Financial Pricing Models for Property-Casualty Insurance Products: Reserve Valuation Rates

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ABSTRACT

This paper analyzes the relationship between the reserve valuation rate and the indicated premium rate. The reserve valuation rate affects the capital embedded in the reserves. Full value loss reserves contain much embedded capital, whereas fair value reserves contain little (if any) embedded capital.

The amount of embedded capital in the reported loss reserves affects the return on capital. If the insurer prices its policies to achieve a target return on capital, the amount of embedded capital affects the premium rates.

This paper discusses the underlying concepts, and it presents the intuition for the analysis. A companion paper, "Federal Income Taxes and the Cost of Holding Capital," extends the analysis to include the effects of federal income taxes and the cost of holding capital. The illustration in this paper is carried over to the companion paper.

TERMINOLOGY

The reserve valuation rate in life insurance is the discount rate used to value the policy reserves. The discount rate is constrained by statutory regulation. For the maximum permitted reserve valuation rate, the NAIC Standard Valuation Law (1990) uses a dynamic standard, based on investment grade corporate bond yields minus a specified margin. The exact valuation rate depends on the characteristics of the insurance product, such as the reserve duration, surrender charges, and market value adjustments.[1]

For property-casualty business, statutory accounting requires full value reserves. This was economically beneficial before 1986, since it helped property-casualty insurance companies defer federal income taxes on their underwriting operations.

This deferment of federal income taxes ended with the Tax Reform Act of 1986, which set a 60 moving average of the federal mid-term rate as the valuation rate for tax basis reserves. After 1986, full value statutory reserves have been justified as a means of providing a risk margin in adverse scenarios, thereby helping maintain the solvency of companies.

[1] The codification of statutory accounting has taken a step in the same direction by setting a dynamic formula for the maximum interest rate permissible for non-tabular discounting; see SSAP 65, "Property and Casualty Contracts," paragraph 12.

With the advent of risk-based capital requirements in 1992, statutory solvency monitoring uses discounted reserves. The RBC formula uses a 5% loss reserve valuation rate coupled with the IRS loss payment patterns by line of business. The reserving risk charge in the RBC formula is expressed as an explicit capital requirement, not as a component of loss reserves.[2]

Loss Reserve Discounting

Property-casualty statutory accounting requires full value (undiscounted) reserves, except in certain limited circumstances:

1. Tabular reserve discounts are permitted on the indemnity portions workers' compensation long term disability claims (pension cases) and on long term disability claims written on accident and health insurance policies. These are annuity claims on impaired lives. Just as they are discounted on the life insurance statutory blank, they are discounted on the fire and casualty blank, whether the policies are written by life insurers, health insurers, or workers' compensation insurers. Tabular discounts are not permitted for medical benefits or for loss adjustment expenses, even if these benefits are paid on the same claims.
2. Reserve discounts are permitted for certain monoline (primarily single-state) medical malpractice writers. This regulation was designed to help privately organized "doctors' mutuals" write medical malpractice coverage without having to raise additional capital.
3. Reserve discounts may be specifically allowed by the insurance commissioner of the domiciliary state. These discounts are intended to enable a domestic company to continue operating even with low statutory surplus.

These three instances are *explicit* reserve discounts. Only the first of these (workers' compensation tabular discounts) is relevant to general property-casualty pricing models.

This paper deals with *implicit* reserve discounts. We differentiate among three items:

4. An *unintended* reserve deficiency stems from miscalculation of the indicated reserves. Sometimes this reflects poor actuarial judgment; sometimes this reflects unforeseeable legal, social, or economic developments. For instance, the surge in asbestos claims in the late 1990's and early 2000's was an unforeseen social and legal phenomenon which raised reserve indications for general liability.
5. An *intended* reserve deficiency is a conscious management decision to hold less than full value reserves to improve the reported surplus of the company. It is a company-wide surplus management decision, not a line of business pricing decision. The cost of an intended reserve deficiency is the increased present value of federal income tax liabilities.
6. An *implicit reserve discount* uses the present value of loss reserves, where the discount rate is the reserve valuation rate. The objective is income optimization, stemming from the reduced cost of holding capital. This is partially offset by the increased present value of federal income tax liabilities.

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[2] On the gradual change of property-casualty reserve valuation from a full value basis to a fair value basis, see Feldblum [1994: LRD].

We differentiate between an intended reserve deficiency and an implicit reserve discount:

Intended reserve deficiency: A company in weak financial condition may lower its carried loss reserves to show greater capital and surplus funds. If the company makes no other change in its operations, its return on invested capital is unchanged. The invested capital is simply moved from the loss reserves to policyholders' surplus.

