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"Crises" in medical malpractice insurance: Evidence of excessive price-cutting in the preceding soft market ☆

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Abstract

Prior work suggests that heterogeneous information or weak incentives for solvency could have caused some general liability insurers to charge low ex ante prices during the early 1980s and mid-to-late 1990s, putting downward pressure on other firms' prices and plausibly aggravating subsequent periods of rapid premium growth. We analyse whether the 1994–1999 "soft" market in medical malpractice insurance led some firms to underprice, grow rapidly, and subsequently experience upward revisions in loss forecasts ("loss development"), which could have aggravated subsequent market "crises". Consistent with the underpricing hypothesis, the results indicate a positive relation between loss development and premium growth among growing firms. Underpricing was likely more prevalent among non-specialist malpractice insurers.

JEL classification: G22; L8; L11

Keywords: Medical malpractice insurance; Underwriting cycles; Underpricing

1. Introduction

Markets for many types of property/casualty insurance exhibit soft market periods, where premium rates are stable or falling and coverage is readily available, and subsequent hard market periods, where premium rates and insurers' reported profits significantly increase and less coverage is available. Conventional wisdom among practitioners and many other observers is that soft and hard markets occur in a regular "underwriting cycle", with potentially excessive price-cutting in soft markets amplifying premium rate increases and reduced coverage availability during subsequent hard markets. A substantial body of work has considered the causes of volatility in insurance prices, with an emphasis on price dynamics during hard markets. Prior analyses of pricing during soft markets of the early 1980s and mid-to-late 1990s in general liability (GL) insurance provide evidence of excessive price-cutting by some firms, which could reflect heterogeneity in information and associated winner's curse effects, or excessive risk-taking by some firms with weak incentives for solvency (Harrington and Danzon, 1994; Harrington, 2004).

We extend this work on excessive price-cutting in GL by using similar methods to analyse the mid-to-late 1990s soft market in medical malpractice insurance, a highly specialized market with significant policy relevance. The conclusions are broadly similar to those from GL insurance. Our empirical findings are consistent with the hypothesis that some firms underpriced and grew relatively rapidly during that period. These results suggest that market crises

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during the early 2000s were plausibly aggravated by previous price-cutting.[1]

Since the 1970s, medical malpractice insurance markets in the US have experienced severe volatility, with periods of sharp premium increases and limited availability followed by periods of flat or falling rates and easy availability, with the full cycle spanning roughly a decade. The malpractice crises of the 1970s and 1980s led some states to adopt tort reforms, including caps on awards for non-economic damages, and measures to assure the availability of insurance and reduce its cost to physicians, including joint underwriting associations and patient compensation funds.[2] Malpractice insurance markets also underwent dramatic voluntary changes to reduce insurer risk, with a shift from occurrence to claims-made coverage and the establishment of physician-sponsored mutuals, reciprocals, and risk retention groups to replace traditional stock companies that withdrew or curtailed their business during the crises.[3]

Nevertheless, after a long period of stable premiums through the mid 1990s, another crisis broke in the early 2000s. The median state-level premium rates for internists, general surgeons, and obstetricians/gynecologists increased 0–2% in 1996 and 1997 but 17–18% in 2003, ranging up to 60% in some states in 2001–2002, after adjusting for inflation (Danzon et al., 2004). In December 2001, the St. Paul Companies, which for decades had been the largest malpractice insurer operating in 45 states, announced its decision to withdraw entirely from writing medical malpractice insurance, citing large losses on its medical liability business. Several other significant malpractice writers reduced their exposure or exited, and some became insolvent. High premiums and carrier exits raised concerns over availability of medical services. Physicians in some states went on strike, threatened to leave the state, and/or discontinued certain high risk services.[4]

As noted above, the academic literature on these underwriting cycles has focused mainly on the hard market periods. The capacity constraint model of insurance market price dynamics (e.g., Winter, 1988, 1994; Gron, 1989, 1994; also see Gron and Winton, 2001) posits that hard markets are triggered by periodic exogenous shocks to insurer capital, often due to unanticipated growth in claim costs. Given the costs of adding external capital, the contraction of insurer capital in turn leads to a reduction in supply and an increase in the price of insurance.[5] The capacity constraint model suggests that anticipation of hard markets contributes to prior excess capacity and soft market pricing by insurers, but the soft market phase is not explicitly modeled and the role of heterogeneous firm behavior is not explored.

Harrington and Danzon (1994) develop a model of excessive price-cutting during soft markets. They posit that heterogeneity in firms' abilities to forecast claim costs and/or firms' incentives to charge adequate prices could lead some firms to set rates below actuarially appropriate levels, leading to rapid premium growth and adverse loss development (excess of ultimate loss costs over initial loss estimates) (see also McGee, 1986; Harrington, 1988).[6] Other insurers faced with excessive price-cutting by competitors may rationally cut prices below long run actuarial levels to preserve their quasi-rents on established business, thus increasing the scope of underpricing during soft markets and further amplifying rate increases during subsequent hard markets. Harrington and Danzon estimate reduced form models of premium growth and loss development as functions of firm characteristics that are plausibly related to pricing incentives, using firm-level data from general liability insurance during the early 1980s soft market. They also estimate a structural model of premium growth using loss development as an endogenous inverse price proxy with two-stage least squares. The overall results are consistent with the model of excessive price-cutting. Insurers with relatively high premium growth on average experienced significantly worse loss development. Similarly, Harrington (2004) analyses the 1990s GL soft market. Viewing firm-level price as an unobservable latent variable that should negatively affect both premium growth and loss develop-

[1] Harrington and Niehaus (2001) provide a survey of theory and evidence on insurance price volatility and insurance cycles. Time-series analyses of insurance underwriting and profit margins often provide evidence of second-order auto-regression, which is consistent with cyclical patterns. Regardless of whether true economic cycles characterize some insurance markets, there is no doubt that fluctuations in insurance premium rates and coverage availability are difficult to explain fully by standard economic models that assume rational agents and few market frictions.

[2] A GAO report (GAO, 2003a) on the early 2000s crises concluded that, although physicians in most states have experienced some increase in premium rates since 1999, the between-state variation has been significant. It also concluded that the rate of premium increase has been significantly lower in states that enacted tort reforms, specifically, caps on awards for non-economic damages. Danzon et al. (2004) provide evidence that states that enacted caps on non-economic damages at or below $500,000 and limits on joint and several liability in response to prior crises had significantly lower premium increases than states without such caps. See Viscusi and Born (2005) for related analysis and findings using data from the 1980s and early 1990s. Also see Born and Viscusi (1994).

[3] In theory, physician-owned companies may have informational and/or risk sharing advantages over stock companies in writing a line such as medical malpractice insurance (e.g., Danzon, 1984; Doherty and Dionne, 1993).

[4] Evidence of widespread, measurable effects of the crisis on availability of medical services is limited (see US GAO, 2003b; also see Baicker and Chandra, 2004; Dranove and Gron, 2005).

[5] Cummins and Danzon (1997) (also see Cagle and Harrington, 1995) extend this model to include insolvency risk of insurers and demand for insurance that depends on the firm's financial quality, stressing that a decline in insurer capital leads to a decline in the price of insurance, as measured by the loading charge, but that premium rates may nevertheless increase, to the extent that expected loss costs increase.

[6] McGee (1986) speculated that insurers with optimistic loss forecasts may cause prices to fall below the level implied by industry average forecasts. Winter (1988, 1991) mentions the possibility of heterogeneous information and winner's curse effects.

ment, he tests for an empirical relation between the two variables. Consistent with excessive price-cutting by some firms leading to more rapid premium growth and greater loss development, he finds evidence of an economically and statistically significant positive relation between the two variables, especially among growing firms and during the depth of the soft market.

