

## *The “Crisis” in Medical Malpractice Insurance*

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Since 1999, many states have experienced a “crisis” in medical malpractice insurance. The median premium increase for internists, general surgeons, and obstetricians-gynecologists increased from 0–2 percent in 1996–97 to 17–18 percent in 2003, climbing to 60 percent in some states in 2001–02, after adjusting for inflation. In December 2001, the St. Paul Companies, which was the largest malpractice insurer operating in forty-five states, announced its decision to withdraw from the market, citing losses of millions of dollars on its medical liability business. Two other major insurers—PHICO and Frontier Insurance Group—exited from the market entirely. Faced with insolvency, the Medical Inter-Insurance Exchange reorganized and restricted its operations to New Jersey. In some states, including Pennsylvania and New Jersey, physicians went on strike, threatened to leave the state, and discontinued high-risk services; however, a recent General Accounting Office study finds no conclusive evidence of widespread, measurable effects of the crisis on the availability of medical services.<sup>1</sup>

This most recent malpractice insurance crisis followed an unusually long period of flat or modest increases in premium rates and widespread availability of insurance, which, in turn, followed a severe crisis of affordability

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1. General Accounting Office (2003a, pp. 5, 12, 13).

in the 1980s and a severe crisis of affordability and availability in the mid-1970s. In response to these earlier crises, many states adopted reforms of tort law that were intended to reduce the level and unpredictability of claims, including caps on awards for noneconomic damages, collateral source offset, and shorter statutes of limitations. At the same time, some states adopted measures to assure the availability of insurance and reduce its cost to physicians. Joint underwriting associations serve as residual market mechanisms for physicians who are unable to obtain coverage in the voluntary market. Patient compensation funds limit the physician's liability at some threshold (for example, \$200,000 per claim); additional compensation to the patient up to a higher threshold (for example, \$1 million) is financed through assessments on all physicians practicing in the state. By shifting costs from individual defendants to all practicing physicians, with assessments levied on a pay-as-you-go basis, these funds produced short-term relief for physicians facing the highest premiums, particularly specialists in urban areas.

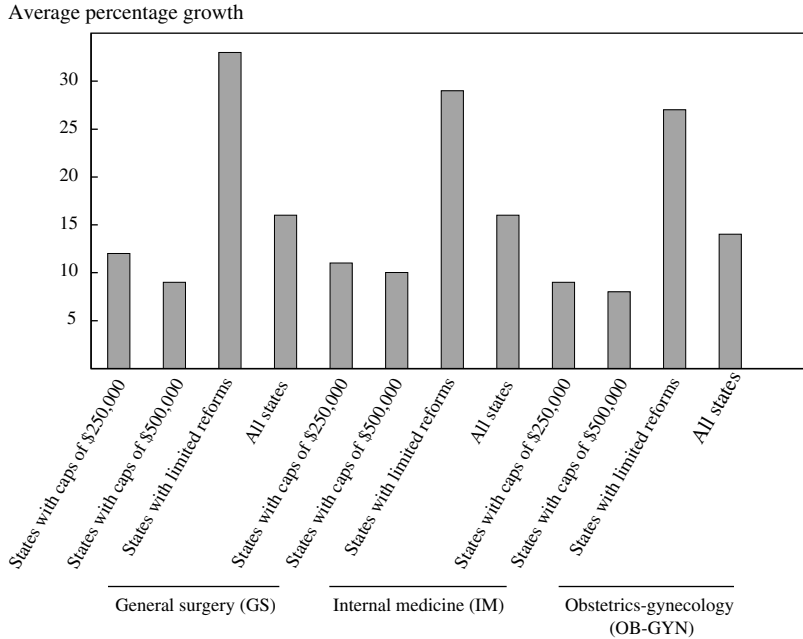
In addition to these statutory changes, malpractice insurance markets adopted voluntary changes to reduce insurer risk and establish more robust sources of coverage. Most insurers replaced the occurrence policy form with the claims-made policy form, thereby shifting from insurer to policyholder the risk related to losses incurred, but not reported, during the policy period.<sup>2</sup> In addition, in many states physicians established their own physician-owned mutuals, reciprocals, and risk retention groups. These physician-directed companies replaced the traditional commercial stock companies, many of which either withdrew or sharply curtailed their malpractice exposure during the crises of the 1970s and 1980s. In theory, physician-owned companies may have informational or risk-sharing advantages over stock companies in writing a line such as medical malpractice insurance.<sup>3</sup>

The most recent malpractice insurance crisis raises the question of whether these tort and insurance market reforms have achieved their goals of moderating premium increases. A General Accounting Office report on the current crisis concludes that, although physicians in most states have

2. A claims-made policy covers all claims filed in the year that the policy is written, provided that the policyholder had coverage with this insurer during the year in which the incident occurred. An occurrence policy covers all claims related to incidents in the year in which the policy is written. Thus if a physician with claims-made coverage switches insurers or retires, he or she generally buys "tail coverage" to cover any future claims that may be filed related to his prior practice.

3. Danzon (1984); Doherty and Dionne (1993).

**Figure 1. Growth in Premiums for Three Physician Specialties in States with and without Caps on Non-economic Damages, 2001–02**



Source: General Accounting Office (2003b, p. 33). General Accounting Office analysis of Medical Liability Monitor base premium rates, excluding discounts, rebates, and surcharges, reported for the specialties of general surgery, internal medicine, and obstetrics-gynecology. Premiums are adjusted for inflation to 2002 dollars.

experienced some increase in premium rates since 1999, the between-state variation has been significant.<sup>4</sup> From 1999 to 2002, the largest writer of medical malpractice premiums for general surgeons in Dade County, Florida, increased premiums 75 percent, while Minnesota’s largest insurer for general surgeons increased premiums only 2 percent for a similar level of coverage. Moreover, the rate of premium increase was significantly lower in states that enacted tort reforms, specifically, the placement of caps on awards for noneconomic damages (see figure 1). Although this evidence suggests that caps on awards for noneconomic damages slowed the growth in premiums, such conclusions remain tentative because the analysis is based on only one year of premium increases and does not control for other factors.

4. General Accounting Office (2003b, p. 10).

Viewing the current crisis from a longer-term perspective, the pattern of premium increases over the last decade—flat or falling rates for several years, followed by sharp increases—resembles the typical insurance cycle that has been experienced in other “long-tailed” lines of liability insurance, in particular, general liability (including product liability) insurance. Several theories have been developed to explain these alternating periods of soft markets with intense competition and flat or falling premiums followed by hard markets with sharp premium increases, insurer exits, and restricted availability. The “capacity constraint” theory posits that hard markets are triggered by periodic exogenous shocks to insurer capital, often due to unanticipated shifts in liability rules that apply retroactively and render prior insurer reserves inadequate, or to declines in asset valuations and investment yields that erode capital.<sup>5</sup> Given regulatory constraints on permissible premium-to-capital ratios and costs of adding external capital, the contraction of insurer capital, in turn, leads to a reduction in the supply of insurance and an increase in its price. Cummins and Danzon extend this model to include insolvency risk of insurers and demand for insurance that depends on the firm’s financial quality.<sup>6</sup> In this model, a decline in insurer capital leads to a decline in the price of insurance, as measured by the loading charge; premium rates may, nevertheless, increase to the extent that expected loss costs increase.

Less attention has been paid to soft markets. One exception is Harrington and Danzon, who develop and test alternative theories of excessive competition.<sup>7</sup> They hypothesize that if some insurers undercharge, due to either inexperience or excessive risk taking, then other insurers will rationally cut their prices below short-run marginal cost in order to preserve quasi rents on their established business. Clearly, soft-market periods of pricing below short-run marginal cost cannot continue indefinitely. Whether this excessive price cutting ultimately contributes to more-than-corrective price increases (in excess of increases in prospective loss costs) and to insurer exits, especially by insurers with low levels of investment and hence low quasi rents, remains an untested hypothesis.

In this paper, we first document the extent of the recent crisis, in terms of premium increases and insurer exits, and then examine the role of several possible contributing factors. In particular, we examine the contribution

5. Grøn (1989, 1994); Winter (1994).

6. Cummins and Danzon (1997).

7. Harrington and Danzon (1994).

of shocks to insurer capital, inexperience, and excessive risk taking during the soft market. These theories of abnormal pricing are tested against the null hypothesis: that the premium increases simply reflect increases in expected loss costs and declines in expected investment yields. We also examine the extent to which tort and insurance market reforms mitigated—or exacerbated—premium increases and insurer exits over the period 1994–2003. Specifically, we test for the effects of caps on awards for noneconomic and total damages, collateral source offset, limits on joint and several liability, and whether the state has a joint underwriting association or a patient compensation fund. We also test whether physician-directed companies behave differently from commercial companies.

Our data on the level of and increases in medical malpractice premiums are from Medical Liability Monitor, which reports premium rates by state for three major specialties: internists, general surgeons, and obstetricians-gynecologists. Our measures of insurer experience are from the annual statement data reported by all insurers to state regulators, as compiled by the National Association of Insurance Commissioners (NAIC).

The structure of the paper is as follows. The first section describes our data. The second section outlines the evidence on the extent of the crisis in terms of trends in premiums, in insurer losses paid and losses incurred, and in number of exits. The third section outlines a model of insurance pricing, extending the standard actuarial model to incorporate the theories of hard and soft markets. The fourth section reports results of multivariate analysis of premium rate increases and insurer exits. A final section concludes.

