AN ECONOMETRIC MODEL OF WORKMEN'S COMPENSATION

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PURPOSE

Recent workmen's compensation underwriting experience has been unprofitable for the insurance industry. Traditional methods of analyzing experience have failed to yield a clear-cut explanation of this trend. This, combined with our company's emphasis on planning and forecasting, caused us to initiate this project: to apply regression analysis techniques in an effort to explain past results and forecast future results.

METHOD

The first step of the project is to identify insurance and economic variables which, over a period of time, demonstrate an important relationship to workmen's compensation premiums and losses. After these variables are identified, models are developed which define a functional relationship between the important independent variables and each of three dependent variables: written and earned premiums, and incurred losses. The models in turn can be used to analyze and explain past results, and to forecast future results.

Listed below are the variables that were studied.

Dependent Variables

$WPREM_i$: Workmen's compensation premiums written in thousands of dollars for stock and mutual companies in year(i).[1]

$EPREM_i$: Workmen's compensation premiums earned in thousands of dollars for stock and mutual companies in year(i).[1]

$LOSS_i$: Workmen's compensation losses and loss adjustment expenses incurred in thousands of dollars for stock and mutual companies in year(i).[1]

[1] *Best's Aggregates and Averages: Property-Liability,* (1948-1973). "Review and Preview," *Best's Review*, LXXIV (January, 1974), p. 97.

Exhibit A, Sheet 1, shows the values for each of the above dependent variables from 1948-1973.

Independent Variables

$WAGE_i$: Wages and salaries disbursed in billions of dollars in year(i).[2]

PC_i: Percent of the workforce covered by workmen's compensation in year(i). This includes certain state funds.[3]

$RATE_i$: Average countrywide rate level index in year(i) for workmen's compensation including law amendments.[4]

WO_i: A wage offset calculated to reflect the effect of payroll limitations for year(i).[4]

$PRODUCT_i$: This variable is the product of $(WAGE_i)(RATE_i)$ (PC_i) (WO_i), and represents workmen's compensation exposures adjusted for rate changes.

$LOSS_{(i-1)}$: Loss in year(i—1).

$WPREM_{(i-1)}$: Written premium in thousands of dollars in year (i—1).

$UNEMP_{(i-1)}$: Unemployment rate in year(i—1).[2]
GNP_i: Gross national product in billions of dollars in year(i).[2]

EMP_i: The number, in thousands, of persons employed in non-agricultural industries in the civilian labor force in year(i).[5]

AWW_i: Average weekly wages of persons employed in non-agricultural industries in the civilian labor force in year(i).[5]

Exhibit A, Sheet 2, shows the values of $WAGE_i$, $RATE_i$, PC_i, WO_i, and $PRODUCT_i$ from 1948-1973. Exhibit A, Sheet 3, shows the values of the economic variables $UNEMP_{(i-1)}$, GNP_i, EMP_i, and AWW_i from 1948-1973.

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[2] Data Resources, Inc. (29 Hartwell Avenue, Lexington, Massachusetts).

[3] D. N. Price and A. M. Skolnik, "Another Look at Workmen's Compensation," *Social Security Bulletin* (October, 1970), p. 6.

[4] National Council on Compensation Insurance, New York, New York.

[5] *Monthly Labor Review* (November, 1972), pp. 93 and 98.

We began by graphing the relationship between these variables (Exhibit B, Sheets 1-5). From these graphs it can be seen that there are indeed some strong relationships between the independent variables and the dependent variables. Since most of the graphs show a linear trend, the statistical technique chosen for the analysis was linear regression.

SELECTING A MODEL

Presented below are three models which tested out most successfully, and a fourth which was proposed but was not selected for use.

Model I: $WPREM_i = A + B_1(PRODUCT_i) + error$

Model II: $LOSS_i = A + B_1(PRODUCT_i) + B_2(UNEMP_{(i-1)}) + B_3(LOSS_{(i-1)}) + error$

Model III: $EPREM_i = A + B_1(WPREM_i) + B_2(WPREM_{(i-1)}) + error$

Model IV: $EPREM_i = A + B_1(GNP_i) + B_2(AWW_i) + B_3(EMP_i) + error$

In the above models, the coefficients (A and B) of the variables are determined by the application of linear regression techniques. An error term is included by convention; it serves to remind the reader that the models do not describe the real world situation perfectly.

Establishing Criteria

We established seven criteria to determine the strength and validity of each model:

1. The importance of an independent variable can be determined by examining the Student's t-statistic associated with the coefficient. The coefficients are the "B's" in the above equations, and the higher the absolute of t, $|t|$, the better. Generally speaking, if $|t| > 2$, then the independent variable may be regarded as significant.

