

PROCEEDINGS

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TESTING THE REASONABLENESS OF LOSS RESERVES: RESERVE RATIOS

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Abstract

This paper introduces the idea of using “reserve ratios” as tools for testing the reasonableness of loss reserves. The reserve ratios introduced in this paper are the ratios of IBNR to premium, IBNR to reported loss, IBNR to paid loss, total reserve to premium, and total reserve to paid loss. These reserve ratios are shown to have relevance, not just by accident year within a line of business, but on a composite basis: across accident years, across lines of business, across companies, and across industry groups. The idea is demonstrated using a database of reinsurance company reserves over a test period spanning accident years 1980–1998, as well as summaries of insurance industry reserves for the period spanning accident years 1991–2000. A general blueprint for using these ratios is also presented, along with a series of observations to provide additional perspective for the use of this tool.

1. INTRODUCTION

The *Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves*, as well as the actuarial standards of practice, call on the actuary to test the reasonableness of loss¹ reserve estimates.²

In the course of searching for tests of reasonableness for a particular set of reinsurance loss reserve estimates, a remarkably stable pattern of IBNR to premium ratios was observed for the industry. The stability of this reserve ratio led to exploring other constructions of reserve ratios. Five³ different reserve ratio constructions showed enough consistency⁴ to suggest the possibility that they be made a part of the casualty actuarial literature so that the inventory of tests of reasonableness of loss reserves may begin to be expanded.

At this point of the discussion, it is useful to make the distinction between the reserve ratios to which actuaries are accustomed and the reserve ratios proposed in this paper. Reserve ratios are widely used by actuaries in the *determination* of loss reserve estimates, and those are commonly known as “loss development factors.” A cumulative loss development factor, when reduced by 1.00, represents the ratio of IBNR to reported (or total reserves to paid) losses. It should also be noted that such ratios are nearly always used within a (sub)line of business, by accident year (or other period), and within company (or insurer group). In contrast, the proposed reserve ratios (a) are intended for use in *testing* a loss reserve estimate after it has been established (or just

¹Whenever the term “loss” is used, it is intended to include both “loss” and associated “loss adjustment expenses.”

²CAS 2002 *Yearbook*, page 319, lines 315–316.

³Five ratios represent the universe of ratios that could be constructed using: either IBNR or total reserves in the numerator and either premiums, reported losses, or paid losses in the denominator. Note that the ratio of total reserves to reported losses is excluded from the set of six ratios possible, as it is a transformation of the ratio of IBNR to paid losses.

⁴“Consistency” as used in this paper simply means a discernible pattern of behavior among the observed ratios over time. Several examples of such consistency are demonstrated in this paper.

before it is adopted—testing it for potential reasonableness) and (b) have application on a composite basis, combining accident years and/or lines of business and/or different companies.

2. THE BASIC IDEA

One of the questions that arises immediately when one attempts to use reserve ratios to test the reasonableness of loss reserve estimates is the source and identity of various benchmarks one could use for such testing. The basic idea advanced in this paper is that compilations of histories of reserve ratios are likely to reveal stable patterns that can be useful in testing loss reserves for reasonableness. This process is described, illustrated, and discussed in the remainder of this paper.

3. DATA SOURCES

The main data source for this paper is a database containing detailed historical data drawn from Schedule Ps of published Annual Statements for all U.S. reinsurers who reported their data to A. M. Best Company.⁵ A secondary source of data is the 2001 edition of *Best's Aggregates & Averages*. This source contains accident year data that span the 1991–2000 experience period.

4. RESERVE RATIOS

The construction of five different reserve ratios is illustrated in Table 1 for the reinsurance industry in total, all lines of business combined as of December 31, 1995. First, the raw data used to calculate the ratios are shown in Table 1. The reserve ratios are now constructed using the natural definition of each of the ratios (column references refer to the columns in Table 1):

IBNR to Premium: This is the ratio of the net IBNR reserve to the net earned premium [the ratio of Column (5) to Column (2)].

⁵The database consisted of all companies whose main business is reinsurance. The database was constructed by A. M. Best Company as a special compilation of all reinsurers.

TABLE 1
 REINSURANCE INDUSTRY
 ALL LINES COMBINED
 AS OF 12/31/1995
 (\$ MILLIONS)

| (1) | (2) | (3) | (4) | (5) |
|------------------|--------------------------|---------------------|------------------------|------------------------|
| Accident Year | Net Earned Premium | Net Paid Loss | Net Case Reserve | Net IBNR Reserve |
| 1995 | 17,748 | 2,521 | 2,593 | 7,549 |
| 1994 | 16,368 | 5,490 | 2,691 | 4,386 |
| 1993 | 14,630 | 6,029 | 1,846 | 2,975 |
| 1992 | 12,777 | 8,384 | 1,312 | 1,952 |
| 1991 | 12,214 | 6,679 | 964 | 1,648 |
| 1990 | 11,130 | 6,094 | 925 | 1,360 |
| 1989 | 10,210 | 6,131 | 596 | 751 |
| 1988 | 10,650 | 5,233 | 603 | 665 |
| 1987 | 11,860 | 5,544 | 437 | 592 |
| 1986 | 11,025 | 5,647 | 464 | 475 |
| Total | 128,613 | 57,751 | 12,430 | 22,355 |

IBNR to Reported Loss: This is the ratio of the net IBNR reserve to the net reported loss (paid plus case reserve) [the ratio of Column (5) to the sum of Columns (3) and (4)].

IBNR to Paid Loss: This is the ratio of the net IBNR reserve to the net paid loss [the ratio of Column (5) to Column (3)].

Total Reserve to Premium: This is the ratio of the net total reserve (IBNR plus case reserve) to the net earned premium [the ratio of the sum of Columns (4) and (5) to Column (2)].

Total Reserve to Paid Loss: This is the ratio of the net total reserve (IBNR plus case reserve) to the net paid loss [the ratio of the sum of Columns (4) and (5) to Column (3)].

These ratios are shown in Table 2 using the raw data from Table 1.

TABLE 2
RESERVE RATIOS
REINSURANCE INDUSTRY
ALL LINES COMBINED
AS OF 12/31/1995

| Accident Year | IBNR to Premium | IBNR to Reported Loss | IBNR to Paid Loss | Total Reserve to Premium | Total Reserve to Paid Loss |
|----------------------|------------------------|------------------------------|--------------------------|---------------------------------|-----------------------------------|
| 1995 | 43% | 148% | 299% | 57% | 402% |
| 1994 | 27% | 54% | 80% | 43% | 129% |
| 1993 | 20% | 38% | 49% | 33% | 80% |
| 1992 | 15% | 20% | 23% | 26% | 39% |
| 1991 | 13% | 22% | 25% | 21% | 39% |
| 1990 | 12% | 19% | 22% | 21% | 38% |
| 1989 | 7% | 11% | 12% | 13% | 22% |
| 1988 | 6% | 11% | 13% | 12% | 24% |
| 1987 | 5% | 10% | 11% | 9% | 19% |
| 1986 | 4% | 8% | 8% | 9% | 17% |
| Total | 17% | 32% | 39% | 27% | 60% |

The fact that each of the five ratios steadily declines as the accident year ages and develops is not surprising, as each ratio must ultimately reach zero when the last claim is closed.

However, when these ratios are calculated for each of the years in the reinsurance database used in this study, and the results for each of the years in the sample universe are aligned so that comparable values are set side by side, some interesting, and at times remarkable, patterns emerge. The concept is illustrated in Table 3 for the ratio of IBNR to premiums.

The construction of this table follows directly from calculations similar to those found in Table 2. For example, the values for calendar year 1995 in Table 2 are inserted in the appropriate cells in Table 3. More specifically, for accident year 1995 at the end of one year of development, the ratio is 43% (see Table 2 for the derivation), for accident year 1994 at the end of two years of development, the ratio is 27% (see Table 2 for derivation), and

TABLE 3
REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|-----------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 3% | 18% |
| 1981 | | | | | | | | | | 3% | 3% | 18% |
| 1982 | | | | | | | | 6% | 5% | 5% | 18% | |
| 1983 | | | | | | | 7% | 7% | 7% | 6% | 17% | |
| 1984 | | | | | | 10% | 9% | 8% | 8% | 7% | 16% | |
| 1985 | | | | | 11% | 10% | 8% | 7% | 6% | 6% | 17% | |
| 1986 | | | | 14% | 11% | 8% | 7% | 6% | 5% | 4% | 17% | |
| 1987 | | | 19% | 14% | 11% | 9% | 7% | 6% | 5% | 4% | 18% | |
| 1988 | | 29% | 21% | 16% | 11% | 9% | 8% | 6% | 5% | 4% | 17% | |
| 1989 | 42% | 27% | 21% | 15% | 11% | 9% | 7% | 6% | 5% | 4% | 15% | |
| 1990 | 43% | 30% | 22% | 17% | 15% | 12% | 10% | 8% | 6% | | | |
| 1991 | 43% | 28% | 19% | 16% | 13% | 12% | 9% | 7% | | | | |
| 1992 | 41% | 25% | 18% | 15% | 13% | 10% | 8% | | | | | |
| 1993 | 40% | 27% | 20% | 16% | 10% | 8% | | | | | | |
| 1994 | 41% | 27% | 20% | 13% | 9% | | | | | | | |
| 1995 | 43% | 28% | 20% | 14% | | | | | | | | |
| 1996 | 41% | 25% | 17% | | | | | | | | | |
| 1997 | 42% | 23% | | | | | | | | | | |
| 1998 | 40% | | | | | | | | | | | |
| Avg. | 42% | 27% | 20% | 15% | 12% | 10% | 8% | 7% | 6% | 5% | 17% | |

so on up a northeasterly direction along the diagonal until the last value for 1995 is shown: for accident year 1986 at the end of 10 years of development, where the ratio is 4% (see Table 2 for derivation). Finally, the composite ratio at 17% is also drawn from Table 2, where it is the sum of the reserves for all accident years divided by the sum of the earned premiums for all the accident years.

The consistency observed in Table 3 is rather remarkable. The composite ratios range from 15% to 18% with a tight distribution around 17%. And the same type of observation can be made about the distribution of ratios for each year of development.

