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**Article** *in* Journal of Risk and Uncertainty · July 1992

DOI: 10.1007/BF00057882 · Source: RePEc



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Journal of Risk and Uncertainty, 5:253–272, (1992)


# Reinsurance and the Liability Insurance Crisis

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**Key words:** reinsurance, liability insurance, liability crisis

*Abstract*

Insurance-industry accounts of the liability insurance crisis of the mid-1980s often cite disruption of supply in reinsurance markets as an important contributing factor. Economic theories of the crisis have not explored this explanation for the severity of the crisis. This article investigates the extent to which events in reinsurance markets affected liability insurance market outcomes. It documents significant shocks to reinsurance supply in the early 1980s and finds evidence of subsequent disruptions to the price and availability of reinsurance. Regression analysis of liability insurance profitability over the time period supports the hypothesis that problems in reinsurance markets played an important role in the crisis.

During the mid-1980s, liability insurance markets in the United States experienced a major crisis—characterized by substantial price increases, reductions in coverage, and unavailability of coverage at any price for some segments of the market. The crisis was precipitated by sharp declines in insurer underwriting profitability that produced record losses for the industry and a significant increase in the number of insurer insolvencies.

The insurance trade literature often cites a disruption of supply in reinsurance markets as an important factor contributing to the crisis conditions. Reinsurance is an arrangement whereby an insurance firm transfers all or part of its liabilities arising from policies sold in the customer market (the *primary* market) to another insurer. The *reinsurer* shares in the losses of the insurance portfolio, in return for payment of a reinsurance premium, or a share of the original premium revenue. Reinsurance arrangements take many specific forms, which serve correspondingly diverse purposes. In liability insurance, *excess of loss* agreements are most common, in which the reinsurer agrees to cover losses in excess of a specified limit (Patrik, 1990). This type of reinsurance is an important mechanism for risk diversification in insurance markets, since it protects the insurer against catastrophic losses and possible insolvency.

The availability of reinsurance is essential in order for insurers to participate in markets for risky coverages such as general liability (GL) insurance. As a result, the volume of reinsurance transactions is considerably higher in GL markets than in markets for less risky lines. A common measure of reinsurance volume in the empirical literature is the percentage of total premiums written that is *ceded*, i.e., transferred from a primary insurer to a reinsurer. For the period 1980–1989, the average industrywide ratio of reinsurance premiums ceded to total premiums in GL insurance was 52%, whereas the ratio for all lines combined was only 42%. Because GL reinsurance tends to be excess of loss, which does not involve a proportional transfer of premiums, this ratio understates the relative importance of reinsurance in GL.

As explained below, by facilitating optimal diversification, reinsurance permits insurers to offer coverage for the lowest possible price consistent with a given solvency level. By spreading risk throughout the international insurance markets, reinsurance also facilitates the supply of insurance policies with high coverage limits. A disruption in the supply of reinsurance thus is likely to lead to higher prices and lower coverage limits.

The apparent disruption in reinsurance supply during the liability crisis is sometimes attributed to a "price war" in the early 1980s, precipitated by the entry of new firms.[1] Other observers point to changes in loss distributions that yielded large, unanticipated losses in reinsurance. These accounts also tend to emphasize the relative inexperience of new entrants in the pricing of risks (Danzon and Harrington, 1990). Whether due to a price war or simply to expectations errors, reinsurance profitability declined. Many reinsurers left the market, and those remaining were less willing to take on risk.[2] Reports in the trade press of the time indicate concern about the effects of this diminished reinsurance capacity. *Best's Review* (March 1986) noted that reductions in capacity had negated the ability of reinsurance to relieve pressure in the tight primary market; *Business Insurance* (January 6, 1986) noted problems in excess of loss coverage and advised insurers to use capacity conservatively (April 28, 1986).

This article explores the extent to which events in reinsurance markets contributed to the dynamics and severity of the liability insurance crisis. We hypothesize that reinsurance acted to buffer insurers from adverse changes in liability insurance loss distributions until the mid-1980s. When it became apparent that losses had been misestimated by reinsurers, this coverage became more difficult and costly to obtain, and fed back into price increases and coverage restrictions in the primary market.

The underlying framework of the analysis coincides with most of the economics literature on insurance crises, which points to supply rigidities as the driving force behind crises. Although a demand shift could have contributed to the changes in equilibrium price and quantity levels observed during the crisis, there is no evidence of any structural change in the demand for liability insurance during this period.[3] On the other hand, several studies have focused on supply problems caused by shocks to loss distributions and the possibility of insurer capacity constraints caused by impediments to capital flows (e.g., Winter, 1989; Cummins and Danzon, 1991). The linkage between primary market capacity and reinsurance market conditions has not been investigated in these studies.

Consideration of the role of reinsurance provides an explanation for several puzzling features of the crisis. First, there is the issue of the sudden onset of the crisis in the face of

a gradual shift in liability awards and legal standards. This may be partly explained by the sudden withdrawal of reinsurance capacity from the market in the mid-1980s. The second feature to be explained is the rapid inflow of new capital coincident with the worst profit performance in the industry's history. This could also be partially due to the withdrawal of reinsurance, which represents an alternative (and perhaps less costly) method of increasing insurer risk-bearing capacity.[4] Third, there is the refusal of insurers to underwrite some risks during the crisis, and the imposition of strict coverage limits in the event insurance was offered. This is in keeping with a reduced ability to reinsure risks, especially the upper tail of the probability of loss distribution, which is reinsured through excess-of-loss contracts. Finally, there is the restriction of the crisis to commercial liability in the face of increases in all types of liability awards. This is consonant with the greater importance of reinsurance in commercial liability than in other lines, such as private passenger auto liability, where losses are generally smaller and more predictable.

The remainder of this article is organized as follows. Section 1 reviews the economic rationale for reinsurance and discusses the connection between reinsurance and equilibrium in the primary insurance market. Section 2 highlights trends in U.S. and international reinsurance markets in the 1980s. Section 3 investigates empirically the links between reinsurance market conditions and the liability crisis, and a final section concludes.

## 1. Theoretical review

### *1.1. The economic rationale for reinsurance*

In spite of its importance in real-world insurance markets, reinsurance has received little attention in the finance and economics literature.[5] The insurance and actuarial literature takes as given that the primary purpose of reinsurance is the reduction of the insurer's risk. This is often defined in terms of the role of reinsurance in reducing the insurer's probability of ruin (insolvency). The most sophisticated literature is concerned with Pareto optimal risk exchanges among insurers that are risk-averse expected utility maximizers (Lemaire, 1990).