## Data

Our data on medical malpractice premiums are from Medical Liability Monitor, which reports premium rates by state or territory, for a standard claims-made policy (\$1 million per claim; \$3 million aggregate for the policy year) for three major specialties: internists, general surgeons, and obstetricians-gynecologists. These data are collected by survey from one or more leading insurers in each state. These premium rates should be reasonably representative of rates for each state; however, the number of physicians written at each rate is not reported.<sup>8</sup> These rates do not reflect discounts and

8. In states with multiple rating territories, we included the highest and lowest rates. For analyses that require a single rate per specialty per state, in cases where we have rates from

dividends to policyholders; to the extent that such discounts and dividends became less frequent in the hard market, the rate increases reported in our data may underestimate the real increase in cost to physicians. In a few states, the Medical Liability Monitor rates are for coverage limits other than the standard \$1 million/\$3 million claims-made policy; possible effects of this on our analysis are noted below. The data on premiums are for select years between 1994 and 2003. All current dollar values are adjusted to constant dollars using the GDP deflator.

Our data on malpractice insurers are from the National Association of Insurance Commissioners database, for the period 1993–2002. This database includes the annual financial reports that all licensed insurers are required to file in each state in which they are licensed. It thus includes many more firms than the Medical Liability Monitor data. For each firm, the NAIC reports state-level data on premiums written and losses incurred for medical malpractice, countrywide data on medical malpractice loss forecast revisions from Schedule P, and countrywide data on all lines of insurer capital, investment yields, and assets. We include all firms that reported at least \$100,000 in net medical malpractice premiums written (in 2002 dollars) in at least one state. We categorize a firm as exiting from a state in year  $t$  if the firm's direct premiums written dropped below \$100,000 in year  $t$  and remained below that threshold in that state for the remainder of our observation period, having previously exceeded the \$100,000 threshold.

Although the NAIC database includes all licensed insurers, a significant fraction of malpractice insurance is not captured by the NAIC data. In particular, if physicians obtained coverage through self-insurance arrangements of hospitals or health maintenance organizations, and these arrangements were not subject to state regulation, they are not represented in our data. Also excluded from the NAIC data are most state-run pools, including joint underwriting associations and patient compensation funds. Since the NAIC data report each firm's aggregate premium and loss experience, they cannot be disaggregated into changes in premium rates versus number of policyholders or limits of coverage. Our analysis of premium increases therefore focuses on the subsample of firms that are represented in the Medical Liability Monitor data for which we have matching NAIC data on firm characteristics.

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multiple insurers or multiple rating territories, we calculate a simple average of the rates reported for that specialty and state, since we lack information on the number of physicians by insurer and territory, which is necessary to calculate a weighted average.

### **Trends in Premiums, Insurers Losses, and Exits**

In this section we document the extent of the recent crisis in malpractice insurance in terms of premium increases and insurer exits to set the stage for the presentation of theoretical models of premium setting.

#### *Premium Levels and Increases*

Table 1 shows the median premium rate across states for \$1 million/\$3 million claims-made coverage, for internal medicine, general surgery, and obstetrics-gynecology for each available year between 1994 and 2003, in constant 2002 dollars. The table also shows the twenty-fifth, fiftieth, and seventy-fifth percentiles and the maximum percentage increase from the distribution of rate increases across states. In 1994 the median premium rates were \$6,075 for internal medicine, \$22,269 for general surgery, and \$39,122 for obstetrics-gynecology. By 2003 the median premium rates were \$9,000 for internal medicine, \$33,297 for general surgery, and \$53,630 for obstetrics-gynecology. Thus for the median state, the cumulative increases over the nine-year period were 52 percent for internal medicine, 47 percent for general surgery, and 35 percent for obstetrics-gynecology, in excess of general inflation.<sup>9</sup> The fact that the increases were concentrated in the last four years rather than spread evenly over the nine years may have limited the ability of physicians to pass on the increases to patients through higher fees for medical services, thereby increasing the burden on physicians and contributing to the sense of crisis. Still, for the typical state, the magnitude of these premium increases does not appear to have constituted a crisis.

However, states at or above the seventy-fifth percentile of annual increases experienced cumulative rate increases over the nine-year period of more than 90 percent for internal medicine and general surgery and more than 74 percent for obstetrics-gynecology, with increases exceeding 10 percent in 2001 and 20 percent in 2002 and 2003, after inflation. The maximum annual increases exceeded 60 percent in 2002. Thus the distribution of premium increases was highly skewed, with a few states facing extreme increases, particularly in the last two years. Presumably, the sense of crisis was greatest in states facing high percentage increases on top of high pre-

9. Our estimates of cumulative percentage increases, by specialty and state, are approximate because the Medical Liability Monitor insurers surveyed are not necessarily the same in each year. Thus the cumulative percentages may reflect differences in territories or insurer selection policies as well as underlying rate increases.

**Table 1. Average Level of Malpractice Premiums and Percentage Increase, by Specialty and Select Year, 1994–2003<sup>a</sup>**

Year and specialty	Median premium rate (U.S. dollars)	Annual percentage change			
		Twenty-fifth percentile	Median	Seventy-fifth percentile	Maximum
1994					
Internal medicine	6,075	0.0	5.4	9.7	27.8
General surgery	22,269	0.0	2.5	6.5	35.5
Obstetrics and gynecology	39,122	0.0	3.0	6.9	40.0
1996					
Internal medicine	6,367	0.0	2.4	7.1	16.0
General surgery	24,598	0.0	2.2	6.9	34.3
Obstetrics and gynecology	39,502	0.0	0.9	5.0	16.0
1997					
Internal medicine	6,706	0.0	0.3	5.1	34.9
General surgery	24,067	0.0	0.6	5.0	15.0
Obstetrics and gynecology	39,318	0.0	0.0	4.3	15.0
2000					
Internal medicine	6,230	n.a.	n.a.	n.a.	n.a.
General surgery	24,066	n.a.	n.a.	n.a.	n.a.
Obstetrics and gynecology	40,503	n.a.	n.a.	n.a.	n.a.
2001					
Internal medicine	6,970	0.0	6.4	12.5	62.5
General surgery	26,030	0.0	6.1	13.5	62.5
Obstetrics and gynecology	40,569	0.0	5.0	11.5	62.5
2002					
Internal medicine	7,544	6.5	13.0	33.7	59.3
General surgery	27,922	5.0	11.0	29.3	57.5
Obstetrics and gynecology	42,928	6.0	11.2	26.5	60.7
2003					
Internal medicine	9,000	8.5	16.9	25.5	43.8
General surgery	33,297	10.8	18.0	25.2	42.0
Obstetrics and gynecology	53,630	8.9	16.8	23.4	42.0

Source: Medical Liability Monitor annual surveys. Authors' calculations of distribution across states.

n.a. Not available.

a. Rates for \$1 million/\$3 million claims-made policy, unadjusted for discounts and dividends, by state. Premiums are reported in 2002 dollars except for 2003, which is unadjusted for inflation.

mium levels. In general, however, the rate of premium increase was greater for states that started from relatively low premium levels: the Pearson correlation between 1994 premium level and 1994–2003 premium increase is  $-0.30$  for internal medicine,  $-0.25$  for general surgery, and  $-0.38$  for obstetrics-gynecology.

The highest cumulative increases were 328 percent in Pennsylvania and 301 percent in South Carolina. Both of these states have joint underwriting associations, and Pennsylvania also has a patient compensation fund (formerly the “catastrophic,” or “cat,” fund, now MCare). In fact, the high premium increase in Pennsylvania is misleading because it reflects in part the increase in the required limits on physicians’ basic coverage, from \$200,000/\$600,000 in 1993 to \$500,000/\$1.5 million in 2003; thus the increase reported in table 1 overstates the increase for constant limits of coverage. Nevertheless, the surcharge for the catastrophic fund also increased. Summing the base rate and the surcharge in Pennsylvania, and averaging across the companies for which we have Medical Liability Monitor rates, the increase in total premiums between 1993 and 2003 ranged from 209 to 273 percent, depending on specialty and territory. The intra-specialty range of rates across territories also increased.<sup>10</sup> Although South Carolina had the second highest rate of increase, absolute levels were only \$18,000 for obstetrics-gynecology in 2003.

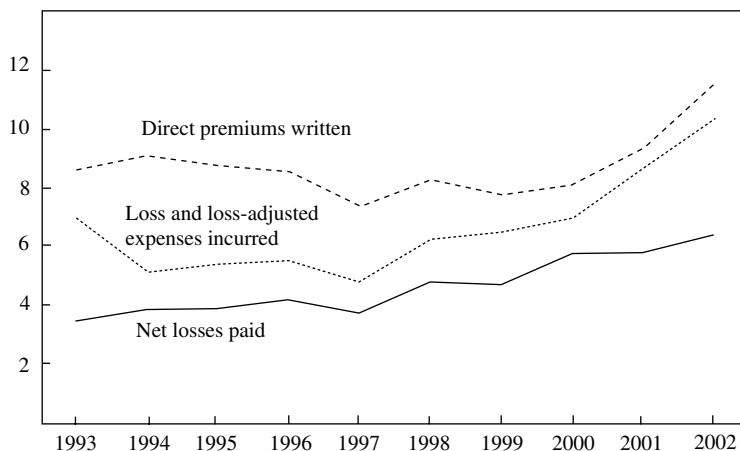
#### *Aggregate Trends in Insurer Losses and Premiums*

Figure 2 shows trends in aggregate loss paid, loss plus loss-adjustment expense incurred, and direct premiums written, summed over all insurers in our NAIC sample. Loss paid trended up gradually, with sharper increases in 1998, 2000, and 2002. By contrast, incurred loss plus loss-adjustment expense, which reflects insurer estimates of losses on policies written in that calendar year plus any adjustments to reserves for prior years, declined between 1993 and 1994, despite an increase in losses paid in that year. From 1995 through 1999, incurred loss plus loss-adjustment expense tracked paid losses reasonably closely, but for 2001–02 incurred losses far overshot paid losses. Aggregate premiums actually declined between 1993

10. According to the Medical Liability Monitor data, the intra-specialty range of premiums charged by the Pennsylvania Medical Society’s medical malpractice insurer (PMSLIC) for base coverage and the mandatory catastrophic fund surcharge grew from 194 to 250 percent for internal medicine, 184 to 239 percent for general surgery, and 217 to 279 percent for obstetrics-gynecology, from 1994 to 2003.

