Financial Pricing Models for Property-Casualty Insurance Products: Income Recognition and Performance Measurement

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by Sholom Feldblum and Neeza Thandi

A financial pricing model determines premium rates that provide an adequate return on invested capital. The pricing of the policy depends on cash flows and capital requirements, both of which are external (exogenous) constraints. They do not depend on the accounting system used for performance measurement. Prospective pricing is not necessarily concerned with the *pattern* of profit recognition, which is an internal accounting construct.

Management compensation systems depend on the profit recognition pattern. We examine six accounting systems in this paper: statutory accounting, GAAP, tax accounting, fair value accounting, an NPV accounting system, and an IRR accounting system.

The profit recognition system is particularly important when managers change positions. Managers should be evaluated for their contributions to company performance. They should not be rewarded or penalized for the activities of past managers which affect the recognition of profits in later accounting periods.

Some of the most common performance measures, such as net after-tax operating income and the operating ratio, do not take account of the cost of capital. Both of these measures lead to perverse capital management incentives, since they reward managers for holding unnecessary capital.

We examine two measures of profitability for each accounting system discussed in this paper: (i) the rate of return and (ii) the economic value added.

1. The rate of return in each period is the net after-tax income divided by the beginning of the year capital.
2. The economic value added (EVA) in each period is the net after-tax income minus the dollar cost of using capital. The dollar cost of using capital is the product of the cost of capital and the amount of capital at the beginning of the year.[1]

IMPLIED EQUITY FLOW

For any accounting system, the implied equity flow equals the after-tax net income minus the change in capital. In this sentence, "capital" refers to the capital in the accounting system, not the invested capital.

Illustration: The implied equity flow equals the statutory income minus the change in required statutory surplus. The implied equity flow also equals the GAAP income minus the change in required GAAP equity.

[1] Some analysts divide by the average capital held during the year, not the capital at the beginning of the year. This does not change the conclusions here, though the figures differ slightly.

The implied equity flow is the capital contribution required of the equityholders or the capital distribution to the equityholders. It is driven by statutory accounting. Once it is determined, it is a exogenous factor that is independent of the accounting assumptions used for performance measurement.

We illustrate the inter-relationships of the accounting systems with the following example.

Illustration: Statutory surplus is \$100 million at time t_i and \$105 million at time t_{i+1}. Net after-tax statutory income from time t_i to time t_{i+1} is \$10 million.

GAAP equity is \$125 million at time t_i, and GAAP after-tax income from time t_i to time t_{i+1} is \$10.5 million.

We solve for GAAP equity at time t_{i+1}. Let period t_{i+1} be the interval from time t_i to time t_{i+1}.

- Using the statutory figures, the implied equity flow during period t_{i+1} is \$10 million – (\$105 – \$100) = \$5 million.
- Using the GAAP figures, we have \$10.5 million – (\$X million – \$125 million) = \$5 million, or \$X million = \$130.5 million.

We compute the statutory return on surplus and the GAAP return on equity.

- The statutory return on surplus during period t_{i+1} is \$10 million ÷ \$100 million = 10%.
- The GAAP return on equity is \$10.5 million ÷ \$125 million = 8.4%.

We compare these figure with the cost of capital to determine the profitability of the insurance operations. Suppose that the cost of capital is 9% per annum.

- The statutory economic value added is \$10 million – 9% × \$100 million = +\$1 million. Using statutory accounting as the measure of profitability, the company has added \$1 million to equityholders' wealth.
- The GAAP economic value added is \$10.5 million – 9% × \$125 million = \$-0.75 million. Using GAAP accounting as the measure of profitability, the company has destroyed \$0.75 million of equityholders' wealth.

The implied equity flows are discussed in a companion paper (Feldblum and Thandi, [2002: Modeling the Equity Flows]). In a return on capital financial pricing model, the policy is priced by setting the net present value of the implied equity flows to zero or by setting the internal rate of return of the implied equity flows to the cost of equity capital.

The companion paper provides a fully documented illustration, showing all cash flows and implied equity flows for underwriting and investment operations. That illustration is continued in this paper, which deals with the income recognition pattern in various accounting systems.

Value of Operations

Neither GAAP nor statutory accounting is a proper reflection of the true value of the insurance operations. Statutory surplus and GAAP equity understate the net worth of the company because they do not recognize the capital embedded in the full value loss reserves. In addition, statutory accounting does not recognize a DPAC asset to offset the pre-paid acquisition costs in the gross unearned premium reserve.

For the same reasons, both statutory income and GAAP income may overstate or understate the change in the company's net worth during the accounting period. If the company is growing, statutory income and GAAP income understate the true change in the company's net worth. If the company is contracting, statutory income and GAAP income overstate the true change in the company's net worth.

We use an economic value added (EVA) yardstick to measure policy performance. Some readers may presume that the EVA measure corrects for the problems mentioned above. This is not the case. The EVA measure subtracts the cost of capital from the net income; it does not correct the distortions in the accounting system itself. If the net income measure is distorted, the EVA measure is distorted as well.

Net income and capital amounts depend on the accounting system. The list below summarizes the attributes shared by all the accounting systems discussed here.

- The company cash flows are the same for all accounting systems. These cash flows are exogenous; they are not affected by the performance measurement system.
- The implied equity flows are the same for all accounting systems. The implied equity flows are determined by the accounting system used for regulation; they are not affected by the accounting system used for performance measurement.
- The remaining capital after all losses are settled is zero for all accounting systems.
- The initial capital before policy inception is the initial implied equity flow. This is the same for all accounting systems.
- The sum of the nominal net income amounts (not the discounted net income amounts) is the same for all accounting systems. It equals the sum of the implied equity flows.

The final statement in the list above seems strange to some readers. They reason that if one accounting system recognizes income more rapidly than another accounting system, the investment income earned in the first accounting system is greater than the investment income earned in the second accounting system. This is not correct. The investment income is a cash flow, and the cash flows are invariant across accounting systems. The difference between accounting systems is that the investment income may be earned on assets backing required reserves in one accounting system and it may be earned on assets backing equity or net worth in another accounting system. Since the

nominal income over the lifetime of the project equals the cash income over the lifetime of the project, the nominal income is invariant across the accounting systems.

SUMMARY CONCLUSIONS

Of the six accounting systems discussed in this paper, only the NPV system and the IRR system take account of the cost of holding capital. Just as only these two accounting systems are appropriate for pricing the policy, only these two accounting systems provide measures of profitability that are suitable for monitoring management performance.

The IRR and NPV accounting frameworks provide the same "accept or reject" decision for policy pricing. However, they recognize profits differently.

- A net present value analysis recognizes profits when the project is undertaken.
- An internal rate of return analysis recognizes profits ratably over the lifetime of the project.

The following characteristics apply to prospective analyses, or the expected economic value added in each policy period.

NPV: In the NPV accounting system, the capital at policy inception is the present value of future implied equity flows. In subsequent periods, the net income is just offset by the dollar cost of capital, which is the percentage cost of capital times the amount of required capital. The EVA generated at policy inception is the net present value of the project. The EVA in subsequent periods equals the net income minus the dollar cost of capital, which nets to zero.

IRR: The IRR profit recognition framework, which recognizes profits ratably, provides a constant return on invested capital over the lifetime of the project. The profit in any time period is the length of the time period times this constant return. More rigorously, the return in any period of length "t" is $(1+IRR)^t - 1$.

The IRR and the NPV frameworks have the following characteristics:

- At the time of policy inception, the NPV accounting system recognizes all expected profits. The profit recognized in the IRR accounting system at policy inception is zero, since the length of this period is just the moment of policy writing.
- In subsequent periods, where the NPV accounting system shows zero EVA, the IRR accounting system shows a constant IRR. If the IRR is greater than the cost of capital, the EVA is positive; if the IRR is less than the cost of capital, the EVA is negative.

The accounting exhibits in this paper separate the return at policy inception from the return during the first year. From this perspective, the NPV accounting system shows a constant return equal to the cost of equity capital after policy inception. In practice, the return on policy inception is included with the first year return. The IRR accounting system shows the same rate of return in each year, whereas the NPV accounting system does not.

Neither the NPV perspective nor the IRR perspective is inherently superior. We discuss the relative benefits of the two perspectives further below.

ECONOMIC VALUE ADDED

We use an economic value added (EVA) framework for performance measurement and management compensation purposes. The comments above may give the impression that under the NPV accounting system, the EVA is zero for all periods after policy inception, and that under the IRR accounting system, the EVA is a constant percentage of capital for all periods after policy inception. Were this true, the EVA yardstick would have limited use for performance measurement.

The generalizations above apply to prospective pricing analysis. Performance measurement deals with actual performance. Actual performance may be viewed as the combination of expected performance and the variance of actual from expected in each accounting period.

For performance measurement, we restate the principles as follows:[2]

- Under the NPV accounting system, the EVA at policy inception is the NPV of the project. During subsequent periods, the EVA is zero if actual experience exactly matches expected experience. If actual performance is more favorable than expected, the EVA is positive. If actual performance is less favorable than expected, the EVA is negative.

- Under the IRR accounting system, the EVA at policy inception is zero. During subsequent periods, the EVA is a constant percentage of the required capital at the beginning of the period. It equals the required capital times the difference between the IRR and the cost of equity capital, as long as actual experience matches expected experience. More favorable experience raises the EVA, and less favorable experience reduces the EVA.

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[2] Measurement of actual performance is discussed more fully in Schirmacher and Feldblum, "Financial Pricing Models for Property-Casualty Insurance: Retrospective Analysis and Performance Measurement."

Illustration: Managers A and B each manage a $100 million book (in premium volume) of commercial fire business. All policies have effective dates of January 1.

At the start of 20XX, Manager A's book of business has a net present value of $5 million, based on best estimates of future loss costs. Manager B's book of business has a net present value of –$5 million, based on best estimates of future loss costs. Based on our assumptions and expectations, we presume that Manager A is adding value to the company whereas Manager B is reducing the value of the company.

Insurance results are inherently uncertain. The value added to the company depends on actual results, not merely on the assumptions and expectations in policy pricing. If Manager A's book of business suffers unexpectedly large losses more than $5 million greater than anticipated, it will have destroyed company value by the end of the year. If Manager B's book of business is unexpectedly free of large losses (more than $5 million less than expected), it will have added value to the company by the end of the year. The EVA yardstick quantifies the actual value added, not the value that the manager expected to add.

