An International Analysis of Underwriting Cycles in Property-Liability Insurance

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ABSTRACT

Most prior analyses of underwriting cycles have explained cycles as a supply-side phenomenon involving irrational behavior on the part of insurers. This paper proposes instead that insurance prices are set according to *rational* expectations. Although rational expectations per se would be inconsistent with an underwriting cycle, the authors hypothesize that cycles are "created" in an otherwise rational market through the intervention of institutional, regulatory, and accounting factors. Empirical evidence is presented indicating that underwriting profits in several industrialized nations are consistent with the hypothesis.

Introduction

The underwriting cycle has been the subject of much recent discussion in the insurance literature (Conning & Co. [3]; Ferguson [11]). The consensus seems to be that the underwriting cycle in the United States is about six years

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in length (Smith and Gahin [25]; Venezian [28]) [1] Experience during 1984-1985 may suggest that the cycle is lengthening, although it is too early to draw any conclusions. In any event, the same market forces seem to be at work; and institutional descriptions of the current cycle trough and upturn do not differ in any really significant way from prior discussions.

Although variations in profits suggest that a market mechanism may be operating, industry observers usually interpret the cycle as a supply-side phenomenon. The typical explanation is that the insurance industry causes the cycle more or less on its own, through periods of destructive competition followed by cutbacks in supply (Wilson [29]). More sophisticated versions usually relate the recurring phases of the cycle to key operating ratios such as the premiums-to-surplus ratio, which is said to represent capacity (Stewart [26]).

Advocates of the supply-side hypothesis typically do not provide an explanation of the causal mechanism through which market reversals take place. The assumption is that insurers "decide" at some point to constrict supply and raise prices. The motive for beginning to restrict supply at one point rather than another is not clearly specified, although some writers argue that it is related to the premiums-to-surplus ratio (Smith [23]) or, as Stewart suggests, to total income.

A supply-side analysis with a slightly different focus has been provided by Venezian [28]. He too implicitly assumes that prices are determined more or less unilaterally by the insurance industry, but he suggests a different connection between insurance industry behavior and the existence of cycles. Specifically, Venezian points out that ratemaking, at least as practiced in the United States, relies on extrapolations of past claim costs as predictors of future claim costs. These extrapolations typically involve an estimation period (for the extrapolation equation) of approximately three years, and an extrapolation period of about two years. (See Cummins and Griepentrog [5].)

Venezian presents a theoretical analysis demonstrating that this type of extrapolation procedure can generate a profit cycle. He conducts empirical tests on U.S. underwriting profit data and concludes that they follow a second order autoregressive process with a cycle length of about six years. In his view, the industry is responsible for creating the cycle through the use of naive forecasting procedures. Outreville [20] also points out problems related to the use of naive models.

Although not specifically concerned with cycles, Smith [24] provides results consistent with Venezian's findings. Specifically, Smith finds that underwriting profits follow a second-order autoregressive process. This type of process is the one hypothesized by Venezian, and it can generate a cyclical series.

Another empirical analysis of cycles is provided by Smith and Gahin [25]. They use spectral analysis to study several industry operating-variables for the period 1950-1978. The results indicate that statutory underwriting profits

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[1] Doty [10] argues that, in addition to the short-term six-year underwriting cycle, both a 20-year insurance cycle and a 50 to 60 year general business cycle exist.

have a cycle period of 5.56 to 6.25 years, which is consistent with Venezian's findings and with the conventional wisdom.

A general equilibrium model of insurance pricing with the capability for explaining cycles has been developed by Doherty and Kang [9]. Their model considers both supply and demand, and the resulting prices and profits arise from the interaction of these two market forces. Relying on capital-asset pricing theory, supply is considered to be a function of interest rates and expected profits. The sign of the interest rate term is expected to be positive, i.e., insurers increase supply when interest rates rise in order to obtain funds to invest (known as cash-flow underwriting).

The demand for insurance in the Doherty-Kang model is hypothesized to be a function of price (the inverse of the loss ratio)[2] and aggregate economic activity (income), with the latter representing an index of the amount of insurable goods and services. The equilibrium price is determined in the model by equating the quantity demanded with the quantity supplied. Although clearly not the final word on the subject, the Doherty-Kang analysis represents the type of approach that must be used in order to develop a viable explanation of insurance prices and underwriting cycles.

As the foregoing discussion suggests, nearly all of the existing studies of underwriting cycles have focused almost exclusively on the United States.[3] If insurance markets have similar economic and institutional characteristics in other countries, one would expect to observe cyclical profit patterns on an international scale. These patterns would be reinforced through the operation of the international reinsurance market.

