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Empirical Evidence for Alternative Loss Development Horizons and the Measurement of Reserve Error

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ABSTRACT

This article examines the sufficiency of alternative loss development horizons in measuring reserve errors and the precision of reserve error measurements taken over the loss development horizon. We find that no single development horizon is adequate in all circumstances. Short development horizons are adequate for tests of significance involving the aggregate error in a sample of insurers. Substantially longer developments must be used when precise measurements of error, taken on individual insurers, are required. This study also provides evidence of statistically significant reserving errors during the years 1977 through 1987.

Introduction

The question of whether or not property-liability insurers "manage" reported reserves for losses and loss adjustment expenses has received considerable attention in the insurance literature. Two distinct but related lines of empirical research have directly addressed this issue: One asks if there is evidence of statistically significant misestimation in the original reserve (Forbes, 1970; Anderson, 1971; Balcarek, 1975; Ansley, 1979; Smith, 1980); the other asks if misestimation of the original reserve can be explained in terms of income smoothing behavior (Smith, 1980; Weiss, 1985; Grace, 1990).

Defining reserve error as the difference between an initial and terminal value of either estimated reserves (e.g., Grace) or incurred losses (e.g., Weiss), existing studies have relied upon four to five years of loss development to measure reserve error. The accuracy of these measurements depends, however, upon how closely the chosen terminal values approximate fully developed

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values. Consequently, an informed choice among alternative loss development horizons requires knowledge of the speed with which subsequent reserve reestimates converge to fully developed values. This issue has remained largely unexplored.

The primary purpose of this research is to provide some initial evidence concerning the dynamics of the underlying reserve reestimation process for a sample of stock insurers. To fulfill this aim, two research questions are addressed. First, when testing for the existence of statistically significant errors in the original reserve estimates of a sample of insurers, what minimum point of loss development is necessary to draw correct statistical conclusions? Second, how is the precision of reserve error measurements affected by the choice among alternative loss development horizons? As a result of addressing these questions, we also extend the existing loss reserve error literature by providing evidence of significant reserve misestimation during the period from 1977 through 1987.

This study suggests that no single measurement horizon is adequate in all circumstances. Shorter development periods appear to be sufficient when trying to detect statistically significant misestimations of the original reserve across a sample of insurers. Substantially longer development periods are necessary when the accuracy of individual insurer reserve error measurements is important.

Motivation

Ideally, reserve error would be measured by the difference between the originally established reserve and its fully developed value. However, the lack of complete loss development data imposes a practical limitation on this ideal. Particularly with respect to the reserves associated with liability losses, reliance on less than fully developed reserves to measure error is virtually inescapable.

The general reliance on five-year loss developments stems from Forbes's (1970, p. 531) observation that

> a four year incurred loss development period is necessary to measure the accuracy of an insurer's reserving policy properly. At the end of this period, 97-100 percent of the original claims will have been settled...and the remaining claims will have developed to a point where their reserve closely approximates their actual unpaid liability.

This observation was based solely upon the automobile bodily injury loss reserves of 1944 through 1961 (Forbes, 1970, p. 528). Since then, the proportion of total premiums attributable to liability risks has increased, extending the period over which losses are paid. Concurrently, the proportion of reserves attributable to incurred but not reported losses has also risen (Aiuppa and Trieschmann, 1987). In light of these changes, it seems prudent to examine the sufficiency of alternative loss development horizons for the purpose of reserve error measurement.

In addition, the data necessary to statistically evaluate the sufficiency of five-year loss developments for measuring reserve error has become available.

Beginning with financial statements dated December 31, 1986, Securities and Exchange Commission (SEC) registrants with material property-liability operations have been required to include ten-year loss and loss expense developments in Form 10K (SEC, 1984). Similarly, beginning with the 1989 statutory annual statement, Schedule P has been revised to provide ten-year loss developments for liability lines.