2. The sign of t indicates whether the relationship is direct or inverse. That is, the sign indicates whether the dependent variable varies directly with, or inversely to, the independent variable. For example, we would expect premium to vary with GNP_i but inversely to unemployment. This criterion requires that the sign of t indicates a correct relationship.

3. R^2 is the multiple correlation coefficient, where $0 \leq R^2 \leq 1$. R^2 is the proportion of total variation about the mean of the dependent variable which has been explained by the regression. In other words, $100R^2$ is a measure of the percent of variation in the dependent variable which has been explained by the independent variables, and so an R^2 very close to 1.00 is desired.

4. In models where more than one independent variable is used, one would expect correlation between some of the independent variables. For example, GNP and average weekly wages are positively correlated. However, each independent variable should be more highly correlated with the dependent variable than it is with any other independent variable. High correlation between independent variables can produce relationships which are not sensible.

5. There are several assumptions made on the errors when doing a linear regression, one of which is that the errors from one year to the next are not correlated. That is, a positive error in one year does not increase the likelihood of a positive or negative error in the following year. If errors are positively correlated, then positive autocorrelation is present. The Durban-Watson "d" statistic is a check on autocorrelation. It would go beyond the scope of the paper to go any further than to say that

$$d = \frac{\sum_{i=2}^{n} (e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2}$$

where $e_i = (y_i - \hat{y}_i)$, y_i and $\hat{y}_i$ are the observed and fitted values, respectively, for the dependent variable in the ith year, and n is the number of years in the model. A sufficiently small value of "d" indicates positive autocorrelation. More will be said about this in Table 1.

6. The percent of mean absolute error is an indicator of the historical and recent accuracy of the model.
The percent of absolute error for year(i) equals

$$\frac{|\,\text{observed}_i - \text{fitted}_i\,|}{\text{fitted}_i} \times 100\%$$

Actually, the error variance is the conventional statistical measure of model precision, but this will suffice for our purposes.

7. Ideally, the model will be intuitively sensible. For example, it's possible that written premiums may have a strong relationship to some extraneous independent variable, such as air passenger miles. Although this might turn out to be an excellent predictor, it would provide little insight into what is really happening.

Table 1 summarizes Models I – IV matched against these seven criteria.

Results vs. Criteria

In this section each of the models presented is evaluated on the basis of the above seven criteria. The reader should refer to Table I for a summary of the discussion.

The model $WPREM_i = A + B_1(PRODUCT_i) + error$ was chosen to forecast written premium. Model I suggests a linear relationship between written premium and exposures adjusted for rate changes.

Model I was chosen to forecast written premium for the following reasons:

1. The value of t for B_1 indicates a highly significant relationship between $PRODUCT_i$ and $WPREM_i$.

2. The sign of t is correct. That is, its positive value tracks with the intuitive notion that written premiums increase with exposures.

3. An R^2 value of .9961 indicates that the model explains more than 99% of the variability observed in written premiums.

4. The correlation of independent variables is not relevant in this model since $PRODUCT_i$ is the only independent variable.

5. Positive autocorrelation is present in the model, indicating that there are periods where the model consistently overestimates written premiums for a period of years or underestimates written premiums for a period. The effect of autocorrelation in the model can be reduced through a transformation on the data using the Durban-Watson statistic and econometric methods. The details of the transformation are quite complex and will not be described in this paper. There is an alternative to a transformation on the

model, which is to adjust the forecast produced by the model. This will be described later in the paper. It also uses the Durban-Watson statistic and produces a more reliable forecast than if no adjustment for autocorrelation were made.

6. The mean absolute error is quite small historically, but greater than we'd like for the last five years. This increased error is largely due to the autocorrelation described in (5) above.
7. Intuitively, the model does very well, since we would expect a linear relationship between premium and exposures adjusted for rate changes.

Model II is $LOSS_i = A + B_1 (PRODUCT_i) + B_2 (UNEMP_{(i-1)}) + B_3 (LOSS_{(i-1)}) +$ error. That is, losses in workmen's compensation in year (i) are a function of $PRODUCT_i$, the unemployment rate the previous year, and losses the previous year. This is a linear model, hypothesizing that there is a linear relationship between $LOSS_i$ and each of the independent variables. Each of the seven criterion is discussed below for this model.

