© The Journal of Risk and Insurance, 1994 Vol. 61, No. 4, 691-709

Theoretical Considerations of the Effect of Federal Income Taxes on Investment Income in Property-Liability Ratemaking

Richard A. Derrig

ABSTRACT

Although the use of investment income in ratemaking for property-liability insurance has received much theoretical discussion since the mid-1970s, little attention has been paid to the role of federal income taxes in ratemaking. The pricing models of Fairley (1979), Hill and Modigliani (1987), and Myers and Cohn (1987) all incorporate federal income taxes as an accounting item, a necessary cost of doing business. This article establishes a theoretical foundation for the proper handling of taxes through the Myers-Cohn pricing model and the Myers Theorem. Explicit derivations of the capital asset pricing model betas for both the tax and the after-tax returns in terms of the asset portfolio beta are included. In particular, it is shown that the after-tax beta is not equal to one minus the tax rate times the investment return beta. Estimation problems for the appropriate effective tax rate on investment income are discussed.

Introduction

Since the mid-1970s much theoretical discussion has occurred on the role of investment income in property-liability ratemaking. Often cited in this regard are the articles by Quirin and Waters (1975), Biger and Kahane (1978), Fairley (1979), Hill (1979), and the follow-up advances by Myers and Cohn (1987), Hill and Modigliani (1987), and Kraus and Ross (1982). Surveys of the general developments of this period can be found in Cummins (1990a, 1990b, 1991) and Derrig (1990).

Interest in this subject is not restricted to academicians. Actuarial notice of the topic resulted in a full Call Paper Program on total returns for insurers at

---

Richard A. Derrig is Senior Vice President of the Automobile Insurers Bureau, Boston, Massachusetts.

This article is based upon a paper presented to the International Actuarial Association, 3rd AFIR Colloquium, March 30-April 2, 1993, in Rome, Italy. The author acknowledges the contributions of Stewart C. Myers and Richard Homonoff as well as helpful discussions with Acheson H. Callaghan Jr., Richard Cohn, and William Panning and the technical production by Eilish Browne and Julie Jannuzzi.

the 1979 meeting of the Casualty Actuarial Society. Applications of the theoretical models, primarily those derived from the capital asset pricing model (CAPM), were made for both the automobile and workers' compensation lines of property-liability insurance in several states, most notably in Massachusetts. Derrig (1987) provides a developmental history of the important issues in Massachusetts for the period 1976-1984. Some of the empirical results of the Massachusetts experiment through 1990 can be found in Derrig (1993).

Regulators, aware of the pressures of inflation on costs and the availability of relatively high current market yields for investments in the late 1970s and early 1980s, began to pay close attention to the question of the inclusion of investment income in ratemaking (a survey of the early methods is provided in Williams, 1983). Explicit recognition of investment income in ratemaking also emerged in the prior approval states of Florida, Minnesota, North Carolina, and Texas. Finally, the National Association of Insurance Commissioners (NAIC) undertook an extensive review of the question, which prompted recommendations by an industry advisory committee (Haayen, 1983).

Throughout this period, little, if any, attention was paid to the crucial role that federal income taxes would play in any ratemaking model. The simple no-tax, no-risk, one-period result of an underwriting profit provision equal to minus the risk-free rate appeared in both the Quirin and Waters and Biger and Kahane articles. Their results led to the surprising observation that the fair premium, or underwriting profit provision, was independent of the amount of supporting surplus (Biger and Kahane, p. 124), but that actual results do seem to depend upon a solvency constraint (Quirin and Waters, pp. 438-439).[1]

The potential importance of the omission of both risk and taxes was recognized immediately in Brennan's (1975) comments on the Quirin and Waters paper. On taxes, Brennan noted:

> I think that one still might find that equilibrium expected underwriting losses were less than predicted by the QW model which focuses on the similarity of insurance companies to investment companies while neglecting a significant difference, namely that insurance companies, must pay taxes on their investment income. So, in opting to become an insurance company rather than an investment company a significant tax burden is accepted. Equilibrium considerations would suggest then that it is only reasonable to expect some countervailing advantage in the form of the ability to borrow at preferential rates from policyholders (pp. 446-447).