At least on the surface, these assumptions regarding risk-averse behavior by insurers concerned with the reduction of total risk do not appear to be consistent with modern financial theory. Financial theory (e.g., the capital asset pricing model and arbitrage pricing theory) asserts that market rates of return on assets reflect only undiversifiable (systematic), not diversifiable (unsystematic), risk. Insurance risk is largely diversifiable, and owners of widely held firms thus can eliminate this type of risk by holding efficiently diversified portfolios. By definition, systematic risk is not diversifiable, so there are no gains from exchanges to reduce this type of risk. Because risk exchange involves transactions costs, these theories predict that reinsurance by a widely held insurer might actually reduce the market value of the firm. Thus, from the owners' perspective, it is not advantageous for insurers to engage in risk exchange.

A broader interpretation of modern financial theory provides an important role for reinsurance as a mechanism for reducing unsystematic risk. There are at least three compelling reasons for the reduction of unsystematic risk by insurance companies, even in the presence of efficient capital markets. The most obvious is that many insurance companies are not owned by diversified investors (Mayers and Smith, 1990). Closely held stock companies, mutuals, and reciprocals play significant roles in the insurance market. The owners (and managers) of such companies tend to hold higher than optimal proportions of their wealth in the insurer. For these firms, reinsurance markets are a partial substitute for access to efficient capital markets.[6]

Tax management provides another rationale for insurers to be concerned about total risk. Because the federal tax liability is similar to a call option on the firm's taxable income, income risk increases the expected value of taxes (Cummins and Grace, 1991). Hence, insurers have an incentive to use reinsurance to reduce income risk and thus minimize taxes.

Finally, publicly traded insurers may reduce risk through reinsurance due to concerns about insolvency. These concerns arise because of the implicit and explicit costs of bankruptcy (Hoerger, Sloan, and Hassan, 1990; Mayers and Smith, 1990). Insurers whose solvency is deteriorating are likely to have their ratings downgraded by financial monitoring services. Like the bond ratings of noninsurance corporations, the solvency ratings of insurers have a direct impact on the cost of capital. The primary source of debt capital to insurers is their policy liabilities: policyholders are analogous to the debt holders of noninsurance firms. Insurers whose ratings are reduced are likely to find their policies selling at lower prices than policies of well-rated insurers (Doherty and Tinic, 1981). This is analogous to the higher cost of capital experienced by corporations issuing risky bonds.[7]

Insurance regulation poses another potential cost of deteriorating solvency. Insurance regulators are likely to seize an insurer if its solvency margin (e.g., asset-to-liability ratio) is declining, even if the firm is still technically solvent.[8] Because the regulator's primary objective is paying off the insurer's policy claimants, he or she is unlikely to act optimally in terms of rehabilitating the firm. Thus, equity owners are likely to lose whatever residual value remains in the firm if the solvency margin reaches the regulatory trigger point.

Perhaps the primary reason for the reduction of solvency risk through reinsurance is that most buyers of insurance are risk averse. Insurance exists to provide the holders of insurable risks with a mechanism for diversification. Most such buyers are individuals and relatively small businesses. These buyers cannot optimally diversify by spreading their insurance coverage among multiple insurers. Thus, they have a direct interest in the risk of insolvency.[9] This rationale for risk management differs somewhat from the risky debt analogy discussed above. Even risk-neutral policyholders will pay a lower price for policies subject to insolvency risk, reflecting the lower expected recovery on these policies. The risk-aversion rationale goes one step further, and asserts that buyers care about risk beyond its effect on expected loss payments.[10]

Insurers are subject to systematic and unsystematic risk from both their asset and liability portfolios. Unsystematic asset risk can be eliminated by holding a diversified portfolio. Insurers manage the unsystematic risk of insurance losses by issuing a large number of policies (creating an internal risk pool). Contrary to the usual assumption in

the economics literature, even large insurers cannot totally eliminate unsystematic insurance risk through their internal risk pools. Insurers can reduce the remaining unsystematic risk by purchasing reinsurance. However, diversification is not complete, because reinsurance involves transactions costs. Thus, insurers face nonzero insolvency probabilities because of systematic risk and imperfectly diversified unsystematic risk.

Insurers hold equity capital as a cushion against adverse loss or investment fluctuations due to systematic risk.[11] To a significant extent, reinsurance and capital are substitute techniques for managing unsystematic risk. The mix of reinsurance and capital used by the firm depends upon the relative magnitudes of reinsurance transactions costs (the reinsurance premium less expected loss recoveries) and the firm's cost of capital. The choice of the optimal mix can be viewed as cost minimization over two inputs (reinsurance and capital) subject to a safety constraint. When reinsurance is relatively inexpensive, insurers will rely more heavily on reinsurance and hold less capital; but unfavorable supply conditions in the reinsurance market will induce lower reinsurance purchases and higher capitalization levels.

Firms that optimally diversify are able to provide the target level of safety at the lowest price. Such firms can be expected to experience higher profitability and to gain market share at the expense of firms that do not engage in optimal risk diversification. Hence, in the presence of bankruptcy costs, reducing unsystematic risk through reinsurance is consistent with the objective of maximizing the value of insurer equity posited by financial theory.

The importance of unsystematic risk in insurance has implications for insurer pricing strategies and market behavior. Greenwald and Stigliz (1990) have shown that firms subject to positive bankruptcy costs will tend to behave as if they were maximizing concave utility functions. An analogous result is provided by actuarial solvency theory, which demonstrates that the insurer can maintain the optimal level of solvency by pricing at the margin as if it were using an exponential utility function (Gerber, 1979), where the "risk aversion" parameter or *ruin constant* is functionally related to the desired solvency probability. Thus, economic and actuarial research provide mathematical foundations for the intuition that insurers concerned with solvency will behave as if they were maximizing expected utility.

### *1.2. Implications for insurance markets*

This theory has implications for the role of reinsurance in insurance market equilibrium. To illustrate, we assume that insurers behave as if they were risk averse, for the reasons given above. Insurers are assumed to choose their equity capital and reinsurance to maximize a concave utility function. The solution of the optimization problem generates a policy offer curve giving the combinations of price ($P$) and coverage amount ($L$) that yield the insurance firm its reservation utility level. The policyholder maximizes utility by choosing a coverage amount, taking the price-coverage schedule as given.