What makes this result particularly interesting is the fact that these patterns “automatically” subsume a vast assortment of differing operational elements implicitly imbedded in the raw data, including, but not limited to:

- A. differences in reserving practices from company to company
- B. changes in coverage limits written from year to year and differences in coverage limits written among companies
- C. changes in coverage definitions
- D. differences due to the varying utilization of special coverage features, such as the index clause and aggregate deductibles
- E. changes due to the introduction of new coverages
- F. variations in mix of business over time
- G. differences in policies with respect to setting additional case reserves
- H. differences in marketing methods
 - I. differences in underwriting policies
 - J. differences in claim adjustment practices
- K. differences in pricing methodologies and philosophies
- L. different business cycles

This list merely illustrates the kinds of things that are, in effect, “netted” completely in Table 3. Of course, the list of such factors is nearly endless and only serves to underscore the remarkable consistency of these patterns. The tables for the other four reserve ratios show similar patterns, and all five tables are included in Appendix A.

5. RESERVE RATIOS BY COMPANY

When similar tables are constructed for individual reinsurers, the patterns of consistency persist, albeit often at slightly different levels. This idea is illustrated in Tables 4 and 5 for the IBNR to premium ratio. Table 4 represents the corresponding ratios for a large reinsurer, while Table 5 represents the corresponding ratios for a mid-sized reinsurer.

Table 4 reveals that the long-term historical composite average for this company is very much in line with the industry levels (16% for the company vs. 17% for the industry). Also, Table 4 demonstrates the expected result that, although consistent with industry levels over a long period of time, the distributions by accident year are not as compact as the distributions for the industry in total. The tables that show the corresponding results for the five reserve ratios for this company are produced in Appendix B. The same observations made in this text extend almost verbatim to the other reserve ratios.

In the case of the mid-sized reinsurer, the patterns are again quite regular, however, overall, this company's composite historical reserve ratio is at 21% vs. 17% for the industry. One must hasten to add that one cannot simply conclude that, by noting just this 21% vs. 17% comparison, this is indicative of a greater degree of adequacy than the industry. Such a conclusion requires significant additional independent confirmation.

One may conclude, however, that the distribution that produces the 21% average is so compact as to be suggestive of a consistent internal reserving policy.⁶ The tables that show the corresponding results for all five reserve ratios for this company are produced in Appendix C. The same observations made in this text extend almost word for word to the other reserve ratios.

⁶The 15% composite ratio for 1998 appears to be an outlier when compared with the historical pattern. All other things being equal, this observation suggests the need for further exploration and rationalization of the derivation of the 1998 reserve level.

TABLE 4
A LARGE REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-----|-----|-----|-----|----|----|----|----|----|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 2% | 18% |
| 1981 | | | | | | | | | | 2% | 2% | 18% |
| 1982 | | | | | | | | 3% | 2% | 2% | | 14% |
| 1983 | | | | | | | 2% | 2% | 2% | 2% | | 12% |
| 1984 | | | | | | 3% | 3% | 2% | 2% | 5% | | 14% |
| 1985 | | | | | 2% | 5% | 2% | 2% | 4% | 4% | | 15% |
| 1986 | | | | 16% | 14% | 9% | 5% | 3% | 3% | 1% | | 16% |
| 1987 | | | 15% | 13% | 8% | 5% | 4% | 3% | 1% | 1% | | 17% |
| 1988 | | 35% | 22% | 14% | 7% | 6% | 5% | 3% | 2% | 3% | | 17% |
| 1989 | 50% | 29% | 15% | 8% | 7% | 5% | 3% | 2% | 6% | 6% | | 15% |
| 1990 | 49% | 22% | 15% | 11% | 8% | 6% | 2% | 5% | 4% | | | |
| 1991 | 42% | 20% | 14% | 10% | 6% | 5% | 6% | 4% | | | | |
| 1992 | 41% | 20% | 14% | 13% | 11% | 8% | 4% | | | | | |
| 1993 | 45% | 28% | 21% | 15% | 11% | 7% | | | | | | |
| 1994 | 48% | 31% | 22% | 14% | 8% | | | | | | | |
| 1995 | 48% | 30% | 21% | 14% | | | | | | | | |
| 1996 | 45% | 26% | 15% | | | | | | | | | |
| 1997 | 47% | 25% | | | | | | | | | | |
| 1998 | 44% | | | | | | | | | | | |
| Avg. | 46% | 27% | 17% | 13% | 8% | 6% | 4% | 3% | 3% | 3% | | 16% |

The research underlying this paper included a review of the reserve ratio patterns for every company in the database for which experience for the entire test period was available, and, with rare exceptions, every company did develop a series of reserve ratio patterns that exhibited regularity. Although the degree of regularity varies by company, for the great majority of cases the regularity that is exhibited is sufficient to render the grid of historical reserve ratios a useful tool for assessing the reasonableness of loss reserves.

TABLE 5
A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|----|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 1% | 22% |
| 1981 | | | | | | | | | | 1% | 0% | 22% |
| 1982 | | | | | | | | 3% | 3% | 2% | 23% | |
| 1983 | | | | | | | 7% | 6% | 6% | 7% | 22% | |
| 1984 | | | | | | 6% | 5% | 5% | 7% | 6% | 21% | |
| 1985 | | | | | 7% | 6% | 8% | 5% | 5% | 3% | 20% | |
| 1986 | | | | 20% | 16% | 15% | 15% | 12% | 10% | 8% | 19% | |
| 1987 | | | 30% | 23% | 24% | 22% | 19% | 17% | 14% | 3% | 21% | |
| 1988 | | 39% | 32% | 27% | 23% | 22% | 21% | 20% | 4% | 4% | 20% | |
| 1989 | 51% | 36% | 28% | 24% | 22% | 18% | 18% | 6% | 6% | 4% | 15% | |
| 1990 | 47% | 31% | 23% | 20% | 17% | 16% | 9% | 8% | 5% | | | |
| 1991 | 45% | 31% | 23% | 18% | 17% | 12% | 9% | 6% | | | | |
| 1992 | 43% | 28% | 17% | 13% | 17% | 13% | 8% | | | | | |
| 1993 | 40% | 20% | 14% | 20% | 15% | 9% | | | | | | |
| 1994 | 49% | 34% | 26% | 16% | 10% | | | | | | | |
| 1995 | 38% | 40% | 27% | 16% | | | | | | | | |
| 1996 | 59% | 46% | 31% | | | | | | | | | |
| 1997 | 48% | 29% | | | | | | | | | | |
| 1998 | 50% | | | | | | | | | | | |
| Avg. | 47% | 33% | 25% | 20% | 17% | 14% | 12% | 9% | 6% | 4% | 21% | |

6. RESERVE RATIOS BY LINE OF BUSINESS

When similar tables are produced by line of business, the regularity of reserve ratio patterns persists, but, as can be expected, the patterns do not exhibit the same degree of compactness of distribution. The line of business phenomenon is illustrated for Other Liability in Tables 6 and 7 for the IBNR to premium ratio for the reinsurance industry in total and for the same large company used above, respectively. In Table 6, as one might expect, due to the nature of the coverage, the progression of the reserve ratios towards zero is slower than for all lines combined. The

patterns are regular in this case as well, although the distributions are not nearly as compact as for all lines of business combined.⁷ Part of this may be due to the discretion that is often exercised in classifying business by Annual Statement line of business category when more than one line of business may apply. There are no hard and fast rules on the application of business to Annual Statement line of business classification whenever the classification is not unique. Nevertheless, the consistency of reserve ratio patterns is, once again, noteworthy.

The set of five tables that extend this analysis to the five reserve ratios is shown in Appendix D.

For the large reinsurance company, the same observations may be made: the reserve ratio patterns are regular, although the distributions are not as compact as the industry distributions. However, the composite ratios once again show a remarkable compactness. The composite all year reserve ratio for this company is 16%, while the industry counterpart is 26%. This is the opposite of the phenomenon that was observed earlier for the mid-sized reinsurer on an all lines basis (where the company ratios were higher than the industry ratios). In this case, the company ratios are lower than the industry counterpart. Once again, this observation, when considered alone, cannot be used to conclude that the company is underreserved for the Other Liability line of business. For additional perspective, we also note that this same company showed, on an overall all lines combined basis, reserve ratios that are quite comparable to the industry counterparts.

The set of five tables that extend this analysis to the five reserve ratios is shown in Appendix E.

⁷Of course, many possibilities can give rise to distributions that are not as compact—and identifying and articulating those is beyond the scope of this paper. However, we should note that exposure and reserving for latent liabilities could be a significant factor in creating distributions that are not as compact as noted for other aggregates of data. Another factor could be the effect of judicial decisions that affect open claims in such lines as Workers Compensation.

TABLE 6
REINSURANCE INDUSTRY
OTHER LIABILITY⁸
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 10% | 33% |
| 1981 | | | | | | | | | | 11% | 12% | 31% |
| 1982 | | | | | | | | 15% | 15% | 16% | 29% | |
| 1983 | | | | | | | 16% | 19% | 20% | 22% | 27% | |
| 1984 | | | | | | 20% | 23% | 25% | 27% | 25% | 25% | |
| 1985 | | | | | 18% | 17% | 16% | 17% | 15% | 13% | 23% | |
| 1986 | | | | 31% | 23% | 18% | 15% | 13% | 10% | 9% | 23% | |
| 1987 | | | 42% | 34% | 26% | 20% | 18% | 16% | 13% | 10% | 24% | |
| 1988 | | 46% | 37% | 25% | 20% | 18% | 16% | 14% | 12% | 10% | 25% | |
| 1989 | 56% | 45% | 33% | 25% | 22% | 17% | 13% | 11% | 10% | 8% | 23% | |
| 1990 | 57% | 45% | 33% | 26% | 22% | 16% | 14% | 11% | 8% | | | |
| 1991 | 62% | 43% | 33% | 25% | 17% | 14% | 10% | 8% | | | | |
| 1992 | 58% | 41% | 30% | 19% | 12% | 12% | 9% | | | | | |
| 1993 | 58% | 44% | 32% | 23% | 17% | 14% | | | | | | |
| 1994 | 55% | 42% | 34% | 22% | 19% | | | | | | | |
| 1995 | 59% | 46% | 32% | 24% | | | | | | | | |
| 1996 | 59% | 40% | 25% | | | | | | | | | |
| 1997 | 65% | 41% | | | | | | | | | | |
| 1998 | 55% | | | | | | | | | | | |
| Avg. | 58% | 43% | 33% | 25% | 20% | 17% | 15% | 15% | 14% | 14% | 26% | |

⁸For this line of business, data for 1989–1992 include all Other Liability business whereas data for 1993–1998 include only the Other Liability-Occurrence Coverage. This is due to the change in Schedule P reporting requirements that occurred first for the 1993 Annual Statement.

Finally, three demonstrations drawn from *Best's Aggregates & Averages* will round out the illustration of patterns that can emerge from the compilation of historical reserve ratios.