**Figure 2. Aggregate Trends in Premiums and Losses**

Billions of 2002 U.S. Dollars



Source: NAIC annual statements.

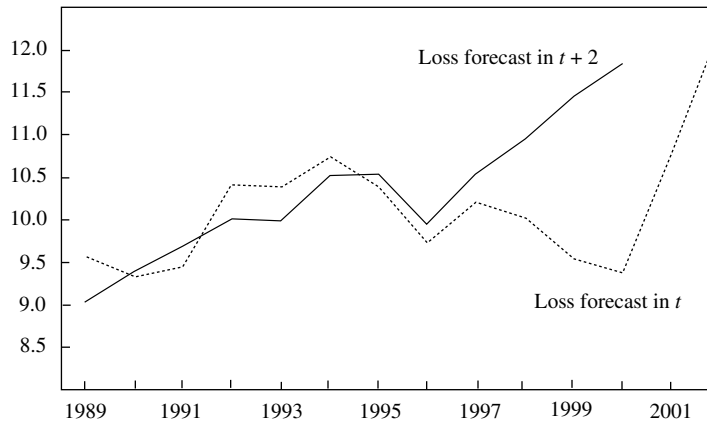
and 1997, stayed roughly flat through 2000, and shot up in 2001–02. Because all three series reflect changes in volume as well as price or loss per unit of coverage, these trends cannot be interpreted as showing trends in premium rates or loss per policy. However, since any change in volume applies to all three series, comparison between them is informative. This comparison shows that premiums written and, to a lesser extent, losses incurred were more cyclical than paid losses. This is consistent with the hypothesis of excessive price cutting during the soft market, possibly with underreporting of incurred loss in order to conceal inadequate pricing.

Figure 3 shows trends in aggregate initial loss forecasts (loss forecast in year  $t$ ) and the loss forecast two years later (loss forecast in year  $t + 2$ ). For claims-made coverage, which was the norm for medical malpractice insurance by this time, the number of claims (claim frequency) is known by the end of the policy year, and only the average payment per claim (claim severity) remains unknown, due to lags in the disposition of claims.<sup>11</sup> Nevertheless, initial loss forecasts were quite inaccurate, following a marked cyclical pattern of underestimates in 1991, overestimates in 1992–94, and persistent underestimates through 2000. By contrast, losses incurred as of  $t + 2$  trended upward quite steadily, except for a dip in 1996.

11. Uncertainty related to claims incurred but not reported during the policy year was eliminated by switching from occurrence to claims-made coverage.

**Figure 3. Aggregate Trends in Loss Forecast and Forecast Error**

Millions of 2002 U.S. Dollars



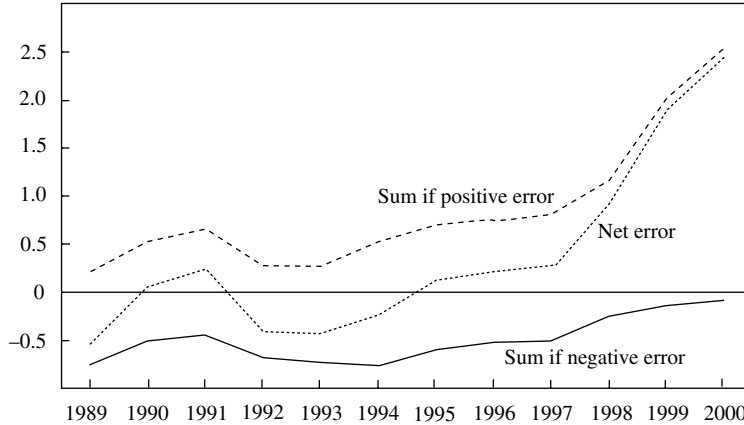
Source: NAIC annual statements.

Remarkably, from 1997 to 2000, the aggregate initial loss forecast declined, despite a steady and sharp increase in losses incurred as of  $t + 2$  and in paid losses. This evidence is consistent with initial understatement of loss forecasts, possibly to conceal inadequate premiums. After 2000 a very sharp increase in initial loss forecasts was necessary to bring the initial forecast more in line with subsequent realizations.

The industry aggregate forecast error in figure 3 may understate the full extent of initial under-reserving by some firms, to the extent that negative forecast errors (initial overestimates) by some firms offset positive errors (initial underestimates) by other firms. To provide evidence on this, figure 4 disaggregates the industry aggregate forecast error into its positive and negative components. In fact, although the overall error was near or below zero from 1989 though 1995, this reflects the offsetting of positive errors by negative errors. The theory of competitive price cutting suggests that if some firms in the industry underestimate losses and set low prices, either intentionally or due to ignorance, this may suffice to set off a price war as other firms match price cuts to preserve market share and quasi rents. Between 1993 and 2000, paid losses increased, while aggregate premiums written fell. This evidence of significant positive forecast errors by some firms throughout the period may explain the period of flat or declining premiums, despite steadily rising paid losses.

**Figure 4. Aggregate Trends in Loss Forecast and Forecast Error**

Millions of 2002 U.S. dollars



Source: NAIC annual statements

From the NAIC data, we cannot disaggregate trends in total paid losses into trends in the frequency and severity, respectively, of claims. Limited evidence of this decomposition is available from the Physician Insurers Association of America (PIAA) for its member companies and from Bovbjerg and Bartow.<sup>12</sup> Claim frequency (number of claims per physician) countrywide reportedly rose little after the mid-1990s, although some states saw increases. By contrast, claim severity increased dramatically. National data from the *Jury Verdict Reporter* show that the median verdict in cases taken to trial where the jury finds in favor of the patient more than doubled between 1995 and 2000, reaching about \$1 million per case. The mean verdict was even higher. However, because *Jury Verdict Reporter* relies heavily on voluntary submission of information by trial attorneys, levels of and trends in payments may be upward biased if attorneys tend to report only the largest cases that they wish to publicize.<sup>13</sup>

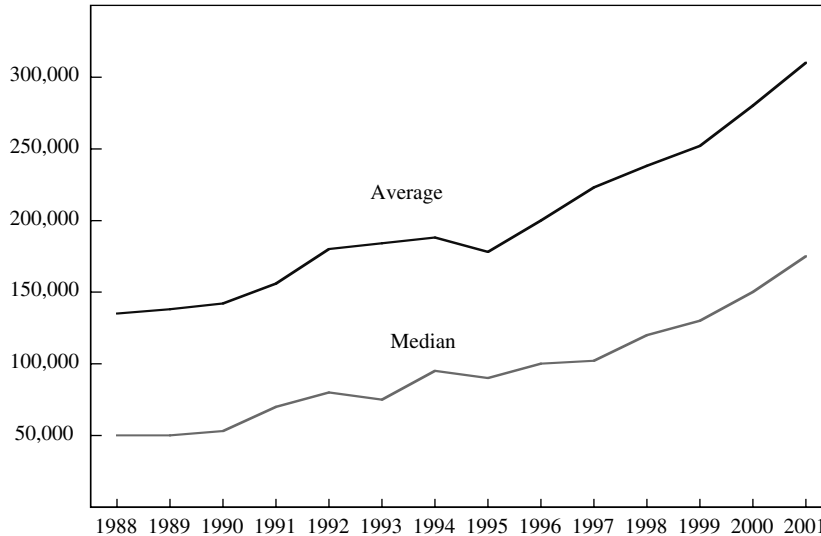
More representative data on total claim payments, including jury verdicts and out-of-court settlements, are available from the PIAA Data Sharing Project. This shows that median claim payments, in nominal dollars, increased from \$50,000 in 1990 to about \$175,000 in 2001, more than a threefold increase, while mean claim payments increased from roughly

12. Bovbjerg and Bartow (2003, pp. 25–27).

13. Bovbjerg and Bartow (2003, p. 26).

**Figure 5. Trends in Mean and Median Payment per Claim, 1988–2001**

U.S. dollars



Source: Physician Insurers Association of America Data Sharing Project in Smarr (2003, p. 15); Bovbjerg and Bartow (2003, p. 27).

\$145,000 in 1990 to \$315,000 in 2001 (see figure 5). Moreover, these upward trends were steady, except for a one-year drop in 1995. Claims exceeding \$1 million were about 8 percent of all claims paid for individual practitioners; the percentage doubled in the past four years.<sup>14</sup> Assuming that these trends in claim severity for the PIAA companies are reasonably representative of experience for all malpractice insurers, the decline in initial loss forecasts from 1994 through 2000 was at odds with available evidence on trends in paid claims.

Since competitive premiums reflect the discounted value of expected losses, trends in expected investment income may have contributed to this apparent failure of premiums and initial loss forecasts to increase with paid losses. The General Accounting Office reports that a significant source of loss for medical malpractice insurers has been the relative decline in their bond-weighted investment portfolios due to declining bond yields since 2000. Although equity values increased through 1999, PIAA reports that 79 percent of its insurers' assets were in bonds.<sup>15</sup> If this is typical of most insur-

14. Smarr (2003, p. 19).

15. General Accounting Office (2003b); Smarr (2003, p. 8).

ers, the increase in equity values in the 1990s would have had only a modest effect on the portfolio of malpractice insurers. Declining bond yields may have contributed but surely cannot fully explain the average increase in premium rates after 2000 or the extreme experience in some states.