1. Each of the variables in the model is significant.
2. The sign of t is correct for each variable.
3. An R^2 value of .999 indicates an almost perfect fit to the data.
4. The independent variables are all more highly correlated with losses than they are with each other.
5. The Durban-Watson "d" is at the upper end of the inconclusive range; so we cannot say for sure there is no autocorrelation. Even if it is present, which is very doubtful, the R^2 value is so high that the effect of autocorrelation would be negligible, i.e., the error is so small that it is of little importance that the error may be of the same sign for a few years.
6. The mean absolute error is 1.95% historically and even better the last five years, .60%.
7. The relationships that have been established statistically are consistent with our intuition. Incurred losses are expected to increase as wages and the percent of the workforce increase; for that reason $PRODUCT_i$ is a significant variable. However, incurred losses generally show a smoother, less erratic pattern than premiums,

i.e., they appear to be less directly affected by outside economic influences. Thus, the prior year's unemployment rate was more significant than the current year's rate, indicating that the full effect of unemployment on loss experience is not felt immediately. Also, the prior year's losses are highly predictive of current losses, which, in addition to reflecting the smoothness of the loss curve, may reflect a steady pattern of year-end reserve run-off. That is, a portion of many calendar years' incurred losses has been the developing inadequacy of the previous year-end reserves.

Model III is $EPREM_i = A + B_1 (WPREM_i) + B_2 (WPREM_{(i-1)})$ + error. This linear model says that earned premium in year(i) is dependent on written premium in year (i) and written premium in year(i—1). That is, the relationship is linear between the dependent variable and each of the independent variables. This model is excellent in six of the seven criteria.

1. Both variables are significant, although premiums written in year(i) are much more significant than premiums written in year(i—1).

2. Each t has a correct sign.

3. $R^2 = .9999$, indicating a near perfect fit.

4. Naturally, premiums written in year(i) are correlated with those written in year(i—1). However, the written premiums in year(i) and year(i—1) are more highly correlated with earned premium than with each other.

5. Slight autocorrelation is present. A small adjustment will be made to the 1974 and 1975 forecasts. The decision to make the adjustment is optional, since R^2 is so high. However, the 1971 and 1972 models did overestimate 1972 and 1973 actual results.

6. The mean absolute error is an impressive .46% historically, and even better the last five years.

7. The model is intuitively consistent with our knowledge of how written premiums are earned. The higher significance of premiums written in year(i) than in year(i—1) surprised us at first. This seems to suggest a widespread practice in the industry of underestimating exposures, and collecting additional premium at the time of audit — this premium is fully earned when booked. That is, premium produced from audits is identically written and earned.

Model IV is $EPREM_i = A + B_1 (GNP_i) + B_2 (AWW_i) + B_3 (UNEMP_{(i-1)})$ + error. This again is a linear model. It is hypothesized that the premium earned in workmen's compensation in year (i) is linearly dependent on the GNP for year(i), the average weekly wages in year(i), and the number of employees in the civilian workforce in year(i). The model has been included to give an example of a model which was tested and rejected.

1. All three of the variables are significant, although AWW is just barely significant.

2. The sign of t indicates that earned premiums decrease as average weekly wages increase. We know this is not reasonable and the reason for this is given in paragraph 4 below. The signs of the other t statistics are correct.

3. $R^2 = .9943$, which is reasonably good.

4. If two variables are very highly correlated in a model, they may interfere with each other in such a way so as to produce unlikely results for the less important of the two variables considered. This is the case for Model IV. GNP_i and AWW_i are very highly correlated, but GNP_i is a much more significant variable than is AWW_i, and so the interference between the two variables has caused the negative t for AWW_i.

5. Autocorrelation is present in this model also. The model was discontinued when it was current through 1971. Model IV almost certainly would have had more autocorrelation when updated through 1973.

6. The mean absolute error is 3.34% for the 24 year period.

7. This model is reasonably accurate for forecasting earned premium. However, Model I is a far better representation of how premiums are actually calculated and produced, and therefore, a more useful analytical tool.

FORECASTING

Models I, II, and III have been shown to closely represent the historic interrelationships between insurance and economic variables. Careful analysis of the models reveals much about the causes of fluctuations in results from year to year. These models can also be used to forecast future results. Obviously though, to forecast values for the dependent variables, we need to input values for the independent variables, and our forecasts of insurance results will be only as good as this input.

Future values of WO_i are quite easy to predict accurately, because these values have been so close to unity since 1960 and should continue so, as more states adopt the unlimited payroll rule.

Future values for PC_i are more difficult to predict, because they are dependent on future legislation. However, in view of The Report of the National Commission on State Workmen's Compensation Laws, we feel confident in predicting that this percentage will continue to increase.

Future values for $RATE_i$ can be based on past changes, pending and likely large benefit increases, and a consideration of how recent experience will affect experience rate indications.