The purpose of this paper is to propose a new explanation for the existence of underwriting cycles. The explanation is consistent both with modern theories of financial markets and with the institutional realities of insurance markets. Specifically, the authors hypothesize that market equilibrium insurance premiums are set in competitive markets and reflect rational expectations.[4] I.e., the subjective expected values of future losses and other relevant variables reflected in market prices are hypothesized to be equal to the objective expectations, conditional on information available at the time rates are established. In the absence of other effects, rational expectations would be inconsistent with the existence of any type of profit cycle. The authors' contention is that institutional and regulatory factors intervene in insurance markets, leading to an "apparent" cycle.

The cycle hypothesized here is apparent in the sense that it has nothing to do with the underlying economic and statistical characteristics of insurance markets but rather is attributable to institutional and regulatory rigidities. Among the intervening factors are data collection lags, regulatory lags, policy

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[2] The inverse of the loss ratio indicates the cost per dollar of losses required to administer the insurance mechanism. See for example Frech and Samprone [12].

[3] With the exception of De Witt [8], Helten [14], and Mormino [18].

[4] Like the Doherty-Kang model, the model postulated here is an equilibrium model. However, the authors explicitly specify only the equilibrium relationship and not the underlying supply and demand relationships.

renewal lags, and statutory accounting rules. Premiums need not be set irrationally in order to generate a cycle.

If this hypothesis proves to be correct, it would provide an explanation for the existence of cycles in countries other than the U.S., where extrapolative forecasting may not be so firmly entrenched. To provide preliminary evidence on this point, the authors test for the presence of cycles in several industrialized nations. Statistically significant cycles in all lines underwriting profits are present in eight of the thirteen countries tested. The cycles are between six and eight years in length in six of the eight countries where cycles exist. Automobile insurance cycles are present in all six of the countries for which auto data were available.

As suggested above, the existence of cycles (second-order autoregressive processes in reported profits) could be consistent both with the authors' hypothesis and with a Venezian-type hypothesis (which might be termed "irrational" expectations). Present data and institutional information on international ratemaking practices are insufficient to make a conclusive distinction between the two hypotheses. To conclude the article, the authors suggest the types of information that might be collected on a country-by-country basis in order to narrow further the range of possible explanations for cycles.

Underwriting Cycles and Rational Decision Making

If cycles exist in insurance markets, institutional and regulatory factors may be responsible. One such institutional factor, the use of extrapolative forecasting techniques, has been investigated by Venezian [28]. Venezian's hypothesis implies a degree of irrationality on the part of insurers, i.e., past loss trends are extrapolated into the future in a rather mechanical way and other potentially relevant information is de-emphasized or disregarded.

In this section, the authors develop an alternative model that also is consistent with observed profit cycles in insurance. Specifically, they show that cycles in reported underwriting profits are consistent with a simple *rational expectations* model of insurance price determination, provided that institutional lags and reporting practices are taken into account. The rational expectations hypothesis implies that economic agents forecast economic variables without systematic error, i.e., that their *subjective* expected values of these variables are the same as the actual or objective expected values, *conditional on all information available at the time the forecasts are made.* The hypothesis is explained in more detail below.

The rational expectations model is intuitively appealing because it is consistent with recent economic theory developed for other types of financial markets. It also would help to explain the existence of underwriting cycles in countries other than the U.S., where mechanical trending procedures may not be employed.

The authors begin with the hypothesis that both demand and supply play a role in the determination of insurance prices. They also assume that insurance markets are competitive so that no monopoly rents exist. They hypothesize that the market's evaluation of the relevant economic variables is rational, but that observed prices (profit margins) are not consistent with rational expectations for the following reasons:

1. Contracting and informational features of the insurance transaction prevent prices from adjusting promptly to changing economic conditions.

2. Reporting practices average together prices from different periods and exacerbate any autocorrelation that may be present in the actual price relationships.

Among the contracting and informational features are (a) data collection lags, (b) regulatory lags, and (c) policy renewal lags. These features, any or all of which may be present in any given national insurance market, are discussed in more detail in Cummins and Nye [6]. A brief explanation of each type of lag is given below.

Ratemaking usually is based on annual data, which are not sufficiently mature for use, even in short-tail lines until several months after the close of the "experience period." This immaturity is due to delays in reporting and settling claims and delays in tabulating and analyzing the data. Projections are made from the experience period to the mid-point of the period for which the rates will apply, but these projections are necessarily based (at best) on information available prior to the projection date.