#### *Insurers and Insurer Exits*

Since the extent of the crisis varies significantly across states, our analysis of insurer exits is at the state level and uses the firm-state as the unit of observation. Recall that our NAIC sample includes all firms that reported at least \$100,000 in net premiums written in at least one state over our 1994–2002 sample period. Our sample includes more than 300 firms per year and 1,619–1,945 firm-states per year. The majority of these firms write a very low volume of premiums, and some may be “shells” that exist mainly to keep active a state license. However, for medical malpractice, many of these small firms are physician initiated, quasi self-insurance arrangements that play an important role in the malpractice insurance market.

The NAIC data characterize firms as stock, mutual, risk retention group, or other type of company. Unfortunately, this categorization does not reliably identify physician-directed firms. Many physician-owned companies started out as mutuals or reciprocals but by 2002 had converted to stock companies and hence cannot be reliably distinguished from commercial firms in the NAIC database. In 2002 sixty-four of the 309 firms (20.7 percent) writing medical malpractice policies were categorized as mutuals, reciprocals, or risk retention groups; these firms accounted for 35 percent of the volume of premiums. By contrast, PIAA reports that physician-owned firms accounted for about 60 percent of the market.<sup>16</sup> To provide a more accurate measure of physician-directed companies, we augment the NAIC designation of mutual, reciprocal, or risk retention group with a listing of physician-directed companies provided to us by PIAA. Using this combined categorization, eighty firms (26 percent) were physician directed, and these firms accounted for 47.4 percent of the direct premiums written. Because the PIAA list only includes firms with premiums over \$1 million in 2002, we almost certainly undercount physician-directed small firms. The percentage of premiums written by physician-owned firms varied widely across states, from almost 12 percent in Wyoming to 85 percent in Oklahoma.

16. General Accounting Office (2003b, pp. 2, 5).

Given the large number of firms that write a very low volume of premiums, the definition of an insurer exit is somewhat arbitrary. Here we define a firm as exiting a state in year  $t$  if its direct premiums written fell below \$100,000 in year  $t$  and did not exceed that threshold during our period of analysis. We define a firm as entering in year  $t$  if its net premium written in a state exceeded \$100,000 for the first time in year  $t$ .

In table 2, the first panel shows entries and exits by firms at the state level (firm-states), and the second panel shows entries and exits by firms writing any malpractice insurance countrywide (national firms), for 1995–2002. For these firm-state-year exits, there was clearly a trend toward more exits from 1999 onward, with more than 200 exits in three of the four subsequent years, compared with 60–136 in the previous years. At the same time, other firms entered the market, with the largest number of entries in 2002, such that the total number of firm-state-years tended to increase over the period. Two caveats are in order in reviewing these data. First the results are sensitive to the definition of entry and exit. Second, entry by small, new firms does not necessarily indicate a healthy insurance market, to the extent that the new firms are quasi self-insurance arrangements adopted to fill a void left by the exit of larger, more diversified firms.

If we restrict the analysis of exits to large firms, defined as firms that wrote at least \$1 million in direct premiums in at least one state during our sample period, there were 6,445 large firm-state-years over the 1996–2002 period. Of these, 378 firms or 6 percent exited during the period, and of these 207 or 55 percent exited in 2001–02. The number of large firm-state-years increased from 862 in 1996 to a maximum of 963 in 2001 and declined to 938 in 2002. Thus the exiting large firms were not fully replaced by entering large firms, resulting in a reduction of twenty-five in the number of large firms in 2002.

In order to distinguish the exit of a firm from an individual state from the exit of an insurer countrywide (national exit), table 2 also reports the number of exits and entries by year with firms aggregated to the national level. Thus a national exit occurs when a firm withdraws from all states. There was at most a slight increase in the number of national exits in the hard market of the early 2000s; however, conclusions are tentative due to the small sample size.

Another measure of the disruption caused by insurer exits is the share of direct premiums written by the exiting firms. Table 3 reports the mean and

**Table 2. Annual Entries and Exits of Medical Malpractice Insurers, by Firm-States and National Firms, 1995–2002**

Year	Firm-states			National firms		
	Firms	Exits	Entries	Firms	Exits	Entries
1995	1,619	60	195	227	9	17
1996	1,665	110	203	229	12	10
1997	1,624	136	170	218	22	17
1998	1,728	112	214	219	12	13
1999	1,699	204	183	209	24	16
2000	1,772	157	178	201	22	9
2001	1,802	246	198	198	18	11
2002	1,945	311	339	206	25	25

Source: NAIC annual statements. Authors' calculations.

**Table 3. Direct Premiums Written by Exiting Firms, 1994–2003<sup>a</sup>**

Millions of U.S. dollars

Year	Direct premiums written		Percentage of premiums		
	Mean	Median	National	Mean state	Maximum state
1994	3.51	0.59	25.0	29.0	49.5
1995	3.69	0.21	3.1	1.6	42.3
1996	0.50	0.24	0.8	2.0	30.5
1997	2.94	0.21	6.0	5.0	34.7
1998	0.39	0.20	0.7	1.2	4.7
1999	1.62	0.23	5.0	3.7	42.0
2000	0.92	0.25	2.3	3.3	27.6
2001	3.48	0.42	13.0	10.2	51.2
2002	1.17	0.38	4.8	6.2	24.0

Source: NAIC annual statements.

a. Premiums in  $t - 1$  by firm-states exiting in year  $t$ .

median direct premiums written in year  $t - 1$  by firm-states exiting in year  $t$ , the percentages of national and state premiums written by exiting firms, and the maximum market share of exiting firms for any state. The mean premium share of exiting firms clearly was higher in 1999–2002 than in the preceding four-year period, reaching 13 percent of national premiums in 2001, the year in which the St. Paul Companies withdrew. The maximum premium share of exiting firms also reached a peak of 51 percent in 2001 and tended to be higher in the 1999–2002 period than in the previous four years, but with significant year-to-year variation. Thus the availability of medical malpractice insurance was severely disrupted by the exit of firms but was limited to a small number of states.

### Theoretical Model of Malpractice Premium Setting

In the standard actuarial model of insurance rate setting,<sup>17</sup> the premium rate for a policy with specified limits of coverage in a given specialty-state-year reflects the discounted expected losses plus loss-adjustment expense in that state, which may depend on tort and insurance market reforms, plus adjustments for taxes and overhead. Ignoring taxes and overhead, this may be written as follows:

$$(1) \quad P_{stm} = \alpha_1 EL_{stm}(Z_{it}) + \alpha_2 EV_{im} + u_{stm},$$

where  $s$  is the state;  $t$  is the year;  $m$  is the medical malpractice line;  $P$  is the premium rate for a policy with given limits of coverage;  $EL$  is the expected loss plus loss-adjustment expense;  $Z$  is a vector of tort and insurance market reforms that affect expected losses;  $EV$  is the expected rate of return on invested assets; and  $u$  is a random error.

This standard model predicts that premium increases will parallel increases in expected losses and move inversely with expected investment income. It cannot explain the observed cycles and crises in markets for liability insurance, including medical malpractice. Several theories have been developed to explain, respectively, the hard phase of insurance cycles, with overshooting on prices and insurer exits, and the soft phase, with undercharging relative to discounted expected loss costs.

#### Capacity Constraints

The “capacity constraint” theory of hard markets starts off by noting that insurance risk for liability lines is imperfectly diversifiable due to factors such as socioeconomic trends that affect all policyholders similarly.<sup>18</sup> Raising external capital to pay unexpected losses is costly due to taxes and other factors. Insurers therefore hold capital reserves to ensure that they can pay claims that exceed expected values. For reasons of both internal solvency and regulatory requirements, insurers have a target ratio of capital to premiums. In this model, a shock to insurer capital, due to factors such as an unexpected increase in claim liabilities for prior policy years, leads to a contraction of capacity, reflected in a leftward shift of the short-run supply of insurance. This can lead to a premium increase in excess of any increase

17. For example, Myers and Cohn (1987).

18. Grøn (1989, 1994); Winter (1994).

in expected losses and, in the extreme, to insurer exit. However, the empirical tests of this model, using industry aggregate data, are inconclusive: the evidence supports the prediction of an inverse relation between the price of insurance and capitalization for cycles prior to 1980, but not for the liability crisis in the 1980s.<sup>19</sup> Other evidence confirms the theory for short-tail lines but not for long-tail lines.<sup>20</sup>

Cummins and Danzon extend this model to incorporate insolvency risk of insurers and policyholder demand for insurance that is positively related to the firm's financial quality—that is, insurance is viewed as risky debt.<sup>21</sup> This model predicts a positive relationship between a firm's financial quality and the price that policyholders are willing to pay for the insurance. The empirical analysis of firm-level data for the period 1980–88 is consistent with this model of insurance as risky debt. Note that although these studies measure the price of insurance by the loading charge (ratio of premiums to discounted losses), this measure is positively correlated with the absolute level of premium rates, controlling for expected losses. Thus the capacity constraint model predicts a negative relationship between the premium rate for given limits of coverage and the (lagged) capital-premium ratio, whereas the risky-debt model predicts a positive relationship.

#### *Underpricing due to Moral Hazard or Inexperience*

Harrington and Danzon find some evidence to support the hypothesis that price cutting during the soft market may reflect moral hazard or inexperienced forecasting that can cause some firms to price too low, leading to matching price cuts by other firms in order to protect their market share and quasi rents in the short run.<sup>22</sup> This analysis does not test whether undercharging during soft markets contributes to hard markets, as these risky firms either exit or raise premiums. Here we provide rough tests for the hypothesis that underpricing during soft markets may contribute to the premium increases and firm exits that characterize hard markets. Specifically, we test for the effects of loss forecast errors on prior policies as well as the firm's experience and indicators of moral hazard or risk taking.

