UNDERWRITING CYCLES

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The property/casualty combined ratio has become extremely volatile. In the last eight years, record underwriting profits and losses have occurred; the combined ratio has fluctuated up and down by about 10 points and is rising again.

As Casualty Actuaries we should be concerned about this phenomenon. Many of us are responsible for the financial stability of our companies. I find it surprising, therefore, that the Proceedings of the Casualty Actuarial Society do not contain a single paper on the underwriting cycle. In fact, as Kaye James points out, there appears to be no in-depth analysis of the industry cycle. Therefore she has performed a valuable service in presenting this paper to the Casualty Actuarial Society.

This paper should be viewed as a beginning. It leaves many important questions unanswered and contains very little new material. Her econometric models cannot really be used to project future combined ratios. The industry as a whole is considered but individual line results are disregarded. To her credit, the author does summarize the causes of the underwriting cycle and provides explanations for the wide fluctuations of the past few years. A logical rationale for the six year cycle is provided. The models do improve our understanding of some factors affecting the combined ratio. The paper is well written using little technical jargon. We could all profit by reading it.

Kaye James organizes her paper into three basic sections.

1) Causes of the underwriting cycle.

2) Factors responsible for increased volatility.

3) Econometric models.

The first two sections are essentially a summary of articles in the trade press. Rather than comment on these sections, I have simply added a few thoughts which seem relevant. In the third section, three econometric models are presented. Using the insights provided by these models, I have developed a simple model which provides an excellent fit.

UNDERWRITING CYCLE AND LAGS

Kaye James suggests that lags are an important cause of the industry cycle. In fact, it can be demonstrated mathematically that lags in reacting cause cyclical results.

For example the differential equation

$$f'(x) = -A \cdot f(x-L)$$

which describes reactions lagged L units of time from the result has the sine curve, with period 4L as its solution (for suitable A)*

Finite difference equations also have cyclic solutions.

The finite difference equation

$$\Delta f(x) = -f(x-1)$$

results in a cycle of length six.** Later I produce a model based on this equation which gives excellent results.

* This idea was presented by Dale A. Nelson at the 1978 Spring Meeting of the C.A.S. It was not published in the Proceedings. For other values of A the solution is approximately a sine curve with damping.

** $\Delta f(x) = \delta f(x+\frac{1}{2})$ so the lag in this equation is really $1\frac{1}{2}$. The cycle period, 6, is again 4 times the lag.

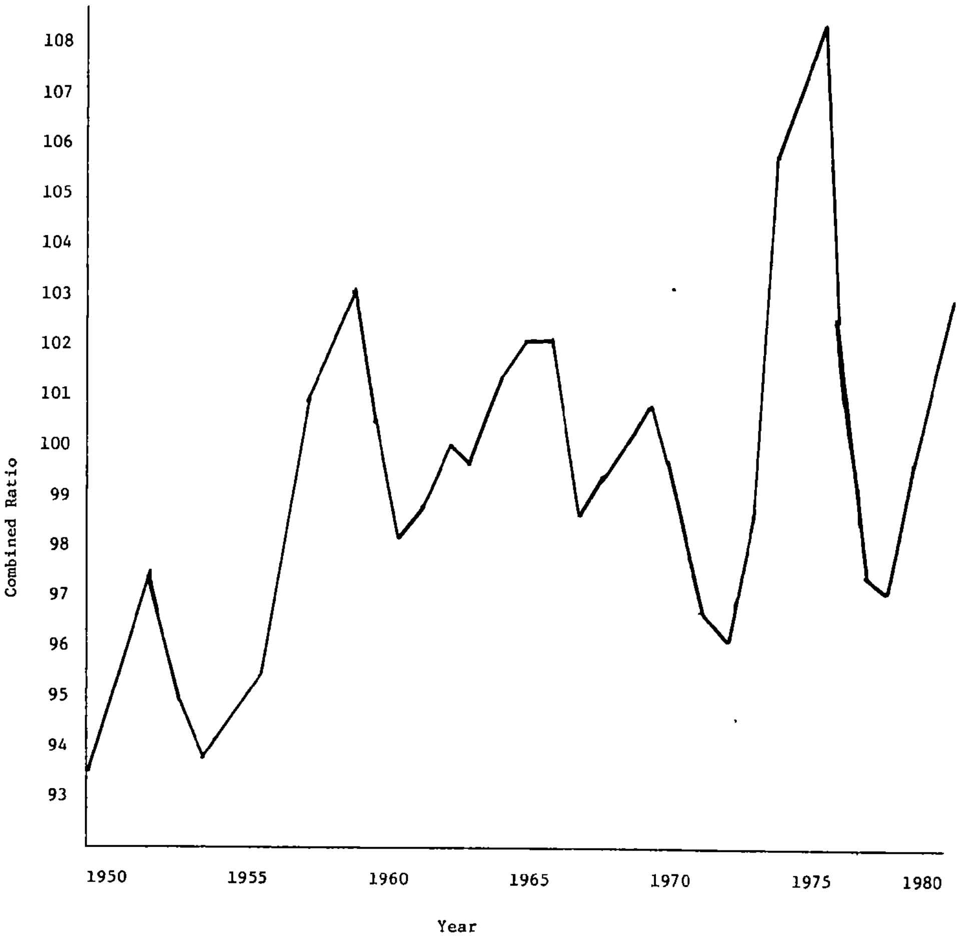

Fig. 1. Stock Company Combined Ratios After Dividends

FACTORS INCREASING VOLATILITY

Figure 1 shows the combined ratios for stock companies including dividends from 1950 to 1980. The dramatic swings in the combined ratio starting in 1973 are quite evident. The average change in the combined ratio from 1973 to 1980 was double the average change over the preceeding 22 years (3.6 vs 1.8). The combined ratios in 1972 and 1975 were the lowest and highest respectively since 1955.