Insurance rates are regulated in many countries (Lemaire [16]). Insurers must have their rates approved by regulatory authorities prior to use (as in the U.S.) or conform to a uniform national tariff (as in Switzerland). Regulation almost always creates additional delays between the experience period and the effective date of the revised rates. In addition, rates may be revised less frequently than under a competitive system. (See, for example, MacAvoy [17].)

Renewal lags are present in most countries in virtually every line of property-liability insurance. Unlike prices for commodities and shares of stock, the prices of insurance policies cannot be changed simultaneously to reflect new information. Most insurance policies have terms of either six months or a year. Thus, for example, if policy terms are annual, rates are revised once a year, and new rates go into effect on January 1, the price for the average policy will change on about July 1 and the new rates will not be in effect for all policies until December 31.

The second major reason that insurance profits are inconsistent with rational expectations has to do with insurance company financial reporting. Most of the data used to demonstrate the existence of underwriting cycles are calendar year data. These data reflect loss estimates on an incurred basis, i.e., losses are matched to coverage provided during the calendar year. In a rational expectations world, loss estimates for any given year would reflect all information available at the end of that year, when the statutory statements are compiled.

The premium figures for the years also are based on accrual accounting, i.e., the premiums are those that were earned by the insurers by providing coverage during the year. However, the premiums earned during the year include premiums for policies issued during a period ranging from the first day of the preceding year to the last day of the reporting year. At best, these premiums reflect only information available at the time the corresponding policies were issued. Due to the lags discussed above, their information content is unlikely to be this current. Thus, a mismatch is very likely to exist between the information content of reported premiums and the information content of reported losses. As shown below, these factors can lead to seemingly irrational profit patterns.

The Rational Expectations Hypothesis

Suppose that an economic variable X_t is generated by the following linear model (see Abel and Mishkin [1]):

$$X_t = Z_{t-1} A + \mu_t \tag{1}$$

where Z_{t-1} = a vector of variables known at the end of $t-1$,

A = a vector of coefficients, and

μ_t = a random error term.

Assume that $E(\mu_t | \phi_{t-1}) = 0$, where ϕ_{t-1} is the set of information available at the end of period $t-1$. Then,

$$E(X_t | \phi_{t-1}) = Z_{t-1} A \tag{2}$$

Now consider a forecast of X_t, denoted X_t^f. Rationality requires that the subjective expectation of X_t, X_t^f, equals the objective expectation. A weak form of the hypothesis can be expressed as follows:

$$E(X_t - X_t^f | \phi_{t-1}) = 0 \tag{3}$$

where $\Xi_t = X_t - X_t^f$.

Since equation (3) is merely the regression of Ξ_t on ϕ_{t-1}, the implication is that Ξ_t is serially uncorrelated and uncorrelated with any information in ϕ_{t-1}. As explained below, a specific pattern of autocorrelation is necessary to develop an underwriting cycle. Thus, if the standard rational expectations model were applicable in insurance, no underwriting cycle would exist.

A Simple Insurance Model With Rational Expectations

In this section, the authors develop a simple, stylized model of an insurance market. The model is based upon simplifying assumptions about ratemaking lags and reporting practices. Although the real world is clearly much more complex, it is remarkable that the model developed below predicts cyclical patterns in underwriting profits very similar to those observed in many industrialized nations.

Consider a second-order autoregressive model for underwriting profits:

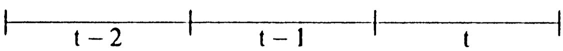
$$\Pi_t = a_0 + a_1 \Pi_{t-1} + a_2 \Pi_{t-2} + \omega_t \tag{4}$$

where Π_t = underwriting profits in period t, and

ω_t = a random error term.

As Venezian [28] points out, a cycle will be present if $a_1 > 0$, $a_2 < 0$, and $a_1^2 + 4 a_2 < 0$ (see below). Under reasonable assumptions, the model developed below predicts coefficients (a_1 and a_2) with the correct signs and magnitudes to generate a cycle in reported profits.

To provide a standard of comparison, the model is first developed assuming rational expectations with no institutional or reporting complications. Consider the following time line:



and assume that rates for all policies can be changed simultaneously at the end of any period on the basis of the information at that time. I.e., premiums are determined as follows:

$$P_t = f(Y_{t-1}) \tag{5}$$

where Y_{t-1} is some set of variables contained in ϕ_{t-1}. P_t is the premium net of expenses and underwriting profit loadings, which are assumed to be a constant proportion of the net premium over time.[5] Y could include past claims experience, interest rates, inflation rates, etc. Rational expectations requires that the following condition hold (Abel and Mishkin [1]):

$$E[L_t - f(Y_{t-1}) | \phi_{t-1}] = 0 \tag{6}$$

where $\Pi_t = L_t - f(Y_{t-1})$ is the unanticipated underwriting loss (profit).

