

*Financial Pricing Models for Property-Casualty  
Insurance Products: The Target Return on  
Capital*

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# Financial Pricing Models for Property-Casualty Insurance Products: The Target Return on Capital

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## INTRODUCTION

The target return on capital is the cost of capital for the insurance enterprise, or the return demanded by suppliers of capital. This paper describes the major considerations in selecting the target return on capital.

A financial pricing model determines the premium rate such that the insurer achieves a target return on capital. The pricing model may take either of two forms:

- A net present value model discounts the projected equity flows at the cost of capital.
- An IRR model compares the internal rate of return implied by the project's equity flows with the cost of capital.

The structure of the pricing model and most of the pricing assumptions are based on the characteristics of the insurance environment and of the line of business. In contrast, the cost of capital is not easily quantified. It is often selected by the insurer's management, based on recommendations by the financial, actuarial, and underwriting departments.

Profitability in the property-casualty insurance industry cycle between hard markets, when returns are high, and soft markets, when returns are low.<sup>1</sup> The target return on capital selected by the company's management may vary with the phases of the underwriting cycle.

*Illustration:* The selected long-term target return on capital may be 700 basis points above the risk-free interest rate on 90-day Treasury bills. The company may add up to 300 basis points during the profitable phases of the underwriting cycle, and it may subtract up to 300 basis points during the unprofitable phases of the underwriting cycle.

## DEBT AND EQUITY CAPITAL

Pricing models for other industries use a weighted average cost of equity capital and of debt capital. The weights depend on the company's intended capital structure.

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<sup>1</sup> We are indebted to Karl Goring for helpful review of this paper.

*Illustration:* A firm can issue long-term debt at an 8% yield. Its common stock is priced in the market to yield 13% per annum. We determine the cost of capital.

Suppose the company's target capital structure is 40% debt and 60% equity. The coupon payments on long-term debt are tax deductible. If the marginal tax rate is 35%, the after-tax interest payments are  $8\% \times (1 - 35\%) = 5.20\%$ . Stockholder dividends are paid with after-tax funds. The weighted average cost of capital is

$$40\% \times 5.20\% + 60\% \times 13\% = 9.88\%.$$

Neither the market yield on the company's common stock nor the market yield on its long-term debt are choices of the company. They depend on investors' perceptions of the risk of the company and the volatility of its securities. This paper does not deal with the reasons for the different returns on equity capital and debt capital; this is a financial issue, not a pricing issue.

### **The Need for Cash**

Long-term debt provides the cash needed to fund research and development, build plants, and purchase equipment. Accounting equity is not necessarily an operating requirement. A firm may operate with low or even negative capital. A high debt to equity ratio may raise the cost of debt capital, but it is not an absolute impediment to corporate operations.

Insurers – both property-casualty insurance companies and life insurance companies – have little or no long-term debt. Insurers have more than sufficient cash for their operations, since they receive premiums well before they pay losses and other benefits. Insurers need statutory surplus to operate. Long-term debt provides cash, but it does not enhance statutory surplus and it can not satisfy capital requirements.

*Illustration:* Leveraged buy-outs (LBO's) illustrate the workings of a firm financed primarily with debt and with little accounting equity. LBO's often provide strong management incentives, and they have succeeded in several industries.

There is no such thing as an insurance company LBO. The low invested capital in the LBO would trigger failure of the risk-based capital requirements and possible liquidation or rehabilitation of the company by state solvency regulators.

For insurance pricing models, we must quantify the cost of equity capital. We need not quantify the cost of debt capital, and we need not deal with capital structure. The following sections of this paper consider several methods which are commonly used to quantify the cost of equity capital.<sup>2</sup>

## MARKET BENCHMARK

The standard benchmark for the cost of equity capital is the average rate of return for publicly traded stock companies. The S&P 500 and the Russell 2000 are commonly used benchmarks for the rate of return in the U.S. for large companies and small companies, respectively.

The nominal rate of return varies with interest rates and inflation rates. Common practice is to treat the cost of equity capital as the risk-free interest rate plus a market risk premium. The risk-free interest rate is the yield on Treasury securities. The market risk premium is often assumed to remain fairly constant from year to year.

*Illustration:* The market risk premium may be estimated from historical experience to be about 7 percentage points above the risk-free yields on 90 day Treasury bills. If the current yield on short term Treasury bills is 5% per annum, the benchmark cost of equity capital is 12% per annum.

For the benchmark cost of equity capital, we use the average market risk premium for publicly traded companies. Even this simple benchmark involves subjective judgment in several areas. We mention three topics: (i) duration of the risk-free interest rate, (ii) multiplicative vs additive models, and (iii) stability of the market risk premium.

1. *Duration:* The market risk premium depends on the duration of the risk-free interest rate. If the average spread between 90 day Treasury bills and 30 year Treasury bonds is 250 basis points, a 90 day Treasury bill rate might have a market risk premium of 800 basis points and a long-term Treasury bond rate might have a market risk premium of 550 basis points. The cost of equity capital at any time depends on the shape of the yield curve.

*Illustration:* The benchmark cost of equity capital might be estimated either as (i) the 90-day Treasury bill rate plus 800 basis points or as (ii) the 30-year Treasury bond rate plus 550 basis points. When the term structure of interest rates is upward sloping with a spread of 250 basis points between the high and low ends, the two formulas give the same cost of equity capital. If the yield curve is inverted one year, with an 8.5% Treasury bill rate and an 8% long bond rate, method (i) gives a cost of equity capital of 16.5% and method (ii) gives a cost of equity capital of 13.5%.

2. *Model:* It is unclear whether a multiplicative model or an additive model should be used. A multiplicative model uses the risk-free interest rate times a constant, whereas an additive model uses the risk-free interest rate plus a constant.

*Illustration:* An additive model may estimate the cost of equity capital as the Treasury bill rate + 800 basis points. A multiplicative model may estimate the cost of equity capital as  $(1 + \text{the Treasury bill rate}) \times (1.075) - 1$ .

When the Treasury bill rate is 7% per annum, the two methods give the same cost of equity capital, since  $0.07 + 0.08 = 15\%$  and  $(1.07 \times 1.075) - 1 = 15\%$ . When the Treasury bill rate is 10% per annum, the second method gives a slightly higher cost of equity capital.

3. *Stability*: It is not clear whether the market risk premium is stable over the years. In the late 1990's, some analysts argued for a lower market risk premium, as more investors become comfortable with stock market volatility.

