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LOSS RESERVING FOR SOLVENCY

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Abstract

Loss reserving plays an important role in safeguarding a casualty insurance company's solvency. The specific role, however, depends upon the size of the carrier.

For example, the primary threat to the surplus of most large, multiline insurers is the sudden and unanticipated development of losses from prior accident years. For such a carrier, loss reserving promotes solvency in the most direct manner possible—by attempting to maintain adequate reserves for each unresolved accident year.

Of course, small casualty insurers share this concern over loss reserve adequacy. For this second type of carrier, however, adverse loss development represents only one of several ongoing threats to its existence. A small insurer's surplus can also fall victim to less controllable hazards, such as a year or two of poor underwriting results or undetected rate level deficiencies.

To combat these added dangers, the capital structures of new, monoline casualty companies often incorporate features seldom seen in larger carriers. Small insurers, for instance, sometimes employ policyholder assessments and expensive, low level reinsurance as primary defenses against surplus impairment.

Unfortunately, most small insurance companies do not efficiently utilize these potentially powerful capital structures. A principal cause of this underutilization is the failure of these companies to choose loss reserving policies appropriate to their specific type of capitalization.

This report demonstrates, by example, how a small insurance company can energize its capital structure by selecting appropriate loss reserving policies. The dramatic impact of such a choice on the company's profit and survival prospects is also quantified.

I. USING COMPUTER SIMULATION TO SELECT LOSS RESERVES THAT COMPLEMENT A SMALL, PRIMARY INSURER'S CAPITAL STRUCTURE

Most loss reserve reviews for large, established casualty insurers focus on the adequacy of the tested reserves. In this type of situation, an actuary's attention centers on factors which directly affect the accuracy of his loss development calculations, such as the quality, availability, and form of underlying data.[1] Once he understands these elements, the actuary typically recommends loss reserves which equal his estimates of each unresolved year's expected loss development.

Usually, recommending appropriate loss reserves for new or small casualty carriers is less straightforward. This complexity is not the result of the obvious, inevitable, and surmountable problem of data unavailability. Rather, loss reserving for a small insurer is more complicated than reserving for an insurance monolith because a smaller company's capital structure is, of necessity, more complex.

These complex capital structures complicate the loss reserving process since a company's loss reserves interact with its capital structure. In a typical captive insurance company, for example, higher than expected loss reserves may trigger additional capital contributions from the insurer's parent, or assessments from its policyholders. Since these contingent capitalizations often form the carrier's first line of defense against insolvency, this interplay between capital and reserves directly impacts the company's chances of survival.

With its survival at stake, a small casualty insurance company should use loss reserve procedures which consider this interaction between loss reserving and its capital structure. Until now, however, an affordable technique for measuring this interplay has not been available.

[1] A fairly complete list of elements to be considered is found in J. R. Berquist and R. E. Sherman [2].

Thanks to recent advances in microcomputer technology, it is now possible to inexpensively simulate the impact of specific loss reserving programs on a small insurer's capital structure. This report illustrates how Monte Carlo computer simulation can be used to quantify the effect of several different loss reserving methods on a hypothetical captive insurance company's policyholder assessment mechanism. As will be demonstrated, observing this interaction between reserves and capital enables the actuary to recommend a loss reserving procedure which unleashes the full potential of the carrier's capital structure, thereby improving both the company's solvency prospects and its expected profitability.

Outline of Section I

Section I demonstrates, by example, how a small primary casualty company can energize its capital structure by selecting appropriate loss reserving policies. Specifically, the following passages describe how a mythical, monoline captive insurer selects and applies loss reserving policies which enhance the effectiveness of its policyholder assessment provisions.

This example is presented in four parts:

1. The two subsections immediately following this outline introduce the Consulting Actuaries' Reciprocal Exchange (CARE), a hypothetical captive insurance company. These sections also review the circumstances prompting CARE to reserve for solvency.
2. The third subsection following discusses the mechanics of establishing "solvency reserves."
3. The fourth and fifth subsections describe the computer simulation model used to compare the effectiveness of different loss reserving methods.
4. Finally, results and conclusions are summarized in the last three subsections of Section I.

The Company

A recent article in these *Proceedings* [1] discusses a computer model for establishing the appropriate operational requirements of a hypothetical professional liability insurance carrier. This paper extends these earlier findings.

The company analyzed in that article, the Consulting Actuaries' Reciprocal Exchange, is an offshore, mutual insurer with the following features:

1. CARE provides $1 million per occurrence of casualty actuaries' errors & omissions insurance.
2. CARE begins operation with 1,000 members.