To simplify the algebra, assume that all relevant information about insurance losses at the end of any year (say t − 1) is contained in the loss experience for that year (L_{t-1}). This variable can be written as follows:

$$L_{t-1} = E(L_{t-1}) + \varepsilon_{t-1} + \mu_{t-1} \tag{7}$$

where $E(L_{t-1})$ = the objective expected value of losses as of the beginning of period t − 1,

[5]The profit loading assumption could be consistent with variance or systematic risk-based relationships, provided that the relationship between the loadings and expected losses remains relatively stable over time.

ε_{t-1} = the permanent or systematic component of the difference between actual and expected losses, and

μ_{t-1} = the transitory or unsystematic component of the difference between actual and expected losses.

The error terms (μ and ε) have zero means, are not autocorrelated, and are uncorrelated with each other. The systematic error (ε) represents a permanent change in loss levels and thus becomes part of the expected value of losses in subsequent periods. The unsystematic error (μ) applies only to the period under consideration.

Rational expectations would imply:

$$E(L_t - E^r(L_t|\phi_{t-1})|\phi_{t-1}) = 0 \quad (8)$$

where $E^r(L_t|\phi_{t-1})$ = the subjective (market assessed) expectation of L_t conditional on information available at the end of $t-1$.

Considering equation (7), (8) implies

$$E(L_t|\phi_{t-1}) = E^r(L_t|\phi_{t-1}) = E(L_{t-1}) + \varepsilon_{t-1} \quad (9)$$

Thus, the premium generating model would be:

$$P_t = E(L_{t-1}) + \varepsilon_{t-1} \quad (10)$$

Underwriting losses (profits) would be:

$$\Pi_t = L_t - E(L_t) = \varepsilon_t + \mu_t \quad (11)$$

Equation (11) implies that profits would not be autocorrelated and no cycle would be observed.

Retaining the assumption that insurance markets take into account all information available at the time premiums are set, now introduce data collection and regulatory lags. Specifically, assume that these lags result in a delay of one year between the experience period and the effective date of the new rates. This assumption implies the following pricing model:

$$P_t = E(L_t|\phi_{t-2}) = E(L_{t-2}) + \varepsilon_{t-2} \quad (12)$$

The model is appropriate because no information from period $t-1$ is available at the time rates are set and because the expected values of ε and μ are zero. Note that it is rational in the sense that the market distinguishes between systematic and unsystematic errors.

Underwriting losses under this rate structure would be:

$$\Pi_t = L_t - P_t = \varepsilon_t + \mu_t + \varepsilon_{t-1} \tag{13}$$

Thus, first-order autocorrelation would be present. Although the second and higher order autocorrelations of Π_t would be zero, the least squares regression coefficient of Π_t on Π_{t-2} in the regression of Π_t on Π_{t-1} and Π_{t-2} generally will not be zero. Thus, profits may appear to follow a second-order autoregressive process. The magnitude of the regression coefficient of Π_{t-2} when profits are generated by equation (13) is less than that usually observed in practice (see appendix), implying that additional complications must be accounted for.

A second-order process can be created by combining informational and regulatory lags with renewal lags and calendar-year reporting practices. Recall that rates are assumed to change at the beginning of each year and to remain in effect for one year. Also assume that policy terms are one year in length and that policies are renewed evenly throughout the year. Under these assumptions, *reported* profits in any given year will be a weighted average of the *actual* profits implied by the two most recent pricing decisions, i.e.,

$$\Pi_t^R = \alpha\, \Pi_t + (1-\alpha)\, \Pi_{t-1}$$

$$= \alpha(\varepsilon_t + \mu_t + \varepsilon_{t-1}) + (1-\alpha)\, (\varepsilon_{t-1} + \mu_{t-1} + \varepsilon_{t-2}) \tag{14}$$

If the ε and μ processes are stationary and neither autocorrelated nor cross-correlated, the regression coefficients of Π_t^R on Π_{t-1}^R and Π_{t-2}^R will be of the correct signs and magnitudes to give rise to an apparent cycle similar to that observed in practice (see appendix). The cycle is apparent in the sense that it has nothing to do with the underlying economic and statistical characteristics of insurance profits but rather reflects institutional factors and accounting practices.