19. Winter (1994).

20. Grøn (1994).

21. Cummins and Danzon (1997).

22. Harrington and Danzon (1994).

*Industry Structure and Corporate Control*

A question of considerable research and policy interest is the extent to which physician-owned firms, which were formed in response to prior crises, behaved differently from commercial firms during the most recent crisis. Theory suggests that mutuals may have informational advantages in selecting and disciplining their policyholders. They may also be better bearers of nondiversifiable, socioeconomic risk,<sup>23</sup> for example, if they are able to assess their members if prior reserves prove to be inadequate due to unanticipated trends in legal rulings. However, physician-owned companies take many forms and may have different strategies. Some are highly selective, whereas others are not. Moreover, many have become stock firms. For other lines of insurance and other types of financial institutions, such conversions have raised questions of expropriation of policyholders. Thus it is an open question whether physician-directed companies now behave differently from stock companies.

Premium rate increases are sometimes blamed on insurer market power. We therefore test for effects of insurer concentration, as measured by the Herfindahl index of premium volume, at the state level.

*Tort Reforms and Insurance Pooling Mechanisms*

Many states enacted tort reforms in response to prior crises. Previous studies have found that caps on awards for noneconomic damages did reduce claim severity in the 1980s, and the bivariate analysis of the General Accounting Office suggests that states with caps under \$300,000 experienced lower premium increases in the 1990s.<sup>24</sup> Caps on awards for total damages may plausibly have a similar or greater effect, depending on the threshold. Collateral source offset is also found to reduce the frequency and severity of claims;<sup>25</sup> however, at most it constrains payments for economic loss, so the effects on growth in total premiums are uncertain. Limitations on joint and several liability could reduce physician premiums by limiting the plaintiff's ability to shift liability to the deepest-pocket defendant, who may be only tangentially related to the incident.

23. Danzon (1984); Doherty and Dionne (1993).

24. Danzon (1984); Zuckerman, Bovbjerg, and Sloan (1990); General Accounting Office (2003b).

25. Danzon (1984).

Joint underwriting associations, like any residual market mechanism, may solve an availability problem in the short run. But because the premiums of joint underwriting associations are usually flat rated or at most roughly differentiated by specialty and territory, such arrangements may ultimately increase total malpractice payouts by subsidizing the highest-cost doctors; depending on incentive structures, pooling arrangements may also weaken incentives for optimal cost control in managing claims. In many states, joint underwriting associations were set up on a pay-as-you-go basis, which bought short-term relief at the cost of creating unfunded liabilities that would have to be paid in the future. To the extent that these accumulated unfunded liabilities now necessitate assessments on physicians currently in practice, premium increases may be higher in states that established joint underwriting associations in the past.

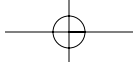
Similarly, patient compensation funds shift liability for the highest tier of losses to pools that are funded on a pay-as-you-go basis, with premium surcharges that are differentiated across physicians at most by broad specialty and territory designations, not by other measures of experience. Like joint underwriting associations, such pools shift rather than reduce claim payments. In fact, such pooling arrangements may ultimately increase total losses, to the extent that the pooling of losses weakens incentives for high-risk physicians to avoid losses or reduces the incentives for the entity running the pool to manage claims, and hence may result in the assessment of larger surcharges on current physicians than would occur in the absence of pooling.

The standard premium model in equation 1 can be modified to test these various hypotheses. First differencing and dividing by the lagged value give a model of the percentage increase in premium rates per physician.<sup>26</sup> Our estimating equation for percentage change in premiums is thus:

$$(2) \quad \begin{aligned} \Delta P_{smf} = & \alpha_1 \Delta L_{s(t-1)f} + \alpha_2 \Delta V_{(t-1)f} + \alpha_3 \Delta R_{s(t-1)f} + \alpha_4 Z_{s(t-1)} \\ & + \alpha_5 \Delta KP_{(t-1)f} + \alpha_6 EXP_{(t-1)f} + \alpha_7 NPG_{(t-1)f} \\ & + \alpha_8 \Delta REIN_{(t-1)f} + \alpha_9 M_f + \alpha_{10} \Delta F_{(t-1)f} + \alpha_{11} G_{(t-1)f} \\ & + HHI_{s(t-1)} + X_{(t-1)f} + Y_t + SPEC_m + e_{smf} \end{aligned}$$

where  $\Delta P_{smf}$  is the percentage change in the premium rate in state  $s$  between years  $t-1$  and  $t$  for specialty  $m$  for firm  $f$ ;  $\Delta L_{s(t-1)f}$  is the percentage change in losses plus loss-adjustment expense incurred between  $t-2$  and  $t-1$ ;

26. The percentage change in any variable  $V$  is calculated as  $[V_t - (V_{t-1})] / \text{abs}(V_{t-1})$ .

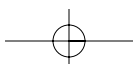
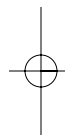
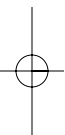


$\Delta V_{(t-1)f}$  is the percentage change in the rate of return on assets between  $t-2$  and  $t-1$ ;  $\Delta R_{s(t-1)f}$  is the percentage change in losses paid between  $t-2$  and  $t-1$ ;  $Z_{s(t-1)}$  is a vector of state-specific tort and insurance market reforms;  $\Delta KP_{(t-1)f}$  is the percentage change in the ratio of capital to net premiums written between  $t-2$  and  $t-1$ ;  $EXP_{(t-1)f}$  is firm experience equal to the quadratic of number of years since 1988 with premiums greater than \$3 million;  $NPG_{(t-1)f}$  is the percentage growth in net premiums written countrywide between years  $t-3$  and  $t-1$ ;  $\Delta REIN_{(t-1)f}$  is the percentage change in the ratio of reinsurance recovered to net admitted assets between  $t-2$  and  $t-1$ ;  $M_f$  is a dummy variable for a mutual or other physician-sponsored company;  $\Delta F_{(t-1)f}$  is the change between  $t-2$  and  $t-1$  in average percentage forecast error for policy years  $t-6$  through  $t-4$ ;  $G_{(t-1)f}$  is the average forecast error;  $HHI_{s(t-1)}$  is a statewide Herfindahl index;  $X_{(t-1)f}$  is a vector variable controlling for expected loss, yield, and availability of capital;  $Y_t$  is a dummy variable for year;  $SPEC_m$  is a dummy for physician specialty; and  $e_{smf}$  is a random error.

In equation 2, we include loss plus loss-adjustment expense incurred and loss paid in year  $t-1$  as proxies for expected loss in year  $t$ . As a measure of the expected yield on invested assets, we use the actual investment gain (net investment income plus realized capital gains, net of tax) divided by total assets in year  $t-1$  to test for the effects of firm-specific returns. Economywide changes in asset yields are captured by year fixed effects.

As a measure of the availability of capital, relative to exposure, we use the ratio of surplus to total net premiums written. This ratio is used in the NAIC's Financial Analysis Tracking System (FAST) developed in the early 1990s for solvency screening and was also used in the earlier Insurance Regulatory Information System (IRIS). Since it measures total surplus and all-lines national net premiums written, it reflects capital shocks from losses on all lines of insurance written by the firm, not just medical malpractice, and any unrealized capital gains and losses on invested assets.

We use two measures of loss forecast error. The average forecast error for policy years  $t-6$  to  $t-4$  measures the absolute reserve shortfall for these three years. The average percentage forecast error for years  $t-6$  to  $t-4$ , differenced, is the growth in this forecast error between years  $t-2$  and  $t-1$ . Since these forecast errors could reflect both unintended prediction error and intentional understatement of initial losses, we include other proxies for these characteristics. Growth in net premiums written between  $t-3$  and  $t-1$  is a measure of riskiness (premium growth is one of the FAST measures



of risk). As a measure of experience in writing medical malpractice, we use the number of years since 1984 that this firm wrote more than \$3 million of net premiums for medical malpractice. The ratio of reinsurance recovered to net admitted assets is included as a measure of risk taking, assuming that firms that grow unduly rapidly may hide this growth from regulators by reinsurance, some of which may be of dubious value.

We include indicator variables for four types of tort reforms: a cap on noneconomic damages at less than or equal to \$500,000 and a cap greater than \$500,000, a cap on total damages, collateral source offset, and modification of joint and several liability. These tort reform variables indicate whether a particular reform was enacted and not repealed in the state in year  $t - 1$ . If caps and collateral source offset limit the absolute level of awards, they should constrain the growth of premiums. We do not attempt to measure the effects of changes in tort reforms because very few states enacted changes during our sample period. Indicator variables are also included for states with joint underwriting associations and patient compensation funds.

We include a Herfindahl measure of market concentration at the state level. Standard models of concentration imply that firms in more concentrated markets have greater market power and hence may be able to raise premiums and should be less likely to exit. However, malpractice insurance markets are contestable—that is, the ability of policyholders to form self-insurance arrangements limits the market power of established firms. In contestable markets, concentration measures based on established firms provide an inaccurate measure of market power. Moreover, in states with joint underwriting associations, concentration may be high due to regulation of rates to levels deemed inadequate by voluntary insurers, in which case concentration would indicate inadequate rather than excessive rates.

We use the identical set of explanatory variables for both the exit equation and the premium equation. This tests the underlying hypothesis: that the same factors that lead to premium increases by financially solid firms may trigger exit by firms in financial distress.

#### *Estimation Methods*

The premium change equation is estimated using ordinary least squares with robust standard errors. We also estimate results adjusted for clustering of residuals across specialties and territories within firm-state-year. The exit equation is estimated using maximum likelihood complementary log-

log regression, with robust standard errors. The coefficients from this procedure reflect the underlying proportional hazards of exit, and taking the antilog of the coefficients yields hazard ratios. Results are also reported with standard errors adjusted for clustering by firm.