These are financial issues, not insurance pricing issues. They are hotly debated and unresolved; we do not address them further. To use the market benchmark, the pricing actuary selects a duration for the risk-free interest rate, a market risk premium, and the type of model (additive or multiplicative). Reasonableness of assumptions and consistency of application are the key attributes of good pricing.

*Illustration*: A common benchmark is the yield on short term Treasury bills plus a 7 percentage point market risk premium. With a 5% yield on short term Treasury securities, the cost of equity capital is 12% per annum. These figures reflect the investment environment in 2002.

## Risk

The risk of the project affects the required return. Investors seek to maximize their returns for a given level of risk, or to minimize their risk for a given return.

There is no consensus on the level of insurance risk versus the level of risk in other industries. We review several common perspectives on this issue.

*Finance*: Some financial analysts consider insurance enterprises to be less risky than the average company, implying that a lower cost of capital may be used in the pricing analysis. This view is generally based on a CAPM analysis (see below), which shows an average beta for property-casualty insurance companies of 85% to 90%. The economic rationale for the low beta value is that insurers have little up-front capital expenditures and most of their expenses are variable costs, thereby lessening their business risk.

*Illustration*: Pharmaceutical companies invest billions of dollars in extensive research to develop new medications. Automobile manufacturers invest billions of dollars in plants and equipment to develop new automobiles. Insurers do not have these up-front capital requirements.

*Actuaries*: Some actuaries perceive property-casualty insurance companies as more risky than other enterprises, for two reasons.

- Insurers don't know their costs until after the policy has been sold.
- The loss severity distribution in some lines of business is highly dispersed.

These two types of risk are of questionable relevance for selecting a target return on capital. For most lines of insurance, such as private passenger automobile or workers' compensation, these characteristics have little effect on business risk or earnings volatility. Even for lines of business where these two characteristics are significant, such as general liability, the risk is diversifiable for shareholders. Modern portfolio theory assumes that diversifiable risk does not receive any additional return.

*Underwriting cycles:* The property-casualty insurance industry has distinct profitability cycles, generally called underwriting cycles. Some past studies, such as the Arthur D. Little studies in the 1960's and the early 1970's, examined the standard deviation of the insurance industry's profitability versus that of other industries to justify a higher rate of return for insurers.

The effect of profitability cycles on the target return on capital depends on their severity, regularity, and correlation with general business cycles.<sup>3</sup> The property-casualty underwriting cycles may be stronger than the cycles in some other industries, but they are also more regular, mitigating the risk to investors. Financial analysts often presume that the market takes into account expected profitability cycle. If the underwriting cycles in the property-casualty insurance industry are not correlated with profitability cycles in other industries, a CAPM analysis would not imply a higher capitalization rate for the insurance industry.

*Catastrophes:* Some insurance industry personnel speak of the above average risks that they face from natural catastrophes (hurricanes, earthquakes) and from man-made catastrophic exposures (terrorism, asbestos, and environmental liabilities). These are indeed unusual risks, though the relative size of the risks in the insurance industry versus those in other industries is hard to judge.<sup>4</sup>

*Longevity:* Some analysts see the longevity of the insurance industry and the persistency of many companies as evidence that the level of risk in this industry is low. The slow rate of innovation in the insurance industry and the high customer loyalty reduces the business risk for insurers.

We do not attempt to resolve these issues. We discuss below the most common methods of quantifying the target return on capital, without claiming that any method is necessarily correct. We do not assume that the insurance industry faces higher or lower risk than other industries.

## **RETURN FACTOR MODELS**

Several mathematical models have been developed to quantify the cost of equity capital for particular industries or firms. Generally, a return factor model is used, such as the Capital Asset Pricing Model or Arbitrage Pricing Theory.

A return factor model with  $N$  factors says that the expected return for security  $s$  in period  $t$  is

$$E(r_s) = \beta_{1s} \times F_{1t} + \beta_{2s} \times F_{2t} + \dots + \beta_{Ns} \times F_{Nt}$$

The factors  $\{F_{1t}, F_{2t}, \dots, F_{Nt}\}$  depend on the time period  $t$  but not on the particular security. The beta coefficients  $\{\beta_{1s}, \beta_{2s}, \dots, \beta_{Ns}\}$  depend on the security  $s$  but not on the time period.

We explain this formula by the CAPM, which is a two factor model.

- $F_{1t}$  is the risk-free interest rate in period  $t$ , and  $\beta_{1s}$  is unity for all securities.
- $F_{2t}$  is the market risk premium, and  $\beta_{2s}$  is the market beta for security  $s$ .

## THE CAPM

In the 1960's and 1970's, the CAPM was commonly accepted among many financial analysts, and the CAPM perspective on the cost of equity capital remains a predominant view. Recent studies of market anomalies have cast doubt on the empirical validity of the CAPM.<sup>5</sup> The CAPM is still widely used for its simplicity, but it has lost some of its former luster.

The acceptance of the CAPM by pricing actuaries and insurance company managers varies. Other return factor models used in securities valuation, such as Arbitrage Pricing Theory, have had negligible effect on actuarial pricing models.<sup>6</sup>

The CAPM says that a security's expected return depends on its systematic risk. Systematic risk is risk that cannot be eliminated by diversification; diversifiable risk is not compensated by additional return. Algebraically, the CAPM says that the expected return on a security equals

$$E[r_s] = r_f + \beta_s \times (E[r_m] - r_f)$$

where

- $r_s$  is the return on the security
- $r_f$  is the risk-free interest rate
- $E[r_s]$  is the expected return on the security
- $E[r_m]$  is the expected overall return on the market of risky securities
- $E[r_m] - r_f$  is the market risk premium

$$\beta_s = \text{cov}(r_m, r_s) / \text{var}(r_m) = \text{corr}(r_m, r_s) \times \text{standard deviation}(r_s) / \text{standard deviation}(r_m).$$

In this equation,  $r_s$  and  $r_m$  are random variables.  $E[r_s]$  and  $E[r_m]$  are scalars; they are the expectations of these random variables.

The rationale for the consideration of systematic risk but not diversifiable risk is compelling. Suppose that the expected return of a security were based on total risk, not on systematic risk only. An arbitrageur might purchase securities with high specific (diversifiable) risk, combine

them in a mutual fund with low specific risk, and sell these low risk shares of the mutual fund to other investors.