3. CARE charges uniform, $1,750 per actuary annual premiums.
4. CARE policyholders pay a flat membership fee.
5. CARE policies are assessable.
6. CARE quota shares a portion of its exposure.

The paper suggested twelve possible CARE membership fee/reinsurance/policyholder assessment combinations. A simulation model then estimated the company's profit and survival expectations under each scenario.

As a result of this analysis, CARE elected to:

- Quota share 25% of its exposures;
- Charge prospective policyholders a $500 membership fee; and,
- Include a policy provision empowering management to assess each member up to 100% of the annual premium whenever operating losses threaten to exhaust the company's surplus.

Given these decisions and the assumptions presented in that paper, CARE management can anticipate average annual surplus growth in excess of 20% with a 4% probability of insolvency over a ten year period.

CARE and the Real World

Unfortunately, the previous paper's idyllic income tax provisions and surplus requirements seldom apply to real captive insurance companies.

- Generally, an insurer's operating income is taxed on a carryback/carryforward basis—that is, operating losses can only be used to offset taxes already paid, or which become due in future years.
- In most cases, a captive insurer's surplus must be maintained at a specified level, sometimes a percentage of net written premium.

Assuming more realistic income tax and surplus requirements dramatically changes the results of the previous analysis. A 250 trial simulation carried out under appropriate tax and surplus assumptions,[2] for example, indicates an 11% chance that CARE's policyholder surplus will be exhausted during the carrier's first ten years of operation. Clearly, this result is in marked contrast to the corresponding 4% probability obtained under the original assumptions.

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[2] Specifically, the model assumes that:

- income is taxed subject to a three year carryback and seven year carryforward of operating losses; and,
- policyholder surplus, after the deduction of all carried reserves, must be maintained at not less than 20% of premium.

Of course, CARE could reduce this probability of insolvency by directly strengthening its capital structure, e.g., by increasing policyholder assessments or purchasing more reinsurance. However, increases in capitalization invariably cost the company money or place a greater risk burden on individual CARE policyholders.

Fortunately, increasing capital or buying more reinsurance are not the company's only options. The remainder of Section I demonstrates that:

1. CARE's existing capital structure operates inefficiently under traditional loss reserving approaches; and
2. CARE can substantially improve its profit and survival prospects by selecting a loss reserving policy which interacts more effectively with its capital structure.

The following paragraphs describe a procedure for choosing such a loss reserving program.

The Mechanics of Establishing Solvency Reserves

The next few subsections investigate the effect on CARE's capital structure, and hence its solvency, of establishing loss liabilities over and above its required reserves.[3] In particular, these subsections examine the profitability and survivability of a carrier that bases its carried loss liabilities on selected upper percentiles of the company's aggregate incurred loss distribution.

This concept of a solvency reserve, then, is quite simple.[4] However, reserving for solvency in a real world situation requires some not so simple decisions regarding methodology.

The following paragraphs present two legitimate techniques for computing solvency reserves. The implications of using each method are also examined; as a result of this examination, one approach is selected for use in this paper.

[3] Required reserves are amounts necessary to fund anticipated loss development.

[4] Some readers may feel that this use of the term "reserve" is inappropriate, since it is not readily apparent that solvency reserves meet generally applicable standards for legal reserves (quantifiability, relationship to specific events, etc.).

Solvency reserves as presented and defined in this paper do meet these traditional standards. For example, Sections I and II establish their quantifiability, and Section III offers a reasonable argument for their foreseeability. In any event, whether they are reserves in the traditional sense or mere accounting nuances, solvency reserves are clearly an effective and necessary management tool for small, risky insurers.

Method 1—Description: The first reviewed calculation sets each accident year's incurred losses equal to a designated percentile of the line's aggregate incurred loss distribution. Thus, the company's total loss reserve equals

Estimated Percentile of Aggregate Incurred Loss Distribution
less
Losses Paid to Date

This total reserve is then broken into its "required" and "solvency" pieces.

For example, suppose that an insurer decides to base its current accident year's loss reserve, at the twelve month valuation, on its estimate of the 95th percentile of the coverage's total loss distribution. Further assume that the company's actuary estimates that this percentile equals 178% of expected losses. Finally, suppose that this coverage's underlying rate levels assume expected losses of $1,000,000.

