15]

$$L_{75} = L(F_{75}, A_{75}, P_{75}, Y_{75}, Z_{75}, X_{75}). \tag{7}$$

[14] Strictly, the δ_t should be treated as endogenous, but the data available do not permit identification. Year subscripts are dropped where the value of a variable over several years is relevant.

[15] The 1974 values of explanatory variables would be more appropriate but 1975 is the earliest year for which claim and premium data are available.

The equations to be estimated are the reduced-form equations for frequency of claims closed (4′), average severity per paid claim (5′), total claim cost (6), and 1975 tort reform (7).

III. Data and Methodology

Data

The data on claims were drawn from two surveys of claims closed by insurance companies in 1970 and 1975–78. The 1970 survey is a weighted random sample of claims closed by 26 insurers that accounted for 90 percent of the market. Because the number of paid claims is very small in some states, severity is not calculated for 1970. The 1975–78 survey covered all insurers writing malpractice premiums of $1 million or more in any year since 1970.[16] Claims against multiple defendants arising from the same incident have been consolidated. These data on claims closed reflect claims filed on average two years earlier.

Data on common law doctrines adopted prior to 1970 are from a survey reported in Dietz, Baird, and Berul.[17] A dummy variable (1970 LAWS) which takes values 0–4 measures the number of the following doctrines recognized: abolition of the locality rule, informed consent, abolition of charitable immunity, and respondeat superior. Data on the statute of limitations, before and after any changes, and on other post-1975 tort reforms, were compiled by a survey of the relevant statutes. Each law is measured as the number of months prior to December 1978 during which the law was in effect. Thus these values range from zero, if a law was never passed, to 48 if a law was passed in January 1975. The pre- and post-1975 statutes of limitations are measured in years for filing for adults. If there is a discovery rule with no outer limit, the statute of limitations is arbitrarily assigned a value of 10.[18] Appendix A lists the statutes and common-law doctrines used in this analysis.

Malpractice insurance costs are measured by two variables: the rate

[16] The 1970 survey is described in Westat, Inc., Study of Medical Malpractice Claims Closed in 1970 (1973). The 1975–78 survey is described in National Association of Insurance Commissioners (NAIC), 2 Malpractice Claims (September 1980). A dummy variable identifying states with known underreporting was not significant in the regressions. In both surveys, claims against physicians are probably more fully represented than claims against hospitals because of hospital self-insurance.

[17] Stephen Dietz, C. Bruce Baird, & Lawrence Berul, "The Medical Malpractice Legal System," in Appendix to the Report of the Secretary's Commission on Medical Malpractice 73–89, DHEW No. (OS) (1973).

[18] Many states have exceptions to the basic statute for cases involving minors or fraud and concealment by the physician. A discovery rule tolls the running of the statute until the injury is, or "with reasonable diligence" should have been, discovered. A dummy variable for states with a discovery rule was not significant.

filed by ISO for general practitioners, for basic limits of coverage, effective March 1975; and the percentage increase recommended by ISO in April 1975.[19]

Data on demographic and medical characteristics were obtained from several sources. Where possible, values as of two years prior to the year of the dependent variable are used, corresponding to the average lag in disposition of claims. All variables are listed in Table 2, together with means, standard deviations, and sources.

Methodology

System Issues. The data consist of four annual cross-sections (five for claim frequency). Serial correlation of residuals is expected, especially for claim frequency where the lag in closing claims induces strong correlation across years. In addition to within-state serial correlation, contemporaneous correlation across states in each year is likely. To allow for an unconstrained autoregressive process with endogenous explanatory variables, I use generalized least squares (GLS) or three stage least squares (3SLS) applied to the pooled cross-sections.[20] The estimated covariances across years are large for adjacent years but decline over time.[21] To allow for contemporaneous correlation, the intercept for each year is free to vary.

In principle, a predicted value of frequency should be included in the severity equation and a lagged predicted value of severity might be included in the frequency equation, as an indicator of r. In practice, when these predicted values were included, all coefficients became insignificant. The equations were therefore estimated in reduced form, omitting predicted values but including explanatory variables from the other equa-

[19] Since ISO specialty and excess limits differentials are uniform across states, the ISO basic rate is a pure index of ISO state differentials. However, since ISO rates are used only for a small fraction of the market, they are an imperfect index of premiums actually paid. Buddy Steves & Archer McWhorter, Jr., Notes on the Malpractice Insurance Market, 28 Chartered Property & Casualty Underwriters (CPCU) Annals (1975). As a more accurate measure of premiums actually paid, I constructed a measure of state relativities based on a survey of premiums paid by a nationwide sample of physicians in 1975. The survey and data are described in Nancy T. Greenspan, A Descriptive Analysis of Medical Malpractice Insurance Premiums, 1974–77, 1, no. 2 Health Care Financing Rev. 69 (1979). The determinants of premium levels are analyzed in Patricia Munch Danzon, Why Are Malpractice Premiums So High—or So Low? (R-2623-HCFA, Rand Corporation 1980). This premium measure had lower explanatory power than the ISO variables.

[20] Estimation from first differences was unsuccessful, possibly because there is little variation in some of the independent variables over the short span of years in the sample, and because the autoregressive process is complex.

[21] The pattern is not sufficiently stable to justify imposing a structure on the covariance matrix.

TABLE 2
MEAN, STANDARD DEVIATION, DEFINITION, AND SOURCE OF ALL VARIABLES

Variable	Mean	Standard Deviation	Definition	Source
% urban	66.8	15.1	% population in places ≥ 25,000 population in 1970	Statistical Abstracts
% old	.102	.018	% population over 65	Statistical Abstracts
MDs per capita	1.21	.412	Total nonfederal physicians in patient care, per 100,000 population	AMA, Physician Distribution and Medical Licensure in the U.S.
1970 LAWS	2.48	.789	No. of doctrines applied by 1970: locality rule expanded or rejected; charitable immunity rejected; respondeat applied; informed consent applied	Dietz, Baird & Berul, *supra* note 17
1970 stat lim	7.76	3.55	Statute of limitations for adults, pre 1975; = 10 if unrestricted discovery period	David W. Louisell & Harold Williams, Medical Malpractice (1973 & supps.).
OLT severity	7.80	.284	Severity per paid claim, owners, landlords and tenants, bodily injury liability · log	Insurance Services Office
No fault	.32	.47	= 1 if state adopted no fault automobile; = 0 otherwise	
1975 stat lim	3.52	3.54	Statute of limitations for adults, after post-1975 changes, if any; = 10 if unlimited discovery	Louisell & Williams
Ad damnum	18.14	17.22	Ad damnum eliminated; months pre Dec. 1978	Statutes
CAP	10.22	16.00	Cap on awards; months pre Dec. 1978	Statutes
Collateral source	5.36	13.52	Mandatory offset of collateral compensation; months pre Dec. 1978	Statutes
Fee limit	12.22	17.11	Limit on contingent fees; months pre Dec. 1978	Statutes
Share	64.60	13.21	Market share of leading insurer, 1974	Steves & McWhorter, *supra* note 19
% medical society	.601	.128	% physicians belonging to state or local medical society, 1975	AMA
1975 ISO rate	5.73	1.79	ISO rate for class 1 physicians, as of March 1975. Log.	ISO
ISO increase	1.45	1.15	% rate of increase recommended by ISO, April 1975	ISO
1970 consent	.48	.50	= 1 if informed consent applied by 1970 = 0 otherwise	Dietz, Baird & Berul
1970 respondeat	.66	.49	= 1 if respondeat superior applied by 1970 = 0 otherwise	Dietz, Baird & Berul
Lawyers per capita	1.83	1.62	Lawyers per 100,000 population	ABA membership report
%ABA	58.67	10.36	% of lawyers belonging to American Bar Association	ABA membership report