Future values for the several economic indicators ($WAGE_i$, EMP_i, $UNEMP_{(i-1)}$, and GNP_i) are available from the myriad of economic forecasts published. We worked with DRI economic forecasts.[6]

Forecasts need not be single point predictions. A range of reasonability can be established by inputting alternative values for the independent variables. For example, we used values for $RATE_i$ on either side of our best estimate along with both a DRI Control Economic Forecast and Pessimistic Financial Economic Forecast.

Adjusting for Autocorrelation

It was mentioned earlier that an adjustment should be made on the forecast if autocorrelation is present. The procedure involves the calculation of an adjustment factor. The factor is: $\rho = \frac{2.0 - d}{2}$, where "d" is the value of the Durban-Watson statistic in the regression. We then multiply the 1973 error in the model by ρ and add the product to the 1974 forecast. We add the product of ρ^2 and the 1973 error to the 1975 forecast etc. Thus,

1974 final prediction $= \rho$ (1973 error) $+$ 1974 prediction
1975 final prediction $= \rho^2$ (1973 error) $+$ 1975 prediction
1976 final prediction $= \rho^3$ (1973 error) $+$ 1976 prediction,

and so on until the adjustment factor is significant.

[6] Data Resources, Inc. (29 Hartwell Avenue, Lexington, Massachusetts).

An Example

The example below is worked out in detail for 1974 using a 7.5% rate increase and the DRI Control Economic Forecast.

Model I: $WPREM_i = 289{,}184 + 5{,}687.23\,(PRODUCT_i)$. In 1974 we anticipate $PRODUCT_i = (753.6)(1{,}490)(.9977)(.90) = 1{,}008.253$. Therefore, $WPREM_i = 6{,}023{,}351$ is the first estimate.

Now, 1973 error = 4,860,000 − 5,049,000 = −189,000 where 5,049,000 is the fitted value for 1973 $WPREM_i$.

$$\rho = \frac{2 - .5745}{2} = .71275$$

1973 error = −134,710

Final estimate = 6,023,351 − 134,710 = 5,888,641

Model II: $LOSS_i = -18{,}198.1 + 2{,}117.2(PRODUCT_i) + 11{,}515.7\,(UNEMP_{(i-1)}) + .00057977(LOSS_{(i-1)})$.

In 1974 we anticipate

1. $PRODUCT_i = 1{,}008.253$
2. $UNEMP_{(i-1)} = 4.9$
   (Note: This is the 1973 unemployment rate.)
3. $LOSS_{(i-1)} = 3{,}613{,}772{,}000$

Therefore, $LOSS_i = 4{,}268{,}059$.

Model III: $EPREM_i = 10{,}081.6 + .07774(WPREM_{(i-1)}) + .89995(WPREM_i)$ where

1. $WPREM_i = 5{,}888{,}641$
2. $WPREM_{(i-1)} = 4{,}860{,}000$

$EPREM_i + 5{,}687{,}380$ is the first estimate. There is slight autocorrelation present in this model. $\rho = \dfrac{2 - 1.1934}{2} = .4033$. This formula was used for a preliminary estimate of $EPREM_i$ in 1973, so this is the second year ρ is used.

ρ^2 (1972 error) $= (.4033)^2(-24{,}000) = -3{,}904$. The final $EPREM_i$ prediction is $5{,}687{,}380 - 3{,}904 = 5{,}683{,}476$.

$$\text{Loss Ratio: } \frac{4{,}268{,}059}{5{,}683{,}476} = .751$$

The above procedure is essentially the same for any forecast using these models.

CONCLUSION

The application of econometric methods to build models for workmen's compensation has proven to be of practical use, since the models proposed give us a better understanding of the linear relationships between insurance results and certain indicators, both insurance and economic. From the models we have also been able to determine the relative importance of the indicators. Finally, a method for using these models to forecast a range of future results was described, although we have not presented herein a specific range of forecasts.

The methods described above are of more relevance than the specific formulas shown. To be of value, they should undergo a continuing process of updating and fine-tuning (the data contained in this paper was compiled one full year prior to this presentation). These methods are applicable to other lines of insurance. However, efforts to apply these methods to other lines of insurance should not be discouraged if the relationships prove to be less direct than for workmen's compensation.

