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# International Insurance Cycles: Rational Expectations/Institutional Intervention

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## Abstract

This study further substantiates the presence of insurance underwriting cycles and analyzes their causes. A generalized least squares analysis of changes in premium levels is used to test the rational expectations/ institutional intervention hypothesis across countries as well as within each country. We also examine the relation between cycle length and the market/institutional features of each country. Finally, a logistic model is used to predict the presence of a cycle based on the market/ institutional features. The results suggest that the rational expectations/ institutional intervention hypothesis explains many aspects of the underwriting cycle, including cycle length.

## Introduction

The cyclicality of underwriting profits for the property-liability insurance industry has been extensively researched.[1] The industry results tend to follow a cycle consisting of alternating uniform periods of rising and then falling underwriting profits. The period in which the cycle "bottoms out" is typically characterized by withdrawal of insurers from some markets resulting in availability crises for some lines (Cummins, Harrington, and Klein, 1992a). Periods of rising underwriting profitability are characterized by increased entry of insurers and expanded coverage for many lines of business. Studies show that the underwriting cycle in the United States tends to follow a second-order autoregressive process with a total period (or cycle) averaging six years (Cummins and Outreville, 1987; Venezian, 1985; Doherty and Kang, 1988; and Smith and Gahin, 1983). But cycles are not limited to the United States; Cummins and Outreville (1987) observe underwriting cycles over long periods of time and in many countries.

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[1] The National Association of Insurance Commissioners (NAIC) and the MacArthur Foundation funded an extensive research effort addressing the cause and public policy implications of underwriting cycles in the U.S. property-liability insurance industry. Analyses were conducted by five research teams. See Cummins, Harrington, and Klein (1992a, 1992b) for a review of these studies and for a discussion of the phenomena.

Explanations for the cycles follow two schools of thought. The first explanation is based on the premise that insurance markets operate irrationally (Venezian, 1985) and/or exhibit market imperfections (Gron, 1994; Winter, 1994), while the second emphasizes rationality with institutional intervention. The argument of irrational behavior suggests that insurance markets are destabilized by phenomena such as extrapolative forecasting and so-called "cash flow underwriting," which can result in prices considerably higher or lower than competitive levels due to erroneous estimates of losses or investment income. The Winter/Gron "capacity constraint" theory posits that cycles are caused by impediments to capital flows that result in alternating periods of excessive and inadequate capacity in the industry.[2] According to this scenario, the underwriting cycle is most prominent in long-tail lines (usually liability lines) because forecasting horizons are longer and anticipated investment income is more substantial for these lines.[3]

The other school of thought, which we call the rational expectations/institutional intervention hypothesis, emphasizes insurance market rationality and considers whether underwriting cycles are caused by external events and market features not under the control of the insurer. Reactions to these phenomena make it appear that insurers behave irrationally. These external events include: (1) institutional, regulatory, and accounting characteristics (Cummins and Outreville, 1987; Witt and Miller, 1981; Outreville, 1990; and Tennyson, 1991); (2) exogenous shocks to surplus attributed to natural catastrophes, unexpected increases in claim costs, or shifts in loss distributions (Cummins and McDonald, 1992); (3) interest rate changes coupled with changes in equity values (Doherty and Garven, 1992; and Cummins and Danzon, 1997); and (4) uncertainties in the market environment (Berger and Cummins, 1992).

Although the evidence is extensive regarding the existence of and causes for underwriting cycles in the United States, the examination of international underwriting cycles is limited to Cummins and Outreville (1987). The purpose of the present article is to explore further the presence of underwriting cycles in international property-liability insurance markets and to test the hypothesized explanations for these cycles. The countries examined are the United States, Canada, West Germany, France, Italy, the Netherlands, Switzerland, Spain, Austria, Denmark, Japan, and Australia. This research extends the Cummins and Outreville sample of countries and updates the estimates for most of the other countries through 1987.[4] The study also expands the scope of Cummins and Outreville by examining results in five additional lines of business (ocean and inland marine, fire and allied lines, accident and health, general liability, and other) and cycles in the average loss ratio

[2] Earlier versions of this argument were proposed by Stewart (1981) and Berger (1988).

[3] Long-tail lines are those lines characterized by a considerable time lag between premium receipts and loss payments.

[4] The sample period in Cummins and Outreville (1987) is 1957 through 1979. Four countries in their study are absent from this analysis: Norway, Sweden, New Zealand, and Finland. Data availability precluded their inclusion. Countries added in our analysis are Spain, Austria, and the Netherlands.

in addition to the overall underwriting profit ratio.[5] The by-line results are particularly meaningful since Cummins, Harrington, and Klein (1992b) report that some economic and institutional variables affect all lines; nevertheless, there are factors particular to each line (at least in the United States).

The benefits of the proposed research are numerous. First, a direct test of the rational expectations/institutional intervention hypothesis provides empirical evidence suggesting that institutional lags and reporting practices cause not only domestic but international underwriting cycles. Second, an integrative study of the effects of capital markets, interest rates, changes in demand for insurance, and catastrophic losses on premium increases can determine the relative importance of these factors on underwriting cycles. Third, further evidence is provided in support of international underwriting cycles since the loss ratio, both average and by line of business, is used to detect the presence of cycles. This provides international evidence as to whether underwriting cycles are attributable, to some extent, to factors specific to the line of business. Finally, we extend previous underwriting cycles research by examining the role of exogenous factors (some of which are proposed by the rational expectations/institutional intervention hypothesis) on cycle period length and the presence of a cycle. The latter analyses will benefit insurers seeking to enter foreign markets since factors affecting premiums, reported results, and underwriting cycle effects are isolated.[6]

The next section reviews a theoretical profit generating insurance model incorporating rational expectations. This model is modified to allow for institutional and reporting complications. The data and methodology used to empirically measure the underwriting cycle periods and to test the rational expectations/institutional intervention hypothesis are then discussed. Next, we discuss the estimated cycle periods and the results from the tests of the rational expectations/institutional intervention hypothesis. A conclusion and discussion of recommended research are presented in the final section.

## CONCEPTUAL BACKGROUND

The theoretical framework underlying the empirical tests has its impetus from observed autocorrelation in property-liability insurers' underwriting results (Venezian, 1985). Several explanations for this autocorrelation have been proposed. Venezian attributes the autocorrelation to ratemaking practices, while Cummins and Outreville provide a more generalized model that links ratemaking practices and other explanatory factors to observed autocorrelation in reported profits. Venezian (1985) and Cummins and Outreville provide the theoretical model used here.

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[5] The loss ratio is defined as the ratio of losses incurred to premiums earned. The underwriting profit ratio is defined as underwriting profit divided by premiums earned.

[6] Our time period precedes regulatory changes and the impact of economic unification in Europe (particularly cross-border sales). However, this analysis can be used to aid foreign insurers and regulators in understanding the changing dynamics of the insurance marketplace. For example, the effect of changing rate regulation on reported results and cycle period length for an individual country can be forecasted with our results.

*Model Overview*

Venezian (1985) describes a ratemaking model in which past loss levels are used (via time trending) to extrapolate estimates of losses in future periods. These forecasted losses, in turn, are used to set premiums. By incorporating reasonable estimates of experience and policy projection periods used in the United States, Venezian predicts that a cycle with average periods ranging from four to nine years should exist.