First, in Table 8, we show the ratio of IBNR to premiums for all lines of business combined for all companies combined. It is clear that the pattern in Table 8 reflects a gradual reduction in the IBNR to premium ratio. The consistency is present at all valuation dates.

TABLE 7
A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 2% | 18% |
| 1981 | | | | | | | | | | 2% | 2% | 18% |
| 1982 | | | | | | | | 3% | 2% | 2% | 14% | |
| 1983 | | | | | | | 2% | 2% | 2% | 2% | 12% | |
| 1984 | | | | | | 3% | 3% | 2% | 2% | 5% | 14% | |
| 1985 | | | | | 2% | 5% | 2% | 2% | 4% | 4% | 15% | |
| 1986 | | | | 16% | 14% | 9% | 5% | 3% | 3% | 1% | 16% | |
| 1987 | | | 15% | 13% | 8% | 5% | 4% | 3% | 1% | 1% | 17% | |
| 1988 | | 35% | 22% | 14% | 7% | 6% | 5% | 3% | 2% | 3% | 17% | |
| 1989 | 50% | 29% | 15% | 8% | 7% | 5% | 3% | 2% | 6% | 3% | 21% | |
| 1990 | 49% | 22% | 15% | 11% | 8% | 6% | 2% | 5% | 1% | | | |
| 1991 | 42% | 20% | 14% | 10% | 6% | 5% | 6% | 2% | | | | |
| 1992 | 41% | 20% | 14% | 13% | 11% | 8% | 4% | | | | | |
| 1993 | 45% | 28% | 21% | 15% | 11% | 7% | | | | | | |
| 1994 | 48% | 31% | 22% | 14% | 15% | | | | | | | |
| 1995 | 48% | 30% | 21% | 35% | | | | | | | | |
| 1996 | 45% | 26% | 26% | | | | | | | | | |
| 1997 | 47% | 35% | | | | | | | | | | |
| 1998 | 50% | | | | | | | | | | | |
| Avg. | 47% | 28% | 19% | 15% | 9% | 6% | 4% | 3% | 3% | 3% | 16% | |

Tables 9 and 10 extend the construction of Table 8 to two lines of business: Workers Compensation in Table 9 and Commercial Automobile Liability in Table 10. In both tables, it is again readily noticeable that the ratios of IBNR to premiums yield another indication of consistent patterns.

7. USING RESERVE RATIOS TO TEST REASONABLENESS

Given that these reserve ratio benchmarks exist, how does one go about using them?

TABLE 8⁹
PROPERTY & CASUALTY INSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | |
|--------------|---------------------|-------|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1991 | 26.2% | 14.0% | 8.9% | 6.0% | 4.3% | 3.2% | 2.4% | 1.9% | 1.5% | 1.1% |
| 1992 | 26.6% | 14.2% | 8.9% | 5.8% | 4.0% | 2.9% | 2.2% | 1.6% | 1.1% | |
| 1993 | 25.1% | 13.9% | 9.1% | 5.7% | 3.7% | 2.8% | 1.9% | 1.3% | | |
| 1994 | 24.6% | 13.3% | 8.1% | 4.9% | 3.6% | 2.5% | 1.8% | | | |
| 1995 | 23.3% | 12.4% | 7.6% | 4.7% | 3.3% | 2.2% | | | | |
| 1996 | 22.2% | 11.4% | 6.7% | 3.8% | 2.4% | | | | | |
| 1997 | 20.9% | 10.4% | 5.9% | 3.2% | | | | | | |
| 1998 | 19.6% | 9.2% | 5.2% | | | | | | | |
| 1999 | 19.5% | 8.9% | | | | | | | | |
| 2000 | 19.7% | | | | | | | | | |

⁹This table, as well as Tables 9 and 10, is truncated because it was not possible to construct the full parallelogram of ratios on a fully consistent basis.

As previously illustrated, reserve ratio benchmarks may be calculated by (a) accident year at various points of development and by calendar year, (b) by line of business and on all lines basis, and (c) by individual company or on an industry-wide basis. Thus, in testing the reasonableness of loss reserve estimates, one may be in a position to test any combination of these year/line/company parameters.

For purposes of this discussion, the focus will be on testing an individual company's proposed loss reserve estimates for a single line of business for all years combined as of a point in time. More specifically, let us assume that an actuary has calculated the loss reserve estimates by line of business by accident year and is interested in using the reserve ratios as a way to test the reasonableness of the proposed reserve estimates as of December 31, 1999.

The first step is to compile the historical reserve ratio grids for the company by accident year, by line of business, and for all

TABLE 9
PROPERTY & CASUALTY INSURANCE INDUSTRY
WORKERS COMPENSATION
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | |
|--------------|---------------------|-------|-------|-------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1991 | 36.1% | 20.1% | 13.0% | 9.2% | 7.1% | 5.9% | 5.0% | 4.1% | 3.3% | 2.4% |
| 1992 | 39.0% | 23.0% | 15.3% | 9.8% | 7.4% | 6.1% | 4.9% | 4.0% | 3.1% | |
| 1993 | 38.3% | 24.1% | 17.4% | 10.6% | 8.4% | 5.8% | 4.2% | 3.2% | | |
| 1994 | 37.2% | 23.3% | 16.0% | 10.1% | 6.9% | 5.2% | 3.8% | | | |
| 1995 | 35.1% | 21.2% | 14.7% | 8.9% | 6.6% | 5.0% | | | | |
| 1996 | 32.4% | 18.8% | 12.8% | 8.0% | 5.6% | | | | | |
| 1997 | 30.9% | 16.7% | 10.7% | 7.3% | | | | | | |
| 1998 | 30.3% | 14.5% | 9.6% | | | | | | | |
| 1999 | 29.4% | 14.0% | | | | | | | | |
| 2000 | 30.3% | | | | | | | | | |

TABLE 10
PROPERTY & CASUALTY INSURANCE INDUSTRY
COMMERCIAL AUTOMOBILE LIABILITY
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | |
|--------------|---------------------|-------|-------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1991 | 37.7% | 19.3% | 10.5% | 6.1% | 3.5% | 2.3% | 1.3% | 1.0% | 0.5% | 0.2% |
| 1992 | 35.7% | 18.3% | 10.4% | 6.1% | 3.5% | 2.0% | 1.2% | 0.7% | 0.2% | |
| 1993 | 33.6% | 16.4% | 9.5% | 5.2% | 2.8% | 1.6% | 0.9% | 0.5% | | |
| 1994 | 31.6% | 16.2% | 8.5% | 4.3% | 2.6% | 1.5% | 0.8% | | | |
| 1995 | 31.4% | 15.3% | 7.5% | 3.6% | 2.2% | 1.3% | | | | |
| 1996 | 30.3% | 14.2% | 7.4% | 3.3% | 1.8% | | | | | |
| 1997 | 29.8% | 14.5% | 6.4% | 3.2% | | | | | | |
| 1998 | 29.8% | 13.3% | 6.5% | | | | | | | |
| 1999 | 28.0% | 13.0% | | | | | | | | |
| 2000 | 28.8% | | | | | | | | | |

lines of business combined for the accident year reserve pieces that make up the calendar year reserve estimate as of December 31, 1999. These calculations are identical to the calculations used

to construct the ratios shown in the Appendices. In addition, the actuary may construct similar reserve ratio grids for the total industry, reinsurance industry, or for some portions of the industry that the actuary deems to be similarly situated to the particular company whose reserves are under review. From this point, the testing branches out in two directions:

A. **Internal Tests.** These are the tests that compare the company reserve ratio vectors for the specific line of business as of December 31, 1999 to the corresponding historical company reserve ratio vectors for the same line of business as of December 31, 1998 and before, as far back as one can identify.

B. **External Tests.** These are the tests that compare the company reserve ratio vectors for the line of business as of December 31, 1999 to the corresponding industry (or portion of the industry) historical reserve ratio vectors for the same line of business as of December 31, 1998 and before, as far back as one can identify.

For each of the two paths, the possible categories of outcomes are identical and the analyses are parallel. The categories of outcomes are listed below, and the general disposition of each is noted:

A. The 1999 reserve ratios (of various types) are close to the historical benchmarks. In this case, one may draw the preliminary conclusion that the level of adequacy has not changed from prior years. Note that even this result does not suggest that this is the end of the test. The actuary needs to review the key operational changes that occurred in 1999 (and possibly 1998) for the subject line of business that might cause the 1999 reserve vectors to differ from historical patterns. If there are no such changes, the test can be concluded at this point. If there are such changes and the reserve vectors do not reflect any corresponding differences, then the actuary is obliged to examine the reserve methodologies and assumptions to make sure that nothing

material was overlooked. The results of the test can thus be confirmed, or the reserve estimates would have to be adjusted to recognize the changes.

B. The 1999 reserve ratios (of various types) for the line of business are at significant variance from the historical benchmarks. The first level of response is to try to pinpoint the source of such variance by examining the reserve ratio vectors for the line of business at the individual accident year level, at various points of development, in order to locate the source (or sources) of the variance. At this point, an examination of the reserve calculations leading to the unusual reserve ratio vectors is called for. The result would be either to rationalize and confirm the original proposed reserve estimate or to make such changes as called for after examination of the facts as well as operational changes that might cause such changes to occur.

C. The 1999 reserve ratios (of various types) are mixed; some are consistent with historical benchmarks, and some are not. In this case, once the source (or sources) of differences has (have) been pinpointed, the analyses described in the two paragraphs immediately preceding apply separately to the parts that are consistent with historical results and to the parts that are not consistent with historical results.

In all these cases, it should be noted that, in comparing the 1999 reserve ratio vectors to the historical reserve ratio vectors, the actuary probably should give some slight preference to the reserve ratio vectors generated by the more recent years, such as those observed in 1998, 1997, and 1996.

8. CONCLUDING REMARKS

A number of observations can be made to round out the presentation and to give additional perspective on the proposed benchmarks and associated methodologies:

A. It should be pointed out that, although it is clearly suggested that reserve ratios can be a useful tool in testing the reasonableness of loss reserves, there is absolutely no suggestion whatsoever that reserve ratios can be used as the basis for setting loss reserves.

B. Although the reserve ratios discussed in this paper may be easily constructed for a single company, it is difficult and may be expensive to obtain the raw data to construct these ratios for the entire industry or some subgroup of the industry.

C. The discussion in the body of this paper relies largely on the reserve to premium ratios, with little reference to the other ratios. It should be emphasized that this choice is possible only because the other ratios do not offer significantly different possibilities. In addition, a cursory review of the Appendices readily shows that the concepts discussed and illustrated for the reserve to premium ratios have equal relevance to the other ratios with relatively modest (and obvious) modifications and/or extensions.