An *implicit reserve discount* removes equityholder provided capital from the loss reserves and from policyholders' surplus. These funds may be

7. returned to the equityholders by means of stockholder dividends or repurchase of shares (or by policyholder dividends in a mutual insurance company), or
8. used for other purposes, such as to write more premium in profitable lines of business, to expand into other geographic areas, or to engage in other activities, such as financial services.

The implicit reserve discount reduces the implied equity flows and raises the return on invested capital. A major responsibility of corporate management is to make optimal use of investors' capital. From this perspective, the misuse of capital might be viewed as a dereliction of duty. Allowing equityholders' capital to sit idly in reserves and incur double taxation might be viewed as poor capital management.[3]

The received wisdom in the insurance industry is that greater reserve adequacy is better, since consumers seek insurance companies that are financially strong, and companies with more adequate reserves are less likely to fail. For well-managed and financially stable companies, this reasoning is not always true. Higher reserve adequacy may indicate poor capital management, a lower return on capital, and higher policy premiums. If the increased risk of insolvency is not material, many consumers would prefer lower premiums.

For a given premium rate, a higher anticipated reserve adequacy causes a lower return on capital. In a line of business where peer companies are holding partially discounted reserves, an insurer with full value reserves may be at an economic disadvantage.

CASH FLOWS VS EARNINGS

The anticipated reserve adequacy is an accounting phenomenon; it does not affect the underwriting cash flows. It *does* affect the federal income tax cash flows, the assets required to support the insurance operations, the capital requirements, and the implied equity flows.

The anticipated reserve adequacy would have little effect on product pricing in a non-regulated industry. It has been ignored by some financial analysts developing insurance pricing models, who have focused more on the company's cash flows than on implied equity flows. The resultant rate

[3] A risk of implicit reserve discounts is rating agencies might require greater statutory surplus. If management has indeed improved the company's return on capital and put the excess capital to better use, their actions may be viewed favorably by rating agencies.

indications are biased downwards, since they do not take into account the full cost of holding capital. For instance, Myers and Cohn [1978] use fully discounted loss reserves. They explicitly admit the inconsistency with statutory accounting (p. 67, footnote 1):

> *This view of policy reserves differs from the usual statutory insurance accounting view of posting full nominal or undiscounted reserves for losses and expenses.*

This can cause the Myers/Cohn model to understate the rate indications.[4]

Insurance rate filings assume that loss reserves are held at undiscounted values; any other assumption would contravene statutory requirements. A regulatory pricing model must assume full value reserves. The current use of the Myers/Cohn model in Massachusetts, with no adjustment for the cost of capital embedded in undiscounted loss reserves or gross unearned premium reserves, is inconsistent with regulatory requirements.

If one's peer companies are holding less than full value reserves, an assumption of full value reserves would produce non-competitive rates. A pricing model for a competitive insurance market should use the level of reserve adequacy expected for the block of business.

COST OF HOLDING CAPITAL

The cost of holding capital is the difference between the cost of equity capital and the after-tax investment yield, adjusted for any additional taxes paid on the funds used to reimburse this cost. The illustration below uses a 10% investment yield and a 15% cost of equity capital, leading to a $15\% - (1 - 35\%) \times 10\% = 8.5\%$ per annum cost of holding capital, exclusive of additional taxes paid on the funds used to reimburse this cost. Each dollar of capital held by the company for a period of one year costs the equityholders 8.5¢.

The policyholders pay this cost through the profit margin in the policy premium. The policy premium is a pre-tax cash flow, and the cost of holding capital is an after-tax cost. The 8.5% after-tax cost is equivalent to an 8.5% / (1 – 35%) = 13.08% addition to the policy premium. If the premium is paid at policy inception, the 13.08% must be discounted to the beginning of the year: 13.08% / 1.100 = 11.89%.

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[4] For discussion of the Myers/Cohn pricing model, see Feldblum [Disc of D&D].

A dollar of capital embedded in reserves for five years to fund the statutory full value reserves is equivalent to an amount of $1 + 1/(1+i) + 1/(1+i)^2 + 1/(1+i)^3 + 1/(1+i)^4 = (1 - v^5)/d = \$4.17$ held for one year.[5] The cost to the policyholder is $\$4.17 \times 11.89\% = \$0.50$.

At an investment yield of 10% per annum, embedding a dollar of extra capital in the loss reserves for five years costs the policyholder 50¢ in extra premium.