Given these assumptions, Method 1 sets accident year incurred losses equal to $1,780,000, or 178% of $1,000,000. This $1,780,000 includes both required and solvency reserves, as well as loss payments to date. Required reserves, of course, are merely the difference between developed accident year losses and amounts paid to date. For instance, if developed incurred losses total $1,200,000, of which $250,000 were paid during the year's first twelve months, then the following breakdown applies:

Paid Losses Through 12 Months	$250,000
Reserve for Expected Losses [$1.2 MM − $250,000]	$950,000
Solvency Reserve [$1.78 MM − $1.2 MM]	$580,000
Total Accident Year Incurred Loss:	$1,780,000

Note that Method 1's logic self-destructs whenever a year's developed incurred losses exceed the specified percentile level. In such cases, reserves must be based on the higher estimate; no solvency reserve is established.

Method 1—Analysis: Method 1 and the procedure for developing Schedule P statutory reserves share a number of similarities. First, unless developed incurred losses exceed the target loss level, the total reserve is established without consideration of the year's actual incurred losses. Second, it follows from the previous observation that a given year's total incurred losses, at least through early valuations, can be projected with reasonable precision. Finally,

for new, small insurers, this approach usually results in incurred loss development factors less than unity.

Method 2—Description: A second technique for calculating solvency reserves utilizes traditional loss reserving procedures to establish the reserve for expected loss development. A separate calculation then sets the solvency reserve equal to the expected difference between the year's specified percentile and its mean loss levels.[5]

Refer again to our earlier example. Given the previous assumptions, Method 2 always produces a solvency reserve of $780,000, or 78% of expected losses. Of course, the required reserve ($950,000) and loss payments to date ($250,000) again apply. Thus, Method 2's incurred losses of $1,980,000, the sum of these three components, are $200,000 higher than the Method 1 estimate. Reflection reveals the reason for this difference—under Method 2, solvency reserves are not reduced as a result of higher than expected reported losses.

Method 2—Analysis: This second approach has the important advantage of directly incorporating the actuary's best estimate of anticipated loss development into the established reserve. Also, Method 2 avoids the illogic of solvency reserves which vary inversely with a given accident year's incurred losses.

For the above reasons, the solvency reserves examined in the following sections are developed using a Method 2 calculation.

Illustrations of typical solvency reserve calculations used in this paper are provided in Appendix C.

The Model: Assumptions

The next few sections describe the computer simulation model used to compare the effectiveness of alternative loss reserving programs for the Consulting Actuaries' Reciprocal Exchange. This model requires assumptions regarding:

- CARE's expected claim frequency and distribution of the number of claims;
- CARE's average claim size, and the corresponding distributions of claim amounts;
- The parameter error in estimating claim frequency and claim size averages;
- The number of participating actuaries;

[5] The reader may recognize this technique of segregating actual and expected losses in the process of establishing loss reserves. See R. L. Bornhuetter and R. E. Ferguson [3].

- Frequency and severity trends;
- Collectibility of assessments;
- Overhead and other administrative costs;
- Policy terms and the distribution of effective dates;
- Anticipated rate level changes;
- Commissions CARE earns on its ceded reinsurance;
- Payout of incurred losses;
- Interest earned on investable funds;
- Taxation of CARE operating income;
- Rate at which the accuracy of a given accident year's pure premium estimate improves;
- Tax treatment of reserves for losses greater than expected amounts; and,
- Statutory policyholder surplus requirements.

A detailed discussion of each of the above sixteen assumptions is provided in Appendix A.

Four Loss Reserving Alternatives

The Monte Carlo model compares simulated CARE operating results under four loss reserving programs:

1. *Standard loss reserving,* in which all accident year reserves equal the actuary's best estimate of expected loss development.
2. A *90-A Program.* Under this second approach, accident year reserves include, in addition to amounts for anticipated loss development, a solvency reserve equal to the expected difference between the company's 90th percentile and mean loss levels.[6]
3. An *80-A Program,* identical to Program 2, but with solvency reserves based upon 80th percentile loss levels.
4. A *95/90/85/80 Program*—i.e., loss reserving in which:

   (a) The current accident year's reserve contains both funding for anticipated loss development and a Method 2 solvency reserve. This solvency reserve equals the expected difference between the company's 95th percentile and mean loss levels.

   (b) The immediately preceding accident year's reserve equals the reserve required for expected loss development, plus a solvency reserve based on the 90th percentile of the line's total loss distribution.

[6] In instances where establishing reserves greater than the actuary's best estimate of expected loss development impairs CARE's surplus, solvency reserves are reduced to the extent necessary to continue operating the company.

(c) Similarly, solvency reserves for the second and third prior accident years are based upon 85th and 80th percentiles of the respective loss distributions.[7]

For the interested reader, Appendix B provides a table displaying simulated percentiles of CARE's go-in pure premium distribution.