D. It is axiomatic that the historical reserve ratio patterns will change over time—whether one is considering an individual company’s pattern or its industry counterparts. However, it should be recognized that such changes should emerge slowly. Sharp and sudden changes should serve as flags for further analysis and examination. Thus, when comparing proposed reserve ratios to historical reserve ratios, absent an event of significant import, one can reasonably rely on historical patterns for guidance in the assessment of the reasonableness of loss reserve estimates.

E. The patterns that are recognized in this paper are empirically based. In other words, without a theoretical proof, the patterns that have emerged through the analyses performed herein are simply recognized to exist and persist. These empirical patterns can serve a useful purpose in shedding some light on the issue of the reasonableness of loss reserve estimates.

F. It should be acknowledged that no ratio should be used alone. In other words, all the available reserve ratios should be tested and a conclusion reached based on analysis of all of them. To put it in the converse, using a single reserve ratio with no other confirmation easily can lead to erroneous conclusions with respect to the reasonableness of reserve estimates.

G. The key idea underlying the use of reserve ratios for testing the reasonableness of loss reserves is to spot significant variances and either to explain the variances or to change the methodology and assumptions that ultimately led to the observed variance.

H. In producing the results presented in this paper, no reserve ratios were available to construct reserve benchmarks that went beyond ten years of development. Even though this condition is due to the limitations inherent to Schedule P reporting requirements, it is possible to test the reasonableness of accident years beyond ten years of development simply by constructing a monotonically decreasing sequence of reserve ratios that approaches zero. Judgment is required in making this construction in terms of the number of years of development to ultimate and in terms of the rate of decrease that can be imputed to the particular reserve ratio vector that is under review. Or, it may be possible to construct reserve ratios that go beyond ten years of Schedule P development using the company's internal databases. Thus one can conduct some simple tests of reasonableness of the reserve estimates of the older years.

I. One of the problems that actuaries face is the occasional need to render an opinion on the reasonableness of loss reserves that were set some time ago. It is clearly unreasonable to re-estimate the reserves a number of years after they were originally set. Although it is technically possible to calculate such reserves, such an exercise cannot be used to pass meaningful judgment on the reasonableness of the reserves at the time they were originally set. However, using the reserve ratios that existed *at the time* the original reserves were set can be a useful tool in testing the

reasonableness of past loss reserves at that time. In conjunction with reviewing the reasonableness of assumptions and appropriateness of methodology used in deriving the reserve estimate, reserve ratios can provide a useful addition to the process of assessing the condition of loss reserve estimates set some years back.

J. It should be noted that these reserve ratios may be of value as yet another view of the condition of loss reserves in connection with merger and acquisition work.

K. Finally, it should be noted that even when very stable patterns (either flat or increasing or decreasing ratios) are observed, it should be clear to the reader that to assume such patterns will persist in the future goes far beyond what is suggested in this paper. In fact, it is strongly suggested that anyone who desires to use reserve ratios as a means of testing reasonableness should take great care to update the data at least annually, lest stale patterns cause erroneous conclusions to creep into the analysis.

It is the author's hope that reserve ratio benchmarks such as described in this paper can provide a few additional guideposts along the difficult path of setting loss reserves that are reasonable and that are neither redundant nor inadequate.

APPENDIX A

EXHIBIT A-1
 REINSURANCE INDUSTRY
 ALL LINES COMBINED
 RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-----------|---------------------|-----|-----|-----|-----|-----|-----|----|----|----|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 3% | 18% |
| 1981 | | | | | | | | | 3% | 3% | 18% | |
| 1982 | | | | | | | | 6% | 5% | 5% | 18% | |
| 1983 | | | | | | | 7% | 7% | 7% | 6% | 17% | |
| 1984 | | | | | | 10% | 9% | 8% | 8% | 7% | 16% | |
| 1985 | | | | | 11% | 10% | 8% | 7% | 6% | 6% | 17% | |
| 1986 | | | | 14% | 11% | 8% | 7% | 6% | 5% | 4% | 17% | |
| 1987 | | | 19% | 14% | 11% | 9% | 7% | 6% | 5% | 4% | 18% | |
| 1988 | | 29% | 21% | 16% | 11% | 9% | 8% | 6% | 5% | 4% | 17% | |
| 1989 | 42% | 27% | 21% | 15% | 11% | 9% | 7% | 6% | 5% | 4% | 15% | |
| 1990 | 43% | 30% | 22% | 17% | 15% | 12% | 10% | 8% | 6% | | | |
| 1991 | 43% | 28% | 19% | 16% | 13% | 12% | 9% | 7% | | | | |
| 1992 | 41% | 25% | 18% | 15% | 13% | 10% | 8% | | | | | |
| 1993 | 40% | 27% | 20% | 16% | 10% | 8% | | | | | | |
| 1994 | 41% | 27% | 20% | 13% | 9% | | | | | | | |
| 1995 | 43% | 28% | 20% | 14% | | | | | | | | |
| 1996 | 41% | 25% | 17% | | | | | | | | | |
| 1997 | 42% | 23% | | | | | | | | | | |
| 1998 | 40% | | | | | | | | | | | |
| Avg. | 42% | 27% | 20% | 15% | 12% | 10% | 8% | 7% | 6% | 5% | 17% | |

EXHIBIT A-2
REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO REPORTED LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 4% | 27% |
| 1981 | | | | | | | | | | 4% | 4% | 28% |
| 1982 | | | | | | | | 6% | 5% | 5% | 28% | |
| 1983 | | | | | | | 7% | 7% | 6% | 5% | 28% | |
| 1984 | | | | | | 9% | 8% | 7% | 7% | 6% | 27% | |
| 1985 | | | | | 13% | 11% | 9% | 8% | 6% | 6% | 30% | |
| 1986 | | | | 28% | 21% | 16% | 13% | 10% | 9% | 8% | 32% | |
| 1987 | | | 43% | 31% | 23% | 17% | 13% | 12% | 10% | 8% | 32% | |
| 1988 | | 65% | 43% | 31% | 21% | 16% | 14% | 11% | 9% | 7% | 30% | |
| 1989 | 117% | 53% | 35% | 24% | 17% | 15% | 11% | 9% | 8% | 6% | 26% | |
| 1990 | 130% | 61% | 41% | 29% | 25% | 19% | 16% | 12% | 9% | | | |
| 1991 | 127% | 55% | 34% | 27% | 22% | 18% | 14% | 10% | | | | |
| 1992 | 91% | 38% | 26% | 20% | 16% | 13% | 9% | | | | | |
| 1993 | 125% | 58% | 38% | 28% | 16% | 12% | | | | | | |
| 1994 | 126% | 54% | 37% | 21% | 14% | | | | | | | |
| 1995 | 148% | 63% | 40% | 26% | | | | | | | | |
| 1996 | 141% | 52% | 30% | | | | | | | | | |
| 1997 | 148% | 48% | | | | | | | | | | |
| 1998 | 116% | | | | | | | | | | | |
| Avg. | 127% | 55% | 37% | 27% | 19% | 15% | 11% | 9% | 7% | 6% | 29% | |

EXHIBIT A-3
REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF IBNR TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 4% | 34% |
| 1981 | | | | | | | | | | 5% | 4% | 35% |
| 1982 | | | | | | | | | 7% | 6% | 5% | 35% |
| 1983 | | | | | | | | 8% | 7% | 7% | 6% | 35% |
| 1984 | | | | | | | 11% | 10% | 8% | 8% | 6% | 33% |
| 1985 | | | | | 16% | 13% | 10% | 9% | 7% | 7% | 37% | |
| 1986 | | | | 37% | 26% | 18% | 15% | 11% | 10% | 8% | 39% | |
| 1987 | | | 57% | 38% | 27% | 19% | 14% | 13% | 11% | 9% | 39% | |
| 1988 | | 101% | 59% | 38% | 25% | 18% | 16% | 13% | 10% | 8% | 36% | |
| 1989 | 264% | 79% | 46% | 29% | 20% | 16% | 12% | 10% | 8% | 7% | 32% | |
| 1990 | 271% | 91% | 55% | 35% | 29% | 22% | 18% | 14% | 10% | | | |
| 1991 | 264% | 83% | 45% | 33% | 25% | 20% | 15% | 11% | | | | |
| 1992 | 174% | 53% | 32% | 23% | 18% | 14% | 10% | | | | | |
| 1993 | 252% | 85% | 49% | 34% | 18% | 14% | | | | | | |
| 1994 | 246% | 80% | 48% | 25% | 16% | | | | | | | |
| 1995 | 299% | 94% | 54% | 32% | | | | | | | | |
| 1996 | 273% | 78% | 39% | | | | | | | | | |
| 1997 | 290% | 72% | | | | | | | | | | |
| 1998 | 225% | | | | | | | | | | | |
| Avg. | 256% | 82% | 48% | 32% | 22% | 17% | 13% | 10% | 8% | 6% | 36% | |

EXHIBIT A-4
REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 7% | 31% |
| 1981 | | | | | | | | | | 9% | 8% | 30% |
| 1982 | | | | | | | | | 17% | 15% | 14% | 30% |
| 1983 | | | | | | | | 20% | 18% | 17% | 15% | 29% |
| 1984 | | | | | | 29% | 25% | 23% | 21% | 16% | 27% | |
| 1985 | | | | | 27% | 24% | 21% | 18% | 15% | 15% | 27% | |
| 1986 | | | | 26% | 21% | 16% | 14% | 10% | 9% | 9% | 27% | |
| 1987 | | | 30% | 23% | 18% | 15% | 11% | 10% | 9% | 8% | 28% | |
| 1988 | | 45% | 34% | 26% | 20% | 15% | 14% | 12% | 10% | 9% | 27% | |
| 1989 | 62% | 44% | 34% | 26% | 19% | 17% | 13% | 12% | 10% | 8% | 26% | |
| 1990 | 60% | 46% | 36% | 27% | 25% | 21% | 18% | 15% | 13% | | | |
| 1991 | 61% | 44% | 32% | 27% | 21% | 19% | 16% | 13% | | | | |
| 1992 | 62% | 43% | 32% | 26% | 21% | 17% | 13% | | | | | |
| 1993 | 57% | 42% | 33% | 26% | 18% | 16% | | | | | | |
| 1994 | 57% | 43% | 33% | 22% | 17% | | | | | | | |
| 1995 | 57% | 42% | 33% | 25% | | | | | | | | |
| 1996 | 56% | 41% | 31% | | | | | | | | | |
| 1997 | 56% | 39% | | | | | | | | | | |
| 1998 | 57% | | | | | | | | | | | |
| Avg. | 59% | 43% | 33% | 25% | 21% | 19% | 17% | 15% | 13% | 11% | 28% | |