A closer examination of figure 1, however, does not show a volatility based on random fluctuations but rather a very regular cycle whose amplitude has doubled. Kaye James has suggested that the increased volatility is due to conglomerate mergers, social inflation, price inflation and high interest rates. These reasons address the high combined ratios in 1974 and 1975, but they do not address the exceptionally good results in 1971 and 1972. In fact, it can be argued that these excellent years increased competition to the extent that the results in 1975 were inevitable.

What caused the excellent results in 1971 and 1972? I do not know but an answer to this question would improve our understanding of the cycle and departures from it.

THE MODELS

The models were designed to test the effect of price changes, cost changes, capacity and investment opportunities. Kaye James admits that the variables chosen to measure capacity and investment opportunities are not very good. Using the author's notation, the remaining variables are

$CRAT_t$ = combined ratio in year for stocks and mutuals excluding dividends

P_t = increase in written premium reduced by increase in GNP

C_t = increase in GNP implicit price deflator. (This variable is expressed as a percent while the remaining variables are ratios.)

The impact of P_t and P_{t-1} on the combined ratio is interesting. If we assume that price changes are effective uniformly over the year, then the price increase would have a 25% impact on the current year and 75% on the following year's combined ratio (e.g. a 4% real premium increase in 1980 would reduce 1980's combined ratio by 1% and 1981's combined ratio by 3%.)

In equations (2) and (3) we see that the coefficient of P_{t-1} is consistent with the above analysis; however, the coeffiicent of P_t is 0 in equation (3) and has the wrong sign in equation (2). However, price increases would be highest when results are the worst and vice versa. Comparing equations (2) and (3), there would appear to be a high correlation between P_t and $CRAT_{t-1}$; this correlation easily accounts for the coefficient of P_t .

If we take equation (3), eliminate all variables which are not significant and replace P_{t-1} by $CRAT_{t-2}$, we obtain an equation of the form

$$CRAT = a \times CRAT_{t-1} - b \times CRAT_{t-2} + CONSTANT$$

If we further assume that the coefficient of $CRAT_{t-1}$ is equal to 1 the equation becomes

$$CRAT_t - CRAT_{t-1} = b \times CRAT_{t-2} + CONSTANT$$

This is the difference equation referred to earlier and for values of b close to 1 it will produce a six year cycle.

To test this model, I ran a regression equation where the dependent variable was $CRAT_t$ - $CRAT_{t-1}$ and the independent variable was $CRAT_{t-2}$. I used stock company combined ratios after dividends for the period 1956-1976. While this is not identical to the data used by Kaye James it should be comparable. The results of the model are as follows.

$CRAT_t - CRAT_{t-1} = -.9115\ CRAT_{t-2} + .9132$

T - value of $CRAT_{t-2}$coeff	- 7.006
Standard error of the estimate	.01597
$\bar{R}^2$	.7209
Durbin-Watson Statistic	1.966
F-value	49.08

The equation can also be put in the form

$$CRAT_t = CRAT_{t-1} - .9115x(CRAT_{t-2} - 1.002) \quad (4)$$

From this form of the equation we can see that the industry has been working towards a combined ratio of 100% over the period from 1956 to 1976.

The combined ratio has been generally increasing over the last 30 years. While many factors have contributed, perhaps the most important factor is investment income.

Kaye James was not successful in incorporating investment income in her models. Similarly I found that the investment return had a poor correlation with the combined ratio. The only success I had was to assume that the industry periodically reassessed its combined ratio goal in light of investment income. For example let us assume that in 1973 the industry decided to raise its goal to 102% from 100%. Then adjusting equation (4) to

$$CRAT_t = CRAT_{t-1} - .9115(CRAT_{t-2} - 1.02) \quad (5)$$

We could have made the following projection early in 1973.

	PROJECTED	ACTUAL
73	101.1%	99.1%
74	106.3	105.9
75	107.1	108.3
76	103.2	102.7
77	98.6	97.7
78	97.5	97.4
79	100.6	100.6
80	104.7	103.5(est)

This table gave rise to my earlier comment that the combined ratio in 1975 was inevitable based on the profits in 1971 and 1972.

Interest rates have increased again so perhaps the industry may reevaluate its combined ratio goal in 1981. Below I show the results of the formula for four such changes.

Combined ratio goal	102%	103%	104%	105%
80 estimated	103.5	103.5	103.5	103.5
81 projected	104.8	105.7	106.6	107.5
82 "	103.4	105.2	107.1	108.9
83 "	100.8	102.7	104.7	106.6
84 "	99.5	100.7	101.9	103.0
85 "	100.6	101.0	101.3	101.5
86 "	102.9	103.1	103.2	103.3
87 "	104.2	104.9	105.7	106.5
88 "	103.4	104.8	106.4	108.0

The GNP implicit price deflator is certainly a valid candidate for measuring the impact of inflation, however, other candidates should have been considered. The correlation between investment return and rate of inflation make it difficult to measure the impact of inflation separately. I have not been able to incorporate investment income or inflation satisfactorily in an econometric model. Further research in this area may yield significant results.

CONCLUSION

Are industry cycles inevitable? They will be unless we understand them better. Kaye James and I have only scratched the surface but I hope we have aroused your interest.