The EVA framework is conceptually identical to the return on capital analysis, but it more clearly separates the return into (i) the net after-tax income to the equityholders and (ii) the cost of equity capital. This enables managers to relate the profit earned from a book of business with the cost of the capital needed to support that book of business.

Although the EVA in each period depends on the accounting system, the present value of the entire series of EVA's equals the NPV of the policy. This is true for all accounting systems, as long as the discount rate for the present value calculation is the cost of capital. A mathematical demonstration of this result is shown in Appendix A.

One may conceive of this relationship as follows. The accounting system moves income and value added from period to period. The accounting system does not enhance or diminish the value added over the lifetime of the project.

- Net income is a nominal amount. The total nominal amount of net income is not affected by the accounting system.
- EVA is a present value concept. The total present value of the EVA's is not affected by the accounting system.

GAAP AND EVA

In other industries, GAAP income and GAAP equity are used for EVA analysis. For insurance profitability, GAAP figures are not an adequate measure of profitability.

GAAP reserve valuation: For non-insurance companies, GAAP equity is a proxy for the capital invested in the project and GAAP income is a proxy for the change in the company value during the accounting period. For property-casualty insurance operations, GAAP reserve valuation follows statutory accounting. GAAP equity and GAAP income are not reasonable proxies of net worth or the change in net worth.

Illustration: An insurer writes large dollar deductible workers' compensation business, with an expense ratio of 35% and a nominal loss ratio of 135%. The present value at policy inception of workers' compensation LDD losses is 45% of their ultimate value. No losses are expected to be paid for several years after policy inception.

If no capital were required to support the policy, the net present value of the policy would be

$$1 - (35\% + 45\% \times 135\%) = 4.25\% \text{ of the policy premium.}$$

Suppose the insurer begins the year with $40 million in capital, it writes $100 million of business on January 1, 20XX, and it earns a yield of 8% on invested funds. Its expected net worth at the end of the year (ignoring taxes) is

($40 million + $4.25 million) × 1.08 = $47.79 million. Its total income is $7.79 million.

The company's combined ratio is 135% + 35% = 170%. The investment income earned during the year is [$40 million (capital) + $65 million (net premium)] × 8% = $8.40 million. The GAAP equity at the end of the year is

$$\$40 \text{ million} - 70\% \times \$100 \text{ million} + \$8.4 \text{ million} = (\$21.60) \text{ million.}$$

Its GAAP income is –$21.6 million – $40 million = –$61.6 million.

The figures used in the illustration are reasonable estimates for LDD workers' compensation business with a high deductible. Large dollar deductible business has an unusually long tail, but the same effects occur in all commercial liability lines of business.

Capital Requirements

For evaluating the economic value added, other industries often use GAAP statements with adjustments to bring the reported amounts closer to fair market value amounts.[3] The use of "adjusted GAAP" statements with reserves shown at fair value does not solve the problems for property-casualty insurance companies. We analyze such fair value accounting systems further below, showing the profit recognition pattern. Our concern here is the intuition.

Illustration: We continue the scenario above. Suppose that the capital requirements for the year of writing the book of business equal 25% of the written premium plus 15% of the loss reserves. The company's statutory surplus declines by $70 million during the year, less the investment income earned during the year. Based on the capital requirements for written premium and nominal reserves, it needs 25% × $100 million + 15% × 135% × $100 million = $45.25 million of surplus at the end of the year. With an 8% per annum investment yield, it must begin the year with surplus of

($70 million + $45.25 million – $65 million × 8%) ÷ 1.08 = $101.90 million.

The cost of supplying this capital is large. We assume that the cost of holding capital equals the cost of equity capital minus the after-tax investment yield.[4] If the cost of equity capital is 6 percentage points above the investment yield, the cost of holding capital is 65% × 8% + 6% = 11.20% per annum.

The total profit from the block of business from a fair value accounting perspective is about $4.25 million. In fact, the company loses about 11.2% × $101.9 million = $11.41 million in the first year alone from the mandated capital requirements. Using the fair value of loss reserves does not solve the double taxation problem on invested capital.

These two issues – the need to hold full value loss reserves and the capital requirements imposed by regulatory authorities – are leitmotifs of this paper. Just as these two items compel us to use pricing models which examine the return on invested capital, they compel us to use profit recognition systems that account for the invested capital.

For insurance enterprises, a useable EVA measure starts with after-tax net income based on an NPV or an IRR accounting system. An EVA measure based on GAAP, statutory, tax, or fair value accounting does not align the performance measure with the actual profitability of the book of

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[3] Common examples of such GAAP adjustments for other industries include

- accounting for depreciation, if GAAP does not use a realistic depreciation basis,
- accounting for investments in subsidiaries, if GAAP ascribes too much value to goodwill,
- accounting for post-retirement benefits, if GAAP spreads liabilities over a period of years.

The most significant adjustment is for the market value of fixed assets, which may differ greatly from cost.

[4] See Feldblum and Thandi [2002], "The Target Return on Capital," for alternative perspectives on the cost of holding capital.

business. The choice of the NPV vs the IRR accounting system reflects the perspective on profit recognition – at policy inception or evenly over the policy lifetime.

ACCOUNTING SYSTEMS

We show the profit recognition pattern for the illustration in the companion paper, "Modeling the Equity Flows," (and repeated below) under six accounting systems:

22. Statutory accounting
23. GAAP
24. Tax accounting
25. Fair value accounting
26. Net present value analysis
27. Internal rate of return analysis

For each accounting system, we consider after-tax net income, the reported capital, the return on capital, and economic value added. We sum up the profit recognition patterns as follows:

- GAAP and statutory accounting defer the recognition of income.
- Tax accounting, fair value accounting, and NPV accounting recognize income up-front.
- IRR accounting recognizes income ratably over the policy lifetime.
- Only NPV and IRR accounting take into account the cost of holding capital.

Illustration: The indicated premium for a long-tailed workers' compensation book of business is $100 million. Because of a hard market, the company writes the policies for $105 million.

GAAP and tax accounting show losses in the initial policy year and profits afterwards. Tax accounting shows the $5 million profit during the policy year. The fair value and NPV accounting systems show the profit at policy inception. The IRR accounting system shows the additional return ratably over the policy lifetime.

Illustration

We examine the profit recognition pattern for the following illustration under six accounting systems. The implied equity flows for this illustration are shown in Feldblum and Thandi, [2002], "Modeling the Equity Flows."

A company writes and collects a $1,000 annual premium on December 31, 20XX. Acquisition expenses of $250 are incurred and paid on that day. Maintenance and general expenses of $150 are incurred and paid evenly over the policy term.

The pre-tax investment yield benchmark is an 8% per annum bond equivalent yield (semi-annual compounding). The marginal tax rate on both underwriting income and investment income is 35%.

Losses are incurred evenly during the policy term and they are paid over several years. To simplify the illustration, we model the losses as if there were two occurrences with ultimate values of $400 each occurring on June 30, 20XX+1, and December 31, 20XX+1. Both losses are paid on December 31, 20XX+3.

The capital requirements are based on the NAIC risk-based capital formula. For this scenario, the capital requirements are 25% of annual written premium plus 15% of loss reserves.

Definitions

The company cash flows and implied equity flows for the illustration are shown in Exhibit ??; the derivations are described in the companion paper. They are based on cash transactions and statutory mandates; they do not depend on the accounting framework used for performance measurement. We show the net income, the reported capital, the return on capital, and the economic value added for this illustration using each accounting framework.

We clarify the meaning of after-tax net income and capital by accounting system.

- *Statutory accounting:* Net income is after-tax statutory income. Direct charges and credits to surplus are included with income. The measure of capital is statutory surplus.

- *GAAP:* Net income is after-tax GAAP income. Direct charges and credits to equity are included with income. The measure of capital is GAAP equity.

- *Tax accounting:* Net income is taxable income minus the tax liability. The measure of capital is statutory surplus adjusted for tax timing differences. The timing differences most relevant to the pricing model are revenue offset, loss reserve discounting, and the deferred tax assets associated with each of these.

- *Fair Value Accounting:* Capital is determined by marking all assets and liabilities to market. If market values are not available, we use present values at a benchmark investment yield. After-tax net income is determined as the change in capital before any capital contributions or shareholder dividends.

- *Internal rate of return:* Capital is defined as the capital invested by equityholders in support of the policy. The net income is the income needed to achieve a constant internal rate of return over the lifetime of the policy. This is analogous to the yield to maturity for a fixed-income security, which is the internal rate of return of the bond's cash flows.

- *Net present value:* The measure of capital is the discounted value of future implied equity flows, using the cost of capital as the discount rate. The net income in all periods except period 0 is the cost of capital times the capital at the beginning of the period. The net income for period 0 is the net present value of the policy at the cost of equity capital.

The implied equity flows and the capital contributed at time t=0 are the same for all accounting systems. The capital contributed at time t=0 is the initial implied equity flow. In the illustration used here, this is the $412.50 contributed by equityholders before policy inception to fund the initial underwriting loss and the initial surplus requirement.

For each accounting system, we show the flow of net income and of capital, using the definitions above. An accounting system is *consistent* if the net income minus the change in capital equals the implied equity flow. As a consequence, the sum of all implied equity flows equals the sum of all after-tax net income flows. All six accounting systems as defined here are consistent. An example of an inconsistent accounting system is one which recognizes only underwriting income but not investment income. Other examples are the following:

- If direct charges and credits to surplus are not included in statutory income, statutory accounting is not a consistent accounting system, because the sum of the equity flows is not equal to the sum of the after-tax net income flows.
- If direct charges and credits to equity are not included in GAAP income, GAAP is not a consistent accounting system.
- If tax exempt income is not included in taxable income, tax accounting is not a consistent accounting system.

We define the after-tax return on capital as the net income during each accounting period divided by the capital at the *beginning* of the period. In the numerical tables, we divide the net income in column "t" by the capital in column "t–1."

For period 0, the net income is the initial underwriting loss for the statutory accounting, GAAP, tax accounting, and fair value accounting. It is the NPV for the NPV accounting system, and it is zero for the IRR accounting system.

Income Recognition by Accounting System

We derive the return on capital and the economic value added for the six accounting systems. We show the pattern of income recognition, and we explain the implications for performance measurement.