EXHIBIT A-5
REINSURANCE INDUSTRY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 10% | 60% |
| 1981 | | | | | | | | | | 12% | 11% | 60% |
| 1982 | | | | | | | | | 20% | 17% | 16% | 59% |
| 1983 | | | | | | | 21% | 18% | 16% | 14% | 59% | |
| 1984 | | | | | | 32% | 26% | 22% | 19% | 14% | 54% | |
| 1985 | | | | | 40% | 32% | 27% | 23% | 18% | 17% | 58% | |
| 1986 | | | | 68% | 49% | 35% | 29% | 20% | 19% | 17% | 60% | |
| 1987 | | | 90% | 61% | 44% | 34% | 25% | 22% | 19% | 17% | 61% | |
| 1988 | | 154% | 96% | 63% | 44% | 32% | 29% | 24% | 21% | 17% | 57% | |
| 1989 | 390% | 127% | 76% | 50% | 34% | 29% | 22% | 19% | 16% | 13% | 53% | |
| 1990 | 380% | 138% | 89% | 58% | 48% | 38% | 32% | 25% | 21% | | | |
| 1991 | 372% | 133% | 75% | 55% | 39% | 33% | 26% | 21% | | | | |
| 1992 | 266% | 92% | 55% | 39% | 30% | 23% | 17% | | | | | |
| 1993 | 353% | 131% | 80% | 56% | 34% | 27% | | | | | | |
| 1994 | 342% | 129% | 77% | 43% | 30% | | | | | | | |
| 1995 | 402% | 143% | 86% | 57% | | | | | | | | |
| 1996 | 367% | 128% | 72% | | | | | | | | | |
| 1997 | 386% | 122% | | | | | | | | | | |
| 1998 | 319% | | | | | | | | | | | |
| Avg. | 358% | 130% | 80% | 55% | 39% | 32% | 25% | 21% | 18% | 15% | 58% | |

APPENDIX B

EXHIBIT B-1

A LARGE REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 2% | 18% |
| 1981 | | | | | | | | | | 2% | 2% | 18% |
| 1982 | | | | | | | | | 3% | 2% | 2% | 14% |
| 1983 | | | | | | | | 2% | 2% | 2% | 2% | 12% |
| 1984 | | | | | | 3% | 3% | 2% | 2% | 5% | 14% | |
| 1985 | | | | | 2% | 5% | 2% | 2% | 4% | 4% | 15% | |
| 1986 | | | | 16% | 14% | 9% | 5% | 3% | 3% | 1% | 16% | |
| 1987 | | | 15% | 13% | 8% | 5% | 4% | 3% | 1% | 1% | 17% | |
| 1988 | | 35% | 22% | 14% | 7% | 6% | 5% | 3% | 2% | 3% | 17% | |
| 1989 | 50% | 29% | 15% | 8% | 7% | 5% | 3% | 2% | 6% | 6% | 15% | |
| 1990 | 49% | 22% | 15% | 11% | 8% | 6% | 2% | 5% | 4% | | | |
| 1991 | 42% | 20% | 14% | 10% | 6% | 5% | 6% | 4% | | | | |
| 1992 | 41% | 20% | 14% | 13% | 11% | 8% | 4% | | | | | |
| 1993 | 45% | 28% | 21% | 15% | 11% | 7% | | | | | | |
| 1994 | 48% | 31% | 22% | 14% | 8% | | | | | | | |
| 1995 | 48% | 30% | 21% | 14% | | | | | | | | |
| 1996 | 45% | 26% | 15% | | | | | | | | | |
| 1997 | 47% | 25% | | | | | | | | | | |
| 1998 | 44% | | | | | | | | | | | |
| Avg. | 46% | 27% | 17% | 13% | 8% | 6% | 4% | 3% | 3% | 3% | 16% | |

EXHIBIT B-2
A LARGE REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO REPORTED LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | | | | | | | | | | |
|-------------|---------------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|-----------|-----------------|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | | | | | |
| 1980 | | | | | | | | | | | 2% | 33% | | | | | | | | | |
| 1981 | | | | | | | | | | | 3% | 2% | 33% | | | | | | | | |
| 1982 | | | | | | | | | | | 3% | 2% | 2% | 25% | | | | | | | |
| 1983 | | | | | | | | | | | 2% | 2% | 2% | 22% | | | | | | | |
| 1984 | | | | | | | | | | | 2% | 2% | 1% | 2% | 4% | 27% | | | | | |
| 1985 | | | | | | | | | | | 3% | 6% | 2% | 2% | 5% | 5% | 32% | | | | |
| 1986 | | | | | | | | | | | 48% | 40% | 26% | 13% | 8% | 7% | 2% | 34% | | | |
| 1987 | | | | | | | | | | | 44% | 34% | 21% | 14% | 8% | 6% | 2% | 2% | 36% | | |
| 1988 | | | | | | | | | | | 109% | 55% | 30% | 14% | 13% | 10% | 6% | 4% | 5% | 32% | |
| 1989 | | | | | | | | | | | 244% | 75% | 31% | 14% | 12% | 9% | 5% | 4% | 10% | 9% | 27% |
| 1990 | | | | | | | | | | | 250% | 48% | 30% | 19% | 14% | 10% | 3% | 8% | 7% | | |
| 1991 | | | | | | | | | | | 153% | 43% | 27% | 18% | 10% | 8% | 10% | 7% | | | |
| 1992 | | | | | | | | | | | 160% | 42% | 23% | 19% | 15% | 11% | 5% | | | | |
| 1993 | | | | | | | | | | | 238% | 69% | 42% | 28% | 17% | 11% | | | | | |
| 1994 | | | | | | | | | | | 191% | 64% | 40% | 21% | 12% | | | | | | |
| 1995 | | | | | | | | | | | 296% | 78% | 43% | 26% | | | | | | | |
| 1996 | | | | | | | | | | | 260% | 57% | 28% | | | | | | | | |
| 1997 | | | | | | | | | | | 259% | 54% | | | | | | | | | |
| 1998 | | | | | | | | | | | 180% | | | | | | | | | | |
| Avg. | 223% | 64% | 36% | 26% | 16% | 11% | 6% | 5% | 4% | 4% | | 30% | | | | | | | | | |

EXHIBIT B-3
A LARGE REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-----------|---------------------|------|-----|-----|-----|-----|----|-----|----|-----|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 3% | 41% |
| 1981 | | | | | | | | | | 3% | 3% | 41% |
| 1982 | | | | | | | | | 4% | 3% | 2% | 31% |
| 1983 | | | | | | | | 2% | 2% | 2% | 2% | 27% |
| 1984 | | | | | | 3% | | 3% | 2% | 2% | 4% | 33% |
| 1985 | | | | | 4% | 7% | | 3% | 3% | 5% | 5% | 39% |
| 1986 | | | | 64% | 49% | 30% | | 15% | 9% | 8% | 2% | 42% |
| 1987 | | | 60% | 43% | 26% | 16% | | 9% | 7% | 2% | 2% | 44% |
| 1988 | | 156% | 76% | 38% | 16% | 15% | | 12% | 6% | 5% | 6% | 38% |
| 1989 | 539% | 114% | 41% | 17% | 14% | 10% | | 5% | 4% | 10% | 9% | 32% |
| 1990 | 520% | 73% | 39% | 24% | 17% | 11% | | 4% | 8% | 7% | | |
| 1991 | 327% | 66% | 36% | 22% | 12% | 9% | | 10% | 7% | | | |
| 1992 | 376% | 66% | 30% | 23% | 17% | 12% | | 5% | | | | |
| 1993 | 638% | 106% | 57% | 34% | 19% | 12% | | | | | | |
| 1994 | 470% | 106% | 56% | 25% | 14% | | | | | | | |
| 1995 | 1004% | 127% | 56% | 31% | | | | | | | | |
| 1996 | 914% | 92% | 37% | | | | | | | | | |
| 1997 | 714% | 85% | | | | | | | | | | |
| 1998 | 494% | | | | | | | | | | | |
| Avg. | 600% | 99% | 49% | 32% | 19% | 13% | 7% | 5% | 5% | 4% | | 37% |

EXHIBIT B-4
A LARGE REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 8% | 29% |
| 1981 | | | | | | | | | | 10% | 9% | 28% |
| 1982 | | | | | | | | | 15% | 12% | 11% | 25% |
| 1983 | | | | | | | | 19% | 17% | 14% | 10% | 22% |
| 1984 | | | | | 24% | | 18% | 18% | 12% | 11% | 22% | |
| 1985 | | | | | 18% | 13% | 12% | 6% | 7% | 9% | 25% | |
| 1986 | | | | 24% | 20% | 14% | 9% | 6% | 6% | 3% | 25% | |
| 1987 | | | 25% | 21% | 15% | 11% | 8% | 6% | 4% | 3% | 27% | |
| 1988 | | 44% | 34% | 24% | 14% | 12% | 11% | 7% | 6% | 5% | 26% | |
| 1989 | 61% | 42% | 27% | 17% | 13% | 11% | 7% | 5% | 9% | 8% | 25% | |
| 1990 | 59% | 38% | 28% | 21% | 18% | 12% | 7% | 9% | 8% | | | |
| 1991 | 56% | 36% | 26% | 21% | 13% | 10% | 10% | 9% | | | | |
| 1992 | 55% | 38% | 28% | 24% | 20% | 15% | 10% | | | | | |
| 1993 | 57% | 42% | 34% | 26% | 18% | 13% | | | | | | |
| 1994 | 62% | 49% | 39% | 24% | 17% | | | | | | | |
| 1995 | 59% | 45% | 32% | 24% | | | | | | | | |
| 1996 | 58% | 44% | 30% | | | | | | | | | |
| 1997 | 58% | 42% | | | | | | | | | | |
| 1998 | 60% | | | | | | | | | | | |
| Avg. | 59% | 42% | 30% | 23% | 17% | 14% | 11% | 10% | 9% | 8% | 25% | |