Venezian's model is substantiated by empirical tests. Parameters needed to measure the cycle period are obtained by estimating the following autoregressive model with ordinary least squares:[7]

$$\Pi_t = a_0 + a_1\Pi_{t-1} + a_2\Pi_{t-2} + \varpi_t, \tag{1}$$

where $\Pi_t$ = the underwriting profit in period t, and
$\varpi_t$ = a random error term.

Venezian (1985) uses the model coefficients to estimate cycle periods for all major property-liability insurance lines. Specifically, the cycle period is expressed as

$$\text{Period (P)} = 2\pi / \cos^{-1}(a_1 / 2\sqrt{-a_2}). \tag{2}$$

A cycle will be observed if $a_1$ is greater than zero, $a_2$ is less than zero, and $a_1^2 + 4a_2$ is less than zero. Annual time series covering the period 1960 through 1980 are used in the estimation. The empirical results confirm the existence of a second-order autoregressive cycle. However, Venezian was not able to show conclusively that the cycle is attributable to extrapolative forecasting.[8]

*Rational Expectations/Institutional Intervention*

The rational expectations/institutional intervention hypothesis implies that the market's evaluation of relevant economic data is rational, even though prices and profit margins appear to follow "irrational" cycles. Instead, the perceived "irrational" behavior is, in fact, caused by a filtration of rational prices through external events (Cummins and Outreville, 1987). One such external influence is the institutional lags attributed to data collection, regulation, and policy renewal periods. That is, insurance prices typically are based on annual data which are not available for use until several months after the close of the "experience" period.

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[7] See Venezian (1985) for a more complete development of this model.

[8] Other important predictions providing insight into the behavior of underwriting profits include (1) phases of the cycle in two lines with the same period can differ, raising diversification issues; (2) delays between the experience period and the period in which rates are put into effect are positively correlated with variability in underwriting results; (3) delays between the experience and projection period increase the length of the cycle—hence, if regulatory lag increases the delay, lines regulated more stringently will have a longer cycle period (*ceteris paribus*); and (4) if $|a_2|$ in equation (1) is less than one, the cycle will dampen.

Certainly, as technological advances in data base management occur, this delay is shortened.[9] Nevertheless, delays are currently experienced in tabulating and analyzing data, and the slow emergence of information on losses in long-tail lines dictate that projections are made based on lagged loss observations. Regulatory lags arise in countries in which insurers are required to submit rates for approval prior to use (Lemaire, 1985). This requirement further extends the delay between the experience period and the effective use of revised rates. This delay can be shortened by simplifying the regulatory process; nevertheless, regulatory rate approval is required in varying degrees across countries and across lines of business. Policy renewal lags exist because the insurance price cannot be adjusted simultaneously to reflect information as it becomes available. Most property-liability insurance policies have a set premium for the entire policy period (e.g., for an entire year). Furthermore, when new rates are approved, typically a lag in changing to the new rate level occurs.

The empirical evidence regarding the effects of rate regulation on underwriting cycles is mixed. Outreville (1990) provides empirical evidence suggesting that price approval regulation is likely to exacerbate any cyclical behavior in underwriting results of automobile insurance. This evidence supports the hypothesis that a simple institutional lag can generate a situation where inadequate price level adjustment leads to a changing expectation of profit from insurance operations. However, Tennyson (1991) finds that the magnitude of rate regulatory effects on loss ratio variability is not large. Furthermore, regulation is not found to increase peak-to-trough differences in loss ratios, although it does not decrease them either. Tennyson (1991) concludes that rate regulation may not mitigate the forces that lead to crises nor can it be said to exacerbate them.

In addition to institutional lags, financial reporting practices may give rise to apparent underwriting cycles in a rational marketplace. Loss estimates for each year would reflect all information available at the end of that year. Nevertheless, calendar-year data are used typically in *financial statement* reporting of losses, and *financial statement* data are used in cycle studies. These data are reported on an incurred basis, meaning that losses are matched to the coverage period during the calendar year. Likewise, premiums are based on accrual accounting; earned premiums include premiums attributed to policies issued within the first day of the preceding year to the last day of the reported year. A mismatch exists between the informational content of the reported premiums and reported losses. This mismatch adds to the institutional lags already discussed.

The discussion above is not meant to preclude the existence of other factors which influence premiums and losses. For example, Cummins and Danzon (1997) and Doherty and Garven (1992) conclude that changes in interest rates and capital market changes may affect underwriting pricing behavior and insurer performance. Because insurance is a discounted cash flow product, there is an inverse relationship between interest rates and underwriting profits (Cummins, 1990). Doherty

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[9] In fact, a study of expected changes in international markets by Arthur Andersen & Co. (1990) includes the effect of these technological developments as a major influence on change. Other significant influences of change are distribution channels and cross-border sales.

and Garven (1992) hypothesize that interest rate changes impact pricing behavior through their effects on losses and insurer capital structure (e.g., asset duration).

Existing literature also differentiates the underwriting cycle from the effect of periodic, exogenous shocks to insurers' surplus. Examples of this phenomena in the United States include the liability crises in the mid-1970s (in medical malpractice insurance) and general liability in the mid-1980s. These crises are characterized by rapid increases in premiums and insurance availability problems. Cummins and Danzon (1997) hypothesize that insurers may raise prices above competitive rates to replenish surplus depleted by the loss shock. Friction in the insurance marketplace attributable to asymmetric information (or private information) which insurers possess about their own policyholders would allow for such premium increases in an otherwise competitive market. Also, loss shocks may be caused by catastrophic losses. As a result of a natural disaster, capacity constraints may develop. Premiums may increase (for those policyholders still able to obtain coverage) while others may have their coverage dropped.

*Rational Expectations: The Evidence*

One of the main differences between most of the cycles literature and Cummins and Outreville lies in the explanation of observed behavior. Venezian attributes the cyclical phenomenon largely to ratemaking practices, while Cummins and Outreville hypothesize the existence of rational expectations prices filtered through institutional, regulatory, and accounting interventions to generate a cycle in reported prices and profits. An analysis of underwriting cycles in other countries should provide evidence of the rational expectations/institutional intervention model because we observe cross-national differences in institutional, regulatory, and accounting practices in insurance markets.

Cummins and Outreville estimate equation (1) for a wide range of countries over the period 1957 through 1979.[10] Cycles with periods ranging from 5.35 (Switzerland) to 11.71 (Italy) were observed from the regressions using overall underwriting results by country as the dependent variable. Separate regressions for auto liability insurance conducted on a smaller sample of countries showed the existence of cycles in this line. However, they stop short of linking their findings to variations in institutional features across national markets.

## DATA AND METHODOLOGY

*Data*

The sample used to analyze international underwriting cycles includes twelve countries, and the sample period for most countries is 1965 through 1987 (the sample period is shorter in a few cases). Table 1 summarizes the model variables by country. This information establishes that differences exist across countries, and these differences may justify the variations in the presence and length of ob-

[10] The sample period of Italy varied from this.

served cycles. Furthermore, this repository of information allows for interesting comparisons and contrasts within the international insurance market.

For each country, Panel A specifies the market share held by the top five insurers, average share price index of the equity markets, average discount rate, whether reserves are discounted, and the average property policy period.[11] Differences exist across countries in these general market characteristics. For example, insurers in Australia and the Netherlands discount reserves for financial reporting purposes, while the other sample countries do not. Also, average interest rates vary from as low as 3.41 percent in Switzerland to 11 percent in Australia. For each country, Panel B states the overall underwriting profit ratio, the average loss ratio, the by-line loss ratio for auto liability and fire and allied lines, whether premium regulation exists for fire and allied lines and general liability (i.e., rate regulation), and whether the government provides coverage in the workers' compensation line. For example, the average overall underwriting profit ratio ranges from −11.20 in France to −0.57 in Japan. The average loss ratio ranges from a low of 44.1 in Japan to a high of 79.5 in Australia. Finally, total catastrophic loss data for North America versus Europe from 1970 through 1985 are used in analyses described later.