The Model: Results

For each of these four loss reserving programs, our computer model simulates 250 trials of CARE operating experience. Each trial incorporates ten years of randomly generated CARE profits and losses.

To illustrate how our model translates earlier assumptions into program output, Table 1 displays results of the third trial of a 95/90/85/80 simulation.

From each simulation, our computer extracts the following information:

- Whether CARE remains solvent;
- CARE's average annual surplus growth[8] over the simulated ten year period;
- The number of times a call for a policyholder assessment is needed during the ten year period.

Table 2 summarizes these results.

[7] The subtle but significant advantages of a 95/90/85/80 program over a 90A or an 80A approach are discussed in the final passage in Section I: "Selecting the Best Loss Reserving Program."

[8] Average Annual Surplus Growth is determined by the tenth root of the ratio:

$$\frac{\text{Ending Surplus} + \text{Year 10 Solvency Reserve} - \text{Policyholder Assessments}}{\text{Surplus at Start (\$500,000)}}$$

Note that this computation purposely includes investment income earned on policyholder assessments. These funds, once received, become a legitimate and indivisible part of CARE's policyholder surplus. For the sake of the comparisons presented in this paper, however, average surplus growth calculations are adjusted to exclude the assessments themselves. Fairer comparisons result if call funds are removed from all calculations.

Of course, other surplus growth calculations are possible.

TABLE 1

RESULTS OF THE THIRD TRIAL OF 95/90/85/80 SCENARIO
(All Dollar Figures are in Thousands)

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Net Earned Premium	$1,313	$1,313	$1,313	$1,444	$1,588
Reinsurance Commission	33	33	33	36	40
Investment Income	106	287	358	460	529
Calendar Year Inc'd Loss*	$1,322	$762	$205	$1,141	$773
Change in Solvency Reserve**	818	536	376	250	191
Expenses Incurred	263	210	175	193	212
Income Taxes Paid	0	0	56	164	451
Surplus at Start***	$500	$863	$987	$1,878	$2,070
Policyholder Assessments	1,313	0	0	0	0
Surplus at End***	863	987	1,878	2,070	2,600
Claim Cost Inflation	12.0%	13.7%	11.7%	12.3%	12.6%
Number of Members	1,000	1,000	1,000	1,000	1,000

	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
Net Earned Premium	$1,922	$2,325	$2,813	$3,404	$4,120
Reinsurance Commission	48	58	70	85	103
Investment Income	629	755	871	991	1,154
Calendar Year Inc'd Loss*	$2,537	$2,831	$2,697	$1,607	$2,329
Change in Solvency Reserve**	347	492	663	804	919
Expenses Incurred	256	310	375	454	549
Income Taxes Paid	−249	−228	9	743	727
Surplus at Start***	$2,650	$2,413	$2,206	$2,283	$3,229
Policyholder Assessments	0	0	0	0	0
Surplus at End***	2,358	2,146	2,217	3,156	4,083
Claim Cost Inflation	12.7%	14.1%	12.0%	9.8%	9.1%
Number of Members	1,100	1,210	1,331	1,464	1,611

Avg. Annual Surplus Growth (includes full solvency reserves):	32.2%
Avg. Annual Surplus Growth (solvency reserves taxed at 46%):	27.5%

* Before inclusion of solvency reserves.
** See Appendix C for underlying calculations.
*** Surplus reflects full deduction of solvency reserves.

The Model: Conclusions

As indicated in Table 2, each nonstandard loss reserving program improves CARE's profit and solvency expectations when compared with corresponding results achieved under standard reserving.

- Column 2 quantifies the dramatic improvement in CARE's solvency prospects which occurs under each alternative loss reserving program. Particular improvement is observed under 90A and 95/90/85/80 reserving.
- Column 3 illustrates that the company's profitability, as measured by its average annual surplus growth over a ten year period, also improves under nonstandard reserving. Reflection (or a glance ahead to Appendix D)

TABLE 2

COMPARISON OF CARE'S SIMULATED SOLVENCY AND PROFITABILITY UNDER ALTERNATIVE LOSS RESERVING PROGRAMS

Reserving Policy (1)	Percent of Trials In Which CARE Becomes Insolvent (2)	Average Annual Surplus Growth[9,10] 50th %ile (3a)	10th %ile (3b)	90th %ile (3c)	# Trials* Requiring: 0 or 1 Call (4a)	2 or More Calls (4b)
Standard Reserving	11.2% (28 Times)	19.1%	CARE Fails	29.1%	193	29
90A	5.6% (14 Times)	29.6%	0	34.4%	96	140
80A	8.8% (22 Times)	25.5%	0	32.1%	132	96
95/90/85/80	5.2% (13 Times)	29.4%	0	34.4%	97	140

* Excluding trials in which CARE becomes insolvent.