Hill (1979) also observed the independence of the profit margin from surplus requirements but went on to derive a simple but necessary dependence in a capital asset pricing model framework with corporate taxes on investment income.[2] Fairley's (1979) CAPM profit margin equation with taxes essentially

---

[1] The nomenclature in this area may be forever hopelessly confused by the intermingling of economic and accounting definitions. In this article, capital, surplus, policyholders' surplus, capital and surplus, and net worth all mean the economic value of equity invested in the insurance enterprise.

[2] Hill's first pricing equation with taxes ignored the taxes on underwriting income and, therefore, in terms of underwriting losses, the potential tax shield available to investment income.

recognizes the same phenomenon. Fairley begins to reveal the potentially large effects from the estimation of an appropriate tax rate. He estimates a three percent increase in the required profit margin when the model insurer is assumed to invest only in U.S. government bonds, taxable at the full 1979 corporate tax rate of 46 percent, rather than investing in a tax-preferred diversified portfolio, taxable when combined with underwriting income at an average rate of about 20 percent.[3]

Hill and Modigliani (1987) spell out more clearly the sources of investment income taxes, the potential tax shield of underwriting losses, and the magnitudes of the effects of both on the underwriting profit provision. At the same time, they modify the one-tax rate Fairley profit equation to incorporate separate tax rates for investment and underwriting. This came as a result of litigation of the 1980 Massachusetts Private Passenger Automobile Rate Case, in which the appropriate tax rate emerged as the principal issue (*Massachusetts Automobile Rating and Accident Prevention Bureau vs. Commissioner of Insurance,* Mass. Adv. Sh. [1980] 2167).

Kraus and Ross (1982) developed a sophisticated insurance pricing model incorporating inflation and risk but assumed a world without taxes. It remained for Myers and Cohn to reveal the essential value of the tax considerations. Their basic equation, derived from a balance sheet net present value principle, is

$$\begin{aligned} \text{PV (Premium)} = {} & \text{PV (Losses and Expenses)} + \\ & \text{PV (Underwriting Taxes)} + \\ & \text{PV (Investment Income Taxes on Surplus)} + \\ & \text{PV (Investment Income Taxes on Operations).} \end{aligned} \tag{1}$$

The Myers-Cohn equation reveals the precise economic reason for the aforementioned independence/dependence of the profit margin on surplus requirements; namely, that the investor expects pre-tax investment income on surplus, as in the case of an investment trust, plus an appropriate profit on the risky underwriting process. Therefore, the present value of the tax burden imposed on the investor's equity must be transferred to the policyholder through the premium charged in order to preserve the value of the investor's equity at the time of investment.[4] By bearing the present value of the tax burden on investment income derived from both surplus and policyholder funds, the policyholder effectively provides a preferential lending rate to the insurer, much as Brennan predicted should be the case.

Hill's more general equation contained both tax terms but only an approximate solution was presented.

[3] This model insurer was called the "regulatory standard company" by the Massachusetts Division of Insurance on the grounds that any insurer can do at least as well in anticipated investment returns as the model company that invests only in relatively riskless government bonds (Derrig, 1990, pp. 7-9).

[4] If no insurance operation were present and the investment income on the company's portfolio were taxed as a corporation rather than as a mutual fund, the value of the invested equity would be immediately decreased by the present value of the corporate tax burden (see discussion below).

Although the general multiperiod framework of the theory of accounting for taxes was well established by Myers and Cohn, the theoretical and empirical support for the magnitude of the appropriate tax rate was not. The absence of a definitive treatment of taxes ultimately led to the 1983 adoption in Massachusetts for private passenger automobile insurance of a "realistic" investment tax rate of about 28 percent to be offset by an underwriting loss tax shield at the 46 percent marginal corporate tax rate. This was accomplished largely by following the Hill and Modigliani methods while ignoring their avoidance of unusable tax credits.