We apply these methods to test for underpricing during the 1990s soft market in medical malpractice and examine the contribution of firm-specific propensities for underpricing due to either inexperience or weak incentives. Our analysis extends previous work by Danzon et al. (2004), which examined malpractice premium increases and state-level insurer exits during the hard market of the early 2000s. They found no evidence that shocks to insurer capital contributed to increases in premium rates, but some evidence that capital shocks contributed to malpractice insurer exits at the state-level. Although they did not explicitly analyse the 1990s soft market, they do show that malpractice insurance loss development was positively related to premium rate increases and positively related to insurer exits. Estimated exit probabilities from individual states were much higher for small firms and for recent entrants, both of which are indicators of inexperience and/or relatively low tangible and intangible capital.[7] This evidence suggests that excessive price-cutting during the soft market may have contributed to the hard market by causing losses, depleting capital, aggravating capacity constraints, and requiring larger premium increases to catch up with growth in expected claim costs.

We provide substantial context for our analysis by reporting aggregate insurance industry level data on trends in malpractice premiums, losses and accounting profits. We then use country-wide firm-level data (i.e., aggregate, group-level data for affiliated insurers) on malpractice experience during the mid-to-late 1990s soft market to test whether firms with limited experience or weak incentives were more prone to underprice, and whether firms that underpriced subsequently grew more rapidly. The empirical strategy is designed to deal with the lack of data on firm-level prices charged or quantity of coverage sold. The theoretically appropriate measure of insurance price is the loading charge or loss-ratio. However, actual reported ratios of losses to premiums are extremely noisy at the firm-level and provide an unreliable estimate of insurance prices. Following Harrington and Danzon (1994) and Harrington (2004), we explain how unobservable heterogeneity in prices should affect premium growth and loss development (i.e. the revision in the insurer's estimate of the ultimate cost of claims). If some insurers undercharge, due to either naive forecasting (e.g., due to inexperience) or excessive risk-taking (due to inadequate incentives for solvency), they are likely to experience more rapid premium growth and adverse loss development; i.e. the ultimate loss realization will exceed the original loss estimate. Viewing price as an unobservable, latent variable, we test for the implied positive empirical relationship between loss development and premium growth. We also test an additional implication of the latent variable approach, that firm characteristics that are related to underpricing should have the same signs in reduced form estimates of loss development and premium growth models.

The empirical evidence is consistent with the underpricing hypothesis. We find a positive relationship between premium growth and loss development, as predicted if firms that underprice tended to grow more rapidly and experience adverse loss development.[8] The results also suggest that underpricing was higher for non-specialist insurers, which may be both poorly informed and/or have weak incentives. These results, together with the evidence of severely negative underwriting margins by the end of the soft market, are consistent with the hypothesis that crisis of the early 2000s, including large premium increases and insurer exits, was aggravated by previous price-cutting.[9] We provide some evidence concerning the empirical relationship between abnormally large premium growth and insurer exit due to insolvency. Results are inconclusive, plausibly due to the small sample of insolvent firms and the fact that some firms that grow rapidly may subsequently contract sales prior to exiting, leading to heterogeneity in the relationship between exit and premium growth immediately prior to exit.

Section 2 briefly reviews the "perfect markets model" of insurance prices and the implications for medical malpractice insurance prices and premium growth, as the benchmark against which to test theories of insurance cycles in general and excessive price-cutting in particular. To test whether the evidence is *prima facie* consistent with the perfect markets model, Section 3 documents trends in aggregate medical malpractice insurance premiums, reported losses, and discount factors, and then reports time series regressions of the relationship between premium growth, loss growth, and changes in discount rates. These data indicate a strong positive relation between premium growth, loss, and discount factor growth, implying that the perfect markets model explains much of the variation in malpractice premiums. However, there is some evidence of significant residual and plausibly cyclical variation in premium growth after controlling for loss and discount factor growth, which suggests some role for models of cycles and excessive price-cutting. Section 4 describes the data

[7] Estimated exit probabilities were much lower for physician-directed firms than for commercial firms, and this differential was greater for small firms.

[8] Strictly, the theoretical model requires the assumptions that (1) firms do not fully anticipate this winner's curse risk and adopt offsetting price adjustments, and (2) buyers are insensitive to any additional insurer insolvency risk that may result from undercharging. These issues are discussed in detail in Harrington and Danzon (1994), which presents a formal model of rational insurer response to underpricing by competitors given fixed costs and winner's curse risk.

[9] We conducted similar analysis using data at the level of the individual (subsidiary or stand alone) insurer. The results had similar implications, albeit with lower and less reliably estimated effects.

and methodology of our analysis of price-cutting, premium growth and insurer exits using firm-level malpractice experience during the 1994–1999 soft market. Section 5 reports results, and Section 6 concludes.

2. The perfect markets model of insurance pricing

When an insurer sells a long-tailed line of insurance such as medical malpractice, it collects a premium P_s for policies sold in year s and pays claims ("losses") C_{st} on this policy in years $t \geqslant s$. With competitive insurance markets and frictionless capital markets, the insurance premium for a given risk will equal the risk-adjusted discounted value of expected loss and loss adjustment expense, sales and underwriting expense, taxes, and any other costs, including the tax and agency costs of holding capital reserves. The amount of capital reserves depends on uncertainties about loss and other costs, regulatory requirements and the insurer's target insolvency risk. For accounting purposes, the firm reports its initial estimate (forecast) of undiscounted losses for all events in year s; loss development is the change over time in this estimate as more claims are filed and paid.

The long payout tail for GL and medical malpractice insurance implies that premiums are highly sensitive to discount rates and that losses may be subject to significant uncertainty. For medical malpractice occurrence coverage, which covers losses arising out of events in the policy year, roughly one third of losses remains unpaid five years after the policy year; for claims-made coverage, which covers claims filed in the policy year, roughly 15% of losses remain unpaid five years after the policy year (see Fig. 1). Because the shorter claims-tail for claims-made coverage reduces forecast error risk, most insurers had switched from occurrence to claims-made coverage by the 1990s.[10]

The perfect markets model implies that premium rate levels and rate changes reflect levels and changes in any of the contributing factors. In practice, changes in expected losses and discount rates are the primary contributors to premium changes, assuming that payout patterns, tax rates and other factors are reasonably stable over time. With competitive insurance markets and frictionless supply, intertemporal variation in the underwriting margin between premiums and discounted (i.e. net of investment income) reported claim costs (which is a measure of the loading charge or price of coverage) will primarily reflect unexpected changes in claim costs. Variation in underwriting margins exclusive of investment income could also

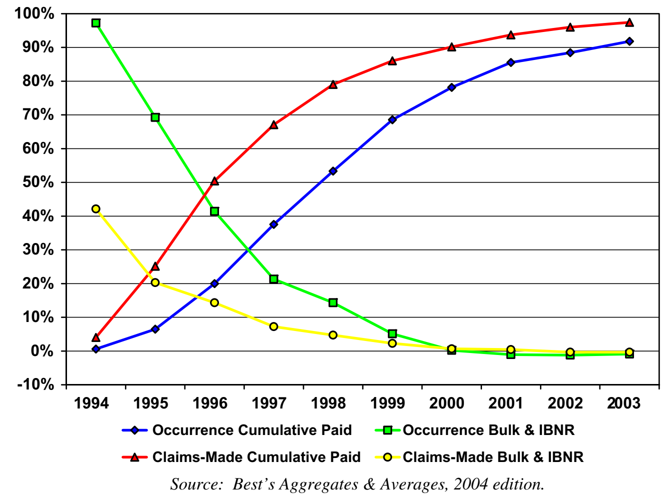


Fig. 1. Medical malpractice insurance cumulative paid claims and bulk and IBNR reserves as proportions of estimated ultimate incurred losses for 1994 accident-year: occurrence and claims-made coverage.

reflect changes in interest rates. These underwriting margins should not be cyclical, although positive correlation across years is possible if, for example, changes in legal doctrines or judicial practices affect the disposition of all outstanding or unfiled claims, including those arising out of prior policy years. In the absence of regulatory constraints, changes in coverage availability should be caused primarily by changes in adverse selection, which may cause low-risk policyholders to reduce coverage.