Insurer offer curves and policyholder indifference curves are illustrated in figure 1. The horizontal axis is the coverage amount ($L$), while the vertical axis is the premium

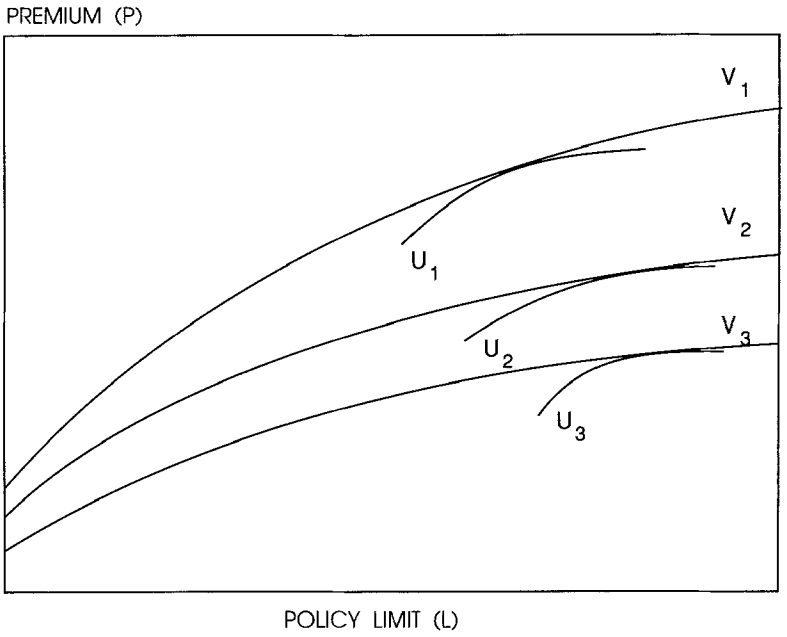


*Figure 1.* Insurance market equilibrium.

(*P*). The consumer prefers lower indifference curves, with lower premiums for each coverage amount. Offer curves are labelled $V_i$ in figure 1, while indifference curves are labelled $U_i, i = 1, 2, 3$. Market equilibrium occurs at the tangency of a consumer indifference curve and the insurer offer curve.

The position of the insurer's offer curve is affected by supply conditions in the reinsurance market. Several types of shocks to reinsurance markets can lead to higher offer curves in the primary market. For example, increases in the riskiness of insurance loss distributions creates more uncertainty for reinsurers, resulting in higher prices in the reinsurance market.[12] Similar effects occur due to increased uncertainty or *ambiguity* about the parameters of the loss distribution. Ambiguity is especially important in liability insurance due to lengthy loss reporting and settlement lags, which exacerbate the problem of forecasting loss costs. Adverse shocks to reinsurer equity may also affect supply if, for example, capital is depleted by unusually high losses.

To illustrate the effects of changes in the offer curve on market equilibrium, assume that $V_3$ in figure 1 represents the insurer's offer curve under "normal" conditions in the insurance and reinsurance market, e.g., where reinsurance is readily available and the reinsurance loading (transactions cost) is relatively low. In equilibrium, the consumer is on indifference curve $U_3$. Now suppose that reinsurance supply retracts, perhaps due to increases in the riskiness of loss distributions or to parameter uncertainty. Although the insurer can partially offset the higher cost of reinsurance by substituting capital for reinsurance, the reinsurance price increase causes the insurer's offer curve to shift to $V_2$. At the new equilibrium, the buyer is on indifference curve $U_2$, with lower expected utility

than $U_3$. Further retraction of reinsurance supply may move the insurer to offer curve $V_1$, again reducing buyer utility. The figure demonstrates that shifts in the offer curve lead to higher prices in the primary insurance markets and potentially to declines in coverage. Supply conditions in the reinsurance market are among the primary determinants of the position of the offer curve. Reinsurance thus plays a critical role in maintaining the availability of insurance at reasonable prices.

This theory of reinsurance also implies that insurer profitability is positively related to the supply of reinsurance. If reinsurance supply retracts, the price of insurance must increase and/or the level of solvency must decline. The resulting deterioration in the price and quality of insurance may lead to adverse selection. To the extent that insurers cannot fully control adverse selection by adjusting policy offers, profits can be expected to decline. Short-run competitive pressures also may prevent the insurer from passing along all of the reinsurance price increase to policyholders, placing further downward pressure on profits.

Reinsurance is especially important in risky lines of insurance. The need to diversify beyond the insurer's internal risk pool and, consequently, the potential price reduction attributable to reinsurance are greater in more risky lines of insurance. Evidence supporting a direct relationship between risk and the demand for reinsurance is provided in Hoerger, Sloan, and Hassan (1990) and Garven (1990).

Risk can be measured along various dimensions including process risk (the risk of the underlying probability of loss distribution), parameter risk (uncertainty about the parameters of the loss process), and timing risk (risk of timing of loss payments). GL insurance is a relatively risky line by all of these metrics. Thus, increases in price or reductions in the supply of reinsurance are likely to have relatively strong effects in the GL market.

The consideration of reinsurance thus provides a potential explanation for the severity of the liability insurance crisis of the mid-1980s. In years preceding the crisis, insurers experienced unusually high underwriting losses, leading to a depletion of equity capital. These underwriting losses were due primarily to adverse changes in loss distributions (Cummins and Danzon, 1990), although underpricing may also have played a role (Danzon and Harrington, 1990). Adverse changes in distributional risk also would have affected the reinsurance market. Thus, insurers experienced a need for substantial new equity capital at the same time that the price of reinsurance was rising. The higher costs of managing risk may have contributed to price increases and availability problems in the primary insurance market. Cummins and Danzon (1990) show that insurers raised significant amounts of new equity in 1985 and 1986. The objective of the following section is to trace corresponding changes in the reinsurance market that may have contributed to the crisis.

## 2. Reinsurance markets of the 1980s

A complete representation of events in reinsurance markets is difficult to obtain due to the structure of the market. It is a highly international market, and hence there is no single organization responsible for developing marketwide statistics. The resulting difficulty in documenting trends is exacerbated by the many types of insurance concerns

offering reinsurance, in addition to specialist reinsurers. Firms within a single insurance conglomerate or *group* usually engage in reinsurance transactions; and many insurance groups also operate separate reinsurance subsidiaries. In addition, captive insurers participate in the reinsurance market.[13] In 1982, for example, only 54% of reinsurance premiums reported by U.S. licensed firms were written by professional reinsurers; 17% were written by reinsurance subsidiaries of primary carriers, and the remaining 29% were written by nonlicensed alien reinsurers, including captives (Zech, 1983).

Partial snapshots of the reinsurance market can nevertheless be obtained from a variety of sources. The Reinsurance Association of America (RAA) gathers statistics from approximately 73 professional reinsurers licensed in the U.S. The A.M. Best Company (Best's) reports extensive statistics of over 900 insurance corporations operating in the U.S. Most firms in the Best's sample are primary market insurers, but data on the reinsurance transactions of these firms are reported. Some information on international reinsurance markets is also available. Statistics on London reinsurance market transactions of U.S. insurers can be obtained from the Reinsurance Offices Association (ROA).[14] The ROA gathers data on the worldwide reinsurance transactions of a variety of professional reinsurers operating in the London market. While none of these sources provides exhaustive data on reinsurance activities, trends substantiated by these distinct sources should be representative of the market as a whole.

