ESTIMATING SALVAGE AND SUBROGATION RESERVES—ADAPTING THE BORNHUETTER-FERGUSON APPROACH

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Abstract

With the recent Internal Revenue Service and NAIC interest in salvage and subrogation reserves, insurance companies must develop methods of estimating anticipated recoveries. This paper examines two traditional methods and proposes an adapted Bornhuetter-Ferguson method for the projection of salvage and subrogation recoveries.

1. INTRODUCTION

Salvage and subrogation reserves recently have become a more prominent issue than ever before. The Internal Revenue Service's new rules requiring an explicit adjustment to the losses for these reserves is at the heart of this piqued interest. Previously the tax calculation was based on loss reserves as reported in the statutory statement adjusted for discounting. According to the statutory rules, salvage and subrogation recoveries were not to be anticipated in these reserves. Beginning with the 1990 tax year, insurance companies have been required to specifically reflect salvage and subrogation recoverable on unpaid losses. In addition, beginning with the 1992 Annual Statement, reserves may be shown net of anticipated recoveries in the statutory statement.

Many companies which previously had never addressed the issue of estimating salvage and subrogation reserves are now faced with the task of determining this amount.

It is difficult to ascertain the impact of salvage and subrogation on an industry-wide basis at this time since there is no source that shows total recoveries including all anticipated recoveries. Also, there are not sufficient data available to independently determine this amount.

2. THE TRADITIONAL METHODS

Ideally, a company would have a sufficient volume of data regarding recoveries so the recoveries could be estimated independently using a paid or incurred loss projection method (Method 1). Salvage would be projected independently of subrogation since there is no expectation that the two types of recoveries develop similarly. In practice, this is seldom the usual case, especially for smaller companies. For some lines, particularly liability lines, there may be few recoveries received until an accident year has reached two or three years of development. In this instance, there is no base of recovery data from which to project.

Exhibit 2 shows a reserve estimate using the paid projection method on the hypothetical data in Exhibit 1. In the example, the 12-to-24 month factor is indeterminable since, historically, there have been no recoveries in the first 12 months. Therefore it is impossible to project a reserve for the current accident year ($ay - 0$) utilizing a strict adherence to this method.

The next most logical approach (Method 2) would be to perform two separate loss projections; one excluding, or gross of, the recoveries and one including, or net of, the recoveries. The difference between the ultimates resulting from these two projections would be the projected recoveries. This is similar to establishing ceded IBNR as the difference between the separate projections of direct IBNR and net IBNR (assuming there are no assumed losses). But, as in the prior case, there can be problems using this method without adjustments.

Exhibit 3 illustrates the major problem which can occur when using this method. In this example, the projected ultimate for $ay - 2$ including recoveries is \$92 less than the projected ultimate excluding recoveries, yielding anticipated ultimate recoveries of \$92. However, we already have received \$100 in recoveries so our reserve indication is \$92 – \$100 = (\$8). Thus our projected ultimate salvage and subrogation recovery is negative. Obviously, this normally would not be acceptable.

3. THE ALTERNATIVE

To avoid these problems, an adaptation of the Bornhuetter-Ferguson method can be used. Briefly, in its original form this method utilizes three input factors to determine an IBNR reserve. These three factors are earned premium, anticipated loss ratio, and a loss reporting pattern. IBNR is then calculated as the product of the premium, loss ratio, and expected percent of ultimate losses which are unreported as of the current valuation.

Adaptation of this method to establish salvage and subrogation reserves (Method 3) involves a substitution of variables. Projected ultimate incurred losses are used in place of earned premium, the anticipated ultimate recovery ratio (ultimate salvage and subrogation divided by ultimate losses) is substituted for the anticipated loss ratio, and the salvage and subrogation reporting pattern is substituted for the loss reporting pattern.

It is assumed that the ultimate losses have been estimated elsewhere. Note that this method is not dependent on whether the losses are gross or net of recoveries, as long as the anticipated recovery ratio utilizes losses on the same basis in the denominator. These two projections will not necessarily yield the same reserves, but, in most cases, the projections should be reasonably close.

