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Economic and Market Predictors of Insolvencies in the Property-Liability Insurance Industry

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ABSTRACT

This article identifies a set of factors exogenous to individual property-liability insurers that are statistically related to the overall rate of insurer insolvencies. This approach represents a departure from the methodologies of prior studies which have focused primarily on firm-specific characteristics in assessing insolvency risk. The study uses quarterly data for the period 1970 through 1990. The empirical results support the hypothesis that economic and insurance market variables are important predictors of property-liability insurer failure rates. The sensitivity of the insurer insolvency rate to two of the insurance market factors is particularly striking: A 10 percent reduction in the number of property-liability insurers results in an 82 percent reduction in the insolvency rate, all else equal. A reduction of five points in the combined ratio results in an 18 percent reduction in the insolvency rate.

Introduction

Solvency surveillance in the property-liability insurance industry has traditionally focused on identifying insurers at high risk of becoming insolvent. This concern has stemmed from the perceived need to protect the public against the consequences of insurer insolvencies and the need to minimize the burden placed on state insurance guaranty funds.

Although comprehensive studies of insolvency have identified insurers in financial trouble, little research has identified market conditions that increase the probability of insolvency for all insurers. Recent experience in the savings and loan industry and to a lesser extent in the life insurance industry suggests that exogenous factors have significant implications for the viability of firms in financial services industries. Although market conditions affect firms to varying degrees, their impact on the number and size of insolvencies in an industry is potentially significant.

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During the period 1970 through 1982, the insolvency rate was relatively low, except during 1975, and there was little variation in the rate of insolvencies that occurred between quarters (see Figure 1). The insolvency rate began to increase sharply in 1983, and the rate of insolvencies between quarters varies considerably beginning in 1983.

The goal of this article is to identify factors exogenous to individual property-liability insurers that increase their susceptibility to insolvency. Previous studies on insolvency have largely focused on firm-specific factors associated with an increased likelihood of insolvency (Pinches and Trieschmann, 1974; Harrington and Nelson, 1986; Ambrose and Seward, 1988). However, as mentioned above, recent failures by firms in the savings and loan and life insurance industries suggest that external conditions may increase the likelihood of bankruptcy. Further, Nelson (1969) and Winter (1991) observed that the number of insolvencies occurring in the property-liability insurance industry roughly follows the industry-wide underwriting cycle.

A greater understanding of conditions external to the firm that increase the likelihood of insolvency should aid regulators in the earliest possible detection of troubled insurers. In addition, it should aid in their choice of means of regulatory intervention to prevent the failure of marginal firms.

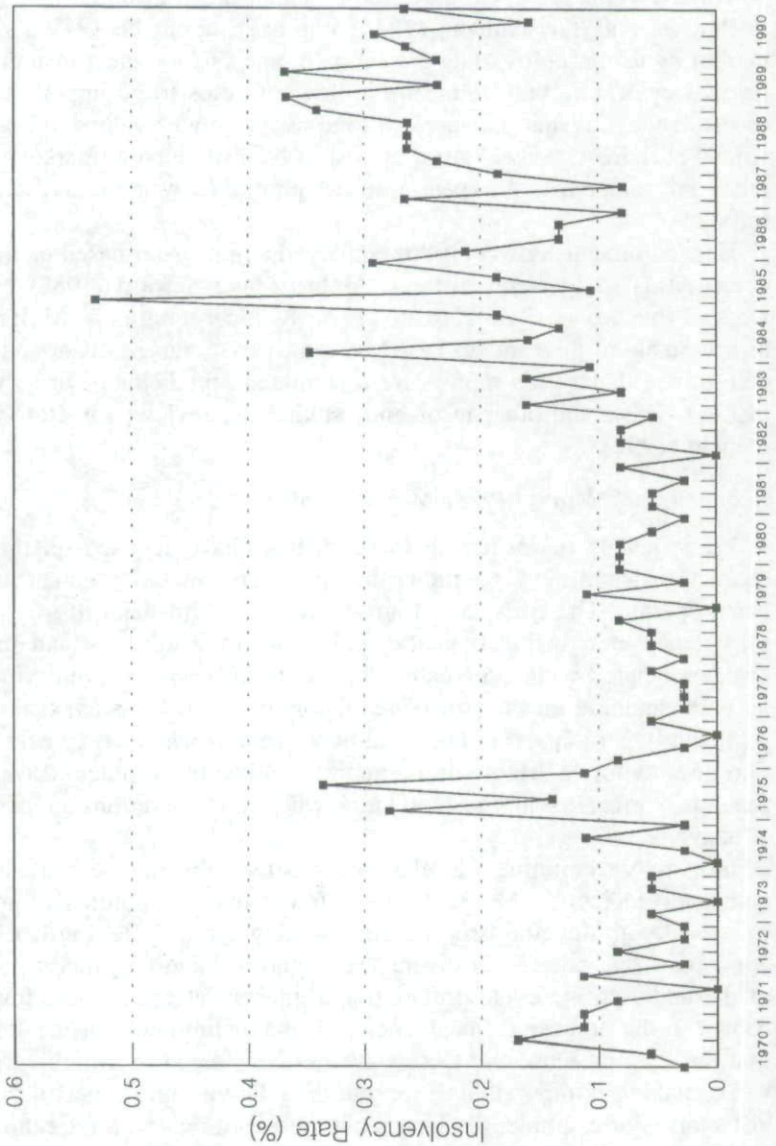
The next section reviews the literature on insolvency and discusses economic factors that increase the probability of insurer failure. The hypotheses of the study are then empirically tested. The article concludes with a review of the major findings and a discussion of their implications for solvency surveillance and regulation.