Ideally, ratemaking practices in the sample countries could be used to test directly the effect of this factor from other factors hypothesized to affect underwriting cycles. Venezian (1985) provides the appropriate material for the United States. Unfortunately, we could not obtain these data for our sample countries, except for Japan.[12]

### *Methodology*

The tests and analyses of international underwriting cycles are performed in two stages. First, tests are performed to determine whether underwriting cycles exist in different countries and in different lines of business. In the second stage, we analyze the relationship between premium changes and market/institutional features of the country and the relationship between cycle period lengths and these same features. Finally, we use the market/institutional features to predict the presence of a cycle.

*Underwriting cycle determination.* The first stage consists of estimating equation (1) individually for each country in the sample using the average loss ratio, the overall combined ratio, and by-line loss ratios for six lines of business (data availability permitting) as the dependent variables.[13] An independent variable, a

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[11] Although the average price per share is used as a proxy for capital market performance, we recognize that stock splits may introduce a biased index. However, there is no evidence that stock splits occur on such a wide scale within a country that the proxy would be seriously affected. For the United States, the average price per share was based on the Dow Jones Industrial Average, and in 1986 its value was $126.2 versus $64.7 for 1980.

[12] The authors are indebted to Mitsui Fire and Marine Insurance Company and especially Ken Inoue for this information.

[13] The combined ratio equals one minus the underwriting profit ratio.

**Table 1**
**General Market Statistics, 1971 Through 1987**

*Panel A*

| | Market Share (Top 5 in % of Premiums) | Average Share Price | Average Discount Rate[a] | Reserve Discount | Property Policy Period Availability |
|---|---|---|---|---|---|
| Australia | N.A. | 57.1 | 11.00 | Yes | 1 |
| Austria | 63.0 | 60.8 | 4.78 | No | 10 |
| Canada | 23.0 | 56.8 | 8.73 | No | 1 |
| Denmark | N.A. | 37.8 | 8.28 | No | 1 |
| France | 35.0 | 54.8 | 8.37 | No | 1 |
| West Germany | 32.0 | 62.0 | 4.61 | No | 1 |
| Italy | N.A. | 60.7 | 10.00 | No | 10 |
| Japan | 48.0 | 48.4 | 5.55 | No | 1 |
| Netherlands | 33.0 | 55.5 | 5.70 | Yes | 5 |
| Spain | 18.0 | 95.4 | 8.91 | No | 1 |
| Switzerland | 51.5 | 68.7 | 3.41 | No | 5 |
| United States | 25.0 | 65.9 | 7.06 | No | 1 |

*Panel B*

| | Underwriting Profit Ratio | Average Loss Ratio | Automobile Liabilitiy Loss Ratio | Fire & Allied Loss Ratio | Rate Regulation Fire & Allied/ General Liability | Goverment Workers' Compensation |
|---|---|---|---|---|---|---|
| Australia | −4.80 | 79.5 | 84.7 | 68.9 | No/No | Yes |
| Austria | N.A. | 67.4 | 80.0 | 43.8 | Yes/No | Yes |
| Canada | −3.37 | 72.9 | 76.9 | 62.6 | No/No | Yes |
| Denmark | N.A. | 68.1 | 77.8 | 65.5 | No/No | No |
| France | −11.20 | 77.7 | 85.1 | 64.5 | No/No | Yes |
| West Germany | −1.30 | 68.0 | 78.3 | 62.4 | Yes/Yes | Yes |
| Italy | N.A. | 78.5 | 82.6 | 62.6 | No/No | Yes |
| Japan | −0.57 | 44.1 | 58.5 | 20.7 | Yes/Yes | Yes |
| Netherlands | −2.44 | 73.4 | NA | 54.1 | No/No | Yes |
| Spain | −9.43 | 66.3 | 73.4 | 51.8 | Yes/No | Yes |
| Switzerland | −5.95 | 55.9 | 64.6 | 51.2 | Yes/Yes | Yes |
| United States | −4.31 | 73.7 | 76.6 | 58.5 | No/No | No |

[a] Average discount rate is the rate of interest charged by monetary authorities to deposit banks for loans.

Sources: Swiss Re (various issues), Coopers & Lybrand (1988); International Monetary Fund (1993), DYP Group Limited (1991), Royal Insurance Company (1992), and CIGNA (1990).

linear time trend, is added to each equation to control for declining expense ratios over time (Cummins and Outreville, 1987). The equations are estimated using ordinary least squares. The period of the cycle, if a cycle is observed, is estimated from equation (2). Independent regressions are run for each country and line of business for which loss ratios are available.

*Premium analysis.* After establishing the presence of underwriting cycles in the twelve countries, the rational expectations/institutional intervention hypothesis is tested empirically. Underwriting cycles in the United States have been associated with wide swings in insurance prices or premiums from year to year. In our analysis of underwriting cycles, we study premium behavior in several countries. That is, if losses really are exogenous, then the manifestation of the underwriting cycle would be linked directly to premiums such that the variables hypothesized to determine underwriting cycles will act directly through premium changes. In fact, previous research on underwriting cycles attempts to determine whether cost-related factors can explain premium changes (see, e.g., Cummins, Harrington, and Klein, 1992a). For example, premiums are affected by discount rates since discounted expected losses are incorporated in the premium. Premiums will be directly affected also by the cost (and supply) of capital, while data used to determine premiums (specifically expected losses) incorporate directly any lags attributable to regulation, data collection, and accrual accounting (i.e., the smoothing of earned premiums and incurred losses over adjacent years). In contrast, losses incurred are reported in almost all sample countries as the nominal amount necessary to pay claims. Therefore, we begin the second step by examining the relationship between premium changes and capital market results, state of the economy, and the regulatory/institutional features of each country's insurance market.

A pooled cross-section time series model is used. More specifically, a generalized least squares (GLS) model which controls for autocorrelation within countries and heteroscedasticity across countries is estimated. The specification of the GLS model is

$$\Delta P_{it} = \alpha + \sum_{j=1}^{J} \beta_j \Delta x_{jt} + \sum_{i=1}^{n-1} c_i D_i + \varepsilon_{it}, \tag{3}$$

where $\Delta P_{it}$ = the change in aggregate premiums for country i and time period t,

$\varepsilon_{it}$ = $\rho\, \varepsilon_{i,\,t-1} + \mu_{it}$,

$\mu_{it}$ ~ $N(0, \sigma^2_{iu})$,

n = the number of countries, and

$D_i$ = a dummy variable equal to one for country i and zero otherwise.