Conclusions

The illustrations in this chapter and the following chapter highlight the relationships among the valuation rate, the implied equity flows, the tax liability, the return on capital, and the indicated premium rate. We summarize the relationships and the pricing implications.

The reserve valuation rate is sometimes seen as an internal accounting matter, with no material effect on the company's cash flows or the indicated premium rate. It is not considered in traditional actuarial ratemaking, and it is sometimes neglected even in financial pricing models.

The true effect of the reserve valuation rate is too substantial for such cursory treatment.

- For the commercial casualty lines of business, the cost of holding capital is one of the largest costs in providing insurance coverage.
- Other insurance costs are needed to service the business. These costs include underwriting services, policy issuance, loss engineering, claims handling, and general home office expenses. The costs of holding full value reserves is a regulatory mandate.
- Most of the cost of holding capital goes to the IRS. The statutory requirements for full value reserves transfers funds from policyholders to the U.S. Treasury.[6]

The objective of insurance regulation is to safeguard the interests of policyholders, not to act as a collection agency for the IRS. The NAIC and the actuarial community would do well to streamline statutory accounting for the benefit of insurance consumers.

[5] In this formula, *v* is the reciprocal of unity plus the interest rate, or $v = 1/(1+i)$; *v* is also called the present value factor and sometimes the discount factor. The variable *d* is the discount rate, defined as $d = i/(1+i)$. If *i* is the interest rate paid in arrears, *d* is the corresponding rate paid in advance.

[6] The federal income tax effects are analyzed in the companion paper, Feldblum and Thandi [2002] "Federal Income Taxes and the Cost of Holding Capital."

Implicit discounting of loss reserves reduces the capital requirements in two ways: there is less capital embedded in the reserves, and the RBC reserving risk charge is reduced. If the reserving risk charge is 10% of held reserves, each dollar of implicit reserve discounting reduces the capital requirements by $1.10.[7]

Illustration: With a 10% investment yield and a 15% cost of equity capital, the after-tax cost of holding capital is 8.5%. Including the risk-based capital reserving risk charge raises this to about $1.10 \times 8.5\% = \$0.0935$. The reduction in the policyholder premium stemming from a dollar of implicit discount is

$$[\$0.0935/(1-35\%)] / 1.1 = \$0.1308.$$

If the reserve is held for five years, the reduction in the policyholder premium stemming from a dollar of implicit discount is

$$[\$0.0935/(1-35\%)] \times 4.17 = \$0.5453.$$

FEDERAL INCOME TAXES

Implicit discounting of loss reserves speeds up the incurral of federal income tax liabilities, though it does not change the nominal tax liability over the lifetime of the claims. The cost of the faster incidence of the federal income tax liability is the investment income lost on the tax payment that is made too early.

Illustration: The ABC Insurance Co. incurs a loss of $100,000 on December 30, 20XX.

- Scenario A: the loss is reported quickly and recognized in the 20XX Annual Statement.
- Scenario B: the loss is reported several months later, and it is not recognized until the 20XX+1 Annual Statement.

Suppose the IRS loss reserve discount factor for accident year 20XX as of December 31, 20XX, is 90%. The pre-tax investment yield is 10% per annum. In both scenarios, ABC ultimately receives an offset of $100,000 to taxable income. In scenario B, the offset is received one year later than in scenario A. We calculate the increased tax cost of the later recognition of the loss.

The offset to taxable income from the early recognition of the loss in 20XX is $90\% \times \$100,000 = \$90,000$. The reduction in the tax liability is $\$90,000 \times 35\% = \$31,500$.

The pre-tax investment yield is 10% per annum, so the after-tax investment yield is $10\% \times (1 - 35\%) = 6.5\%$ per annum. The after-tax investment income on the $31,500 of tax refund held for one year is $\$31,500 \times 6.5\% = \$2,047.50$.

[7] The 10% risk-based capital charge is a lower bound; for most scenarios, the charge is about 25%.

The recognition of the loss one year earlier causes a cash gain equal to 2% of the loss. The total profit margin from underwriting and investment income in the insurance industry is about 7% of premium or about 9% of losses; the precise figure varies by company, by line of business, and by year. A one year deferral of loss recognition reduces the profit margin from 9% of losses to 7% of losses, for a 22% reduction. This stems solely from the tax effect.[8]

The net gain from implicit reserve discounting is the gain from freeing up capital minus the cost of deferring the recognition of losses. Using the figures above, a rough calculation gives 9.35% – 2.05% = 7.30%. This figure is correct only if the company has other uses for the freed-up capital that yield 15% per annum. If the released capital languishes idly in surplus, there is a net dollar cost of 2.05%.[9]