tion. To show net effects of explanatory variables, equations for total claim cost per capita are also reported.[22]

Functional Form. Logarithmic transformations of the two dollar-dependent variables, severity per claim, and claim cost per capita are used for theoretical and empirical reasons. If the effects of random shocks and changes in law are multiplicative rather than additive, then the log transformation is appropriate. Empirically, severity per claim and claim cost per capita are approximately log normally distributed.[23] For the frequency of claims per capita, a logistic transformation is used. This yields a closer approximation to a normal distribution than either claims per capita or the log of claims per capita.[24]

Weighting. Because each observation represents grouped data, weighting to account for heteroscedasticity seems appropriate, but without prior knowledge of the error structure, the choice of weighting system entails judgment. For severity per claim and claim cost per capita, each observation is weighted by the number of observations in the underlying sample: number of paid claims and population in the state, respectively.[25] For the frequency of claims per capita, the weights are related to but not strictly proportional to the state population, following a formula proposed by Amemiya and Nold.[26] The influence of weighting on estimates for frequency are discussed below and in Appendix B.

[22] Coefficients in the (log) total claim cost equation are not expected to be precisely the sum of coefficients in the frequency and severity equations because the logit rather than the log transformation of frequency is used and because different weights were used for the frequency and severity equations.

[23] The estimation techniques presuppose that the residuals are normally distributed. Normality of the dependent variable is a rough guide to the normality of the residuals.

[24] Because claims are measured per 100,000 population, the logit formulation is only approximately correct. Since claims per 100,000 is near zero, the error is very small.

[25] Since four years of data are pooled but sample size is relatively constant across years for each state, the weight used is the average of the four individual year weights.

[26] Let n_{it} be the population of state i in year t, and for $k = 1, \ldots, n_{it}$, let Y_{it} be a binary random variable representing the closing of a claim by the kth person, which takes the value of one with probability,

$$P_{it} = \frac{1}{1 + e - (\beta X_{it} + v_{it})}$$

where $v_{it} \sim (0, \sigma_t^2)$. Then the logit of claim frequency is

$$f_{it} = \log\left(\frac{F_{it}}{1 - F_{it}}\right) = \beta X_{it} + v_{it} + u_{it} \equiv \beta X_{it} + \epsilon_{it}$$

where

$$F_{it} = \frac{1}{n_{it}} \sum_{k=1}^{n_{it}} Y_{it}^k.$$

The variance of ϵ_{it}, $\sigma_{\epsilon it}^2$, is approximately $\sigma_t^2 + [n_{it}F_{it}(1 - F_{it})]^{-1}$ An estimate of $\sigma_{\epsilon i}^2$, the

IV. Empirical Estimates

Table 3 reports coefficient estimates from pooled, cross-section equations, including medical, demographic, and legal characteristics existing prior to 1975, with all coefficients constrained to be equal in all years. In order to identify the net effects of laws, which are of primary interest but are highly correlated with and may merely reflect demographic variables, the estimates were performed in a stepwise fashion. For each dependent variable (frequency, severity, and total claim cost) three specifications are reported. The first includes only medical and demographic factors (physicians per capita, population over sixty-five, and degree of urbanization). The second equation adds characteristics of the legal profession intended to measure the supply price of legal services (lawyers per capita and membership in the American Bar Association). The third adds specific laws. Table 4 reports implied elasticities from the third equation. The post-1975 tort reforms were then added. Table 5 reports constrained and unconstrained year-specific coefficients for all law variables.[27]

Medical and Demographic Factors

Medical exposure, as measured by number of physicians per capita, is a significant determinant of claim frequency but not severity. The estimates imply that, at variable means, an increase of 100 physicians per capita adds an additional 3.6 claims per capita, with an elasticity of 0.6. Thus the 40 percent increase in physicians per capita between 1960 and 1978 could account for a 24 percent increase in claims over this period, a small fraction of the total increase. The elasticity less than unity suggests that marginal medical treatments involve less risky procedures.

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average state-specific variance over the period 1975–78, is obtained as follows: Calculate

$$s^2 = \frac{1}{4}\frac{1}{50}\left\{\sum_{t=1}^{4}\sum_{i=1}^{50}(f_{it} - \beta X_{it})^2 - 4\sum_{i=1}^{50}\left[n_i\bar{F}_i(1 - \bar{F}_i)\right]^{-1}\right\},$$

where β is estimated from the unweighted system of four equations, and $\bar{F}_i = \frac{1}{4}\Sigma_{t=1}^{4} F_{it}$. Then $\hat{\sigma}^2_{\epsilon_i} = s^2 + [n_i\bar{F}_i(1 - \bar{F}_i)]^{-1}$ and $w_i = \hat{\sigma}^{-2}_{\epsilon_i}$ is the weight applied to the ith state. This yields weights ranging from 2.48 to 2.99, whereas weights for claim cost per capita (population) range from 20 to 147 and for severity (number of paid claims) range from 2.5 to 34.4. Weights which assign most weight to the few most populous states, tend to yield higher t-statistics, but the main conclusions are not affected by the weighting system used. Takeshi Amemiya & Frederick Nold, A Modified Logit Model, 57 Rev. Econ. & Stat. 255 (1975).

[27] Constraining coefficients to be equal across years effectively quadruples sample size so increases estimation efficiency if the coefficients are equal in all years. In the reduced-form equations of Table 3, coefficients are theoretically not equal for variables which affect claims both directly and indirectly through their effect on tort reforms. However, using an F-test, the hypothesis of equal coefficients could not be rejected.