Hypotheses and Methods

When testing for the statistically significant errors in the original reserve estimates of a sample of insurers, what is the minimum loss development necessary to draw correct statistical conclusions? To answer this first research question, we examine each calendar-accident year separately, measuring the error in the original reserve of individual insurers at each year of available reserve development. For each year of development, these individual observations are then aggregated into separate samples and examined for evidence of statistically significant misestimation by testing the first hypothesis—that, with respect to the calendar-accident year reserve originally established in year t, the mean error indicated by reserve error measurements taken after n years of loss development is equal to zero—against the alternative—that the mean error is not zero.

The statistical conclusions drawn from incomplete loss development data are then compared to those drawn from the most fully developed estimate available for the given reserve. The minimum point of loss development necessary to draw correct statistical conclusions is taken to be that point of development where the same statistical conclusions are reached using either complete or incomplete loss developments in measuring error. (This minimum can also be viewed as the point beyond which the use of additional reserve development has no effect on the test of statistical significance.)

To test this hypothesis, error is defined as the percent error contained in the original reserve established in year t by insurer i. That is,

$$\text{Error}(1)_{i,t} = \frac{\left(R_{i,t+0} - R_{i,t+n}\right)}{R_{i,t+0}} \tag{1}$$

where $R_{i,t+0}$ is the reserve initially established by insurer i in year t, and $R_{i,t+n}$ is the reestimate of this reserve given n years of loss development. Mean error with respect to the reserve established in year t measured after n years of loss development is computed as

$$\text{Mean Error}(1)_{t,t+n} = \frac{\sum_{i} \frac{\left(R_{i,t+0} - R_{i,t+n}\right)}{R_{i,t+0}}}{\text{no. of insurers}} \,. \tag{2}$$

How is the precision of reserve error measurement affected by the choice among alternative loss development horizons? This second research question is addressed from two perspectives: precision with respect to the sample insurers taken in the aggregate and precision with respect to the estimation errors of the individual insurers comprising the sample.

First, error is redefined to capture the percent error contained in each subsequent reestimate of the original reserve. That is,

$$\text{Error}(2)_{i,t+n} = \frac{\left(R_{i,t+n} - R_{i,t+N}\right)}{R_{i,t+N}} \tag{3}$$

where n = 0, 1,...,N, and N is the maximum number of years of development available for reserves established in year t. As before, each calendar-accident year is examined separately, and the individual observations are aggregated. Mean Error(2) is computed as

$$\text{Mean Error}(2)_{t,t+n} = \frac{\sum_i \frac{\left(R_{i,t+n} - R_{i,t+N}\right)}{R_{i,t+N}}}{\text{no. of insurers}} . \tag{4}$$

We would expect, within a given calendar-accident year, to observe increasing precision (decreasing standard deviation) as information from additional loss development is impounded into the reserve reestimates. To determine the point at which the reserve reestimates converge to their fully developed values, we examine each calendar-accident year by testing the second hypothesis—that, with respect to the calendar-accident year reserve originally established in year t, the mean error indicated by reserve error measurements taken after n years of development is equal to the mean error indicated by reserve error measurements taken after N years of development—against the alternative—that the mean errors are not equal. Convergence is defined here as that point of reserve development at (and beyond) which hypothesis two fails to be rejected.

Second, we attempt to quantify the magnitude of the individual estimation errors contained in the sample at each stage of loss development. For this purpose, attention is directed toward the absolute values of the individual errors. That is,

$$\text{Error}(3)_{i,t+n} = \left| \frac{\left(R_{i,t+n} - R_{i,t+N}\right)}{R_{i,t+N}} \right| \tag{5}$$

and

$$\text{Mean Error}(3)_{t,t+n} = \frac{\sum_i \left| \left(R_{i,t+n} - R_{i,t+N}\right) / R_{i,t+N} \right|}{\text{no. of insurers}} . \tag{6}$$

Because our intent is to quantify the magnitude of errors over the reserve development horizon, the use of absolute values is necessary in order to eliminate the offsetting of under- and overestimates within the sample.