We have not yet considered the deferred tax asset resulting from IRS loss reserve discounting. In this example, the deferred tax asset from earlier recognition of the loss is $100,000 × (1 – 90%) × 35% = $3,500. Only a portion of this deferred tax asset is recognized on the statutory balance sheet. The portion depends on the payout pattern of this loss and on the IRS loss reserve discount factors for the line of business; the calculation procedure is shown in Appendix A of Feldblum and Thandi [2002], "Modeling the Equity Flows." As a rough estimate, the admitted DTA may be about $1,000. This is 1% of the losses. If the after-tax cost of holding capital is 8.5%, the value of this DTA is $85. This is 0.085% of the loss.

THEORY AND INTUITION

We use a heuristic example to show the effects of anticipated reserve adequacy. The example uses a one-day policy to avoid the complications of the IRS revenue offset provision and the capital embedded in the gross unearned premium reserve.

An company writes a one-day insurance policy on December 31, 20XX, for a premium of $1,000. A loss occurs on that day, and it will be paid for $1,000 on December 31, 20XX+3.

1. The pre-tax investment yield is 10% per annum.
2. The cost of equity capital is 15% per annum.
3. The tax rate is 35% on all income.
4. The required surplus capital is 20% of held loss reserves.
5. Acquisition expenses are $170, paid on December 31, 20XX.

[8] See also Feldblum and Schirmacher [2002: Reinsurance Pricing], who show the federal income tax effects of finite reinsurance, and Feldblum [2002: The Pricing of Commutations], who discusses the federal income tax effects stemming from claim commutations.

[9] Even if the company has other uses for the capital, not all the benefit can be realized. If a company has less adequate reserves, rating agencies may require higher surplus. Perhaps half to two thirds of the capital is truly freed up; the remainder sits idly in surplus. The exact amount depends on the circumstances of each case.

To simplify the example, we assume that the IRS discounted reserves match the discounted value of the loss shown here.[10]

We determine the internal rate of return and the net present value at reserve valuation rates of 0% (current statutory accounting) and of 10% (fair value accounting). Full value statutory accounting requires more capital to be contributed by equityholders. Both the NPV and the IRR of the implied equity flows are lower if full value reserves are held than if fair value (discounted) reserves are held. We then re-price the policy at these two valuation rates such that the internal rate of return equals the cost of equity capital. The indicated premium rates are higher if statutory full value reserves are held than if fair value reserves are held.

The policyholder premium is a pre-tax figure; the NPV and the IRR are after-tax measures. The reserve valuation rate has a larger effect on the indicated premium than a cursory examination of the NPV might show.

ILLUSTRATION

The illustration speaks of a reserve valuation rate.

- At a 0% reserve valuation rate, the company holds full value reserves.
- At a 10% reserve valuation rate, the company holds fully discounted reserves. The anticipated reserve adequacy at policy inception is $1/1.100^3 = 75.13\%$ in this example.

Casualty actuaries speak of the level of reserve adequacy or the amount of implicit discount. If "i" is the reserve valuation rate and "n" is the average number of years between loss occurrence and loss payment, the anticipated reserve adequacy equals $1/(1+i)^n$.

Illustration: In the heuristic example above, "i" = 10% and "n" = 3. If losses are paid 3 years after they occur (on average) and the reserve valuation rate is 10% per annum, the anticipated reserve adequacy = $1/(1.10)^3 = 75.13\%$. At a 10% reserve valuation rate, the level of reserve adequate is 90.91% if the loss will be paid in 1 year and 75.13% if the loss will be paid in three years.

PRICING AT A 0% VALUATION RATE

The illustrations in the companion papers use full value reserves, semi-annual valuations, and both acquisition and maintenance expenses. The focus in the present illustration is on the reserve valuation rate. We use annual valuation periods, with implied equity flows at December 31 of each year.

- From the cash flows, reserve changes, and capital requirements, we determine the implied equity flows.

[10] This assumption is reasonable. For a real block of business, the IRS discount factors (over the long-run) are relatively unbiased estimates of the actuarially correct discount factors; see Feldblum [2002: SchP] and Sarason *et al.* [2002]. The 16 year limit to the IRS loss reserve payout pattern is not material in most lines of business. We note the magnitude of the tax effects on the rate indications later in this chapter.

- From the implied equity flows, we determine the NPV and the IRR.
- We show the resultant NPV and IRR at a 0% reserve valuation rate and a 10% reserve valuation rate.
- To actually price the policy, we solve for the premium rate that generates an NPV of zero or an IRR equal to the cost of equity capital. We show the pricing results in the exhibits below.