Solvency Surveillance of Property-Liability Insurers

An important function of insurance regulators is to monitor the solvency of insurers. Rejda (1989) notes that there are two primary reasons for regulators' concern with insurer solvency. First, due to the nature of the insuring agreement, premiums are typically paid prior to the payment of any losses that may arise. Regulation reduces the possibility that future losses will not be paid. Second, through solvency surveillance, the economic hardship insureds would suffer as a result of failure of an insurer can be reduced.

Regulation to prevent insolvencies includes minimum capital and surplus requirements, rate regulation, requirements that annual statements be filed with regulatory authorities, and periodic examination of insurers' books and records. In addition, a set of ratios, known as the Insurance Regulatory Information System (IRIS) ratios are calculated annually for each insurer by the National Association of Insurance Commissioners (NAIC). An acceptable range is set for each of these 11 ratios. If four or more of an insurer's ratios are outside the acceptable range, the insurer is targeted for a more extensive examination, and regulatory action affecting the viability of the insurer may follow. The NAIC also calculates a broader set of ratios known as the Financial Analysis and Tracking system and recently adopted risk-based capital standards for both property-liability and life insurers.

Figure 1
Property-Liability Insurer Insolvency Rate
by Quarter, 1970 Through 1990



Prior Solvency Research

Munch and Smallwood (1980) found that capital and surplus requirements are the most effective means for reducing the number of insurer insolvencies. However, they note that high capital and surplus requirements also may restrict potentially valuable services offered by small niche insurers.

Pinches and Trieschmann (1974) improved upon the IRIS early warning system by using multivariate discriminant analysis to detect insurers at risk of insolvency. Their study found the following ratios to be important predictors of insolvency: agents' balances to total assets, stocks valued at cost to stocks valued at market, bonds valued at cost to bonds valued at market, loss adjustment and underwriting expenses to net premiums written, and the combined ratio.

Harrington and Nelson (1986) employed a regression-based methodology to detect firms in financial distress. Ambrose and Seward (1988) built on the work of Pinches and Trieschmann (1974) by incorporating A. M. Best's ratings as a variable in their model based on multivariate discriminant analysis. They determined that Best's ratings are a significant predictor of firms in financial distress. These and other insolvency studies are reviewed in BarNiv and McDonald (1992).

Economic and Market Predictors of Insolvencies

Prior models of insurer financial distress have focused on the operating characteristics of the firms rather than the economic environment in which the firms operate. The early detection of insurers in financial distress is of great importance in reducing both the probability of insolvency and the eventual costs associated with insolvency. Potentially of equal or greater importance is an understanding on the part of regulators of when firms are operating under particularly perilous economic conditions. To make an analogy with the regulation of automobile driving, it is important to identify problem drivers, but it is perhaps of greater importance to know when road conditions are dangerous for all drivers.

In a study examining the relationship between insurance market conditions and insolvencies, A. M. Best (1991) found that the number of insolvencies increased with downturns in the underwriting profit cycle. Further, the size of companies that became insolvent was found to be closely tied to the severity of the underwriting cycle. Inflation and interest rates also were found to contribute to the number of insolvencies. A major limitation of the Best study is that the various economic factors are not considered in a multivariate framework, making it impossible to sort out the relative significance of the individual factors. For example, the Best study observed that both the nominal rate of inflation and the nominal rate of interest are negatively related to the rate of insolvencies. Of course, nominal inflation and interest rates are highly positively correlated. Thus, in a univariate framework it is unclear which of the factors is important.

An understanding by regulators of the economic conditions under which insurers operate is important for several reasons. First, to the extent that regulators can influence market conditions, the potential for insurer insolvencies will be reduced. For instance, one goal of rate regulation is to ensure adequate rates. Second, the optimal form of regulatory action taken with respect to a firm in financial distress may depend on prevailing economic conditions. Third, the resources regulators devote to solvency surveillance should reflect the economic environment in which insurers are operating. That is, more resources need to be devoted to detection of insurers in financial distress during difficult economic periods than during better economic times.