The independent variables ($\Delta x_{jt}$) are specified in Table 2; and the remainder of the section discusses these variables.[14]

**Table 2**
**Specification of the Premium Change Equation**

| Variable | Variable Definition |
|---|---|
| $\Delta Premiums_{it}$ | ln [(Premiums Incurred)$_{it}$] – ln [(Premiums Incurred)$_{i,t-1}$] |
| $\Delta Loss_{1it}$ | ln [(Losses Incurred)$_{i,t-1}$] – ln [(Losses Incurred)$_{i,t-2}$] |
| $\Delta Loss_{2it}$ | ln [(Losses Incurred)$_{i,t-2}$] – ln [(Losses Incurred)$_{i,t-3}$] |
| $\Delta Loss_{3it}$ | ln [(Losses Incurred)$_{i,t-3}$] – ln [(Losses Incurred)$_{i,t-4}$] |
| $\Delta$Discount Rate$_{it}$ | ln (Discount Rate)$_{it}$ – ln (Discount Rate)$_{i,t-1}$ |
| $\Delta$Stock Index$_{it}$ | ln (Average Share Price)$_{it}$ – ln (Average Share Price)$_{i,t-1}$ |
| $\Delta GDP_{it}$ | Change in Gross Domestic Product$_{it}$ |
| Concentration$_{it}$ | Market Share of the Top Five Property-Liability Insurers$_{it}$ |
| Regulation$_i$ | Dummy Variable = 1 If Rate Regulation Exists in Property-Liability Lines$_i$ |
| Policy Period$_i$ | Length of Policy Period in Years for Property Lines$_i$ |
| $\Delta Cat_2$ | ln [(Catastrophic Losses)$_{i,t-2}$] – ln [(Catastrophic Losses)$_{i,t-3}$] |

Note: Share price is a stock index of common stock traded on a national or overseas stock exchange reported annually. Discount rate is the rate of interest charged by monetary authorities to deposit banks for loans.

Sources: All data were obtained from Swiss Re (various years) except for discount rate and stock index, which were obtained from International Monetary Fund (1993).

Cummins and Outreville (1987) indicate that expense ratios have been declining over their sample period. The intercept term in equation (3) indicates the average annual change in premium levels. If expense ratios have improved over time, the intercept should be negative, everything else held constant. The hypothesis that composite regulatory, accounting, and data collection lags affect premium changes can be tested partly by including lagged values of the change in losses and variables for rate regulation and policy period length. Therefore, changes in one-year, two-year, and three-year lagged losses are included as independent variables as indicated in Table 2. Regressions are run for the entire sample of countries.

Previous research indicates that the underwriting cycle is affected by interest rate changes. The loss ratio expresses the nominal value of losses as a proportion of premiums in most countries, where premiums reflect discounted expected losses. Thus, as interest rates rise (and discounted expected losses become smaller, in particular for long-tail lines), the loss ratio is expected to increase. Hence, the change in the discount rate is included also as an explanatory variable.

[14] Two variables in Table 2 are estimated in the regression equation directly rather than the change in the variable. The two variables are regulation and policy period. Similar regression variables were used in Weiss (1991) to explain varying productivity growth rates for a sample of six countries.

Cummins, Harrington, and Klein (1992a, 1992b) note that economic factors other than interest rates affect underwriting profitability. Overall demand for insurance is expected to vary with growth in the economy, with periods of expansion and contraction corresponding to increases and decreases in demand for insurance (Insurance Services Office, 1992). The law of demand and supply suggests that premiums would rise in times of expansion, everything else held constant. The change in real gross domestic product (GDP) is included as an independent variable to control for this effect.

Demand and supply conditions also partly govern the capital markets and capital costs. Berger (1988) and Stewart (1981) hypothesize that a capital supply effect contributes to the underwriting cycle. Periods of increasing stock prices are associated with lower required rates of return, everything else held constant (e.g., expected cash flows and inflation rates). The change in share prices (i.e., the stock market index) is included in the model to test the extent to which insurance premiums are affected by movements in a country's stock market. A negative coefficient is expected for this variable.

Historically, it is not unusual for insurance markets to display high concentration. If concentration is reflective of insurer market power, concentration and premiums may be positively related. We control for this effect by including the market share (expressed as a percent of premiums) attributable to the five largest property-liability insurers in each country.[15] In some regressions, the lagged value of changes in catastrophic losses ($\Delta Cat_2$) are included to determine any effect on premiums from such losses. Year dummy variables also are included in the regression model.

Some of the variables in the prior analysis test the rational expectation/institutional intervention hypothesis only indirectly. For example, we do not know the specific ratemaking procedures used for different lines in different countries. The loss variables and their lags would be expected to be positively related to premium changes if rates are based on extrapolation of past losses. However, the results from the prior analysis would not prove this relationship; they would merely be consistent with the hypothesis. The detailed data required to directly test the hypothesis are not available on a by-line basis for all countries. Therefore, in the following section, we perform a direct analysis of cycle period lengths and characteristics associated with the appearance of a cycle to more fully understand cycle behavior.

*Analysis of cycle length.* If the rational expectations/institutional intervention hypothesis is correct, one would reasonably expect that the variables isolated in the analysis (rate regulation, policy period, etc.) would have a direct impact on the length of the underwriting cycle. Therefore, in this analysis we regress the underwriting cycle period on the regulatory and market characteristics of our sample

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[15] The market share of the top five property-liability insurers is available from Swiss Re for the years 1970 and 1987. Therefore, the sample was split in two: the 1970 concentration variable was used for the first half of the sample period, and the 1987 top five market share was used for the remainder of the sample period.

countries. The sample included in this analysis consists of only those countries and lines in which a cycle is present. The regression model is stated as follows:

$$CycPer_{ij} = \alpha_0 + \beta_1 Dis_{ij} + \beta_2 Per_{ij} + \beta_3 Cat_{ij} + \beta_4 Reg_{ij} + \beta_5 Res_{ij} + \beta_6 CVLoss_{ij} + \sum_{k=1}^{K} \beta_k D_{ijk} + \varepsilon_{ij}, \tag{4}$$

where the dependent variable is the cycle period in country i in line j, and the independent variables are averages for the interest rate, policy period, catastrophe loss growth, premium regulation, reserve discount, coefficient of variation of the loss ratio, and dummy variables for line (ocean and inland marine) and for some countries (see below). The reserve discount variable is a dummy variable equal to one if reserves are discounted and zero otherwise. The number of observations available to do this analysis is much smaller than in the previous analyses. That is, at most only twelve cycle periods for the average loss ratio are available as dependent variables. Therefore, to increase the number of observations and degrees of freedom, we stack the data from more than one line together. That is, cycle $period_{ij}$ varies by country and line, and j lines are simultaneously included in the analysis.

Three different models are estimated. In the first two models, the cycle periods for all individual lines (auto liability, fire and allied lines, ocean and inland marine, accident and health, general liability, and other) are included. Some of the regression factors described below vary by line of insurance and by country, making it possible to determine statistically which country- and line-specific variables are significant. Arguably, one might consider that some lines included in the analysis are fundamentally different from each other, especially for liability lines. Therefore, the third model includes only the cycle periods for liability lines (auto liability, general liability, and other). While the lines included in the latter case may be more comparable, the drawback of this model is that the number of observations decreases substantially.

The variables included in this analysis are those directly posed by the rational expectations/institutional intervention hypothesis: policy period and rate regulation. Longer policy periods would be associated with longer cycle lengths, because, among other things, they would prolong the accounting period over which losses are reported. If rate regulation restricts premium changes due to regulatory lag, a direct relationship between cycle period length and rate regulation would be expected.