*Illustration:* Suppose securities  $\{s_1, s_2, \dots, s_N\}$  have high but uncorrelated risks. The price of each security is the present value of its future cash flows at the capitalization rate for that security. If the market were to base the capitalization rate on the total risk of the security, each security would have a high price to earnings ratio. A mutual fund composed of these securities would have a similarly high price to earnings ratio, even though its total risk is reduced by the addition of uncorrelated random variables. Based on its lower capitalization rate, the mutual fund could be sold at a higher price. This would lead to arbitrage profits.

### **Market Returns and Security Returns**

The CAPM derives the expected return on specific securities from the risk-free interest rate and the expected overall market return. Most applications of the CAPM consider the market risk premium, or the expected market return minus the risk free interest rate, as a known value.

The expected excess return on a specific security, or the expected return on that security minus the risk-free interest rate, is a function of its beta. Since the beta equals  $\text{corr}(r_m, r_s) \times \text{standard deviation}(r_s) / \text{standard deviation}(r_m)$ , this excess return is proportional to

- i. the standard deviation of the security's returns, and
- ii. the correlation of the security's returns with the overall market return.

Intuitively, these two relationships imply that

- i. The greater the specific security's standard deviation, the more uncertainty is inherent in that security and the greater must be the return to the investor.
- ii. The stronger the correlation of a specific security with the overall market, the less risk-reduction is available from diversification and the greater must be the return to the investor.

### **CAPM and Insurance Returns**

If three conditions are true, the CAPM enables us to derive an estimate of the cost of equity capital for insurance companies. Specifically

- If the CAPM formula is valid,
- if betas for property-casualty insurance enterprises can be reasonably estimated, and
- if these betas are stable from year to year,

we can derive the expected return for insurance companies. The expected return, or the capitalization rate, is the cost of equity capital.

Betas for individual securities in any industry are not easy to determine, since the random fluctuation of common stock returns provides unstable estimates for the standard deviations and for the correlations with the market.<sup>7</sup> The common practice in the investment community is to assume that the betas for firms in the same industry are similar, and to use the industry's beta as a proxy for the betas of individual securities. The assumptions that firms within an industry have similar betas is questionable in any industry. For the property-casualty insurance industry, there are two reasons why the assumption of a common beta is dubious.

*Asset risks:* Firms have different investment portfolios. A firm with a more aggressive investment portfolio should have a higher beta for its own equity.

An insurer that invests only in high grade corporate bonds and in Treasury securities might have an investment portfolio with an overall beta close to zero. An insurer that invests half of its assets in common stocks and venture capital might have an overall beta closer to unity. The systematic risk in the investment portfolio translates into a leveraged systematic risk for the insurer's own equity.

*Illustration:* Suppose an insurer has a four to one assets to capital ratio; assets are \$400 million and capital is \$100 million. The insurer's investment portfolio has a beta of unity. We assume that the liabilities of the insurer, which equal \$400 million – \$100 million = \$300 million, are not correlated with overall market returns.

If the overall stock market return increases by 1 percentage point, the insurer's assets increase by \$4 million. Since the liabilities are uncorrelated with the overall market returns, the insurer's capital increases by \$4 million as well, for a 4% increase.

In sum, the composition of the investment portfolio has a leveraged effect on the systematic risk of the insurer's equity. An industry-wide beta for individual firms gives biased results.

*Underwriting risks:* Many actuaries assume that risk and expected return vary significantly by line of business. Empirical estimation of betas by line of business requires data from publicly traded monoline insurers; such data are not available. There have been sporadic studies of the systematic risk for certain lines of business, such as workers' compensation and private passenger automobile, but there are no conclusions that are broadly accepted.

### **Insurance Betas**

Betas for the property-casualty insurance industry as a whole are estimated by investment firms. Values between 85% and 95% have been used. With a risk-free interest rate between 5% and 6% and a market risk premium of 7 to 8 percentage points, the CAPM estimate for the cost of equity capital is between  $5\% + 90\% \times 7\% = 11.3\%$  and  $6\% + 95\% \times 8\% = 13.6\%$ .

We have limited our comments on the CAPM to general statements. Our objective is not to advocate or to criticize the CAPM. In our own work, we examine the cost of capital implied by the CAPM as well as other financial valuation models, in combination with our judgment on the competitiveness of the insurance market in each state and line of business. We may summarize the implications of the CAPM as “the cost of capital for the property-casualty insurance industry *may be* a percentage point or so below the overall market average.” More specific conclusions are hard to justify.

## HISTORICAL EXPERIENCE

Historical returns are sometimes used to estimate the cost of capital. If there are no impediments to capital flows or to marketplace competition, the long-run observed return on capital should not deviate much from the required return on capital.

- If the actual return on capital exceeds the return required by investors, additional capital should flow into the industry and the actual return should decline.
- If the actual return is less than the return required by investors, capital should leave the industry and the actual return on the remaining capital should rise.<sup>8</sup>

In practice, capital flows in the insurance industry are not frictionless:

- Much capital is held by mutual insurance companies, who have less incentive to return excess capital to their owners.
- Much capital is tied up in full value loss reserves.
- Managers of insurance companies may seek to hold more capital than is economically efficient to avoid surplus drains during adverse scenarios.

Historical returns on *statutory surplus* are available from industry publications, such as Best’s *Aggregates and Averages*. They have been used at times by state regulators to set ratemaking targets, but they are rarely used by market analysts.<sup>9</sup> Neither GAAP nor statutory book values reflect the invested capital for property-casualty insurance companies.<sup>10</sup>

*Illustration:* Suppose an insurer writes a \$100 million block of workers’ compensation large dollar deductible business on January 1, 20XX. Expenses equal to 30% of premium are paid at policy inception. Loss reserves with a nominal value of \$150 million and a present value of \$70 million are held on December 31, 20XX. No losses are paid during the year. The investment yield is 8% per annum and capital requirements are 15% of written premium and 10% of held reserves.

- The required statutory surplus on December 31, 20XX, is  $15\% \times \$100 \text{ million} + 10\% \times \$150 \text{ million} = \$30 \text{ million}$ .<sup>11</sup>
- The invested capital on December 31, 20XX, is the statutory surplus plus the capital embedded in the undiscounted loss reserves, or  $\$30 \text{ million} + \$80 \text{ million} = \$110 \text{ million}$ .<sup>12</sup>

The pricing model bases the premium rate on the target return on capital. The return on surplus and the return on equity are not suitable proxies for the return on capital.