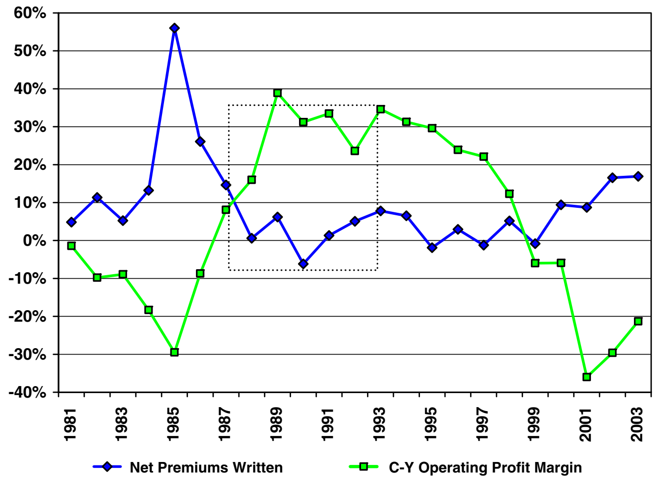
Previous studies, primarily focusing on GL insurance (including product liability), have shown that the modern expansion of tort liability has led to substantial long-run growth in claim costs, including episodes of rapid short-run cost growth and high loss adjustment expense, and substantial uncertainty about claim frequency and severity (Winter, 1994; Harrington, 2004). For long-tailed lines such as GL and medical malpractice insurance, rapid growth in expected claim costs in conjunction with increased uncertainty about costs can produce sharp increases in premium rates, particularly if accompanied by declining interest rates. The next section presents trends in aggregate premiums, losses, discount factors and underwriting margins, to provide some evidence on the extent to which changes in malpractice premiums can be explained by changes in expected losses and interest rates, consistent with the perfect markets model, or whether other factors, such as excessive price-cutting, plausibly contribute to the observed premium cycles.

3. Trends in aggregate premiums, losses and underwriting margins

3.1. Aggregate trends

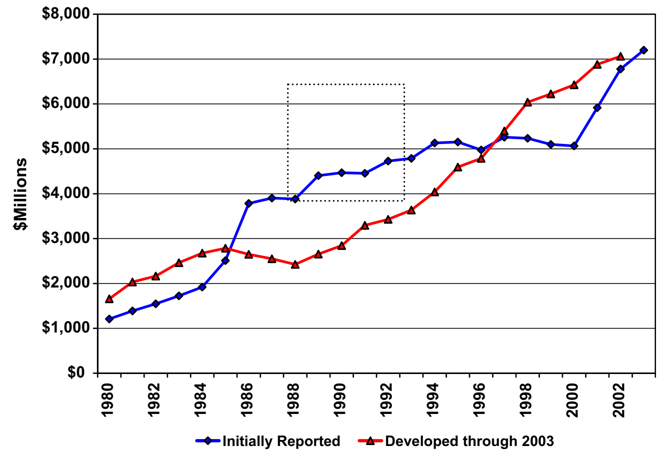
Fig. 2 plots percent growth in aggregate net (after reinsurance) premiums written for medical malpractice insurance from 1981 through 2003, for occurrence and

[10] Fig. 1 also shows that a large proportion of initially reported losses represented estimated costs for claims predicted to have occurred but that had not yet been reported to insurers and for bulk reserves (insurers' forecast of how case reserves in the claim files are likely to develop). Reserves for the estimated costs of claims that have been incurred by not reported as of the report date (IBNR) and bulk reserves for occurrence coverage represented over 40% of incurred losses in two years after the end of the 1994 accident-year. Both forms of reserves are subject to large forecast errors.



Source: Best's Aggregates & Averages, various editions.

Fig. 2. Medical malpractice insurance net written premium growth and calendar-year pre-tax operating profit margins, 1981–2003 (1994–1999 soft market period highlighted in rectangle).



Source: Best's Aggregates & Averages, various editions.

Fig. 3. Medical malpractice insurance accident-year incurred losses: initially reported and developed through 2003.

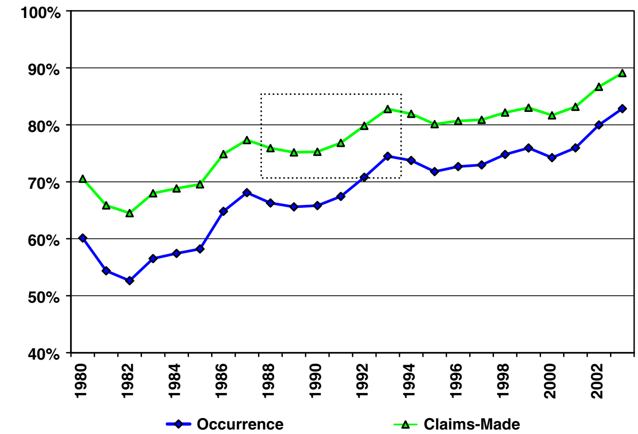
claims-made coverage combined.[11] It also shows pre-tax operating margins (premiums minus reported losses and other sales expenses, as a proportion of premiums) plus the ratio to earned premiums of net investment income (interest and dividends) and realized capital gains or losses. The operating margin is on a "calendar-year" basis; that is, the reported loss for year t includes expected loss for policies written in year t plus changes in loss forecasts for claims arising from prior policy years. Dramatic premium growth during the mid 1980s in conjunction with negative operating margins was followed by about a dozen years of relatively stable premiums and favorable margins. The figure shows a strong inverse relation between premiums and operating margins. Following the dramatic premium growth in the mid-1980s, operating margins turned positive; however, after almost 12 years of essentially zero premium growth in the 1990s, operating margins turned sharply negative in 2000–2001, while premiums rose sharply. This evidence is *prima facie* consistent with the hypothesis that the period of flat or falling premiums in the late 1990s contributed to the sharply negative margins and hence to the subsequent premium increases.

Evaluating whether the flat premiums of the 1990s were consistent with reasonable loss expectations is problematic due to the unobservability of insurers' loss forecasts at the time policies are priced, the possibility of large but rational forecast errors and the possibility of intentional "management" of reported losses to smooth accounting earnings. Nevertheless, to shed some light on trends in expected losses, Fig. 3 plots reported incurred losses (including allocated claim adjustment expenses) on an "accident-year" basis (i.e. excluding revisions of prior loss forecasts) from 1980 through 2003. Two series are shown: (1) losses "initially reported" at the end of the year for events during year t, and (2) losses "developed" through year $t+9$ or 2003 if sooner, which reflect subsequent revisions to loss estimates for year t. The large malpractice premium increases of the mid 1980s "crisis" were associated with a sharp increase in initially reported accident-year losses, consistent with similar evidence for the GL insurance crisis (e.g., Harrington, 1988; Harrington and Litan, 1988). From 1986 through 2000, initially reported losses grew moderately, while premiums remained flat. Initially reported losses then jumped in 2001–2003 in conjunction with significant premium increases. Developed losses substantially exceed initially reported losses for 1980–1984. From 1986 through the mid 1990s, however, developed losses are less than initially reported losses; that is, loss forecasts on an accident-year basis were revised downward through 1998, but this pattern reversed from 1998–2002. Thus this evidence suggests that the soft market of the late 1990s was due at least in part to initial underestimation (or underreporting) of losses.