McDonald (1993) found that defaults in the property-liability insurance industry follow a bimodal distribution. Marcus (1984) and Herring and Vankudre (1987) note that insolvencies in the banking industry follow a bimodal distribution as well. The industries are similar in that insurers and banks hold and invest customer funds. The deposits held by banks and the potential loss settlements owed by insurers are each insured against the possibility of default of the respective financial institution by a government fund.

Cummins (1988) and White (1989) assert that the presence of insurance against default creates a moral hazard problem. The limited liability that owners of insured financial institutions enjoy encourages risk-taking behavior that would not be profit maximizing for the firm in the absence of default insurance. Banks and insurers assume risk through their investments. Insurers' investments include a broad range of financial instruments and the insurance coverage that they underwrite.

To minimize the potential for insolvency, government regulators require that financial institutions maintain a prescribed level of capital to act as a buffer against loss and to some extent discourage owners from taking excessive risks. Intangible assets such as reputation, growth opportunities, and valuable licensing agreements also likely discourage owners from taking excessive risks. Firms with significant intangible assets are less likely to engage in excessively risky behavior than those with less valuable intangible assets. Marcus (1984) and Herring and Vankudre (1987) attribute the bimodal distribution of insolvencies in the banking industry to disparities in the value of intangibles. Firms with significant intangible assets demonstrate a relatively lower probability of insolvency than those with a lower value of intangible assets. Their studies of insolvencies in the banking industry have implications for the property-liability insurance industry.

Although there are many reasons why insurers may become insolvent, limited liability and the presence of guarantee funds is likely an important factor in many insolvencies. In theory, limited liability encourages insurers to implement riskier underwriting and investment strategies than would otherwise be warranted. Firms with relatively little capital and with little value in intangible assets are particularly likely to pursue riskier strategies. If limited liability results in increased risk taking and, thereby, in an increased likelihood of insolvency, then the probability of insolvency will depend on factors external

to the insurer. Factors that affect the success of risky investment strategies and risky underwriting likely will affect the solvency of insurers.

Empirical Hypotheses

Number of Insurers

The insolvency rate during a quarter is hypothesized to be positively related to the number of insurers for several reasons. If the number of companies proxies the stringency of the regulatory environment, the insolvency rate would be expected to increase with the number of companies. Munch and Smallwood (1980) found some evidence that the number of insolvencies increases when capital and surplus requirements are comparatively lower. The presence of a comparatively large number of companies in the market may indicate that capital and surplus requirements are relatively low and that a higher insolvency rate is likely. The number of companies also may proxy the degree of competition in the insurance market. Increased competition could contribute to an increase in the rate of insolvency. Further, competitive bidding may result in a "winner's curse" that is positively related to the number of bidders.

California and Texas had two of the highest insolvency rates during 1969 through 1990 (A. M. Best, 1991). Table 1 reports the minimum capital requirements in both nominal and real terms for a domestic property-liability insurer in these states from 1970 through 1990.[1] The failure of states to maintain the level of minimum capital requirements in real terms suggests an implicit loosening in regulatory stringency during the period. Although the capital requirements have been adjusted, they typically do not keep pace with inflation. In addition, even when capital requirements were adjusted periodically, they have remained quite low until recently and, generally, have been adjusted only after periods during which high numbers of insolvencies occurred. For example, Florida, Pennsylvania, and California, all states with high failure rates during the period of the Best study, each significantly raised their minimum capital requirements in either 1989 or 1990. The analysis suggests that the decrease in real capital requirements as a result of inflation has led to an increase in the number of insurers being formed and, consequently, to an increase in the rate of insolvencies during the period. Risk-based capital is likely to mitigate the erosion of capital and surplus requirements by inflation. However, since the risk-based capital system took effect in 1994, it has no impact on insolvency rates during our study period.

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[1] From a review of the laws of California, Florida, New York, Pennsylvania, and Texas, it appears common for the states to require all insurers licensed in a state to meet its minimum capital requirements. Hence, the "overall" stringency of capital requirements in the United States becomes important in determining insolvency rates. This further justifies the use of the number of insurers as a measure of regulatory stringency.

Table 1
Minimum Capital Requirements for Domestic Property-Liability Insurers in Texas and California

Texas			*California*		
Year	*Actual Requirement*	*Inflation Adjusted Equivalent*[b]	*Year*	*Actual Requirement*	*Inflation Adjusted Equivalent*[b]
1970	$100,000	$295,967	1970	$250,000	$312,904
1980	100,000	664,516	1975	250,000	397,580
1983[a]	500,000	778,226	1980	250,000	585,484
1987[a]	1,000,000	883,870	1985	250,000	837,903
1990	1,000,000	1,000,000	1990[a]	1,000,000	1,000,000

[a] The minimum capital requirement was revised in this year to the amount shown in the Actual Requirement column.
[b] The values in this column are computed by deflating the minimum capital requirement in the state in 1990 by the rate of inflation as measured by the Consumer Price Index.

