Revisions In Loss Reserving Techniques Necessary To Discount Property-Liability Loss Reserves

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Abstract

Statutory accounting principles for property-liability insurers in the United States in all but very special circumstances do not recognize the time value of money in the establishment of the loss reserves. The Tax Reform Act of 1986 stipulates an interest rate and a methodology for discounting loss reserves for tax purposes. The National Association of Insurance Commissioners (NAIC) is studying the discounting issue. Insurers need to consider the appropriate procedures and interest rates to be used in discounting loss reserves. This paper proposes a method of calculating loss payout patterns based on paid loss development data combined with other reserving techniques that would minimize the additional effort involved in adopting discounting and also analyzes the repercussions of adopting discounting for statutory accounting purposes.

Discounting loss reserves would have both positive and negative effects on the property-liability insurance industry. Discounting at an appropriate interest rate would increase the usefulness of the combined ratio as a profitability measure, with values less than 100 indicating profits and in excess of 100 indicating losses subject to the accuracy of loss reserves. Statutory surplus would increase as a result of discounting, which, although having no real economic effect, might provide more capacity for the insurance industry due to regulatory reliance on statutory values. Conversely, discounting would increase the complexity of loss reserving, create a dependence of reserve adequacy on future interest rate levels, and increase the expenses of insurers by raising tax levels. Discounting would have its greatest impact on commercial and professional liability insurers.

Introduction

The Revenue Act of 1921 established the statutory accounting principles of the property-liability insurance industry as the basis for determining federal income taxes. These accounting principles include the provision for an unearned premium reserve that ignores prepaid expenses, thus leading to an equity in the unearned premium reserve. These principles also establish that the loss reserves represent the best estimate of total future payments on losses that have already occurred regardless of when the payment is to be made. Discounting, although allowed in specific instances of periodic payments, is generally not used. Statutory accounting principles are based on the need to assure company solvency and, in most instances, are recognized as being conservative.

Several recent developments led the federal government to reconsider the provisions of the Revenue Act of 1921. The property-liability insurance industry has been extremely unprofitable from 1982 through 1986, based on statutory accounting principles, reducing federal income tax receipts. The industry received tax refunds of approximately $1.7 billion in 1984 and $2.0 billion in 1985 for taxes paid in prior years [16, 21]. New forms of insurance transactions also demonstrate that in times of high interest rates, the opportunity to use undiscounted loss reserves can lead to tax driven financial transactions. A group of insurers provided retroactive liability insurance at a price below expected losses to MGM Grand Hotels after a major fire had occurred. Leading to this below full cost pricing was

the knowledge that the underwriting loss created by this transaction would shelter other income from taxes and the premium income would be invested for a number of years before the loss would be paid [28]. In another case, a large insurer with a surfeit of tax losses sold loss reserves to an insurer in a tax paying situation by transferring responsibility for paying losses to the other insurer and paying that insurer a sum less than the value of the loss reserves. The first insurer immediately booked an underwriting profit and the second an underwriting loss on the transaction [15]. Finally, an important motive behind the development of captive insurers is for noninsurance corporations to obtain the right to use insurance accounting techniques for their self insurance programs by meeting whatever legal constraints apply [27].

The combined ratio is the total of the loss ratio and the expense ratio. Traditionally, an insurer is considered profitable as long as the combined ratio is below 100 percent. The use of an undiscounted loss ratio generates problems with this benchmark because insurers can operate profitably with combined ratios well in excess of 100 percent. An alternative profitability measure is the operating ratio, which subtracts the ratio of investment income to earned premium from the combined ratio. Often an operating ratio less than 100 percent is considered profitable for the insurer in total by combining underwriting and investment results. Two problems arise from this measure. First, the investment income value includes interest and dividend income and realized capital gains and losses, but does not include unrealized gains or losses. The realized gains may have been generated in the current period, or in prior years. Thus the investment income does

not really reflect the achieved rate of return in the current period. Second, the investment income is based to a large extent on prior periods' premiums collected, loss reserves established and investments made. It does not reflect the future investment experience on the current book of business as it develops. Therefore, the operating ratio is an inexact profitability measure.

Although the emphasis of the discounting issue has involved loss reserves, premiums may also need discounting. If the premium is paid after the coverage period, as is the case for paid loss retrospective contracts, premiums must be discounted if losses are discounted.

The General Accounting Office (GAO) proposed requiring property-liability insurers to discount loss reserves for determining federal income taxes [10, 14]. This provision would immediately boost insurer taxable income which would increase the amount of Federal taxes payable by the property-liability insurance industry. Use of tax loss carry-forwards could delay the impact of the increased tax level. Under the GAO proposal, loss reserves would be discounted based on the average pre-tax investment income rate achieved by each insurer over the preceding five years. The Treasury Department recommended requiring property-liability insurers to establish qualified reserve accounts (QRA) as a method of discounting loss reserves for all policies issued on or after January 1, 1986 [13, 23]. This proposal allows insurers to establish their own procedures and interest rates for the QRA, subject to approval of the Internal Revenue Service. Under certain circumstances, the QRA method is equivalent to applying a cash accounting system to losses.