CASH FLOWS, DEFERRED TAX ASSET, AND EQUITY FLOWS

On December 31, 20XX, the gross premium is $1,000 and the acquisition expenses are $170. The loss reserves are $1,000, and the required surplus is $200.

Since this is a one day policy, the unearned premium reserve is $0 at the end of the day. There is no tax effect from revenue offset, and there is no associated deferred tax asset.[11]

We assume that the IRS discount rate is also 10% per annum, and the IRS loss payment pattern corresponds to the actual loss payment pattern in this example. The discounted reserves for tax purposes are $1,000 / 1.10^3 = $751.31. The taxable underwriting income is

$$premium - expenses - discounted\ losses = \$1000.00 - \$170.00 - \$751.31 = \$78.69.$$

The tax liability is $78.69 × 35% = $27.54.

The gross deferred tax asset is 35% × ($1000 – $751.31) = $87.04. Statutory accounting recognizes the portion of the gross deferred tax asset which reverses within 12 months. Since no losses are paid in the coming 12 months, this amount equals the tax rate times the undiscounted loss reserves times the change in the IRS loss reserve discount factor from the current valuation date to the valuation date 12 months from now.

$$35\% \times \$1000 \times (1/1.100^2 - 1/1.100^3) = 35\% \times \$1000 \times (82.64\% - 75.13\%) = \$26.30.$$

The required surplus on December 31, 20XX, is $1000 × 20% = $200. The total required assets are $1000 of loss reserves + $200 of required surplus = $1,200. The assets held by the insurance company are

	$1,000 of premium
–	$170 of acquisition expenses
–	$27.54 of federal income tax payment
+	$26.30 of deferred tax asset
=	$828.76

The implied equity flow on December 31, 20XX, is a capital contribution of $1,200 – $828.76 = $371.24. The investable assets are $1,200 – $26.30 = $1,173.70.

[11] None of the conclusions here depend on the one-day policy term. In fact, the gross unearned premium reserves cause additional capital to be tied up in statutory reserves, magnifying the effects discussed in the text.

YEAR 20XX+1

- The investment income during 20XX+1 is \$1173.70 × 10% = \$117.37.
- The tax on the investment income is \$117.37 × 35% = \$41.08.
- The tax on underwriting income is 35% × (\$751.31 – \$826.45) = –\$26.30.
- The combined tax liability for 20XX+1 is \$41.08 – \$26.30 = \$14.78.

The deferred tax asset from December 31, 20XX, is eliminated at December 31, 20XX+1. A new deferred tax asset is set up on that day for 35% × \$1000 × (90.91% – 82.64%) = \$28.93. The change in the deferred tax asset is \$28.93 – \$26.30 = \$2.63.[12]

The net income in 20XX+1 equals

\$117.37 of investment income
– \$14.78 of federal income tax payment
\+ \$2.63 of change in the deferred tax asset
= \$105.22

The required surplus remains \$200 during 20XX+1. The implied equity flow equals the net income minus the change in capital. The implied equity flow on December 31, 20XX+1, is a payment to equityholders of \$105.22.

IRR AND NPV CALCULATIONS

We repeat this analysis for 20XX+2 and 20XX+3, as shown in Exhibit ??. The implied equity flows at the four valuation dates are shown below:

Valuation date	12/31/20XX	12/31/20XX+1	12/31/20XX+2	12/31/20XX+3
Implied equity flow	–\$371.24	+\$105.22	+\$107.94	+\$275.93

The internal rate of return on these implied equity flows is the solution to the equation

$$-\$371.24 + \$105.22/(1+x) + \$107.94/(1+x)^2 + \$275.93/(1+x)^3 = 0.$$

The solution is x = 12.68%. The cost of equity capital is 15.0% per annum. The internal rate of return is lower than the cost of equity capital, and the policy is not profitable.

At a 15% cost of equity capital, the net present value of this policy is

$$-\$371.24 + \$105.22/(1.15) + \$107.94/(1.15)^2 + \$275.93/(1.15)^3 = -\$16.71.$$

[12] The deferred tax asset increases in this illustration because there are no interim loss payments. When losses are paid gradually over the years, the deferred tax asset decreases steadily to zero.

The NPV equals the economic value added at policy inception under an NPV accounting system. This is also the present value of the total EVA under any accounting system, if the EVA's are discounted at the cost of equity capital. The premium must be increased by at least $16.71 for the insurer to break even on the policy.[13]

PRICING AT 10% VALUATION RATE

A 0% valuation rate represents full value reserves. A 10% valuation rate represents reserves discounted at the investment yield. These are the reserves that would be held in a fair value accounting system, except that here we assume the discounting is implicit. The implicit discounting raises the present value of the federal income taxes and reduces the benefits of the deferred tax asset.