To shed light on the potential contribution of interest rates to malpractice premium growth, Fig. 4 plots estimated discount factors (the estimated present value of $1 in ultimate claim costs) using estimates of the claims payment tail for occurrences in 1994 (see Fig. 1) and spot rates for US Treasury securities.[12] Significant reductions in interest rates during 1983–1987, 1991–1993, and 2001–2003 produced significant increases in the discount factors. The 1983–87 and 2001–2003 periods of declining interest rates

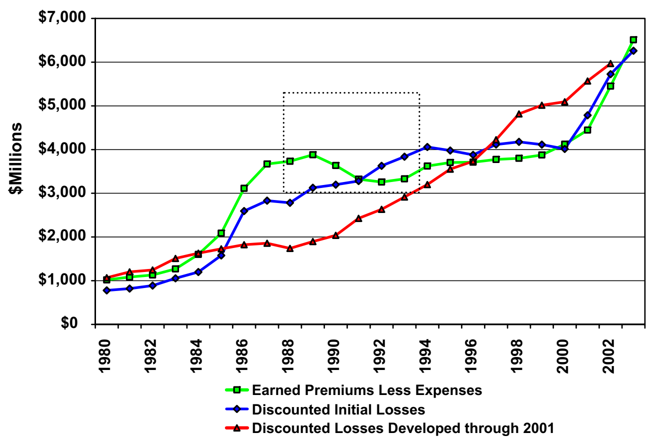
[11] Although aggregate premiums reflect both price and quantity of coverage, intertemporal variation primarily reflects changes in premium rates (price), under the plausible assumption that the number of practicing physicians is reasonably stable over time and almost all physicians obtain insurance.

[12] We assume a 12-year payout period with payments made mid-year and that remaining unpaid losses as a proportion of incurred losses after nine years are paid equally over the next three years. Constant maturity US Treasury yields are reported for 1, 2, 3, 5, 7, and 10-year maturities. We used linear interpolation to generate spot rates for years 4, 6, 8, and 9. For Figs. 4–6, we use the average spot rates for years t and $t-1$ to better match the year premiums are earned and losses occur.



Source: Best's Aggregates & Averages,various editions, and Federal Reserve. Authors' calculations.

Fig. 4. Medical malpractice insurance estimated discount factors for occurrence and claims-made coverage, 1980–2003.

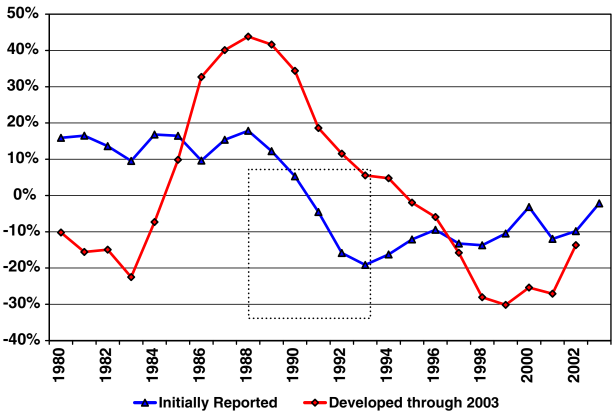


Source: Best's Aggregates & Averages, various editions, and Federal Reserve. Authors' calculations.

Fig. 5. Medical malpractice insurance premium margins and estimated discounted accident-year incurred losses, 1980–2003.

coincided with rapid growth in incurred loss estimates, thus putting further upward pressure on medical malpractice premiums. More generally, the decline in interest rates and consequent increase in discount factors since the early 1980s contributed significantly to overall premium growth.

Fig. 5 plots three series for 1980–2003: (1) underwriting margins (earned premiums less loss plus loss adjustment expenses, a rough approximate GAAP margin), (2) discounted initially reported accident-year losses, and (3) discounted developed accident-year losses.[13] The underwriting margin is more cyclical than initial loss forecasts. In particular, from 1994–1999 although initial losses were rising and loss development was positive, underwriting margins were flat, presumably due to flat premiums, in the face of rising losses, which is consistent with underpricing.



Source: Best's Aggregates & Averages, various editions, and Federal Reserve. Authors' calculations.

Fig. 6. Medical malpractice insurance estimated discounted operating margins: initially reported and developed (through 2003) accident-year incurred losses, 1980–2003.

Finally, Fig. 6 plots the pre-tax operating profit margins (as a percent of premiums) based on discounted reported initial and developed losses. The margin based on initial losses is mildly cyclical, at roughly +15% through the 1980s, turning negative after 1990, reaching a minimum of −23% in 1993. This pattern could be consistent with the perfect markets model only if insurers had experienced a significant decrease in risk or in per unit capital costs. The margin based on developed losses follows initial losses with a lag and with much wider cyclical swings, ranging from −22% in 1983 to +43% in 1988, back to −30% in 1999, which indicates large forecast error, including both lags and possible overshooting in adapting expectations to claim cost realizations.

Overall, these aggregate data suggest that rising expected claim costs and declining interest rates were major contributors to malpractice premium increases over the 1980–2003 period, and that forecast errors were significant. However, the pattern of flat premiums from 1994–2000, in the face of rising loss forecasts, negative margins, and deteriorating loss development, is suggestive of excessive price-cutting. The resulting persistently negative margins, of −10 to 20% on initial losses and up to −30% for developed losses, plausibly contributed to the sharp premium increases of the early 2000s.[14]

3.2. Time series regressions

In order to provide additional evidence of the extent to which changes in estimated losses and interest rates can explain changes in aggregate malpractice premiums, we estimated simple time series regressions of premium growth on

[13] Discounted losses are calculated using the estimated discount factors shown in Fig. 4. The margin between premiums and underwriting expenses should correspond fairly closely to the policies that produced losses each year.

[14] It is possible that some forecast error could reflect uncertainty as to the effects of tort reforms that some states enacted. However, most state reforms were enacted in the 1970s and 1980s or following the 2000s crisis.

Table 1
Time series regressions of us medical malpractice insurance log growth in net premiums earned, 1981–2003

Estimation Method	Constant	Log loss growth$_t$	Log discount factor growth$_{t-1}$	Log loss development$_t$	AR(1)	AR(2)	Adj. R^2	Log–likelihood
OLS	0.019	**0.820**					0.636	
	(0.315)	**(0.000)**						
	0.013	**0.802**	**0.733**				0.757	
	(0.489)	**(0.000)**	**(0.000)**					
	0.017	**0.784**	**0.856**	**0.080**			0.803	
	(0.226)	**(0.000)**	**(0.000)**	**(0.054)**				
MLE	**0.084**				**0.847**	−0.236		27.70
	(0.096)				**(0.000)**	(0.341)		
	0.044	**0.516**			**0.739**	−0.182		41.15
	(0.207)	**(0.001)**			**(0.002)**	(0.387)		
	0.044	**0.478**	**0.577**		**0.906**	−0.224		41.52
	(0.217)	**(0.000)**	**(0.003)**		**(0.001)**	(0.490)		

Note: *p*-values in parentheses. OLS *p*-values based on Newey-West standard errors (allowing two lags). Bold values are significant at the 0.10 (0.05) level for a two-tailed (one-tailed) test.

initially reported accident-year loss growth, estimated discount factor growth, and loss development using annual data during 1981–2003.[15] The models are motivated by the following discrete representation of premiums in year t (P_t):

$$P_t = \lambda_t \delta_t E_t(L_t), \tag{1}$$

where $E_t(L_t)$ is the expectation at the beginning of year t of total losses, L_t, for policies sold in year t; δ_t is the discount factor for payments arising out of those losses, which reflects the expected payout pattern and spot interest rates; and λ_t is the loading factor to reflect underwriting expenses and the expected pre-tax profit margin.

