TITLE: THE RESPONSIVENESS OF AUTOMOBILE TREND FACTORS

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INTRODUCTION

The essence of most actuarial ratemaking techniques is the adjustment of past actual loss experience to anticipated prospective levels. One decision the actuary is confronted with as a part of this process relates to the selection of trend factors to reflect the fact that inflation (and other socio-economic factors) will cause average claim costs to be higher during the future period covered by the revised rates than during the experience period being reviewed. This paper concerns itself with the responsiveness of current procedures used to determine these trend factors, specifically with regard to automobile insurance. First, a critical review of current techniques will be undertaken, with the conclusion being reached that the present methodology is not sufficiently responsive. Following this, an alternative approach (utilizing current cost factors and econometric models) will be suggested that should better respond to changing economic conditions which have been so characteristic in the past few years.

CURRENT TECHNIQUES

Under present procedures, average paid claim costs are compiled for the twelve most recently available year-ending quarters (generally, there is a 1 to 1 1/2 year lag between the end of a quarter and the inclusion of this data in the above time series). Using regression techniques, an exponential curve is fitted to these twelve points and an average annual percent change in claim costs determined from the curve. This average annual change is then

used to adjust losses from the average accident date of the experience period to prospective cost levels that will underlie the revised rates. It is worthy of note that because of the age of the basic experience period being reviewed, the length of time covered by the trend adjustment often spans more than 3 years; hence, for every one percentage point by which the assumed annual claim cost change is inaccurate, the projected losses will be misstated by more than 3%. This suggests how sensitive rate level adequacy is to the selection of proper trend assumptions.

The present methodology, which has been used since at least the early 1960's, worked well for many years when economic factors affecting insurance claims costs were relatively static. In the environment that has existed since the mid-70's, however, during which inflation rates have increased and shown significant variation, this methodology is not responsive. This is readily demonstrated by the following hypothetical example.

Let us make the following assumptions:

1) Rate review is being conducted on 1/1/80 with revised rates to be effective immediately (average accident date of revised rates will be 1/1/81).

2) Accident years 1977 and 1978 are being reviewed, with weights of 15%-85%, respectively (average accident date of experience period is approximately 5/1/78).

3) Trend factors are determined from hypothetical average paid claim cost data through 12/31/78 (i.e., twelve year-ending quarters, with the latest point ending 12/31/78).

4) As respects the hypothetical claim cost data noted in 3), it is assumed that insurance costs have increased during the period embraced by the trend data at the same rate as the Consumer Price Index (CPI); although this obviously did not actually happen, it is appropriate for purposes of this example in that it does demonstrate the degree by which inflation rates can fluctuate over time--it would not be unrealistic to think that insurance claim costs could also show a comparable pattern over a similar time span--(note: the overall CPI increased by 4.8%, 6.8%, 9.0% and 13.4% in 1976, 1977, 1978 and 1979, respectively).

Accordingly, the annual trend factor based upon the present methodology and the hypothetical claim cost series referred to above would be 7.1%, as follows:

	Average Paid Claim Cost Index (1/1/76 = 1.000)					
12 Mos. Ending:	Actual		(Hypothetical)			Expon. Fit
3/31/76			(1.048)1/4	=	1.012	1.001
6/30/76			(1.048)1/2	=	1.024	1.018
9/30/76			(1.048)3/4	=	1.036	1.036
12/31/76			(1.048)	=	1.048	1.053
3/31/77		(1.048)	(1.068)1/4	=	1.066	1.072
6/30/77		(1.048)	(1.068)1/2	=	1.083	1.090
9/30/77		(1.048)	(1.068)3/4	=	1.101	1.109
12/31/77		(1.048)	(1.068)	=	1.119	1.128
3/31/78	(1.048)	(1.068)	(1.09)1/4	=	1.144	1.147
6/30/78	(1.048)	(1.068)	(1.09)1/2	=	1.169	1.167
9/30/78	(1.048)	(1.068)	(1.09)3/4	=	1.194	1.187
12/31/78	(1.048)	(1.068)	(1.09)	=	1.220	1.208

Average annual % change = $\frac{1.208}{1.128}$ = 1.071 (or +7.1%)

Based upon the above assumptions, the factor (current methodology) used to adjust losses from the average accident date of the experience period to the present level (5/1/78 to 1/1/80, or 20 months) is $(1.071)^{1.5/1.2} = 1.122$.