The Tax Reform Act (TRA) of 1986 includes five changes in property-liability insurance taxation in addition to the general corporate tax changes. Starting in 1987 loss reserves are to be discounted using the applicable federal rate on midmaturity (three to nine year) securities based on the five year period prior to the calendar year for which discounting is applied. However, months prior to August, 1986, are not included in determining the discount rate. A "fresh-start" approach applies under which beginning reserves are treated as having been discounted, but the change in accounting profits generated by applying discounting to previously undiscounted loss reserves is not taxed. Insurers can use either loss payout patterns calculated by the Treasury Department or company payout patterns. In addition to discounting loss reserves, 20 percent of the change in unearned premium reserve is included in taxable income, the loss reserve deduction is reduced by 15 percent of tax-exempt interest and dividends received on investments made after August 7, 1986, the protection against loss account (PAL) for mutuals is eliminated, and special deductions for small mutual insurers are rescinded. Of the general corporate tax provisions included in TRA, applying the alternative minimum tax to book earnings, which include tax-exempt income, will also significantly affect property-liability insurance operations.

All federal discounting provisions apply only to loss reserve deductions used in determining taxable income. They do not address the issue of discounting statutory loss reserves, which have always been subject to state regulation. The current situation requires maintaining statutory loss reserves as stipulated by state insurance

law and separately calculating the discounted loss reserves for income tax purposes. The National Association of Insurance Commissioners is also considering loss reserve discounting, although no model regulations have been adopted. A number of industry trade associations have raised issues related to discounting [1, 9].

By not discounting loss reserves, insurers are maintaining a safety margin, which varies by reserve accuracy, interest rates, and loss payout patterns. There is no formal recognition of this safety margin and it is not generally quantified. If loss reserves were discounted, this safety margin would be eliminated. In its place some actuaries propose the establishment of a formal risk loading. This risk loading would vary with the size and degree of accuracy of the loss reserve. It could vary by line and by insurer. If such a risk loading were adopted as an allowable deduction, it would serve to reduce the tax impact of discounting and improve the theoretical support for conservatism in statutory accounting.

The purposes of this paper are to determine what steps property-liability insurers would have to take in order to comply with loss reserve discounting and to analyze the repercussions of these changes. This research demonstrates the effect of discounting on the industry and proposes a methodology for insurers to calculate loss payout patterns based on company data.

Loss Reserving Techniques

Currently a number of loss reserving techniques are used to determine the value for the loss reserve. For statutory accounting purposes,

actuaries need only project the total amount to be paid in the future for losses that have already occurred (or reported for claims-made coverage), without any concern about when the loss will be paid. The one exception is for periodic payments under workers' compensation. The difficulty of achieving this goal is apparent by observing the accuracy of past loss reserve figures. Numerous studies have indicated that large errors in loss reserves, either under or overreserving, have occurred from the 1960's through the most recent reserves tested. Forbes [12], Anderson [2], and Balcarek [3] demonstrate that loss reserves for the industry were progressively less adequate through the 1960s. Smith [26] determines a pattern of overreserving during the period 1955-1961, underreserving for 1962-1970, overreserving for 1971-1972, and underreserving for 1973-1974, for a sample of insurers' automobile liability loss reserves. Weiss [30] shows that reserving errors tend to stabilize insurer profitability.

A number of specific loss reserving techniques are described and critiqued in the actuarial literature [24, 25]. Among the more commonly used reserving procedures are individual case estimates, the average value method, the loss ratio method, incurred loss development, and paid loss development. Also, for each basic technique a number of enhancements have been proposed to deal with special circumstances. Each technique has its advantages and disadvantages. Generally actuaries recommend using more than one technique and establishing the loss reserve at the level about which several methods cluster.

The paid loss development reserving technique, described in detail later, is readily adaptable to discounting. However, insurers should

not emphasize this reserving technique and dismiss the other reserving methods simply due to this feature. Actuaries should continue to determine loss reserves based on a variety of reserving techniques, and then apply the paid loss development data, as demonstrated in this paper, to establish the loss payout pattern. The primary loss reserving techniques will be presented and critiqued to demonstrate the need for reliance on a number of calculations in establishing the loss reserve.

Individual Case Estimates

Under the individual case estimates method of loss reserving, claims department personnel assign an individual value to all known claims. The total loss reserve is the sum of all the individual claim estimates, with an adjustment to reflect historical differences between the total case reserve and ultimate loss development. This adjustment covers the incurred but not reported loss reserve plus or minus any systematic underreserving or overreserving on the case estimates. The individual case estimates method is accurate only if any bias in individual case reserving estimates is consistent and if claim reporting patterns do not change. The case reserve value is based on the presumed final settlement value of the claim and does not consider the length of time until settlement. This method does not provide any information concerning when the loss is likely to be paid.