Log premium growth from $t-1$ to t can be written:

$$\ln(P_t/P_{t-1}) = \alpha_0 + \alpha_1 \ln(E_t(L_t)/E_{t-1}(L_{t-1})) + \alpha_2 \ln(\delta_t/\delta_{t-1}) + \varepsilon_t, \tag{2}$$

where $\alpha_0 = 0$, $\alpha_1 = \alpha_2 = 1$, and $\varepsilon_t = \ln(\lambda_t/\lambda_{t-1})$. If expected losses and discount factors were observable, Eq. (2) would provide direct evidence of the extent to which premium growth could be explained by changes in discounted expected claim costs. If the "disturbance", ε_t, were uncorrelated with the regressors, the probability limit of the least squares slopes would be one. Coefficient estimates that are significantly different from unity would imply non-zero correlation between the disturbance and one or both regressors. A perfect markets interpretation of such a result would require explanation of why non-claim expenses and/or the pre-tax expected profit margins would be correlated with expected loss or discount rate growth.

We estimate Eq. (2) using 1981–2003 data on log growth in net earned premiums, log growth in initially reported accident-year losses, and log growth in discount factors estimated with the 1994 accident-year pay-out tail and spot rates on US Treasury securities. The discount factor is lagged one year, to allow for lag in adjustment of premium rates to interest rate changes. Log growth in initially reported losses may measure log growth in true initial expected losses with error, to the extent that loss forecasts are revised between the time policies are sold and the report date or reporting is biased for purposes of earnings management. Random error in either loss growth or discount factors would likely bias the estimated slope coefficients downward and reduce explanatory power.

Table 1 presents the results of estimating several versions of Eq. (2). The first panel shows ordinary least squares (OLS) estimates using Newey-West standard errors (allowing two lags) to allow for serial correlation in the disturbances. Log loss growth alone explains 64% of log premium growth. The estimated slope of 0.82 is significantly less than one at the 0.05 level, but it seems reasonably close to one given the use of accounting data and potential downward bias due to measurement error.[16] Adding the discount factor raises explanatory power to 76% of the variation in log premium growth. The third equation adds the log of loss development (developed through year $t+9$ or, if earlier, 2003). If insurers systematically overestimate initially reported losses during hard markets, log loss development would be negatively related to log premium growth because initial loss forecasts would subsequently be revised downward. Instead, the estimated slope for log loss development is positive, possibly due to the highly variable pattern of annual changes in premiums and losses, as documented earlier.[17]

[15] We simply assume stationarity of the series for conceptual reasons (e.g., shocks should be transitory), the small sample size, and related empirical evidence (see Yu and Harrington, 2003).

[16] The high correlation between reported losses and premiums for malpractice insurance at the industry level contrasts with analyses using firm-state level data (Danzon et al., 2004) and state-level data on paid claims (Baicker and Chandra, 2004). Firm-level or firm-state level loss data are subject to large random variation in incurred (and thus reported) losses. Given the long claims-tail, changes in paid losses will likely be only roughly correlated with changes in loss forecasts.

[17] Note that while Fig. 3 indicates large negative development following the large premium increases in the mid 1980s, negative loss development continued for years after premium increases had slowed, perhaps indicating, at least in part, favorable loss shocks.

The second panel of Table 1 shows maximum likelihood estimates (MLE) of Eq. (2) that allow for second-order autocorrelation in the disturbances. The MLE estimates could be subject to non-trivial bias in a sample this small. The estimated slopes for log loss growth and log discount factor growth decline compared with OLS but remain positive and statistically significant. The large positive first-order autocorrelation parameter implies strong first-order serial correlation in the disturbances. The second-order terms are negative, consistent with "cyclical" disturbances, although small relative to their standard errors. By itself, this finding provides only modest support for the hypothesis of cyclical variation in log premium growth during 1981–2003, but the sample obviously is very small, including only two soft and two hard markets. Estimates of an AR(2) model for log loss development (not shown) were consistent with second-order auto-regression in loss forecast revisions.

4. Testing for underpricing using firm-level data: Data and methodology

We use the latent variable approach outlined in Section 1 to test for underpricing during the soft market period 1994–1999. Omitting firm and time subscripts, let g denote firm j's premium growth, d denote its loss development (the difference between loss forecasts for claims in period t as of the end of period $t+n$ versus those initially reported at the end of year t), and p^* denote its unobservable (average) price or premium rate which is based on ex ante loss forecasts. Ignoring for simplicity non-random factors that could affect premium growth, assume further that

$$g = \alpha_0 - \alpha_1 p^* + \varepsilon, \quad \alpha_1 > 0,$$
$$d = \beta_0 - \beta_1 p^* + \upsilon, \quad \beta_1 > 0,$$

i.e., premium growth and loss development are negatively related to price, where ε and υ are random disturbances.

Substituting for p^* in the loss development equation:

$$d = \gamma_0 + \gamma_1 g + \upsilon - \gamma_1 \varepsilon, \quad \gamma_1 = \beta_1/\alpha_1 > 0.$$

Thus, d and g are positively related due to their joint dependence on p^*. Because g is correlated with ε, least squares estimates of γ_1 will be subject to attenuation bias.[18]

Estimates of the loss development equation will therefore be biased against finding evidence consistent with price-cutting induced premium growth and adverse loss development.[19]

To test for effects of heterogeneous firm characteristics, let x represent a vector of firm characteristics that influence price setting, with $p^* = \lambda' x$ plus a disturbance. Substituting for p^* in the premium growth and loss development equations yields reduced form equations where the coefficients on each characteristic will have the same sign in both equations. Thus any characteristic that is significantly related to premium growth and loss development with the same sign is plausibly related to underpricing. Absent underpricing or biased loss reporting for reasons unrelated to pricing, loss development should be random (unrelated to firm characteristics except by chance).[20]

Given this framework, we use firm-level data (aggregated across subsidiaries with common ownership) for 1994–1999 from the National Association of Insurance Commissioners (NAIC) database to estimate Eq. (3):

$$\mathrm{LRD}_{jt} = \delta_0 + \delta_1 \ln(P_{jt}/P_{jt-1}) + \delta_2 \ln(P_{jt-1}) + e_{jt}, \tag{3}$$

where, for firm j and year t, LRD_{jt} is the firm's loss ratio development, defined as the difference between the firm's developed accident-year loss ratio for year t (with losses developed through 2002, to provide at least three years of development for any year) and its initially reported accident-year loss ratio for year t; $\ln(P_{jt-1})$ is log net earned premiums in $t-1$; $\ln(P_{jt}/P_{jt-1})$ is log premium growth; and e_{jt} is a disturbance term.[21] If relatively high premium growth is associated with a relatively low price, δ_1 is expected to be positive. We include lagged (log) premiums to control for possible variation in the relationship between premium level and premium growth by firm size, due to life cycle effects (firm growth rates tend to be inversely related to firm size) or other factors.