Empirical Measurement of Cycle Periods

A necessary but not sufficient condition for the above hypothesis to be valid is the existence of autoregressive profit patterns in insurance underwriting profits. Specifically, equation (4) should hold with $a_1^2 + 4\, a_2 < 0$. In this case, the characteristic equation of the second order difference equation in underwriting profits will have complex roots, implying that profits follow a cyclical pattern.[6] The period of the cycle is obtained from the following formula:

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[6]See for example Nelson and Plosser [19]. Slutsky [22] notes that the second-order case is simple and unambiguous but that there is no reason why we should not fit higher order difference equations if this adds to the explanatory power. A discussion on the measures of cyclic variation can be found in Harvey [13].

$$\text{Period (P)} = 2\,\pi/\cos^{-1}\,(a_1/2\sqrt{-a_2}\,) \qquad (15)$$

The cycle will be damped (i.e., have a tendency to die down over time) if $\sqrt{-a_2} < 1$. If $\sqrt{-a_2} > 1$, the cycle will be explosive. Even a damped cycle will be maintained over time if random shocks occur.

To test for the existence of international underwriting cycles, equation (4) was estimated using data from several industrialized nations. Two principal data sets were available: Outreville [21] and Szpiro [27]. The former included all lines and automobile insurance results for six countries, while the latter reported all lines results for thirteen countries.[7] A decision was made to utilize the largest possible data set for each variable. Hence, the Szpiro data were analyzed for overall results and the Outreville data for auto.[8]

The data period in all of the regressions is 1957-1979. A few additional years of data (either before or after the 1957-1979 data period) were available for a minority of the countries. Outside of the U.S., the earliest available data for any of the countries begain in 1950 and the most recent data were for 1981. The years of the early 1950s were not included in the analysis because they are unlikely to be comparable with more recent experience. The 1980 and 1981 data were eliminated because it was considered desirable to utilize a uniform sample period. Estimation including 1980 and 1981 where data for these years were available yielded results very similar to those for the period 1957-1979.

The dependent variable in most of the regressions is the ratio of premiums to losses. This ratio reflects the proportionate loading or transactions costs of insurance and is a measure of the aggregate economic value of insurance (Frech and Samprone [12]). Profit ratios were not used because expense data are unavailable for most of the countries analyzed. The authors do not consider this use of premiums-to-surplus ratios to be a serious limitation because profit ratios are highly correlated with premium-to-claim ratios in countries for which both types of data are available (see Cummins and Nye [6] and Outreville [21]) and because a trend variable was included in all equations to account for the downward trend in expenses which is present in many countries (see Outreville [21]).

The results for all lines profit ratios are shown in table 1. The equations in the table were estimated utilizing ordinary least squares. The coefficient of at least one of the lagged profits terms was statistically significant (at the 5 percent level) in 12 of the 13 countries, indicating some degree of autocorrelation in insurance profits in nearly all of the markets tested. The

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[7] Data for Israel were included in Szpiro's data base but were omitted from the study because of the high rate of inflation and prevalence of indexation in the Israeli economy.

[8] Although the data available in Outreville [21] and Szpiro [27] represent a significant improvement over that in prior sources, a number of limitations are present. Loss and expense ratios are available for all lines combined in most of the countries, but in some European countries, the data reported are not consistent with North American countries' data. Comparative data by line are available only for automobile insurance, and in many cases only the loss ratio is available.

second-order lagged profits term was statistically significant and negative in eight countries and was close to significance for Italy. Thus, evidence of cyclicality was present in a majority of the countries tested. The cycle length was between six and eight years in six of the countries tested and slightly above eight years for a seventh (France). The cycle period for Italy also fell in this range when the observations for 1957-1959, apparent outliers for this country, were eliminated. As noted above (and in the appendix) a six to eight year cycle length is consistent with the rational expectations/institutional intervention hypothesis.

The automobile insurance profit ratio regressions are presented in table 2. A significant underwriting cycle is present in all six countries tested. The cycle length ranges from 5.17 to 9.92 with a mean of 7.09.