### *2.1. Trends in reinsurance prices and profitability*

Table 1a presents data on annual underwriting results over the 1980s from the sample of reinsurers reporting to the RAA. It documents that reinsurance premium revenue was relatively stable during the early 1980s, rose sharply from 1984 to 1986, and then leveled off and declined in the late 1980s. Policyholders' surplus also rose only moderately in the early 1980s, followed by a sharp decline in 1984 and rapid increases thereafter. *Policyholders' surplus* is simply the difference between accounting assets and liabilities of an insurance firm, and is the net equity of the firm. The ratio of premiums written to surplus is thus a measure of the insurance leverage of the firm. A gradual decline in leverage occurred over the early 1980s, followed by a sharp increase in this measure in 1984. Leverage remained high through 1986, when it rapidly declined. These trends in premiums, surplus, and leverage are consistent with considerable price increases for 1984 to 1986, following years in which prices were low (relative to losses).

The reinsurance *combined ratio* in the 1980s (see table 1a) also supports this interpretation. The combined ratio is defined as the ratio of losses incurred plus other underwriting expenses to premium income, and hence represents the relative profitability of underwriting. A combined ratio of 1.0 means that losses and expenses just equal premium income, and is sometimes interpreted as the "break-even" point for underwriting operations.[15] Reinsurer combined ratios varied significantly over the decade, peaking in 1984, also suggesting considerable price increases in 1985–1986.

*Table 1a.* Reinsurance market data[a]

| RAA data: professional reinsurers | | | | |
|---|---|---|---|---|
| Year | Net premiums written[b] | Policyholders surplus[b] | Premiums/surplus | Combined ratio |
| 1980 | 6.871 | 3.499 | 1.964 | 107.3 |
| 1981 | 6.683 | 3.878 | 1.723 | 110.2 |
| 1982 | 6.824 | 4.495 | 1.518 | 111.6 |
| 1983 | 7.047 | 4.898 | 1.439 | 116.4 |
| 1984 | 7.880 | 4.227 | 1.864 | 128.2 |
| 1985 | 10.119 | 5.250 | 1.927 | 121.4 |
| 1986 | 13.556 | 7.955 | 1.704 | 104.7 |
| 1987 | 13.556 | 9.059 | 1.496 | 103.6 |
| 1988 | 12.341 | 10.391 | 1.188 | 102.6 |
| 1989 | 10.799 | 12.255 | 1.135 | 106.9 |

[a]Data are not strictly comparable from year to year because of changes in the composition of the samples. However, they should be indicative of overall trends.
[b]In billions of dollars.
*Note:* Policyholders' surplus (surplus) = assets − liabilities; combined ratio = 100 × (losses incurred/premiums earned + expenses/premiums written); net premiums written = direct premiums written + reinsurance assumed − reinsurance ceded.
*Source:* Reinsurance Association of America, *Reinsurance Underwriting Review: Premiums and Losses* (Washington, DC, various years).

*Table 1b.* General liability market reinsurance transactions[a]

| A.M. Best's data: primary market insurers | | | | |
|---|---|---|---|---|
| | | Premium Growth Rates | | |
| Year | Combined ratio | Reinsurance ceded | Direct market | Net reinsurance |
| 1980 | 107.2 | .02 | −.03 | .494 |
| 1981 | 116.0 | .04 | −.03 | .519 |
| 1982 | 129.4 | .01 | −.06 | .536 |
| 1983 | 138.1 | .09 | .01 | .555 |
| 1984 | 151.8 | .23 | .19 | .572 |
| 1985 | 145.8 | .68 | .77 | .553 |
| 1986 | 116.5 | .45 | .55 | .524 |
| 1987 | 111.1 | .05 | .03 | .519 |
| 1988 | 109.9 | −.10 | −.07 | .517 |
| 1989 | 110.1 | −.03 | −.03 | .517 |

[a]Data are not strictly comparable from year to year because of changes in the composition of the samples. However, they should be indicative of overall trends.
*Note:* Combined ratio = 100 × (losses incurred/premiums earned + expenses/premiums written); net reinsurance = reinsurance premiums ceded/(direct premiums written + reinsurance premiums assumed).
*Source:* A.M. Best Company, *Best's Aggregates and Averages* (Oldwick, NJ, various years).

The reinsurance market trends parallel those in the primary market for GL insurance; the GL combined ratios reported in table 1b for the sample of firms reporting to Best's show a similar pattern. Table 1b also shows that GL primary (direct) market premiums declined while reinsurance premiums ceded grew very slowly in the early 1980s, with marked increases in both variables in the mid-1980s. The upward trend in reinsurance premium growth slightly preceded that in the primary market, beginning in 1983; increases in the primary market occurred more dramatically in 1985–1986. These data are not ideal for measuring trends in insurance prices, since they represent price multiplied by quantity of transactions. Nevertheless, when coupled with the other data, they suggest that significant price increases occurred in both the primary and reinsurance markets for GL during the period 1984–1986. The timing of these price increases is also consistent with the idea that price increases in reinsurance perhaps contributed to more dramatic price increases in primary markets.

Similar developments took place in international reinsurance markets. Loss statistics from London's ROA reveal that reinsurance business was characterized by unexpectedly high losses and/or low premiums in the early 1980s. Figure 2 shows the *incurred loss ratio* for London market reinsurance written for U.S. ceding companies. This ratio is defined as the ratio of losses incurred to premium income, and hence approximates that percentage of premium income devoted to loss payments.[16] Increases in the loss ratio thus reflect high losses relative to prices. Loss ratios for reinsurance were close to or above 1.0 in 1982. Very sharp declines in the loss ratio occurred beginning in 1983, reflecting substantial price increases (relative to loss amounts).

The London reinsurance price increases appear even more dramatic when considered alongside the volume of nominal and real premiums. This comparison also appears in figure 2. Real premiums (deflated by the CPI) increased only moderately from 1982 to

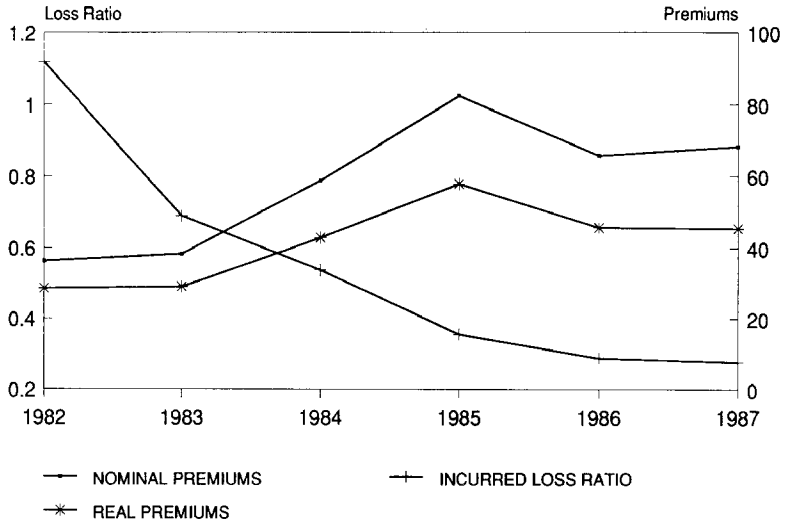


*Figure 2.* U.S. casualty reinsurance, London Market. (*Source:* Reinsurance Offices Association.)