STATUTORY ACCOUNTING

Period	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Income	($162.50)	($44.87)	$104.93	$40.57	$40.21	$23.05	$23.48
ΔSurplus	($162.50)	$60.00	($190.00)	$0.00	$0.00	$0.00	($120.00)
Surplus	$250.00	$310.00	$120.00	$120.00	$120.00	$120.00	$0.00
Return	-39.4%	-17.9%	33.8%	33.8%	33.5%	19.2%	19.6%
EVA	($162.50)	($59.45)	$86.85	$33.58	$33.21	$16.05	$16.49

Table 1: Statutory Accounting: Return on Surplus and EVA

The rows refer to (1) statutory net after-tax income, (2) change in policyholders' surplus, (3) policyholders' surplus, (4) return on statutory surplus, and (5) economic value added.

Statutory accounting shows the net income to the company, not the net income to the equityholders. This is true for tax accounting, GAAP, and fair value accounting as well. Net statutory income has the following pattern:

- A large underwriting loss occurs at policy inception, because the equityholders must fund the equity in the gross unearned premium reserves. The initial underwriting loss does not depend on the profitability of the policy.
- For long-tailed lines of business, additional underwriting losses occur during the policy term, because the equityholders must fund part of the full value loss reserves.
- For very short-tailed lines, statutory accounting shows positive income during the policy year if the business has been priced adequately. The magnitude of the profit or loss during the policy term depends on both the rate adequacy and the length of time between premium collection and average loss payment.
- Investment income accrues steadily after policy expiration. For prospective pricing, there is no expected underwriting gain or loss after policy expiration to augment or offset the investment income. Expected net income (i.e., after-tax underwriting + investment income) is positive regardless of the adequacy of policy pricing, since all the underwriting gain or loss occurs during the policy period, when the losses are incurred.

The capital shown on the statutory balance sheet is policyholders' surplus only; it does not include the capital embedded in the loss reserves and unearned premium reserves. The return on statutory surplus is negative at

policy inception, because of the initial underwriting loss. During the policy term, the return on surplus is negative for long-tailed lines of business and either low or negative for the shorter-tailed lines of business. The return on surplus turns positive after the policy expires and as losses are settled, because the investment income on the assets supporting the loss reserves is not offset by amortization of any reserve discount.

Illustration – Initial Underwriting Loss

At policy inception, or period 0, the after-tax net income equals

the expenses incurred (a negative amount)
+ the tax incurred (a negative amount for a tax liability and a positive amount for a tax refund)
+ the change in the deferred tax asset recognized on the statutory balance sheet.

In the illustration, this is

–$250 (expenses) + $17.50 (tax refund) + $70.00 (deferred tax asset) = –$162.50.

The capital is the statutory surplus. Before the policy is written, the statutory surplus equals the $412.50 that must be contributed by equityholders before policy inception to fund the initial underwriting loss and the regulatory capital requirements.

To visualize this, suppose that a company incorporates on December 30, 20XX, and it writes the policy in the illustration on December 31, 20XX. Its owners must supply it with statutory surplus of $412.50 on December 30 so that it can write the policy on the next day.

- The initial underwriting loss is $162.50.
- The capital requirements at policy inception are $250.00.
- The shareholder contribution needed to begin insurance operations is $162.50 + $250.00 = $412.50.
- The after-tax return on surplus in period 0 is –$162.50 ÷ $412.50 = –39.4%.

Illustration – Subsequent Valuation Period

We name the valuation periods by the ending valuation date. For example, period 2.5 extends from time t=2.0 to time t=2.5, or the first half of year 3. The net income in any period equals

the premiums earned
+ the investment income accrued
– the losses incurred
– the expenses incurred
– the federal income taxes incurred
+ the change in the deferred tax asset

For a prospective pricing model, premiums are earned and losses are incurred during the policy term, not afterwards, assuming the company holds full value loss reserves.

The statutory net income in period 2.5 equals the investment income minus the tax liability plus the change in the deferred tax asset. The deferred tax asset declines from $33.60 at December 31, 20XX+2, to $16.80 at June 30, 20XX+3, for a change of –$16.80.

$35.46 (investment income) –(–$4.39) (tax refund) +(–$16.80) (change in DTA) = $23.05.

The statutory surplus is the risk-based capital requirement. For period 2.5, this is 15% of the full value loss reserves: $900 × 15% = $120. The change in surplus is zero, since the reserves do not change during this period. The return on surplus is $23.05 ÷ $120.00 = 19.2%.

Economic Value Added

The economic value added analysis subtracts the cost of capital from each period's net income. The length of period 0 is infinitesimally small, so the EVA for period 0 is the same as the net income in period 0 for each accounting system.

For most lines of business, the statutory EVA remains negative throughout the policy term, unless the policy is overpriced.[5] The size of the negative statutory income during the policy term is greater for long-tailed lines of business and smaller for short-tailed lines of business.

The expected EVA turns positive after the policy expiration date, regardless of the premium rate adequacy. If the policy is priced adequately, the total EVA is zero. Since the EVA before policy expiration is negative, the EVA after policy expiration must be positive. If the policy is inadequately priced, the additional losses are accrued during the policy term, not afterwards.

To clarify the positive EVA, we examine the sources of gain or loss after policy expiration:

28. gain: investment income on the assets backing discounted loss reserves
29. gain: investment income on the assets backing the capital embedded in reserves
30. gain: investment income on statutory surplus
31. gain: tax refund on amortization of the interest discount in tax basis loss reserves
32. loss: federal income taxes on all sources of investment income
33. loss: the dollar cost of capital, or the percentage cost of capital × the amount of capital
34. loss: the decline in the admitted portion of the deferred tax asset

19. The amortization of the tax basis loss reserves equals the risk-free mid-term rate times the beginning discounted reserves. As an incurred loss, it is an offset to taxable income, and it offsets the expected investment income on the assets backing the discounted reserves.

20. Statutory accounting admits only the portion of the deferred tax asset which is expected to reverse in the coming 12 months. Since the IRS loss reserve discount factors are relatively even until the last few years of the loss payout pattern, the change in the admitted portion of the

[5] The policy term is the period during which the premiums are earned. The policy lifetime is the period from policy inception until the claims are settled. The illustration uses a one year policy term with a three year policy lifetime.

deferred tax asset is small; see Appendix A of Feldblum and Thandi [2002], "Modeling the Equity Flows," for explanation of the tax effects.

21. The remaining gains are the full (pre-tax) investment income on the assets backing the tax basis discounted reserves plus the after-tax investment income on the remaining assets held by the company. These exceed the dollar cost of capital.

The statutory EVA is a biased measure of performance. Its expected value is negative for the first year and moderately positive for subsequent periods. It penalizes managers for writing profitable business and rewards their successors.

GENERALLY ACCEPTED ACCOUNTING PRINCIPLES

GAAP for insurance transactions follows statutory accounting, with two major differences.

- Pre-paid acquisition costs are capitalized and amortized over the term of the policy.
- The entire deferred tax asset from IRS loss reserve discounting may be recognized.[6]

GAAP Results

Period	*0*	*0.5*	*1.0*	*1.5*	*2.0*	*2.5*	*3.0*
Income	$0.00	($109.32)	$40.48	$23.77	$23.41	$23.05	$23.48
ΔEquity	$0.00	($4.45)	($254.45)	($16.80)	($16.80)	$0.00	($120.00)
Equity	$412.50	$408.05	$153.60	$136.80	$120.00	$120.00	$0.00
Return	0.0%	(26.5)%	9.9%	15.5%	17.1%	19.2%	19.6%
EVA	$0.00	($133.37)	$16.69	$14.82	$15.43	$16.05	$16.49

Table 2: Generally Accepted Accounting Principles: Return on Equity and EVA

The rows refer to (1) net after-tax GAAP income, (2) change in GAAP equity, (3) GAAP equity, (4) return on GAAP equity, and (5) economic value added.

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[6] Other SAP-GAAP differences are relevant in specific scenarios; these include

- The timing of the recognition of policyholder dividends for workers' compensation carriers; see SSAP No. 65, "Property and Casualty Contracts."
- The statutory offset for agents' balances more than 90 days past due versus the GAAP offset for uncollectible receivables. This is relevant for commercial casualty policies where the insurer collects the premium periodically over the policy lifetime. See SSAP No. 6, paragraph 9.
- The statutory non-admitted charge of 10% of earned but unbilled premiums vs the GAAP offset for uncollectible receivables. This is relevant for policies with low deposit premiums and high audits. See SSAP No. 53.
- The statutory non-admitted charge of 10% of accrued retrospective premiums vs the GAAP offset for uncollectible receivables. This is relevant for retrospectively rated policies. See SSAP No. 66.

Other SAP-GAAP differences that my be relevant for specific companies include (i) the valuation of subsidiaries, (ii) the post-retirement benefit liabilities, (iii) the valuation of fixed-income securities, and (iv) the statutory Schedule F provision for reinsurance.

GAAP shows more rapid recognition of underwriting income during the policy term than statutory financial statements show, giving a more even spread of income over the policy term. GAAP statements do not show an initial underwriting loss. The GAAP matching principle implies that net underwriting income should be constant over the policy term.[7]

For long-tailed lines of business, the GAAP income during the policy term is low or negative, since loss reserves are set at undiscounted values. The GAAP division of income between the policy term and subsequent valuation periods is distorted almost as much as the statutory income. The primary difference between the two accounting systems is that GAAP statements recognize the full deferred tax asset. This speeds up the recognition of income.

The GAAP deferred tax asset or liability from revenue offset depends on the relationship between the deferred policy acquisition costs (DPAC) and the 20% tax assumption.

- If the GAAP DPAC ratio to written premium is more than 20%, the company sets up a deferred tax liability for 35% of the excess over 20%.
- If the GAAP DPAC ratio to written premium is less than 20%, the company sets up a deferred tax asset for 35% of the amount below 20%.

In the illustration, the deferred policy acquisition costs are 25% of written premium. The GAAP deferred tax liability at policy inception is 35% × (25% – 20%) × the written premium, or

$$35\% \times 5\% \times \$1000 = \$17.50.$$

This equals the tax refund at policy inception. If the DPAC is less than 20% of written premium, the GAAP deferred tax asset equals the tax liability at policy inception.

Total GAAP income during the policy term exceeds total statutory income by the amount of the deferred tax asset from IRS loss reserve discounting that is not recognized on the statutory balance sheet. This difference reverses (relatively smoothly) between the policy expiration date and the final settlement of losses.