The nominal rate of return varies with inflation. If inflation is 4% per annum, investors might be satisfied with a 12% annual return. If inflation is 15% per annum, the 12% annual return would be inadequate. Historical averages may be converted into real dollar terms by subtracting an adjustment for monetary inflation.<sup>13</sup>

We note several problems with basing the cost of capital on historical returns.

- Invested capital versus statutory surplus
- Calendar year investment income
- Portfolio yields versus new money yields
- Allocation of surplus by line of business
- Stock market fluctuations
- Possible over-capitalization of the insurance industry

#### *INVESTED CAPITAL*

Invested capital equals statutory surplus plus the capital embedded in the gross unearned premium reserves and the full value loss reserves to statutory surplus. The returns on statutory surplus are biased proxies for the return on capital. For a company holding full value loss reserves in the long-tailed lines of business, statutory surplus may be only half of invested capital. A 12% return on statutory surplus may be equal to a 6% return on invested capital.

The observed returns on surplus are not comparable across lines of business. Homeowners has little capital embedded in loss reserves, and the return on surplus is similar to the return on invested capital. For workers' compensation, the return on surplus may be twice as great as the return on invested capital.

Inter-company differences further hinder the interpretation of industry results. Expense ratios differ between direct writers and independent agency companies; industry results may not be appropriate for a specific insurer. Differing reserve adequacy levels by company are hard to measure, and they distort inter-company comparisons.<sup>14</sup>

#### *CALENDAR YEAR INVESTMENT INCOME*

The return on surplus calculated from Best's *Aggregates and Averages* uses the investment income from current calendar year reserves, not the expected investment income from future reserves on the current year's writings. The figures are distorted by growth or decline in the volume of business.

*Illustration:* Suppose losses in a block of business are 75% of gross premium, the losses are paid (on average) four years after they occur, and the investment yield is 10% per annum. In a steady-state, \$1 million of premium would generate about \$3 million in loss reserves.

- If policies are written evenly during the year, the average policy effective date is July 1 and the average date of loss is December 31.
- Total losses are three quarters of gross written premium.
- Since losses are paid four years after they occur (on average), loss reserves are four times annual incurred losses or three times annual written premium.

The pre-tax investment income on the assets backing the loss reserves is  $10\% \times \$3 \text{ million} = \$0.3 \text{ million}$ , or 30% of the gross written premium.

Even if the investment income does not grow in exposure counts, it grows with monetary inflation. If inflation is 10% per annum and the company's book of business is growing with inflation, the reserves are  $\$0.75 \text{ million} \times (1 + 1.100^{-1} + 1.100^{-2} + 1.100^{-3}) = \$2,615,139$ .

The expected investment income from the current year's book of business is \$0.75 million for four years. The present value at a 10% discount rate is  $\$0.75 \text{ million} \times (1 + 1.100^{-1} + 1.100^{-2} + 1.100^{-3}) = \$2,615,139$ . We summarize the steady state illustration as follows.

*If the company's book of business grows with monetary inflation but there is no change in the overall exposures, and if the inflation rate equals the discount rate, then the present value of the investment income expected on the current year's book of business equals the calendar year investment income.*<sup>15</sup>

If the insurer has been growing, it holds less reserves than it would hold in a steady state. The investment income in the current calendar year is less than the present value of the investment income on the future reserves. The operating profit, or 1 minus the operating ratio, understates the true profitability.

The effects of this distortion are clearest when an insurer enters a new line of long-tailed business. There are no existing reserves, so there is no investment income on the assets backing previous years' reserves. The statutory operating ratio may be low or negative even for adequately priced business.

**Illustration:** Suppose an insurer commences operations by writing a \$100 million block of workers' compensation large dollar deductible business on January 1, 20XX. Expenses equal to 30% of premium are paid at policy inception. Loss reserves with a nominal value of \$150 million and a present value of \$70 million are held on December 31, 20XX.

Were there no surplus requirements and no need to hold undiscounted loss reserves, the block of business would be profitable. The statutory operating gain, however, is the premium minus losses and expense plus the calendar year investment income. Since the investment income received during the calendar year is small, the statutory operating gain is negative.

The opposite distortion occurs when business volume is declining, as would be the case when a company switches from first dollar workers' compensation policies to large dollar deductible policies. The statutory operating ratio may overstate the true profitability of the company.

#### *PORTFOLIO YIELDS*

The operating income figures in statutory exhibits, such as the Insurance Expense Exhibit, and in most rating agency reports, such as Best's *Aggregates and Averages*, use portfolio yields, not market yields. If interest rates have been declining, the statutory exhibits overstate the present value of the investment income expected in the future and overstate the return.

**Illustration:** Suppose the insurer holds 10% coupon bonds valued at par on January 1, 20XX. On that day, interest rates on comparable bonds rise to 11% per annum. The bonds have a duration of four years on December 31, 20XX. We contrast the statutory yield, the GAAP yield, and the market yield.

- The statutory asset yield in 20XX is 10% per annum. The bonds are held at amortized cost. Neither the current market interest rates nor the change in the market value of the bonds affect the statutory investment yield.
- The GAAP asset yield in 20XX is the 10% coupon rate plus the change in the market value during the year. The market value change is about  $-1 \times 4 \times 1\% = -4\%$  of the bond's market value before the change. The GAAP asset yield in 20XX is  $10\% - 4\% = 6\%$ .<sup>16</sup>
- The new money rate in 20XX is 11% per annum. The coupon rate of the bonds held by the insurer are not relevant to a financial pricing model.

The new money interest rate may vary considerably over the bond's life. The book yield from trade industry reports is a biased proxy for the new money interest rate.

#### *SURPLUS BY LINE*

The surplus figures in published reports are for all lines of business combined. Rates of return by line of business can not be observed. Best's does not allocate surplus by line of business, so it does not compute a return on surplus by line of business.

Return on statutory surplus by line of business can not be estimated indirectly. A. M. Best's *Aggregates and Averages* groups companies by category, such as personal lines predominating companies or commercial lines predominating companies. The company category is sometimes used as a proxy for the line of business, though this proxy is too crude for a financial pricing model.

### *EQUITY RETURNS*

Property-casualty insurers hold considerable amounts of equity in their investment portfolios – common stocks, venture capital, and real estate. Fluctuations in equity markets affect the observed returns for property-casualty insurers. During the 1990's, the long bull market in common stocks raised the observed returns for insurance companies, and the stock market decline in 2000-2002 reduced the observed returns for insurance companies.