1987, from about 28 to 45 million pounds. However, the loss ratio declined from 1.1 to about 0.3. While this trend is consistent with interest rate trends, it is much too dramatic to reflect interest rates alone. The trend suggests coverage of a smaller volume of real losses at the end of the period than at the beginning, i.e., a contraction of output in the reinsurance market.

### *2.2. Trends in the volume of reinsurance transactions*

Deterioration in reinsurance market conditions during the period 1983–1985 is further borne out by examination of the volume of reinsurance transactions of primary market carriers. Table 1b shows the growth in the volume of reinsurance transactions in U.S. GL coverage, calculated using the Best's sample. Reinsurance volume is measured as the ratio of reinsurance premiums ceded to the sum of direct premiums written and reinsurance premiums assumed. This statistic is a common measure of the demand for reinsurance used in the empirical literature (Mayers and Smith, 1990; Garven, 1990). The data demonstrate that the volume of reinsurance ceded varied considerably over the 1980s, rising dramatically from 1980–1984, and then quickly declining.[17]

This overall growth pattern is consistent with descriptions of a "price war" in reinsurance markets in the early 1980s, and with accounts that reinsurance supply reductions exacerbated the liability insurance crisis. The decline in GL reinsurance volume coincided with the liability insurance crisis. This further suggests that the severity of the crisis in GL may be partially explained by problems in reinsurance markets.

The Herfindahl index for reinsurance assumed over this time period also provides support for this hypothesis. The Herfindahl index is defined as the sum of each firm's market share squared, and takes on values between $1/N$ if all market shares are equal and 1 if the market is a pure monopoly, where $N$ is the number of firms in the industry. The Herfindahl index is typically used to measure the degree of competition in a market. In this market, however, the index varied only between .043 and .071 over the period, levels that would be conventionally interpreted as indicative of a competitive market. We interpret the Herfindahl index in this context as a measure of the breadth of participation in the assumption of reinsurance, i.e., as a rough index of market entry and exit, rather than an indicator of perfect versus imperfect competition.[18]

Figure 3 compares changes in the Herfindahl index for reinsurance assumed in GL and for all lines combined, using data from Best's. The index for both categories supports the conclusion of broader market participation in 1980–1982, followed by a gradual increase in reinsurance market concentration. The pattern is much more pronounced for GL, however; beginning in 1983 there was a marked increase in this Herfindahl index, consistent with the hypothesized contraction of reinsurance supply.

### *2.3. Factors underlying reinsurance market trends*

Significant changes in GL reinsurance loss development patterns appear to be a key element driving the trends in coverage price and quantity in the 1980s. Insurers tend to

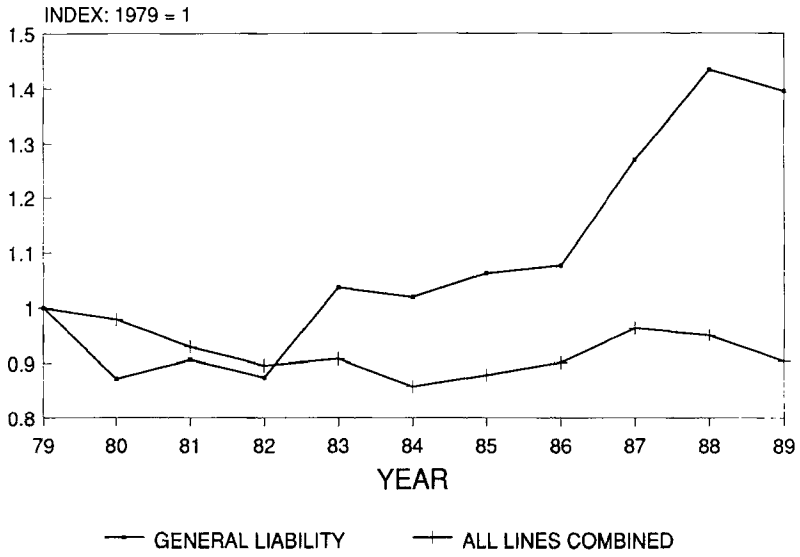


*Figure 3.* Reinsurance assumed: Herfindahl indices. (*Source:* A.M. Best Company Tapes.)

report loss data on an accident-year basis. Accident-year losses are defined as all losses the insurer is liable for as a result of providing coverage during the accident year, i.e., all accidents occurring during the year. The loss figures are said to *develop* over time as additional reports come in on a given accident year.

In GL reinsurance this development profile can extend over many years. Other things being equal, a long payout tail implies a lower present value of losses and therefore a lower premium. However, a longer payout tail also increases the insurer's exposure to interest rate risk and parameter estimation error. A lengthening of the loss payout profile thus increases the uncertainty surrounding reinsurance pricing. RAA data suggest a significant lengthening of the loss development profile in the 1980s. For the 1983 accident year, the RAA estimated that 10% of ultimate losses had been reported to reinsurers by the end of 1983 (the *first development year*); in 1985 this estimate had fallen to only 3%. Similarly, for 1983 40% of losses had been reported by the fourth development year, whereas reported losses had slipped to only 20% for 1985.

Further evidence that reinsurance loss development patterns sustained major shocks during the 1980s is presented in figure 4. This figure shows *loss development ratios* for U.S. reinsurers as reported by the RAA. The numbers plotted in the figure are the ratios along the diagonal of the loss development matrix. The diagonal represents a particular calendar year. For example, consider the curve labeled 1983. The figure shows that the lag-2 loss development at the end of 1983 was 2.75. This means that the ratio of incurred losses for 1982 business at the end of 1983 was 2.75 times the incurred losses for 1982 business reported at the end of 1982. Thus, this is the report-2 (or development lag-2) development ratio observed in 1983. Likewise, report-3 development on the 1983 curve is the ratio of 1981 incurred losses as reported at year end 1983 to 1981 incurred losses as reported at year end 1982, and so forth.