In practice, the hypothesized positive relation between loss development and premium growth due to underpricing may be more likely for firms that experienced positive growth during our period. The reason is that if some firms exhibited poor underwriting experience prior to 1994, due

[18] Under the standard assumptions that the disturbances are homoskedastic and uncorrelated, the probability limit of the least squares estimator is

$$\mathrm{plim}(\hat{\gamma}_1) = \frac{\gamma_1}{1 + \frac{1}{\alpha_1^2}\frac{\mathrm{var}(\varepsilon)}{\mathrm{var}(\upsilon)}}.$$

Note that in theory we could alternatively substitute for d in the premium growth equation and regress premium growth on loss development. We prefer the former approach because the high empirical variability in loss development suggests that $\mathrm{var}(\upsilon)$ may be large compared with $\mathrm{var}(\varepsilon)$. Regressing premium growth on loss ratio development supported the same conclusions as the results reported in Table 3 (a statistically reliable positive relation between premium growth and loss ratio development for growing firms, with virtually identical p-values).

[19] It has been suggested that some firms with high premium growth and high profits might inflate initial reported losses to defer taxes. If that were to occur, such firms would tend to report favorable loss development, also biasing the results against finding a positive relation between loss development and premium growth.

[20] Loss ratio development should be less vulnerable to omitted variables than the possible alternative of using the ratio of developed losses to premiums. The difference between developed and initial loss ratios should largely sweep out systematic cross-firm differences in expected loss ratios at the time coverage is sold that could arise from differences in service intensity, length of the claims-tail, or required capital. Moreover, if some firms grow rapidly while exploiting profitable opportunities arising from superior information and risk selection, premium growth would be negatively related to loss ratios, but there would be no expected relation between premium growth and loss ratio development.

[21] The use of log growth diminishes positive skewness compared with percentage premium growth.

Table 2
Descriptive statistics for medical malpractice insurer log premium growth, accident-year loss ratios, and loss ratio development, 1994–1999

		Mean	Std dev	Percentile 5th	25th	50th	75th	95th
1994–1999, $N = 445$	Log premium growth	0.028	0.275	−0.401	−0.059	0.040	0.126	0.402
	Initial loss ratio	1.015	0.395	0.498	0.761	0.996	1.204	1.684
	Developed loss ratio	1.004	0.551	0.329	0.693	0.945	1.189	1.949
	Loss ratio development	−0.018	0.471	−0.584	−0.243	−0.080	0.080	0.834
1994–1996, $N = 219$	Log premium growth	0.054	0.237	−0.264	−0.044	0.053	0.158	0.423
	Initial loss ratio	1.041	0.402	0.517	0.787	1.020	1.239	1.878
	Developed loss ratio	0.918	0.428	0.246	0.653	0.904	1.125	1.629
	Loss ratio development	−0.125	0.368	−0.723	−0.308	−0.113	0.013	0.456
1997–1999, $N = 226$	Log premium growth	0.002	0.307	−0.531	−0.079	0.028	0.113	0.357
	Initial loss ratio	0.989	0.388	0.420	0.719	0.984	1.181	1.640
	Developed loss ratio	1.086	0.639	0.329	0.729	0.986	1.284	2.555
	Loss ratio development	0.086	0.533	−0.494	−0.168	−0.018	0.164	1.115

Note: log premium growth is $\ln(P_{jt}/P_{jt-1})$), where P_{jt} is log net earned premiums. The initial loss ratio is the accident-year loss ratio reported at the end of year t for occurrences in year t. The developed loss ratio is the accident-year loss ratio reported for occurrences in year t at the end of year $t + 6$, or 2002 if earlier. Loss ratio development is the developed loss ratio minus the initial loss ratio. N is the sample size (in firm-years). Statistics are for Winsorized values of the variables (see text).

to either inadvertent underpricing and rapid growth or simply bad luck, some of these firms may have subsequently constrained sales during 1994–1999 to prevent or slow ensuing financial distress and possible regulatory intervention. Moreover, if policyholders learn of a firm's increased insolvency risk, market discipline in the form of reduced demand could constrain sales.[22] These behaviors could lead to a negative relation between premium growth and loss development for firms experiencing slow growth during the observation period. As a simple control for this possibility, we estimate some equations for subsets of firms with growing or shrinking premiums during 1994–1999.[23]

We estimate Eq. (3) including year indicator variables with panel data for medical malpractice insurance during 1994–1999 and two subperiods, 1994–1996 and 1997–1999. The first subperiod was characterized by moderately positive average premium growth and favorable loss ratio development (through 2003) (see Table 2). The soft market deepened during the latter period, prior to the onset of the hard market, with flat average premium growth and unfavorable loss ratio development (through 2003).

To be included in the sample in a given year, a firm had to (1) be included in the NAIC database in that year, the prior year, and 2002 (the year from which Schedule P, Part 2 data on incurred and developed accident-year losses were obtained); (2) have at least $1 million of net earned premiums for medical malpractice insurance in the prior year; (3) have non-negative reported losses for the year; and (4) have positive reported surplus. Given large volatility and skewness in premium growth and loss ratio development, we Winsorized (trimmed) log premium growth at −1 and the 99th percentile value for the sample and loss ratio development at the 1st and 99th percentile values.

The use of 2002 data to calculate loss ratio development ensured at least three years of loss development for the latest sample year, and provides more accurate loss development for the earlier years than the alternative of using three-year development for each sample year. Using 2002 could introduce survival bias, if exiting firms grew more or less rapidly on average than surviving firms. Under the underpricing hypothesis, the expectation might be that such firms would grow rapidly on average, so that survivor bias would work against finding evidence of underpricing.

Table 2 reports descriptive statistics for log premium growth, initially reported loss ratios, developed loss ratios, and loss ratio development for the overall sample period and the two subperiods. Each variable varies substantially across insurers in each period. Average (median) log premium growth was 5.4% (5.3%) during 1994–1996 and 0.2% (2.8%) during 1997–1999. Average (median) loss ratio development was −13% (−11%) during 1994–1996 and 8.6% (−1.8%) during 1997–1999. As noted above and as would be predicted if underpricing worsened over time, premium growth was smaller and basically flat for the latter period, and loss ratio development switched from favorable (downward revisions in forecasts during 1994–1996, perhaps due to favorable loss shocks) to unfavorable (upward forecast revisions during 1997–1999).

5. The relation between premium growth and loss development

The theory predicts that the dependence of both loss development and premium growth on unobservable price

[22] Epermanis and Harrington (2006) provide evidence that financial rating downgrades for property/casualty insurers are associated with premium declines, especially for insurers that specialize in commercial lines of coverage (i.e., selling coverage to businesses).

[23] Also see the discussion of this issue for GL insurance in Harrington (2004), which also divides the sample in to subsets of growing and shrinking firms.