Exhibit 4 illustrates this proposed method using the same hypothetical data as above. One immediate benefit of this method can be seen in Column 2. The fact that we cannot calculate an age-to-age factor for the 12-24 month period does not cause a problem for us. We know that no recoveries are anticipated to have been made as of 12 months, so the percent reported is 0%. The percentages in Column 2 are subtracted from 100% to yield the expected portion of recoveries which have not yet been reported, Column 3. It is this column that will be used in the calculation.

By incorporating the projected ultimate losses excluding recoveries from Exhibit 3, we have two of the three necessary factors. Only one factor needs to be determined, the anticipated recovery ratio. This

can be estimated in a variety of ways, from historical information to pure judgment. This ratio may vary from year to year. In the example we have no reason to expect that this ratio should not be relatively static. It is therefore assumed that our a priori estimate is the same for each accident year, as shown in Column 6. The derivation of this factor will be explained later. The product of these three factors is the estimated salvage and subrogation reserve, shown in Column 7. Columns 10 through 14 repeat the procedure using losses including recoveries. In this example, the results are equivalent.

It is possible to stop here, but there are a few additional steps necessary to explain the choice of 0.111 (and 0.125) as the ratio of recoveries to losses. Column 4 displays recoveries received to date. Adding these actual recoveries to the reserves gives us the estimated ultimate recoveries, shown in Column 8. Column 9 is the ratio of ultimate recoveries to ultimate losses. It is the expected value of this ratio that we needed as the third input factor. Thus, it is the average of this column, or 0.111 in the example, which was selected as the input factor. The twist is that Column 9 depends on the value placed in Column 6 which, in turn, depends on Column 9. Obviously, this is not a straightforward computation.

If we assume that the anticipated recovery ratio should be constant, this factor can be mathematically determined as follows:

Since

$$R/L = \Sigma\,[UL \times PRU \times R/L + SS]/\Sigma\,UL,$$

where:

R/L = expected ratio of recoveries to losses,

UL = ultimate losses,

PRU = percent of recoveries unreported, and

SS = salvage and subrogation recoveries to date.

Then

$$R/L \times \Sigma\, UL = R/L \times \Sigma\, [UL \times PRU] + \Sigma\, SS$$
$$R/L \times [\, \Sigma\, UL - \Sigma\, [UL \times PRU]] = \Sigma\, SS$$
$$R/L = \Sigma\, SS/[\Sigma\, UL - \Sigma\, [UL \times PRU]]\,.$$

Thus, in the example,

$$\begin{aligned} R/L &= 600/[7{,}500 - (1{,}500 \times 0\% + 1{,}500 \times 0\% + 1{,}500 \times 0\% \\ &\quad + 1{,}500 \times 40\% + 1{,}500 \times 100\%)] \\ &= 600/[7{,}500 - 2{,}100] \\ &= 0.111. \end{aligned}$$

The 0.125 is similarly determined.

This variation of the Bornhuetter-Ferguson method is similar to the Stanard-Bühlmann method of loss development as described in Chapter 6 of the *Foundations of Casualty Actuarial Science* text.

4. APPLICATION TO REAL DATA

Exhibits 5 through 7 take real data extracted from *Best's Aggregates and Averages* Consolidated Industry Schedule P for Other Liability and project the indicated salvage and subrogation reserve using Methods 1 through 3, respectively. All data are from the 1990 Annual Statement reproduction except for salvage and subrogation received as of 12/31/89. These data are from Part 1H, Column 9 of the 1989 reproduction. Although it is technically incorrect to match this data with the corresponding data from the 1990 statement due to the change in the mix of companies included in the consolidated statements, I have done so for demonstration purposes. The data shown for paid loss and ALAE are from Part 3H, Columns 10 and 11. The projected ultimate loss and ALAE shown in Column 6 of Exhibit 7 is from Part 2H, Column 11.

Columns 5 and 10 of Exhibit 6 highlight another potential problem with Method 2. While these two columns of projections are consistent with one another and make sense within the context of

estimating the salvage and subrogation reserves, there is a large disparity if they are compared to the actual estimated ultimate losses, shown in Column 6 of Exhibit 7. It would be difficult to explain why the estimated ultimates used for establishing salvage and subrogation reserves were so different from the Statement ultimates. The only alternative would be to adjust the projections so that they reconcile, which would require modifying both sets of factors, which, in turn, may distort the salvage and subrogation projection process.