Interest Rates

Staking and Babbel (1991) note that one way insurers incur risk with their financial portfolio is by holding assets with a longer duration than their liabilities. This results in an interest rate risk since the magnitude of the change in the value of assets will be greater than that of the liabilities when interest rates move. When interest rates decrease, insurers with this duration mismatch will experience an increase in surplus. On the other hand, an increase in interest rates leads to a larger drop in the value of assets than liabilities. This results in increased leverage and a greater probability of insolvency for the insurer. Therefore, interest rate changes are expected to be positively related to the insolvency rate. Differences in asset and liability durations should be interpreted as only a possible indication of exposure to interest rate risk since insurers can pay losses as they become due by using cash, including premium income and other assets. If insurers have sufficient funds from current operations (investment earnings, investment turnover, and premiums collected) to offset loss payments, then the effect of an interest rate change on the insolvency rate may be relatively insignificant.

The absolute level of interest rates also may affect the rate of insolvencies. Since interest earnings are a significant source of revenue for insurers, companies are more likely to remain solvent when interest earnings are high. To the extent that interest earnings are credited back to insureds through lower rates, the effect of interest earnings on solvency will be reduced. Interest rates are hypothesized to be negatively related to the insolvency rate during a quarter.

The Underwriting Cycle and the Combined Ratio

The underwriting cycle is characterized by periods of intensely competitive insurance pricing that result in low premiums and sizeable insurer underwriting losses, followed by periods of much higher insurance prices (see, e.g., Venezian, 1985; Cummins and Outreville, 1987; and Winter, 1991). A high

combined ratio indicates unfavorable underwriting results. Firms that have pursued an overly risky underwriting strategy may be seriously impaired by unfavorable underwriting results. Since the financial position of many insurers is considerably weakened during periods close to the peaks in the underwriting cycle, the insolvency rate is hypothesized to be positively related to the combined ratio.

Doherty and Garven (1993) provide additional theoretical support for the hypothesized positive relationship between the combined ratio and the insolvency rate. They state that an increase in interest rates that disturbs the capital stock of an insurer may affect an insurer's underwriting and pricing practices. Insurers that are not driven to insolvency by the equity shock will attempt to increase prices and reduce supply when equity decreases. This, in turn, leads to a turn in the underwriting cycle as the combined ratio decreases. Therefore, the insolvency rate will be larger when the underwriting cycle peaks.

A strong relationship between the underwriting cycle and the rate of insurer insolvencies is suggested by the combined ratio and the insolvency rate per quarter from 1970 through 1990 (see Figure 2).

Unanticipated Inflation

In addition to unfavorable underwriting and investment experience, unanticipated inflation also may increase the insolvency rate. Insurers use projections of their loss costs to establish premiums. If the rate of inflation exceeds the anticipated rate of inflation, insurers' losses will exceed the amount that was expected when premiums were established, placing a financial strain on insurers that will increase the likelihood of insolvencies.

The First Quarter

Other things equal, the insolvency rate is hypothesized to be greatest during the first quarter of the year. As previously discussed, a company is first recognized as being insolvent at the time of regulatory intervention. Since annual reports must be filed with state insurance commissioners during the first quarter of the year, regulatory action is most likely during the first quarter. Further, insolvent companies may reveal themselves during the first quarter by failing to file the required financial statements.[2] Average insolvency rates by quarter are illustrated in Figure 3. See Table 2 for a summary of this study's hypotheses.

[2] No ex ante argument is apparent to support a relationship between the insolvency rate and each of the last three quarters of the year. However, empirical models were estimated with dummy variable specifications for all quarters. No statistical relationship was found between the insolvency rate and each of the last three quarters of the year.