EXHIBIT B-5
A LARGE REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 11% | 67% |
| 1981 | | | | | | | | | | 13% | 12% | 63% |
| 1982 | | | | | | | | | 17% | 14% | 11% | 55% |
| 1983 | | | | | | | | 20% | 17% | 13% | 9% | 47% |
| 1984 | | | | | | 23% | 16% | 15% | 9% | 8% | 53% | |
| 1985 | | | | | 29% | 19% | 17% | 7% | 9% | 11% | 63% | |
| 1986 | | | | 97% | 73% | 47% | 27% | 19% | 16% | 8% | 66% | |
| 1987 | | | 98% | 70% | 47% | 32% | 20% | 15% | 9% | 6% | 68% | |
| 1988 | | 198% | 115% | 67% | 33% | 28% | 24% | 15% | 12% | 10% | 58% | |
| 1989 | 660% | 164% | 72% | 38% | 26% | 20% | 12% | 9% | 15% | 13% | 53% | |
| 1990 | 628% | 125% | 72% | 48% | 36% | 24% | 13% | 15% | 13% | | | |
| 1991 | 442% | 119% | 68% | 47% | 27% | 19% | 18% | 15% | | | | |
| 1992 | 511% | 122% | 60% | 42% | 31% | 23% | 14% | | | | | |
| 1993 | 807% | 159% | 93% | 58% | 31% | 21% | | | | | | |
| 1994 | 615% | 170% | 97% | 44% | 28% | | | | | | | |
| 1995 | 1244% | 188% | 85% | 51% | | | | | | | | |
| 1996 | 1166% | 152% | 73% | | | | | | | | | |
| 1997 | 890% | 142% | | | | | | | | | | |
| 1998 | 669% | | | | | | | | | | | |
| Avg. | 763% | 154% | 83% | 56% | 36% | 26% | 18% | 14% | 12% | 10% | 59% | |

APPENDIX C

EXHIBIT C-1

A MID-SIZED REINSURANCE COMPANY
 ALL LINES COMBINED
 RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-----------|---------------------|-----|-----|-----|-----|-----|-----|-----|----|-----|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 1% | 22% |
| 1981 | | | | | | | | | 1% | 0% | 22% | |
| 1982 | | | | | | | | 3% | 3% | 2% | 23% | |
| 1983 | | | | | | | 7% | 6% | 6% | 7% | 22% | |
| 1984 | | | | | 6% | 5% | 5% | 7% | 6% | 21% | | |
| 1985 | | | | 7% | 6% | 8% | 5% | 5% | 3% | 20% | | |
| 1986 | | | 20% | 16% | 15% | 15% | 12% | 10% | 8% | 19% | | |
| 1987 | | 30% | 23% | 24% | 22% | 19% | 17% | 14% | 3% | 21% | | |
| 1988 | | 39% | 32% | 27% | 23% | 22% | 21% | 20% | 4% | 4% | 20% | |
| 1989 | 51% | 36% | 28% | 24% | 22% | 18% | 18% | 6% | 6% | 4% | 15% | |
| 1990 | 47% | 31% | 23% | 20% | 17% | 16% | 9% | 8% | 5% | | | |
| 1991 | 45% | 31% | 23% | 18% | 17% | 12% | 9% | 6% | | | | |
| 1992 | 43% | 28% | 17% | 13% | 17% | 13% | 8% | | | | | |
| 1993 | 40% | 20% | 14% | 20% | 15% | 9% | | | | | | |
| 1994 | 49% | 34% | 26% | 16% | 10% | | | | | | | |
| 1995 | 38% | 40% | 27% | 16% | | | | | | | | |
| 1996 | 59% | 46% | 31% | | | | | | | | | |
| 1997 | 48% | 29% | | | | | | | | | | |
| 1998 | 50% | | | | | | | | | | | |
| Avg. | 47% | 33% | 25% | 20% | 17% | 14% | 12% | 9% | 6% | 4% | 21% | |

EXHIBIT C-2
A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO REPORTED LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|-------------|------------|------------|------------|------------|------------|------------|-----------|-----------|-----------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 1% | 36% |
| 1981 | | | | | | | | | | 1% | 0% | 37% |
| 1982 | | | | | | | | | 3% | 3% | 2% | 39% |
| 1983 | | | | | | | 6% | 6% | 5% | 5% | 38% | |
| 1984 | | | | | | 6% | 5% | 4% | 6% | 5% | 38% | |
| 1985 | | | | | 8% | 7% | 9% | 4% | 4% | 3% | 38% | |
| 1986 | | | | 34% | 26% | 27% | 28% | 21% | 15% | 13% | 39% | |
| 1987 | | | 69% | 50% | 58% | 55% | 46% | 38% | 35% | 7% | 41% | |
| 1988 | | 103% | 72% | 56% | 45% | 44% | 45% | 42% | 8% | 9% | 37% | |
| 1989 | 175% | 79% | 53% | 41% | 37% | 30% | 29% | 9% | 9% | 6% | 25% | |
| 1990 | 190% | 75% | 45% | 36% | 29% | 25% | 14% | 13% | 8% | | | |
| 1991 | 171% | 75% | 49% | 33% | 31% | 21% | 16% | 11% | | | | |
| 1992 | 150% | 63% | 29% | 20% | 25% | 18% | 11% | | | | | |
| 1993 | 160% | 45% | 26% | 35% | 23% | 12% | | | | | | |
| 1994 | 227% | 106% | 69% | 34% | 19% | | | | | | | |
| 1995 | 131% | 91% | 50% | 25% | | | | | | | | |
| 1996 | 216% | 101% | 53% | | | | | | | | | |
| 1997 | 227% | 75% | | | | | | | | | | |
| 1998 | 232% | | | | | | | | | | | |
| Avg. | 188% | 81% | 52% | 36% | 30% | 25% | 21% | 15% | 9% | 5% | 37% | |

EXHIBIT C-3
A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF IBNR TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-------------|------------|------------|------------|------------|------------|------------|------------|-----------|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 1% | 44% |
| 1981 | | | | | | | | | 1% | 0% | 47% | |
| 1982 | | | | | | | | 3% | 3% | 2% | 49% | |
| 1983 | | | | | | | 8% | 7% | 6% | 6% | 46% | |
| 1984 | | | | | | 7% | 5% | 5% | 6% | 2% | 46% | |
| 1985 | | | | | 10% | 8% | 10% | 5% | 5% | 3% | 46% | |
| 1986 | | | | 41% | 32% | 29% | 29% | 22% | 17% | 14% | 49% | |
| 1987 | | | 101% | 76% | 71% | 64% | 53% | 43% | 40% | 7% | 53% | |
| 1988 | | 144% | 107% | 79% | 60% | 55% | 52% | 47% | 8% | 9% | 47% | |
| 1989 | 330% | 112% | 66% | 49% | 41% | 33% | 31% | 10% | 10% | 7% | 33% | |
| 1990 | 371% | 110% | 59% | 42% | 33% | 29% | 16% | 14% | 9% | | | |
| 1991 | 346% | 125% | 68% | 42% | 34% | 23% | 17% | 12% | | | | |
| 1992 | 274% | 88% | 39% | 26% | 31% | 21% | 13% | | | | | |
| 1993 | 348% | 72% | 37% | 46% | 28% | 16% | | | | | | |
| 1994 | 672% | 196% | 112% | 48% | 25% | | | | | | | |
| 1995 | 347% | 150% | 77% | 35% | | | | | | | | |
| 1996 | 853% | 198% | 78% | | | | | | | | | |
| 1997 | 757% | 172% | | | | | | | | | | |
| 1998 | 864% | | | | | | | | | | | |
| Avg. | 516% | 137% | 74% | 48% | 37% | 29% | 23% | 17% | 11% | 5% | 46% | |

EXHIBIT C-4
A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 7% | 34% |
| 1981 | | | | | | | | | | 7% | 3% | 36% |
| 1982 | | | | | | | | | 16% | 14% | 11% | 34% |
| 1983 | | | | | | | | 25% | 27% | 29% | 25% | 32% |
| 1984 | | | | | | 18% | 21% | 24% | 18% | 13% | 30% | |
| 1985 | | | | | 23% | 21% | 25% | 13% | 12% | 13% | 30% | |
| 1986 | | | | 31% | 27% | 20% | 18% | 15% | 14% | 12% | 29% | |
| 1987 | | | 44% | 39% | 31% | 28% | 24% | 22% | 19% | 7% | 32% | |
| 1988 | | 50% | 46% | 40% | 35% | 32% | 28% | 25% | 5% | 6% | 31% | |
| 1989 | 65% | 49% | 38% | 33% | 28% | 24% | 21% | 13% | 11% | 10% | 29% | |
| 1990 | 60% | 44% | 35% | 29% | 26% | 24% | 18% | 15% | 12% | | | |
| 1991 | 58% | 47% | 37% | 29% | 22% | 16% | 13% | 12% | | | | |
| 1992 | 56% | 41% | 32% | 28% | 29% | 23% | 22% | | | | | |
| 1993 | 53% | 37% | 29% | 34% | 27% | 28% | | | | | | |
| 1994 | 63% | 49% | 41% | 29% | 23% | | | | | | | |
| 1995 | 56% | 58% | 45% | 35% | | | | | | | | |
| 1996 | 79% | 68% | 49% | | | | | | | | | |
| 1997 | 62% | 51% | | | | | | | | | | |
| 1998 | 66% | | | | | | | | | | | |
| Avg. | 62% | 49% | 40% | 33% | 27% | 23% | 22% | 18% | 14% | 11% | 32% | |

EXHIBIT C-5
A MID-SIZED REINSURANCE COMPANY
ALL LINES COMBINED
RATIO OF TOTAL RESERVE TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|-----------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 10% | 68% |
| 1981 | | | | | | | | | 9% | 4% | | 75% |
| 1982 | | | | | | | | 20% | 16% | 12% | | 74% |
| 1983 | | | | | | | 30% | 31% | 30% | 24% | | 68% |
| 1984 | | | | | | 20% | 23% | 23% | 17% | 11% | | 65% |
| 1985 | | | | | 33% | 27% | 30% | 14% | 12% | 12% | | 68% |
| 1986 | | | | 63% | 56% | 38% | 34% | 28% | 24% | 21% | | 73% |
| 1987 | | | 149% | 126% | 93% | 80% | 69% | 56% | 52% | 17% | | 80% |
| 1988 | | 184% | 155% | 119% | 94% | 80% | 70% | 60% | 12% | 13% | | 74% |
| 1989 | 418% | 154% | 91% | 67% | 53% | 43% | 37% | 22% | 19% | 17% | | 63% |
| 1990 | 466% | 155% | 88% | 60% | 49% | 43% | 32% | 26% | 20% | | | |
| 1991 | 450% | 192% | 108% | 69% | 46% | 31% | 24% | 22% | | | | |
| 1992 | 356% | 129% | 74% | 57% | 51% | 39% | 35% | | | | | |
| 1993 | 466% | 133% | 80% | 77% | 51% | 49% | | | | | | |
| 1994 | 867% | 282% | 174% | 90% | 60% | | | | | | | |
| 1995 | 512% | 215% | 131% | 74% | | | | | | | | |
| 1996 | 1148% | 293% | 126% | | | | | | | | | |
| 1997 | 991% | 302% | | | | | | | | | | |
| 1998 | 1138% | | | | | | | | | | | |
| Avg. | 681% | 204% | 118% | 80% | 59% | 45% | 38% | 30% | 21% | 14% | | 71% |