The polar cases of a 0% valuation rate and a 10% valuation rate highlight the pricing and profitability effects of the reserve valuation rate. The exhibits at the end of this chapter also show the results for a partial discount at a 5% valuation rate. An implicit discount midway between full value reserves and fair value reserves better reflects the practice in the long-tailed lines of business and probably represents a better use of equityholders' capital.

The implied equity flows change in several ways when the valuation rate changes to 10%.

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[13] A premium increase just equal to the EVA is generally insufficient, for two reasons:

- Increasing the premium increases the variable expense costs, such as agents' commissions.
- Increasing the premium generally increases the capital requirements.

In theory, higher premium rates should lead to reduced risk-based capital requirements. In practice, the written premium risk charge is a direct function of the premium rates, not an inverse function.

1. *The assets needed to back the loss reserves change.* At a 0% valuation rate, the December 31, 20XX, loss reserves are $1,000. At a 10% valuation rate, the December 31, 20XX, loss reserves are $751.31 . The change in the implied equity flow stemming from the difference in the loss reserves is $1,000 – $751.31 = $248.69.[14] (The full change in the implied equity flow incorporates other items as well.)
2. *The risk-based capital requirements change.* The required capital is 20% × $1,000 = $200 if a 0% valuation rate is used and 20% × $751.31 = $150.26 if a 10% valuation rate is used. The difference in the implied equity flow on December 31, 20XX, is $200.00 – $150.26 = $49.74.[15]

In theory, the company's capital requirements should depend on indicated reserves, not held reserves. If the company holds less assets to back the loss reserves with a 10% valuation rate, it should hold more capital to offset the increased insolvency risk. In practice, the RBC formula sets the capital requirements as a function of held reserves. It makes no attempt to quantify the adequacy of these reserves.[16]

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[14] The assets needed to fund the unearned premium reserves on annual term policies show a similar effect. After adjusting for the deferred tax asset, the difference between gross and net unearned premium reserves is 65% of the pre-paid acquisition costs on the unexpired portion of the policies.

[15] There is no corresponding effect on the unearned premium reserves, since there is no risk-based capital charge on the unearned premium reserves.

[16] The opposite is true for explicit reserve discounts. If the 10% reserve valuation rate is make explicit, the amount of the discount is removed from statutory surplus and the risk-based capital reserving risk charge is based on the undiscounted loss reserves.

The rating agencies do attempt to estimate the required reserves, and they may adjust the capital requirements for the difference between their estimates of required reserves and the company's held reserves. We do not attempt to model the effects of loss reserve valuation rates on rating agency capital requirements. This is an important consideration to keep in mind, but there is too much uncertainty to formulate a fixed pricing procedure.[17]

3. The timing of the federal income tax liabilities changes if the discount on the loss reserves is left implicit and not disclosed in the statutory Annual Statement. If the loss reserve discount is disclosed in the Annual Statement, the statement loss reserves are grossed up for the amount of the discount and there is no change in the IRS discounted reserves.[18]

The total dollar amount of taxes paid does not depend on the valuation rate. However, a higher valuation rate causes the tax liabilities to be incurred earlier, leading to a loss of investment income and a higher present value of the tax cash flows.

- With a 0% reserve valuation rate, (i) the IRS discounted loss reserves on December 31, 20XX, are 75.13% × $1,000 = $751.31, (ii) the IRS discounted loss reserves on December 31, 20XX+1, are 82.64% × $1,000 = $826.45, and (iii) the tax-basis incurred losses in 20XX+1 are $826.45 – $751.31 = $75.13.
- With a 10% loss reserve valuation rate, (i) the IRS discounted loss reserves on December 31, 20XX, are 75.13% × $751.31 = $564.47, (ii) the IRS discounted loss reserves on December 31, 20XX+1, are 82.64% × $826.45 = $683.02, and (iii) the tax-basis incurred losses in 20XX+1 are $683.02 – $564.47 = $118.54.[19]

Because the interest discount is not disclosed, the loss reserves are "doubly discounted" for computing taxable income. If the greater loss reserve discount were entirely offset by a deferred tax asset, the increased tax payment would *not* change the implied equity flow on December 31, 20XX. The only effect would be a decrease in the investment income received in 20XX+1, since the deferred tax asset is not an investable asset.