TABLE 3
MALPRACTICE CLAIM FREQUENCY AND SEVERITY: MEDICAL, DEMOGRAPHIC, AND PRE-1975 LEGAL VARIABLES

	Claim Frequency per 100,000 Pop. Log $\left(\frac{F}{1-F}\right)$			Severity per Claim (Log)			Total Claim Cost per 100,000 (Log)		
% urban	.012	.012	.014	.015	.013	.012	.034	.030	.032
	(3.31)	(3.18)	(3.85)	(3.94)	(3.41)	(3.11)	(5.66)	(5.02)	(5.50)
M.D.'s per capita	.516	.610	.543	.356	.170	.026	.327	.156	.087
	(4.23)	(3.66)	(3.33)	(3.15)	(1.03)	(.16)	(1.45)	(.51)	(.29)
% old	2.99	3.32	.774	1.81	1.25	.391	6.62	5.65	2.59
	(1.32)	(1.42)	(.34)	(.99)	(.70)	(.21)	(1.98)	(1.65)	(.75)
1970 laws	. . .	. . .	.143	. . .	. . .	.069	. . .	. . .	.215
			(2.81)			(1.38)			(2.80)
1970 statute of limitations	. . .	. . .	.011	. . .	. . .	.016	. . .	. . .	.025
			(.98)			(1.59)			(1.44)
OLT severity	. . .	. . .	−.089	. . .	. . .	.163	. . .	. . .	.072
			(1.31)			(1.35)			(.58)
No fault	. . .	. . .	−.143	. . .	. . .	.102	. . .	. . .	.104
			(1.56)			(1.57)			(.85)
Lawyers per capita		−.030	−.024	. . .	.051	.065	. . .	.043	.048
		(.80)	(.62)		(1.20)	(1.59)		(.42)	(.50)
% ABA member		.003	.005	. . .	−.008	−.005	. . .	−.008	−.003
		(.84)	(1.25)		(2.53)	(1.85)		(1.47)	(.65)
R^2	.239	.246	.333	.314	.347	.410	.308	.292	.371

NOTE.—$|t|$ in parentheses. Weighted GLS estimates of equations (4′), (5′), and (6). Coefficients constrained across years 1970, 1975–78 for frequency, 1975–78 otherwise.

TABLE 4
PARTIAL DERIVATIVES AND ELASTICITIES DERIVED FROM TABLES 3 AND 5

	CLAIM FREQUENCY PER 100,000 POPULATION		SEVERITY PER CLAIM		TOTAL CLAIM COST PER 100,000 POPULATION	
EXPLANATORY VARIABLE	Partial $\left(\frac{\partial F}{\partial X}\right)$	Elasticity $\left(\frac{\partial F}{\partial X}\frac{X}{F}\right)$	Partial $\left(\frac{\partial LnA}{\partial X}\right)$	Elasticity $\left(\frac{\partial A}{\partial X}\frac{X}{A}\right)$	Partial $\left(\frac{\partial LnT}{\partial X}\right)$	Elasticity $\left(\frac{\partial T}{\partial X}\frac{X}{T}\right)$
% urban	.0009**	.86**	.012**	.80**	.032**	2.16**
M.D.'s per capita	.036**	.61**	. . .	. . .	. . .	. . .
1970 laws	.330**	.33**	.069	.17	.215**	.53**
1970 statute of limitations	. . .	. . .	.016	.12	.025	.19
No fault	−.0096	−.043	.102	.03	. . .	. . .
Informed consent	.018**	.121**	.102	.05	.210*	.10*
Lawyers per capita	. . .	. . .	.065	.12	. . .	. . .
Respondeat superior	. . .	. . .	. . .	. . .	.243*	.16*

* Significant at $P = .10$.
** Significant at $P = .05$.

TABLE 5
YEAR-SPECIFIC EFFECTS OF LAWS ON FREQUENCY (F), SEVERITY (A), AND TOTAL CLAIM COST (T)*

	1970	1975	1976	1977	1978	All Year Constrained†
1970 laws:						
F	.116	.168	.239	.159	.123	.143
	(1.35)	(2.51)	(3.14)	(2.14)	(1.41)	(2.81)
A	. . .	.167	.031	.048	.066	.069
	. . .	(1.72)	(.35)	(.60)	(.92)	(1.38)
T	. . .	.077	.391	.340	.229	.215
	. . .	(.72)	(3.38)	(3.41)	(2.16)	(2.80)
1970 statute of limitations:						
A	. . .	.028	−.025	.013	.035	.016
	. . .	(1.43)	(1.38)	(.79)	(2.47)	(1.59)
T	. . .	.009	.054	.020	.068	.025
	. . .	(.35)	(2.00)	(.89)	(2.77)	(1.44)
No fault:						
F	. . .	−.201	−.06	−.07	.003	−.143
	. . .	(1.81)	(.50)	(.58)	(.02)	(1.56)
A	. . .	.205	.108	−.005	.103	.102
	. . .	(1.74)	(1.66)	(.05)	(1.15)	(1.57)
T	. . .	.114	.128	.036	.130	.104
	. . .	(.68)	(.71)	(.23)	(.77)	(.85)
1970 informed consent						
F	.202	.265	.404	.314	.338	.272
	(1.54)	(2.51)	(3.38)	(2.83)	(2.57)	(3.51)
T	. . .	.132	.560	.340	.246	.210
	. . .	(.80)	(3.11)	(2.07)	(1.48)	(1.75)
1970 respondeat superior						
T	. . .	.225	.378	.278	.305	.243
	. . .	(1.24)	(1.77)	(1.49)	(1.67)	(1.85)
Cap:						
A	. . .	−.008	−.014	−.009	−.001	−.008
	. . .	(1.26)	(2.28)	(1.54)	(.23)	(2.03)
Collateral source:						
A	. . .	−.011	−.035	−.027	−.009	−.021
		(.84)	(2.96)	(2.66)	(.87)	(2.61)
Ad damnum:						
T	. . .	−.088	−.035	−.050	−.048	−.073
	. . .	(3.38)	(1.27)	(1.98)	(1.76)	(3.17)
Fee limit:						
A	. . .	.006	−.020	−.013	.002	−.007
	. . .	(.52)	(1.85)	(1.46)	(.16)	(1.03)
T	. . .	−.013	−.011	−.012	.011	−.016
	. . .	(.77)	(.61)	(.76)	(.60)	(1.21)

* Coefficients from adding law variables to final specification in table 3; $|t|$ in parentheses.
† Coefficients constrained to be equal in all years.