In reality, however, we would know from actual recorded data that costs have actually increased over this period by the following:

$$\frac{12/31/79 \text{ index}}{5/1/78 \text{ index}} = \frac{(12/31/78 \text{ index})\ (1.134)}{(12/31/77 \text{ index})\ (1.09)^{1.5}}$$

$$= \frac{1.220(1.134)}{1.119(1.029)} = 1.202$$

Hence, in adjusting losses to the present (1/1/80) level, the current methodology would understate the answer by 6.7% (i.e., 1.122/1.202 = .933). It should be noted that this is probably a conservative estimate of the deficiency in that it only addr-sses the adjustment of costs to current levels. To the extent that claim costs would increase during the prospective segment of the projection period (1/1/80 to 1/1/81) by more than 7.1%, the shortfall would become even more pronounced.

The above example would seem to indicate that the existing methodology for determining trend factors is not responsive in a dynamic environment of changing inflation rates. Not only does it fail to attempt to predict changes in future rates of inflation, but it also neglects actual variations that have occurred since the compilation of the trend data. In this particular example, the 7.1% average annual claim cost change was determined from a three year time series during which

annual inflation rates were 4.8%, 6.8% and 9.0%, respectively. The resulting answer is inadequate for two reasons. First, inflation during that segment of the projection period which is also embraced by the trend data (5/1/78 to 12/31/78) is known to have been higher than the 7.1% (i.e., inflation rate in 1978 was 9.0%). Also, in 1979 (i.e., between the latest point of the trend data and the time of the rate review), the inflation rate is known to have been 13.4%, which again is in excess of the 7.1%. The key observation to be made from this example is that the existing model would not have accurately reflected known changes in costs that had occurred since the experience period; this is quite apart from the much more difficult problem of attempting to predict what future rates of inflation will be.

Before presenting an alternative approach, it should be stated at this point that casualty actuaries have indeed recognized and begun to address this problem in the past few years. Supplemental trend factors, above and beyond those indicated by the traditional methodology, have at times been used by the Insurance Services Office in their rate filings; these supplemental factors were generally based upon review of external cost indices. Also, extensive research is currently under way at the ISO with regard to econometric models.

PROPOSED MODIFICATIONS TO CURRENT TECHNIQUES

A major criticism of the current procedure, as illustrated in the preceding section, is the lack of res-

ponsiveness to known changes in inflation/claim costs that may have occurred between the experience period and the date on which the review is being conducted. A modification to the present methodology that would serve to overcome this deficiency would be to utilize a current cost factor indexing approach similar to that used in property insurance ratemaking. Under such an approach, actual known changes in costs, generally based on data external to the insurance industry, are used to adjust past losses to current (or most recently available) cost levels. This is in contrast to the present automobile trend methodology whereby an estimate based upon regression of a historical, often out-of-date series of insurance paid claim costs is used to trend losses over this time period.

In terms of the mechanics, it is recommended that the period in question be adjusted in two separate stages, as follows:

1) from average accident date of experience period to date of most recent insurance claim cost data--in most rate reviews, data used to generate trend assumptions (i.e., insurance paid claim costs) is more current than that underlying the experience period. Accordingly, it is recommended that the endogenous insurance claim cost data be utilized to adjust losses over this time span with the adjustment merely being the percent by which the claim costs changed between the average accident date of the experience period and the last quarter of the claim cost trend data series.

2) from date of most recent insurance claim cost data to date of latest available external data--to adjust for inflationary cost changes during this period, external data such as the various indices of the Consumer Price Index would be utilized. Those indices that most closely correspond to the respective insurance coverages could be used. For example, a weighted average of the CPI Medical, Hospital Rooms and Wages indices may be thought to most closely resemble the bodily injury liability coverage, while the Auto Repair & Maintenance and Average Hourly Earnings (Production Workers) indices may be considered as representative of property damage liability.

Also, if it can be demonstrated that insurance claim costs generally rise at a faster rate than is portrayed by external cost indices, as has often been conjectured, it would be appropriate to adjust the current cost factor in 2) above for the difference. A review of movements in insurance claim costs vs. the external indices for a common, most recently available time period may suggest the degree of such an adjustment. For example, in 1978, a year for which both insurance paid claim cost data and external price indices are available, commercial automobile property damage liability insurance claim costs increased by slightly more than 14%, whereas both the CPI Repair and Maintenance and the Production Workers Hourly Earnings indices rose by only about 8%. Hence, if the subsequent year, 1979, is included in the period to be adjusted by the current cost factor based on external data and if an assumption is made that the

relationship between changes in insurance claim costs and external indices follow the 1978 pattern, it would be appropriate to increase the current cost factor by 6% per annum for the 1979 portion of the period embraced by the trend factor (i.e., the difference between 14% and 8%).

In addition to making the trend factor more responsive to actual inflationary increases in costs between the basic experience period and the latest available external data, the modifications described above also serve to shorten the period over which the actuary's prediction of future inflationary claim cost changes is applied. For example, it was noted previously that the total trend adjustment often spans more than three years. Under the approach suggested above, only a little more than one year would be modified by the actuary's estimate of future inflation, with most of the trend period being adjusted by actual changes in costs, per 1) and 2) above. This is a desirable feature as it reduces the sensitivity between rate adequacy and the accuracy of the prediction of future inflation.