One problem with this reserving methodology is the learning process of claims personnel. As these individuals develop more expertise in settling claims, any consistent bias they may have reflected in prior years could be corrected. For example, a claims person who consistently underreserved losses is likely to increase reserve values.

If this change occurred throughout the claims department, the adjustment made to total case reserves based on historical factors would prove to be inaccurate.

Another problem is the effect of shifts in reporting patterns. If new claim procedures increase the speed of entering claims into the system, or if a weekend or other work interruption delays recording claims at the end of a reporting period, this method could be incorrect. Consistency in both claim estimation and reporting is necessary for the individual case estimate method to be accurate.

Average Value Method

The average value method of loss reserving uses claim counts and average claim values to determine the loss reserve. If this method is used to value reported claims only, the number of reported but unsettled claims is multiplied by an estimate for the average cost of settling the claims. Individual loss estimates are not material. If this method is used to value the total reserve, the total number of claims is projected from reported claims based on historical claim reporting patterns. Average claim values are projected from prior claim payments, with the recognition that larger claims tend to be settled more slowly than smaller claims.

The average value loss reserve method provides no information on when a claim is to be paid. Although this procedure does not depend on consistency in claims department reserving estimates, it does depend on consistency in reporting and settlement patterns. Also, the projection of average values, based on historical averages and trends,

must be accurate. Changes in the rate of inflation or other factors that affect claim severity, such as deductibles or policy limits, must be considered.

A commonly used combination of reserving techniques is for insurers to use the average value reserving method for quickly settled claims. After a claim has been open for a period of time, a case estimate method is used. In this situation, the strengths and weaknesses of each method apply depending on the length of time the claim is open. For claims that have not been open long, on which information is likely to be incomplete, average values are used to establish the reserve. The simple cases that are settled quickly never change value using this reserving method. As a case remains open and the opportunity exists for more information to be collected, individual case reserve estimates are used. During the average reserve period, reporting patterns must be consistent for this method to produce accurate reserves. Also, the method used to determine average claim values must be accurate. For the time that the case estimate method is used, reserving bias and reporting patterns have to be consistent for the method to generate accurate reserves. The major advantage of this combination of reserving methods is that claims personnel need not maintain reserving consistency prior to the investigation of the claim.

Loss Ratio Method

The loss ratio method of loss reserving determines the reserve by subtracting the losses paid to date from the total expected losses. Total expected losses are calculated by multiplying the expected loss

ratio by the earned premium. Changes in claim reporting patterns, bias in establishing case reserves, and shifts in average claim values do not affect the accuracy of this reserving procedure. As long as the ultimate loss ratio estimate is accurate, this procedure will be correct. However, any inaccuracy in the loss ratio estimate generates inaccurate loss reserves.

This method of loss reserving does not provide any information on when the loss is to be paid. It is a useful method when the expected loss ratio can be projected accurately, and claim reporting and reserving patterns have not been consistent. For lines of business with long loss payment tails, this method can be risky for an insurer since rates are established from past loss experience and any inaccuracy in this loss reserving procedure would not be apparent for a long time.

Incurred Loss Development

The incurred loss development method of loss reserving calculates the loss reserve by projecting current incurred losses, which are paid losses plus outstanding case reserves, to ultimate incurred loss levels based on historical development patterns. The loss reserve is the total projected incurred losses minus losses paid to date. Outstanding reserves may be established on an average value basis, by individual case estimates, or by a combination of these methods. Unlike the case estimate reserving method, losses paid to date are also used in projecting ultimate losses.

Partial and ultimate incurred loss development factors are calculated from historical information. Partial loss development factors are generally determined by examining the change in incurred losses for a specific accident year (or other exposure period) from one report period to the next. The ultimate incurred losses are not known until all losses are settled which, for liability lines, can take decades. Reliance on loss development factors based on an era when conditions may have been considerably different from the current time introduces substantial risk into the reserving process. A commonly used technique in this reserving method is to combine partial incurred loss development factors with ultimate development factors. This technique combines the currency of recent development experience for the most volatile segment of the reserve period with the stability of older values for the remaining period.

This method of loss reserving does not provide information on when losses are to be paid. The accuracy of this method depends on consistency in loss reporting, settlement and reserving. It is less sensitive to changes in loss reserving than the case estimate methodology since paid losses are also included. This reserving procedure is widely used by insurers and is useful for long tailed lines.