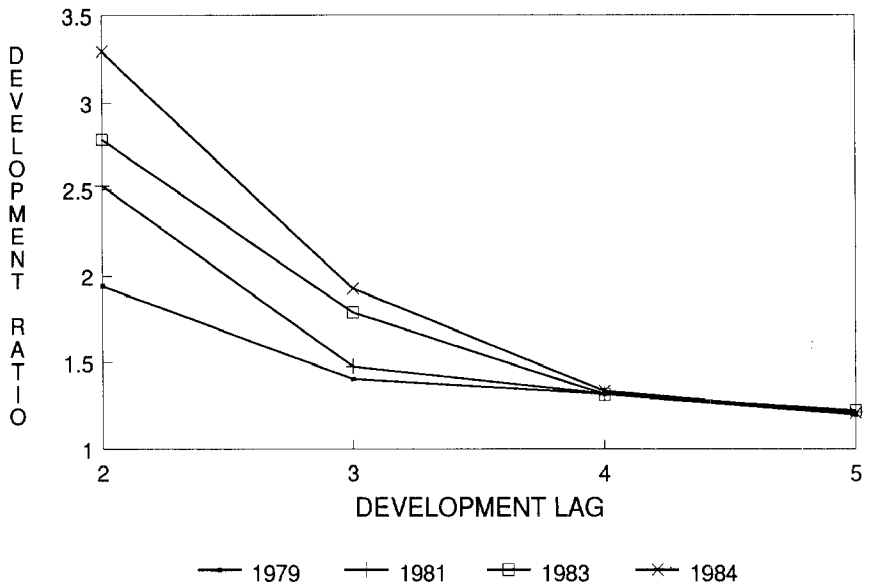


*Figure 4.* General Liability loss development ratios for four calendar years. If $L_{t,s}$ is losses incurred for accidents occurring in year $t$ as reported $s$ periods after the start of accident year $t$, then the development ratio is $d_{t,s} = L_{t,s}/L_{t,s-1}$. The line for calendar year t plots (left to right) $d_{t-1,2}$, $d_{t-2,3}$, $d_{t-3,4}$, and $d_{t-4,5}$. (*Source:* Reinsurance Association of America.)

Figure 4 shows that major loss-development shocks occurred at lag 2 in 1981, 1983, and 1984 and that major shocks also occurred at lag 3 in 1983 and 1984. Thus, at the end of 1983 and 1984, insurers made significant adjustments in reserves for claims on policies written in 1980–1982. This implies that insurers increased their estimates of losses on these policies, perhaps because reported losses were higher than originally anticipated during these years.

In summary, the data presented in this section document significant adverse developments in reinsurance markets in the 1980s. Due to unanticipated changes in loss distributions, prices appear to have been too low (relative to losses) in the early 1980s, lowering underwriting profitability and depleting equity capital. This led to significant price increases and corresponding quantity decreases in reinsurance transactions, especially for liability insurance. The timing of these changes is consistent with the idea that a decrease in reinsurance supply exacerbated the crisis in primary liability insurance markets.

## 3. Reinsurance and the liability crisis

Important changes clearly took place in reinsurance markets in the 1980s, and these changes affected the reinsurance transactions of insurers in GL markets. It is not clear from the data, however, to what extent these events affected equilibrium in the primary

market for liability insurance. The reinsurance data above could merely document common trends in reinsurance markets and the primary insurance market, since prices and profitability in the two markets exhibit similar patterns over the decade. It is also likely that the lengthening of and shocks to the reinsurance loss payout profile, and consequent underpricing of reinsurance in the early 1980s, reflected underlying trends in the primary insurance market.

This section uses regression analysis to investigate the effect of reinsurance market conditions on the crisis in primary insurance markets. Ideal data for this analysis would include measures of GL prices and quantities; unfortunately, such data are not available. Data are available, however, on GL insurers' profitability during the period. From the perspective of insurance firms, the crisis was precipitated by low underwriting profits in the years preceding the crisis. This analysis thus measures the effects of reinsurance on the crisis by measuring its effect on GL insurance profitability. The sample consists of firms reported by Best's, which wrote at least 0.1% of the GL market over the period 1979–1987.[19] Eliminating specialist reinsurers and firms with missing data leaves a total of 71 insurance groups in the sample. Summary statistics for these firms are presented in table 2.

### *3.1. The empirical model*

The measure of underwriting profitability used is one minus the firm's economic loss ratio ($1 - E$) for GL insurance. The *economic loss ratio* is the ratio of losses incurred to

*Table 2.* Summary statistics, 71-group sample: A.M. Best's data, 1979–1987

| Variable | Mean[a] | Std. Dev.[a] |
|---|---|---|
| Surplus | 645,241.0 | 1,196,394.3 |
| Assets | 2,707,180.2 | 3,889,393.5 |
| Liabilities | 2,061,939.2 | 2,860,025.4 |
| Assets/liabilities | 1.3626 | 0.2811 |
| GL direct premiums | 144,836.5 | 310,271.3 |
| GL net/direct premiums | 0.7956 | 0.2102 |
| GL specialization % | 0.1414 | 0.1553 |
| GL incurred losses | 70,921.2 | 134,662.4 |
| GL loss ratio | 0.6340 | 0.3247 |
| Reinsurance losses recoverable | 788,639.4 | 1,370,592.9 |
| Reinsurance losses recoverable/liabilities | 0.3273 | 0.2832 |
| GL ceded reins./total prems. | 0.4072 | 0.2032 |
| Fraction of stock companies | 0.6948 | 0.4608 |
| Fraction of direct writers | 0.1362 | 0.3432 |

[a]All data in thousands except for ratios.

*Note:* Surplus = policyholders' surplus = assets − liabilities; GL = general liability; GL net/direct premiums = (GL direct premiums written + reinsurance assumed − reinsurance ceded)/GL direct premiums written; GL specialization % = GL direct premiums written/total (all lines) direct premiums written; GL loss ratio = GL losses incurred/GL premiums earned; GL ceded reinsurance/total premiums = GL reinsurance premiums ceded/(GL direct premiums written + GL reinsurance premiums assumed).

net premiums written, with losses discounted to reflect the loss payout profile.[20] This approximates an underwriting price-cost margin for each firm: letting $L$ denote discounted losses and $R$ denote premium revenue yields $1 - E = 1 - L/R = (R - L)/R$. Noting that the quantity of insurance will cancel out of both the loss and revenue terms implies that this ratio is just the price of one unit of insurance less its marginal cost, divided by price (assuming approximately constant returns-to-scale).[21]

The specification of the model is consistent with recent empirical studies relating insurer capitalization to insurance crises (e.g., Winter, 1989; Cummins and Danzon, 1991). Winter hypothesizes that relatively low levels of capitalization will be associated with higher insurance prices and profits because of impediments to capital flows. This hypothesis is not supported by evidence from GL insurance in the 1980s, however, which experienced both low capital levels and low profitability. Cummins and Danzon interpret insurance liabilities as risky debt and predict that safer companies will command higher prices. Their empirical results, and the finding that profits are positively related to capitalization in GL, support the hypothesis that safer firms command higher price markups.

The regression equation thus includes the firm's lagged asset-to-liability ratio and the lagged ratio of policyholders' surplus to its previous three-year average. A relative measure of surplus is used to assess the effect of shocks to equity on price markups. The ratio of assets to liabilities is expected to increase prices, since it represents lower leverage; likewise, positive shocks to surplus are expected to increase prices.