Other control variables are present as well, including some country and line dummy variables. Specifically, dummy variables for the United States and Switzerland are included. The former is included because it is the world's largest property-liability insurance market with pronounced underwriting cycles and crises. Accounting reporting rules for Switzerland are the least restrictive among the countries in the sample, with a fair amount of latitude in reporting (DYP Group Limited, 1991). A dummy variable is included for ocean and inland marine insurance, because these lines are less regulated and more international in scope than lines where the bulk of business is written on domestic risk.[16]

The model also controls for reserve discounting and catastrophic losses. Discounting of loss reserves affects reported losses and, hence, the loss ratio. Higher interest rates allow an insurer to incur greater losses in nominal terms but still have the same discounted value of losses. Reserve discounting would have no effect if interest rates remained stable, but, depending on the length of the interest rate cycle, it could either shorten or lengthen the underwriting cycle.[17] Alternatively, catastrophic losses may represent a shock to the "normal" progression of the underwriting cycle, thereby affecting its length. Catastrophic losses are expected to shorten the cycle if the shock displaces the normal pricing pattern from its trend. The coefficient of variation of the loss ratio is included to determine the relationship between cycle period length and volatility of underwriting results.[18]

*Cycle prediction.* The final analysis attempts to predict the presence of cycles using market characteristics and institutional/regulatory features for the sample countries using a logit model:

$$\begin{aligned} \text{Log}[P_i / (1-P_j)] &= \alpha_0 + \beta_1 \text{Dis}_{ij} + \beta_2 \text{Reg}_{ij} + \beta_3 \text{Cat}_{ij} \\ &+ \beta_4 \text{Per}_{ij} + \beta_5 \text{Res}_{ij} + \sum_{k=1}^{K} \beta_k D_{ijk} + \varepsilon_{ij}, \end{aligned} \tag{5}$$

where $P_i$ is the probability that the cycle exists in country i in line j, and the cycle is equal to one if the cycle exists in country i in line j and zero otherwise. The full sample (cycle present or not) is used in this analysis. As explained above, the observations are stacked to provide more observations and degrees of freedom. More specifically, observations for all individual lines of insurance (but not the average loss ratio and overall underwriting results) are included as dependent variables.

The control variables used in this analysis include a dummy variable equal to one if reserves are discounted and zero otherwise, growth in catastrophic losses, a rate regulation dummy variable, and an interest rate variable. The coefficient for the reserve discount variable is difficult to predict. In general, discounting of losses smooths out the mismatch of losses incurred with premiums used to compute the loss ratio. It would have no effect if interest rates remained stable but, depending on the length of the interest rate cycle, could either shorten or lengthen the underwriting cycle, as explained earlier. Growth in catastrophic losses may disrupt the otherwise steady pattern of the cycle and result in insurance crises. That is, loss shocks (e.g., caused by natural catastrophes) exert their individual impacts on

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[16] With the implementation of the insurance directives for economic unification, this situation will change.

[17] The authors are thankful to Stephen D'Arcy for pointing this out.

[18] The authors are grateful to a referee who recommended a nested test of the relationship between underwriting cycle lengths and volatility in loss ratios through inclusion of the latter variable in equation (4).

the insurance industry's results (NAIC, 1991). Other control variables for different countries and lines of business are included in the model as well.

## RESULTS

### *Underwriting Cycle Periods*

This section discusses the results from the ordinary least squares and generalized least squares equations (equations [2] and [3], respectively) as well as direct tests of our hypotheses through equations (4) and (5). Equation (1) is estimated with overall underwriting profits, the average loss ratio, and by-line loss ratios for each of six lines.[19] Cycle periods are reported in Table 3. We found ten cycles out of ten cases for overall underwriting results, eight of twelve for the overall loss ratios, and 41 out of 68 cases for the by-line results. Only three of eleven countries exhibit cycles in accident and health insurance. The cycle period estimated from the average loss ratio ranges from 5 years for Australia to 18 years for Japan. Due to the limited time series used in estimation, the cycle periods of 18 years or over should not be considered meaningful here and in other results. A cycle occurs in all eight results for the United States and in six out of eight results for Canada, West Germany, and Japan. In France, a cycle exists in five out of seven results, while in Austria three out of seven results exhibited a cycle. In Italy and Spain, three out of eight results showed a cycle, and in Switzerland four out of eight results exhibit a cycle. Denmark, the Netherlands, and Australia exhibit a cycle in more than one-half of the results. Hence, the empirical evidence largely supports cyclicality.

The combined ratio (inclusive of expense data) is available for ten countries. Table 3 reports the estimated cycle period lengths for this variable in column 3. The combined ratio results are consistent with the previous analysis and provide more support for cyclicality. The cycle periods range from almost 5 years for Italy to 12 years for the Netherlands.

Table 3 reports cycle periods in six major lines of insurance: auto liability, fire and allied lines, ocean and inland marine, accident and health, general liability, and other. In general, the results suggest that underwriting cycles are present in all countries and in at least one line. For auto liability, the cycle ranges from 5 years in Denmark to almost 10 years in Spain. The underwriting cycle ranges from 4 years in Australia to almost 8 years in West Germany for fire and allied lines. In six countries analyzed, no cycle in this line is evident. Ocean and inland marine insurance tends to follow a cycle from almost 5 years in Austria to 22 years in France. The general liability insurance cycle ranges from 4 years in Denmark to 10½ years in Italy. The cycle for accident and health ranges from 6 years in the Netherlands to 10 years in the United States, with many countries exhibiting no cycle. Other lines of business experience a cycle ranging from 4 years in Canada to 7 years in the Netherlands.

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[19] Regression results are available in an appendix, available from the authors upon request.

The analyses using the average loss ratio are reasonably comparable with Cummins and Outreville (1987) for Canada (6½ for Cummins and Outreville versus 5½), Germany (almost 8 for Cummins and Outreville versus 6½), and the United States (6 for Cummins and Outreville versus 7). The results for Cummins and Outreville are somewhat different for Switzerland (5 for Cummins and Outreville versus 7) and France (8 for Cummins and Outreville versus almost 7), and very different for Japan (almost 8 for Cummins and Outreville versus 18).[20] In Denmark, no cycle in average loss ratios was detected in this study or by Cummins and Outreville. Unlike Cummins and Outreville, no cycle exists for Italy. For comparison purposes, Cummins and Outreville report the following cycle periods for automobile insurance: 6 (versus 5) for Canada, 8 (versus 5) for France, 10 (versus 7½) for Italy (1957 to 1979), 5 (versus 6) for Switzerland, and almost 6 (versus 6) for the United States.

**Table 3**
**Cycle Periods by Country and Line of Insurance, 1965 Through 1987**

| Country | Average Loss Ratio | Overall Underwriting Result | Automobile Liability | Fire & Allied Loss | Marine Loss | Accident & Heath Loss | General Liability Loss | Other Loss |
|---|---|---|---|---|---|---|---|---|
| United States | 6.932 | 7.389 | 5.948 | 5.178 | 6.924 | 10.015 | 8.076 | 7.061 |
| Canada | 5.537 | 5.786 | 5.257 | 6.095 | None | None | 6.222 | 4.088 |
| West Germany | 6.448 | 5.128 | 5.472 | 7.811 | 12.193 | None | None | 4.348 |
| France | 6.700 | 10.194 | 5.386 | None | 21.974 | None | 5.986 | N.A. |
| Netherlands | 6.149 | 12.031 | N.A. | 5.364 | None | 6.248 | N.A. | 7.348 |
| Switzerland | 6.869 | 6.489 | 5.955 | None | None | None | None | 4.327 |
| Spain | None | 5.703 | 9.756 | None | None | None | None | 5.095 |
| Austria | None | N.A. | 8.596 | None | 4.707 | None | None | 4.510 |
| Denmark | None | N.A. | 4.961 | 6.218 | 8.886 | None | 4.361 | None |
| Japan | 18.352 | 7.066 | 7.574 | None | 9.594 | 7.698 | 5.947 | None |
| Australia | 5.044 | 5.180 | 5.298 | 4.390 | 5.504 | N.A. | None | 5.604 |
| Italy | None | 4.840 | 7.529 | None | None | None | 10.489 | None |