EXHIBIT A
Sheet 1

WORKMEN'S COMPENSATION EXPERIENCE*
('000 omitted)

Accounting Year	Written Premiums	Earned Premiums	Incurred Losses and Loss Adjustment Expenses	Ratio (4)÷(3)
(1)	(2)	(3)	(4)	(5)
1948	$ 731,888	$ 707,262	$ 425,622	.602
1949	718,283	706,827	440,571	.623
1950	697,267	694,076	489,277	.705
1951	817,380	802,558	596,167	.743
1952	917,872	897,134	641,873	.715
1953	1,031,139	995,763	683,023	.686
1954	1,016,493	998,740	637,694	.638
1955	1,035,444	1,017,260	673,324	.662
1956	1,110,732	1,093,290	736,949	.674
1957	1,199,476	1,181,217	808,191	.684
1958	1,209,319	1,201,948	854,139	.711
1959	1,296,947	1,277,933	936,536	.733
1960	1,419,361	1,386,805	1,006,646	.726
1961	1,484,009	1,456,324	1,072,723	.737
1962	1,603,940	1,572,207	1,125,581	.716
1963	1,725,158	1,686,013	1,229,594	.729
1964	1,868,411	1,836,256	1,319,680	.719
1965	2,042,231	1,990,355	1,423,910	.715
1966	2,347,828	2,290,022	1,647,891	.720
1967	2,601,625	2,525,288	1,814,342	.718
1968	2,890,872	2,833,023	1,973,845	.697
1969	3,199,743	3,128,806	2,207,136	.705
1970	3,492,307	3,406,433	2,431,040	.714
1971	3,660,066	3,568,271	2,729,889	.765
1972	4,104,090	3,964,267	3,096,354	.781
1973	4,860,000**	4,693,211	3,614,000	.770

**Best's Aggregates and Averages: Property-Liability* (1948-1973).
"Review and Preview," *Best's Review*, LXXIV (January, 1974), p.97.
**This is a preliminary estimate from *Best's Review*. The other 1973 figures are based upon this estimate.

EXHIBIT A
Sheet 2

COMPONENTS OF THE INDEPENDENT VARIABLE "PRODUCT"

Year	Wage	Rate*	PC**	WO	Product
1948	135.341	0.811	.7700	0.9955	84.1361
1949	134.551	0.784	.7690	0.9912	80.4064
1950	146.748	0.758	.7720	0.9869	84.7485
1951	171.019	0.803	.7840	0.9826	105.792
1952	185.098	0.860	.7890	0.9873	124.001
1953	198.335	0.866	.8000	0.9739	133.820
1954	196.474	0.844	.7970	0.9679	127.919
1955	211.266	0.825	.8000	0.9618	134.109
1956	227.842	0.813	.8020	0.9558	141.993
1957	238.695	0.841	.8050	0.9497	153.469
1958	239.926	0.849	.8020	0.9436	154.151
1959	258.187	0.886	.8030	0.9376	172.227
1960	270.844	0.910	.8040	1.0000	198.160
1961	278.080	0.937	.8030	1.0000	209.230
1962	296.091	0.972	.8040	1.0000	231.392
1963	311.095	0.997	.8050	1.0000	249.680
1964	333.683	1.025	.8080	1.0000	276.356
1965	358.885	1.067	.8150	1.0000	312.088
1966	394.499	1.104	.8310	1.0000	361.923
1967	423.075	1.134	.8310	0.9999	398.647
1968	464.862	1.129	.8380	0.9998	439.719
1969	509.690	1.166	.8360	0.9995	496.585
1970	541.976	1.183	.8340	0.9992	534.298
1971	573.250	1.208	.8340	0.9988	576.840
1972	627.845	1.295	.8500	0.9977	689.511
1973	691.500	1.386	.8750	0.9980	836.939

*Rate = 1.000 in Base Year 1939

**The values for PC in 1971, 1972, and 1973 are the authors' estimates based on a review of law changes, since more recent data could not be found.

EXHIBIT A
Sheet 3

ECONOMIC INDEPENDENT VARIABLES

Year	UNEMP	GNP	EMP	AWW
1948	3.8	257.6	50,713	49.00
1949	5.9	256.5	49,990	50.24
1950	5.3	284.8	51,760	53.13
1951	3.3	328.4	53,239	57.86
1952	3.0	345.5	53,753	60.65
1953	2.9	354.6	54,922	63.76
1954	5.5	364.8	53,903	64.52
1955	4.4	398.0	55,724	67.72
1956	4.1	419.2	57,157	70.74
1957	4.3	441.1	58,123	73.33
1958	6.8	447.3	57,450	75.08
1959	5.5	483.7	59,065	78.78
1960	5.5	503.7	60,318	80.67
1961	6.7	520.1	60,546	82.60
1962	5.6	560.3	61,759	85.91
1963	5.6	590.5	63,076	88.46
1964	5.2	632.4	64,782	91.33
1965	4.5	684.9	66,726	95.06
1966	3.8	749.9	68,915	98.82
1967	3.9	793.9	70,527	101.84
1968	3.6	864.2	72,103	107.73
1969	3.5	929.1	74,296	114.61
1970	5.0	974.1	75,165	119.46
1971	6.0			
1972	5.6			