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[7] For simplicity, the $150 of general expenses that are incurred evenly over the policy term are modeled as a cash flow at time t=½; see the companion paper, Feldblum and Thandi [2002], "Modeling the Equity Flows," for the modeling assumptions and the simplifications used in the illustration. If the $150 of general expenses were spread over the policy term, the net income would be – $133.37 + $75.00 = ($58.37) for the first half year and $16.69 – $75.00 = ($58.31) for the second half year. The 6 cent difference stems from differences in the investment income in the two half years. GAAP spreads the expected underwriting income evenly over the policy term. The incidence of the expected investment income is determined by the expected capital requirements and held reserves in each half year.

Illustration – Deferred Tax Asset: The deferred tax asset on the GAAP balance sheet is $39.20 on December 31, 20XX+1, and $33.60 on December 31, 20XX+2. The difference of $5.60 is the amount of the deferred tax asset that reverse in the 12 months between 12/31/20XX+1 and 12/31/20XX+2. This equals the deferred tax asset on the statutory balance sheet on December 31, 20XX+1.[8]

Illustration – Policy Inception: We compare statutory after-tax net income with GAAP after-tax net income at policy inception.

Statutory after-tax net income is a combination of three items: (i) the pre-paid acquisition costs, (ii) the tax liability or tax refund, (iii) the deferred tax asset from revenue offset. GAAP after-tax net income at policy inception has the following characteristics:

- The pre-paid acquisition costs are capitalized at policy inception. No premiums have been earned and no investment income has accrued, so pre-tax net income is zero.
- Since pre-tax net income is zero, the after-tax net income is also zero. Any tax liability or tax refund is offset by a deferred tax asset or liability of the same size but opposite sign.

We compare the statutory and GAAP figures at policy inception to highlight the differences. The current tax liability is a $17.50 refund at policy inception for all accounting systems.

- Statutory accounting shows incurred expenses of $250 and a deferred tax asset of $70.
- GAAP shows incurred expenses of $0 and a deferred tax liability of $17.50.

The table below shows the current tax liability, the deferred tax liability, and the incurred expenses for GAAP and statutory accounting at policy inception. The statutory deferred tax asset is shown as a negative liability.

	Statutory	GAAP	Difference
Current Tax Liability	($17.50)	($17.50)	$0.00
Deferred Tax Liability	($70.00)	$17.50	$87.50
Incurred Expenses	$250.00	$0.00	($250.00)
Total	$162.50	$0.00	($162.50)

The statutory liability is $162.50 greater than the GAAP liability, so the GAAP after-tax net income is $162.50 greater than the statutory income.

Illustration A: Subsequent Valuation Period: We compare GAAP and statutory accounting for period 2.5 (from time t=2.0 to time t=2.5).

- The policy has expired. The GAAP DPAC is zero, and the deferred tax asset from revenue offset is zero for both GAAP and statutory accounting.

[8] The computation of GAAP and statutory deferred tax assets is explained in Appendix A of the companion paper, Feldblum and Thandi, [2002], "Modeling the Equity Flows." For the long-tailed lines of business, the full deferred tax asset stemming from IRS loss reserve discounting is considerably larger than might be inferred from the illustration here.

- A year or less remains until losses are settled. The deferred tax asset from IRS loss reserve discounting is the same for statutory as for GAAP financial statements.
- Loss reserves are held at full values on both the statutory and GAAP balance sheets.

There are no differences in the last year between GAAP and statutory accounting. The net income, return on capital, and economic value added are the same.

Illustration B: Subsequent Valuation Period: For period 1.5 (from time t=1.0 to time t=1.5) we calculate the GAAP after-tax net income in two ways: (i) by comparison with statutory income and (ii) by an independent computation.

Statutory income is $40.57. The only difference between statutory and GAAP after-tax net income is the change in the deferred tax asset stemming from IRS loss reserve discounting.

- At December 31, 20XX+1, the statutory DTA is $5.60 and the GAAP DTA is $39.20.
- At December 31, 20XX+2, both the statutory and GAAP DTA's are $33.60.
- During 20XX+2, the statutory DTA rises by $28.00, and the GAAP DTA declines by $5.60. The difference is $28.00 – (– $5.60) = $33.60.
- This difference is spread evenly between the two halves of the year, for a difference of $16.80 between statutory and GAAP after-tax net income each half year.
- The statutory after-tax net income in period 1.5 is $40.57.
- The GAAP after-tax net income is period 1.5 is $40.57 – $16.80 = $23.77.

Alternatively, we work out GAAP after-tax net income independently. The after-tax net income equals the investment income minus the liability minus the change in the deferred tax asset:

$36.58 *(investment income) – ($12.80) (tax liability on investment income) – (–$2.80) (tax refund on reserve amortization) + (–$2.80) (change in GAAP DTA) = $23.77.*

For long-tailed lines of business, the GAAP EVA is relatively constant and negative during the policy term, since premiums are earned evenly, losses and incurred evenly, and GAAP expenses are written off evenly over the policy term. The negative sign of the EVA stems from the requirement to hold full value loss reserves.

After the policy expiration date, the GAAP EVA is lower than the statutory EVA, since the full DTA from loss reserve discounting has been recognized during the policy term.

Performance Measurement

None of these four measures – statutory income, GAAP income, statutory EVA, and GAAP EVA – reflects the flow of income to the equityholders, and none is suitable for performance measurement. All of them show losses at policy inception (and during the policy term for long-tailed lines of business) and gains in valuation periods after policy expiration. This is the opposite of the profit recognition pattern needed for effective performance management.

Nevertheless, some insurers use GAAP or statutory income measures for performance measurement, such as "net operating income after tax." This measure does not consider the cost of holding capital, and it has perverse effects on management incentives.

- The more capital that is allocated to a manager, the greater is the investment income, and the higher is the net operating income after tax.
- In truth, the more capital that is allocated to a manager, the lower is the net present value or the internal rate of return of the block of business.

When net operating income after tax is used as the performance measure, operating managers seek more capital for their business units. Some pricing actuaries conclude that the manager does not appreciate the cost of holding capital. This is not necessarily correct. Sometimes the pricing actuary does not appreciate the incentive structure of the performance measurement system. If the performance measurement system does not consider the cost of holding capital, the rational manager acts as though this cost were zero.

Tax Accounting

Net income is defined as taxable income minus the tax liability. Taxable income is statutory income adjusted for tax timing differences. The timing differences stem from IRS loss reserve discounting and revenue offset, as well as from the deferred tax assets associated with each.

Period	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Income	($32.50)	$37.33	($0.87)	$26.57	$10.21	$39.85	($55.72)
ΔSurplus	($32.50)	$142.20	($295.80)	($14.00)	($30.00)	$16.80	($199.20)
Surplus	$380.00	$522.20	$226.40	$212.40	$182.40	$199.20	$0.00
Return	-7.9%	9.8%	-0.2%	11.7%	4.8%	21.8%	-28.0%
EVA	($32.50)	$15.18	($31.32)	$13.38	($2.17)	$29.21	($67.33)

Table 3: Tax Accounting: Return on Capital and EVA

The rows refer to (1) net after-tax taxable income, (2) change in tax-basis equity, (3) tax-basis equity, (4) return on tax-basis equity, and (5) economic value added.

Terminology

Tax accountants often speak of differences between taxable income and GAAP income (or between taxable income and statutory income) as permanent tax differences. This perspective leads to a tax accounting system that is not a consistent accounting system, since the sum of the implied equity flows does not equal the sum of the after-tax net income flows.

The better perspective is that the tax *rate* differs by type of investment, not that taxable income differs by type of investment. Taxable income differs from statutory pre-tax income or GAAP pre-tax income only in the timing of income recognition, not in the amount of income.

Illustration: A property-casualty insurer has $100 million of municipal bond interest income. For insurance companies, the proration provision of the 1986 Tax Reform Act adds 15% of tax-exempt income to regular taxable income.

Common parlance is to say that the insurer has $100 million of statutory income and of GAAP income, but that its taxable income is 15% × $100 million = $15 million in the regular tax environment and 15% × $100 million + 85% × 75% × $100 = $78.75 million in the alternative minimum income tax environment.[9]

Although this is standard terminology, it confuses the tax rate with the amount of income. Tax accountants use the term taxable income to mean income which is subject to federal income taxes. We use the term taxable income to mean the company's income as seen through the lens of tax accounting. The net after-tax income in the regular tax environment is

$$\$100 \text{ million} - 15\% \times \$100 \text{ million} \times 35\% = \$94.75 \text{ million.}$$

It makes little sense to say the company has $15 million of pre-tax net income and $94.75 million of after-tax net income. Rather, the company has $100 of pre-tax net income with a 5.25% tax rate, or 15% × 35%, applied to this income.[10]

Illustration – Policy Inception: At policy inception, the pre-tax net income equals the tax basis deferred policy acquisition costs – or 20% of written premium – minus the actual pre-paid acquisition costs. The after-tax net income equals the pre-tax net income minus the tax liability or plus the tax refund:

$$-\$250.00 \text{ (expenses)} + \$200 \text{ (tax basis DPAC)} + \$17.50 \text{ (tax refund)} = -\$32.50.$$

The capital at time t=0, right after the policy has been written, equals

statutory surplus + the tax basis DPAC – the statutory deferred tax asset, or

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[9] For personal taxpayers and for corporate taxpayers other than insurance companies, municipal bond income is tax exempt. For insurance companies, both life insurers and property-casualty insurers, 15% of this tax exempt income is an offset to the loss reserve tax deduction by the proration provision of the 1986 Tax Reform Act. This effectively imposes a tax rate of 15% × 35% = 5.25% on municipal bond income.

In the alternative minimum tax environment, 75% of the tax exempt income is added to the regular taxable income to obtain the alternative minimum taxable income. The 75% of the tax exempt income is called the ACE adjustment. This terminology is unfortunate, since it appears that the amount of taxable income differs between the regular tax environment and the alternative minimum tax environment, when in truth it is the tax rate on municipal bond income that differs between the two environments.

The alternative minimum tax rate is 20%. The alternative minimum tax rate on municipal bond income is 20% × 15% (the regular taxable income portion) + 20% × 85% × 75% (the ACE adjustment portion) = 15.75%.

[10] This view of tax accounting accords with the general accounting perspective in this paper. In no accounting system does income just disappear. The total after-tax net income over the life of the project is the same for all accounting systems; it equals the total cash inflow to the company. The IRS can change the tax rates, and it can vary the tax rate by type of income. It does not change the income received by the company. Similarly, it varies the tax rate between the regular tax environment and the alternative minimum tax environment; the income of the company does not depend on the tax environment.

$250.00 (statutory surplus) + $200 (tax basis DPAC) – $70.00 (DTA) = $380.00.