Paid Loss Development

The paid loss development method of loss reserving calculates the reserve by projecting ultimate losses from losses paid to date based on historical development patterns. The loss reserve is the total projected losses less the losses paid to date. This method of loss

reserving can easily be used to indicate when losses will be paid in the future. A number of variations of paid loss development are described in Berquist and Sherman [4], all of which could be used to calculate when losses will be paid.

The accuracy of this reserving technique depends on consistency in loss settlement patterns. It is not dependent on consistent reporting patterns or case reserve estimates. Changes in the rate of inflation, which can affect loss payments, shifts in company procedures that influence settlement patterns, or societal shifts such as changes in court backlog can all cause inaccuracies in this reserving method. This procedure is widely used by insurers. The major drawback for this technique is the length of time necessary to determine ultimate loss payments for long tailed lines and the likelihood of changes in factors that influence payment patterns occurring during this time. A possible combination of reserve procedures is to use payment development for a number of years and then incurred development to ultimate subsequent to that period. When losses will be paid cannot be determined directly from the loss development data for the time incurred loss development is applied.

An example of the method used to calculate paid loss development values is illustrated below:

Accident Year	Paid Losses Development Year 1	2	3	4	5	6	7	8	Incurred Losses
1976	$C_{76,1}$	$C_{76,2}$	$C_{76,3}$	$C_{76,4}$	$C_{76,5}$	$C_{76,6}$	$C_{76,7}$	$C_{76,8}$	$C_{76,8} + R_{76,8}$
1977	$C_{77,1}$	$C_{77,2}$	$C_{77,3}$	$C_{77,4}$	$C_{77,5}$	$C_{77,6}$	$C_{77,7}$		$C_{77,7} + R_{77,7}$
1978	$C_{78,1}$	$C_{78,2}$	$C_{78,3}$	$C_{78,4}$	$C_{78,5}$	$C_{78,6}$			$C_{78,6} + R_{78,6}$
1979	$C_{79,1}$	$C_{79,2}$	$C_{79,3}$	$C_{79,4}$	$C_{79,5}$				$C_{79,5} + R_{79,5}$
1980	$C_{80,1}$	$C_{80,2}$	$C_{80,3}$	$C_{80,4}$					$C_{80,4} + R_{80,4}$
1981	$C_{81,1}$	$C_{81,2}$	$C_{81,3}$						$C_{81,3} + R_{81,3}$
1982	$C_{82,1}$	$C_{82,2}$							$C_{82,2} + R_{82,2}$
1983	$C_{83,1}$								$C_{83,1} + R_{83,1}$

where C_{ij} = cumulative paid losses for accident year i through the end of development year j, and

R_{ij} = reserves for accident year i as of the end of development year j.

Ultimate paid losses for accident year i, C_{iu}, are projected from losses paid through development year j, C_{ij}, by the following calculation:

$$C_{iu} = C_{ij} \left(\frac{C \cdot u}{C \cdot j}\right)$$

where $\frac{C \cdot u}{C \cdot j}$ = standard paid loss development factor from development year j to ultimate

The standard paid loss development factor is calculated from historical experience. The most recent ultimate experience, average values for a number of years, or trended values, could be used to determine the standard factors. Once the ultimate paid losses are projected, the outstanding reserves are determined by subtracting paid losses to

date, C_{ij}, from the estimate of ultimate paid losses, C_{iu}. Partial paid loss development factors are often used to modify indications produced by the use of a ultimate paid loss development factors. This technique, similar to the use of partial incurred loss development factors, is useful when changes in the loss payment pattern have occurred.

In order to determine when losses will be paid in the future, loss payout patterns can be calculated from paid loss development factors. Let P_{ij} equal the percent of ultimate paid losses for accident year i paid in development year j. P_{ij} is calculated by:

$$P_{ij} = (C_{ij} - C_{i,j-1})/C_{iu}$$

The more mature an accident year, the more accurate the estimate of ultimate losses is likely to be. The paid loss development factors can be used to project when the outstanding reserves will be paid. The outstanding reserve for accident year i at the end of development year j represents the following:

$$R_{ij} = (\sum_{k=j+1}^{u} P_{ik})C_{iu}$$

This equation states that the outstanding reserve is the sum of the percentage of losses to be paid in each subsequent development year times ultimate losses. The amount to be paid in the next development year, j+1, can be determined by the following:

$$C_{i,j+1} - C_{ij} = R_{ij} \left(\frac{P_{i,j+1}}{\sum_{k=j+1}^{u} P_{ik}}\right)$$

Similarly, subsequent years of loss payments can be determined. Thus, this method of loss reserving can be used to project when losses will be paid for use in discounting loss reserves.

Proposed Revision in Reserving Techniques

In order to discount loss reserves, it is necessary to estimate both the total future payments on losses that have already occurred and when the loss payments will be made. Since most insurance accounting occurs on an annual basis, projecting the year of loss payment will usually be sufficient. This paper assumes annual periods for loss payment patterns. More accurate determination of the proper discounting reserve level could be made if a shorter unit of time were used. McClenahan has proposed a reserving methodology based on monthly periods that would allow discounting [18].