Table 3
Least squares estimates of relation between accident-year loss ratio development and premium growth, 1994–1999

Regressor or statistic	Sample								
	Log premium growth > 0			All firms			Log premium growth ⩽ 0		
	1994–1999	1994–1996	1997–1999	1994–1999	1994–1996	1997–1999	1994–1999	1994–1996	1997–1999
Log premium growth$_t$	**0.862**	**0.345**	**1.191**	0.149	−0.083	0.286	−0.163	−0.343	−0.095
	(0.005)	**(0.090)**	**(0.009)**	(0.291)	(0.546)	(0.205)	(0.447)	(0.331)	(0.711)
Log premiums$_{t-1}$	−0.007	−0.016	−0.001	−0.024	−0.027	−0.024	−0.001	−0.020	0.012
	(0.781)	(0.525)	(0.982)	(0.371)	(0.286)	(0.464)	(0.985)	(0.616)	(0.727)
Adj. R^2	0.240	0.080	0.264	0.092	0.029	0.066	0.088	0.035	0.090

Note: the regression equation is $\text{LRD}_{jt} = \beta_0 + \beta\ln(P_{jt}/P_{jt-1}) + \beta_1\ln(P_{jt-1}) + \upsilon_{jt}$ where, for firm j and year t, LRD_{jt} is the loss ratio development (developed loss ratio – initial loss ratio) P_{jt} is net earned premiums, and T is a vector of year indicator variables. Winsorized values of the variables are used (see text). Two-tailed p-values based on robust cluster standard errors are in parentheses beneath coefficient estimate. Bold values are significant at 0.10 level (0.05) level for a two-tailed (one-tailed) test.

will produce a positive relationship between premium growth and loss development. Table 3 shows least squares estimates of δ_1 and δ_2 for Eq. (3) and associated p-values using standard errors that are robust to heteroskedasticity and withinfirm correlation in disturbances. Estimates are shown for each sample period and for subgroups of observations with positive premium growth and non-positive premium growth.[24] For firms with positive premium growth, there is a strong, positive relation between loss ratio development and premium growth, particularly during the 1997–1999 period, which represents the depth of the soft market ($\hat{\delta}_1 = 1.19$). The coefficient implies that a 10% point increase in growth for that sample and subperiod is associated with a 12% point increase in loss ratio development, with p-value <0.01. For 1994–1996, $\hat{\delta}_1$ for the growing firm subsample is much lower (0.35) but still significant at the 0.05 level for a one-tailed test. For growing firms over the entire 1994–1999 period, $\hat{\delta}_1$ is 0.86 (p-value < 0.01). Thus, the results for growing firms, which abstract from the experience of shrinking firms with poor loss experience, provide strong evidence consistent with price-cutting during the 1994–1999 soft market, especially during 1997–1999, with low-priced firms capturing market share and ultimately experiencing relatively high loss ratio development, which would presumably ultimately necessitate substantial premium increases in order to restore positive margins.

By contrast, for firms with contracting sales, premium growth is unrelated to loss ratio development, as might be expected if at least some of these firms were intentionally reducing sales or less able to attract and retain policyholders due to poor underwriting experience. For the full sample of all firms, the estimated relationship is positive for 1997–1999 and for the overall period, but not statistically significant. The coefficients on lagged log premiums are close to zero and statistically insignificant.

6. Premium growth, loss ratio development, and firm characteristics

Having confirmed a positive relation between premium growth and loss development, at least for the subsample of firms and time period where such a relation is most likely, we now examine whether certain firms were consistently more likely to underprice and thus grow rapidly and experience adverse loss development. As explained earlier, if a particular insurer characteristic is associated with price, it will have the same sign in equations for premium growth and loss development. On the other hand, if a characteristic is related to one variable but not the other, or is related to both variables but with opposite signs, this characteristic is not strongly related to price.

The firm-level covariates that are proxies for experience and/or incentives for adequate pricing are as follows: (1) the log of total (all-lines) earned premiums, (2) the proportion of total premiums earned represented by medical malpractice, (3) the log of the number of states where the insurer wrote malpractice coverage, (4) the log of assets, (5) reinsurance recoverable as a proportion of assets, (6) an indicator variable for mutual organizations, and (7) an indicator variable for risk retention groups.[25]

The log of total premiums in the prior year is one measure of general experience, which could be related to the ability for accurate forecasting and/or adjusting pricing to avoid winner's curse effects. It also could affect premium growth through life cycle effects. The proportion of total premiums in medical malpractice measures a firm's relative focus on medical malpractice insurance. If specialization in medical malpractice insurance contributes to expertise in pricing and underwriting, and thus the ability to avoid underpricing, this variable should be negatively related to premium growth and loss ratio development. Moreover, most insurers that specialize in medical malpractice insurance are affiliated with or owned by physicians or medical

[24] Selection bias is not a significant issue given that the objective is to estimate parameters for the models conditional on positive or non-positive premium growth.

[25] The rationale for some of these variables and results for GL insurance are discussed in Harrington and Danzon (1994).

Table 4
Log premium growth and loss ratio development regressions, firms with log premium growth > 0

Variable	1994–1999				1997–1999			
	Log premium growth		Loss ratio development		Log premium growth		Loss ratio development	
	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value
Log total premiums	−0.076	0.123	0.018	0.880	−0.074	0.267	0.011	0.951
Proportion prem. med. mal.	**−0.141**	**0.027**	−0.306	0.105	**−0.204**	**0.026**	−0.476	0.104
Log number of states	0.003	0.860	0.012	0.785	−0.009	0.707	−0.008	0.901
Mutual	−0.053	0.125	0.053	0.672	−0.010	0.842	0.108	0.513
Risk retention group	0.009	0.794	0.023	0.802	0.041	0.420	0.021	0.873
Log assets	**0.069**	**0.077**	0.001	0.995	0.070	0.181	0.029	0.841
Reins. recoverable/ assets	−0.114	0.243	0.051	0.863	−0.133	0.280	0.102	0.777
1995	**−0.051**	**0.063**	0.067	0.111				
1996	−0.032	0.315	**0.131**	**0.025**				
1997	**−0.092**	**0.001**	**0.144**	**0.019**				
1998	0.011	0.821	**0.419**	**0.000**	**0.100**	**0.013**	**0.250**	**0.002**
1999	−0.033	0.363	**0.290**	**0.000**	**0.053**	**0.076**	**0.110**	**0.106**
Constant	0.311	0.178	−0.365	0.596	0.205	0.495	−0.483	0.615
R-squared	0.128		0.233		0.149		0.282	

Note: bold values are significant at the 0.10 (0.05) level for a two-tailed (one-tailed) test based on robust standard errors.

associations. Such firms may have greater knowledge about risks and stronger incentives to remain financially healthy in order to stay in business, compared to commercial firms.[26] This measure of specialization may thus be correlated with the indicator variable for mutual status; moreover specialization may be a more accurate proxy for physician-sponsorship than mutual status, because many of the physician-sponsored malpractice insurers had demutualized by the 1990s. Harrington and Danzon (1994) provide some evidence that mutuals were less prone to underpricing, rapid growth and adverse loss development during the early 1980s soft market in GL insurance. Another indicator variable identifies risk retention groups which, like mutuals, are likely to be physician-owned and hence possibly have stronger incentives for financial solidity than commercial firms. However, risk retention groups are subject to less stringent regulatory oversight than other insurers, which might make this organization form on average more prone to underpricing.

Controlling for total premiums, the log of the number of states where a firm writes malpractice coverage is a measure of diffuseness of geographic focus, which may be related to lack of experience and hence a tendency for underpricing, high premium growth and positive loss ratio development. The log of assets and ratio of reinsurance recoverable to assets are rough measures of incentives for excessive risk-taking. Holding the log of total premiums fixed, greater log assets should be associated with larger amounts of capital at risk, as well as intangible capital, thus increasing incentives for adequate pricing.[27] If reinsurance is used to support rapid growth induced by underpricing, the ratio of reinsurance recoverable to assets should be positively related to premium growth and loss ratio development.