The return on capital at policy inception is the net income divided by the capital provided by equityholders before policy inception, or –$32.50 ÷ $412.50 = –7.9%.

Illustration – Subsequent Periods: After policy expiration,

the after-tax net income = the statutory after-tax net income
41. the tax basis incurred loss
42. the change in the statutory deferred tax asset.

The tax basis incurred loss equals the amortization of the IRS loss reserve discount.[11]

		Period 2.5	Period 3.0
	statutory net income	$23.05	$23.48
–	tax basis incurred loss	$0.00	$96.00
–	change in deferred tax asset	($16.80)	($16.80)
=	taxable net income	$39.85	($55.72)

[11] For simplicity, the illustration shows the tax basis incurred loss at year-end dates and the change in the deferred tax asset spread through the year. For consistency, an actual pricing model would show both at year-end dates or both spread through the year.

NET PRESENT VALUE

Period	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Income	($62.49)	$20.41	$27.71	$12.13	$10.47	$8.74	$7.90
Δ Capital	($62.49)	$125.28	($267.22)	($28.44)	($29.74)	($14.31)	($135.58)
Capital	$350.01	$475.29	$208.07	$179.62	$149.89	$135.58	$0.00
Return	-15.1%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
EVA	($62.49)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Table 4: NPV Accounting: Return on Capital and EVA

The rows refer to (1) net after-tax NPV income, (2) change in NPV capital, (3) NPV capital, (4) return on NPV capital, and (5) economic value added.

The NPV to the equityholders of a financial project is the present value of the implied equity flows. The discount rate is the cost of equity capital. The NPV is an estimate of the market value of the project.

If the company cash flows are a reasonable proxy for the implied equity flows, we can use the present value of these cash flows. For property-casualty insurers, we must independently estimate the implied equity flows.

The NPV of a project is similar to the fair value of a project, with two differences.

- The fair value accounting system takes the present value of the company cash flows, with property-casualty reserves discounted at the company's benchmark investment yield. The NPV accounting system uses the present value of the implied equity flows, discounted at the cost of equity capital.
- The fair value accounting system does not include the cost of holding capital. It is the accounting system implicit in the consumer's value perspective described in the companion paper ("Modeling the Equity Flows"). The NPV accounting system is the shareholders' cost perspective; the cost of capital is paramount.

The net present value accounting framework recognizes the expected gains and losses at policy inception. This is the perspective used for valuing financial securities. In contrast, an IRR perspective recognizes the expected gains and losses over the life of the contract.

Illustration – Common Stock: Financial valuation models assume that the market value of a share of common stock equals the present value of the expected future dividends. A change in the expected future dividends causes an immediate change in the market value. There is no amortization over the expected holding period of the stock. Amortization is an accounting concept, not a financial concept.

Illustration – Fixed-income Securities: The market value of a fixed-income security is the present value of the expected coupons and principal repayment. If market interest rates change after issuance of the fixed-income security, market value accounting recognizes the change in value immediately.

NPV Income and EVA

Four principles govern the NPV net income and economic value added:

- The expected income at policy inception equals the NPV of the project.
- The expected income in valuation periods after policy inception is the dollar cost of capital, or the percentage cost of capital × the capital held at the beginning of the period.
- The expected economic value added at policy inception equals the NPV of the project.
- The expected economic value added in valuation periods after policy inception is zero.

The NPV framework implicitly assumes that the business risk in managing a policy after it has been written is not material compared to the underwriting and pricing risk at policy inception. This is a fair assumption for most personal lines products, such as life insurance, annuities, automobile insurance, and Homeowners. When there is continuing company involvement in the management of risk, such as loss engineering services or managed care rehabilitation services, the NPV analysis perhaps allocates too much of the gain or loss to the policy inception date.

A performance measurement system uses actual income, not expected income. The actual income in valuation periods after policy inception equals (i) the expected income (ii) plus or minus unexpected gains or losses. These unexpected gains or losses may result from

- random loss fluctuations
- unanticipated reserve development
- changes in financial conditions, such as interest rates or common stock prices.[12]

PERFORMANCE MEASUREMENT

The IRR and NPV analysis are alternative perspectives which give the same "accept or reject" decision for the proposed project.

- The NPV is better suited for rate filings, since a loss of value is denoted by a negative dollar figure. If the project is not profitable, the IRR is less than the cost of capital, but it may still be positive; see Feldblum [1992: IRR].
- The IRR is better suited for comparison of projects, since it is not affected by the size or the duration of the project.

For performance measurement and the recognition of income, the two methods differ.

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[12] This difference between expected and actual income is true for all accounting systems. We use the NPV the IRR accounting systems for retrospective performance measurement; see Schirmacher and Feldblum [2002] "Retrospective Analysis and Performance Measurement." GAAP uses similar "true-up" procedures for determining the profitability of universal life-type contracts; see SFAS 97.

- The IRR determines a constant rate of return for the equityholders. Income is recognized ratably over the lifetime of the project. An IRR of 10% per annum implies that the equityholders earn 10% each year on their invested capital.
- The NPV provides a single dollar figure, generally valued at inception of the project. An NPV of $5,000 implies that the business decision to undertake this project has added $5,000 to the company's worth. If the return at policy inception is added to the first year return (as is done in practice), the return on capital differs between the first year (the policy term) and all subsequent years.

Illustration: A workers' compensation policy with a 20 year lifetime until final settlement of losses is sold on January 1, 20XX for $500,000. At a 12% per annum cost of equity capital, the policy has an NPV of $50,000. The internal rate of return is 14% per annum.

The NPV analysis recognizes the $50,000 profit on January 1, 20XX. This accords with economic reasoning, since the profit results from the underwriting decision made on that day. The nominal after-tax net profit in subsequent periods is 12% times the invested capital, or a $0 economic value added. This perspective is not consistent with the conceptual accounting principles underlying GAAP, which recognize profit over the course of the contract.[13]

The IRR analysis recognizes 14% of the initial capital contribution as the net income in 20XX, 14% of the capital requirement in 20XX+1 as the net income in 20XX+1, and so forth. Since the cost of equity capital is 12% per annum, this represents a 2% economic profit each period. This economic profit is termed here the EVA. This perspective accords with the GAAP principle of recognizing income ratably until performance is complete, but it does not accord with economic reality. There may have been no business action in 20XX+1 and subsequent years that warrants the recognition of profits in those years.

COMPARISON WITH OTHER ACCOUNTING SYSTEMS

A comparison of the NPV accounting system with the three systems discussed earlier (statutory, GAAP, and tax accounting) clarifies the important attributes.

Statutory accounting and property-casualty insurance GAAP defer the recognition of profits, since both accounting systems use undiscounted loss reserves and statutory accounting does not recognize deferred policy acquisition costs as an asset.[14]

[13] Actual GAAP for property-casualty insurance contracts values loss reserves on an undiscounted basis, just as statutory accounting does, so it defers the recognition of profits over the settlement period of the losses. GAAP for life insurance contracts illustrates the recognition of profits over the course of the policy. For traditional policies, profits are recognized ratably over the premium paying period; see SFAS 60. For universal life-type contracts, net profits are recognized in proportion to expected gross profits; see SFAS 87. For retroactive reinsurance contracts, GAAP recognizes the profit over the settlement period of the reserves; see SFAS 113. GAAP for life insurance has a slight conservative tilt (conservative interest rates and conservative mortality assumptions) that defer some of the profit to later periods.

[14] Differences in expense costs and expected loss costs between new and renewal policies magnifies the deferral of profits for property-casualty insurance contracts under all accounting systems. This paper prices a single policy, using the average loss costs and expense ratios. A more complete analysis is needed for pricing a cohort of policies; see Feldblum [Asset Share, 1996].

Tax accounting uses discounted loss reserves and it recognizes deferred policy acquisition costs by the revenue offset provision. It shows the same profit recognition pattern as the NPV analysis. The dollar amounts may be slightly different, since the revenue offset provision may not exactly match the deferred policy acquisition costs and the IRS loss reserve discounting calculation may not exactly match an economic discounting calculation.[15]

NPV vs EVA

The net present value is a "stock" of money that represents the worth of a project; it is generally valued at inception of the project. The EVA is a "flow" of money that represents the value added in each reporting period. The NPV is the present value of the future EVA's, discounted at the cost of capital.

The NPV calculation combines the net after-tax income with the required capital flows and determines the worth of a project. The EVA calculation separates the net after-tax income from the cost of holding capital. This facilitates the reconciliation of the EVA calculations with the company's accounting statements, and it allows managers to more easily understand the performance measurement system.

The EVA in an accounting system reflects the attributes of that accounting system. To illustrate this, we contrast the EVA based on statutory accounting with the EVA based on NPV accounting.

Because of the requirements to hold gross unearned premium reserves and undiscounted loss reserves, statutory accounting shows negative expected income the first year of a policy's life and positive income in subsequent years (assuming the book of business is profitable). EVA magnifies this distortion because the required capital is generally greatest during the first year of the policy's lifetime, after which the required capital declines.

For the GAAP, statutory, tax, and fair value accounting systems, the EVA equals the after-tax net income minus the dollar cost of holding capital. These accounting systems have accepted definitions of net income. The NPV accounting system is a financial accounting system. It is the accounting system that supports the recognition of profit as the net present value of the project. This means that the EVA equals the NPV at policy inception and is zero in all other periods.

We can rephrase this by defining the performance measurement yardstick as the change in the discounted value of future EVA from the beginning of the year to the end of the year and subtracting the cost of holding capital. This measure recognizes all profit up front – at the time of the underwriting decision or the sale of the insurance contract. Inadequate premiums cause a negative expected profit at policy inception; redundant premiums cause a positive expected profit at policy inception. The expected profit in this measure is zero for all subsequent years, regardless of the premium rate level.

ILLUSTRATIONS

[15] In the simplified illustration used here, all $150 of general expenses are recognized at time t=½; in practice, these expenses would be recognized evenly over the policy term. In addition, the illustration here uses a 2 to 2½ year lag between loss occurrence and loss payment, but it uses IRS loss reserve discount factors that are appropriate for a line of business with a longer lag. These simplifying assumptions ease the calculations, but they slightly distort the expected income recognition patterns. The comments in the text refer to the patterns observed in actual blocks of business, not in the illustration here.

The NPV is the present value of the implied equity flows at policy inception, discounted at the cost of equity capital. In truth, any date may be chosen as the valuation date for the NPV perspective; we use the policy inception date by convention. This implies that we recognize all expected profits and losses up front, at the time of the business decisions that lead to the expected profit or loss.