Exhibit 8 compares the projections from each of the methods. While we cannot know at this time which method is closest to being correct, it appears that the proposed method (Method 3) yields a result which is at least as reasonable as the others without any of the potential drawbacks.

5. CONCLUSION

Salvage and subrogation reserves can be computed simply even when the available data are limited. All that is required are three factors. One of these, ultimate incurred losses, should already be available. Another, the expected ratio of ultimate recoveries to ultimate losses, can be determined within the process. The only other requirement, a salvage and subrogation reporting pattern, can be computed by using a loss triangle approach. If a triangle is unavailable, it is possible that data on recoveries from Schedule P, Part 1 of two consecutive statutory blanks could be used to derive the needed development factors.

REFERENCES

[1] Bornhuetter, Ronald L., and Ferguson, Ronald E., "The Actuary and IBNR," *PCAS* LIX, 1972, p. 181.

[2] Patrik, Gary S., "Reinsurance," *Foundations of Casualty Actuarial Science,* Casualty Actuarial Society (First Edition), 1990, Chapter 6.

[3] A. M. Best Company, *Best's Aggregates & Averages Property-Casualty,* 1991 Edition.

[4] A. M. Best Company, *Best's Aggregates & Averages Property-Casualty,* 1990 Edition.

EXHIBIT 1

LOSS TRIANGLES

ACTUAL SALVAGE AND SUBROGATION RECOVERIES

Accident Year	Months of Development				
	12	24	36	48	60
$ay-4$	0	100	200	200	200
$ay-3$	0	100	200	200	
$ay-2$	0	100	100		
$ay-1$	0	100			
$ay-0$	0				
Age-to-Age Factor		xx	1.667	1.000	1.000
Factor to Ultimate		xx	1.667	1.000	1.000

PAID LOSSES EXCLUDING RECOVERIES

Accident Year	Months of Development				
	12	24	36	48	60
$ay-4$	1,000	1,200	1,400	1,500	1,500
$ay-3$	1,000	1,200	1,400	1,500	
$ay-2$	1,000	1,200	1,400		
$ay-1$	1,000	1,200			
$ay-0$	1,000				
Age-to-Age Factor		1.200	1.167	1.071	1.000
Factor to Ultimate		1.500	1.250	1.071	1.000

PAID LOSSES INCLUDING RECOVERIES

Accident Year	Months of Development				
	12	24	36	48	60
$ay-4$	1,000	1,100	1,200	1,300	1,300
$ay-3$	1,000	1,100	1,200	1,300	
$ay-2$	1,000	1,100	1,300		
$ay-1$	1,000	1,100			
$ay-0$	1,000				
Age-to-Age Factor		1.100	1.121	1.083	1.000
Factor to Ultimate		1.336	1.215	1.083	1.000

EXHIBIT 2

SALVAGE AND SUBROGATION RESERVE PROJECTION

METHOD 1—PAID RECOVERIES DEVELOPMENT METHOD

Accident Year	(1) Salvage & Subrogation Received to Date	(2) Factor to Ultimate	(3) Projected Ultimate Recoveries [(1) x (2)]	(4) Salvage & Subrogation Reserve [(3) - (1)]
$ay-4$	200	1.000	200	0
$ay-3$	200	1.000	200	0
$ay-2$	100	1.000	100	0
$ay-1$	100	1.667	167	67
$ay-0$	0	xx	xx	xx
Total	600		xx	xx

EXHIBIT 3

SALVAGE AND SUBROGATION RESERVE PROJECTION

METHOD 2—DIFFERENCE BETWEEN LOSSES PROJECTED WITH AND WITHOUT RECOVERIES

Accident Year	(1) Losses Paid to Date Excluding Recoveries	(2) Factor to Ultimate	(3) Projected Ultimate Losses Excl. Recoveries [(1) x (2)]
ay – 4	1,500	1.000	1,500
ay – 3	1,500	1.000	1,500
ay – 2	1,400	1.071	1,500
ay – 1	1,200	1.250	1,500
ay – 0	1,000	1.500	1,500
Total	6,600		7,500