Differences in the presence and length of the underwriting cycle are evident across countries and across lines of business. For example, when comparing a long-tail line of business such as liability insurance to a short-tail line of business such as fire and allied lines, the cycle is considerably longer for liability insurance in the United States (8 years versus 5 years for fire and allied lines). Alternatively,

[20] The dependent variable in Cummins and Outreville (1987) is the ratio of premiums to losses rather than the loss ratio as in this study. The sample period in Cummins and Outreville is 1957 through 1979 except for Italy, for which separate analysis was done for the period 1960 through 1979 with a resulting cycle period of 7.38.

in Denmark, the cycle is shorter for the long-tail line than for the short-tail line (4 years for liability versus 6 years for fire and allied lines).

*Analysis of Changes in Premium Levels*

The generalized least squares results from equation (3) are presented in Tables 4 and 5. Nine countries have continuous time series data available for all model variables and so analyses are conducted for these countries. The sample comprises the United States, Canada, West Germany, Italy, Switzerland, Spain, Austria, Denmark, and Japan. Table 4 reports results based on overall premium changes within each country and for two prominent lines of business: fire and allied lines and auto liability. Auto liability insurance is the most significant line in the sample countries. The fire and allied line is significant for most sample countries (although not for the United States). We include these lines to determine whether the independent variables might affect premium changes in these lines differently. The coefficients estimated in Table 4 are effectively constrained to be equal for all sample countries. To determine whether factors such as changes in discount rates, changes in stock index, and real gross domestic product affect premium changes differently among the sample countries, separate regressions using overall premium changes in the country are estimated.

The results shown in Table 4 indicate that changes in current aggregate premium levels are significantly related to changes in past loss levels. Specifically, current overall premium changes reflect 20.5 percent of the most recent loss change and 16.7 and 1.7 percent of two- and three-year lagged loss changes, respectively. These results are consistent with Venezian (1985). Also, overall premium changes are related to the concentration measure, change in stock index, premium regulation, and policy period as hypothesized, and are statistically significant. The coefficients for changes in real gross domestic product and the discount rate are not significant. The explanatory power of the model ($R^2 = 0.67$) is high; over one-half of premium changes from year to year are explained by this model.

The results from estimating equation (3) for auto liability and fire and allied lines insurance are also reported in Table 4. Broad comparisons then can be made concerning underwriting cycles in liability (auto liability) versus property (fire and allied lines) insurance. The coefficients for lagged losses in the by-line analysis are similar to the results for overall premium changes except that the coefficient of $\Delta Loss_2$ is positive but not significant for fire and allied lines. The premium regulation variable is significant at the 10 percent level for fire and allied lines insurance. Neither the premium regulation nor (property) policy period variables are significant in the auto liability equation; perhaps this reflects the fact that the policy period for property insurance is not the same for auto liability and property insurance in all countries and that auto liability (unlike property insurance) is regulated in all sample countries.

**Table 4**
**Results of Regression Analysis for Eight Countries, 1971 Through 1987**
**Dependent Variable: Change in Premiums**

| Variable | Expected Sign | GLS: Overall | GLS: Auto | GLS: Fire & Allied |
|---|---|---|---|---|
| Intercept | N.A. | 0.147*** | 0.010 | 0.026 |
| | | (4.20) | (0.37) | (0.71) |
| $\Delta Loss_1$ | + | 0.205*** | 0.479*** | 0.356*** |
| | | (2.85) | (6.62) | (7.420) |
| $\Delta Loss_2$ | + | 0.167** | 0.241*** | 0.050 |
| | | (2.31) | (3.09) | (1.03) |
| $\Delta Loss_3$ | + | 0.017 | 0.245*** | 0.106** |
| | | (0.23) | (3.41) | (2.24) |
| ΔStock Index | – | –0.060** | –0.048 | –0.181*** |
| | | (–2.16) | (–1.33) | (–3.87) |
| ΔDiscount Rate | – | 0.000 | –0.007 | –0.039 |
| | | (0.03) | (–0.35) | (–1.44) |
| ΔReal GDP | + | –0.069 | –0.223 | 0.181 |
| | | (–0.67) | (–1.26) | (0.72) |
| Concentration | + | 0.176** | –0.006 | 0.128 |
| | | (2.14) | (–0.12) | (0.99) |
| Regulation | – | –0.106*** | –0.007 | –0.050* |
| | | (–4.12) | (–0.67) | (–1.68) |
| Policy Period | – | –0.049** | 0.007 | –0.014 |
| | | (–2.18) | (0.49) | (–0.49) |
| $R^2$ | | 0.67 | 0.68 | 0.69 |

Note: Countries included are the United States, Canada, West Germany, Italy, Switzerland, Spain, Austria, Denmark, and Japan. All variables except for intercept, dummy variables, and concentration defined as lnX – ln (Lag X). Numbers in parenthesis are t-statistics.
*** Significant at 1 percent. ** Significant at 5 percent. * Significant at 10 percent.

Table 5 contains generalized least squares results based on individual countries (results are reported with and without the variable for change in catastrophe loss). Changes in loss levels for the most recent and prior year are generally positively related to changes in premiums. The coefficient for the most recent loss change in the model excluding the variable for change in catastrophe loss is significant at the 5 percent level for all countries except Japan, Switzerland, and Denmark. The coefficients for these three countries are lower than for the other countries, also. These results suggest that longer or no lags in premium changes may exist with respect to losses in these countries. These lags may reflect regula-

**Table 5**
**Results of Generalized Least Squares Regression Analysis for Individual Country Samples, 1968 Through 1987 (Dependent Variable: Change in Premiums)**

| Variable | United States | | Canada | | West Germany | | Italy | |
|---|---|---|---|---|---|---|---|---|
| | With Catastrophe Loss Variable | Without Catastrophe Loss Variable | With Catastrophe Loss Variable | Without Catastrophe Loss Variable | With Catastrophe Loss Variable | Without Catastrophe Loss Variable | With Catastrophe Loss Variable | Without Catastrophe Loss Variable |
| Intercept | −0.080*** | −0.121*** | −0.052 | −0.132* | −0.003 | 0.057 | 0.185*** | 0.172*** |
| | (−5.820) | (−15.172) | (−1.428) | (−2.668) | (−0.242) | (1.589) | (5.225) | (13.998) |
| $\Delta Loss_1$ | 0.910*** | 1.285*** | 0.650*** | 0.986*** | 0.586*** | 0.202 | 0.916*** | 0.503*** |
| | (7.104) | (17.602) | (4.298) | (5.046) | (5.062) | (1.144) | (4.333) | (7.401) |
| $\Delta Loss_2$ | 0.236 | −0.140 | 0.297** | 0.302 | 0.415*** | 0.247 | −0.482 | −0.117 |
| | (1.227) | (−1.474) | (2.506) | (1.454) | (3.469) | (1.326) | (−1.607) | (−1.229) |
| $\Delta Loss_3$ | 0.181 | 0.555*** | 0.077 | 0.177 | −0.248** | −0.269** | −0.372 | −0.321** |
| | (1.002) | (6.139) | (0.607) | (1.322) | (−2.386) | (−3.021) | (−1.818) | (−4.357) |
| ΔStock Index | −0.189*** | −0.183*** | −0.074 | 0.019 | 0.050 | −0.006 | −0.044 | −0.050*** |
| | (−5.681) | (−13.377) | (−1.669) | (0.304) | (1.220) | (−0.168) | (−1.615) | (−6.527) |
| ΔDiscount Rate | −0.073*** | −0.098*** | −0.032 | −0.111* | 0.010 | 0.046 | −0.025 | −0.019** |
| | (−3.837) | (−11.600) | (−0.887) | (−2.562) | (0.477) | (1.163) | (−0.654) | (−2.794) |
| ΔReal GDP | 1.754*** | 1.619*** | 1.142*** | 1.723*** | 0.668* | 0.129 | −0.270* | 0.043 |
| | (14.175) | (30.296) | (3.712) | (4.588) | (2.247) | (0.242) | (−1.836) | (1.211) |
| ΔNatural Catastrophe $Loss_2$ | | −0.009* | | 0.030 | | 0.092 | | 0.037 |
| | | (−2.153) | | (1.312) | | (2.041) | | (1.998) |
| $R^2$ | 0.85 | 0.99 | 0.53 | 0.92 | 0.77 | 0.91 | 0.69 | 0.97 |