APPENDIX D

EXHIBIT D-1

REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|------------|------------|-----|------------|------------|-----|--------------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 10% | 33% |
| 1981 | | | | | | | | | 11% | 12% | | 31% |
| 1982 | | | | | | | 15% | 15% | 16% | | 29% | |
| 1983 | | | | | | 16% | 19% | 20% | <u>22%</u> | 25% | <u>27%</u> | 25% |
| 1984 | | | | | 18% | 20% | 23% | 25% | <u>27%</u> | 25% | | 25% |
| 1985 | | | | 18% | 23% | 17% | 16% | <u>17%</u> | 15% | 13% | | 23% |
| 1986 | | | 31% | 23% | 18% | <u>15%</u> | 13% | 10% | 9% | | | 23% |
| 1987 | | 42% | 34% | 26% | <u>20%</u> | 18% | 16% | 13% | 10% | | | 24% |
| 1988 | | 46% | 37% | 25% | <u>20%</u> | 18% | 16% | 14% | 12% | 10% | | 25% |
| 1989 | 56% | 45% | 33% | <u>25%</u> | 22% | 17% | 13% | 11% | 10% | 8% | | 23% |
| 1990 | 57% | 45% | <u>33%</u> | 26% | 22% | 16% | 14% | 11% | 8% | | | |
| 1991 | 62% | <u>43%</u> | 33% | 25% | 17% | 14% | 10% | 8% | | | | |
| 1992 | <u>58%</u> | 41% | 30% | 19% | 12% | 12% | 9% | | | | | |
| 1993 | 58% | 44% | 32% | 23% | 17% | 14% | | | | | | |
| 1994 | 55% | 42% | 34% | 22% | 19% | | | | | | | |
| 1995 | 59% | 46% | 32% | 24% | | | | | | | | |
| 1996 | 59% | 40% | 25% | | | | | | | | | |
| 1997 | 65% | 41% | | | | | | | | | | |
| 1998 | 55% | | | | | | | | | | | |
| Avg. | 58% | 43% | 33% | 25% | 20% | 17% | 15% | 15% | 14% | 14% | | 26% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT D-2
REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF IBNR TO REPORTED LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio |
|--------------|---------------------|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 1980 | | | | | | | | | | 9% | 50% |
| 1981 | | | | | | | | | 9% | 10% | 48% |
| 1982 | | | | | | | | 10% | 10% | 11% | 46% |
| 1983 | | | | | | | 10% | 11% | 11% | <u>11%</u> | 45% |
| 1984 | | | | | | 11% | 12% | 12% | <u>12%</u> | 11% | 43% |
| 1985 | | | | | 19% | 17% | 15% | <u>16%</u> | 14% | 11% | 46% |
| 1986 | | | | 73% | 47% | 37% | <u>31%</u> | 24% | 18% | 18% | 49% |
| 1987 | | | 133% | 89% | 64% | <u>46%</u> | 41% | 35% | 30% | 22% | 51% |
| 1988 | | 151% | 100% | 61% | <u>47%</u> | 41% | 37% | 30% | 26% | 23% | 50% |
| 1989 | 230% | 126% | 71% | <u>47%</u> | 38% | 28% | 21% | 19% | 17% | 13% | 44% |
| 1990 | 270% | 131% | <u>78%</u> | 52% | 44% | 29% | 24% | 19% | 14% | | |
| 1991 | 284% | <u>130%</u> | 74% | 48% | 28% | 22% | 15% | 11% | | | |
| 1992 | <u>272%</u> | 112% | 61% | 32% | 18% | 17% | 13% | | | | |
| 1993 | 290% | 122% | 70% | 42% | 29% | 24% | | | | | |
| 1994 | 326% | 126% | 77% | 42% | 32% | | | | | | |
| 1995 | 370% | 152% | 73% | 47% | | | | | | | |
| 1996 | 350% | 109% | 48% | | | | | | | | |
| 1997 | 385% | 95% | | | | | | | | | |
| 1998 | 233% | | | | | | | | | | |
| Avg. | 301% | 125% | 79% | 53% | 37% | 27% | 22% | 19% | 16% | 14% | 47% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT D-3
REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF IBNR TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-------------|-------------|-------------|------------|------------|------------|------------|------------|------------|--------------------|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 10% | 70% |
| 1981 | | | | | | | | | | 10% | 11% | 64% |
| 1982 | | | | | | | | 12% | 12% | 12% | | 60% |
| 1983 | | | | | | | 12% | 13% | 13% | <u>13%</u> | | <u>57%</u> |
| 1984 | | | | | | 14% | 14% | 14% | <u>14%</u> | 12% | | 53% |
| 1985 | | | | | 26% | 21% | 18% | <u>18%</u> | 15% | 13% | | 56% |
| 1986 | | | | 118% | 65% | 45% | <u>35%</u> | 27% | 21% | 20% | | 61% |
| 1987 | | | 221% | 132% | 85% | <u>57%</u> | 49% | 40% | 33% | 25% | | 63% |
| 1988 | | 307% | 168% | 87% | <u>59%</u> | 50% | 42% | 34% | 29% | 25% | | 63% |
| 1989 | 811% | 282% | 123% | <u>68%</u> | 50% | 35% | 26% | 21% | 18% | 14% | | 57% |
| 1990 | 995% | 269% | <u>127%</u> | 78% | 54% | 34% | 27% | 21% | 15% | | | |
| 1991 | 896% | <u>247%</u> | 113% | 63% | 34% | 25% | 17% | 12% | | | | |
| 1992 | <u>679%</u> | 206% | 90% | 42% | 21% | 19% | 14% | | | | | |
| 1993 | 746% | 233% | 108% | 58% | 36% | 28% | | | | | | |
| 1994 | 800% | 255% | 122% | 60% | 41% | | | | | | | |
| 1995 | 815% | 265% | 123% | 68% | | | | | | | | |
| 1996 | 803% | 212% | 80% | | | | | | | | | |
| 1997 | 988% | 202% | | | | | | | | | | |
| 1998 | 519% | | | | | | | | | | | |
| Avg. | 805% | 248% | 128% | 77% | 47% | 33% | 25% | 21% | 18% | 16% | | 60% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT D-4
REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-------------|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 22% | 51% |
| 1981 | | | | | | | | | | 25% | 24% | 48% |
| 1982 | | | | | | | | 36% | 34% | 32% | | 44% |
| 1983 | | | | | | | 48% | 45% | 44% | <u>45%</u> | | <u>40%</u> |
| 1984 | | | | | | 58% | 53% | 53% | <u>52%</u> | 49% | | 37% |
| 1985 | | | | | 43% | 36% | 33% | <u>29%</u> | 27% | 24% | | 33% |
| 1986 | | | | 46% | 36% | 26% | <u>22%</u> | 18% | 16% | 14% | | 32% |
| 1987 | | | 54% | 46% | 36% | <u>29%</u> | 26% | 21% | 17% | 14% | | 33% |
| 1988 | | 62% | 52% | 37% | <u>29%</u> | 26% | 22% | 19% | 16% | 14% | | 35% |
| 1989 | 73% | 64% | 53% | <u>41%</u> | 36% | 28% | 23% | 20% | 14% | 12% | | 36% |
| 1990 | 72% | 62% | <u>49%</u> | 42% | 32% | 25% | 21% | 17% | 13% | | | |
| 1991 | 77% | <u>59%</u> | 49% | 37% | 28% | 22% | 17% | 14% | | | | |
| 1992 | <u>70%</u> | 57% | 45% | 33% | 22% | 20% | 16% | | | | | |
| 1993 | 70% | 61% | 48% | 37% | 29% | 24% | | | | | | |
| 1994 | 66% | 59% | 50% | 37% | 32% | | | | | | | |
| 1995 | 67% | 59% | 50% | 40% | | | | | | | | |
| 1996 | 68% | 58% | 46% | | | | | | | | | |
| 1997 | 75% | 63% | | | | | | | | | | |
| 1998 | 68% | | | | | | | | | | | |
| Avg. | 71% | 60% | 50% | 40% | 32% | 29% | 28% | 27% | 26% | 14% | | 39% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT D-5
REINSURANCE INDUSTRY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-------------|-------------|-------------|------------|------------|------------|------------|------------|------------|--------------------|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 24% | 108% |
| 1981 | | | | | | | | | 24% | 22% | | 97% |
| 1982 | | | | | | | | 30% | 26% | 23% | | 90% |
| 1983 | | | | | | | 36% | 31% | 28% | <u>26%</u> | | <u>83%</u> |
| 1984 | | | | | 41% | | 32% | 29% | <u>26%</u> | 23% | | 78% |
| 1985 | | | | | 64% | 46% | 37% | <u>31%</u> | 27% | 23% | | 79% |
| 1986 | | | | 178% | 104% | 67% | <u>51%</u> | 39% | 33% | 30% | | 85% |
| 1987 | | | 287% | 180% | 118% | <u>83%</u> | 69% | 53% | 45% | 35% | | 87% |
| 1988 | | 411% | 234% | 129% | <u>85%</u> | 71% | 57% | 48% | 38% | 32% | | 90% |
| 1989 | 1064% | 404% | 194% | <u>113%</u> | 82% | 58% | 45% | 37% | 26% | 22% | | 87% |
| 1990 | 1264% | 375% | <u>189%</u> | 126% | 77% | 51% | 41% | 32% | 24% | | | |
| 1991 | 1112% | <u>338%</u> | 168% | 94% | 55% | 38% | 27% | 22% | | | | |
| 1992 | <u>829%</u> | 289% | 137% | 70% | 39% | 34% | 25% | | | | | |
| 1993 | 903% | 324% | 162% | 95% | 61% | 48% | | | | | | |
| 1994 | 945% | 358% | 181% | 101% | 69% | | | | | | | |
| 1995 | 936% | 339% | 192% | 110% | | | | | | | | |
| 1996 | 933% | 305% | 147% | | | | | | | | | |
| 1997 | 1145% | 314% | | | | | | | | | | |
| 1998 | 642% | | | | | | | | | | | |
| Avg. | 977% | 346% | 189% | 120% | 75% | 54% | 42% | 35% | 30% | 26% | | 88% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