As the 1983 Massachusetts auto decision demonstrated, the choice of the effective tax rates on investment and underwriting income is a major parametric issue in the implementation of theoretical underwriting profit models. Table 1 compares the overall profit margins that arose from the proposed continued use of the marginal corporate investment tax rate of 46 percent and the tax rate of 28 percent adopted by the Commissioner.[5] There was a 5.5 percent difference in premium.[6] Considering that the magnitude of the total expected operating profit, after investment income and taxes, was approximately 2 percent of premiums, the investment tax rate choice becomes critically important.[7]

Table 1
Massachusetts Private Passenger Automobile Insurance:
1983 Regulatory Tax Rate Assumptions

Policy Year	*Investment Tax Rate (%)*	*Underwriting Tax Rate (%)*	*Overall Profit Margin (%)*
Proposed	46	46	-2.2
Decision	28	46	-7.7

Note: Proposed = the proposed continued use of the marginal corporate investment tax rate by the industry rating bureau. Decision = the tax rate adopted by the state insurance commissioner.

This article provides an analysis of the appropriate treatment of federal income taxes on investment income. For purposes of this article, it is assumed that the underwriting tax rate is the marginal corporate rate. This is tantamount to assuming that any tax credits that arise from the underwriting operation can be used immediately to offset taxable income from some insurer source. The alternative is beyond the scope of this article. Theoretical results are presented along with case examples drawn from Massachusetts private passenger auto

[5] As in the Fairley footnote, the 46 percent investment tax rate was appropriate at the time for the so-called regulatory standard insurer that invested only in Treasury securities.

[6] The reduction in tax preferences for property-liability company underwriting and investment income contained principally in the Tax Reform Act of 1986 causes the profit provision difference to narrow substantially. For 1994 auto rates, the Commissioner used an effective investment income tax rate of 31.6 percent instead of the marginal tax rate of 35 percent, producing a difference of only 0.4 percent.

[7] A risk loading of slightly under 2 percent emerged from the use of an underwriting beta of –0.16 combined with a market risk premium of 9 percent for the risk-adjustment in the Massachusetts Myers-Cohn profit model.

insurance rate regulation. Myers' Theorem (Myers, 1984) that the risk-adjusted present value of the investment tax burden depends only on the risk-free interest rate and the effective investment tax rate of an assumed investment portfolio, is presented next. Then, the general framework for estimating an appropriate effective investment tax rate is discussed. A summary section concludes.

The Present Value of the Investment Tax Liability

The general net present value model of Myers and Cohn calls for the inclusion of the present value of the investment tax liability on all assets invested in support of the policy.[8] These investments are normally made in a variety of risky bond and stock portfolios. The U.S. tax code currently provides for an income tax rate of approximately 35 percent on all investment income but allows various deductions based upon the source of the income.[9] For example, some income from tax-exempt bonds is fully deductible, while 70 percent of dividend income from stocks is deductible. These deductions from taxable investment income lead to nominal tax rates between zero (all tax-exempt bonds purchased prior to August 1986) and 35 percent (all fully taxable Treasury bills and bonds) depending upon the composition of the portfolio.

Somewhat ironically, the Tax Reform Act of 1986 also imposed a tax on 15 percent of the income from tax-exempt bonds purchased after August 8, 1986, by property-liability insurers.[10] At the end of 1992, the twelve major writers of Massachusetts private passenger automobile insurance had asset proportions of tax-exempt bonds purchased after August 8, 1986, ranging from a low of 37.4 percent for Travelers to a high of 100 percent for Commercial Union among others (Automobile Insurers Bureau, 1993, p. 107). For those companies at least, the minimum marginal tax rate on tax-exempt bonds income now ranges not from zero but from 2 percent (0.15 x 0.374 x 0.35) to 5.25 percent (0.15 x 0.35), depending upon the age of their tax-exempt portfolio.