Several of the firm financial variables from NAIC had extreme values. The results reported here reflect the exclusion of outliers using two thresholds applied to the key explanatory variables: three standard deviations from the mean and the highest and lowest percentile values. Because of the large number of missing and outlier values for the percentage change in losses paid, we include an indicator variable for outlier or missing values of this variable. Using both screens reduces the number of state-year-firm-specialty observations for the premium change equation from 1,320 to 1,170. Results are very similar using either the three-standard-deviations screen alone or both screens. Results are also generally robust to excluding the top and bottom fifth percentile of observations. We report results here excluding outliers based on the two screens.

All dollar-denominated variables are adjusted to 2002 using the GDP deflator.

## Empirical Results

This section reports the results of multivariate analysis of premium rate increases and insurer exits.

### *Premium Increases*

Table 4 reports the analysis of premium increases. The dependent variable is the percentage increase in the premium rate for a specific firm-specialty-state-year. Significance levels are based on robust standard errors adjusted for clustering of residuals within firm-state-year to reflect possible correlation of a given firm's change in rates for different specialties and territories within a given state. The first specification omits year fixed effects, which are added in the second equation.

**ACTUARIAL MODEL.** The standard actuarial model, at least as proxied by our data, cannot explain the pattern of premium increases for medical malpractice insurance. Premium increases are unrelated to state-specific growth in lagged loss plus loss-adjustment expense incurred or paid, our proxies for

**Table 4. Annual Percentage Change in Malpractice Premiums, Select Years, 1994–2003\***

<i>Variable</i>	<i>Year fixed effects not included</i>	<i>Year fixed effects included</i>	<i>Variable</i>	<i>Year fixed effects not included</i>	<i>Year fixed effects included</i>
Percentage change in losses and loss-adjustment expenses ( $t-2$ to $t-1$ )	0.002 [0.416]	0.002 [0.357]	Years since 1984 with total medical malpractice net premiums earned $\geq$ \$1 million	-0.001 [0.944]	0.038* [0.060]
Percentage change in losses and loss-adjustment expenses paid ( $t-2$ to $t-1$ )	-0.001 [0.423]	-0.001 [0.522]	Years since 1984 with total medical malpractice net premiums earned $\geq$ \$1 million squared	0.001 [0.345]	-0.002* [0.057]
Percentage change in losses and loss-adjustment expenses paid is an outlier dummy ( $t-2$ to $t-1$ )	-0.003 [0.505]	-0.005 [0.227]	General surgery specialty dummy	-0.003 [0.481]	-0.002 [0.550]
Percentage change in investment gain ( $t-2$ to $t-1$ )	0.033 [0.286]	0.03 [0.326]	Obstetrics-gynecology specialty dummy	-0.013* [0.070]	-0.012* [0.085]
Noneconomic damage cap $\geq$ \$500,000 dummy	-0.008 [0.754]	-0.023 [0.366]	Average forecast error $t-6$ to $t-4$ ( $t-1$ )	-0.025 [0.691]	0.03 [0.626]
Noneconomic damage cap $<$ \$500,000 dummy	-0.054*** [0.001]	-0.057*** [0.001]	Average difference in forecast $t-6$ to $t-4$ ( $t-2$ to $t-1$ )	0.447 [0.212]	0.453 [0.214]
Total damage cap (any size) dummy	0.01 [0.785]	0.015 [0.657]	Forecast error variables are missing dummy	0.009 [0.825]	0.014 [0.734]
Collateral source offset in effect dummy	0.003 [0.842]	-0.001 [0.941]	Log of net medical malpractice premiums written (in millions of dollars) ( $t-1$ )	-0.013 [0.169]	0.002 [0.816]
Joint and several liability in effect	-0.056***				
	-0.041**				



the firm's expectation of future loss growth, assuming that current loss forecasts are based on immediate prior experience. Reported calendar-year loss plus loss-adjustment expense is an inaccurate measure of policy-year losses to the extent that calendar-year losses include revisions to reserves in prior policy years. However, these reserve adjustments are roughly controlled for through the two measures of countrywide change in forecast error. The finding that premium increases are unrelated to changes in state-specific losses incurred may reflect the considerable variability in year-to-year growth of losses at the state level, particularly for small firms whose loss experience has low credibility.

The change in investment yield is positive but insignificant, rather than negative, as predicted under the hypothesis that a firm's prior yields are a reasonable proxy for its expected future yields and that these rates are passed on to policyholders through premiums. Finding no significant effect of firm-specific yields on pricing is consistent with the alternative hypothesis: that pricing is based on economywide investment yields, such as Treasury bill rates, and that deviations of firm-specific yields from these economywide averages accrue to firms, not to policyholders, in competitive markets.

Testing for the effect on premiums of changes in economywide yields is problematic because the effects of yields cannot be distinguished from other time-varying but firm-invariant factors, which all are subsumed in the year variables. The significant year fixed effects imply average premium rate increases of 12.1, 21.6, and 26.8 percent, for 2001, 2002 and 2003, respectively, after controlling for increases in losses paid, losses incurred, and revisions to prior-year reserves. This pattern is consistent with the hypothesis that the decline in expected asset yields contributed to premium increases; however, the average effects seem too large to reflect yield effects alone. Moreover, changes in countrywide yields cannot explain the differences in premium increases and insurer exits across states and firms.

**CAPACITY CONSTRAINT HYPOTHESIS** The change in the capital-premium ratio is also insignificant. Thus these data *prima facie* provide no support for either the capacity constraint hypothesis, which posits a negative relationship between prices and the capital-premium ratio, or the insurance-as-risky-debt hypothesis, which posits a positive relationship between prices and the capital-premium ratio. It is possible that this finding of no effect of the premium-capital ratio on premiums reflects the fact that our dependent variable—the percentage increase in premium levels—does not directly measure the price of insurance, which is measured more appro-

priately by the loading charge or economic loss ratio. However, since our estimating equation controls for percentage change in loss plus loss-adjustment expense incurred, the change in premium rate controlling for change in  $L + LAE$  should measure the change in loading.

It is possible that the finding of no significant association on average between premium increases and an insurer's financial capacity may conceal differential effects, depending on the financial condition of the firm. For example, a financially sound firm that experiences a modest decline in its capital-premium ratio may be able to raise prices in the short run, assuming that policyholders would incur costs in switching insurers. However, if the shock to capital is sufficient to threaten insolvency, then the risky-debt hypothesis may dominate: the firm is unable to raise premiums, and policyholders may switch to other insurers, thereby increasing the risk of exit. This is a subject for future research.

**MORAL HAZARD AND INEXPERIENCE.** Premium increases are positively related to the growth in the forecast error on prior policies. This effect is highly significant when we exclude the fifth percentile outliers and is economically significant. A 10 percentage point increase in the forecast error is associated with a 63 percent increase in premiums, controlling for year effects. The effect is smaller and only significant at the 21 percent level in the specifications reported, which use a more parsimonious definition of outliers. This evidence is consistent with the hypothesis that firms that underestimate prior losses and undercharge, due to either inexperience or intentional risk taking, must eventually raise premium rates disproportionately if they are to stay in business.

Premium rate increases are positively related to prior growth in a firm's premiums written for years  $t - 3$  to  $t - 1$ , which is *prima facie* also consistent with the hypothesis that firms that undercharge and grow relatively rapidly during the soft market must eventually raise premium rates to stay in business.<sup>27</sup> However, this effect becomes insignificant once we control for year effects, which suggests that it reflects industrywide correlation of premium increases over time rather than variation across firms in response to their differential rates of prior premium growth. Premium increases are also unrelated to growth in reinsurance, another proxy for prior risk-taking behavior.

27. Growth in premiums written is positively correlated with growth in volume if demand is elastic.

Premium increases are significantly positively related to the firm's experience writing medical malpractice premiums, measured by the number of years since 1984 that the firm's net malpractice premiums written exceeded \$1 million. However, premium increases are unrelated to the firm's volume of malpractice premiums in  $t - 1$ , at either the state or the national level. This evidence suggests that willingness and ability to raise rates are related more to years of experience in the market than to the volume of a firm's current malpractice business.

**TORT REFORMS.** Noneconomic damage caps with thresholds at or below \$500,000 have slowed the growth in premiums, controlling for other factors. States with such caps, on average, have 6 percent smaller premium increases, on average, than states without such caps. By contrast, there is no evidence of significant effects of caps on awards for noneconomic damages at higher thresholds or of caps on awards for total damages. Limits on joint and several liability also appear to slow the rate of growth of premiums: states with such limits, on average, have 4.1 percent lower annual premium increases than states without such limits. Collateral source offset laws, on average, appear to have no effect. It is possible that the more stringent laws do indeed have an effect, even though the average effect is not significant.

The presence of a joint underwriting association or a patient compensation fund has no significant effect on premium increases in the specifications reported here. However, the effect of the joint underwriting association is significantly positive in some specifications, depending on outlier screens. As noted earlier, two of the joint underwriting association states, Pennsylvania and South Carolina, had the largest cumulative premium increases during the period studied. Thus it seems reasonable to conclude that joint underwriting associations at best do not reduce premium growth and, at worst, perhaps exacerbate premium increases.

**MARKET STRUCTURE AND CORPORATE CONTROL.** The Herfindahl measure of insurer concentration is negative and significant, indicating that premium increases are smaller in states with more concentrated insurance markets. This is inconsistent with allegations that malpractice premium increases reflect the market power of insurers that remain in the market after other firms exit. Rather, the evidence suggests that, in the context of malpractice insurance, insurer concentration is an indicator of inadequate rates, possibly due to rate regulation, which makes the market unattractive to new entrants. More generally, given the ease of entry to and exit from the

malpractice insurance market, market power of established insurers is unlikely to be significant.