**(Continued)**

**Table 5 (Continued)**

| | Japan | | Spain | | Austria | | Denmark | | Switzerland | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | With | Without | With | Without | With | Without | With | Without | With | Without |
| Intercept | 0.239** | 0.083 | 0.101* | 0.005 | – 0.058** | –0.048* | 0.093*** | 0.079* | 0.083* | 0.081** |
| | (2.820) | (1.536) | (2.010) | (0.270) | (–4.119) | (–2.337) | (3.982) | (2.298) | (2.119) | (2.933) |
| $\Delta Loss_1$ | 0.090 | 0.536 | 0.452** | 0.563** | 0.377** | 0.248** | 0.009 | –0.203 | –0.020 | 0.053 |
| | (0.227) | (1.633) | (2.493) | (4.045) | (4.04) | (2.917) | (0.084) | (–1.692) | (–0.162) | (0.316) |
| $\Delta Loss_2$ | –0.588 | –0.233 | –0.242 | –0.041 | 0.584** | 0.524*** | 0.011 | –0.009 | 0.095 | –0.248 |
| | (–1.507) | (–0.628) | (–1.327) | (–0.269) | (9.054) | (5.569) | (0.112) | (–0.082) | (0.521) | (–1.734) |
| $\Delta Loss_3$ | –0.064 | 1.152 | 0.192 | 0.243* | 0.440** | 0.498*** | –0.015 | 0.295* | –0.003 | 0.121 |
| | (–0.185) | (1.484) | (1.216) | (2.178) | (4.426) | (4.900) | (–0.129) | (2.286) | (–0.017) | (0.572) |
| ΔStock Index | 0.412* | 0.759* | 0.014 | –0.046 | 0.041* | 0.052* | –0.070 | –0.119** | –0.020 | –0.023 |
| | (2.234) | (2.568) | (0.305) | (–1.926) | (1.852) | (2.133) | (–1.745) | (–2.958) | (–0.448) | (–0.331) |
| ΔDiscount Rate | 0.080 | 0.136 | 0.003 | –0.035 | –0.004 | 0.009 | –0.064 | 0.008 | –0.014 | 0.008 |
| | (1.534) | (1.461) | (0.091) | (–1.838) | (–0.268) | (0.979) | (–1.224) | (0.136) | (–0.591) | (0.263) |
| ΔReal GDP | –2.302 | –5.708 | –0.260 | 1.194*** | 0.057 | 0.180* | 1.180** | 1.877** | –0.185 | –0.005 |
| | (–1.629) | (–1.782) | (–0.540) | (5.598) | (1.160) | (2.229) | (2.915) | (3.028) | (–0.700) | (–0.009) |
| ΔNatural Catastrophe $Loss_2$ | | –0.077 | | –0.151** | | –0.030* | | –0.092 | | 0.083 |
| | | (–0.662) | | (–4.481) | | (–2.733) | | (–1.780) | | (1.676) |
| $R^2$ | 0.27 | 0.68 | 0.31 | 0.91 | 0.72 | 0.97 | 0.59 | 0.84 | 0.43 | 0.65 |

Note: In Italy, period extends to 1986. All variables (except for the intercept) are expressed as a rate of change (i.e., lnX – ln (Lag X)). T-statistics are in parentheses below each coefficient.

*** Significant at 1 percent. ** Significant at 5 percent. * Significant at 10 percent.

tory, data collection, and accounting phenomena, as discussed above. In the model excluding the change in catastrophe loss variable, the change in losses for the most recent period are the most important loss variables associated with premium changes for six countries, implying at least a one-year lag between changes in losses and premiums.

It would be desirable to link the coefficients for the lagged change in losses with ratemaking practices. Since comparative data across countries regarding ratemaking practices are unavailable, we consider only ratemaking practices in Japan (since we were able to obtain these data). In general, rates for personal accident and health insurance, fire and allied lines insurance, and auto liability are reexamined every year; otherwise, rates are reviewed every three years. For most insurance lines, the data used for revising rates are for the preceding five years, although for (residential) fire and allied lines it is three years and for (warehouse) fire and allied lines or ocean and inland marine insurance it is ten years. The data used to revise rates are generally older than just indicated because it takes from three to six years before claim payments for a cohort of policies are complete. Trends in loss ratios are seldom used in revising rates; rather, the average value of the loss ratio during the period studied is used. The results for Japan shown in Table 5 are consistent with these practices. The data used in revising rates go back farther in time than the change in loss variables; and the coefficients for the change in loss variables are not significant, unlike for many countries in our sample.

For the model excluding the change in catastrophe losses, the change in the discount rate is significant (at the 1 percent level or higher) for the United States. Change in the stock market index is significant (at the 10 percent level or higher) for the United States, Japan, and Austria in the model excluding change in catastrophe losses, although only in the United States is the sign of the coefficient negative as expected. In the model excluding change in catastrophe losses, real gross domestic product is significant (at the 10 percent level or higher) for the United States, Canada, West Germany, Italy, and Denmark.

The intercept terms for Italy, Spain, Japan, Denmark, and Switzerland are positive in the model excluding catastrophe losses. The positive intercept coefficient offsets partially the negative coefficient on the change in real GDP.[21] A positive intercept further reinforces the reasons underlying the interest in some of these insurance markets by foreign insurers. In particular, Spain's market is growing rapidly as a result of improvement in economic conditions; these conditions probably result in increasing competition and dampened premium increases; hence, the negative sign for changes in real GDP. The Japanese insurance market is perceived as desirable, too, although restrictive insurance regulations have virtually closed this market to foreign insurers. The presence of these countries may be responsible for the unexpected sign on the coefficients for change in the discount rates and for real gross domestic product. Interestingly, the coefficient for the stock index variable is positive and significant for Japan; the reason may be that auto liability insurance in Japan contains a savings component. Thus, as in-

[21] In Austria and Italy, policies covering more than one year (long-term agreements) are available and may be affecting the results for these two countries.

vestment opportunities improve, policyholders might accept higher premiums if this increase in premium is treated as an addition to the savings component of the policy.