Table 1

ALL-LINES UNDERWRITING PROFIT RATIO REGRESSIONS FOR THIRTEEN MAJOR NATIONS

	a(0)	a(1)	a(2)	Time	R-SQ	Cycle Period
Australia	1.911	0.294	-0.411	-0.016	0.63	4.69
		1.407	1.939	3.402		
Canada	1.193	0.959	-0.670	-0.008	0.76	6.65
		6.031	4.161	3.545		
Denmark	0.667	0.477	0.109	-0.008	0.16	NC
		2.074	0.476	1.556		
Finland	0.932	0.490	-0.029	-0.004	0.29	NC
		2.159	0.136	0.920		
France	1.770	0.904	-0.392	-0.395	0.90	8.23
		4.476	2.365	3.048		
Germany	1.191	0.879	-0.406	-0.021	0.88	7.76
	.	4.246	1.943	2.951		
Italy: 1957-1979	0.676	0.865	-0.253	< .001	0.65	11.71
		4.779	1.398	0.011		
1960-1979	1.036	0.775	-0.346	-0.003	0.46	7.38
		3.475	1.680	0.674		
Japan	1.268	0.812	-0.349	-0.005	0.65	7.72
		4.588	2.017	1.029		
New Zealand	1.305	0.694	-0.397	-0.010	0.73	6.36
		3.337	1.995	2.635		
Norway	0.377	0.515	0.233	< .001	0.57	NC
		2.320	1.074	0.338		
Sweden	1.103	0.714	-0.434	0.004	0.46	6.29
		3.379	1.895	1.084		
Switzerland	1.826	0.355	-0.210	-0.015	0.78	5.35
		1.614	0.933	3.048		
United States	1.379	0.904	-0.767	-0.010	0.90	6.11
		6.848	5.946	5.694		

NOTE: The estimation period is 1957-1979, unless otherwise indicated. The estimation equation is: $CR(t) = a(0) + a(1)CR(t-1) + a(2)CR(t-2) + u(t)$ where CR(t) = the premiums to claims ratio in year t and u(t) = a random error term. All equations were estimated by ordinary least squares. Absolute values of t-statistics appear below coefficients.

As suggested above, an examination of the institutional and regulatory characteristics of insurance markets in each of the countries tested would be needed to link the empirical findings with the rational expectations/ institutional intervention hypothesis. Little published information is available on the relevant institutional features of international insurance markets.

In order to judge the consistency of the results with the hypothesis, information would be needed on: (1) the automobile insurance ratemaking process, including any trending procedures, (2) the length of time between policy renewal dates, (3) regulatory practices and competitiveness of markets, and (4) profit and loss accounting practices. This listing can serve as a preliminary research agenda for future investigations of international underwriting cycles.

Table 2

AUTOMOBILE INSURANCE LOSS RATIO REGRESSIONS
FOR SIX MAJOR NATIONS

	a(0)	a(1)	a(2)	Time	R-SQ	Cycle Period
Canada*	1.297	0.851	-0.635	-0.014	0.78	6.24
		5.012	3.764	3.985		
France	0.696	0.946	-0.431	-0.007	0.90	8.20
		4.802	2.612	2.955		
Italy	0.741	1.261	-0.612	-0.014	0.87	9.92
		7.619	4.016	1.320		
Sweden	0.802	0.816	-0.397	-0.001	0.43	7.26
		3.781	2.087	0.150		
Switzerland	1.758	0.445	-0.409	-0.010	0.46	5.17
		2.219	2.242	2.522		
United States	1.347	0.735	-0.653	-0.007	0.73	5.72
		4.816	4.657	3.896		

NOTE: The estimation period is 1957–1979, unless otherwise indicated. The estimation equation is: $CR(t) = a(0) + a(1)CR(t-1) + a(2)CR(t-2) + u(t)$ where CR(t) = the premiums to claims ratio in year t and u(t) = a random error term. All equations were estimated by ordinary least squares. Absolute values of t-statistics appear below coefficients.

*Estimation period for Canada is 1958–1979.

Summary and Conclusions

This paper proposes a new explanation for the cyclical profit patterns that appear to exist in property-liability insurance. Unlike most prior studies, which have assumed that insurance profits were determined primarily by supply- side considerations, the authors hypothesize that prices and profits are established in a rational, competitive market. Prices are rational in the sense that they accurately reflect the expected value of losses, conditional upon all information available at the time rates are set.

In the absence of intervening factors, the rational expectations hypothesis would be inconsistent with the existence of cycles. The authors hypothesize that institutional and regulatory lags, combined with insurer accounting practices, are responsible for the cyclical behavior of reported underwriting profits. A simple model is specified in the paper which generates apparent profit cycles.

A necessary but not sufficient condition for the hypothesis to be valid is the existence of cyclicality in observed underwriting profits. Tests of all lines underwriting profits in thirteen countries reveal that a cycle is present in a majority of the countries tested. In six of the countries, the cycle is between six and eight years in length. Cycles are present in automobile insurance profits in all six countries tested. The average cycle length for auto is 7.1 years.

While the empirical findings are consistent with the rational expectations/ institutional intervention hypothesis, they also may be consistent with other hypotheses such as Venezian's extrapolative expectations hypothesis. In order to narrow the field of competing hypotheses, additional information is needed on the institutional and regulatory characteristics of insurance markets in the countries tested. Information on ratemaking procedures, regulatory constraints, lengths of policy terms, and accounting procedures would be helpful and should be the subject of future international insurance research. More precise and detailed information on actual rather than reported profits also would be useful.