Whether or not particular medical procedures generate disproportionately high claim frequencies is of some policy interest. Unequal probability of suit if negligent distorts the expected cost to physicians of different procedures and hence may distort medical choices and the quality of care. However, separate effects of quantity and complexity or mix of medical treatments could not be identified. Controlling for physician density, explanatory power was not increased by adding full-time equivalent hospital staff per patient day (a measure of labor intensity or quality) or the ratio of hospital cost per day to the average manufacturing wage (a measure of capital intensity). The effect of number of surgeons per capita was not statistically different from the effect of nonsurgical specialists. This evidence casts doubt on Mueller's conclusion that complex hospital facilities generate more claims, and Feldman's that surgery rates are a significant determinant of claims.[28] Neither study controlled for quantity of medical treatments. This is likely to bias upward the estimated effect of the particular type of treatment measured, since quantity and complexity are highly correlated.[29] Mueller's results are also influenced by the use of population weights, which yields estimates dominated by the few most populous states (see Appendix B).

Claim frequency is unrelated to the percentage of the population over sixty-five. Since hospital admission rates of the elderly are roughly twice as high as for persons under sixty-five and the rate of negligent injury per admission is roughly twice as high for the elderly, the absence of any significant difference in claim frequency implies that the probability of filing a claim, given a potentially actionable injury, is roughly one-fourth that of persons under sixty-five, presumably because of lower compensable damages.[30] This evidence suggests the more general conclusion, that claims with small stakes are deterred from filing by the fixed costs of litigation.[31] If so, the tort system will underdeter minor carelessness.

[28] Roger Feldman, The Determinants of Medical Malpractice Incidents: Theory of Contingency Fees and Empirical Evidence, 7, no. 2 Atlantic Econ. J. 59 (1979). Marnie Mueller, The Economics of Medical Malpractice: Claims, Awards and Defensive Medicine, paper presented at Am. Econ. Ass'n meetings (1976).

[29] The correlation between surgical and nonsurgical specialists per capita is 0.85.

[30] CMA, *supra* note 9, reports a rate of iatrogenic injury twice as high for persons over sixty-five, but no difference in the proportion due to negligence. The positive relation between claim frequency and population over sixty-five reported in Mueller, *supra* note 28, is due to the large weight assigned to Florida, which was an outlier in 1970. Either including a dummy variable for Florida or replacing population with Amemiya-Nold weights eliminates the positive coefficient of population over 65. See Appendix B.

[31] It is consistent with the findings in Danzon and Lillard, that small claims are more likely to be dropped without payment and are less likely to be pursued to verdict. Patricia Munch Danzon & Lee A. Lillard, Settlement Out of Court: The Disposition of Medical Malpractice Claims, 12 J. Legal Stud. 345 (1983).

Per capita income has no significant effect on frequency or severity, after controlling for physician and lawyer densities. This suggests that the high simple correlations between income and both frequency and severity are attributable to the medical and legal characteristics associated with high income. Income apparently has little effect on the *net* expected payoff and propensity to sue, possibly because the positive effect of higher compensable damages is offset by the negative effect of high time costs.

A measure of urbanization was included without any specific theoretical justification, although it can be rationalized as a catch-all for such factors as easier access to litigation, greater willingness to sue because of depersonalized physician-patient relationships, and so forth. Controlling for physician density, urbanization is the most significant and, in terms of elasticities, the most powerful predictor of frequency. The elasticity of frequency with respect to the percentage of the state urbanized is .86. In part this may reflect a supply response to the higher verdicts awarded by urban courts: the elasticity of severity with respect to percentage of state urbanized is .80. This understates the difference in compensation per unit of loss (r) if an increase in r induces the filing of more marginal claims which pulls down *observed* average severity. Attempts to identify further the characteristics of urban environments that influence claim frequency and severity were unsuccessful. The urban coefficient is essentially unaffected by including number of lawyers and specific laws. Other variables that proved insignificant and were therefore dropped include: the percentage of the population on welfare, the unemployment rate, and court delay.[32]

As a measure of the deterrent effect of tort sanctions on physicians' behavior, I tried including the level and rate of increase of malpractice insurance premiums. If such deterrence exists, these variables do not capture it.[33]

Price of Legal Services

The number of lawyers per capita was included as a proxy for the cost of legal services. But the finding, that lawyer density has no effect on claim frequency after controlling for physician density and urbanization and is positively related to claim severity, suggests that high lawyer den-

[32] Average time from service of answer to trial in personal injury litigation in federal courts in the major urban areas of the state. Source: Institute for Judicial Administration, Calendar Status Study (1970, 1972, 1974).

[33] The signs were always positive, possibly because any negative deterrent effect was dominated by the reverse, positive effective of frequency on premiums. However, there was also no evidence of a deterrent effect of premiums on the rate of change of claim frequency.

sity does not in fact indicate low cost of legal services.[34] A decline in the cost of legal services is expected to increase the frequency of suits but not necessarily affect severity since optimum legal effort for both plaintiff and defense increases, with offsetting effects on severity. A plausible explanation for the findings is that high lawyer density reflects high demand for legal services and therefore does not imply low cost.[35] Even the low estimated elasticity of severity with respect to number of lawyers (.12) overestimates any net effect of lawyer density on severity, because of endogeneity bias.

At the time of the malpractice crisis, the surge of malpractice litigation was widely blamed on lawyers displaced from automobile litigation by the passage of no-fault laws.[36] This argument would be sound only if the number of displaced lawyers was sufficiently large to depress the supply price of legal services on malpractice cases. It is unpersuasive a priori because most of the automobile tort thresholds were set so low as to constitute little bar to litigation, and it tends to be refuted by the evidence. The constrained estimates show a positive effect of no-fault on malpractice severity but a negative effect on claim frequency, whereas the predicted effects are positive for frequency, and ambiguous for severity, if no-fault did indeed depress attorney wage rates. Even if the coefficients are taken at face value, they imply minimal effects: states that adopted no-fault had an 11 percent higher claim severity, a 13 percent lower claim frequency, with no significant net effect on total claim cost per capita.

If professional associations can raise wage rates by restricting competition, then the percentage of attorneys who are members of the American Bar Association (ABA) should be positively related to attorney wage rates. Contrary to the implications of this hypothesis, claim frequency is unrelated to ABA membership and claim severity is lower in states where ABA membership is high. Thus none of these variables yields a plausible estimate of the supply response of claims to the cost of legal services.

[34] If lawyers per capita and percentage ABA are included alone, the elasticity of frequency with respect to lawyer density is .275 and significant at $P = .05$.

[35] This is consistent with Pashigian's conclusion from time-series analysis of the market for legal services, that increases in the number of lawyers reflect demand rather than exogenous supply shifts. Between 1959 and 1969, the number of lawyers per capita increased, but mean and median annual earnings of lawyers rose relative to those of other salaried male workers. B. Peter Pashigian, The Market for Lawyers: The Determinants of the Demand for and Supply of Lawyers, 20 J. Law & Econ. 53 (1977).