[9] Median surplus growth figures are used instead of mean results due to the extreme skew of the average surplus growth distribution.

[10] Column 3 assumes that solvency reserves are never taxed. A case can be made that these reserves must ultimately be repatriated and, therefore, taxed at 46%. Taxing year 10's solvency reserve changes average annual growth figures as follows:

Program	50th %ile	10th %ile	90th %ile
90A	24.5%	0	31.0%
80A	22.0%	0	30.0%
95/90/85/80	23.4%	0	30.9%

reveals the two sources of this increased profitability:

Income tax savings, and accrued investment income thereon.

Increased use of policyholder assessments, particularly during CARE's early years. These policyholder assessments generate additional investment income.

Most importantly, column 4 demonstrates the reason for the column 2 and 3 improvements. Specifically, this final column details the increased usage of CARE's principal source of contingent capitalization—policyholder assessments—under all three nonstandard programs.

In summary, Table 2 reveals that each of the three tested loss reserving alternatives energizes CARE's capital structures and thus improve both the company's profit and survival prospects. In so doing, prudent solvency oriented loss reserving policies enable CARE to avoid excessive use of more expensive capitalization or reinsurance options.

The Final Step: Selecting the Best Loss Reserving Program

Finally, CARE's actuary must choose a reserving program to recommend to the company's management. A review of Table 2 narrows his choices to the second and fourth programs tested. Moreover, given the obvious analytical parity of these two alternatives, selecting the more appropriate program—90A or 95/90/85/80—becomes a matter of the actuary's preference.

For both aesthetic and practical reasons, a 95/90/85/80 approach should be favored.

Aesthetically, 95/90/85/80 loss reserving allocates a larger proportion of the company's solvency reserves to recent, unsettled accident years. In so doing, this program places a heavier share of the financial burden of solvency protection on those accounts whose riskiness poses the gravest threat against continued solvency.

More importantly, despite the minimal difference suggested in the second column of Table 2, 95/90/85/80 loss reserving is often more effective than a 90A approach. First, since a 95/90/85/80 program places greatest emphasis on the most recent accident years, this approach better protects solvency during periods of rapid premium growth. Furthermore, the following section demonstrates that this difference in effectiveness increases in proportion to the riskiness of the underlying exposure.

II. LOSS RESERVING FOR SOLVENCY: ANOTHER SITUATION

Intuitively, the solvency reserving program described in Section I might seem less appropriate for a reinsurer dealing in volatile, excess layers of coverage. The following paragraphs test this conjecture by simulating the impact of a solvency oriented reserving policy on an insurance company that provides excess errors & omissions insurance.

The Consulting Actuaries' Reciprocal Exchange (Revisited)

Again consider CARE, our hypothetical captive insurance company. In this case, however, suppose that the company provides $900,000 of insurance in excess of the first $100,000 of loss sustained in any covered occurrence.

Assumptions (Revisited)

As in Section I, we use computer simulation to test CARE's relative solidity under four loss reserving policies. Also, most of the assumptions utilized in the earlier analysis apply again in this second situation. However, note the following three differences:

1. First Year Premium: Given the layer of coverage insured and earlier assumptions regarding applicable claim size distributions, a more realistic per actuary premium is $875 ($1,750 in Section I).
2. Loss Payout: To reflect the slower loss payout anticipated at this higher level of coverage, a uniform five year (i.e., 20/20/20/20/20) payout pattern is assumed.
3. Member Assessability: Due to the smaller premium base and added riskiness of this insurance, CARE empowers its management to assess each member as much as 200% of his annual premium during a given calendar year.

Results and Conclusions (Revisited)

Given these revised assumptions, we used the same model to compare the relative effectiveness of the four reserving programs discussed earlier. Table 3 shows the observed results.[11]

[11] Results for Section I were based upon 250 simulations for each tested reserving policy. The results presented in Table 3, on the other hand, are generated from only 100 trials. Allowances must be made for the larger sampling error in these results.

TABLE 3

EFFECTIVENESS OF ALTERNATIVE RESERVING PROGRAMS FOR EXCESS E&O INSURER (Coverage: $900K excess of $100K)

Reserving Policy (1)	Percent of Trials In Which CARE Becomes Insolvent (2)	Average Annual Surplus Growth			# Trials* Requiring:	
		50th %ile (3a)	10th %ile (3b)	90th %ile (3c)	0 or 1 Call (4a)	2 or More Calls (4b)
Standard Reserving	16% (16 Times)	16.4%	CARE Fails	24.1%	74	10
90A	10% (10 Times)	24.2%	Fails	30.2%	41	49
80A	12% (12 Times)	20.6%	Fails	28.3%	49	39
95/90/85/80	8% (8 Times)	26.1%	0	31.0%	32	60

* Excluding trials in which CARE becomes insolvent.