Each of these proxy variables for leverage or "safety" of the firm is available only for the firm's overall operations, not for GL insurance separately; hence, these will only partially reflect liability insurance market conditions. Partly to correct for this, and also to correct for the fact that our profits measure is an ex-post one, the lagged ratio of GL losses incurred to its previous three-year average is included in the model. The expected sign on this proxy for shocks to GL loss experience is negative, since larger than expected (average) losses should lead to lower ex-post profits.

A measure of the firm's specialization in GL insurance is also included in the model. This is defined to be the ratio of premiums written in GL to total premiums written. This variable is defined in terms of direct premiums written to distinguish direct business from the assumption of reinsurance, which might be subject to greater volatility over the period. Because of the importance of underwriting expertise and risk diversification in GL, it is hypothesized that specialist firms will experience higher profits.

An important contribution of our analysis is its recognition of the role of reinsurance as a source of capital and as a risk-diversification device. The theoretical discussion above implies that insurance profits will be positively related to the supply of reinsurance. This study hypothesizes that the ceding of reinsurance should increase profits, since it facilitates diversification and reduces leverage. Our measure of the volume of reinsurance is, as in the previous section, the percentage of GL premiums ceded to reinsurers.

The regression model also takes into account that the overall reinsurance exposure of the firm may affect profits. Reinsurance exposure is measured by the (lagged) ratio of the firm's reinsurance losses recoverable to its overall liabilities. Profit is expected to decrease in this variable. Recoverable losses under reinsurance represent a risky source of

funds; thus a higher level exposes the firm to greater potential losses from reinsurer failures. This reduces the safety of the firm, and hence will reduce profit.

In addition to the hypothesis that reinsurance transactions affect underwriting profits, a central hypothesis is that a retraction of reinsurance supply in the 1980s affected profitability in GL. This hypothesis is tested by including the Herfindahl index for GL reinsurance assumed as an independent variable in the regression. As noted earlier, the Herfindahl index is meant to index the breadth of participation in GL reinsurance assumption. It is therefore hypothesized that a higher Herfindahl index (fewer participants) will be associated with lower underwriting profitability. The reinsurance volume variable is also interacted with year-specific dummy variables to investigate whether reinsurance price increases lowered GL profitability in this period.

### *3.2. Estimation results*

Two versions of the regression equation are reported. Both equations allow for firm-specific fixed effects, and both use an instrumental variables approach to control for simultaneity bias in the determination of profit and the amount of reinsurance ceded.[22] The first equation omits the reinsurance-assumed Herfindahl index, to investigate the simple relationship between GL profits and the volume of reinsurance transactions. The second equation includes this variable in order to further investigate whether changes in reinsurance supply conditions affected GL profits over the period.

The results of the regressions are reported in table 3. The estimated coefficients in both models are generally as expected. One exception is the negative sign on the asset-to-liability ratio in both specifications, although this variable is not significant in either equation. This is likely due to the only approximate linkage between overall firm leverage and GL profits and to the fact that capitalization is also proxied by the surplus shock variable, which has the expected positive sign.

The results strongly support the general hypothesis that reinsurance transactions affect primary market profit. Current profitability is improved by the ceding of reinsurance, consistent with a view of reinsurance as an alternative to other risk diversification devices. Yet the (lagged) level of recoverable reinsurance to liabilities decreases markups, as expected if reinsurance leverage also matters.

The results also support the hypothesis that changes in reinsurance market conditions contributed to the liability insurance crisis. The reinsurance dummy-variable interaction terms in the first estimated model imply that the ceding of reinsurance became less advantageous in 1984. This is consistent with the evidence that significant price increases occurred in reinsurance markets during this period.

This interpretation is supported by the significantly negative effect of the Herfindahl index in the second model specification. The variable approximates the level of reinsurance supply, since a larger value of the index indicates that fewer firms are willing to accept reinsurance. Its negative effect is thus consistent with the hypothesis that supply conditions influenced liability insurance profits over the 1980s. This provides further support for the hypothesis that supply disruptions in reinsurance markets exacerbated

*Table 3.* GL price markup regressions, A.M. Best 71-group sample (includes firm-specific fixed effects)

| DEPENDENT VARIABLE = 1 − ECONOMIC LOSS RATIO | | | | |
|---|---|---|---|---|
| | Model 1[a] | | Model 2[a] | |
| | Coefficient | Std. error | Coefficient | Std. error |
| $(\text{ASSET/LIABILITY})_{t-1}$ | −0.0366 | 0.0503 | −0.0257 | 0.0502 |
| $(\text{SURPLUS SHOCK})_{t-1}$ | 0.0785** | 0.0252 | 0.0609** | 0.0259 |
| $(\text{LOSS SHOCK})_{t-1}$ | −0.0348** | 0.0108 | −0.0324** | 0.0108 |
| $(\text{GL SPECIALIZATION})_t$ | 0.4184** | 0.2079 | −0.3784** | 0.2073 |
| $(\text{REINS RECOVERABLE/LIABILITIES})_{t-1}$ | −0.3877** | 0.0962 | −0.3665** | 0.0960 |
| $(\text{GL HERFINDAHL})_t$ | — | | −9.5467** | 3.5821 |
| $(\text{REINS CEDED \%})_t$ | 0.5948** | 0.1660 | 0.5730** | 0.1654 |
| (DUMMY: 84)* $(\text{REINS CEDED \%})_t$ | −0.0816 | 0.0560 | −0.0782 | 0.0557 |
| (DUMMY: 85)* $(\text{REINS CEDED \%})_t$ | 0.0148 | 0.0567 | −0.0078 | 0.0570 |
| (DUMMY: 86)* $(\text{REINS CEDED \%})_t$ | 0.0989 | 0.0580 | 0.0088 | 0.0669 |
| $R^2$ | 0.512 | | 0.518 | |

**denotes statistically different from 0 at 5% significance, and * denotes statistically different from 0 at 10% significance, 2-tailed test.

[a]Each model also includes a time trend and time$^2$ trend.

*Note:* ECONOMIC LOSS RATIO = present value of losses incurred/net premiums written; SURPLUS = policyholders' surplus = assets − liabilities; $\text{SURPLUS SHOCK}_t = 3 * \text{surplus}_t/(\text{surplus}_{t-1} + \text{surplus}_{t-2} + \text{surplus}_{t-3})$; $\text{LOSS SHOCK}_t = 3 * \text{GL losses incurred}_t/(\text{GL losses incurred}_{t-1} + \text{GL losses incurred}_{t-2} + \text{GL losses incurred}_{t-3})$; GL specialization = GL direct premiums written/total (all lines) direct premiums written; GL HERFINDAHL = Herfindahl index for reinsurance assumed in the GL market; REINS CEDED % = reinsurance premiums ceded/(direct premiums written + reinsurance premiums assumed; DUMMY: 8$y$ = 1 if year = 198$y$, 0 otherwise, $y$ = 4, 5, 6.