Rate increases appear to be significantly higher for physician-directed insurers; however, this effect becomes insignificant after controlling for year effects. Thus to the extent that physician-directed firms do assess their members, this must be in the form of special assessments, not premium increases.

### *Insurer Exits*

Table 5 reports the complementary log-log regression estimates of determinants of firm exits over the period 1996–2002.<sup>28</sup> Recall that exit is defined at the firm-state level as a reduction in net premiums written below \$100,000 for the duration of our sample period. This measure designates firms as exiting if they become insignificant participants in a state, even if they remain solvent. In table 5, columns 1 and 3 omit year fixed effects, which are included in columns 2 and 4. Adjusting for year fixed effects may over-control for some variables that are highly correlated across firms over time, such as loss shocks or financial yields. Columns 3 and 4 include interaction terms, to test for differential effects for small insurers, defined as firms with under \$1 million direct premiums written in the state. Columns 3 and 4 report the average or large-firm effect; columns 5 and 6 report the small-firm interaction effect, with  $p$  values on the tests for significant differences between small and large firms. Columns 7 and 8 report the net effects for small firms; the  $p$  values indicate whether these net effects for small firms are significantly different from zero. All  $p$  values use robust standard errors. We also estimate significance levels adjusted for within-firm clustering of standard errors; if this adjustment changes the significance level, the new level is indicated in parentheses. The effects reported are  $e^{\beta} - 1$ , where  $\beta$  is the vector of estimated coefficients from the complementary log-log regression. These reported effects represent the percentage change in the hazard ratio for a one-unit change in the independent variable.

ACTUARIAL MODEL. Exits are unrelated to growth in lagged incurred or paid losses. Together with the similar finding of no effect of incurred or paid losses on premium increases, this evidence suggests either that recent state-specific loss experience is a poor proxy for expected future losses or that

28. The need for lagged explanatory variables eliminates from the regression sample exits that occurred in 1993–95.

**Table 5. Determinants of Firm-State Exit by Malpractice Insurers, 1993–2002<sup>a</sup>**

Variable	Exits no outliers		Large or average effect	Small interaction effect		Small net effect		
	(1)	(2)		(4)	(5)		(6)	(7)
Percentage change in losses and loss-adjustment expenses ( $t-2$ to $t-1$ )	0.002 [0.810]	0.000 [0.968]	-0.01 [0.375]	-0.011 [0.351]	0.016 [0.250]	0.015 [0.309]	0.01 [0.211]	0 [1.000]
Percentage change in losses and loss-adjustment expenses paid ( $t-2$ to $t-1$ )	0.001 [0.734]	0.001 [0.719]	-0.001 [0.877]	-0.002 [0.741]	0.005 [0.460]	0.006 [0.363]	0.004 [0.423]	0.005 [0.977]
Percentage change in losses and loss-adjustment expenses paid in missing dummy	0.019 [0.153]	0.018 [0.184]	0.014 [0.296]	0.012 [0.374]				
Percentage change in investment gain ( $t-2$ to $t-1$ )	0.623*** [0.000]	0.537*** [0.003]	0.265 [0.249]	0.163 [0.488]	0.673* [0.069]	0.721* [0.072]	1.116*** [0.000]	1.001*** [0.004]
Noneconomic damage cap $\geq$ \$500,000	-0.171 [0.213]	-0.173 [0.211]	-0.191 [0.161]	-0.189 [0.169]				
Noneconomic damage cap $<$ \$500,000	-0.046 [0.705]	-0.102 [0.398]	-0.009 [0.940]	-0.07 [0.572]				
Total damage cap (any size) dummy	0.247** [0.082]	0.191* [0.166]	0.301** [0.038]	0.261* [0.066]				
Collateral source offset in effect dummy	0.086 [0.444]	0.129 [0.259]	0.112 [0.329]	0.156 [0.184]				
Joint and several liability in effect dummy	-0.168** [0.050]	-0.15* [0.083]	-0.172** [0.048]	-0.154* [0.078]				
Joint underwriting association dummy	-0.011 [0.923]	-0.008 [0.947]	-0.017 [0.887]	-0.014 [0.903]				
Patient compensation fund dummy	-0.029 [0.815]	-0.015 [0.907]	-0.082 [0.504]	-0.081 [0.510]				
Percentage change in capital / net premiums ( $t-2$ to $t-1$ )	-0.321** [0.026]	-0.24* [0.051]	-0.429* [0.053]	-0.342* [0.088]	0.237 [0.560]	0.154 [0.638]	-0.294 [0.114]	-0.24 [0.76]
Percentage change in direct med mal premiums written ( $t-3$ to $t-1$ )	-0.253*** [0.005]	-0.271*** [0.002]	-0.704*** [0.008]	-0.704*** [0.008]	2.416*** [0.009]	2.346*** [0.009]	0.01 [0.881]	-0.01 [0.96]
Percentage change in reinsurance recovered / assets ( $t-2$ to $t-1$ )	-0.042** [0.027]	-0.047** [0.020]	-0.046** [0.040]	-0.054** [0.034]	0.006 [0.888]	0.015 [0.729]	-0.04 [0.241]	-0.039 [0.341]

Firm is physician directed dummy	-0.672*** (**) [0.000]	-0.676*** (**) [0.000]	-0.418*** (**) [0.004]	-0.393*** [0.011]	-0.686*** [0.000]	-0.711*** [0.000]	-0.817*** [0.000]	-0.825*** [0.013]
Years since 1984 with total medical malpractice net premiums earned $\geq$ \$1 million	-0.071*** ( ) [0.006]	-0.057** ( ) [0.034]	-0.002 [0.960]	0.025 [0.588]	-0.089 [0.123]	-0.097* [0.098]	-0.091** [0.017]	-0.074*** [0.000]
Years since 1984 with total medical malpractice net premiums earned $\geq$ \$1 million squared	0.000 [0.881]	-0.002 [0.231]	-0.005** [0.015]	-0.008*** [0.001]	0.007** [0.027]	0.008** [0.019]	0.002 [0.317]	0 [1.000]
Average forecast error $t-6$ to $t-4$ ( $t-1$ )	0.421** ( ) [0.018]	0.422** ( ) [0.019]	0.016 [0.944]	0.094 [0.702]	0.547 [0.195]	0.594 [0.172]	0.573* [0.063]	0.745*** [0.000]
Average difference in forecast $t-6$ to $t-4$ ( $t-2$ to $t-1$ )	-0.959*** (**) [0.000]	-0.972*** (**) [0.000]	-0.693 [0.180]	-0.892** [0.023]	-0.956** [0.012]	-0.913* [0.065]	-0.986*** [0.000]	-0.991*** [0.000]
Forecast error variables are missing dummy	10.121*** (***) [0.000]	8.813*** (**) [0.000]	15.851*** (**) [0.000]	14.371*** [0.000]	-0.768** [0.022]	-0.787** [0.019]	2.91*** [0.007]	2.271*** [0.000]
Log of net medical malpractice premiums written (in millions of dollars) ( $t-1$ )	-0.069* ( ) [0.051]	-0.059 [0.110]	0.048 [0.450]	0.069 [0.299]	-0.178** [0.018]	-0.201*** [0.009]	-0.138*** [0.005]	-0.146 [0.383]
Log of state direct medical malpractice premiums written (in millions of dollars) ( $t-1$ )	-0.292*** (***) [0.000]	-0.299*** (***) [0.000]	-0.215*** (***) [0.000]	-0.215*** [0.000]	-0.146 [0.225]	-0.197* [0.100]	-0.329* [0.07]	-0.369*** [0.000]
State-year Herfindahl-Hirschman index ( $t-1$ )	-0.797*** (***) [0.003]	-0.772*** (***) [0.007]	-0.831** (**) [0.020]	-0.807** [0.032]	0.104 [0.917]	0.098 [0.923]	-0.813** [0.015]	-0.788*** [0.003]
Year 1997 dummy		-0.566*** (*) [0.000]		-0.594*** [0.000]				
Year 1998 dummy		-0.533*** (*) [0.000]		-0.558*** [0.000]				
Year 1999 dummy		-0.106 [0.399]		-0.152 [0.250]				
Year 2000 dummy		0.011 [0.937]		0.01 [0.946]				
Year 2001 dummy		0.536*** ( ) [0.001]		0.533*** [0.001]				
Firm is small dummy			1.522** [0.014]	1.664** [0.011]				
Number of observations	8,163	8,163						

Source: NAIC annual statements, Medical Liability Monitor annual survey. Authors' calculations.  
 a. Robust p values in brackets. Significance levels in parentheses indicate significance with clustering by firm.  
 \* Significant at 10 percent.  
 \*\* Significant at 5 percent.  
 \*\*\* Significant at 1 percent.

state-specific loss experience is not a significant factor in a firm's decision to increase premiums or exit from a particular state.

Exits are significantly positively related to investment yield, which is inconsistent with the hypothesis that declining investment yields precipitate exits, at least for realized returns. However, this effect is confined to small firms, and the average effect becomes insignificant, with clustering of standard errors within firms.

**CAPACITY CONSTRAINT HYPOTHESIS.** Exit is significantly negatively related to growth in the capital-premium ratio. The effect is large and significant (with lower significance after adjusting for firm clustering): a one-unit increase in the capital-premium ratio is associated with a 32 percent (24 percent) reduction in the exit hazard without (with) controls for year fixed effects and is not significantly different for small versus large firms. Thus capacity constraints seem more likely to be associated with exits than with premium increases. This is not surprising for malpractice insurance, since physician policyholders are likely to be aware of and concerned about an insurer's financial quality and can switch at relatively low cost to other firms or to self-insurance arrangements rather than buy insurance from financially weak firms. This mobility of policyholders presumably constrains the ability of impaired firms to raise premiums beyond prospectively fair levels to recoup prior losses and restore their capital.