Columns 2 and 3 confirm that nonstandard loss reserving techniques improve this excess insurer's profit and solvency expectations less dramatically than they improve the corresponding prospects of the primary company analyzed in Section I. Just as clearly, however, some improvements in both profitability and survivability occur.

Again, reasons for these improvements are suggested by Column 4.

III. ON CHOOSING LEGITIMATE LOSS RESERVING POLICIES

The preceding analysis draws specific conclusions regarding the effectiveness of solvency oriented loss reserving as a means of energizing the potentially powerful capital structures of new, small insurance companies. Nothing said thus far, however, addresses the equally important question of what constitutes an acceptable loss reserving policy for such an insurer.

Any legitimate reserving policy must meet at least two standards:

1. Reserves must be based upon reasonably foreseeable estimates of incurred loss.

   Applying this standard to a large, multiline carrier severely restricts the range of legitimate reserving policies, possibly to those based on traditional estimates of developed losses. For this reason, the analysis

presented on the preceding pages has little relevance for many domestic U.S. insurance companies.

For small, risky insurers like the ones discussed in this paper, however, estimates of ultimate losses are subject to substantial error, even when made at a 24- or 36-month development. For example, Appendix B illustrates that a given year's losses for the primary insurance company described in Section I can be expected to differ from go-in estimates of expected losses by more than 30% in half of all instances.

Thus, for carriers like the ones considered in this paper, this writer believes that loss reserving programs based on loss percentiles greater than expected levels meet this standard of foreseeability.

2. The principal purpose of such a policy must be to decrease the company's chances of insolvency, and not to avoid paying income taxes.

In this regard, the following section demonstrates how solvency oriented loss reserving may actually increase the expected present value of the insurer's ultimate tax payments.

IV. ON THE INCOME TAX IMPLICATIONS OF LOSS RESERVING FOR SOLVENCY

The results presented in Sections I and II assume favorable tax treatment of all established loss reserves, including solvency reserves.[12] That is, the preceding analysis assumes that taxing authorities allow a carrier to deduct from its taxable income an amount equal to its solvency reserve.

Of course, the degree to which income tax authorities accept solvency reserves as legitimate deductions will depend upon several external factors, not the least of which is the incorporation of a solvency reserve calculation into the N.A.I.C. Convention Statement. Thus, speculating on the likelihood or timing of solvency reserves becoming deductible is probably premature, and certainly beyond the scope of this report. However, two general observations can be made:

1. For reasons already presented, reserving for solvency works with or without favorable tax treatment of solvency reserves.

2. Properly applied, reserving for solvency increases long-term tax expense. This increase occurs for three reasons:

[12] See assumption 15, Appendix A.

a. As described earlier, a new or risky insurer carrying solvency reserves can be expected to generate more investment income (on additional assessments and income tax savings) than a company not opting for these reserves.

b. Eventually, a surviving insurer becomes large or mature enough to eliminate its dependence on solvency reserves. At such a time, the carrier's solvency reserves would be taken down, resulting in a sizable flow of taxable income.

c. A carrier which reserves for solvency is more likely to survive long enough to pay its income taxes.

A Net Present Value Comparison of Income Tax Liabilities

Straightforward actuarial analysis illustrates that reserving for solvency, when properly applied, actually increases the expected present value of an insurer's income tax payments.

Consider, for example, Appendix D's development of the expected present value of CARE's taxable income, discounted for both inflation and survivability, under traditional and solvency reserving. In particular, a comparison of lines 11.c and 14.c demonstrates that the expected present value of the company's income tax payments under 95/90/85/80 reserving is greater than the corresponding figure developed under standard loss reserving. In addition, comparing lines 12 and 15 establishes that the company can expect to have more investable assets at the end of ten years—a result of additional collected assessments and the investment income accruing thereon—under nonstandard loss reserving. This latter observation, of course, implies that CARE's future taxable earnings will continue to be greater under the nonstandard reserving scenario, despite the just completed takedown of all solvency reserves.

Clearly, loss reserving for solvency is anything but an effective means of avoiding income taxes.

V. LOSS RESERVING FOR SOLVENCY: A POST-MORTEM

This paper demonstrates the importance of a small casualty insurer selecting loss reserving policies which complement its capital structure.