Again, each calendar-accident year is examined separately. Mean Error(3) is examined in terms of our prior expectation of increasing precision over the reserve development horizon, but no formal statistical tests are conducted with respect to this error metric.

Data and Sample

The data employed in this study were extracted from the required reserve disclosures contained in the SEC Form 10K filed by property-casualty insurers for 1986 through 1988. In part, these required disclosures include, for the current and ten preceding years, the original reserve, the reserve as reestimated in each following year, and the cumulative amount paid against the reserve in each subsequent year.

These data are not directly comparable to those contained in statutory financial statements. The statutory statements present the original reserves and the reestimated reserves on a calendar-accident year basis. That is, the data relate to the "year in which premiums were earned and losses were incurred" (Statutory Schedule P, Part 1, Summary, column 1). In contrast, reserves and reestimated reserves reported on a reserve-date basis include amounts for not only the current year but also all previous years. This precludes using them to form judgments concerning an insurer's reserving practices with respect to policies underwritten in any single year.

The required disclosures are, however, sufficient to allow the conversion of reserve-date basis data to a calendar-accident year basis (a statement to this effect is included with the disclosures in Form 10K). Because the research questions in this study, as well as those posed in earlier research, are framed in terms of calendar-accident year data, the necessary conversion was undertaken prior to analysis. See Appendix A for details of the conversion.

The insurers comprising the data set for this study include all property-liability insurers and groups subject to the SEC reserve disclosures. Most of these companies were identified in Tillinghast (1987); additional insurers were identified by a search of the National Automated Accounting Research System data base. The number of insurers ranges from 48 in 1977 to 67 in 1985 as a consequence of new formations, mergers, and changes in SEC reporting status. See Appendix B for a list of insurers in the sample.

Reserves of the sample insurers totaled $30.2 billion in 1977 and $115 billion in 1987. This represents more than 71 percent of all stock insurer reserves and approximately 53 percent of total industry reserves (A. M. Best, 1990). The consolidated financial statements from which the data are drawn include the combined results of approximately 500 individual insurers.

Results

Table 1 provides the calculated values of Mean Error(1) and the associated t-statistics (in parentheses) for the test of our first hypothesis. In this table, each column represents a single calendar-accident year, while each row represents one additional year of reserve development.

Table 1
Mean Error(1) in the Original Liability for Loss and Loss Adjustment Expenses Measured at Each Year of Reserve Development
(Calendar-Accident Year Basis)

Reestimated in Year:	Year Liability Established *1977* *(n = 48)*	*1978* *(n = 52)*	*1979* *(n = 54)*	*1980* *(n = 56)*	*1981* *(n = 61)*	*1982* *(n = 55)*	*1983* *(n = 64)*	*1984* *(n = 65)*	*1985* *(n = 67)*	*1986* *(n = 66)*	*1987* *(n = 66)*
One	5.95%	9.18%	5.46%	3.32%	1.67%	1.03%	-5.55%	-8.25%	0.21%	5.44%	5.19%
	(2.109)	(2.506)	(2.489)	(2.407)	(0.898)	(0.421)	(-3.112)	(-4.346)	(0.035)	(1.772)	(2.983)
Two	6.02%	5.47%	4.65%	2.58%	1.93%	-1.56%	-10.83%	-14.72%	-3.91%	6.03%	
	(1.259)	(2.152)	(1.859)	(1.475)	(0.983)	(-0.556)	(-5.941)	(-6.634)	(-0.654)	(1.678)	
Three	4.93%	10.09%	7.60%	5.19%	4.14%	-1.44%	-14.40%	-17.33%	-2.72%		
	(1.400)	(2.605)	(2.729)	(2.598)	(1.401)	(-0.428)	(-6.891)	(-7.351)	(-0.433)		
Four	5.18%	10.51%	6.90%	5.56%	1.84%	-2.84%	-15.94%	-17.38%			
	(1.392)	(2.722)	(2.742)	(2.662)	(0.596)	(-0.817)	(-6.974)	(-6.562)			
Five	6.39%	9.75%	6.45%	4.42%	1.66%	-3.88%	-13.35%				
	(1.597)	(2.729)	(2.639)	(2.087)	(0.547)	(-1.101)	(-4.694)				
Six	6.58%	8.96%	6.18%	3.71%	0.04%	-3.12%					
	(1.645)	(2.722)	(2.490)	(1.705)	(0.014)	(-0.828)					
Seven	7.04%	7.92%	5.80%	3.94%	0.21%						
	(1.867)	(2.554)	(2.299)	(1.778)	(0.077)						
Eight	6.30%	7.30%	5.78%	3.78%							
	(1.569)	(2.382)	(2.272)	(1.622)							
Nine	6.08%	6.57%	5.40%								
	(1.479)	(2.057)	(2.036)								