There are two reasons why the greater loss reserve discount is not entirely offset by a greater deferred tax asset.

✓ The change in the federal income tax liability is a multi-year effect. Statutory accounting admits only the portion of the deferred tax asset that will reverse within 12 months.

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[17] In practice, the company's chief actuary meets periodically with A. B. Best's and with Standard & Poor's to review the company's ratings and financial condition. These meetings generally give a good sense of how the rating agencies view the company's capital management stance. The information gained at these meetings is a necessary component for determining the optimal reserve valuation rate, even though we can not easily provide a generic formula to incorporate rating agency views.

[18] The one constraint is the IRS discounted loss reserves may not be greater than the Annual Statement loss reserves (see Feldblum [2002: Schedule P]). This constraint affects the Schedule P "prior years" row for workers' compensation and long term disability insurance.

[19] This illustration uses a valuation rate equal to the IRS loss reserve discount rate. This would be rare in the property-casualty insurance industry. The reserve valuation rate would generally be lower than the IRS loss reserve discount rate.

✓ Since the reserve discount is left implicit, the company must set up the deferred tax asset *as if the reserves were held at full value.* At a higher reserve valuation rate, the deferred tax asset decreases; it does not increase.

Illustration: The full deferred tax asset for a 10% valuation rate ought to be 35% × ($1,000 – $564.47) = $152.44. The company can not put up this deferred tax asset without acknowledging that its loss reserves are under-stated. Since the company holds a loss reserve of $751.31, the full deferred tax asset is the tax rate 35% × ($751.31 – $751.31 × 0.75131) = $65.40.

The effect on the statutory deferred tax asset is similar. The full statutory deferred tax asset on December 31, 20XX, ought to be 35% × ($826.45 × 0.82645 – $751.31 × 0.75131) = $41.49. The company can not put up this deferred tax asset without acknowledging that its loss reserves are under-stated. Since the company holds a loss reserve of $751.31 with a corresponding tax-basis reserve of $564.47, the deferred tax asset that can be admitted on the statutory balance sheet is 35% × [($751.31 – $564.47) – ($751.31 – $683.01)] = $19.76, or 35% × ($564.47/0.90909 – $564.47) = $19.76.

CASH FLOWS AND IMPLIED EQUITY FLOWS

To show the magnitude of these effects, we compute the cash flows, the accounting entries, and the implied equity flows for a 10% valuation rate.

On December 31, 20XX, the premium is $1,000 and the acquisition expenses are $170. The loss reserves are $1,000 / 1.10^3 = $751.31, and the required surplus is $150.26.[20]

The IRS discounted reserves are $751.31 / 1.10^3 = $564.47. The loss reserves are doubly discounted: once (implicitly) by the company and a second time (explicitly) by the IRS. The taxable underwriting income is

$$premium - expenses - discounted\ losses = \$1000.00 - \$170.00 - \$564.47 = \$265.53.$$

The tax payment is $265.53 × 35% = $92.94. The deferred tax asset is 35% × ($564.47 × 1.100 – $564.47) = $19.76, since the company records $751.31 as its statutory loss reserve.

The total required assets on December 31, 20XX, equal $751.31 of loss reserves + $150.26 of required surplus = $901.57. The assets held by the insurance company are

$1,000 of written premium
– $170 of acquisition expenses
– $92.94 of federal income tax payment

[20] The reserve valuation rate has no effect on the unearned premium reserve, the revenue offset effects, or the deferred tax asset from revenue offset. In any case, we are using a one-day policy in this illustration, so this subject is moot; there is no unearned premium reserve.

+ $19.76 of deferred tax asset
= $756.82 of held assets

The implied equity flow on December 31, 20XX, is a capital contribution of $901.57 – $756.82 = $144.75. This is only $144.75/$371.24 = 38.99% of the capital contribution needed with a 0% valuation rate.

YEAR 20XX+1

- The investable assets are $901.57 – $19.76 = $881.81.
- Investment income during 20XX+1 is $881.81 × 10% = $88.18.
- The tax on the investment income is $88.18 × 35% = $30.86.
- The tax on underwriting income is 35% × ($751.31 × 0.75131 – $826.45 × 0.82645) = $-41.49.
- The deferred tax asset on December 31, 20XX+1, is 35% × ($683.01 × 1.100 – $683.01) = $23.91, since the tax reserve at this date is $683.01.