[36] For example, U.S. Senate Committee on Labor and Public Welfare, Subcommittee on Health, Hearings December 3, 1975, Continuing Medical Malpractice Insurance Crisis, at 142.

Pre-1975 Laws

Specific laws were added last to test whether they merely reflect demographic factors or whether they have additional explanatory power.[37] The estimates imply that the four pro-plaintiff common-law doctrines included in the compound variable, 1970 LAWS (abolition of the locality rule and of charitable immunity, admission of informed consent, and respondeat superior) contributed significantly to claim frequency through the mid-1970s. On average over the period 1975–78, states which recognized all four doctrines by 1970 had 53 percent higher claim frequency per capita, 28 percent higher severity, and 86 percent higher total claim cost per capita than states which recognized none. Of the four doctrines, informed consent had the greatest impact.

The effects of these laws on severity are positive but not statistically significant, which on theoretical grounds is not surprising. By expanding the scope of liability, informed consent, abolition of charitable immunity, and application of respondeat superior will induce the filing of claims which would not otherwise have been filed. The mean true damages of claims filed may rise or fall. The possibility of naming hospitals as codefendants on claims against physicians will tend to raise potential awards by raising defense costs.[38] Abolition of the locality rule expands liability and reduces the cost of establishing liability, so it may raise the plantiff's optimum legal effort, hence raising potential awards on all claims but inducing more marginal claims, with an ambiguous net effect on observed severity.

These estimates probably overstate the net causal effect on claims of these specific laws because of correlation with other unmeasured differences in legal doctrine and endogeneity bias; that is, these doctrines may have been adopted in states which, for other reasons, had a relatively high claim frequency. Nevertheless, the hypothesis that the laws had a net positive effect is supported by the pattern of the coefficients over time, and their significance after controlling for variables which might be included as predictors in a full simultaneous model. Table 5, which reports individual year coefficients, shows that the effects peaked in 1976 and declined thereafter. Claims closed in later years would include an increasing number filed after 1970, for which 1970 LAWS is an inaccurate measure of applicable law, since the doctrines became more widespread during the 1970s.

[37] The choice of which variables to consider predetermined is to some extent arbitrary.

[38] Danzon & Lillard, *supra* note 31.

To test whether trends in malpractice litigation merely mirror trends in litigation in general, measures of the frequency and severity of claims for two other lines—owners', landlords', and tenants' (OLT) and manufacturers' and contractors' liability—were included.[39] The correlations were surprisingly low, and only the most significant, OLT severity, is included here. It is positively related to malpractice severity and average claim cost per capita, negatively related to malpractice claim frequency. The negative relation between claim frequency and OLT is consistent with a negative correlation between observed severity and r, because a high r induces marginal claims.

Post-1975 Tort Reforms

These data on claims closed 1975–78 cannot show full long-run effects of reforms enacted 1975–76 because many of the claims would have been filed before the effective dates of the reforms and hence would be unaffected. Nevertheless, if the reforms significantly reduced the expected net payoff to filing, then the number of claims filed, especially claims with low potential recoveries, might be expected to fall immediately. Since minor claims account for a large fraction of the total and settle quickest, a reduction in claims filed could reduce claims closed within a year. Thus, whether the postcrisis tort reforms contributed to the observed reduction in frequency after 1975 is an important empirical question.

Error in measuring the post-1975 tort reforms is inevitable, because of the need to reduce the diverse and complex statutes to a few common dimensions. The laws are measured here as months from the date on which changes became effective. This emphasizes differences between states passing laws early rather than late, and is more accurate if the full impact of a change only appears with a lag because of lags in disposition.[40] Predicted values of the laws are used. The coefficients are expected to increase in magnitude and significance over time as the fraction of claims closed subject to the new laws increases. Table 5 reports individual year coefficients where these approach conventional statistical significance in any year.

Several of the measures designed to reduce awards appear to have had their intended effect. Using the coefficients for the full 1975–78 period (last column) the estimates imply that states enacting a cap effective in

[39] These were the only other liability lines for which data were available by state.

[40] Dummy variables for states ever passing a law yielded estimates similar to those using months, which are reported here.

January 1975 had 19 percent lower awards on average by January 1977.[41] States mandating the offset of compensation from collateral sources in January 1975 had 50 percent lower awards by January 1977, whereas laws admitting evidence of collateral compensation without mandating offset had no significant effect. Elimination of the plaintiff's ad damnum is estimated to have a significantly negative effect on total claim cost, although for frequency or severity individually the effect is not statistically significant. Limits on contingent fees show some sign of reducing severity and total claim costs, but the significance level is low. There is no evidence that the tort reforms contributed to the post-1975 reduction in frequency. Contrary to the expectation that the impact of the reforms would increase over time, the coefficients tend to be largest in 1976. This casts doubt on how much of the observed effect is attributable to the laws per se rather than to changes in attitude that accompanied (and contributed to) changes in the law. If so, the observed effects may be short-lived.

The statute of limitations was expected to be positively related to claim frequency, particularly in times of changing legal standards. The measured effect of the pre-1975 statute of limitations on claim frequency is positive but not statistically significant, whereas the effect on severity is significantly positive.[42] A plausible explanation is that claims filed long after the incident involve above average stakes, because delay increases the costs of filing so eliminates proportionately more minor claims. Because the sample of paid claims is under 100 in many states, one or two very large claims can dominate average severity.[43] The effect on claims closed peaks in 1978, reflecting filings in the peak filing years of 1973–75.

There is no evidence in these data that the post-1975 reductions in statutes of limitations had any effect. However, since these changes will operate with an even longer lag than other tort reforms, less impact is expected to be evident in 1975–78 closures. In fact, there may be an initial perverse effect, if filings are accelerated in response to a shortening of the statute.

Regressions not reported here failed to show any significant effect on claim frequency or severity of any of the following post-1975 laws: voluntary or mandatory pretrial screening panels; arbitration; restrictions on

[41] $.008 \times 24 = .192$. Obviously this effect does not accumulate indefinitely. Individual year coefficients may be insignificant because of small sample size.

[42] Measurement of the statute of limitations is inaccurate to the extent courts in fact recognize a discovery rule even in states where no such rule is enacted in statute.

[43] The dominating influence of large claims is illustrated by the fact that 3 percent of claims account for 50 percent of total dollars paid.

informed consent; restrictions on the use of res ipsa; periodic payment of future damages.

Because of data limitations, these are rough estimates of short-run effects, especially for changes in the statute of limitations. Nevertheless, it is reasonably safe to conclude that while the laws limiting awards have had an immediate effect on severity, neither these nor the other tort reforms can explain the dramatic post-1975 drop in frequency.