Figure 2
Insolvency Rate V. Combined Ratio
by Quarter, 1970 Through 1990

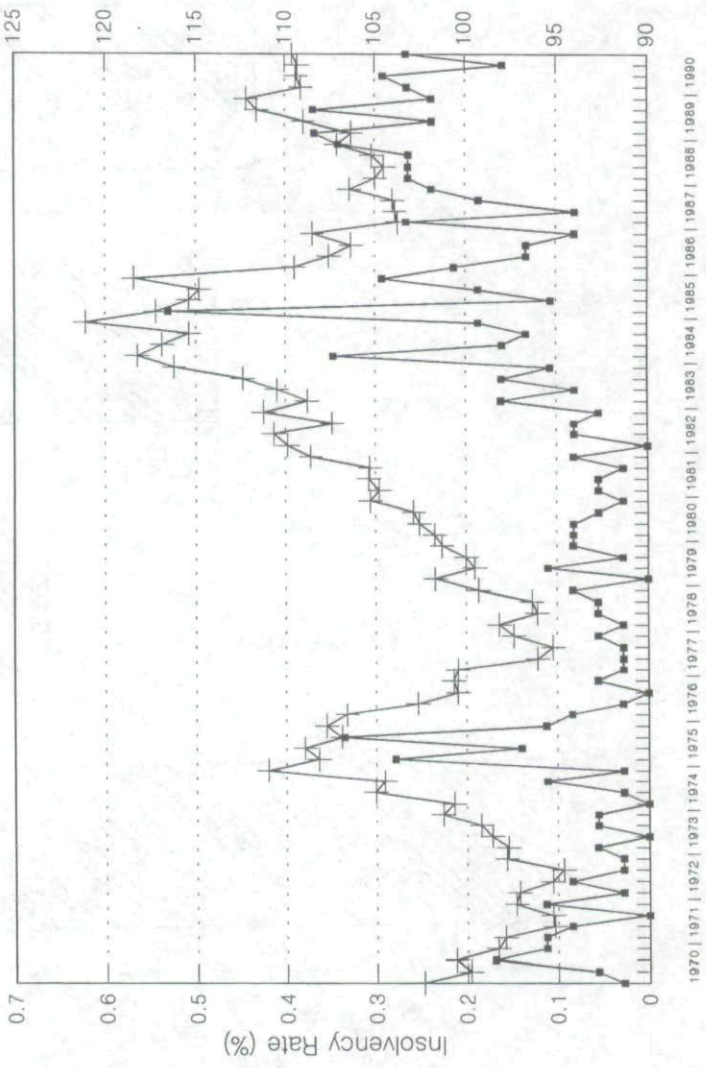

Figure 3
Average Insolvency Rate by Quarter
1970 to 1990

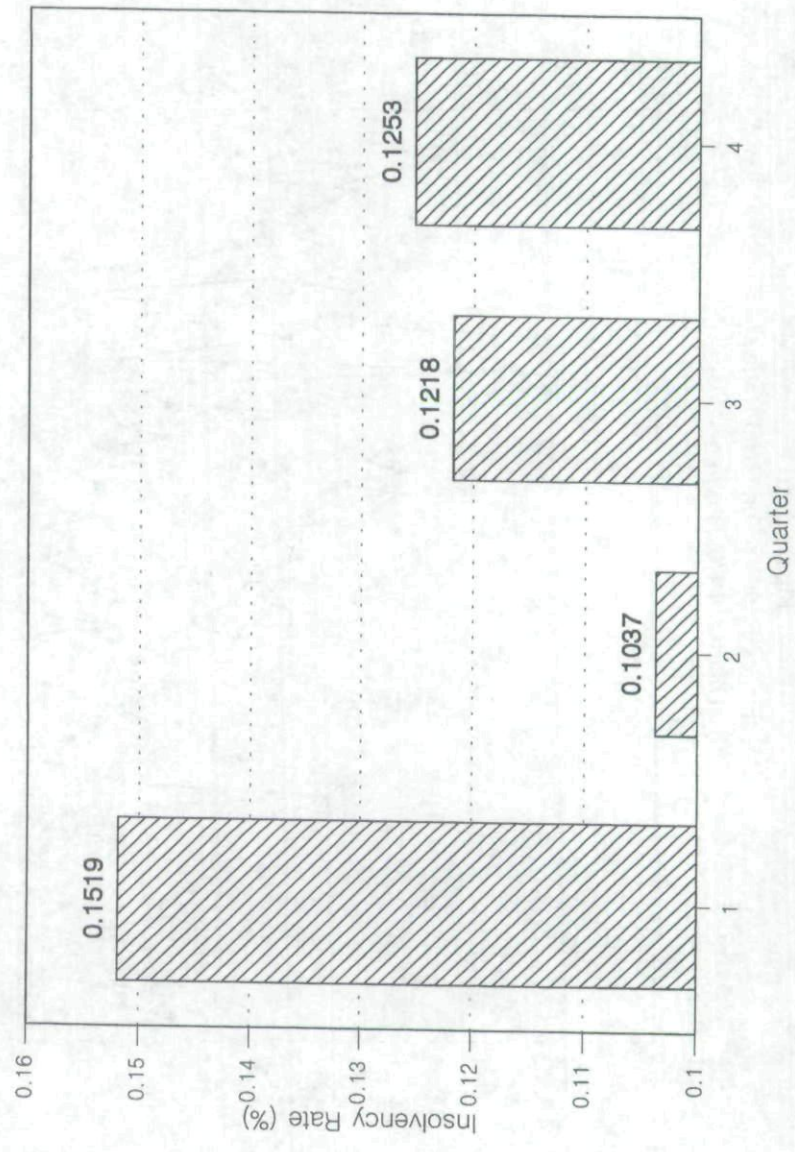

Table 2
Summary of Hypotheses

Variable	*Hypothesized Relationship*
Number of Insurers	Positive
Interest Rate Change	Positive
Interest Rate Level	Negative
Combined Ratio	Positive
Unanticipated Inflation	Positive
First Quarter	Positive