If insurers relied solely on paid loss development to establish reserves, shifts in loss settlement patterns could lead to inaccurate reserves. Although this loss reserving technique directly projects when losses will be paid, a combination of paid loss development and other reserve procedures can be used to estimate loss reserves and to project when losses will be paid.

In order to discount loss reserves without reducing the accuracy of loss reserving methods, the loss reserve should be established based on the best reserving methods available without regard to discounting. This approach will generally involve selecting a value from a number of reserve indications determined by applying several methods of loss reserving. The payment pattern for the outstanding reserves can then be determined as follows:

Let R_{ij} = the outstanding reserve for accident year i as of the end of development year j

$P_{\cdot j}$ = the standard percentage of losses paid during development year j

The standard percentage of losses paid, $P_{\cdot j}$, can be determined by a number of methods, subject to the constraint that $\sum_{j=1}^{n} P_{\cdot j} = 1$. Averages, least squares regression, trending, or use of the most recent values are all potential methods to determine $P_{\cdot j}$.

The losses for accident year i to be paid within one year of the evaluation date j can be calculated by:

$$E_{i,j+1} = R_{ij}\left(P_{\cdot j+1} \Big/ \sum_{k=j+1}^{u} P_{\cdot k}\right)$$

where $E_{i,j+1}$ = losses for accident year i projected to be paid in development year j+1.

The best estimate of the loss reserve as of evaluation date j for accident year i is multiplied by the proportion of outstanding losses based on the paid loss development method that will be paid during the next, j+1, development year. The paid loss development method is used to project the payout pattern, but not necessarily the loss reserve. Similarly, the losses for accident year i to be paid in the second year after the evaluation date j are determined:

$$E_{i,j+2} = R_{ij}\left(P_{\cdot,j+2} \Big/ \sum_{k=j+1}^{u} P_{\cdot,k}\right)$$

To determine the total losses from all accident years to be paid in the year following evaluation date j, the following calculation should be performed:

$$T_1 = \sum_{i=f}^{\ell} R_{i,\ell-i+1}\left(P_{\cdot,\ell-i+2} \Big/ \sum_{k=\ell-i+2}^{u} P_{\cdot,k}\right)$$

where f is the first accident year with losses still outstanding

ℓ is the latest accident year

T_1 is the total losses from prior accident years to be paid in following development year.

Industry Impact

Assuming that property-liability insurers do not implicitly discount loss reserves now, the adoption of discounting would result in a number of changes. Loss reserves would be lower, surplus would increase, and loss ratios would decline [17]. To examine the effect of discounting on the industry, the 1983 Industry Total Annual Statement, provided by A. M. Best Company, was analyzed. The loss development data included on Schedules O and P were used to project industry loss payment patterns for the Schedule O lines, automobile liability, other liability, medical malpractice, workers' compensation, and the multiple peril lines. These payment patterns were then applied to the outstanding reserves to project when the outstanding losses would be paid. The future payments were then discounted.

Determination of the appropriate discount rate is a crucial problem in implementing loss reserve discounting. No consensus yet exists on the correct methodology. The GAO proposal relies on an individual insurer's past investment income rate. The TRA dictates use of the historical interest rate on midmaturity U.S. securities. Cummins and Chang propose use of the current risk-free interest rate, which is generally considered the rate on short term U.S. government issues [5].

Myers and Cohn propose use of the risk adjusted rate of return based on the capital asset pricing model [19]. However, the risk adjustment factors are not constant over time or consistent across insurers, which leads to severe implementation problems [6].

The discount rates as of 1987 determined by the various approaches described above range from approximately 5 percent for the risk free rate to 10 percent for some insurers' historical values. A rate of approximately 7 percent will be required by the TRA method for 1987 and prior accident years. The two endpoints are used to illustrate the ramifications of loss reserve discounting. The results are extremely sensitive to the selected discount rate, indicating that much additional research should focus on the proper methodology for determining the discount rate. The rate mandated under the Tax Reform Act of 1986 does not have any theoretical support and was chosen primarly for revenue producing considerations [20].

As discussed earlier, a number of methods exist for determining loss payment patterns based on historical data. The 1983 Annual Statement blank provides for information on cumulative paid losses and loss adjustment expense for the most recent eight years as shown on Table I. Losses paid in a particular development year can be determined by subtracting adjacent cumulative values, if both are available. The percent of ultimate losses can be determined by dividing the losses paid in a development year by the total accident year losses, which can be estimated by adding the outstanding reserve for a given accident year to the cumulative paid losses through the latest available development year.