V. Determinants of the Post-1975 Tort Reforms

In response to the 1975 crisis, legislatures in every state adopted some program of tort reforms, which vary in number, stringency, and timing. Here I consider four measures: an aggregate of the total number out of twelve possible laws which were passed, each weighted by the number of months in effect;[44] limits on contingent fees; the reduction in the statute of limitations; and the number of years of the new statute of limitations.

The medical profession has an obvious stake in reducing the mean and variance of claim costs. If premiums are unregulated, the insurance industry has an interest in reducing the variance but not necessarily the mean of claim costs, since the demand for insurance may rise as expected losses increase. However, by 1975 insurance rate increases were being denied by regulators in many states. The legal profession is expected to oppose legislation designed to reduce frequency and size of claims or bypass judicial forums. Following standard public choice theory, I hypothesize that the power of a lobby is positively related to the number of its members, negatively related to the costs of organization. The numerical strength and organization costs of the medical profession are measured by physician density per capita and the percentage of physicians in the state who belonged to the state or local medical society in 1974. Lawyer density per capita measures the numerical strength of the legal profession. The number of insurers active in the state is not known precisely, but as a rough proxy I include the market share of the leading writer in 1974.

The incentive of physicians to lobby for legislation is expected to be positively related to the absolute level and percentage increase of insurance premiums in 1975. I hypothesize that public support of tort reform would be stronger, the more severe the crisis, as measured by the frequency and severity of claims in 1975. I also include the number of pro-plaintiff common-law doctrines recognized, to test whether rulemaking

[44] 1975 LAWS $= \Sigma_{j=1}^{12} M_j$, where M_j = months prior to December 1978 that the jth law was in effect. The twelve laws are listed in Table A2.

through the common law and the statutory law processes are substitutes or complements.

Table 6 reports the results. Three equations are reported for two of the dependent variables, each including a different measure of the severity of the crisis: the 1975 level and proposed increase in insurance premiums, the actual frequency of claims closed in 1975 and the predicted frequency.[45]

The size and cohesiveness of the medical profession apparently had little impact on the total number/early enactment of tort reforms. The early passage of a limit on contingent fees was more likely in states with high physician density and a large proportion of physicians belonging to a local medical society, but these effects are not highly significant. The number of lawyers has the expected effect: high density of lawyers per capita tends to reduce the number of reforms enacted and, in particular, to reduce the probability of a limit on contingent fees.

The expected sign of the share of the insurance market written by the largest carrier is ambiguous a priori: high concentration implies few firms but a larger stake per firm and lower organization costs. In fact, the number of laws passed is significantly negatively related to the dominant firm's market share, which suggests that the number of insurers with a stake in the market contributed to the number and promptness of tort reform. But if this interpretation is correct, the absence of any significant effect on the statute of limitations is surprising, since a long statute of limitations is a major source of risk to insurers.

Urbanized states tended to adopt more numerous and early reforms, reduce their statutes of limitations by a greater amount, and adopt absolutely shorter statutes. States with relatively pro-plaintiff common law made more numerous/early changes in statutory law, including limits on contingent fees. Since these tort reforms tend to restrict plaintiff rights, this suggests significant differences in the relative power of the various interest groups in influencing common and statutory law.

All of the measures of the extent of crisis—level and proposed increase in insurance premiums, frequency or severity of claims—appear to have had only a weak effect on the extent of tort reform. Of the various measures tried, the proposed premium increase in 1975 has the greatest explanatory power. This is not surprising. In the long run, high premiums can be passed through in higher fees for medical services, but in the short run fees are sticky due to reimbursement practices of third-party payers.

[45] Because of the lag between filing and closing claims, frequency of claims closed in 1975 may be viewed as predetermined. Predicted values of severity were not significant.

TABLE 6
DETERMINANTS OF POST-1975 TORT REFORMS

	Number of Laws (1975 Laws)			Limit on Contingent Fees			Post-1975 Statute of Limitations	Change in Statute of Limitations
M.D.'s per capita	−.310	−1.348	4.559	18.290	14.236	27.003	4.177	−4.111
	(.04)	(.18)	(.51)	(1.29)	(.94)	(1.51)	(1.34)	(.09)
1970 laws	3.151	2.763	3.541	9.549	8.522	10.208	.337	−.930
	(2.21)	(1.84)	(2.14)	(3.34)	(2.87)	(3.09)	(.53)	(1.05)
% urban	.217	.159	.174	.110	.001	.003	−.174	.176
	(2.23)	(1.64)	(1.70)	(.566)	(.001)	(.16)	(4.04)	(2.92)
% medical society	.085	−1.399	5.367	23.529	19.151	33.778	−5.061	9.916
	(.01)	(.12)	(.41)	(1.05)	(.82)	(1.29)	(1.02)	(1.44)
1975 premium	.469	. . .	. . .	1.184	. . .	. . .	.465	−.699
	(.78)			(.98)			(1.74)	(1.87)
ISO increase	1.714	. . .	. . .	2.852	. . .	. . .	−.442	.022
	(1.78)			(1.47)			(1.04)	(.04)
Share	−.236	−.206	−.223	−.199	−.139	−.174	−.002	.006
	(2.88)	(2.46)	(2.51)	(1.21)	(.84)	(.99)	(.06)	(.12)
Lawyers per capita	−1.502	−2.358	−1.35	−4.869	−6.725	−4.544	−1.07	−.277
	(1.07)	(1.56)	(.80)	(1.73)	(2.25)	(1.34)	(.17)	(.32)
1975 actual claims per capita	. . .	38.755	. . .	. . .	94.593	. . .	. . .	. . .
		(1.14)			(1.40)			
1975 predicted claims per capita	. . .	. . .	−33.046	. . .	. . .	−60.940	. . .	. . .
			(.57)			(.53)		
C	3.254	11.141	3.245	−44.963	−26.488	−43.557	13.769	−9.867
	(.28)	(.92)	(.24)	(1.91)	(1.10)	(1.58)	(2.65)	(1.36)
R^2	.395	.350	.318	.389	.362	.319	.365	.310

Thus a large sudden premium increase imposes greater costs on physicians than an equivalent, more gradual total increase.

VI. Conclusions

Although trends in malpractice litigation have paralleled trends in other lines, this analysis of the contribution of medical, demographic, and legal factors to malpractice litigation indicates that factors specific to medical care and malpractice law have significant explanatory power. The growth in medical services since the mid-1960s has contributed to, but certainly does not fully account for, the increase in claims and persistent diversity among states. In the absence of good measures for expected compensation per unit damages (r) or the cost of legal services, I have been unable to estimate explicit supply elasticities of claims in response to changes in these variables. The supply of lawyers does not appear to have a significant independent effect.