Empirical Model

Logistic regression (see Hosmer and Lemeshow, 1989) is used to estimate the following test equation:

$$\ln[r_t/(1-r_t)] = ß_0 + ß_1N_t + ß_2\Delta i_t + ß_3 i_t + ß_4R_t + ß_5U_t + ß_6Q1_t + e_t, \quad (1)$$

where $ß_i$ = the estimated coefficient,
e_t = the error term,
r_t = (n_t/N_t) = the insolvency rate in quarter t,
N_t = the total number of insurers at the beginning of quarter t,
n_t = the number of insolvent insurers in quarter t,
$\ln[r_t/(1-r_t)]$ = the logit,
Δi_t = the interest rate change from quarter t-1 to quarter t,
i_t = the three-year average portfolio interest rate at time t,
R_t = the combined ratio at time t,
U_t = the rate of unanticipated inflation during time t, and
$Q1_t$ = an indicator variable equal to one if time period t is the first quarter of the calendar year and 0 otherwise.

For the purposes of this study, insolvency is defined as the involuntary retirement of an insurer, including companies that were ordered to liquidate, were placed in receivership, or were placed in conservatorship (A. M. Best, annual).[3]

Since, over time, a particular insolvent insurer could be placed in more than one of the categories described above, the first date of activity in any of the categories is used to assign insolvent insurers to particular quarters. For example, an insurer might be placed in conservatorship and then several months later be placed in liquidation. In this case, the insurer would be classed as insolvent on the date that it was placed in conservatorship. The number of

[3] Insolvency rates are based on the number of companies becoming insolvent rather than the number of groups since neither the group nor other members of the group are necessarily responsible for the insolvency costs of one of the affiliated companies. Prior insolvency studies have utilized companies as the unit of exposure as well. A similar approach for defining insolvencies has been used in prior studies of insurer failures (see, e.g., Harrington and Nelson, 1986, and Hershbarger and Miller, 1986).

insolvent insurers obtained from *Best's Insurance Reports—Property/Casualty Edition* was compared to a list of insolvent insurers for which guaranty fund payments had been made. This list, prepared by the National Committee on Insurance Guaranty Funds, showed a similar number of insolvencies.[4]

The tally of insolvent insurers excludes mergers, which could bias the results if a nearly insolvent insurer is taken over. It appears reasonable to assume, however, that most target insurers had adequate residual value in order to attract takeover interest.[5] The data presented in Table 3 support our focus on involuntary retirements (insolvencies) rather than mergers and voluntary retirements. No statistically significant correlation exists between the number of involuntary retirements and either merged or voluntary retirements. In addition, no significant correlation exists between involuntary retirements and the total of other retirements, further supporting the exclusion of merged and voluntary retirements from the definition of insolvencies.

The change in interest rates variable, Δi_t, is calculated as the change in the three-month Treasury bill rate from quarter t-1 to quarter t. The Treasury bill rate—representing a short-term, risk-free rate—is chosen for this variable to capture the impact of duration mismatch by insurers. The interest rate variable, i_t, is equal to the average yield on Aaa corporate bonds over the three-year period preceding quarter t. This measure is chosen since the purpose of the variable is to reflect the earnings on insurers' investment portfolios. The three-year time period is based on asset duration measures provided in Staking and Babbel (1991). The Aaa bond yield is chosen because it highly correlates with overall yields on insurers' investment assets, which are heavily weighted toward bonds (70 to 80 percent of invested assets).

Several measures of unanticipated inflation are computed. The first measure is calculated by fitting a distributed lag model to the Consumer Price Index (CPI) monthly inflation series and determining the difference between the predicted and realized rates of inflation.[6] Outreville (1985) uses a similar approach in measuring anticipated price changes. Various models were tested, but the autocorrelation structure of the series for the period 1970 through 1990 suggests that a first-order moving average process in its first differences provides the best fit. The model is similar to one identified by Nelson and Schwert (1977). For all subperiods, an ARIMA(0,1,1) model provided the best fit, and the estimated coefficient was relatively stable.

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[4] An alternative variable to the number of insolvencies would be the amount of guaranty fund assessments. Due to reporting lags in guaranty fund assessments, use of this variable appears intractable. As an example, in 1989, assessments continued to be made for insolvencies dating back to 1970.

[5] This assumption would apply to other cases of "near insolvency," such as the situation of the supervised shoring up of GEICO in the mid-1970s.

[6] In addition to using various statistical measures of unanticipated inflation, the durable goods and medical care cost indexes were substituted for the CPI in the estimation. The results were not affected in any significant way by the use of these other indexes.