The capital at any point in time is the economic worth of the project, or the present value of future implied equity flows. The illustrations below use an annual effective rate of 12% as the cost of capital, or 5.83% for each half-year valuation period ($1.0583^2 = 1.120$). The net income in any period equals the implied equity flow plus the change in required capital (cf Robbin 1993).

Illustration: We begin with period 3.0, the final valuation period. The cost of equity capital is 12% per annum, or 5.83% each half year. The implied equity flow at time t=3.0 is $143.48. The capital at the beginning of period 3.0 is $143.48 / 1.0583 = $135.58. The net income in period 3.0 is $143.48 – $135.58 = $135.58 × 5.83% = $7.90.

The capital at the end of period 2.5 is the capital at the beginning of period 3.0 plus the implied equity flow at time t=2.5:

$$\$135.58 + \$23.05 = \$158.63.$$

The capital at the beginning of period 2.5 is $158.63 discounted for half a year at the cost of equity capital, or $158.63 / 1.0583 = $149.89. The net income for period 2.5 equals the implied equity flow plus the change in capital, or

$$\$23.05 + (\$135.58 - \$149.89) = \$8.74.$$

We continue in this fashion back to the earliest valuation date.

The EVA for all periods after policy inception is zero, since the net income equals the capital at the beginning of the period times the cost of capital. The EVA at policy inception is the NPV of the project.

When the company's business risk occurs predominantly at policy inception, the NPV performance measurement system is ideal. Business risk is the risk stemming from the company's business decisions. For most policies, the predominant business risk lies in the underwriting decision to accept or reject the policy and in the choice of the premium rate.

Some insurance risks do not occur at policy inception. For instance, risks relating to random loss fluctuations or unanticipated loss development do not occur at policy inception.

Illustration: A catastrophe excess-of-loss treaty on January 1, 20XX covers the layer $40 million excess of $10 million, with a rate of 3% of subject premium. The underwriting and pricing risks on January 1, 20XX, are the reinsurer's decision to write the treaty and the chosen premium rate. For a first dollar book percentage point business, these underwriting and pricing risks account for the majority of the variance in the final profit or loss. The NPV profit recognition perspective is suitable. For the catastrophe reinsurance treaty, the random

occurrence of windstorms and other natural catastrophes is a material risk. For the reinsurance treaty, an IRR profit recognition pattern better reflects the "release from risk."

Some business risks, such as the legal defense stance on complex tort liability cases, are not always within the purview of underwriting managers responsible for line of business profitability. Performance measurement for in-house legal counsel would not be measured by an NPV pattern that recognized profits on the policy inception date.

We note these exceptions to guard against over-generalization of the profit recognition pattern exemplified by the NPV accounting system. For most insurance operations, the NPV perspective is appropriate.

Period	0	0.5	1	1.5	2	2.5	3
Income	($37.88)	$14.98	$19.78	$8.77	$7.50	$6.19	$5.52
Δ Capital	($37.88)	$119.85	($275.15)	($31.80)	($32.71)	($16.85)	($137.96)
Capital	$374.62	$494.48	$219.33	$187.52	$154.82	$137.96	$0.00
Return	-9.2%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
EVA	($37.88)	($6.86)	($9.05)	($4.01)	($3.43)	($2.83)	($2.52)

Table 5: Fair Value Accounting: Return on Capital and EVA

The rows refer to (1) net after-tax FV (fair value) income, (2) change in FV capital, (3) FV capital, (4) return on FV capital, and (5) economic value added.

Fair value accounting values all assets and liabilities at market value if a liquid market exists, or at a discounted value if no liquid market exists. Market values or reasonable proxies exist for most financial assets held by insurers.

For property-casualty loss reserves, liquid markets do not exist; a proxy is needed. Financial theory assumes that the market value for stocks and bonds equals the present value of the expected future dividend payments, coupon payments, and principal repayments. By analogy, the fair value of loss reserves should equal the present value of the expected loss payments.

Actuaries differ on the proper discount rate for loss reserves. The exhibits here use the pre-tax benchmark investment yield, so that assets and liabilities are valued at the same rate. This is similar to the GAAP investment yield benchmark for valuing pension liabilities; see SFAS 87. Non-investable assets and non-traded assets may be valued in the same manner.

We mention below other views on the appropriate discount rate. For more complete discussion, see Feldblum and Thandi [2002], "Benchmark Investment Yield."

56. Woll [1987], followed by Lowe [19??] uses the risk-free rate to give the value of the underwriting operations in an "economic value accounting" framework. The differential between the risk-free rate and the company's investment yield is the value added by the company's investment department, not by its underwriting operations.

57. Myers and Cohn [1987], following on the work of Kahane [1978], Hill [1979], and Fairley [1979], use a CAPM-type adjustment to the risk-free rate to derive the loss discount rate. The beta of losses in the Myers/Cohn model is intended to reflect the covariance of the loss cash flows with the overall stock market returns.

The theory of underwriting betas was popular in the late 1970's and early 1980's, when the CAPM was the dominant stock valuation model for investment analysts. The CAPM has since lost its luster in the financial world, particularly after the 1992 Fama and French analysis of stock market anomalies. In addition, the betas of losses has been impossible to measure or even detect (see Cummins and Harrington [1984], Kozik [1995], and Feldblum [1996: Betas]). The theory of underwriting betas is rarely mentioned now except in Massachusetts rate hearings. See Feldblum, [PCAS d/d disc].

58. Butsic [1988] uses a utility theory argument to determine the economic value of reserves, and he suggests a 3% to 4% risk adjustment below the risk-free rate. Although popular in the casualty actuarial community, Butsic's perspective does not differentiate between systematic risk and unique risk.

We do not arbitrate among these views here. Our objective is to show the accounting flows and the pattern of income recognition.

The selected discount rate affects the pattern of profit recognition. A higher discount rate causes profits to be recognized earlier; a lower rate causes profits to be recognized later (cf Lowe and Philbrick [1985], Lowe [19??: GAAP]).

Illustration – Policy Inception: The cash outflow at policy inception equals the pre-paid acquisition costs plus the tax liability: \$250 + (–\$17.50) = \$232.50. The present value at a 8% per annum bond equivalent yield of the future losses, expenses, and taxes is \$805.38. The premium is \$1,000, and the net income equals

$$\$1,000.00 - \$232.50 - \$805.38 = -\$37.88.$$

Some version of fair value accounting may eventually be adopted for international accounting standards and perhaps even by U.S. regulatory authorities. We summarize several of the relationships with other accounting systems.

Fair value accounting is like an NPV accounting system in that the capital at any time is the present value of future losses and expenses. The specifics of the computation are different.

- The fair value accounting in this paper uses a benchmark investment yield to determine the present value of insurance liabilities. The NPV accounting system uses the cost of equity capital as the discount rate.

- Fair value accounting takes the present value of the insurance cash flows. The NPV accounting system takes the present value of the implied equity flows. The fair value perspective is similar to the consumer's value perspective discussed in Feldblum and Thandi, [2002], "Modeling the Equity Flows," since it takes no account of the cost of holding capital.

Some actuaries argue that the fair value assessment is only part of profitability measurement, and that explicit account must be taken of the cost of holding capital. We agree with this view; this

makes the fair value perspective similar to the NPV perspective, though the hurdles rates are different. Other actuaries add that a negative risk adjustment to the loss reserves discount rate, as proposed by adherents of underwriting betas, transforms the fair value perspective into the net present value perspective. Numerically, there is some truth in this.[16] We prefer to discuss the two accounting systems separately, since the rationale for each is different.

FAIR VALUE ACCOUNTING AND TAX ACCOUNTING

Fair value accounting is similar to tax accounting. Both value loss reserves at discounted values, and neither takes account of the cost of capital. However, tax accounting uses pre-set formulas, whereas fair value accounting uses actuarial or financial estimates. The following examples compare the treatment of pre-paid acquisition costs and of loss reserve discounting among the accounting systems.

Deferred policy acquisition costs: The revenue offset provision in the Internal Revenue Code assumes that pre-paid acquisition costs equal 20% of written premium. GAAP uses the actual acquisition cost percentage. The revenue offset provision does not necessarily equal the actual pre-paid acquisition costs. Both GAAP and tax accounting spread the profit or loss in the rest of the policy premium over the policy term.

> *Illustration:* If the pre-paid acquisition costs are 20% of written premium, tax accounting has no gain or loss at policy inception. If the pre-paid acquisition costs are 15% of written premium, tax accounting recognizes 5% of written premium as an immediate gain at policy inception. If the pre-paid acquisition costs are 25% of written premium, tax accounting recognizes 5% of written premium as an immediate loss at policy inception.

Instead of a using a deferred policy acquisition cost asset, fair value accounting values the unearned premium reserve as the present value of future losses and expenses. The NPV and IRR accounting systems implicitly do the same. Fair value accounting and NPV accounting recognize the expected profit or loss at policy inception. The IRR accounting system spreads the profit or loss over the lifetime of the policy.

The expected profit or loss from the policy is a subjective estimate. GAAP and tax accounting seek objective estimates. The pre-paid acquisition costs incurred when issuing the policy can be quantified, and GAAP relies on this figure. The categorization of expenses as pre-paid acquisition costs is somewhat subjective, and it relies on the discretion of the insurer. Tax accounting prefers to rely on a strict formula, which cannot be changed by company management. The NPV, IRR, and fair value accounting systems are geared to policy pricing and internal performance measurement, not to external reporting. They rely on internal (actuarial) estimates of policy profitability, not on actual costs incurred.

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[16] Butsic's [1988] formula, $Z = e \times (R - r_f)$, formalizes this relationship between the loss discount rate and the cost of equity capital.

Loss reserve discounting: There is no consensus on loss reserve discounting rates or procedures. GAAP, statutory, and tax accounting seek objective figures. GAAP and statutory accounting use undiscounted reserves unless the discount is derived from a published mortality or morbidity table. The taxing authorities need discounted reserves to speed up the incurral of tax liabilities, but they seek to avoid company discretion in the choice of discounting parameters. Tax accounting uses a 60 month average of federal mid-term rates along with a formulaic loss payment pattern to determine discounted reserves.

Fair value accounting uses the discount rate and the loss payment pattern appropriate for the given book of business, as selected by the pricing actuary. The IRS loss reserve discount factors do not necessarily reflect the true discount in full value reserves.