Most of the discussion to this point has been with regard to the adjustment of past losses to current cost levels. Shortcomings of present techniques have been illustrated and modifications to overcome these deficiencies have been set forth. In a sense, what has been discussed thus far should be the easy part of the process for the actuary as all that is required is to adjust the losses

for a phenomenon that has already occurred. The truly difficult task for the ratemaker is to estimate the effect of inflationary increases in claims costs over the future period for which the revised rates will be effective.

Current techniques are not responsive in this regard for much the same reasons that have been noted earlier. In the hypothetical example, the current procedure would have employed a 7.1% annual increase in claim costs over the prospective (1980) portion of the projection period; clearly this is inadequate. It is the opinion of this writer that in a dynamic, changing economic environment, econometric modeling offers the best chance of success.

Econometric modeling has become of increasing interest to casualty actuaries in recent years. Our CAS literature (Proceedings and Call Paper Programs) is well documented with some fine papers that have utilized these techniques in one form or another. Also, our Syllabus of Examinations now contains readings on this topic. Hence, econometric modeling has and should continue to become an important component of the casualty actuary's forecasting techniques. It is not the intent of this paper to rigorously develop this area, but rather to set forth some basic concepts and perceived advantages of this technique for predicting prospective changes in automobile insurance claim costs.

A simple econometric model has been defined as "a mathematical representation of economic relationships

using linear equations." (1) An example would be

$$Y_t = \sum_i C_i X_{it} + C_j$$

where Y_t is the dependent variable being predicted (at time t), X_{it} is the i^{th} independent variable (at time t) and the C_i's are constants.

In building a model to predict a dependent variable (y), it is necessary to identify the explanatory independent variables (X_i) that are going to be used on the right hand side of the equation, as well as the coefficients (C_i) and the relationships among the variables (i.e., linear, exponential, etc.).

Several statistical tests can be performed to assist in the selection of the best equation(s). For example, the T-statistic can be used to test how significant each independent variable is in explaining the behavior of the dependent variable. The r-bar squared and standard error of the regression statistics give a measure of how well the equations have predicted the dependent variable in the past. Also, there are statistical means of determining whether undesirable traits are present, such as collinearity (where the X_i's are not truly independent) and autocorrelation (where there is a correlation between successive errors of differences between actual and fitted values). (2)

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(1) Oakley E. Van Slyke, "Is Econometric Modeling Obsolete?", CAS 1980 Discussion Paper Program, page 651.

(2) Donald L. McLagan, "A Non-econometrician's Guide to Econometrics, "Business Economics, Vol. VIII, No. 3, May 1973, page 38.

As noted earlier, research is currently under way at the Insurance Services Office. In their models, they are using external wage and medical cost indices as independent variables to predict bodily injury liability claim costs; similarly, transportation equipment cost and wage indices are being considered as explanatory variables to forecast property damage liability claim costs.

The use of econometric models in ratemaking to project future claim cost changes has some important advantages. One, which is noted by Van Slyke (3) as having been suggested by the ISO, stands out as being key as respects the question of responsiveness. Namely, by using these models, turning points are more likely to be projected (somewhat related to this is the fact that external non-insurance data, which is considerably more current than insurance data, is used).

Van Slyke (4) also notes a disadvantage of these models being that the claim cost projection is no more accurate than the projection of the independent variables, such as the wages and medical costs for the bodily injury model. While his concern is valid, I also see inherent advantages to this situation. Namely, it would seem that in selecting a projection for a given independent variable, the outlook for one (or a few) specific areas of the economy would be most

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(3) See Van Slyke, op. cit., p. 655.

(4) Ibid., p. 658.

useful. For example, the effect of an anticipated recession and/or rising interest rates may adversely impact new car sales and hence cause auto repair costs to increase at an inordinate rate. Also, predicted medical costs may be effected by the prospect and/or provisions of an anticipated national health insurance bill; increases in overall wage levels may be thought to tie in closely to overall economic inflation during the past year. The point is that under an econometric modeling approach, it is possible to make use of the research and many scenarios that are continually produced by economists and financial analysts, especially as they relate to specific areas of the economy. In other words, there is a vast body of information and research available to the actuary that has been relatively untapped under current procedures.

CONCLUSION

This paper has attempted to demonstrate that current automobile trend procedures are not responsive in today's economic environment, as well as present some suggested revisions that would help to overcome this deficiency. It is hoped that these recommendations warrant consideration and will stimulate other actuaries to further study this most timely issue.