Historical statutory underwriting, investment, and federal income tax data are shown in Table 2. While statutory accounting does not allow detailed analyses of the finer points of corporate tax accounting (the effects of consolidation, for example), the data in Tables 2 and 3 reinforce the importance of the federal tax component, especially subsequent to the Tax Reform Act of 1986.

---

[8] Myers and Cohn used per period supporting assets roughly equal to the value of total reserves plus surplus proportional to outstanding loss and expense liabilities, all at present value.

[9] An extensive revision of the tax code, as it applies to property-liability insurers, was made by the Tax Reform Act of 1986. The marginal corporate tax rate was reduced from 46 to 34 percent effective July 1, 1987. The Act also redefined the scope of taxable income for property-liability insurers in significant ways (Cummins and Grace, 1994). The net effect of the tax reform was to raise the required underwriting profit margins (Massachusetts Rating Bureau, 1987). The marginal corporate tax rate was increased from 34 percent to 35 percent, effective January 1, 1993, by the so-called Clinton Tax Plan, August 6, 1993.

[10] This "proration" tax applies also to the 70 percent stock dividend preference for stocks purchased after August 8, 1986, resulting in a 1992 marginal tax rate on stock dividends of 13.8 percent (0.3 x 0.34 + 0.15 x 0.7 x 0.34).

That Act fundamentally changed the tax system applicable to property-liability insurers. As a result, the net tax credit of \$5.4 billion in 1980-1986 has been replaced by a tax liability of \$19 billion in 1987-1992 (see Figure 1). More importantly for ratemaking purposes, the explicit tax liability had reached about two percent of premiums in 1991.[11]

Fortunately, one key simplification for ratemaking is possible. As shown directly by Myers in 1984, the present value of the investment tax burden depends upon the tax rate but is independent of the riskiness of the portfolio. This result is implicit, if somewhat obscured, in the derivations of the tax terms in Fairley and Hill. Details of the Myers Theorem and proof are given below.

The Myers Theorem

Assume a corporation holds a portfolio yielding one-period investment returns and is subject to a tax liability on the realized income. Further assume a simple CAPM market where the effective tax rate T is known with certainty. Myers' Theorem says that, within the CAPM framework, the risk-adjusted present value of the tax liability on investment income from a risky portfolio held by a corporation is

$$PV\ (T\tilde{r}_A) = \frac{Tr_f}{1+r_f}, \tag{2}$$

where T = the effective tax rate on investment income,
r_f = the risk-free rate of return, and
$\tilde{r}_A$ = the rate of return on the risky portfolio.

Following Myers (1984), suppose \$1 is invested at the beginning of the period in a risky asset or portfolio with a beta of β_A and an expected rate of return consistent with the capital asset pricing model:

$$r_A = r_f + \beta_A\ (r_m - r_f). \tag{3}$$

The corporation must pay taxes at the rate T on investment income at the end of the period. The net present value (NPV) of this investment is

$$\begin{aligned} NPV &= (\$1 \text{ invested}) + PV\ (\text{pre-tax return}) - PV\ (\text{tax liability}) \\ &= -1 + PV\ (1+\tilde{r}_A) - PV\ (T\tilde{r}_A), \end{aligned} \tag{4}$$

where $\tilde{r}$ indicates the actual return, which is not known when the investment is made. The NPV of the first two terms is zero, because the expected payoff $1 + r_A$ is discounted at the same risky rate r_A.

[11] The *explicit* tax liability arises from taxes actually incurred; the *implicit* tax liability appropriate for ratemaking also includes items such as the foregone yields implicit in tax-exempt investments. The 1992 tax results were quite unusual due to the large effects of catastrophes (e.g., Hurricane Andrew) on the underwriting income.