The NPV and IRR accounting systems also use a company determined loss payment pattern, though neither system discounts reserves. The NPV accounting system determines implied equity flows based on the loss payment pattern, and it discounts the implied equity flows at the cost of equity capital. The IRR accounting system does not discount any figures. It determines the nominal implied equity flows and determines the internal rate of return among them.

Internal Rate of Return

Period	0.0	0.5	1.0	1.5	2.0	2.5	3.0
Income	$0.00	$6.13	$7.77	$3.51	$2.96	$2.41	$2.10
Δ Capital	$0.00	$111.00	($287.15)	($37.07)	($37.25)	($20.64)	($141.38)
Capital	$412.50	$523.50	$236.34	$199.28	$162.02	$141.38	$0.00
Return	0.0%	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
EVA	$0.00	($17.92)	($22.75)	($10.27)	($8.66)	($7.04)	($6.14)

Table 6: IRR Accounting: Return on Capital and EVA

The rows refer to (1) net after-tax IRR income, (2) change in IRR capital, (3) IRR capital, (4) return on IRR capital, and (5) economic value added.

The IRR is the rate of return which equates the present value of the equity inflows with the present value of the equity outflows. One may also conceive of the IRR as the dividend yield that the equityholders receive each year.[17]

Measuring Base

The IRR perspective shows a constant rate of return as a percentage of the invested capital. Some actuaries presume that the amount of invested capital in an insurance project should reflect the risk of the project. A greater amount of risk requires a greater amount of capital and a greater dollar return.

This perspective is not necessarily correct. The capital invested in an insurance project is based upon statutory mandate, not actuarial risk quantification. This capital comprises two pieces: (i) the capital embedded in statutory reserves, and (ii) the capital explicitly held in policyholders' surplus.

- The capital embedded in reserves is not risk related, except in so far as longer duration reserves are more risky. Some long duration reserves, such as reserves for environmental and toxic tort liabilities, are highly uncertain. Other long duration reserves, such as reserves for long term disability cases and workers' compensation lifetime pension cases, are not more risky than shorter-tailed casualty reserves.

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[17] The implied dividend each period is appealing to some business managers. The implied dividend is sometimes more and sometimes less than the implied equity flow.

Illustration: The equityholders fund an insurance project with $10,000 at time t=0, and they receive $12,100 at time t=2. The formal definition of the internal rate of return sets $10,000 – $12,100 / $(1+z)^2 = 0$ and solves for $z = 10\%$. To conceive of the IRR as a periodic dividend, we assume a dividend payment of $1,000 at time t=1 along with a capital contribution from the equityholders to the company of $1,000 at time t=1. The combined cash flows form two loans at 10% per annum interest: a two year loan of $10,000 at time t=1 and a one year loan of $1,000 at time t=1.

- The capital explicitly held in surplus reflects the risk to *policyholders* that they may not be reimbursed for their losses. This is not the same as the risk to equityholders.[18]

Illustration – Policy Inception: The income recognition pattern for the IRR perspective is determined by the constant return on invested capital. The initial capital contribution is $412.50. At time 0, the return to the equityholders is IRR × 0 years × $412.50 = $0, since the invested capital has been held for an insignificant amount of time.

Illustration – Valuation Periods after Policy Inception: At time t=½, the $412.50 has been held for half a year. The semi-annual internal rate of return computed from the implied equity flows is 1.485%. We derive net income and capital amounts as follows:

- The net income is 1.485% × $412.50 = $6.13.
- The implied equity flow for time t=½ is –$104.87; see the table of implied equity flows at the beginning of this paper.
- The implied equity flow equals the net income minus the change in capital, so the change in capital is $6.13 – (–$104.87) = $111.00.
- The total capital at time t=½ is $412.50 + $111.00 = $523.50.

We use the same procedure for other valuation periods.

- At time t=1.0, the $523.50 has been held for half a year.
- The net income is 1.485% × $523.50 = $7.77.
- The implied equity flow for time t=1.0 is +$294.93; see the table of implied equity flows at the beginning of this paper.
- The change in capital is $7.77 – $294.93 = –$287.15.
- The total capital at time t=1.0 is $523.50 – $287.15 = $236.64.

Alternatively, we could determine the net income and capital amounts starting from the last valuation period.

- The final implied equity flow at time t=3.0 is $143.48.
- Since the return is 1.485% each half year, the capital at the beginning of the final valuation period is $143.48 ÷ 1.01485 = $141.38.
- The net income in the final valuation period is $143.48 – $141.38 = $2.10.

IRR and Yield to Maturity

Insurance risk varies over the lifetime of a block of business. Presumably, the rate of return should be higher when the risk to the equityholders is higher. The risk to equityholders is greatest during the policy term, when there is uncertainty regarding the occurrence of claims.

[18] The invested capital reflects risk in that the invested capital is the maximum amount that can be lost by equityholders. The variability of gain or loss differs by line of business, but the amount of capital "at risk" is represented by the invested capital. For a more complete discussion of the risk inherent in different lines of business, see Feldblum and Thandi [2003: Capital Allocation].

The IRR perspective makes no such adjustments. The rate of return is a level amount over all periods, just like the yield to maturity is a level yield over the life of the security.

Illustration: Suppose the Treasury spot rates are 5% for one year, 6% for two years, and 7% for three years. For simplicity, assume that these rates are effective annual yields, and that Treasury securities have annual coupon payments. The coupon rate and the yield to maturity "Z" for an on-the-run three year Treasury note issued at par would be the solution to

$$Z/(1.05) + Z/(1.06)^2 + (1+Z)/(1.07)^3 = 1$$
$$Z = 6.91\%.$$

If the Treasury note is issued with a 7% annual coupon, the market value of the note is

$$\$7/(1.05) + \$7/(1.06)^2 + \$107/(1.07)^3 = \$100.24.$$

The yield to maturity of this security is the solution to

$$\$7/(1+Z) + \$7/(1+Z)^2 + \$107/(1+Z)^3 = \$100.24$$
$$Z = 6.909\%.$$

The internal rate of return has the same interpretation. It is the constant yield over the lifetime of the policy that provides the appropriate return to investors for the risk undertaken in each period.

Illustration: Suppose that the capital required to support an insurance policy is $10,000 during the policy term. After policy expiration, the required capital runs off as losses are paid. The amount of capital needed each year is $5,000 in the first year after policy expiration, $3,000 in the next year, and $1,000 in the next year. Investors require a 15% return on capital during the policy term and an 8% return on capital after policy expiration.

The required after-tax net income for each year of this policy and the implied equity flows are shown in the table below.

Year	*Implied Equity Flow*	*Assets*	*Net Income*	*Rate of Return*
1	($10,000)	$10,000	$1,500	15%
2	$6,500	$5,000	$400	8%
3	$2,400	$3,000	$240	8%
4	$2,240	$1,000	$80	8%
5	$1,080			

The internal rate of return "Z" on the implied equity flows is 11.984%. The 11.984% internal rate of return may be thought of as a 15% return on capital during the policy term and an 8% return on capital as the reserves run

off. The constant internal rate of return is an accounting construct to simplify the presentation of the policy profitability.

Funding the Rate of Return

The IRR perspective lends itself to an intuitive understanding of the return to equityholders. The income of an insurance enterprise may be divided into two pieces:

- the investment income on equityholder provided capital, and
- the profits from insurance operations.

The sum of these two pieces is the return on invested capital. The profits from insurance operations includes both the underwriting income and the investment income from the policy transaction funds (sometimes termed the policyholder supplied funds).

We use the figures in our illustration. The benchmark investment yield is 8% per annum compounded semiannually, or 4% each half-year. The target IRR equals the cost of equity capital, or a 12% effective annual rate.

The insurance operations must fund the cost of holding capital. The cost of holding capital is the cost of equity capital minus the investment yield received on the equityholder supplied funds. The cost of equity capital is an after-tax return. The benchmark investment yield of 8% is a pre-tax yield. The corresponding after-tax yield is $8\% \times 65\% = 5.2\%$ per annum.

To induce equityholders to provide supporting capital, the insurance enterprise must provide two parts of the required return to equityholders:

- The federal income taxes on the investment income on equityholder funds. This is the cost of double taxation, or the difference between the pre-tax yield and the after-tax yield, or $8\% - 5.2\% = 2.8\%$ per annum. The equityholders could obtain the pre-tax yield by investing directly on their own (or by investing in a mutual fund), instead of investing through the insurance enterprise.
- The difference between the cost of equity capital and the benchmark investment yield, or about 4% per annum.[19] This is the compensation for the risk undertaken by the equityholders. If the insurance enterprise provided a return just equal to the benchmark investment yield, the equityholders would prefer to invest their money in a mutual fund or directly in the financial markets, thereby avoiding the risk of insurance operations.

These two components of the policy premium comprise the profit margin. The remainder of the premium funds the expected loss and expense costs of the policy.[20]

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[19] The benchmark investment yield in the illustration is bond equivalent yield, whereas the cost of equity capital is an effective annual yield. On an effective annual basis, the investment yield is 8.16%.

[20] These two components are after-tax amounts. The policy premium is a pre-tax amount. Using the figures in the text, the needed profit margin in the policy premium would be $(2.8\% + 4\%) / (1 - 35\%) = 10.46\%$ for each year that equityholder provided capital is invested.

EQUITYHOLDERS AND POLICYHOLDERS: FUNDING THE INSURANCE POLICY

The combination of the IRR perspective and the fair value perspective allows a finer analysis of the funding of the insurance policy.

Were there no capital requirements and no statutory mandates for full value reserves, the "consumers' value perspective," as reflected in a fair value accounting system, would properly price an insurance product.[21] The requirement to hold capital imposes an additional cost, the cost of holding capital.

At a minimum, this cost is the cost of double taxation on the investment income on equityholder supplied funds (see Myers and Cohn [1987]). The pricing model here implicitly assumes that the cost of holding capital is the difference between the cost of equity capital and the after-tax investment yield of the company (cf. Atkinson and Dallas [2000, ch 11]). To induce equityholders to provide funds to support insurance operations, this cost of holding capital must be paid by the policyholders. The tax on underwriting income adds an additional cost to capital funded through the policy premium.

THREE SCENARIOS

[21] On the consumers' value perspective, see Feldblum and Thandi, [2002], "Modeling the Equity Flows."