Accident Year	(4) Losses Paid to Date Including Recoveries	(5) Factor to Ultimate	(6) Projected Ultimate Losses Incl. Recoveries [(4) x (5)]
ay – 4	1,300	1.000	1,300
ay – 3	1,300	1.000	1,300
ay – 2	1,300	1.083	1,408
ay – 1	1,100	1.215	1,336
ay – 0	1,000	1.336	1,336
Total	6,000		6,680

Accident Year	(7) Projected Ultimate Recoveries [(3) - (6)]	(8) Salvage & Subrogation Received to Date	(9) Salvage & Subrogation Reserve [(7) - (8)]
ay – 4	200	200	0
ay – 3	200	200	0
ay – 2	92	100	(8)
ay – 1	164	100	64
ay – 0	164	0	164
Total	820	600	220

EXHIBIT 4

SALVAGE AND SUBROGATION RESERVE PROJECTION

METHOD 3—ADAPTED BORNHUETTER-FERGUSON

Accident Year	(1) Salvage and Subrogation Factor to Ultimate	(2) Percent of Recoveries Reported [1/(1)]	(3) Percent of Recoveries Unreported [100% – (2)]	(4) Salvage and Subrogation Rec'd to Date
ay – 4	1.000	100%	0%	200
ay – 3	1.000	100	0	200
ay – 2	1.000	100	0	100
ay – 1	1.667	60	40	100
ay – 0	xx	0	100	0

PROJECTION USING LOSSES EXCLUDING RECOVERIES AS A BASE

Accident Year	(5) Projected Ultimate Losses Excluding Recoveries [Exh. 3, Col (3)]	(6) Expected Recovery Ratio	(7) Projected Salvage and Subrogation Reserve [(3) × (5) × (6)]	(8) Projected Ultimate Recoveries [(4) + (7)]	(9) Indicated Recovery Ratio [(8) / (5)]
ay – 4	1,500	0.111	0	200	0.133
ay – 3	1,500	0.111	0	200	0.133
ay – 2	1,500	0.111	0	100	0.067
ay – 1	1,500	0.111	67	167	0.111
ay – 0	1,500	0.111	167	167	0.111
Total	7,500		234	834	0.111

PROJECTION USING LOSSES INCLUDING RECOVERIES AS A BASE

Accident Year	(10) Projected Ultimate Losses Including Recoveries [Exh. 3,Col (6)]	(11) Expected Recovery Ratio	(12) Projected Salvage & Subrogation Reserve [(3)×(10)×(11)]	(13) Projected Ultimate Recoveries [(4)+(12)]	(14) Indicated Recovery Ratio [(13)/(10)]
ay – 4	1,300	0.125	0	200	0.154
ay – 3	1,300	0.125	0	200	0.154
ay – 2	1,408	0.125	0	100	0.071
ay – 1	1,336	0.125	67	167	0.125
ay – 0	1,336	0.125	167	167	0.125
Total	6,680		234	834	0.125

EXHIBIT 5

SALVAGE AND SUBROGATION RESERVE PROJECTION
METHOD 1—PAID RECOVERIES DEVELOPMENT METHOD

Accident Year	(1) Salvage and Subrogation Received @ 12/31/89	(2) Salvage and Subrogation Received @ 12/31/90	(3) Age-to-Age Factor [(2) / (1)]	(4) 12/31/90 Factor to Ultimate	(5) Projected Ultimate Salvage and Subrogation [(2) × (4)]	(6) Estimated Salvage and Subrogation Reserve [(5) − (2)]
Prior	33,261(a)	22,146(b)	1.6658(c)			
1981	44,596	49,701	1.1145	1.6658	82,793	33,092
1982	51,216	58,268	1.1377	1.8565	108,175	49,907
1983	45,169	52,804	1.1690	2.1121	111,530	58,726
1984	54,051	61,176	1.1318	2.4692	151,053	89,877
1985	42,666	62,954	1.4755	2.7946	175,934	112,980
1986	29,999	38,052	1.2684	4.1235	156,908	118,856
1987	20,291	28,045	1.3821	5.2304	146,688	118,643
1988	13,697	20,971	1.5311	7.2292	151,604	130,633
1989	9,801	17,834	1.8196	11.0684	197,394	179,560
1990		6,452		20.1404	129,944	123,492
Total						1,015,766

(a) Accident year 1980
(b) 1990 recoveries for all years prior to 1981
(c) 1 + (2)/(1)