APPENDIX E

EXHIBIT E-1

A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF IBNR TO PREMIUM

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|-----------|---------------------|-----|-----|-----|-----|----|----|----|----|----|-----------------|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 2% | 18% |
| 1981 | | | | | | | | | 2% | 2% | 2% | 18% |
| 1982 | | | | | | | | 3% | 2% | 2% | 2% | 14% |
| 1983 | | | | | | | 2% | 2% | 2% | 2% | 5% | 14% |
| 1984 | | | | | | 3% | 3% | 2% | 2% | 3% | 4% | 15% |
| 1985 | | | | | 2% | 5% | 2% | 2% | 3% | 4% | 1% | 16% |
| 1986 | | | | 16% | 14% | 9% | 5% | 4% | 3% | 3% | 1% | 16% |
| 1987 | | | 15% | 13% | 8% | 5% | 4% | 3% | 1% | 1% | | 17% |
| 1988 | | 35% | 22% | 14% | 7% | 6% | 5% | 3% | 2% | 3% | | 17% |
| 1989 | 50% | 29% | 15% | 8% | 7% | 5% | 3% | 2% | 6% | 3% | | 21% |
| 1990 | 49% | 22% | 15% | 11% | 8% | 6% | 2% | 5% | 1% | | | |
| 1991 | 42% | 20% | 14% | 10% | 6% | 5% | 6% | 2% | | | | |
| 1992 | 41% | 20% | 14% | 13% | 11% | 8% | 4% | | | | | |
| 1993 | 45% | 28% | 21% | 15% | 11% | 7% | | | | | | |
| 1994 | 48% | 31% | 22% | 14% | 15% | | | | | | | |
| 1995 | 48% | 30% | 21% | 35% | | | | | | | | |
| 1996 | 45% | 26% | 26% | | | | | | | | | |
| 1997 | 47% | 35% | | | | | | | | | | |
| 1998 | 50% | | | | | | | | | | | |
| Avg. | 47% | 28% | 19% | 15% | 9% | 6% | 4% | 3% | 3% | 3% | 3% | 16% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT E-2
A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF IBNR TO REPORTED LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|------------|------------|-----------|-----------|-----------|-----------|--------------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 2% | 33% |
| 1981 | | | | | | | | | | 3% | 2% | 33% |
| 1982 | | | | | | | | 3% | 2% | 2% | | 25% |
| 1983 | | | | | | | 2% | 2% | 2% | <u>2%</u> | | <u>22%</u> |
| 1984 | | | | | 2% | 2% | 1% | <u>2%</u> | 4% | | | 27% |
| 1985 | | | | 3% | 6% | 2% | <u>2%</u> | 5% | 5% | | | 32% |
| 1986 | | | 48% | 40% | 26% | <u>13%</u> | 8% | 7% | 2% | | | 34% |
| 1987 | | 44% | 34% | 21% | <u>14%</u> | 8% | 6% | 2% | 2% | | | 36% |
| 1988 | 109% | 55% | 30% | <u>14%</u> | 13% | 10% | 6% | 4% | 5% | | | 32% |
| 1989 | 244% | 75% | 31% | <u>14%</u> | 12% | 9% | 5% | 4% | 10% | 4% | | 36% |
| 1990 | 250% | 48% | <u>30%</u> | 19% | 14% | 10% | 3% | 8% | 2% | | | |
| 1991 | 153% | <u>43%</u> | 27% | 18% | 10% | 8% | 10% | 2% | | | | |
| 1992 | <u>160%</u> | 42% | 23% | 19% | 15% | 11% | <u>6%</u> | | | | | |
| 1993 | 238% | 69% | 42% | 28% | 17% | <u>10%</u> | | | | | | |
| 1994 | 191% | 64% | 40% | 21% | <u>28%</u> | | | | | | | |
| 1995 | 296% | 78% | 43% | <u>48%</u> | | | | | | | | |
| 1996 | 260% | 57% | <u>53%</u> | | | | | | | | | |
| 1997 | 259% | <u>80%</u> | | | | | | | | | | |
| 1998 | <u>487%</u> | | | | | | | | | | | |
| Avg. | 254% | 67% | 39% | 28% | 17% | 11% | 6% | 4% | 4% | 3% | 31% | |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT E-3
A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF IBNR TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|-----|-----|-----|----|-----|-----------|--------------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 3% | 41% |
| 1981 | | | | | | | | | | 3% | 3% | 41% |
| 1982 | | | | | | | | | 4% | 3% | 2% | 31% |
| 1983 | | | | | | | | 2% | 2% | 2% | <u>2%</u> | <u>27%</u> |
| 1984 | | | | | | | 3% | 3% | 2% | <u>2%</u> | 4% | 33% |
| 1985 | | | | | 4% | 7% | 3% | 3% | 3% | 5% | 5% | 39% |
| 1986 | | | | 64% | 49% | 30% | 15% | 9% | 8% | 2% | | 42% |
| 1987 | | | 60% | 43% | 26% | 16% | 9% | 7% | 2% | 2% | | 44% |
| 1988 | | 156% | 76% | 38% | 16% | 15% | 12% | 6% | 5% | 6% | | 38% |
| 1989 | 539% | 114% | 41% | <u>17%</u> | 14% | 10% | 5% | 4% | 10% | 4% | | 46% |
| 1990 | 520% | 73% | <u>39%</u> | 24% | 17% | 11% | 4% | 8% | 2% | | | |
| 1991 | 327% | <u>66%</u> | 36% | 22% | 12% | 9% | 10% | 2% | | | | |
| 1992 | <u>376%</u> | 66% | 30% | 23% | 17% | 12% | 7% | | | | | |
| 1993 | 638% | 106% | 57% | 34% | 19% | 11% | | | | | | |
| 1994 | 470% | 106% | 56% | 25% | 38% | | | | | | | |
| 1995 | 1004% | 127% | 56% | 72% | | | | | | | | |
| 1996 | 914% | 92% | 92% | | | | | | | | | |
| 1997 | 714% | 163% | | | | | | | | | | |
| 1998 | 1878% | | | | | | | | | | | |
| Avg. | 738% | 107% | 54% | 36% | 21% | 12% | 7% | 5% | 4% | 3% | | 38% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT E-4
A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PREMIUM

| Acc. Year | YEAR OF DEVELOPMENT | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|------------|------------|------------|------------|------------|------------|------------|-----------|-----------|--------------------|------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 8% | 29% |
| 1981 | | | | | | | | | | 10% | 9% | 28% |
| 1982 | | | | | | | | 15% | 12% | 11% | | 25% |
| 1983 | | | | | | | 19% | 17% | 14% | 10% | | 22% |
| 1984 | | | | | | 24% | 18% | 18% | 12% | 11% | | 22% |
| 1985 | | | | | 18% | 13% | 12% | 6% | 7% | 9% | | 25% |
| 1986 | | | | 24% | 20% | 14% | 9% | 6% | 6% | 3% | | 25% |
| 1987 | | | 25% | 21% | 15% | 11% | 8% | 6% | 4% | 3% | | 27% |
| 1988 | | 44% | 34% | 24% | 14% | 12% | 11% | 7% | 6% | 5% | | 26% |
| 1989 | 61% | 42% | 27% | 17% | 13% | 11% | 7% | 5% | 9% | 9% | | 33% |
| 1990 | 59% | 38% | 28% | 21% | 18% | 12% | 7% | 9% | 6% | | | |
| 1991 | 56% | 36% | 26% | 21% | 13% | 10% | 10% | 10% | | | | |
| 1992 | 55% | 38% | 28% | 24% | 20% | 15% | 11% | | | | | |
| 1993 | 57% | 42% | 34% | 26% | 18% | 11% | | | | | | |
| 1994 | 62% | 49% | 39% | 24% | 28% | | | | | | | |
| 1995 | 59% | 45% | 32% | 59% | | | | | | | | |
| 1996 | 58% | 44% | 47% | | | | | | | | | |
| 1997 | 58% | 57% | | | | | | | | | | |
| 1998 | 58% | | | | | | | | | | | |
| Avg. | 58% | 44% | 32% | 26% | 18% | 13% | 11% | 10% | 9% | 8% | | 26% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.

EXHIBIT E-5
A LARGE REINSURANCE COMPANY
OTHER LIABILITY
RATIO OF TOTAL RESERVE TO PAID LOSS

| Acc. Year | Year of Development | | | | | | | | | | Composite Ratio | |
|--------------|---------------------|-------------|-------------|-------------|------------|------------|------------|------------|------------|------------|--------------------|-------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1980 | | | | | | | | | | | 11% | 67% |
| 1981 | | | | | | | | | | 13% | 12% | 63% |
| 1982 | | | | | | | | | 17% | 14% | 11% | 55% |
| 1983 | | | | | | | 20% | 17% | 13% | <u>9%</u> | | <u>47%</u> |
| 1984 | | | | | | 23% | 16% | 15% | <u>9%</u> | 8% | | 53% |
| 1985 | | | | | 29% | 19% | 17% | <u>7%</u> | 9% | 11% | | 63% |
| 1986 | | | | 97% | 73% | 47% | 17% | <u>27%</u> | 19% | 16% | 8% | 66% |
| 1987 | | | 98% | 70% | 47% | <u>32%</u> | 20% | 15% | 9% | 6% | | 68% |
| 1988 | | 198% | 115% | 67% | <u>33%</u> | 28% | 24% | 15% | 12% | 10% | | 58% |
| 1989 | 660% | 164% | 72% | <u>38%</u> | 26% | 20% | 12% | 9% | 15% | 11% | | 73% |
| 1990 | 628% | 125% | <u>72%</u> | 48% | 36% | 24% | 13% | 15% | 9% | | | |
| 1991 | 442% | <u>119%</u> | 68% | 47% | 27% | 19% | 18% | 9% | | | | |
| 1992 | <u>511%</u> | 122% | 60% | 42% | 31% | 23% | 23% | | | | | |
| 1993 | 807% | 159% | 93% | 58% | 31% | 18% | | | | | | |
| 1994 | 615% | 170% | 97% | 44% | 73% | | | | | | | |
| 1995 | 1244% | 188% | 85% | 120% | | | | | | | | |
| 1996 | 1166% | 152% | 164% | | | | | | | | | |
| 1997 | 890% | 269% | | | | | | | | | | |
| 1998 | 2164% | | | | | | | | | | | |
| Avg. | 913% | 167% | 92% | 63% | 41% | 25% | 19% | 14% | 12% | 10% | | 61% |

For calendar years prior to 1993, the OL numbers represent all of OL, not just the “occurrence basis” segment.