If institutional features such as renewal lags are partially responsible for the existence of underwriting cycles, it is interesting to speculate on why these practices continue to be used. Market stability would seem to be enhanced if insurers were able to change premiums more easily to reflect newly emerging information. This change would imply shorter policy terms and less cumbersome rate calculation procedures.

Adverse selection and the accompanying underwriting costs may play a role in explaining why insurance prices do not change more rapidly. In the stock market, for example, relatively little investigation or "underwriting" of market participants is necessary; the price of a share is the same for all buyers. In insurance, on the other hand, the price is buyer-specific; and the transactions costs of underwriting and classifying risks are high. However, the underwriting process is necessary in order to prevent market failure due to misclassification (Cummins, et al. [7]). Perhaps profit cyclicality is the price that must be paid to keep underwriting costs within manageable limits. Future research into these and other aspects of insurance transactions would help to clarify further the causes of and possible solutions to the underwriting cycle.

Appendix

The equation to be estimated is the following:

$$\Pi_t^R = a_1\, \Pi_{t-1}^R + a_2\, \Pi_{t-2}^R + \omega_t \tag{A1}$$

where $\Pi_t^R = \rho\, \Pi_t + (1 - \rho)\, \Pi_{t-1}$

$$= \rho(\varepsilon_t + \mu_t + \varepsilon_{t-1}) + (1-\rho)\,(\varepsilon_{t-1} + \mu_{t-1} + \varepsilon_{t-2}) \tag{A2}$$

The latter expression is equation (14) from the text.

The assumptions on the regressors and regression error terms are as follows:

$$E(\varepsilon_t) = E(\mu_t) = E(\omega_t) = 0 \tag{A3}$$

$$\mathrm{Var}(\varepsilon_t) = \sigma_\varepsilon^2\,;\ \mathrm{Var}(\mu_t) = \sigma_\mu^2\,;\ \mathrm{Var}(\omega_t) = \sigma_\omega^2 \tag{A4}$$

$$E(\varepsilon_t\varepsilon_{t-i}) = E(\mu_t\mu_{t-i}) = E(\omega_t\omega_{t-i}) = 0,\ \text{all } i \geqslant 1 \tag{A5}$$

$$\text{and } E(\varepsilon_{t-i}\, \mu_{t-j}) = E(\varepsilon_{t-i}\, \omega_{t-j}) = E(\mu_{t-i}\, \omega_{t-j}) = 0,\ \text{all } i,j \tag{A6}$$

Using a notational simplification that is correct in the limit, the regression coefficients in (A1) can be written as indicated below (in the following, the R superscripts on the Πs are dropped to simplify the notation; all Πs after this point are understood to refer to *reported* profits):

$$\hat{a}_1 = E(\Pi_t\Pi_{t-1})\,[E(\Pi_t^2) - E(\Pi_t\Pi_{t-2})]/D \tag{A7}$$

$$\hat{a}_2 = [E(\Pi_t\Pi_{t-2})\, E(\Pi_t^2) - E(\Pi_t\Pi_{t-1})^2]/D \tag{A8}$$

$$\text{where } D = E(\Pi_t^2)^2 - E(\Pi_t\Pi_{t-1})^2 \tag{A9}$$

Also:

$$E(\Pi_t^2) = (1/(T-2)) \sum_{t=3}^{T} \{[\varepsilon_{t-1}^2 + \varepsilon_t^2 + \mu_t^2]\,\rho^2 + [\varepsilon_{t-2}^2 + \varepsilon_{t-1}^2 + \mu_{t-1}^2]\,(1-\rho)^2 + 2\rho(1-\rho)\,\varepsilon_{t-1}^2\} \tag{A10}$$

$$E(\Pi_t\Pi_{t-1}) = (1/(T-2)) \sum_{t=3}^{T} \{[\varepsilon_{t-2}^2 + \varepsilon_{t-1}^2 + \mu_{t-1}^2]\,\rho\,(1-\rho) + (1-\rho)^2\,\varepsilon_{t-2}^2 + \rho^2\,\varepsilon_{t-1}^2\} \tag{A11}$$

$$E(\Pi_t\Pi_{t-2}) = (1/(T-2)) \sum_{t=3}^{T} [\rho\,(1-\rho)\,\varepsilon_{t-2}^2] \tag{A12}$$

where T = the number of periods for which data are available and the superscript R on the Πs has been dropped to simplify the notation.