For this project the loss payment pattern was determined by using the cumulative paid loss value for each accident year as of the latest development period. This method assumes that all years develop similarly and all future paid loss development will be consistent with the latest year's experience. Use of averages or trended values can produce more stable results, but the annual statement does not provide enough information to use a better method for all development years and for all lines. For the five years that multiple development is available, paid loss development factors have been fairly consistent for automobile liability, workers' compensation, and multiple peril lines. Other liability and medical malpractice both indicate a shift to greater loss payments in the early development years starting in 1982. Introduction of claims made policies may have caused this shift in payment pattern or underreserving for these years may be indicated.

Paid loss development must be projected for each development year until all losses are paid. The Annual Statement shows only eight years of development. Based on the outstanding reserves after eight years, Schedule O lines have 2.85 percent of losses unpaid, automobile liability 1.74 percent, other liability 16.19 percent, medical malpractice 32.16 percent, workers' compensation 13.69 percent, and multiple peril lines 1.63 percent. For all except the Schedule O lines, the same percent of losses paid in development year eight are assumed to be paid in subsequent years until all losses are settled. This assumption is conservative since losses are likely to be paid at a decreasing rate. This method results in all losses being settled by development year 18. Unpaid losses after eight years of development on

Schedule O lines generally represent reinsurance involving lines that would normally appear on Schedule P. The same 18 year maximum settlement time is applied to Schedule O development. The calculated percent of losses and loss adjustment expenses paid in each development year by line is shown on Table II.

Assuming that the payment patterns by line projected from the 1983 Industry Total Annual Statement apply to accident year 1983, a discounted accident year loss and loss adjustment expense ratio by line can be calculated. Losses paid in the first development year, 1983, are undiscounted. Losses to be paid in the second development year, 1984, are discounted by $(1+d)^{1/2}$, where d is the interest rate at which losses are discounted. The use of this factor assumes that losses to be paid in the second development year will be paid halfway through the year or equally throughout the year. Losses to be paid in the third development year, 1985, are discounted by $(1+d)^{3/2}$, and so forth with losses to be paid in the 18th development year, 2000, are discounted by $(1+d)^{33/2}$. The undiscounted loss and loss adjustment expense ratios by line for 1983 and the corresponding discounted loss and loss adjustment expense ratios based on a 5 percent and 10 percent interest rate are shown in Table III.

Discounting reduces the total loss and loss adjustment expense ratio from 82.43 percent to 77.67 at a 5 percent discount rate and to 74.18 percent at 10 percent discount rate. The combined ratio, based on the 28.44 percent industry expense ratio, is 110.87 percent undiscounted, but only 102.62 if loss and loss adjustment expense reserves are discounted at 10 percent. Even with discounting at a rather high

rate, the industry did not earn an underwriting profit based on discounted loss reserves for 1983.

Several caveats should be emphasized at this point. Calculation of these discounted loss and loss adjustment expense ratios assumes that the outstanding reserves for accident year 1983 are correct. Many observers feel these reserves are inadequate [22]. Second, it is assumed that current reserves are not discounted. If they are already discounted, this calculation indicates the effect of additional discounting. At the end of 1983, most insurers were not explicitly discounting any reserves except some periodic payments under workers' compensation. Some medical malpractice writers now do discount loss reserves, but the insurer used as an illustration was not explicitly discounting at the end of 1983.

The procedure used to discount all years' loss reserves is similar to the method used to discount accident year 1983 loss and loss adjustment expense reserves. For accident year 1982 outstanding reserves, two years of payments have already occurred by the end of 1983. Thus, the outstanding losses are projected to be settled based on payment development from year three to ultimate. Similarly, outstanding reserves for accident years 1976 through 1981 are projected to be paid based on the remaining payment tail values. The annual statement blank combines all accident years prior to 1976; for this project these reserves are treated as accident year 1975 losses.

The effect on the industry of discounting all years' loss and loss adjustment expense reserves but not including any increase in income taxation (based on the "fresh-start" provision) is shown in Table IV.

The loss and loss adjustment expense reserve declines from $121 billion undiscounted to $106 billion if discounted at 5 percent and $94 billion if discounted at 10 percent. Discounting reserves would increase policyholders' surplus which would affect premium to surplus ratios. The 1983 industry premium to surplus ratio is 1.66 without discounting, 1.34 discounting reserves at 5 percent, and 1.18 discounting reserves at 10 percent. The industry's reported financial position would be dramatically different if loss reserves were discounted. In economic terms, no real change would occur. Statutory values would be different, but no change in the economic value of the industry would take place.

Individual Company Impact

The impact of discounting loss reserves varies markedly by company based on line of business mix, claim settlement patterns, and individual financial position. Three companies were selected to illustrate the differing impact. Company A is a multiline insurer, company B specializes in personal lines, and company C writes only medical malpractice insurance. The effect of discounting loss reserves on the loss and loss adjustment expense ratio, the combined ratio, and the net written premium to surplus ratio for each company is shown on Table V.