The strong effect on claim frequency of pro-plaintiff common-law doctrines implies that laws do make a difference and are not merely a reflection of more fundamental, underlying forces. This conclusion is reinforced by the evidence that post-1975 tort reforms designed to reduce awards—in particular, dollar caps and mandatory offset of compensation from collateral sources—have significantly reduced severity. However, these estimates of the effect of the post-1975 tort reforms must be viewed as rough measures of their short-run impact.

Two important questions remain unanswered. The first is to identify the characteristics of urban environments which generate higher claim frequency and severity. Urbanization is the single most powerful predictor of both frequency and severity, even after controlling for higher physician and lawyer density in urban states, more pro-plaintiff common law and the frequency and severity of claims in other liability lines. Higher awards by urban courts are probably one factor inducing the higher claim frequency. Other factors which were tried but do not account for urban litigiousness include more complex medical facilities, per capita income, welfare and unemployment rates.

The second unexplained puzzle is the post-1975 decline in claim frequency. It can apparently not be attributed to the tort reforms—which does not mean that these reforms will not reduce frequency in the longer run. The decline in frequency can apparently also not be attributed to the deterrent power of tort sanctions, at least as measured by malpractice insurance premiums. It is possible that the post-1975 decline in frequency was a temporary lull due to a transitory attitude associated with the 1975 crisis. It is also possible that the preceding peak was the aberration,

reflecting the backlog of potential claims which became worth filing as a result of the pro-plaintiff shift in common law in the sixties, combined with long statutes of limitations. The postcrisis reduction in statutes of limitations should have reduced the destabilizing potential, should another such pro-plaintiff shift in doctrine occur. Until a longer time series of claim data is available, this hypothesis remains untested speculation.

Appendix A
Common and Statutory Laws

TABLE A1
Application of Key Doctrines: 1970

State	Locality Rule*	Respondeat Superior†	Charitable Immunity‡	Informed Consent§
AL	0	0	1	. . .
AK	. . .	. . .	. . .	. . .
AZ	0	. . .	1	1
AR	0	1	0	. . .
CA	1	1	1	1
CO	0	1	0	1
CT	0	0	1	. . .
DE	0	1	0	1
FL	1	1	1	1
GA	1	0	0	. . .
HI	. . .	1	1	1
ID	0	1	1	. . .
IL	0	1	1	. . .
IN	0	0	1	1
IA	1	1	1	1
KS	0	0	1	1
KY	1	1	1	. . .
LA	0	0	0	1
ME	0	. . .	1	. . .
MD	0	. . .	1	. . .
MA	1	. . .	1	. . .
MI	1	1	1	1
MN	1	1	1	1
MS	0	1	1	. . .
MO	0	1	1	. . .
MT	0	1	1	0
NE	0	1	1	. . .
NV	0	. . .	0	. . .
NH	1	1	1	. . .
NJ	1	. . .	1	1
NM	0	. . .	. . .	1
NY	1	1	1	1
NC	1	1	1	1
ND	1	. . .	1	. . .
OH	1	1	1	. . .
OK	1	1	1	. . .

TABLE A1 (*continued*)

State	Locality Rule*	Respondeat Superior†	Charitable Immunity‡	Informed Consent§
OR	1	1	1	1
PA	1	1	1	1
RI	0	1	1	. . .
SC	0	. . .	0	. . .
SD	0	1	. . .	1
TN	0	1	1	1
TX	1	1	0	1
UT	1	1	1	. . .
VT	0	. . .	1	. . .
VA	0	1	0	. . .
WA	1	1	1	1
WV	1	1	1	. . .
WI	1	1	1	. . .
WY	. . .	. . .	1	1
DC	0	1	1	. . .

SOURCE.—Stephen Dietz, C. Bruce Baird, & Lawrence Berul, The Medical Malpractice System, in Appendix to the Report of the Secretary's Commission on Medical Malpractice, 73–89, DHEW No. (OS) (1973).

NOTE.—. . . = missing data.

* 1 = rejected or expanded, 0 = applied.

† 1 = expanded or applied, 0 = rejected.

‡ 1 = rejected, 0 = expanded or applied.

§ 1 = applied, 0 = rejected or expanded.

TABLE A2
POST-1975 TORT REFORMS

State	PAT (1)	AD (2)	COLL (3)	REC (4)	PER (5)	LOC (6)	RES (7)	PAN (8)	ARB (9)	INF (10)	FEE (11)	ST70 (12)	D70 (13)	ST75 (14)	D75 (15)
AK	. . .	76	76	. . .	76	. . .	76	76	76	76	. . .	2	1	2	1
AL	. . .	75	. . .	. . .	75	75	75	. . .	75	. . .	. . .	6	0	4	0
AZ	. . .	76	76	. . .	. . .	76	76	76	. . .	. . .	76	2	1	3	0
AR	. . .	79	. . .	. . .	79	. . .	79	76	. . .	. . .	. . .	2	1	2	1
CA	. . .	75	75	75	75	. . .	. . .	. . .	75	75	75	1	1	3	0
CO	76	76	. . .	76	. . .	. . .	. . .	77	. . .	. . .	. . .	2	1	5	0
CT	. . .	. . .	. . .	. . .	. . .	. . .	. . .	78	. . .	. . .	. . .	3	0	3	0
DE	. . .	. . .	76	. . .	76	76	76	76	. . .	76	76	2	0	3	0
FL	75	75	76	. . .	76	76	76	75	. . .	75	76	4	1	4	0
GA	. . .	76	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2	1	2	0
HI	76	76	. . .	. . .	. . .	. . .	. . .	76	. . .	76	77	6	1	6	0
IA	. . .	75	75	. . .	. . .	. . .	. . .	. . .	. . .	75	75	2	1	6	0
ID	. . .	76	75	75	. . .	75	75	75	. . .	75	75	2	1	2	1
IL	77	. . .	. . .	77	77	. . .	. . .	75	76	. . .	. . .	5	1	4	0
IN	75	75	. . .	75	. . .	. . .	. . .	75	. . .	. . .	75	2	0	2	1
KS	76	76	76	. . .	76	. . .	. . .	76	. . .	. . .	76	2	0	4	0
KY	76	76	. . .	. . .	. . .	. . .	. . .	. . .	. . .	76	. . .	1	1	1	1
LA	75	75	. . .	75	. . .	75	. . .	75	75	75	. . .	1	1	3	0
ME	. . .	77	. . .	. . .	. . .	. . .	. . .	77	78	77	. . .	2	1	2	1
MD	. . .	76	. . .	. . .	76	. . .	. . .	76	. . .	. . .	76	3	1	5	0
MA	. . .	76	. . .	. . .	. . .	. . .	. . .	76	. . .	. . .	. . .	3	1	3	1
MI	. . .	. . .	. . .	. . .	75	. . .	78	. . .	76	. . .	. . .	2	1	2	1
MN	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2	1	2	1
MS	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	6	1	2	1
MO	. . .	73	. . .	. . .	. . .	. . .	. . .	77	. . .	. . .	. . .	2	1	10	0
MT	. . .	. . .	. . .	. . .	. . .	. . .	. . .	77	. . .	. . .	. . .	3	1	5	0