Table 3
Property-Liability Insurer Retirements by Type
1970 through 1990

Year	*New*	*Retired*	*Net Change*	*Involuntary (Insolvent)*	*Merged*	*Voluntary*
1970	32	46	-14	13	27	6
1971	34	39	-5	13	23	3
1972	63	37	26	6	21	10
1973	58	25	33	6	13	6
1974	35	35	0	5	21	9
1975	25	54	-29	28	21	5
1976	46	26	20	3	15	8
1977	38	18	20	6	5	7
1978	44	27	17	8	14	5
1979	51	22	29	9	4	9
1980	50	15	35	5	3	7
1981	26	17	9	9	2	6
1982	38	14	24	8	1	5
1983	47	31	16	11	7	13
1984	72	42	30	26	7	9
1985	58	64	-6	49	12	3
1986	37	36	1	25	1	10
1987	66	32	34	19	5	8
1988	72	56	16	35	11	10
1989	41	63	-22	39	11	13
1990	27	47	-20	32	6	9

Source: A. M. Best Company, various years, *Best's Insurance Management Reports* (Oldwick, N.J.: A. M. Best).

The second measure of unanticipated inflation is equal to the difference between the nominal rate of inflation over the period and the risk-free rate at the beginning of the period with a maturity equal to the length of the period. This measure is based on the assumption that the risk-free rate incorporates expectations of inflation over the upcoming period. A similar measure is discussed in Kandel, Ofer, and Sarig (1991). In our study, unanticipated inflation using this measure is equal to the nominal rate of inflation over the past three years minus the three-year Treasury yield at the beginning of the three-year period. A three-year period is chosen since this is commonly cited as the average payout period in property-liability lines (see, e.g., Venezian, 1985).

The third measure, commonly referred to as the naive measure of unanticipated inflation, is computed by taking the difference between the realized inflation rate over the three-year period and the average inflation rate over the year just prior to the three-year period. In other words, actual inflation over the past year represents the expectation of future inflation. A similar measure of unanticipated inflation is presented by Card (1990).

Empirical Results

The Appendix reports the sources of the data used to estimate equation (1). The analysis uses quarterly data for the period from the first quarter of 1970 through the last quarter of 1990. Table 4 reports summary statistics for each of the variables and the estimated parameters of equation (1). The Score and -2 log L statistics (see Table 5) both indicate that the model fits the data well. Additionally, no evidence of either multicollinearity or autocorrelation was found.[7]

Table 4
Summary Statistics for Insolvency Equation Variables

Variable	*Definition*	*Mean*	*Standard Deviation*
r	Insurer Insolvency Rate	0.00126	0.00109
N	Number of Companies	3675.63	91.354
i	One-Period Change in Three-Month Treasury Bill Rate	0.005	1.106
i	Three-Year Average Yield on Aaa Bonds (%)	9.629	1.995
R	Industry Combined Ratio	105.061	6.409
U	Rate of Unanticipated Inflation (%)	-0.026	0.051
Q1	1 if First Quarter, 0 Otherwise	0.2409	0.430

The number of property-liability insurers is highly—and, as hypothesized, positively—correlated with the insolvency rate, suggesting that the increase in the insolvency rate since 1970 is attributable in part to the increase in the number of insurers. As mentioned above, this relationship may be at least partially attributable to a laxity in the level of capital and surplus requirements.

Consistent with the findings of Winter (1991) and with the analysis of Doherty and Garven (1993), the combined ratio is positively correlated with the insolvency rate and the relationship is statistically significant.

The sensitivity of the insolvency rate to these first two factors is striking. A 10 percent reduction in the number of property-liability insurers results in an 82 percent reduction in the insolvency rate, all else equal. A reduction of five points in the combined ratio results in an 18 percent reduction in the insolvency rate.

The relationship between the insolvency rate and the quarter of the year is statistically significant. *Ceteris paribus,* the insolvency rate is greatest during the first quarter of the year. This relationship likely results from the seasonal nature of the regulatory process concerned with detecting insolvent insurers. The filing of annual reports with state insurance departments during the first quarter presents regulators with a once-a-year source of detailed information on

[7] There is no widely accepted statistic comparable to the Durbin-Watson statistic that can be used to assess the degree of autocorrelation in logistic regression. Plots of the residuals over time yield no evidence of autocorrelation.

Table 5
Logistic Regression Estimation of the Insolvency Test Equation
Dependent Variable: $\ln[r_t/(1-r_t)]$

Variable	Definition	Parameter Estimate	Standard Error	P-Value
$ß_0$	Intercept	-27.8037	2.9921	0.0001
N	Number of Companies	0.00461	0.000862	0.0001
i	One-Period Change in Three-Month Treasury Bill Rate	-0.00947	0.0515	0.8542
i	Three-Year Average Yield on Aaa Bonds (%)	-0.0224	0.0155	0.1488
R	Industry Combined Ratio	0.0394	0.0118	0.0009
U	Rate of Unanticipated Inflation (%)	-0.3882	1.2498	0.7561
Q1	1 if First Quarter, 0 Otherwise	0.3083	0.1121	0.0060

Goodness of Fit	Chi-Square for Covariates	P-Value
-2 Log L	130.077	0.0001
Score	126.969	0.0001

Note: The insolvency rate, r_t, is equal to the number of insurers becoming insolvent in quarter t divided by the number of insurers at the beginning of quarter t.

which to base regulatory action. This finding suggests that many insolvencies may be detected earlier by regulators if more information on insurer operations was available throughout the year.