EXHIBIT 6
Part 1
SALVAGE AND SUBROGATION RESERVE PROJECTION
METHOD 2—DIFFERENCE BETWEEN LOSSES PROJECTED WITH & WITHOUT RECOVERIES

Accident Year	(1) Paid Loss & ALAE @ 12/31/89 Including Recoveries	(2) Paid Loss & ALAE @ 12/31/90 Including Recoveries	(3) Age-to-Age Factor [(2)/(1)]	(4) 12/31/90 Factor to Ultimate	(5) Projected Ultimate Loss & ALAE Incl. Recoveries [(2) ×(4)]
Prior	4,210,629(a)	1,285,126(b)	1.3052(c)	1.0000	1,285,126
1981	4,538,025	4,708,084	1.0375	1.3052	6,145,038
1982	5,034,356	5,260,011	1.0448	1.3541	7,122,695
1983	5,374,654	5,809,967	1.0810	1.4148	8,220,043
1984	5,886,801	6,538,530	1.1107	1.5294	10,000,085
1985	5,837,150	6,915,234	1.1847	1.6987	11,747,115
1986	4,741,568	6,086,522	1.2837	2.0125	12,248,970
1987	3,413,265	4,975,690	1.4578	2.5833	12,853,781
1988	2,377,818	4,116,062	1.7310	3.7658	15,500,397
1989	1,129,567	2,688,211	2.3799	6.5187	17,523,770
1990		1,118,052		15.5137	17,345,130

EXHIBIT 6
Part 2
SALVAGE AND SUBROGATION RESERVE PROJECTION
METHOD 2—DIFFERENCE BETWEEN LOSSES PROJECTED WITH & WITHOUT RECOVERIES

Accident Year	(6) Paid Loss & ALAE @ 12/31/89 Excluding Recoveries	(7) Paid Loss & ALAE @ 12/31/90 Excluding Recoveries	(8) Age-to-Age Factor [(7)/(6)]	(9) 12/31/90 Factor to Ultimate	(10) Projected Ultimate Loss & ALAE Excl. Recoveries [(7) × (9)]
Prior	4,243,890(a)	1,307,272(b)	1.3080(d)	1.0000	1,307,272
1981	4,582,621	4,757,785	1.0382	1.3080	6,223,355
1982	5,085,572	5,318,279	1.0458	1.3580	7,222,404
1983	5,419,823	5,862,771	1.0817	1.4202	8,326,163
1984	5,940,852	6,599,706	1.1109	1.5362	10,138,749
1985	5,879,816	6,978,188	1.1868	1.7066	11,909,083
1986	4,771,567	6,124,574	1.2836	2.0254	12,404,820
1987	3,433,556	5,003,735	1.4573	2.5997	13,008,396
1988	2,391,515	4,137,033	1.7299	3.7886	15,673,594
1989	1,139,368	2,706,045	2.3750	6.5538	17,734,971
1990		1,124,504		15.5656	17,503,604

EXHIBIT 6
Part 3
SALVAGE AND SUBROGATION RESERVE PROJECTION
METHOD 2—DIFFERENCE BETWEEN LOSSES PROJECTED WITH & WITHOUT RECOVERIES

Accident Year	(11) Projected Ultimate Recoveries [(10) – (5)]	(12) Salvage and Subrogation Received @ 12/31/90	(13) Salvage and Subrogation Reserve [(11) – (12)]
1981	78,317	49,701	28,616
1982	99,709	58,268	41,441
1983	106,120	52,804	53,316
1984	138,664	61,176	77,488
1985	161,967	62,954	99,013
1986	155,850	38,052	117,798
1987	154,614	28,045	126,569
1988	173,197	20,971	152,226
1989	211,201	17,834	193,367
1990	158,474	6,452	152,022
Total	1,438,113	396,257	1,041,856

(a) Accident year 1980
(b) 1990 payments for all years prior to 1981
(c) 1 + (2)/(1)
(d) 1 + (7)/(6)