In fact, the previous sections illustrate how a well thought out loss reserving program can energize a dormant but potentially powerful capital structure, thereby improving a carrier's chances of profitably surviving. Moreover, this

increased capital effectiveness enables the carrier to reduce its reliance on other, expensive forms of capitalization, such as stop loss or quota share reinsurance.

On a more subjective level, reserving for solvency injects an element of discipline into the financial management of new, risky insurers. In particular, an actuarially sound, solvency oriented loss reserving program provides a carrier with a ready-made philosophy of maintaining specific levels of operating capital within the company. This discipline, in turn, may profoundly affect the insurer's ability to withstand the temptation to distribute to its members premature and potentially unwarranted dividends. Furthermore, for exchanges like the ones discussed in this paper, loss reserving for solvency provides the most legitimate possible justification for delaying repatriation (hence taxation) of questionable captive income.

I hope that this report will encourage a fuller examination of present and possible solvency oriented loss reserving procedures, and thereby promote the development of other applications of the concepts presented in this paper.

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APPENDIX A

SIXTEEN ASSUMPTIONS UNDERLYING CARE SOLVENCY SIMULATION (SECTION I)

1. Expected Claim Frequency / Underlying Frequency Distribution: CARE anticipates 2.5 claims per 100 insured actuaries. Also, a Poisson frequency process is assumed.

2. Expected Average Claim Size / Assumed Severity Distributions: An average claim size (limited to $1,000,000/occurrence) of approximately $56,500 is assumed. CARE also estimates that 98% of all claims will be lognormally distributed with a 3.5 coefficient of variation; the remaining 2% of losses, each above $500,000, will follow a Pareto distribution (Pareto parameter = 1.30).

3. Parameter Error: The average frequency and severity noted in the previous assumptions are subject to standard errors of 0.2 claims and $6,000, respectively.

4. Number Of Insureds: CARE anticipates 1,000 participating actuaries in each of its first five years, with 10% annual membership growth thereafter.

5. Frequency And Severity Trends: A 12% increase in CARE claim costs is assumed for the first year. Thereafter, the annual change in the claim inflation rate is assumed to be normally distributed with an average change of 0 and a 1 point standard deviation. No claim frequency trend is anticipated.

6. Assessment Collectibility: Three fourths (75%) of assessments are assumed to be collectible when due.

7. Expenses: CARE's administrative expenses and unallocated adjustment costs total 15% of premium during year 1, 12% in year 2, and 10% thereafter.

8. Policy Term And Policy Effective Date: All policies are written for one year, effective January 1.

9. Rate Level Changes: Annual premium increases of 10% occur at the end of each of years 3 through 9.

10. Ceded Reinsurance Commission: CARE receives a 7.5% commission on all reinsurance it cedes.

11. Loss Payout: A given policy year's losses are paid over five years, in 30/25/20/15/10 proportions.

12. Investment Return: Funds invested by CARE earn an average 10% return.

13. Taxation Of CARE Income: Operating income is taxed at 46%, subject to standard (3 year/7 year) carryback/carryforward provisions.

14. Improvement In Policy Year Pure Premium Estimates: At its outset, a policy year's pure premium estimate is subject to the variability described in Appendix B. These estimates improve linearly through the end of year five, at which point the pure premium is assumed to be fully known.

15. Favorable Tax Treatment Of Solvency Reserves: All reserves are treated as an offset to CARE income in the year in which they are established.

16. Surplus Requirements: Per the standards of certain offshore jurisdictions, CARE is required to maintain policyholder surplus at not less than 20% of the current year's net written premium.

APPENDIX B

APPROXIMATE PERCENTILES OF A TYPICAL FIRST YEAR CARE TOTAL LOSS DISTRIBUTION

(Based on 1,000 Simulations)

Percentile	Insurer Providing First $1 MM of E&O Insurance (Section I) Percentage of Expected Loss	Insurer Providing $900K x/s $100K of E&O Coverage (Section II) Percentage of Expected Loss
25th	59%	22%
40th	79%	58%
50th	93%	79%
60th	107%	102%
70th	122%	133%
75th	131%	153%
80th	141%	175%
85th	157%	198%
90th	173%	222%
95th	197%	277%
97.5th	219%	314%

APPENDIX C

CALCULATION OF 95/90/85/80 SOLVENCY RESERVES

FIRST FOUR CALENDAR YEARS PRESENTED IN TABLE 1

(Dollar Figures in Thousands)