Random loss fluctuations can have a similar effect. The favorable weather during the latter half of the 1990's and the sparsity of natural catastrophes raised observed returns. The damages from the World Trade Center incident in 2001 reduced observed returns. The magnitude of these fluctuations offsets the value that might be gleaned from historical experience.

### *ADEQUACY OF RETURNS*

The cost of capital reflects the return needed to induce investors to supply capital to insurance enterprises. For industries that are over- or under-capitalized, observed returns are not good proxies for required returns.

Returns for property-casualty insurance companies have been lower than the returns in other financial industries. Two perspectives are often heard:

- The property-casualty insurance industry has less systematic risk than the average industry, and the returns are proper.
- The lower than average returns stem from the competitive nature of the property-casualty insurance industry, not from the level of systematic risk.

The latter perspective is commonly associated with Michael Porter's writings on competitive strategy. The ease of entry into the insurance market, the hundreds of insurance companies, and the possible overcapitalization of the industry account for the lower than average returns, regardless of systematic risk.<sup>17</sup>

### **Flexible Pricing**

The target return on capital is not a rigid figure. Some insurers select both a desired return on capital and a minimum return on capital. Management incentives and marketplace structure affect the target return on capital used in a financial pricing model.

*Illustration:* Suppose the average cost of equity capital for publicly traded stock companies is 14% per annum. Based on a CAPM analysis, the current state of the underwriting cycle, and a perceived over-capitalization of the industry, management believes that the expected return for property-casualty insurance companies is 12% per annum. The investment yield on a conservative investment grade fixed income portfolio is 8% per annum.

The company may price its policies with a 14% target return on capital, and allow its underwriters to give premium credits if necessary. It may use a 12% cost of capital to measure management performance. If the expected return on the business is less than 8% per annum, the company may curtail its writings in that market.

### **RISK ADJUSTED RETURNS**

Actuarial standards relentlessly advise the actuary to use risk adjusted returns, risk adjusted discount rates, or risk adjusted yields. Rarely is there a coherent explanation of the risk adjustment to be used.<sup>18</sup>

Some actuaries assume that the IRR target return, or the NPV discount rate, should vary by line of business, depending on the risk inherent in the book of business. This inherent risk is sometimes assumed to exist without being rigorously quantified. Sometimes the risk of a line of business is assumed to be proportional to the duration of the liabilities. This is not consistent with the low risk of long-tailed fixed annuities or the high risk of short-tailed property insurance.<sup>19</sup>

Much of the actuarial literature on risk loads measures the process risk of individual policies, not the pricing risk in the book of business. More recently, some actuaries have tried to measure the expected process risk of an insurer's portfolio of risks. Although this is more meaningful than the process risk of an individual policy, there is little reason to assume that the expected process risk of an insurer's portfolio of risks is a proxy for the risk that is relevant to the target return on capital.<sup>20</sup>

Several consulting firms provide risk measures that purport to quantify correlations and covariances among lines of business. In many cases, these correlations and covariances reflect the white noise of random loss fluctuations.

*Illustration:* The ABC Consulting Firm quantifies the covariances of loss ratios by line from industry-wide Schedule P figures. These covariances stem primarily from random statistical correlations generated by the white noise of loss fluctuations.

Meaningful estimates of systematic risk by line of business have been impossible to attain. Even the CAPM adherents who propose risk adjustments based on modern portfolio theory have been forced to rely on round-about estimates. Underwriting betas and betas of losses are derived from asset betas and equity betas, using data for all lines of business combined. Sampling error and white noise obscure any information these derivations might have.<sup>21</sup>

## **RATES OF RETURN AND CAPITAL REQUIREMENTS**

In theory, for any two lines of business, the line with the greater systematic risk should have a higher profit margin in competitive markets. There are two ways to conceive of this.

1. Both lines have the same capital requirements per dollar of written premium, but the riskier line requires a higher return on the invested capital.
2. The riskier line requires more capital per dollar of written premium, but neither line has a higher required return on the invested capital.

The first view was dominant before the advent of risk-based capital requirements in the early 1990's; the latter view is more common since then. We review the history of actuarial thinking on this topic, along with the related issues of capital structure.

Before 1992, capital requirements were based on rules of thumb, which were not related to the risk in each line of business. The capital requirements were based on overall leverage ratios, which were the same for most lines of business.

- State regulators often used a two to one premium to surplus leverage ratio (the revised "Kenny rule").
- The NCCI has used a three to one reserves to surplus leverage ratio in its IRR pricing model, reflecting the average leverage ratio for workers' compensation insurers.<sup>22</sup>

If the capital requirements per dollar of written premium do not differ by line of business, the target return on capital should depend on the risk in each line. The actuarial analysis of leverage ratios is similar to the financial analysis of capital structure, to which we now turn.

## *CAPITAL STRUCTURE*

Some analysts have proposed viewing insurance reserves as debt capital and statutory surplus as equity capital; see Ferrari [1968], Bailey [1969], and Balcarek [1969]. The optimal leverage ratio for a property-casualty insurer is analogous to the optimal capital structure for a manufacturing concern.

*Illustration:* A bank receives money from depositors, which it lends to borrowers. The depositors are creditors of the bank (like bond-holders), and the interest paid on deposits times  $(1 - \text{the corporate tax rate})$  is the after-tax cost of debt capital. The shareholders of the bank also contribute capital; their expected return is the cost of equity capital.

By writing policies, an insurer receive funds from policyholders. The underwriting loss of an insurer as a percentage of loss and unearned premium reserves is the implicit interest rate paid to policyholders for the use of their funds. This is the implicit cost of debt capital.

Beyond the Miller and Modigliani propositions, modern finance lacks an accepted theory for capital structure. The dominant interpretation of the Miller and Modigliani propositions has two implications.

- Capital structure does not matter in a tax-free world.
- Under the U.S. tax system, debt is often preferable to equity, since bond interest payments are tax deductible whereas stockholder dividends are not.

*Illustration:* A manufacturing concern needs \$15 million in fixed assets and \$5 million in net working capital. Corporate bonds can be issued at an 8% coupon rate. Equityholders expect a 12% per annum after-tax return.

- If the company is financed with debt only, it needs a \$400,000 pre-tax return to meet its coupon payments.
- If the company is financed with equity only, it needs a \$600,000 after-tax return, or a  $\$600,000 / (1 - 35\%) = \$923,077$  pre-tax return.