EXHIBIT B
Sheet 1

Written Premium Versus
Gross National Product
1948 to 1973

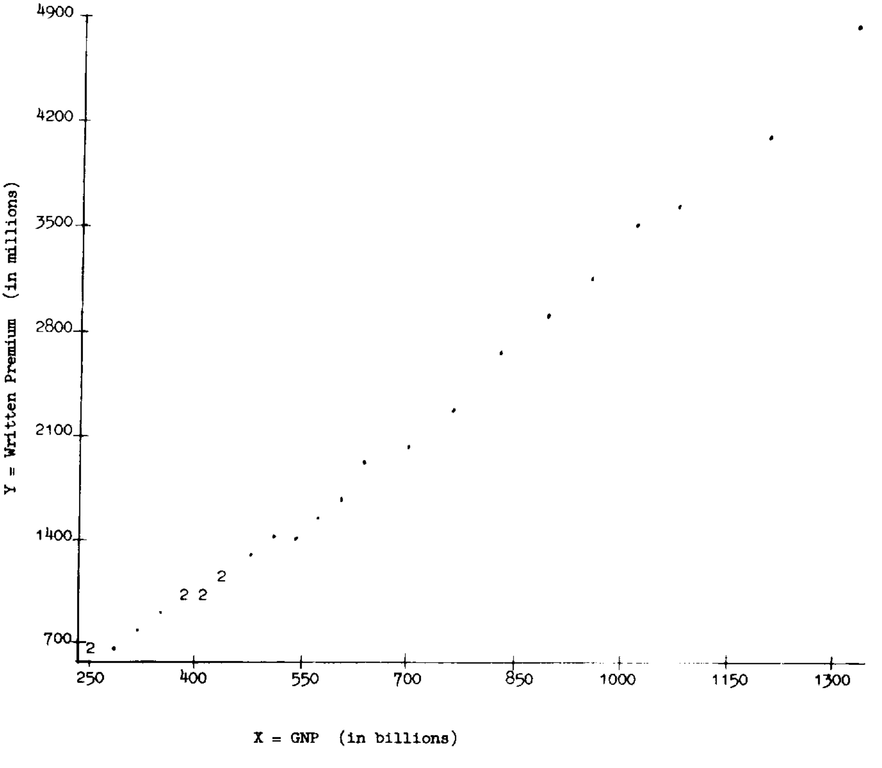

EXHIBIT B
Sheet 2

Written Premium
Versus $PRODUCT_i$
1948 - 1973