The relationship between unanticipated inflation and the insolvency rate is not significant. The data do not support the hypothesis that insurers are at greater financial risk during periods of high unanticipated inflation. This result may arise for several reasons. First, since the combined ratio is included in the model, it may capture much of the effect that unanticipated inflation has on losses. Second, the estimated levels of unanticipated inflation are relatively low over the period of the study and do not appear to generate a large cumulative effect that could seriously impact insurer solvency. Finally, the measure of unanticipated inflation used in the study may not be sufficiently precise to properly test the hypothesis.

It should be noted that the Best (1991) study found a significant relationship between inflation and the rate of insolvencies. However, as discussed above, the Best study provides a univariate analysis and utilized nominal inflation instead of unanticipated inflation. Hence, much of the relationship found in the Best study is attributable to correlation between the nominal inflation rate and the combined ratio and the nominal interest rate.

The change in interest rates variable is not significant in the model. This result may suggest that, over the period of the study, any adverse effect on insurer surplus caused by duration mismatch was sufficiently mitigated by cash flow effects. However, on a firm-specific basis, it is still possible that excessively duration-mismatched firms could be exposed to a greater risk of insolvency. The interest rate variable marginally supports the hypothesis that insurers are less likely to become insolvent during periods of high interest earnings.

Conclusions

Studies of insolvency in the property-liability insurance industry have traditionally focused on identifying insurers at risk of insolvency. But rather than focus on individual insurers, our study tests for relationships between the rate of insolvency in the industry and temporal market conditions. The insolvency rate is found to be positively related to the industry combined ratio and the number of companies in the industry. The level of the relationship between these two variables and the insolvency rate is particularly noteworthy. Over the period of the study, a 10 percent reduction in the number of property-liability insurers would result in an 82 percent reduction in the insolvency rate, while a decrease of five points in the combined ratio would result in an 18 percent reduction in the insolvency rate. The rate of insolvencies also is found to be significantly higher during the first quarter of the year than during the remainder of the year, suggesting that more stringent regulation might reduce the insolvency rate.

Rate regulators are charged with ensuring that insurance premiums are fair, adequate, and not excessive. The latter two goals are at times conflicting. The current study finds that a failure by regulators to keep premiums at sufficient levels can result in a greater rate of insolvency in the insurance industry. Political pressures to drive premium rates below the level of adequacy must be weighed against the costs of a higher rate of insolvency. Separation of rate and solvency regulation, by assigning the role of solvency regulation to the federal government and keeping the responsibility of rate regulation at the state level, is inadvisable. Such a split would leave state regulators with little or no direct incentive to require that rates be adequate. In contrast, federal regulators would be responsible for ensuring solvency, but, without the ability to control rates, they would not have the means to be successful.

The relatively low minimum capital requirements for insurers and the states' failure to adjust these requirements over time probably contributed to the increase in the insolvency rate that occurred in the mid-1980s. The recent adoption of risk-based capital standards may help to mitigate this problem.

This study's finding that the failure rate is higher in the first quarter of the year suggests that regulatory oversight with respect to insurer solvency is not being applied evenly throughout the year. This can be a serious problem if it reflects delays in identifying insurers that are financially troubled.

Several implications for future research arise from the findings of this article. Fairley (1979) notes that the capital assets pricing model (CAPM)-based ratemaking framework does not consider the probability of insolvency. Obviously, the significant relationship found in this study between the insolvency rate and underwriting results casts some doubt on the validity of a CAPM-based model without adjustment for insolvency probability. Future research in the ratemaking literature should aim to determine the appropriate method for incorporating insolvency risk.

Finally, as mentioned above, most studies of insurer insolvency have focused on identifying operating characteristics of individual insurers that predict

insolvency. However, our study suggests that underwriting profitability has a significant impact on insolvency rates. Failure to incorporate measures of general economic and industry conditions may explain the relatively inconsistent results of previous studies. Future studies aimed at identifying insurer-specific characteristics that predict insolvency should include measures of the overall industry and economic environment.

Appendix
Data Sources

Variable	*Source*
Number of Insolvencies	A. M. Best (annual)
Number of Companies	Insurance Information Institute (annual)
Change in Three-Month T-Bill Rate	Board of Governors of the Federal Reserve System (monthly)
Three-Year Average Yield on AAA Bonds	Board of Governors of the Federal Reserve System (monthly)
Industry Combined Ratio	A. M. Best (1991); A. M. Best (various issues)
Unanticipated Inflation	Board of Governors of the Federal Reserve System (monthly)

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