Table 2
Statutory Underwriting, Investment, and Tax Results for the Property-Liability Insurance Industry

	Net Underwriting Income	*Net Investment Income*	*Pretax Operating Income*	*Income Tax*	*Implicit Tax Rate (%)*[a]	*Implicit Investment Tax Rate (%)*[b]	*Net Operating Income*	*Realized Capital Gain/Loss*	*Unrealized Capital Gain/Loss*	*Other Gain/Loss*
1980	-3,334	11,063	7,729	614	7.4	18.5	7,115	533	4,274	275
1981	-6,288	13,248	6,960	49	0.7	21.7	6,911	276	-2,666	467
1982	-10,290	14,907	4,617	-677	-13.1	26.2	5,294	572	2,908	276
1983	-13,322	15,973	2,651	-1,196	-25.1	27.3	3,847	2,110	1,358	511
1984	-21,268	17,660	-3,609	-1,667	NOL	39.2	-1,942	3,063	-2,848	-132
1985	-25,288	19,508	-5,780	-1,958	NOL	38.7	-3,822	5,483	5,228	-214
1986	-16,613	21,924	5,312	-599	-4.9	24.5	5,911	6,874	2,027	-474
Tax Reform Act of 1986										
1987	-10,620	23,960	13,340	3,347	20.1	27.8	9,993	3,335	-3,026	-87
1988	-11,800	27,723	15,923	3,667	19.7	25.2	12,256	2,725	2,703	-265
1989	-21,093	31,207	10,114	2,944	19.9	28.2	7,170	4,649	8,035	72
1990	-21,856	32,901	11,046	3,059	22.0	29.3	7,987	2,880	-5,116	-333
1991	-20,930	34,247	13,317	4,396	24.3	29.5	8,921	4,806	13,427	-478
1992	-34,904	33,734	-1,170	1,559	17.9	30.8	-2,729	9,893	-64	-494
80-86	-96,403	114,283	17,880	-5,435	-14.8	29.2	23,315	18,911	10,281	708
87-92	-121,203	183,772	62,570	18,972	20.9	28.1	43,597	28,289	15,959	-1,585
80-92	-217,606	298,055	80,450	13,537	10.6	28.6	66,912	47,200	26,240	-877

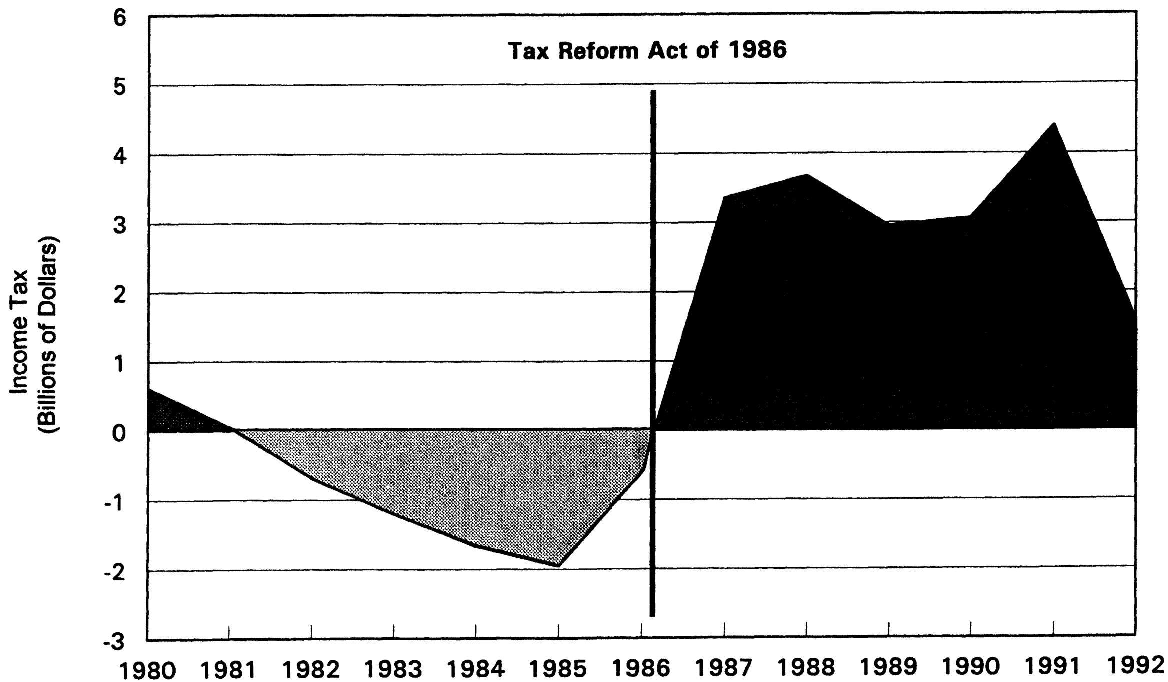
Source: A. M. Best Company (1981-1993).
Note: NOL = Net Operating Loss: Pretax Operating + Realized Capital Gain Income < 0.
[a] Income Tax / [Pretax Operating Income + Realized Capital Gains]
[b] [Income Tax - (Tax Rate)(Underwriting Income)] / [Net Investment Income + Realized Capital Gains]. This calculation ignores carryforwards and carrybacks and post-1986 effects of discounting of loss reserves, fresh start, revenue offset, and AMT effects. The tax rates used are 46 percent (1980-1986), 40 percent (1987), and 34 percent (1988-1992).