The implication for insurance is that equityholders should prefer higher leverage ratios wherever permitted by regulation.<sup>23</sup> This conclusion is belied by the one to one premium to surplus leverage ratio that now prevails in the property-casualty industry, despite the high cost of holding capital and the lack of regulation mandating this level. Property-casualty insurers have the highest capital to asset ratios for any financial intermediary: about 40% for property-casualty insurers, but less than 10% for life insurers. Modern financial theory has not been of much aid in explaining empirical leverage ratios for insurance or in recommending optimal leverage ratios for policy pricing.<sup>24</sup>

#### *ACTUARIAL ANALYSES OF REQUIRED CAPITAL*

Some actuaries have used to probability of ruin analyses to determine capital requirements.<sup>25</sup> The required capital was the capital needed so that the probability of ruin was below a given threshold. Butsic [1994] and Hodes, *et al.* [1999] extend the theory by looking at the expected policyholder deficit instead of the probability of ruin.<sup>26</sup>

These analyses, which often use financial analysis (DFA) models of an insurer's operations, suffer from two detriments.

1. Many actuaries contend that financial modeling using the probability of ruin or the expected policyholder deficit can suggest relative capital requirements among blocks of business. They are less useful for determining the absolute dollars of capital.<sup>27</sup>
2. A common perception is that DFA analyses can determine capital requirements if one first selects a probability of ruin or an expected policyholder deficit ratio. For example, if one selects a 1% probability of ruin or a 2% expected policyholder deficit, a DFA analysis can determine the capital needed to meet these requirements.

This ascribes too much predictive power to DFA analysis. Solvency risks depend on variables that actuaries have not succeeded in quantifying, such as underwriting cycles, marketplace competition, regulatory actions, and unexpected catastrophes. The standard probability of ruin analyses, which focus on loss frequency and loss severity distributions, are of little relevance to these solvency risks. The events that have led to most property-casualty insolvencies in recent years, such as Hurricane Andrew, asbestos claims, environmental exposures, or the September 2001 World Trade Center incident, are not amenable to standard loss frequency and loss severity analyses.

#### **RISK-BASED CAPITAL**

With the advent of risk-based capital requirements, the focus of actuarial work has shifted. Instead of improvising theoretical capital requirements, actuaries now address the actual capital requirements imposed by the NAIC or the rating agencies. The hypothesized relation between the required return on capital and various actuarial or financial measures – such as probability of ruin, expected policyholder deficit, process risk, or tail value at risk – are of limited relevance for policy pricing.

To determine the capital requirements for the financial pricing model, we use the actual capital requirements from the NAIC risk-based capital requirements and from the similar rating agency formulas. These requirements affect the capital that companies must hold to avoid regulatory intervention in their operations and to maintain their desired ratings.<sup>28</sup>

#### **COST OF HOLDING CAPITAL**

The cost of holding capital connects the target return on capital and the indicated premium rate. Yet a problem with terminology has plagued many discussions of this topic. To clarify the terms, we differentiate between the *cost of capital* and the *cost of holding capital*.

- The *cost of capital* is the return on capital demanded by the equity-holders or other suppliers of capital to the firm. For a manufacturing enterprise, the cost of capital may be

8% for long-term debt, 13% for retained earnings, and somewhat higher for a new stock issue.<sup>29</sup> Insurance enterprises rarely have long-term debt. The cost of capital for insurers is the cost of internal equity (retained earnings). To highlight this attribute of insurance enterprises, we use the term “cost of *equity capital*” in our papers on financial pricing models.

- The *cost of holding capital* is the amount that equity-holders would lose by providing capital to the insurance enterprise were they not compensated by a profit margin in the policyholder premium. At a minimum, the cost of holding capital is the cost of double taxation. Investors supplying capital to an insurance enterprise are taxed twice on the investment income on capital funds.

*Illustration – Double Taxation:* Suppose insurance regulation requires investors to contribute \$100 million to support the writing of insurance policies. The opportunity cost of this capital is the amount that the equity-holders would receive if they invested the \$100 million elsewhere; this is the cost of capital. The cost of holding capital is the difference between this cost and the return received by investment through the insurance company.

Suppose the equity-holders would otherwise invest this \$100 million in bonds with an investment yield of 10%. The insurance enterprise could invest the \$100 million in the same bonds and receive the same investment yield.

If the equity-holders invest the \$100 million in 10% coupon taxable bonds, they pay personal income taxes on the \$10 million return. If the insurer makes the same investment, it pays \$3.5 million of corporate income taxes before returning the remaining investment income to the equity-holders. The equity-holders pay personal income taxes on the \$6.5 million that they receive from the insurance company.

The cost of holding this capital stemming from double taxation is the difference in the taxes incurred between (i) direct investment of capital and (ii) investment of capital through an insurance company.

- The taxes paid on direct investment of capital =  $investment\ yield \times personal\ tax\ rate$ .
- The taxes paid on investment of capital through an insurance company =  
 $investment\ yield \times [corporate\ tax\ rate + (1 - corporate\ tax\ rate) \times personal\ tax\ rate]$
- The difference between these two is

$$\begin{aligned}
 & investment\ yield \times \\
 & [corporate\ tax\ rate + (1 - corporate\ tax\ rate) \times personal\ tax\ rate] \\
 & = investment\ yield \times corporate\ tax\ rate \times (1 - personal\ tax\ rate)
 \end{aligned}$$

This is the after-tax difference to the equityholder. The difference before personal income taxes is the investment yield  $\times$  the corporate tax rate.

*Illustration:* If the investment yield is 10% per annum, the corporate tax rate is 35%, and the average personal tax rate is 30%, the cost of holding capital is

$$10\% \times [35\% + (1 - 35\%) \times 30\% - 30\%] = \\ 10\% \times 35\% \times (1 - 30\%) = 0.0245, \text{ or } 2.45\%.$$

The equityholders pay an additional 2.45% of the yield on their capital to the taxing authorities. This is the after-tax loss to the equityholders. The loss before personal income taxes is  $10\% \times 35\% = 3.5\%$ .<sup>30</sup> To induce investors to fund the insurance enterprise, the 3.5% of lost yield must be paid by the policyholders, not the equityholders.