Recalling that ε and μ are stationary (i.e., their variances are constant through time) and taking probability limits in (A7) and (A8) yields:

$$\operatorname*{plim}_{T\to\infty} \hat{a}_1 = \{\rho\,(1-\rho)\,[2\,\sigma_\varepsilon^2 + \sigma_\mu^2] + (1-\rho)^2\,\sigma_\varepsilon^2 + \rho^2\sigma_\varepsilon^2\}$$
$$\{[\rho^2\,(2\sigma_\varepsilon^2+\sigma_\mu^2) + (1-\rho)^2\,(2\sigma_\varepsilon^2+\sigma_\mu^2)$$
$$+ 2\,\rho\,(1-\rho)\,\sigma_\varepsilon^2] - \rho\,(1-\rho)\,\sigma_\varepsilon^2\}/D \qquad \text{(A13)}$$

$$\operatorname*{plim}_{T\to\infty} \hat{a}_2 = \{\rho\,(1-\rho)\,\sigma_\varepsilon^2\,[\rho^2\,(2\sigma_\varepsilon^2 + \sigma_\mu^2) + (1-\rho)^2\,(2\,\sigma_\varepsilon^2 +$$
$$\sigma_\mu^2) + 2\,\rho\,(1-\rho)\,\sigma_\varepsilon^2] - [\rho(1-\rho)\,(2\,\sigma_\varepsilon^2+\sigma_\mu^2)$$
$$+ (1-\rho)^2\,\sigma_\varepsilon^2 + \rho^2\,\sigma_\varepsilon^2]^2\}/D \qquad \text{(A14)}$$

$$\operatorname*{plim}_{T\to\infty} D = [\rho^2\,(2\,\sigma_\varepsilon^2+\sigma_\mu^2) + (1-\rho)^2\,(2\,\sigma_\varepsilon^2+\sigma_\mu^2) +$$
$$2\,\rho\,(1-\rho)\,\sigma_\varepsilon^2]^2 - [\rho\,(1-\rho)\,(2\,\sigma_\varepsilon^2+\sigma_\mu^2)$$
$$+ (1-\rho)^2\,\sigma_\varepsilon^2 + \rho^2\,\sigma_\varepsilon^2]^2 \qquad \text{(A15)}$$

These expressions simplify considerably if $\rho = .5$. In this case:

$$\text{plim}\ \hat{a}_1 = [(4\,\sigma_\varepsilon^2+\sigma_\mu^2)\,(6\sigma_\varepsilon^2+2\,\sigma_\mu^2-\sigma_\varepsilon^2)]/(16\ \text{plim}\ D) \qquad \text{(A16)}$$

$$\text{plim}\ \hat{a}_2 = [\sigma_\varepsilon^2\,(6\sigma_\varepsilon^2+2\,\sigma_\mu^2) - (4\,\sigma_\varepsilon^2+\sigma_\mu^2)^2]/(16\ \text{plim}\ D) \qquad \text{(A17)}$$

$$\text{plim}\ D = \{[6\,\sigma_\varepsilon^2+2\,\sigma_\mu^2]^2 - [4\,\sigma_\varepsilon^2+\sigma_\mu^2]^2\}/16 \qquad \text{(A18)}$$

Further insight into the problem can be gained by considering three special cases:

Case 1: Assume that $\sigma_\varepsilon^2 = \sigma_\mu^2$

In this case, plim $\hat{a}_1$ = 35/39 = .897
plim $\hat{a}_2$ = 17/39 = −.436
The implied cycle length would be 7.63 periods.

Case 2: Assume that $\sigma_\varepsilon^2 = 0$

This assumption yields plim $\hat{a}_1$ = .667; plim $\hat{a}_2$ = −.333
This cycle length would be 6.57 periods.

Case 3: Assume that $\sigma_\mu^2 = 0$

This assumption yields plim $\hat{a}_1$ = 1; plim $\hat{a}_2$ = −.5
The cycle length would be 8.0 periods.

Of course, in practice, the coefficients would be more complicated functions of the ε_t and σ_t because policy renewals and rate changes would not occur in the predictable patterns assumed in developing the model. Nevertheless, it is quite revealing that a simple institutional lag hypothesis can generate regression coefficients and cycle lengths very similar to those observed in practice.

Finally, assume that equation (13) applies, so that

$$\Pi_t = \varepsilon_t + \mu_t + \varepsilon_{t-1} \quad \text{(A19)}$$

In this case,

$$\text{plim } \hat{a}_1 = .375 \text{ and plim } \hat{a}_2 = -.125$$

The coefficients are smaller than those observed in most countries.

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