Table 3
Statutory Underwriting, Investment, and Tax Results
as Percentages of Premiums: Property-Liability Insurance Industry

	Net Earned Premiums	*Net Underwriting Income*	*Net Investment Income*	*Pretax Operating Income*	*Net Income Tax*	*Realized Operating Income*	*Unrealized Capital Gain/Loss*	*Capital Gain/Loss*	*Other Gain/Loss*
1980	95,702	-3,48	11.56	8.08	0.64	7.44	0.56	4.47	0.29
1981	99,373	-6.33	13.33	7.00	0.05	6.95	0.28	-2.68	0.47
1982	104,038	-9.89	14.33	4.44	-0.65	5.09	0.55	2.80	0.27
1983	109,247	-12.19	14.62	2.43	-1.09	3.52	1.93	1.24	0.47
1984	118,591	-17.93	14.89	-3.04	-1.41	-1.64	2.58	-2.40	-0.11
1985	144,860	-17.46	13.47	-3.99	-1.35	-2.64	3.79	3.61	-0.15
1986	176,993	-9.39	12.39	3.00	-0.34	3.34	3.88	1.15	-0.27
				Tax Reform Act of 1986					
1987	193,689	-5.48	12.37	6.89	1.73	5.16	1.72	-1.56	-0.05
1988	202,285	-5.83	13.70	7.87	1.81	6.06	1.35	1.34	-0.13
1989	208,834	-10.10	14.94	4.84	1.41	3.43	2.23	3.85	0.03
1990	218,100	-10.02	15.09	5.06	1.40	3.66	1.32	-2.35	-0.15
1991	223,243	-9.38	15.34	5.97	1.97	4.00	2.15	6.01	-0.21
1992	227,751	-15.33	14.81	-0.51	0.68	-1.20	4.34	-0.03	-0.22
80-86	848,804	-11.36	13.46	2.11	-0.64	2.75	2.23	1.21	0.08
87-92	1,273,902	-6.77	11.78	5.00	1.37	3.64	1.44	1.26	-0.09
80-92	2,122,706	-8.61	12.45	3.85	0.56	3.28	1.76	1.24	-0.02

Source: A. M. Best Company (1993).