NE	76	76	76	76	. . .	. . .	. . .	76	. . .	76	76	2	1	6	0
NV	. . .	. . .	. . .	. . .	. . .	. . .	75	75	. . .	75	. . .	2	0	4	0
NH	. . .	77	77	77	77	. . .	77	72	. . .	77	77	6	1	6	1
NJ	. . .	. . .	. . .	. . .	. . .	. . .	. . .	78	. . .	. . .	. . .	2	1	2	1
NM	76	77	. . .	76	. . .	. . .	. . .	76	. . .	. . .	. . .	3	1	3	0
NY	. . .	76	75	. . .	. . .	. . .	. . .	75	. . .	76	76	3	1	2	0
NC	. . .	76	. . .	. . .	. . .	. . .	. . .	. . .	. . .	76	. . .	3	0	4	0
ND	77	. . .	77	77	77	. . .	77	77	. . .	77	. . .	2	1	6	0
OH	. . .	75	75	75	. . .	. . .	. . .	75	75	75	. . .	1	0	4	0
OK	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0	0	3	0
OR	75	. . .	. . .	. . .	75	. . .	. . .	. . .	. . .	. . .	75	2	1	5	0
PA	76	. . .	76	76	. . .	. . .	. . .	76	. . .	76	76	2	1	2	0
RI	. . .	76	76	. . .	. . .	. . .	76	76	. . .	76	. . .	2	1	2	1
SC	76	. . .	. . .	. . .	76	. . .	. . .	. . .	. . .	. . .	. . .	6	0	6	1
SD	. . .	. . .	76	76	. . .	. . .	. . .	. . .	76	. . .	. . .	2	0	3	1
TN	. . .	75	75	. . .	. . .	75	75	75	. . .	75	75	1	0	3	0
TX	. . .	77	. . .	77	. . .	. . .	77	. . .	. . .	77	. . .	2	1	2	0
UT	. . .	76	. . .	. . .	. . .	. . .	. . .	. . .	. . .	76	. . .	4	1	4	0
VT	. . .	. . .	. . .	. . .	. . .	. . .	76	. . .	76	76	. . .	3	1	20	0
VA	. . .	. . .	. . .	76	. . .	76	. . .	76	76	. . .	. . .	2	0	2	1
WA	. . .	76	76	. . .	76	76	. . .	. . .	. . .	76	76	3	0	8	0
WV	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2	0	2	1
WI	76	76	. . .	75	75	. . .	. . .	75	76	. . .	75	3	1	3	1
WY	78	76	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1	0	2	1
DC	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3	1	3	1

NOTE.—Entries indicate year change became effective; includes reforms subsequently challenged.

(1) PAT = patient compensation fund pays awards above threshold, usually $100,000. (2) AD = ad damnum: prohibits mention in claim of dollar amount demanded. (3) COLL = collateral source rule modified to permit evidence or mandate offset. (4) CAP = limit on recovery. (5) PER = periodic payment of award for future damages permitted or mandated. (6) LOC = standard of care defined by "similar communities." (7) RES = prohibits or clarifies use of res ipsa. (8) PAN = pretrial screening panel. (9) ARB = provides for voluntary, binding arbitration. (10) INF = clarifies required elements of informed consent. (11) FEE = limit on plaintiff attorney's contingent fee. (12) ST70 = pre-1975 statute for adults. (13) D70 = pre-1975 discovery rule. (14) ST75 = post-1978 statute for adults. (15) D75 = post-1978 discovery rule.

APPENDIX B
EFFECTS OF WEIGHTS

Table B1 shows the effects of different weights on regression estimates of claim frequency in 1970. The specification is not identical to that in Mueller, but is sufficiently similar to illustrate the point.

Using population weights, surgeon density (surgeons per M.D.) and the percentage of population aged sixty-five or older have *positive* coefficients in the first equation. A Cook's distance test shows that California and Florida have a significant impact on these coefficient estimates.[46] In the second equation, which includes dummy variables for California and Florida, the coefficients of surgeon density and the percentage of old people are similar in magnitude and significance but the signs are *negative*. This suggests that the positive association between surgeon density and old people and claim frequency reported by Mueller is due to the fact that these variables take relatively high values in states which, for other reasons, have relatively high claim frequency and which are relatively populous, hence receive large weight in population-weighted regressions. In the second pair of regressions, using Amemiya-Nold weights, neither variable is significant at conventional levels, with or without controlling for Florida and California.

TABLE B1
EFFECT OF ALTERNATIVE WEIGHTS DEPENDENT VARIABLE: CLAIM FREQUENCY $\left[\log\left(\frac{F}{1-F}\right)\right]$

	Weight$_i$ = (n_i)		Weight$_i$ = $\left[s^2 + \frac{1}{n_i F_i(1-F_i)}\right]^{-1}$	
C	−8.33	2.95	−3.39	1.24
	(2.35)	(.77)	(.85)	(.28)
% old	4.69	−4.69	3.03	−.98
	(1.48)	(1.30)	(.73)	(−.22)
% rich	.001	.001	.0006	.0009
	(.77)	(.95)	(.34)	(.57)
% urban	.005	.002	.008	.004
	(.67)	(.28)	(1.17)	(.59)
M.D.'s per capita	.61	.34	.53	.52
	(3.01)	(.91)	(2.10)	(2.11)
Surgeons per M.D.	4.54	−4.77	−1.04	−4.27
	(1.84)	(1.65)	(−.34)	(1.29)
% unemployed	.02	.12	.007	.06
	(.28)	(1.73)	(.08)	(.66)
1970 LAWS	.09	.08	.09	.08
	(1.63)	(1.63)	(1.42)	(1.30)
Lawyers' income:	.17	−.65	−.19	−.54
	(.44)	(1.81)	(−.50)	(1.32)
California	. . .	.34	. . .	.32
		(2.54)		(.77)
Florida	. . .	1.31	. . .	1.07
		(4.30)		(2.10)
R^2	.620	.755	.478	.536

[46] A Cook's distance test identifies observations which shift parameter estimates outside a selected confidence interval (10 percent in this application) around the point estimate obtained using the full sample.