GL profit declines preceding the crisis, contributing to the timing and severity of the crisis in primary insurance markets.

## 4. Conclusion

The insurance trade press often points to disruptions in reinsurance supply as exacerbating the liability crisis of the 1980s. This article provides support for this hypothesis. Our theoretical discussion highlights the fact that insurers can provide lower prices in the primary product market through the use of reinsurance. Increased uncertainty in the market or shocks to capital lead to supply restrictions and price increases in reinsurance markets that are transmitted directly into the primary markets.

The empirical data examined in this study are generally consistent with this view and with the hypothesis that events in reinsurance markets exacerbated the crisis in GL insurance in the mid-1980s. It is clear that reinsurance prices were too low relative to losses in the early 1980s. The problem was manifested in the London reinsurance market in 1982 and had hit its peak in the U.S. by 1984. Many factors contributed to these

problems in reinsurance markets. Anecdotal evidence suggests that an increasingly liberal tort liability system played a major role. The lengthening of the reinsurance payout tail during the period added to the uncertainty and increased the difficulty of parameter estimation. While the hypothesis of a price war in GL and reinsurance markets is not explicitly tested in this article, the data suggest that these events in reinsurance were more likely triggered by expectations errors about losses.

These events appear to have exacerbated the significant price and availability problems in the primary GL markets. The resulting uncertainty surrounding the market, and the contraction of reinsurance supply, meant that primary market carriers faced greater difficulty in obtaining reinsurance coverage for GL business at given prices. This in turn resulted in lower profitability in GL insurance in the mid-1980s, contributing to subsequent crisis conditions in this market.

## Notes

1. Entry was primarily by *captive* insurance firms. Captive insurers are subsidiaries to non-insurance firms, formed to fill the insurance needs of the parent firm. There was an increase of over 40% in the number of registered captives in Bermuda, the largest registrar, between 1979 and 1983 (*National Underwriter*, April 16, 1989).
2. Data from the Reinsurance Association of America (RAA) also suggest significant turnover of firms in professional reinsurance markets of this time. See RAA, *Reinsurance Underwriting Review* (Washington, DC, annual). There is also anecdotal evidence that some London reinsurance providers withdrew from U.S. markets in 1985 (*Best's Review*, March 1986).
3. There is evidence of demand elasticity, however, as insurance buyers sought other forms of protection against liability risks. These included the formation of captive insurance companies, more extensive use of self-insurance, and the formation of risk-retention groups (RRGs), which were authorized by a special act of Congress.
4. An alternative explanation is offered by Cummins and Danzon (1991). They hypothesize that price increases as well as the strengthening of reserves acted as signals to the securities markets that insurance was being written at profitable rates and that new equity would not be used to discharge liabilities on old policies.
5. The existing literature includes papers by Doherty and Tinic (1981), Hoerger, Sloan, and Hassan (1990), and Mayers and Smith (1990).
6. Reinsurance substitutes for the capital market as a diversification mechanism and as an alternative source of financing. However, it is probably less effective in the latter role.
7. The indirect costs of deteriorating solvency are also likely to be severe. Many buyers will not deal with insurers who are not in the top solvency category. These buyers, many of whom are large corporations, monitor insurers through their agents and brokers and are likely to switch to another company if an insurer's ratings begin to decline. Deteriorating solvency also may lead to the loss of key executives and other personnel. Indirect costs of bankruptcy are discussed in more detail in Shapiro and Titman (1986).
8. This is an especially severe problem in insurance because regulators use a separate accounting system, *statutory accounting*, to measure insurer solvency. Statutory accounting is designed to provide a conservative estimate of the firm's net worth. Regulators may place restrictions on an insurer's operations due to a low statutory solvency margin even though the firm's margin is much higher on a market-value basis.
9. Corporate purchasers of insurance also may be averse to insolvency risk if there are significant costs of insurer bankruptcy (Mayers and Smith, 1982).
10. State insurance guaranty funds provide partial protection against insurer insolvency. However, buyers are still likely to avoid risky insurers because guaranty fund protection is not complete. For example, payments from guaranty funds are likely to be delayed and subject to caps and deductibles.

11. Insurers also use other risk-management techniques such as asset-liability management and financial hedging through futures and options. These methods for risk reduction are primarily focused on financial risk rather than insurance risk. Reinsurance is the primary risk-management device for insurance risk.
12. Reinsurers are also assumed to behave as if risk averse, for reasons similar to those that apply to primary insurers.
13. Many captives entered the reinsurance market because of tax rulings stating that parent firms could not deduct premiums paid to captives for federal income tax purposes unless the captives wrote significant amounts of "outside" business.
14. These data do not, however, include market leader Lloyds of London.
15. This is an incorrect interpretation, because the combined ratio does not take into account cash flow timing or investment income. For example, if interest rates rise, the combined ratio can be expected to increase because premiums (the denominator) reflect the present value of expected loss and expense flows, while the losses and expenses used in the numerator are reported at undiscounted values. Such an increase does not necessarily imply lower overall profits. However, interest rate trends during the period 1982-1986 would have suggested lower rather than higher combined ratios.
16. Reinsurance claims settle relatively slowly, and companies continue to update each year's experience as new data become available. The data in figure 2 are as of three years after the start of each experience year shown.
17. The Best's data also show that this trend differs markedly from reinsurance volume in all other lines, which grew fairly steadily over the decade.
18. Nevertheless, to the extent that reinsurers specialize in particular layers of coverage, the level of concentration in particular market segments may have been considerably higher than the overall index would suggest. Unfortunately, data are not available to measure concentration by market segment in GL reinsurance.
19. The sample period ends in 1987 because this is the last year for which reinsurance transactions are available separately for each line of insurance.
20. Losses were discounted using annual U.S. Government T-Bill rates, based on the paid loss payout profile from Best's Schedule P data for GL insurance. Some prior studies have used premiums earned rather than premiums written in computing the loss ratio. Premiums earned is an accrual accounting measure that represents a weighted average of prices over a two-year period. Thus, premiums earned impedes tests relating the loss ratio in a given year to other variables specifically related to that year. The authors consider premiums written to be superior for present purposes, because this variable measures premiums on policies issued during a given calendar year.
21. This is not strictly true, because the marginal cost term omits underwriting expenses, which are not readily available by line. These expenses do not vary significantly over time; and the model attempts to capture differences in expense levels over firms by the GL specialization variable and firm-specific effects.
22. Excluded instruments used are the lagged values of the firm's total assets, policyholders surplus, premium-to-surplus ratio, the ratio of premiums-in-force to liabilities, the ratio of reinsurance premiums-in-force with nonaffiliated companies to liabilities, the percentage of reinsurance-in-force with nonaffiliated companies, and the latter two variables interacted with year dummies.

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