In calculating the effect of discounting for individual insurers, two differences from the industry method were used. First, cumulative paid loss development for each of the first eight development years is the average of values shown in the 1982 and 1983 annual statements. Prior years are not available for the industry aggregate experience. Second, Schedule P experience for that insurer in total, rather than by

line, is used, to avoid distortions of a single line's payout pattern of an insurer.

For the multiline insurer, Company A, discounting at a 10 percent rate reduces the accident year loss and loss adjustment expense ratio from 95.7 percent to 79.1 percent. The combined ratio is still unprofitable at 111.3 percent, reduced from 127.9 percent. The personal lines carrier, Company B, shows a much smaller reduction in loss and loss adjustment expense ratio, from 85.8 percent to 82.0 percent. The smaller reduction results from faster loss payments in these lines. Even this minor reduction is enough to reduce the combined ratio below 100 from 103.0 percent to 99.2 when loss reserves are discounted at a 10 percent rate. For Company C, the medical malpractice insurer, discounting reduces the loss and loss adjustment expense ratio significantly, from 156.8 percent to 96.1 percent when discounted at a 10 percent rate. The combined ratio reduces from 161.5 percent to an almost profitable 100.8 percent.

Similar differences in the impact on the premium to surplus ratio occur. On the extremes, Company B shows only a modest shift in this ratio, whereas for Company C the premium to surplus ratio plummets from 3.71 to 0.43 when reserves are discounted at the 10 percent rate. It should be remembered that these values are correct only if current reserves are accurate and undiscounted, and loss payment patterns are consistent.

Repercussions from Adopting Discounting

Discounting property-liability insurance loss reserves would have a number of effects on the industry, some favorable and some unfavorable. Among the favorable results would be:

1) Reestablish the value of the combined ratio as a profitability indicator. Investment earnings would be directly included in this ratio. Hence, levels under 100 would be profitable and levels over 100 would be producing losses, assuming the proper discount rate is used and reserve accuracy was consistent at the beginning and end of the year.

2) Increase the statutory capacity of the industry. Statutory surplus would increase as loss reserve liabilities were reduced. To the extent that statutory surplus values serve as a constraint on an insurer's ability to write more business, this accounting change would indicate that there is more surplus available to write additional business or to shift to other uses. Current concerns over capacity shortages may be alleviated by this accounting change [29]. Many insurance conventions, including allowable premium to surplus ratios, have evolved from historical periods when economic conditions were significantly different from today. Compared with any time prior to the 1970s, interest rates are now higher and loss payout patterns longer. Both of these changes serve to reduce the value of discounted loss reserves compared to undiscounted values. Thus statutory surplus, which is calculated based on undiscounted loss reserves, is reduced well below the level that would have been determined based on a market value accounting for loss reserves. When interest rates were low and loss payments relatively short, discounted loss reserves did not differ much from the undiscounted values. Thus, statutory surplus was a reasonable estimate of

the insurer's economic worth. The higher interest rates and slower loss payment patterns have, in effect, made statutory surplus a far more conservative estimate, but allowable premium to surplus ratios have not been adjusted to offset this development. Adopting loss reserve discounting for statutory accounting would correct this distortion that has gradually crept into insurance accounting.

Among the unfavorable effects of discounting would be the following:

1) Complicate the reserving process by requiring estimates of the total value of losses to be paid in the future, the timing of those payments, and the discount rate. The process, which is currently a time consuming calculation, will become even more involved, delaying the production of operating results.

2) Create a dependence on future interest rates. Discounting loss reserves is reasonable only if the insurer can earn interest on invested assets supporting the reserves in line with projected values. Volatile interest rates create the risk that the insurer may earn a rate less than that projected. To the extent that actual earnings fall below the interest rate used to discount loss reserves, loss reserves would be inadequate. Currently changes in interest rates do not affect the accuracy of statutory loss reserve levels for almost all cases. It is conceivable that future insurance insolvencies could result from falling interest rates if discounting is adopted for statutory accounting, as this would cause the loss reserves to

be inadequate. Several authors have suggested that property-liability insurers could match assets and liabilities, as is common for life insurers and banks, to eliminate interest rate risk [8, 11]. Liabilities of property-liability insurers vary stochastically, in some cases in line with changes in inflation. Therefore, it is impossible to match those liabilities with bond investments [7].

3) Increase taxation. The purpose of discounting proposals for the federal government is to raise additional tax revenue from the property-liability insurance industry. Additional taxes would simply be an expense passed on to the policyholders. Raising expenses would make the insurance product less attractive to consumers with a viable alternative to insuring.