Note: Errors are calculated using equation (2) and converted to percentages for presentation; t-statistics are given in parentheses. Each column represents a single calendar-accident year, while each row represents one additional year of reserve development.

Based upon the most fully developed reserve estimates (shown in the last entry of each column), statistically significant (α = .05) over-reserving occurred during the calendar-accident years 1978, 1979, and 1987. Statistically significant under-reserving occurred in the calendar-accident years 1983 and 1984. The remaining years—1980 through 1982, 1985, and 1986—were not significantly misestimated. Calendar-accident year 1987 also seems to have been significantly overestimated, but a single year of development was not deemed sufficient to draw such a conclusion. This issue is discussed below.

We compared statistical conclusions (α = .05) drawn at each year of development with those drawn using the most fully developed reserve reestimates (see Table 2). A minimum of three years of development were considered necessary to make meaningful comparisons. Consequently, the results presented in Table 2 are confined to calendar-accident years 1977 through 1985. Relying upon two years of development, a single Type II error[1] is noted in the test of the 1979 reserve. The correct conclusion in this case would have been drawn at the .10 significance level. Developments of from three to five years each produced a single Type I error,[2] all of which occurred in the tests of the 1980 reserve. Tests relying upon six or more years of development produced no Type I or Type II errors.

With respect to the precision of reserve estimates made over the development horizon, we calculated the values of Mean Error(2) and the associated t-statistics for the test of our second hypothesis (see Table 3). Based upon the tests of hypothesis two (α = .05), reserve reestimates converge to fully developed values in the third development year. Reestimates of the 1978 reserve, however, show a deterioration in accuracy at and beyond the fifth development year. A similar divergence is also noted for the reestimate of the 1980 reserve made in the fifth development year. In practical terms, reserve reestimates fall within 3 percent of the fully developed values given four or more years of development.

With respect to the estimation errors of individual insurers, the mean absolute percentage errors ((Error(3)) for all calendar-accident years decrease monotonically with time, a result consistent with our expectations (see Table 4). The associated variance, while generally declining with time, is somewhat erratic. At least one instance of increased variance between succeeding reserve estimates is noted for all calendar-accident years.

A comparison of the mean absolute percent errors and Mean Error(2) reveals substantial differences in precision when the perspective changes from the aggregated sample to individual insurers. For example, Mean Error(2) with respect to the original 1977 reserve is 6.08 percent, but the comparable mean absolute percentage error is 19.28 percent. Similarly large differences are noted for all calendar-accident years, and these differences persist throughout the entire reserve development horizon.

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[1] A Type II error incorrectly concludes that the mean error is not statistically different from zero.

[2] A Type I error incorrectly concludes that the mean error is statistically different from zero.

In terms of the individual insurer, a minimum of three to four years of development is necessary to correct 50 percent of the error contained in the original reserve estimate. To correct 80 percent of the original error in estimation, a minimum of seven to eight years of development is required.