If the policyholders paid this money directly to the equityholders, this would be the full cost of holding capital. In practice, there are no direct transactions between the policyholders and the equityholders. Instead, the policyholders pay this money as part of the policy premium, and the insurance company remits the money to the equityholders. This introduces another layer of taxation, since the policy premium is pre-tax and the compensation to the equityholders is post-tax. The additional margin in the policy premium, as a percentage of the investment yield on equityholder supplied capital, is

$$\text{investment yield} \times \text{corporate tax rate} / (1 - \text{corporate tax rate}) = \\ \text{investment yield} \times 35\% / (1 - 35\%) = \text{investment yield} \times 53.85\%$$

The double taxation affect invested capital, whereas the money paid by policyholders is a margin on premium. This margin is  $\text{capital} \times \text{investment yield} \times 53.85\% / \text{premium}$

There are other potential costs to holding capital, which are subject to considerable debate in the financial community.<sup>31</sup> A common actuarial argument is that the cost of holding capital is the difference between the cost of equity capital and the after-tax investment yield of the insurance company. This perspective underlies the pricing model in Atkinson and Dallas [2000] as well as the pricing model in this paper.

*Illustration:* Suppose the cost of equity capital is 12% per annum, but the insurance enterprise invests in 8% Treasury securities. The cost of double taxation is  $35\% \times 8\% = 2.8\%$ . The additional cost of holding capital stemming from the conservative investments of the insurance company is  $12\% - 8\% = 4\%$ . The total cost of holding capital is  $2.8\% + 4\% = 6.8\%$ . This is the amount that policyholders must pay to the equityholders to induce them to fund the insurance operations. Since the policyholders pay this money indirectly through the profit margin in the premium, which is taxed as underwriting income, the additional premium is 6.8%

$/(1-35\%) = 10.46\%$ .<sup>32</sup> Since the premium is paid at policy inception, the profit margin is  $10.46\% / 1.08 = 9.69\%$ .

This implies that with an 8% investment yield and a 400 basis point spread between the target return on capital and the investment yield, the policyholders pay 9.69% of equityholder supplied capital to compensate for the indirect investment of their funds.<sup>33</sup>

## CONCLUSION

The target return on capital is a somewhat discretionary assumption that drives any financial pricing model. There are diverse views on selecting the target return on capital, and we do not pretend to declare any of them correct. This paper reviews the considerations that the pricing actuary should take into account when selecting the target return.

### Appendix: Investment Tax Rates and Double Taxation

The discussion of double taxation in the text of this paper does not fully reflect some adjustments that Miller and other have made to the theory. This appendix provides a brief synopsis for the interested reader.

#### MILLER'S TAX ADJUSTMENT

In 1963, Merton Miller qualified the tax advantage of debt financing; see also Myers (1999) and Miller (1997). Miller surmised that the double taxation of equity financing may be partially offset by the higher personal tax rates on interest income than on long-term capital gains. The following illustration explains this offset.

*Illustration:* Investors can receive 10% per annum interest on Treasury bonds, on which they pay personal income taxes. Assume that the investors have high personal income tax rates of 36%, so they receive \$64 in after-tax income from \$1,000 of invested capital. Alternatively, they can invest their capital in a property-casualty insurance company, which purchases Treasury bonds. The insurance company pays \$35 in corporate income taxes on the interest income from the Treasury bonds. The investors receive the remainder as long-term capital gains (not as dividends), on which they pay a 20% marginal tax rate.<sup>34</sup> With a 10% average stock turnover rate, the effective tax rate on long-term capital gains is about 18%. The net return to the investors from the insurance company is  $\$65 \times (1 - 18\%) = \$53.30$ . The cost of double taxation is  $\$64.00 - \$53.30 = \$10.70$ .

Miller deals with the gain to the company from debt financing, which is analogous to double taxation but viewed from the company's perspective.<sup>35</sup> He expresses the gain as

$$G_L = (1 - [(1 - t_c)(1 - t_{PS})]/(1 - t_{PB})) \times B_L$$

where  $t_c$  is the corporate tax rate  
 $t_{ps}$  is the personal tax rate on stock capital gains  
 $t_{pb}$  is the personal tax rate on bond coupon interest.<sup>2</sup>

If the personal tax rate on capital gains is low enough and the personal tax rate on coupon interest is high enough, the gain from debt financing disappears and the cost of double taxation is zero.

The exact cost of double taxation is unclear. Even if Miller's adjustment is correct, the current tax structure in the U.S. causes only a small reduction in the cost of double taxation. The cost is probably substantial, but there is disagreement on its exact size. It may depend on the tax brackets of individual investors and the form in which the investors receive income from the insurance company.

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<sup>2</sup> See also Megginson (1997), who provides a general review of this subject.

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<sup>1</sup> Hard markets and soft markets are insurance industry terms for the high profitability and low profitability phases of the underwriting cycle. On underwriting cycles in the U.S., see Berger [1988], Cummins, Harrington, and Klein [1991], McGee [1986], Stewart [1984], and Venezian [1985]. On underwriting cycles in Europe, see Daykin, Pentikäinen, and Pesonen, [1994], Cummins and Outreville [1987], and Lamm-Tennant and Weiss [1997]. On general business cycles in the U.S., with an emphasis on commodity cycles, see Sterman [2001]. For a pricing perspective on underwriting cycles, see Felddblum [2001].

<sup>2</sup> This paper discusses considerations and methods; it does not present hard recommendations. For efficient corporate management, employees need definite targets, even if they are subjectively determined.