To clarify the funding of the insurance policy, we trace the flow of funds for three scenarios, which differ only in the premium rate. For each scenario, the cost of the policy is the present value of all benefits, expenses, and federal income taxes on the insurance transactions. The discount rate for the present value calculation is the pre-tax investment yield.[22]

21. When the internal rate of return on the implied equity flows is less than the pre-tax investment yield, the policyholder premium is not sufficient to pay the costs of the policy, and the equityholders must supply capital to pay the unfunded costs.
22. When the internal rate of return on the implied equity flows exactly equals the pre-tax investment yield, the policyholder premium is just sufficient to pay the costs of the policy. The indicated premium in this scenario is the premium determined in a fair value accounting system that takes no account of invested capital. The equityholders receive the company's benchmark investment yield on their funds, not the cost of equity capital. The return on the invested capital is not sufficient to induce them to supply funds to the insurance industry.[23]
23. When the internal rate of return on the implied equity flows exceeds the pre-tax investment yield, the profit in the policyholder premium is transferred to equityholders to fund all or part of the cost of holding capital. The equityholders will supply capital only if the internal rate of return on the implied equity flows is at least equal to the cost of equity capital.

The policy premium is $1,000.00 in Scenario A, $1,058.27 in Scenario B, and $1,096.07 in Scenario C. A higher policy premium needs a lower capital contribution from equityholders. A lower capital contribution means a lower cost of holding capital. The schematic for each scenario shows the implied equity flows. These schematics address the issue of "who is funding whom" in each scenario.

SCENARIO A: PREMIUM INADEQUACY

If the insurance policy is inadequately priced, the profit margin in the premium is not sufficient to provide the needed return on equityholder funds. The illustration in the text, with a policy premium of $1,000, shows an IRR of 3% per annum, or $(1.03^{0.5} - 1) \approx 1.485\%$ each half year.

This does *not* mean that the insurance operations are earning a 3% profit. The IRR is the net income; it does not subtract the cost of equity capital. The company's economic profit is reflected by the EVA, not by the IRR.

To see this, we compare the insurance enterprise to an investment trust. The equityholder provided capital would earn an 8.0% in a pure investment trust. An investment trust, such as a mutual fund, passes the investment earnings to the investors without having to pay corporate income taxes on the earnings. Unlike the investment trust, the property-casualty insurance enterprise is fully taxable; the

[22] Since we are explicitly modeling federal income taxes as an expense, we use the pre-tax investment yield as the discount rate, not the after-tax investment yield. For further discussion of pre-tax and after-tax investment yields for modeling insurance operations, see Feldblum, [2002], "The Pricing of Commutations."

[23] We include the federal income taxes on the investment income on equityholder supplied funds as a policy cost, since this is a cash outflow from the company stemming from state mandated capital requirements.

after-tax return is 5.2%. Not only is the policyholder premium too meager to reimburse the equityholders for the costs of double taxation, but the premium is not sufficient to cover the losses and expenses of the insurance operations. Part of the 5.2% after-tax return is transferred to policyholders to finance the insurance operations.

If the policy premium were even lower, the investment income on the equityholder funded capital might not suffice to fund the insurance operations. In such a scenario, the IRR on the implied equity flows would be negative, and the equityholders' capital would be invaded to fund the insurance operations.

Exhibit ?? shows a schematic for the first two periods of Scenario A. An implied dividend of 1.485% is paid each half year to the equityholders from the investment income on their funds. The rest of the investment income is transferred to the insurance operations: $10.37 in the first half year and $13.17 in the second half year.

An alternative means of viewing the flow of funds is to conceive of the equityholder provided capital in two parts. At policy inception, the equityholders provide $412.50. Of this amount, $374.62 is used to provide the 1.485% dividend each half year and to repay the principle as the losses are settled. We don't need the full $412.50, because the 1.485% equityholder dividend each half year is less than the after-tax investment yield of 3.85% each half year.

The remainder of the funds, or $37.88, is used to offset the deficiency in the policyholder premium. If the policy were adequately priced, part of the policy premium funds the cost of holding capital. We call this the policyholder funded capital. In this scenario, the policy is inadequately priced, and the schematic labels this $37.88 as the negative of the policyholder funded capital, or "–PFC."

Illustration: The $412.50 of equityholder funded capital accumulates at the pre-tax investment yield, adding $412.50 × 4.0% = $16.49 in the first half year. The equityholder dividend is 1.485% (semi-annual internal rate of return) of the contributed capital, or $6.13. The equity flow = the equityholder dividend – the capital contribution. The implied equity flow at time t=½ is –$104.87, so the capital contribution at time t=½ is $6.13 – (–$104.87) = $111.00.[24]

We examine the flow of funds in the first two periods. The original $412.50 plus the implied equity flow of $104.87 equals the equityholder funded capital of $523.50 at time t=½. The pre-tax investment income on the original equityholder funded capital was $16.49, and the dividend to the equityholders was only $6.13. The difference of $16.49 – $6.13 = $10.36 is transferred to fund the insurance policy.[25]

In the second period <<** Neeza to fill in **>>

SCENARIO B: FAIR VALUE PREMIUM

The policy premium of $1,058.27 covers the acquisition expenses of $252.89 and the present value at the pre-tax investment yield of future loss and expense costs of $805.38. The left hand side of the graphic shows the accumulated premium paying the insurance costs of each period. The remainder of the accumulated premium in each period covers the loss and expense liabilities.

The right-hand side of the graphic shows the flow of equityholder funds. The equityholders contribute $374.62 at time t=0 to support the policy.[26]

The pre-tax semi-annual investment yield on equityholders' funds is $374.62 × 4.0% = $14.98. The equityholders receive the full pre-tax investment yield; the federal income taxes on this investment yield are included in the policy costs paid by the policyholders. The internal rate of return is the pre-tax investment yield, so the $14.98 is paid as a shareholders dividend at time t=½. At that date, the equityholders make a second capital contribution of $119.85 to support the loss reserves. The additional capital contribution minus the dividend equals the implied equity flow at time t=½:

$$\$119.85 - \$14.98 = \$104.87.$$

[24] The implied equity flow is the combination of the equityholder dividend and any other capital exchanges. It equals the dividend minus any capital contribution or the dividend plus any return of capital.

[25] The schematic shows this as the full investment income on the policyholder funded capital of –$37.88 plus a portion of the capital itself: $1.51 + $8.86 = $10.37.

[26] The change in the policy premium is not equal to the change in the initial equity flow. In scenario B, the policy premium is $1,058.27 – $1,000.00 = $58.27 greater than in scenario A, and the initial equity flow is $412.50 – $374.62 = $37.88 lower. The policy premium is a one-time payment. The capital contribution made by the equityholders is held for several years.

The two values – the policy premium and the equityholder funded capital – are not in the same units. The policy premium is measured in dollars; the equityholder provided capital is measured in dollar-years. When the equityholder provided capital is multiplied by the cost of holding capital, which is a percentage amount per year, the product is measured in dollars. See Feldblum and Thandi, [2002], "Federal Income Taxes and the Cost of Holding Capital," for further discussion.

Although the equityholders' funds are not needed to fund the insurance operations, the policy is not adequately priced. The equityholders are receiving the benchmark investment yield of 8.0% per annum, when the opportunity cost of equity capital is 12% per annum. The equityholders have assumed the risks of insurance operations. If the insurance enterprise is unprofitable, the equityholders fund the losses.[27]

[27] Some analysts differentiate between investment risks and underwriting risks. This may be useful in distinguishing systematic risks from diversifiable risks. We do not differentiate risks in this fashion. Whether the risks of insurance operations are underwriting risks or investment risks, the equityholders fund the losses.

SCENARIO C: ADEQUATE PREMIUMS

In Scenario C, the internal rate of return exactly equals the cost of equity capital. We divide the policyholder premium into two segments. One segment covers the policy costs, including the federal income taxes on the investment income on equityholder supplied funds. The other segment is the capital (or profit) supplied by the policyholders. This capital is transferred incrementally to the equityholders to fund the difference between the investment yield and the cost of equity capital.

Illustration: The policyholder funded capital (PFC) in the original premium is $24.57. The remainder of the premium, or $1,096.07 – $24.57 = $1,071.50, funds the policy costs. The policy costs equal the paid amounts of $266.13 plus the present value of future costs (at the pre-tax investment yield) of $805.38:

$$\$266.13 + \$805.38 = \$1,071.51.$$

At time t=½, the equityholders receive the pre-tax investment yield from their own funds, or $350.05 × 4.0% = $14.00. The equityholders require a return of 5.83% each half year. The remaining 1.83% comes from the policyholder funded capital.[28]

At time t=½, the equityholders contribute additional capital of $125.27 to support the loss reserve. The implied equity flow at time t=½ is

$$\$125.27 - \$16.37 = \$104.90.$$

We continue in this fashion through all valuation periods. By the end of the third year, the full policyholder funded capital of $24.75 has been transferred to the equityholders.

[28] The graphic portrays this as the investment income on the policyholder funded capital plus a portion of the capital itself: $0.98 + $5.41= $6.39 = 1.83% × $350.05 = $6.41.

ACCOUNTING SYSTEM GRAPHICS

The accompanying graphics show after-tax net income and capital amounts for the six accounting systems discussed in this paper. The accounting systems are grouped into three pairs:

- GAAP and statutory accounting
- NPV and IRR accounting systems
- Fair value and tax accounting

The accounting system graphics apply to the illustration in the text. The comments in the text relating to common elements for each pair of accounting systems refers to the expected income recognition pattern for property-casualty insurance products, not to the illustration in the text. We have deliberately chosen a somewhat unusual expense and loss pattern for the illustration, to better illustrate the computation of the deferred tax assets and the equity flows. The patterns in the graphics are close to the generalizations in the text, though they are not identical.

Appendices

Appendix A to this paper shows the equivalence of the net present value of the EVA's over the lifetime of the project under any accounting system. The demonstration applies to a consistent accounting system as defined in this paper; see the comments above about direct charge and credit to surplus under statutory accounting and tax-exempt income under tax accounting. The reasoning in the appendix follows from the definition of the economic value added and the relationships among income and capital between accounting systems. The intuition for our treatment of accounting systems is provided in the text of the paper; the appendix provides a formal mathematical proof.

Appendix B to this paper, contributed by Dr Ernesto Schirmacher, provides an alternative perspective for viewing the implied equity flows under any accounting system. In the text of the paper, we have provided separate analyses of each accounting system, along with the unique characteristics of each of them. Appendix B shows that all the accounting systems can be viewed from the same perspective, but the rate of return varies from one system to another in each accounting period.