Table 2
Statistical Conclusions Using Alternative Reserve Error Measurement Horizons

Development Year	*Number of Tests*	*Number of Type I Errors*[a]	*Number of Type II Errors*[b]
One	9	2	0
Two	9	0	1
Three	8	1	0
Four	7	1	0
Five	6	1	0
Six	5	0	0
Seven	4	0	0
Eight	3	0	0

[a] A Type I error incorrectly concludes that the mean error is statistically different from zero.
[b] A Type II error incorrectly concludes that the mean error is not statistically different from zero.

Conclusions

Two to three years of development are sufficient to detect statistically significant reserve errors within a sample of insurers. Confirmation is provided by evidence that insurers' reestimates of the original reserve converge to fully developed values in the third development year. This conclusion should be of interest to researchers concerned with detecting systematic bias in the estimation of reserves, in that the use of shorter developments allows for more timely reporting of results.

With respect to the estimation errors of individual insurers, the evidence supports a quite different conclusion. For any given level of desired precision in the reserve estimates of individual insurers, it is necessary to use substantially longer development periods to measure error.[3]

This finding should be of particular interest to researchers who wish to employ measures of reserve error either as dependent or independent

[3] The question of what constitutes an adequate level of precision depends, of course, upon the use to which the measurements will be put.

Table 3
Mean Error(2) in the Reestimated Liability for Loss and Loss Adjustment Expenses at Each Year of Reserve Development
(Calendar-Accident Year Basis)

Reestimated in Year:	Year Liability Established *1977* *(n = 48)*	*1978* *(n = 52)*	*1979* *(n = 54)*	*1980* *(n = 56)*	*1981* *(n = 61)*	*1982* *(n = 55)*	*1983* *(n = 64)*	*1984* *(n = 65)*	*1985* *(n = 67)*	*1986* *(n = 66)*	*1987* *(n = 66)*
One	6.08%	6.57%	5.40%	3.78%	0.21%	-3.12%	-13.35%	-17.38%	0.21%	5.44%	5.19%
	(1.479)	(2.020)	(2.036)	(1.622)	(0.077)	(-0.828)	(-4.694)	(-6.562)	(0.035	(1.772)	(2.983)
Two	0.44%	-1.33%	0.52%	0.72%	-0.77%	-5.59%	-8.22%	-10.43%	-3.91%	6.03%	
	0.149	(-0.652)	(0.232)	(0.333)	(-0.298)	(-2.073)	(-3.099)	(-4.923)	(-0.654)	(1.678)	
Three	1.02%	0.91%	1.13%	1.43%	-1.41%	-3.13%	-3.32%	-3.32%	-2.72%		
	(0.447)	(0.610)	(0.680)	(0.714)	(-0.627)	(-1.576)	(-1.406)	(-1.960)	(-0.433)		
Four	0.49%	-2.31%	-1.56%	-1.34%	-3.00%	-2.23%	0.97%	-0.13%			
	(0.295)	(-1.789)	(-1.170)	(-1.064)	(-1.750)	(-1.207)	(0.439)	(-0.088)			
Five	0.32%	-2.72%	-1.33%	-1.81%	-0.57%	-1.03%	3.12%				
	(0.218)	(-2.236)	(-1.391)	(-2.111)	(-0.341)	(-1.127)	(1.459)				
Six	-0.54%	-2.50%	-1.09%	-0.69%	-0.84%	-0.07%					
	(-0.558)	(-2.887)	(-1.428)	(-0.973)	(-0.800)	(-0.094)					
Seven	-0.75%	-2.09%	-0.81%	0.05%	0.27%						
	(-0.783)	(-2.650)	(-1.192)	(0.084)	(0.339)						
Eight	-1.36%	-1.34%	-0.44%	-0.22%							
	(-1.065)	(-2.580)	(-0.758)	(-0.477)							
Nine	-0.31%	-0.85%	-0.44%								
	(-0.560)	(-2.640)	(-0.920)								

Note: Errors are calculated using equation (4) and converted to percentages for presentation; t-statistics are given in parentheses. Each column represents a single calendar-accident year, while each row represents one additional year of reserve development.