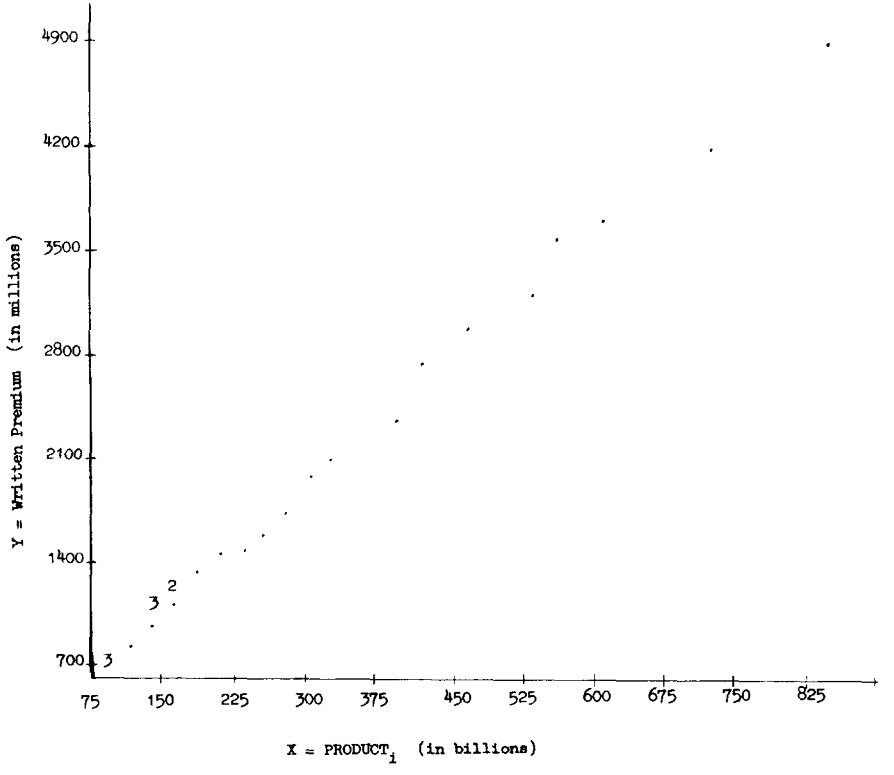

EXHIBIT B
Sheet 3

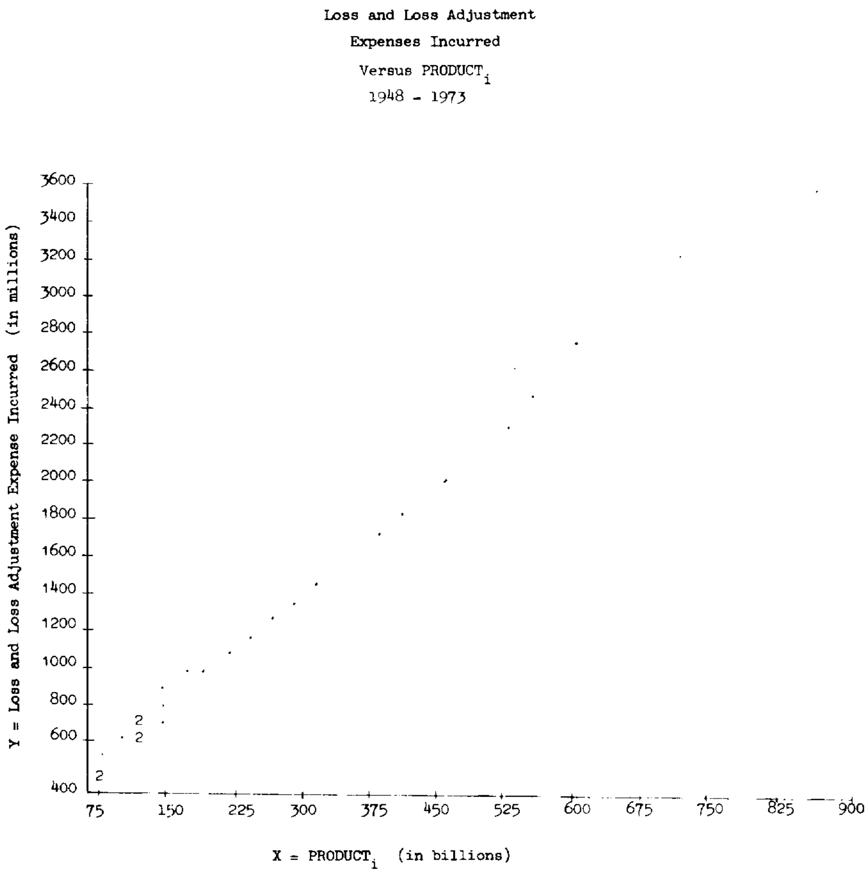

EXHIBIT B
Sheet 4

Loss and Loss Adjustment
Expenses Incurred
in Year(i) Versus Year(i-1)
1948 - 1973