The total required assets on December 31, 20XX+1, equal loss reserves of $826.45 + required surplus of 20% × 826.45 = $165.29, for a total of $991.74. The assets held by the insurance company are

$901.57 of assets at December 31, 20XX
+ $88.18 of investment income
– $30.86 of federal income tax payment on investment income
+ $41.49 of federal income tax payment (a tax refund) on underwriting income
+ $23.91 – $19.76 of change in the deferred tax asset
= $1,004.53 of held assets

The implied equity flow on December 31, 20XX, is a capital distribution of $1004.53 – $991.74 = $12.79.

EQUITY FLOWS AND INTERNAL RATE OF RETURN

We continue in this fashion for years 20XX+2 and 20XX+3, as shown in Exhibit ??. The implied equity flows are shown below.

Valuation date	12/31/20XX	12/31/20XX+1	12/31/20XX+2	12/31/20XX+3
Implied equity flow	–$144.76	+$12.80	+$18.96	+$191.76

The internal rate of return on these implied equity flows is the solution to the equation

$$-\$144.76 + \$12.80/(1+x) + \$18.96/(1+x)^2 + \$191.76/(1+x)^3 = 0.$$

The solution is x = 16.93%. The cost of equity capital is 15.0% per annum. The internal rate of return is higher than the cost of equity capital, and the policy is profitable.

At a 15% cost of equity capital, the net present value of this policy is

$$-\$144.76 + \$12.80/(1.15) + \$18.96/(1.15)^2 + \$191.76/(1.15)^3 = +\$6.79.$$

This is also the economic value added under the NPV accounting system, which we use as the performance measure. Writing the policy increases the value of the company.

At a 0% valuation rate, the internal rate of return was 12.68%. The change in the reserve valuation rate, without any change in the underwriting cash flows, increases the IRR by 16.93 – 12.68 = 4.25 percentage points, turning a money losing policy into a profitable policy.

CONSUMER'S PERSPECTIVE

The illustration above assumes that the policyholder premium is fixed at $1000, and that insurers earn economic profits or suffer losses depending on the cost of providing coverage.

The actual U.S. insurance markets are highly competitive, with scores of competing firms in each region, low concentration ratios, no perceptible economies of scale, low barriers to entry, and no significant product differentiation. Rates of return in excess of the cost of capital do not persist. The lower cost of holding capital stemming from fair value reserves would reduce the policyholder premium.

Exhibits ?? and ?? show the policy priced to provide a 15% internal rate of return on the implied equity flows. At a 0% valuation rate, the indicated premium is $1025.70. At a 10% valuation rate, the indicated premium is $989.55. The change in the valuation rate reduces the indicated premium by 3.5%.

In both scenarios, the present value of expected losses and expenses is $921.31. The profit margin in the premium is $104.39, or 11.33% of the discounted net premium, for a 0% reserve valuation rate, and $68.23, or 7.41% of the discounted net premium, for a 10% reserve valuation rate. The change in the valuation rate reduces the profit margin by $36.16, or 34.64%.

SUMMARY

We summarize the effects of different valuation rates below; see Exhibit ?? for the calculations. The premium in each scenario is $1,000.

- *Full value loss reserves* (0% valuation rate) require the greatest capital investment ($317.24), but the net present value of the tax credit stemming from incurred losses is also greatest ($394.18).

- *Implicit discounting* (10% valuation rate) requires the least capital investment, though only if the capital requirements do not change because of the discounting. However, implicit discounting reduces the tax credit stemming from incurred losses to $381.91.
- *Explicit discounting* (10% valuation rate) requires an intermediate capital investment, and the full tax credit stemming from incurred losses is retained.

The table below shows the premium for the three scenarios in the list above if the policy is priced to yield a 15% internal rate of return.

	No Discounting	*Implicit Discounting*	*Explicit Discounting*
Premium	$1,025.70	$989.35	$981.03
NPV(FIT)	$66.76	$48.41	$38.31
NPV(tax credit on losses)	$394.18	$381.91	$399.18

Other Pricing Assumptions

The full analysis of the effect of the reserve valuation rate on the indicated premium rates requires careful consideration of four other components of policy pricing:

1. The target return on capital demanded by the company's equityholders.
2. The benchmark investment yield that the company expects to earn on its investable assets.
3. The expected reserve duration for the block of business being priced.
4. The effects of federal income taxes on both investment income and underwriting income.

This paper has dealt with the underlying concepts regarding the reserve valuation rate and its effects on policy pricing. The four issues listed above are complex, and they warrant more rigorous treatment than can be provided here. We deal with these four issues in detail in the companion paper,"Federal Income Taxes and the Cost of Holding Capital." The companion paper begins where this paper leaves off, and it provides a rigorous analysis of the interaction between the reserve valuation rate and the other pricing assumptions.