Table 4
Mean Absolute Percent Error in the Liability for Loss and Loss Adjustment Expenses Reestimated at Each Year of Reserve Development (Calendar-Accident Year Basis)

Reestimated in Year:	Year Liability Established									
	1977 (*n* = *48*)	*1978* (*n* = *52*)	*1979* (*n* = *54*)	*1980* (*n* = *56*)	*1981* (*n* = *61*)	*1982* (*n* = *55*)	*1983* (*n* = *64*)	*1984* (*n* = *65*)	*1985* (*n* = *67*)	*1986* (*n* = *66*)
One	19.28%	15.39%	14.10%	12.20%	11.81%	19.06%	21.13%	21.69%	17.67%	12.08%
	(20.63)	(18.03)	(13.79)	(12.39)	(16.03)	(18.08)	(15.01)	(16.58)	(16.36)	(14.55)
Two	13.53%	10.05%	11.22%	11.18%	8.65%	14.97%	16.76%	15.47%	11.87%	6.92%
	(14.31)	(9.73)	(11.38)	(11.08)	(15.12)	(12.59)	(14.68)	(12.37)	(16.65)	(6.29)
Three	10.60%	8.07%	8.05%	8.72%	6.98%	10.09%	12.75%	9.40%	7.66%	
	(11.51)	(6.68)	(8.74)	(11.75)	(17.14)	(10.30)	(13.72)	(10.18)	(16.50)	
Four	7.34%	6.09%	6.44%	6.62%	5.80%	7.92%	8.82%	6.07%		
	(8.41)	(7.06)	(7.19)	(6.49)	(20.08)	(10.82)	(14.97)	(10.12)		
Five	5.83%	5.23%	4.96%	4.75%	4.67%	4.44%	6.39%			
	(8.10)	(7.24)	(4.89)	(4.47)	(18.53)	(6.13)	(15.76)			
Six	4.09%	4.22%	3.90%	3.76%	2.20%	2.93%				
	(5.11)	(5.02)	(3.95)	(3.60)	(13.17)	(5.77)				
Seven	4.02%	3.35%	3.25%	2.73%	1.06%					
	(5.09)	(4.87)	(3.70)	(3.79)	(11.74)					
Eight	3.60%	2.25%	2.67%	1.59%						
	(7.88)	(3.17)	(3.25)	(2.94)						
Nine	1.68%	1.52%	1.99%							
	(3.32)	(2.62)	(2.77)							

Note: Errors are calculated using equation (6) and converted to percentages for presentation; variances are given in parentheses. Each column represents a single calendar-accident year, while each row represents one additional year of reserve development.

variables in statistical models (e.g., Grace, 1990). Similarly, this finding advises caution in the use of short developments to assess reserve adequacy, for example, with the Insurance Regulatory Information System one- and two-year reserve development ratios.

As a consequence of the analyses, we found evidence that sample insurers significantly overestimated reserves in 1978 and 1979 and underestimated reserves in 1983 and 1984. Reserve errors for the years 1977, 1980 through 1982, 1985, and 1986 were not statistically significant. Although this pattern may suggest nonrandom behavior, the sample period of ten years is insufficient for extensive analysis.[4]

Limitations

The major limitations of this study stem from the use of Generally Accepted Accounting Principles (GAAP) basis data reported in SEC Form 10K. Relying upon SEC Form 10K limits the sample to stock insurers. Consequently, caution must be exercised in extending these results to mutual insurers or nonpublicly traded stock insurers.

There are also differences between reserves reported on a GAAP basis and those reported on a Statutory Accounting Principles (SAP) basis. The most significant difference arises from GAAP's recognition of anticipated recoveries from salvage and subrogation; SAP, in contrast, delays recognition until collection is made. In general, however, these differences are small and are unlikely to lead to significantly different conclusions with respect to the *behavior* of reserve reestimates.[5]

This study's reliance on SEC Form 10K data also restricts the analysis to data available from the consolidated financial statements. Consequently, the data include the aggregated results of approximately 500 individual insurers. For drawing inferences to a larger population, this may be more of a strength than a weakness. With such a sample, there is more than reasonable assurance that diversification effects across insurers (and across affiliated insurers) are fully realized. However, it is impossible to extend the analysis either to the level of the individual insurer or to individual lines of business.