For the model excluding change in catastrophe losses, the intercept terms for the United States, Austria, and Canada indicate that premiums have been decreasing on average by 8, 6, and 5 percent, respectively (see Table 5). (For the United States and Austria, the coefficient is statistically significant at the 1 percent level.) These decreases may result from expense efficiency improvements and regulation that restricts premium increases. For example, in the United States, premiums for automobile liability and workers' compensation were subject to premium rate suppression over part of the study's time period, and these lines represent a significant volume of premiums. U.S. insurers are concerned, at least publicly, with inadequate rates of return for these lines during the latter part of the sample period.[22] Another possible explanation is that increases in interest rates over the sample period result in less than proportional increases in premiums vis à vis losses. Also, growth in captives and other alternative market vehicles may explain this effect.

All of the regression equations are reestimated with an added independent variable: two-year lagged catastrophic loss changes (see Table 5).[23] The lagged catastrophic loss change variable is significant in the United States, Austria, and Spain and almost significant for West Germany and Italy. According to the hypotheses reviewed above, the coefficient of this variable may reflect the netting of two factors: increases in premiums to recoup lost surplus and premium declines attributable to restrictions in coverage (e.g., through deductible increases and nonrenewal of some policies). Alternatively, the variable could be capturing changes in loss expectations. In four of the models, the coefficient is positive but never significant. The coefficient is negative and significant at the 10 percent level or better for the United States, Spain, and Austria, suggesting perhaps that availability effects outweigh premium increases attributable to natural catastrophes. This result would most likely occur in those countries with inflexible insurance rate regulation. Addition of this variable greatly increases the explanatory power of the models in all countries (e.g., $R^2 > 0.90$ for the United States, Canada, West Germany, Italy, Spain, and Austria).

With this added variable, the results are generally consistent with those reported excluding the variable for change in catastrophe loss except that the change in real GDP is now significant (at the 10 percent level or higher) in the United States, Canada, Spain, Austria, and Denmark. Also, when the added variable is included, the change in the stock index is significant (at the 10 percent level or higher) in the United States, Italy, Japan, Austria, and Denmark. Clearly, catastrophic losses should be controlled for in determining whether premium increases are directly related to cost factors.

[22] Premium rate regulation need not necessarily dampen rates; regulators concerned primarily with insurer solvency may approve premium rates (in the short term) which are higher than competitive premiums.

[23] One-year changes in natural catastrophe losses were tested, but the two-year lagged catastrophic losses had higher explanatory power.

*Underwriting Cycle Period Lengths*

Table 6, Panel A reports the regression results for underwriting cycle period lengths. Results for three models are shown. In the first two models, all by-line cycle periods not equal to zero are included in the analysis, while the third model includes only cycle periods for general liability, auto liability, and other. Overall, the results are similar for both sample sets.

Growth in the discount rate and catastrophic losses are significant across all models. Thus, a negative relationship exists between catastrophic losses and cycle period, and a positive relationship exists between discount rate growth and cycle period. The significance of the coefficient for the catastrophic loss variable in Model 3 (liability lines only) is surprising. The presence of rate regulation is positively related to the cycle period, and this relationship is statistically significant in two of the three models.

Several variables are statistically significant in the three-line liability model but not in the other model. These include policy period length and the coefficient of variation for the loss ratio. A positive and statistically significant relationship between policy period length and cycle period is found; similarly, the coefficient of variation of the loss ratio is positive and significant, suggesting that longer cycle periods are associated with more volatility in underwriting results as measured by the loss ratio. The loss reserve discount variable was tested in some models, but the results were not significant. To preserve degrees of freedom, this variable is deleted from the final models.

*Prediction of Underwriting Cycle Presence*

Panel B of Table 6 presents the results of the logit regression. Growth in catastrophic losses and the loss reserve discounting dummy variable are statistically significant at the 10 percent level or better. These results conform to expectations. Liability lines are more likely than property lines to exhibit an underwriting cycle.

None of the other variables tested, such as rate regulation and policy period, are statistically significant. The limited data available and a degrees of freedom problem are the most likely reasons. However, these preliminary results can be considered as promising for future work on cycle predictability.

## CONCLUSION

This study further substantiates the presence of underwriting cycles in the average loss ratio and by-line loss ratios for a sample of twelve countries. The lines studied include the major insurance lines in the countries (auto liability, ocean and inland marine, fire and allied lines, general liability, accident and health, and other). Generalized least squares analysis of changes in premium levels provide some support for the rational expectations/institutional intervention hypothesis.

**Table 6**
**Results of Regression Analysis, 1971 Through 1987**
**Dependent Variable: Cycle Period**

*Panel A: Dependent Variable: Cycle Period*

| Variable | Model 1 All Lines | Model 2 All Lines | Model 3 Liability Lines Only |
|---|---|---|---|
| Intercept | 7.432*** | 6.854*** | 5.312*** |
| | (4.798) | (4.348) | (5.820) |
| Discount Rate Growth | 0.721*** | 0.796*** | 0.324** |
| | (3.073) | (3.361) | (2.294) |
| Policy Period | −0.177 | −0.172 | 0.151* |
| | (−1.174) | (−1.160) | (1.717) |
| Catastrophe Loss Growth | −1.359* | −1.634** | −1.339** |
| | (−1.890) | (−2.229) | (−2.636) |
| Regulation | 1.650* | 1.558 | 1.549** |
| | (1.691) | (1.619) | (2.712) |
| CV Loss Ratio | | 0.771 | 1.508** |
| | | (1.441) | (2.456) |
| $R^2$ | 0.300 | 0.322 | 0.440 |

*Panel B: Logistic Regression All Lines: Dependent Variable: Cycle = 0 or 1*

| Variable | |
|---|---|
| Intercept | 1.855** |
| | (3.86) |
| Liability Line | 1.499*** |
| | (6.76) |
| Loss Reserve Discount | −0.831** |
| | (−3.25) |
| Catastrophe Loss Growth | −0.983** |
| | (−4.87) |

Note: Countries included are the United States, Canada, West Germany, Italy, Switzerland, Spain, Austria, and Japan. Numbers in parenthesis are t-statistics.
*** Significant at 1 percent. ** Significant at 5 percent. * Significant at 10 percent.

Changes in premium levels are targeted for analysis since factors hypothesized to drive apparent underwriting cycles affect premiums directly. These factors include loss lags attributable to regulatory or data collection considerations, policy period lengths, and accounting conventions. Further, changes in discount rates and stock indexes are also significantly related to premium changes in some countries. Demand effects arising from the level of a country's economic activity play a role in understanding premium changes and underwriting cycles. Finally, based on the more direct tests of underwriting cycles, discount rates are a significant explanatory variable for cycle period, along with rate regulation and catastrophic loss growth. Evidence indicates that reserve discounting is a significant variable when predicting the presence of a cycle.

Future research that analyzes separately the effect of lags caused by regulation, data collection (ratemaking), and accounting principles is needed for better understanding of underwriting cycles in different countries. As more international data become available, other factors affecting changes in premiums and underwriting cycles may be tested. For example, the amount of business produced by domestic insurers (versus nondomestic insurers) might provide for a better understanding of the interaction between demand, price, and insurance supply within a country. Similarly, the analysis of insurers' investments (by type of asset and international diversification) may indicate different risk attitudes affecting the variability of investment versus underwriting profit. By conducting an analysis on an international level, valuable comparisons and contradictions between the various insurance markets facilitates an understanding of this global phenomenon.

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