Valuation at End of Calendar Year	Acc. Year	Accident Yr Net Expected Losses	Selected Percentile: Per 95/90/85/80 Reserving Program	(4A) As a Percentage of Expected Losses (Per App B)	% of Accident Year Variability Remaining (App A, # 14)	A/Y Solvency Reserve As a Percent of Expected Loss {[(4B)-100]X(4C)}	Accident Year Contribution To Solvency Reserve [(3) X (4D)]
(1)	(2)	(3)	(4A)	(4B)	(4C)	(4D)	(5)
1	1	$1,058	95th	196.6%	80%	77.3%	$818
					Total Solvency Reserve for Calendar Year:		$818
					Calendar Year Change in Solvency Reserve:		$818
2	2	$1,151	95th	196.6%	80%	77.3%	$890
	1	$1,058	90th	173.2%	60%	43.9%	$464
					Total Solvency Reserve for Calendar Year:		$1,354
					Calendar Year Change in Solvency Reserve:		$536
3	3	$1,270	95th	196.6%	80%	77.3%	$982
	2	$1,151	90th	173.2%	60%	43.9%	$505
	1	$1,058	85th	157.4%	40%	23.0%	$243
					Total Solvency Reserve for Calendar Year:		$1,730
					Calendar Year Change in Solvency Reserve:		$376
4	4	$1,386	95th	196.6%	80%	77.3%	$1,071
	3	$1,270	90th	173.2%	60%	43.9%	$557
	2	$1,151	85th	157.4%	40%	23.0%	$265
	1	$1,058	80th	140.8%	20%	8.2%	$87
					Total Solvency Reserve for Calendar Year:		$1,980
					Calendar Year Change in Solvency Reserve:		$250

APPENDIX D

COMPARISON OF EXPECTED PRESENT VALUE OF CARE'S INCOME TAX PAYMENTS UNDER STANDARD AND SOLVENCY LOSS RESERVING PROCEDURES

(Dollar Figures are in Thousands)

	Standard Loss Reserving				95/90/85/80 Reserving With Solvency Reserves Taken Down at End of Year 10				
Year	Expected Net Revenues	Expected Losses & Expenses	Taxable Income [(2)−(3)]	Income Taxes Paid [46% of (4)]	Expected Net Revenues‡	Change in Solvency Reserve	Taxable Income [(6)−(7)−(3)]	Tax Loss Carry-Forward From Prior Years	Income Taxes Paid [46% of (8) +(9): 0 if neg.]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	$1,431	$1,320	$111	$51	$1,434	$818	−$704	N/A	0
2	$1,498	$1,361	$137	$63	$1,638	$536	−$259	N/A	0
3	$1,549	$1,431	$118	$54	$1,709	$365	−$87	N/A	0
4	$1,721	$1,565	$156	$72	$1,903	$244	$94	−$43	0
5	$1,898	$1,715	$183	$84	$2,106	$184	$207	−$95	0
6	$2,279	$2,072	$207	$95	$2,516	$334	$110	−$51	0
7	$2,746	$2,506	$240	$110	$3,017	$471	$40	−$19	0
8	$3,315	$3,036	$279	$128	$3,625	$608	−$19	N/A	0
9	$4,005	$3,682	$323	$148	$4,360	$756	−$78	N/A	0
10	$4,841	$4,474	$368	$169	$5,248	−$4,316	$5,090	−$84	$2,258

SUMMARY—STANDARD LOSS RESERVING:

11. (a) Present Value (at 10%) of Expected Income Tax Payments, Years 1–10	$565
(b) Probability of CARE Surviving Through Year 10 [Table 2]	88.8%
(c) Present Value of Taxes, Discounted for Survivability [(11a) × (11b)]	$502
12. Investable Assets Available to CARE at the End of its Tenth Year	$7,036
13. Policyholder Surplus at the End of CARE's Tenth Year	$1,951

SUMMARY—95/90/85/80 RESERVING WITH RECOVERY:

14. (a) Present Value (at 10%) of Expected Income Tax Payments, Years 1–10	$871
(b) Probability of CARE Surviving Through Year 10 [Table 2]	94.8%
(c) Present Value of Taxes, Discounted for Survivability [(14a) × (14b)]	$825
15. Investable Assets Available to CARE at the End of its Tenth Year	$9,341‡‡
16. Policyholder Surplus at the End of CARE's Tenth Year	$4,257‡‡

‡ Column (6) revenues are higher than column (2) figures because investment income is higher under a 95/90/85/80 program. Investment income is higher due to reduced income taxes and interest on policyholder assessments.

‡‡ Includes $1,312,500 of collected first year assessments, plus accumulated interest thereon.