[4] A test on the signs of the reserve errors (using two years of loss development) is insignificant ($p = .107$).

[5] Insurers are also required to provide a reconciliation between GAAP and SAP reported total reserves. Generally, differences arise from the advanced recognition of salvage and subrogation, and, to a lesser extent, the discounting of reserves. Generally, such differences are on the order of 5 percent or less. Although it is not possible to allocate these differences to individual calendar-accident years, it is clear that their influence on a calendar-accident year basis would be substantially diminished.

Appendix A
Conversion of Reserve-Date Basis Data to Calendar-Accident Year Basis

Form 10K Reserves on a Reserve-Date Basis

Reserve for Losses and Loss Adjustment Expenses	Year 1	Year 2	Year 3	Year 4
Original Reserve	A_0	B_0	C_0	D_0
1st Reestimate	A_1	B_1	C_1	
2nd Reestimate	A_2	B_2		
3rd Reestimate	A_3			
Cumulative Paid				
After 1 Year	E_1	F_1	G_1	
After 2 Years	E_2	F_2		
After 3 Years	E_3			

Original and Reestimated Reserves on a Calendar-Accident Year Basis

Reserve for Losses and Loss Adjustment Expenses				
Original Reserve	A_0	B_0-A_1+E_1	C_0-B_1+F_1	D_0-C_1+G_1
1st Reestimate	A_1	B_1-A_2+E_1	C_1-B_2+F_1	
2nd Reestimate	A_2	B_2-A_3+E_1		
3rd Reestimate	A_3			

Note: This computation results in the loss of some data. Year 1 (1976 in this study) cannot be restated from a reserve date basis. Additionally, one year of reserve development is lost in the conversion. Consequently, although the disclosure includes developments through ten years, only nine years are available for analysis on a calendar-accident year basis. This conversion is the same as that used in the Tillinghast (1987) disclosures.

Appendix B
Sample Insurance Companies and Groups

Aetna Life & Casualty
AID Corporation
Allcity Insurance Company
Allstate Insurance Group
American Financial Corporation
American General Corporation
American Indemnity Financial
American International Group
AVEMCO
Capitol Transamerica Corporation
Celina Financial Corporation
The Chubb Corporation
CIGNA Corporation
Cimarron Investment Company
Cincinnati Financial Corporation
Classified Financial Corporation
CNA Financial Corporation
The Commerce Group, Inc.
The Continental Corporation
Crum & Forster
EMC Insurance Group, Inc.
Fairmont Financial, Inc.
Fireman's Fund Corporation
Fremont General Corporation
GAINSCO
GEICO Corporation
General Re Corporation
Guaranty National Corporation
The Hanover Insurance Company
Harleysville Group, Inc.
The Home Insurance Company
Hartford Insurance Group
Kemper Corporation
Lawrence Insurance Group
Lincoln National Corporation
McM Corporation
Mercury General Corporation
Meridian Insurance Group
Motor Club of America
NAC Re Corporation
NYMAGIC
Nobel Insurance Ltd.
North East Insurance Company
Ohio Casualty Corporation
Old Republic Corporation
Orion Capital Corporation
Piedmont Management Company
The Progressive Corporation
Reliance Insurance Company
RLI Corporation
Rockwood Holding Company
SAFECO Corporation
Scor U.S. Corporation
The Seibels Bruce Group
Selective Insurance Group
Seneca Insurance Group
The St. Paul Companies
Teledyne Group
Transamerica Corporation
The Travelers Corporation
20th Century Industries
United Fire & Casualty
USF&G Corporation
USLICO Corporation
W. R. Berkley Corporation
Zenith National Insurance

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