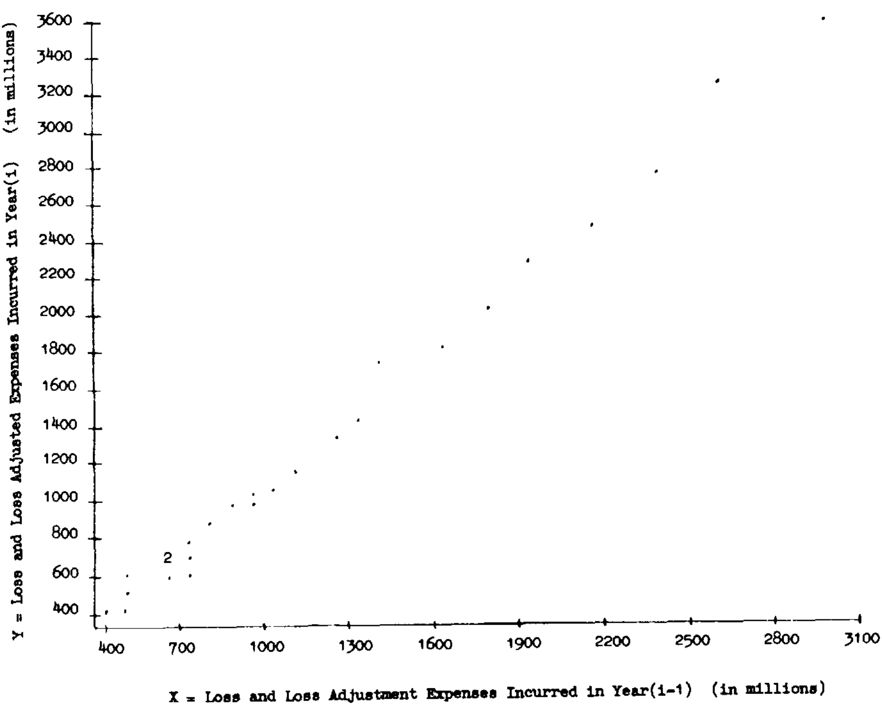

EXHIBIT B
Sheet 5

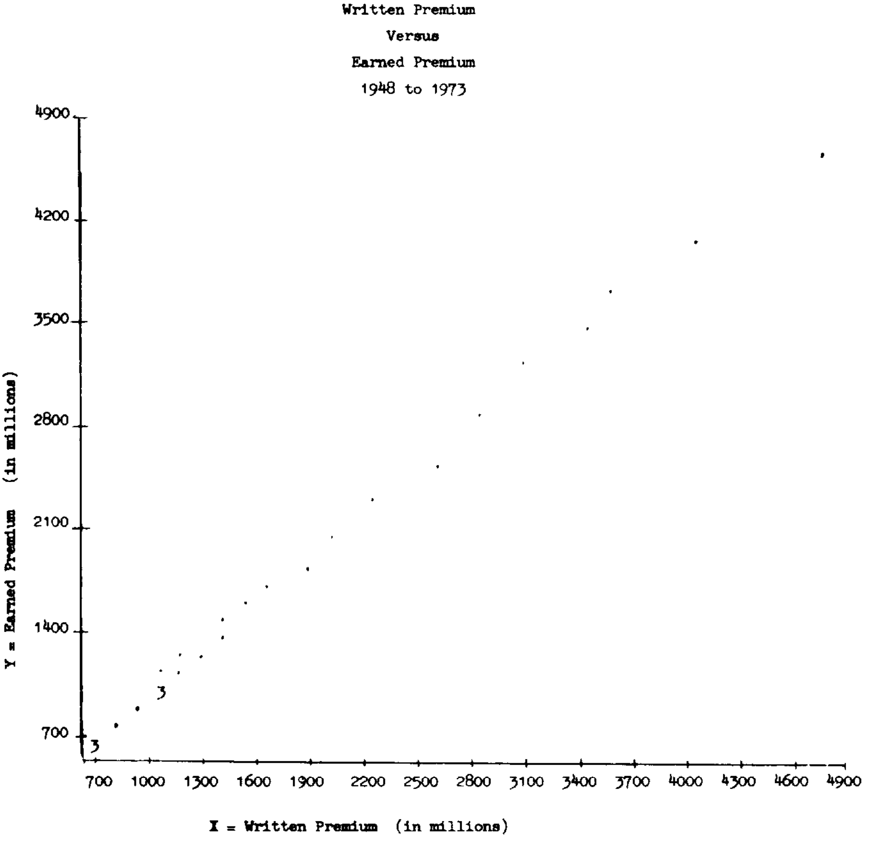

TABLE 1

	Values of A and B_i	Value of t for A and B_i	Sign of t Correct	R^2	Correlation of Independent Variables	Durban-Watson Statistic	Mean Absolute Error	Intuitive Criteria
MODEL I								
Intercept	A = 289184.0	11.7719	*	.9961		d = .5745	2.86% historically; 3.30% last 5 years	Good
$PRODUCT_i$	B_1 = 5687.23	79.8545	Yes		None	d_L = 1.30**		
						d_U = 1.46		
MODEL II								
Intercept	A = −18198.1	−.646560	*	.9990		d = 1.6041	1.95% historically; .60% last 5 years	Good
$PRODUCT_i$	B_1 = 2117.20	6.30748	Yes		Slight Correlation	d_L = 1.14		
$UNEMP_{(i-1)}$	B_2 = 11515.7	2.2575	Yes			d_U = 1.65		
$LOSS_{(i-1)}$	B_3 = .00057977	6.37912	Yes					
MODEL III								
Intercept	A = 10081.6	2.37009	*	.9999	Slight Correlation	d = 1.1934	.46% historically; .42% last 5 years	Good
$WPREM_i$	B_1 = .899949	29.0373	Yes			d_L = 1.21		
$WPREM_{(i-1)}$	B_2 = .077736	2.25731	Yes			d_U = 1.55		
MODEL IV								
Intercept	A = −1494860	−1.61492	*	.9943		d = 1.0115	3.34% historically; .0193 last 5 years	Fair
GNP_i	B_1 = 4719.37	8.02251	Yes		Serious Correlation	d_L = 1.10		
AWW_i	B_2 = −26836.5	−4.71399	No			d_U = 1.66		
EMP_i	B_3 = 44.2167	1.7887	Yes					

*Neither the sign nor the magnitude of t is important for A.

**If $d < d_L$, positive autocorrelation is present.

If $d_L \le d \le d_U$, the test is inconclusive.

If $d > d_U$, no autocorrelation is present.