Table 4 reports regressions for log premium growth and loss ratio development on these firm characteristics lagged one year, plus year indicators. Equations are reported for the subsample of firms with positive premium growth for the entire 1994–1999 period and for the 1997–1999 subperiod. These equations provide no evidence of underpricing related to overall experience as measured by log total premiums. However, there is modest evidence that malpractice specialist insurers were less likely to engage in underpricing; i.e., they grew less rapidly and experienced lower loss development than non-specialists. Specifically, the proportion of premiums in medical malpractice is negatively and significantly related to log premium growth (two-tailed *p*-values less than 0.03) and negatively related to loss ratio development (two-tailed *p*-values just outside the 0.10 threshold).

The only other significant firm characteristic in either the log premium growth equation or the loss ratio development equation is log of assets in the premium growth equation for 1994–1999. The coefficients on the year indicators generally indicate sharply deteriorating loss ratio development over time. Estimates for all firms combined and for 1994–1996 generally had the same signs with somewhat higher *p*-values.

7. Underpricing, premium growth and exits

In order to provide rough evidence of whether rapid premium growth was plausibly associated with underpricing

[26] When we estimated the model including an indicator variable for entities that appeared to be organized or directed by physicians or hospitals, the coefficients for this variable generally were not significant, especially in the premium growth equation, and its inclusion had little effect on the other estimates, plausibly because most firms with high proportions of total premiums in medical malpractice insurance fell into this category, for which the mean proportion of premiums in medical malpractice during 1994–1999 was 0.93 (212 observations) versus 0.45 (233 observations) for non-physician or hospital directed firms.

[27] We also estimated models including the ratio of capital to assets, with similar (insignificant) results.

Table 5
Estimated abnormal log premium growth during 1994–1999 for selected entities

Category	Entity	1994–1999		1994–1996		1997–1999	
		Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value
Insolvent, ceased reporting prior to 2002	Associated physicians	**−0.723**	**0.000**	**−0.485**	**0.000**	**−0.714**	**0.000**
	Coastal enterprises	**0.129**	**0.000**	0.035	0.309	**0.196**	**0.000**
	Fremont general	0.074	0.129	0.092	0.123	0.085	0.184
	Legion	**−0.265**	**0.000**	**−0.313**	**0.000**	**−0.257**	**0.001**
	Med. mal. ins. assn.	**−0.128**	**0.026**		**−0.211**	**0.006**	
	Paradigm	**−0.150**	**0.000**	**−0.285**	**0.000**	0.029	0.640
	PHICO	**0.054**	**0.074**	**−0.111**	**0.002**	**0.190**	**0.000**
	PIE mutual	**−0.347**	**0.000**	**−0.243**	**0.000**		
	Reliance	−0.030	0.404	−0.043	0.402	−0.033	0.514
	Unisource	**0.230**	**0.000**	**0.362**	**0.000**	0.061	0.379
Insolvent, reported through 2002	Frontier	−0.006	0.825	**0.103**	**0.002**	**−0.126**	**0.003**
	Reciprocal of America	−0.044	0.128	**−0.087**	**0.018**	−0.017	0.737
Exited med. mal.	St. Paul	**−0.119**	**0.001**	**−0.128**	**0.018**	**−0.124**	**0.014**

Note: bold values are significant at the 0.10 (0.05) level for a two-tailed (one-tailed) test based on robust standard errors.

for some firms that later failed, we identified all firms with at least $1 million in malpractice premiums during any year during 1993–1996 that disappeared from the NAIC database after 1996. Based on internet searches for explanations of their exit (merger, insolvency, or unknown), we identified 10 entities that became insolvent. Because we obtained accident-year loss data from 2002 annual statements only, we do not have such data for these insurers. However, prior evidence of adverse loss development for failed property/casualty firms (e.g., A.M. Best, 1991) suggests that most of these firms were likely to have experienced adverse loss development prior to their demise.

We analyse the failed firms' premium growth by expanding our sample to include firms for which we have growth and other financial statement data but not accident-year loss data. We also examine premium growth for three other insurers of interest.[28] Two of the entities, the Frontier group and Reciprocal of America, became insolvent after 2002. The third entity, the St. Paul Companies, announced in December 2001 its intended exit from medical malpractice nationwide.[29]

We estimate abnormal premium growth for these 13 entities for 1994–1996, 1997–1999, and 1994–1999 by adding entity level indicator variables to the model reported in Table 4 and estimating the models for growing and non-growing firms combined. The coefficients on the entity indicators are shown in Table 5. Consistent with greater premium growth that is plausibly associated with underpricing, the coefficients for three of the 10 entities that later failed (Coastal Enterprises, PHICO, and Unisource) are positive and statistically significant for the overall period and for either the 1994–1996 subperiod (Unisource) or the 1997–1999 subperiod (Coastal and PHICO). The coefficients for Fremont General are positive but not reliably estimated. On the other hand, the coefficients for five of the 10 entities are negative and significant for 1994–1999, and their slower growth generally began during the 1994–1996 period. To the extent that those entities' ultimate demise was influenced by underpricing and rapid growth, it must have occurred prior to 1994.

The coefficients for Frontier and Reciprocal of America, which failed after 2002, provide no evidence of significantly faster growth except for Frontier during 1994–1996, which was followed during 1997–1999 by significantly slower growth. Reciprocal of America had significantly slower than average growth during 1994–1996. St. Paul had significantly slower growth during the overall period and both subperiods.

Thus, this evidence suggests that although underpricing is associated with faster premium growth, premium growth is not a good predictor of imminent exit, plausibly because some firms may constrain their growth in an attempt to avoid exit, either through voluntary action or in response to market discipline or regulatory pressures. It would be desirable for future work to develop a fuller understanding of such differences. Given the relatively small number of exits within reasonable time frames, it would likely be necessary to study individual cases in detail.

8. Conclusions

The evidence presented here shows that aggregate trends in malpractice premiums over the period 1980–2003 largely reflected increasing trends in losses and declining interest rates, consistent with the perfect markets model. However, some of the sharp cyclical trends – in particular, the soft market of the late 1990s — cannot be fully explained by the perfect markets model. The detailed analysis of firm-level data for that time period shows that, for firms with positive premium growth during the 1994–1999 soft market, firm-level premium growth was positively related to subsequent loss development. This result is consistent with the hypothesis that some firms priced too low *ex ante*, lead-

[28] Each firm experienced adverse loss development through 2002.

[29] St. Paul's affiliates generally were rated A+ by A.M. Best.

ing to relatively rapid growth and adverse loss development. Such behavior by some firms would plausibly lead to short-term underpricing by other firms, in order to preserve quasi-rents (see Harrington and Danzon, 1994), thereby deepening the soft market. Such underpricing would also aggravate the subsequent hard market, as firms increased premiums to restore profitability, as occurred starting in 2000.

Our analysis of firm characteristics that are associated with underpricing during 1994–1999 provides some evidence that lack of specialization in medical malpractice insurance was associated with relatively rapid growth and adverse loss development. Since specialized insurers in medical malpractice are typically physician-owned or sponsored companies, this result is consistent with inexperience and/or lack of incentives contributing to underpricing. These findings from national data at the insurer-group level are thus broadly consistent with the evidence in Danzon et al. (2004), using state-level exits by individual subsidiaries of insurer groups, that small firms and recent entrants – who were plausibly inexperienced and with relatively low capital at risk – were more likely to exit from individual states.

Thus, the overall results of this study are consistent with the hypothesis that underpricing by some firms during the soft market contributed to their rapid growth and adverse loss development. Further research is needed to analyse empirically the extent to which such underpricing during soft markets amplified the premium rate increases and availability problems in subsequent hard markets.

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