Several factors may have contributed to shocks to insurer capital over this period. The decline in equity values during 2000–02 presumably reduced insurer capital somewhat. However, the effect was limited if most insurers held the majority of their assets in bonds.<sup>29</sup> Unanticipated losses on insurance lines other than medical malpractice may have played a role for larger, multiple-line companies. However, the finding of no significant difference in the capital-premium ratio coefficient for small versus large companies suggests that losses on other lines were not a major contributor and that loss shock effects were more likely attributable to medical malpractice.

**MORAL HAZARD AND INEXPERIENCE.** Exits are significantly positively related to the average forecast error on prior malpractice policies written countrywide. This average effect is due solely to small firms: a one-unit change in the forecast error for small firms is associated with a 74.5 percent increase in the exit hazard, controlling for year fixed effects.

29. About 79 percent of assets of PIAA insurers is in bonds; Smarr (2003).

Exit is also strongly related to the indicator for firms with missing data for the forecast error. Since our estimate of the forecast error requires six prior years of data, firms with missing data have fewer than six years of experience writing malpractice insurance countrywide. The coefficients are bigger for large firms than for small firms; both imply a very large increase in the probability of exit for firms with less than six years of experience. Growth in the forecast error is significantly negatively associated with exit hazard. This is contrary to expectations. It may be influenced by the very large positive coefficient on the indicator variable for missing forecast data.

For small firms, the probability of exit is significantly negatively related to the firm's malpractice experience, as measured by the number of years with premium volume greater than \$1 million. A one-year increase in experience reduces the probability of exit 7–9 percent. Similarly, the exit hazard is negatively related to state-specific volume of business (malpractice premiums written), and this effect is greater for small firms than for large firms. A one-unit increase in the (log of) direct premiums written in the state reduces the exit hazard 22 percent for large firms and 37 percent for small firms. This strong evidence—that exit is more likely for firms with little experience or relatively small volume of premiums—is consistent with the hypothesis that firms with relatively little investment of tangible and intangible capital—hence relatively low quasi rents at risk—are more likely to exit.

Exit is significantly negatively related to growth in reinsurance recovered, relative to assets, but the effect is small and applies only to large firms. This suggests that, if anything, reinsurance is successfully used as a device to spread risk. Thus we find no evidence for the joint hypothesis: that firms tend to use reinsurance to conceal intentional risk taking and that this eventually leads to financial trouble and exit.

**MARKET STRUCTURE AND CORPORATE CONTROL.** Physician-directed firms are, on average, 67 percent less likely to exit than commercially owned firms, with larger differentials for small firms (82 percent) than for large firms (39 percent). This suggests that, although many physician-directed firms change their corporate form from mutual or reciprocal to stock firms, they nevertheless continue to behave more likely policyholder-owned firms than do the commercial stock firms. Whether this greater staying power reflects more conservative strategies, greater ability to assess their members, greater ability to restore inadequate reserves and depleted surplus, or other factors cannot be fully resolved with these data.

Exit is less likely in states with concentrated markets. This is consistent with the hypothesis that competition may be “excessive” in some states, leading to exit by firms with little experience and little tangible or intangible capital at risk. Consistent with this, the probability of exit is more than twice as high for small firms than for large firms, controlling for other factors such as experience.

### **Conclusions**

The most recent crisis in medical malpractice insurance exhibits some of the characteristics of a typical insurance cycle, but with some differences. In the late 1990s, aggregate premiums written and initial loss forecasts remained flat or declined, although insurers paying out larger amounts on claims were revising upward their loss forecasts and reserves for prior years. This “soft market” was followed by a sharp increase in premiums from 2000–2003, with inflation-adjusted median rate increases of 11–18 percent a year and rate increases of 30–60 percent for states in the top quartile of rate increases. At the same time, the number of firms exiting the market increased, including many small firms with relatively low premium volume and little experience but also several very large firms, including the St. Paul Companies, which had business in more than forty states.

This pattern is typical of insurance cycles, and our analysis of premium increases and insurer exits supports some of the hypotheses that have been developed to explain such cycles. A surprising finding is that state-specific premium rate increases are not significantly related to prior increases in state-specific losses paid or incurred, contrary to standard models of insurance pricing. This may reflect lack of credibility of firm-specific experience, especially for small firms in small states; however, it may also reflect strategic pricing, in particular, intentional undercharging in soft markets to gain market share.

The evidence also provides no support for the capacity constraint theory, in which rate increases are associated with shocks to an insurer’s capital-premium ratio. However, such loss shocks are associated with insurer exits. Taken together, this evidence suggests that firms experiencing significant declines in their premium-surplus ratio are unable to increase premiums to restore surplus and hence are more likely to exit. Given the relative ease with which physician policyholders can switch to self-insurance arrange-

ments and, more generally, the apparent ease with which new firms enter the medical malpractice insurance market, it is not surprising that established firms experiencing shocks to their surplus are unable to recoup these losses by raising premiums.

There is considerable support for the hypothesis that some of the problems of the crisis or hard market originated in the prior soft-market period. We find that premium increases were positively related to upward revisions of reserves following initial under-reserving and that firms with large prior forecast errors were more likely to exit. These findings are consistent with the hypothesis that under-reserving in the years of the soft market contributes to the premium increases and insurer exits of the hard market. How far this under-reserving reflects inexperience of new firms versus intentional undercharging to gain market share is not fully resolved here. However, we do find that firms with few years of experience and low premium volume—hence firms with relatively little experience and relatively low tangible and intangible capital at risk—are much more likely to exit. The theory of competitive price cutting implies that undercharging by some firms in the market can lead to matching price cuts by other firms seeking to preserve market share and quasi rents, which may in turn lead to large premium increases and to exit of the weakest firms. The evidence here is broadly consistent with this model; however, conclusions are tentative because our analysis does not incorporate changes in premiums over the 1998–2000 soft-market period.

Although the malpractice crisis is broadly consistent with models of insurance crises more generally, it is mitigated by certain features specific to medical malpractice. In particular, two types of tort reform—caps on awards for noneconomic damages with thresholds at or below \$500,000 and limits on joint and several liability—significantly reduce premium increases in states enacting such reforms. By contrast, caps on awards for noneconomic damages at higher levels and caps on awards for total damages appear to have no effect; conclusions are tentative, however, because of the small number of states with such caps.

The finding that caps on awards for noneconomic damages of under \$500,000 slow the growth of malpractice premiums is not by itself a sufficient reason for adopting such caps. The policy case for any tort reform, including caps on awards, should be based on whether such reforms improve the efficiency of the malpractice system in deterring medical negligence and providing appropriate compensation to injured patients. These

issues are discussed in detail elsewhere.<sup>30</sup> Placing some limits on awards for noneconomic damages is consistent with appropriate compensation. Such noneconomic losses are, by definition, irreplaceable; hence any attempt to place a dollar value on them is likely to be arbitrary and exposed to moral hazard. No form of private or social insurance other than tort law provides compensation for noneconomic damages. Thus, as individuals, we do not choose to buy such compensation for ourselves when faced with the choice and the bill; yet tort law effectively forces us to buy high levels of compensation for noneconomic loss for medical injuries, which we pay for as patients through higher fees for medical services. If some compensation for noneconomic damages is to be retained, economic theory suggests that a schedule of payments related to the severity of the injury and the patient's life expectancy would provide more appropriate compensation than a single cap that is most binding for young, severely injured victims who face a lifetime of disability. In designing an appropriate schedule of payments for noneconomic loss, an important issue is whether limiting the amount payable by the defendant might undermine the deterrence effects of the malpractice system. In practice, since physicians are generally heavily insured for monetary damages, it seems unlikely that reasonable limits on noneconomic loss would undermine any deterrence effects of the malpractice system. Indeed, such deterrence is plausibly derived primarily from the time costs, embarrassment, and other nonmonetary factors associated with being sued; these intangible costs depend on the frequency of claims rather than the severity per claim and so are unlikely to be affected significantly by caps on awards for noneconomic damages. Thus economic analysis supports scheduled limits on compensation for noneconomic damages, on grounds that such schedules improve the efficiency of tort compensation with minimal, if any, loss of deterrence. The fact that caps also tend to reduce malpractice premiums may have the added benefit of reducing disruption in insurance and medical markets; however, this is not the main rationale for such reforms.

Insurance market regulations, including joint underwriting associations and patient compensation funds, clearly do not reduce premium increases overall or reduce the probability of exit. Whether these mechanisms tend to increase costs remains an open question. Two states with joint underwriting associations (Pennsylvania and South Carolina) had among the largest

30. Danzon (1984).

cumulative premium increases over the period. This plausibly reflects the lagged effects of these pay-as-you-go mechanisms, which tend to shift losses to future years and may increase total loss payouts, if these pooling mechanisms undermine incentives for loss prevention and for claims management. More detailed analysis of the effects of these mechanisms is warranted but is beyond the scope of this paper.

In contrast to these mandatory pools, the voluntary changes in the insurance market have an effect. In particular, physician-directed firms are much less likely to exit, and this effect is greater for physician-directed small firms than for physician-directed large firms. Thus to the extent that entry, undercharging, and subsequent exit of inexperienced small firms contribute to the problems in this market, the evidence suggests that this problem applies less to physician-directed firms than to commercial firms.

If these tentative conclusions are correct—that the entry and subsequent exit of small, inexperienced firms contribute to the soft- and hard-market periods experienced in medical malpractice—appropriate policy response would have to weigh the competitive benefits of easy entry and exit against the costs, if indeed inexperienced players with little to lose do exacerbate insurance cycles.

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