Summary and Conclusions

Federal government pressure to raise revenues collected from the insurance industry has led to discounting loss reserves for income tax purposes. Arguments for a uniform accounting system and the desire to constrain rate levels may in turn lead regulators to impose discounting requirements for statutory accounting. This paper indicates some of the complications raised by discounting loss reserves. The effect of discounting loss reserves is significant. Current combined ratios reduce toward 100 percent when discounting at market rates is applied. Premium to surplus ratios also decline drastically, potentially indicating the presence of additional insurance capacity that was not evident under statutory accounting conventions. The reported financial

position of the property-liability insurance industry would look very different if discounting for statutory accounting were adopted.

The property-liability insurance industry officially ignores the concept of the time value of money and publicly declares that undiscounted values are the best indicators of industry results. Although many insurers do reflect the time value of money for internal reporting purposes, little uniformity in techniques exists. Lengthening loss payouts and high interest rates, in addition to the TRA provisions, are bound to increase pressure on regulators to extend this concept. Including investment income in rate calculations is one method of recognizing the time value of money. Discounting loss reserves is another. Insurers should initiate a more open discussion of the various techniques for dealing with discounting. This paper presents a method for calculating discounted loss reserves that can be implemented without disrupting the current loss reserving calculations. Hopefully, this research will encourage greater discussion and debate about incorporating the time value of money into insurance calculations.

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Table I

Annual Statement Information
Cumulative Paid Losses and Loss Adjustment Expense

Accident Year	Development Year 1	2	3	4	5	6	7	8
1976								Y
1977	X	X	X	X	X		Y	
1978	X	X	X	X	X	Y		
1979	X	X	X	X	X+Y			
1980	X	X	X	X+Y				
1981	X	X	X+Y					
1982	X	X+Y						
1983	X+Y							

Source:

X Schedule P, Part 3
Y Schedule P, Part 1; Schedule O, Part 3

Table II

Percent of Ultimate Loss and Loss Adjustment Expense Paid
in Each Development Year by Line
Property-Liability Industry Totals

Development Year	Schedule O Lines	Automobile Liability	Other Liability	Medical Malpractice	Workers' Compensation	Multiple Peril
1	58.90	35.95	12.10	5.80	27.42	56.18
2	29.37	29.75	15.56	8.59	24.80	26.87
3	4.53	14.38	11.38	9.00	12.71	5.12
4	2.00	9.00	13.09	12.17	8.75	4.46
5	1.44	4.49	9.91	10.34	4.84	2.26
6	0.59	2.58	8.25	10.58	3.51	1.44
7	0.18	1.19	6.98	8.07	2.88	1.31
8	0.14	0.92	6.54	3.29	1.40	0.73
9	0.29	0.92	6.54	3.29	1.40	0.73
10	0.29	0.82	6.54	3.29	1.40	0.73
11	0.29		3.11	3.29	1.40	0.17
12	0.29			3.29	1.40	
13	0.29			3.29	1.40	
14	0.29			3.29	1.40	
15	0.29			3.29	1.40	
16	0.29			3.29	1.40	
17	0.29			3.29	1.40	
18	0.24			2.55	1.09	
	100.00	100.00	100.00	100.00	100.00	100.00

Table III

Accident Year 1983 Loss and Loss Adjustment
Expense Ratios
Property-Liability Industry Totals

	Undiscounted	Discounted at 5%	Discounted at 10%
Schedule O	78.03	75.75	74.10
Automobile Liability	88.78	84.29	80.59
Other Liability	93.40	79.71	69.68
Medical Malpractice	117.41	90.70	73.92
Workers' Compensation	84.35	75.10	68.97
Multiple Peril	75.13	72.73	70.79
Total	82.43	77.67	74.18
Expense Ratio	28.44	28.44	28.44
Combined Ratio	110.87	106.11	102.62

Table IV

Net Written Premium to Surplus Ratios
Property-Liability Industry Totals
(000 omitted)

	Undiscounted	Discounted at 5%	Discounted at 10%
Loss and Loss Adjustment Expense Reserve	121,205,523	105,534,079	94,449,381
Policyholders' Surplus	65,835,979	81,507,423	92,592,121
Net Written Premium	109,263,815	109,263,815	109,263,815
Premium/Surplus	1.66	1.34	1.18

Table V

Impact of Discounting on Individual Insurers
Accident Year 1983

	Company A			Company B			Company C		
Discount Rate	0%	5%	10%	0%	5%	10%	0%	5%	10%
Loss and Loss Adjustment Expense Ratio	95.7	86.3	79.1	85.8	83.7	82.0	156.8	121.0	96.1
Expense Ratio	32.2	32.2	32.2	17.2	17.2	17.2	4.7	4.7	4.7
Combined Ratio	127.9	118.5	111.3	103.0	100.9	99.2	161.5	125.7	100.8
Net Written Premium to Surplus Ratio	1.60	1.24	1.06	0.96	0.93	0.90	3.71	0.68	0.4