- <sup>3</sup> Most analyst see little correlation of the insurance underwriting cycle with general business cycles, though this is disputed by some. For workers' compensation, loss experience is inversely correlated with general business cycles; see Hartwig, Kahley, and Restrepo [1994], Hartwig, Kahley, Restrepo, and Retterath [1997], and Feldblum [2003; wcr].
- <sup>4</sup> The efficiency of the reinsurance marketplace further reduces the severity of catastrophic exposures. Well managed companies with sound reinsurance arrangements have weathered most natural catastrophes.
- <sup>5</sup> See especially Fama and French [1992; 1993]. The theoretical underpinnings of the CAPM have also been weakened by the criticisms raised by Roll [1977].
- <sup>6</sup> CAPM-based target returns and capitalization rates were used in Fairley's pricing model and in the Myers/Cohn discounted cash flow pricing model. These models were developed for the state mandated rating system in Massachusetts; neither of these models has been used in competitive markets. See Fairley [1987], Derrig [1987], Myers and Cohn [1987], D'Arcy and Doherty [1988], D'Arcy and Dyer [1997], Cummins [1990], Mahier [1998], Feldblum [2003: Fyf; 2003; mc]. On the estimation of underwriting betas, see Cummins and Harrington [1985], Kozik [1995], and Feldblum [1996].
- <sup>7</sup> In statistical terms, both the sampling error of the historical observations and the subsequent changes in betas are too great for useable results. See Blume [1975] and Vasicek [1973] for theoretical discussions, and McNulty, Yeh, Schulze, and Lubatkin [2002] for practical problems with CAPM estimates.
- <sup>8</sup> The relationship between the return on capital and the premium rate is similar. The price of a product depends on its supply, and its supply depends (in part) on the amount of capital available for its production. An increase in the available capital enlarges supply and lowers product prices. For property-casualty insurance, the relationship between the amount of capital and the supply of coverage is more tenuous. Prices fluctuate with the phases of the underwriting cycle, despite an ample supply of capital.
- <sup>9</sup> California, Texas, New Jersey, and several other states use return on surplus measures in their rate approval process. See Roth [1992] for one regulator's perspective on this issue.
- <sup>10</sup> The differences among statutory surplus, GAAP equity, and invested capital are discussed in Feldblum and Thandi, [2003A; 2003B]; see also Feldblum [1995].
- <sup>11</sup> GAAP equity is larger by the amount of the deferred tax asset stemming from loss reserve discounting that is not recognized on the statutory balance sheet; see Feldblum and Thandi [2003D; 2003A, Appendix A].
- <sup>12</sup> Federal income taxes paid increases invested capital, and the statutorily admitted portion of the deferred tax asset lowers it; for simplicity, we don't model the tax liability or the deferred tax asset in this paper.
- <sup>13</sup> This is similar to the CAPM decomposition into the risk-free interest rate and a market risk premium. The use of the inflation rate versus the risk-free interest rate is not material; either adjustment may be used.
- <sup>14</sup> Random loss fluctuations and the vicissitudes of the underwriting cycle render most published conclusions highly suspect. Some authors have used long time intervals to estimate the historical relationship between insurance industry returns and the risk-free interest rate. Even over long time intervals, this relationship has not been stable.
- <sup>15</sup> This is the rationale for using calendar year investment income as a proxy for discounted reserves; see Feldblum [1997: IEE].

- <sup>16</sup> We assume that the bonds are categorized as available for sale, not held to maturity; see SFAS 115.
- <sup>17</sup> See Joskow [1973] on the possible over-capitalization of the property-casualty insurance industry.
- <sup>18</sup> Actuarial Standards Board, "Actuarial Standard of Practice No. 19: Actuarial Appraisals" (October 1991), page 2, Definition 2.7, says: "Risk-Adjusted Rate of Return – An expected or target annual return to the investor that includes a risk-free return that compensates the investor for the use of the funds (recognizing anticipated inflation so as to maintain the real value of those funds), plus a risk premium above the risk-free rate that compensates the investor for the risk that actual returns will deviate from expected. The size of the risk premium varies with the degree of risk associated with the returns." This standard is too vague to guide actuarial practice.
- <sup>19</sup> See Hodes, *et al.*, [1999] for an analysis of the risk inherent in long-tailed workers' compensation reserves.
- <sup>20</sup> For the actuarial risk load literature, see Miccolis [1977], Meyers [1991; 1996], Feldblum [1993], Kreps [1990], Gogol [1996].
- <sup>21</sup> See Kozik [1995]. The long quest to quantify underwriting betas may one day be recorded as an embarrassing interlude in the development of financial pricing models for property-casualty insurance.
- <sup>22</sup> See Cummins [1990], Feldblum [1992], and Kahley and Halliwell [1992].
- <sup>23</sup> Ferrari [1967] concluded that the optimal capital structure for insurance companies was as little capital as possible.
- <sup>24</sup> For further discussion of capital structure, see especially Modigliani and Miller [1958; 1963], Miller [1963; 1977; 1999], Stiglitz [1969], DeAngelo and Masulis [1980], Myers [1984; 1999], Titman and Wessels [1988], Harris and Raviv [1991], and Meggison [1997], chapter 7, "Capital Structure Theory," pages 305-352. For an analysis of capital structure for property-casualty insurers, see Meyers [1989].
- <sup>25</sup> See Daykin *et al.* [1987], Daykin and Hey [1991, Pentikäinen, *et al.*, [1989], Pentikäinen and Rantala [1982], and Daykin, Pentikäinen, and Pesonen [1994]).
- <sup>26</sup> See also Kreps [1990] and Butsic [2000 on reinsurance] for additional actuarial approaches.
- <sup>27</sup> See Feldblum and Thandi [2003J], who use an expected policyholder deficit analyses to allocate company capital to lines of business, not to determine the required capital for the company itself.
- <sup>28</sup> See Feldblum and Thandi [2002J] for a complete treatment of this subject.
- <sup>29</sup> Financial analysts sometimes differentiate between the cost of internal equity (retained earnings) and the cost of external equity (new stock floatation). The difference is the floatation costs of a new stock issue. For simplicity, we consider only the cost of internal equity.
- <sup>30</sup> The effect of double taxation is mitigated if the implied equity flow from the insurance company is in the form of capital gains instead of stockholder dividends from the insurance company. This topic is treated in the general finance literature.

<sup>31</sup> In addition to the cost discussed in the text, some analysts argue that corporate managers with discretionary control over excess capital may not invest it solely in the interests of equityholders. They cite examples from various industries, such as the oil industry in the 1970's, to show that managers often use excess capital to increase market share at the expense of profitability. Investors may be reluctant to provide more capital than is essential for the company's operations. This is particularly relevant to those analysts who believe the insurance industry is over-capitalized.

<sup>32</sup> Some financial analysts retort that the lower risk of the Treasury securities increases the present value of their returns to a level approximately equal to the return on other securities. This assumes that equityholders consider the risk of placing their capital in an insurance enterprise that invests in risk-free securities similar to the risk of investing in those risk-free securities themselves. The alternative perspective is that the risk of placing capital in an insurance enterprise, regardless of its investment policy, is an equity risk. There are sound arguments on both sides, and we do not judge the issue here; see Miccolis [1987].

<sup>33</sup> There are additional taxes paid for the double discounting of loss reserves if held reserves are less than full value reserves and for personal income taxes paid by the equityholders; see Feldblum and Thandi [2003D].

<sup>34</sup> The deferral of the tax on capital gains until the gains are realized lowers the effective tax rate; see Jeffrey [1995] or Feldblum and Thandi [2003G].

<sup>35</sup> Debt financing has one layer of federal income taxes (only personal); equity financing has two layers (corporate and personal).