EXHIBIT 7
Part 1
SALVAGE AND SUBROGATION RESERVE PROJECTION
METHOD 3—ADAPTED BORNHUETTER-FERGUSON

Accident Year	(1) Salvage and Subrogation Received @ 12/31/89	(2) Salvage and Subrogation Received @ 12/31/90	(3) Age-to-Age Factor [(2)/(1)]	(4) 12/31/90 Factor to Ultimate	(5) Percent of Recoveries Unreported [1 − 1/(4)]
Prior	33,261(a)	22,146(b)	1.6658(c)	1.0000	0%
1981	44,596	49,701	1.1145	1.6658	40
1982	51,216	58,268	1.1377	1.8565	46
1983	45,169	52,804	1.1690	2.1121	53
1984	54,051	61,176	1.1318	2.4692	60
1985	42,666	62,954	1.4755	2.7946	64
1986	29,999	38,052	1.2684	4.1235	76
1987	20,291	28,045	1.3821	5.2304	81
1988	13,697	20,971	1.5311	7.2292	86
1989	9,801	17,834	1.8196	11.0684	91
1990		6,452		20.1402	95

EXHIBIT 7
Part 2
SALVAGE AND SUBROGATION RESERVE PROJECTION
METHOD 3—ADAPTED BORNHUETTER-FERGUSON

Accident Year	(6) Projected Ultimate Loss & ALAE	(7) Expected Recovery Ratio	(8) Estimated Salvage and Subrogation Reserve [(5) × (6) × (7)]	(9) Estimated Ultimate Salvage and Subrogation [(2) + (8)]	(10) Indicated Recovery Ratio [(9)/(6)]
1981	5,405,329	0.016	33,514	83,215	0.015
1982	6,197,270	0.016	44,188	102,456	0.017
1983	7,101,341	0.016	58,339	111,143	0.016
1984	8,432,516	0.016	78,424	139,600	0.017
1985	9,734,415	0.016	96,568	159,522	0.016
1986	11,018,491	0.016	129,801	167,853	0.015
1987	12,441,103	0.016	156,201	184,246	0.015
1988	13,278,817	0.016	177,011	197,982	0.015
1989	13,416,986	0.016	189,251	207,085	0.015
1990	13,696,887	0.016	201,691	208,143	0.015
Total	100,723,155		1,164,986	1,561,243	0.016

(a) Accident year 1980
(b) 1990 recoveries for all years prior to 1981
(c) 1 + (2)/(1)

EXHIBIT 8
Part 1
SALVAGE AND SUBROGATION RESERVE PROJECTION
COMPARISON OF ESTIMATES

Accident Year	Ultimate Recoveries Method 1	Ultimate Recoveries Method 2	Ultimate Recoveries Method 3
1981	82,793	78,317	83,215
1982	108,175	99,709	102,456
1983	111,530	106,120	111,143
1984	151,053	138,664	139,600
1985	175,934	161,967	159,522
1986	156,908	155,850	167,853
1987	146,688	154,614	184,246
1988	151,604	173,197	197,982
1989	197,394	211,201	207,085
1990	129,944	158,474	208,143
Total	1,412,023	1,438,113	1,561,243

EXHIBIT 8
Part 2
SALVAGE AND SUBROGATION RESERVE PROJECTION
COMPARISON OF ESTIMATES

Accident Year	Salvage and Subrogation Reserve Method 1	Salvage and Subrogation Reserve Method 2	Salvage and Subrogation Reserve Method 3
1981	33,092	28,616	33,514
1982	49,907	41,441	44,188
1983	58,726	53,316	58,339
1984	89,877	77,488	78,424
1985	112,980	99,013	96,568
1986	118,856	117,798	129,801
1987	118,643	126,569	156,201
1988	130,633	152,226	177,011
1989	179,560	193,367	189,251
1990	123,492	152,022	201,691
Total	1,015,766	1,041,856	1,164,986

EXHIBIT 8
Part 3
SALVAGE AND SUBROGATION RESERVE PROJECTION
COMPARISON OF ESTIMATES

Accident Year	Ultimate Recovery Ratio Method 1	Ultimate Recovery Ratio Method 2	Ultimate Recovery Ratio Method 3
1981	0.015	0.014	0.015
1982	0.017	0.016	0.017
1983	0.016	0.015	0.016
1984	0.018	0.016	0.017
1985	0.018	0.017	0.016
1986	0.014	0.014	0.015
1987	0.012	0.012	0.015
1988	0.011	0.013	0.015
1989	0.015	0.016	0.015
1990	0.009	0.012	0.015