Figure 1
Property-Liability Insurance Industry
Federal Income Taxes Incurred



Source: A. M. Best (1981-1993).

$$PV\ (1+\tilde{r}_A) = \frac{1+r_A}{1+r_A} = 1. \tag{5}$$

This simply assumes an efficient market, in which the extra return offered by a risky asset just compensates for its risk. Therefore, combining equations (4) and (5), and noting that, in an efficient market, present value is a linear function,

$$\begin{aligned} \mathbf{NPV} &= -\mathbf{PV}\ (\mathbf{T}\tilde{\mathbf{r}}_A) = -\mathbf{T}\ \mathbf{PV}\ (\tilde{\mathbf{r}}_A) \\ &= -\mathbf{T}\ \mathbf{PV}\ ((1+\tilde{\mathbf{r}}_A) - 1) \\ &= -\mathbf{T}\ [\mathbf{PV}\ (1+\tilde{\mathbf{r}}_A) - \mathbf{PV}(1)], \end{aligned} \tag{6}$$

but PV $(1+\tilde{r}_A) = 1$, as in equation (5), and $PV(1) = 1/(1+r_f)$, since the present value of a safe future dollar, the allowed deduction of the original investment from the total return, is found by discounting at the risk-free rate. Thus, it follows from equation (6) that

$$NPV = -T\ (1 - \frac{1}{1+r_f}) = -\frac{Tr_f}{1+r_f}. \tag{7}$$

A more rigorous version of this proof is provided in Taylor (1994).

In other words, the present value of the tax liability on the risky return r_A is calculated as if that return were risk free. The present value of the tax liability on r_A does not depend on β_A.

An alternative proof of the Myers Theorem using the "certainty equivalent" form of the CAPM (Brealey and Myers, 1988) is due to Homonoff (1985). That form of the one-period CAPM can be stated as follows:

$$PV\ (\tilde{CF}_1) = \frac{E\ (\tilde{CF}_1) - \lambda\ COV\ (\tilde{CF}_1, 1+\tilde{r}_m)}{1 + r_f},$$

where $E\ (\tilde{CF}_1)$ = expected value of cash flow in period 1,

$COV\ (\tilde{CF}_1, 1+\tilde{r}_m)$ = covariance between cash flow and market return

$\lambda = [E\ (\tilde{r}_m) - r_f]\ /\ \sigma_m^2$, and

σ_m^2 = variance of return on the market. (8)

For Myers' present value of the tax on a random return $(\tilde{r}_A)$, the cash flow per dollar invested is

$$\tilde{CF}_1 = Tr_A = T\ [r_f + \beta_A\ (r_m - r_f) + \tilde{\varepsilon}], \tag{9}$$

where T = tax rate,

β_A = asset portfolio beta, and

$\tilde{\varepsilon}$ = a zero mean random variable with zero covariance with the market.

Combining equation (9) into equation (8), the certainty equivalent CAPM, gives

$$PV(T\tilde{r}_A) = \frac{E[T(r_f+\beta_A(r_m-r_f)+\tilde{\varepsilon})]-\lambda COV[T(r_f+\beta_A(r_m-r_f)+\tilde{\varepsilon}),1+\tilde{r}_m]}{1+r_f}$$

$$= \frac{T\,[r_f+\beta_A\,(r_m-r_f)]-\lambda\,\beta_A\,\sigma_m^2]}{1+r_f} \qquad (10)$$

But $\lambda = \dfrac{r_m - r_f}{\sigma_m^{\ 2}}$, so that

$$PV(T\tilde{r}_A) = \frac{T\,r_f}{1+r_f}, \text{ as Myers showed.}$$

The above result does not mean that the tax liability is risk free; the tax is risky. The beta of the tax can be calculated and the same present value can then be obtained by discounting the tax at a risk-adjusted rate.

Let β_{TAX} = the beta of the tax payment. Since $T\tilde{r}_A = T\,((1+\tilde{r}_A) - 1)$, and since linearity of PV yields $PV\,(T\tilde{r}_A) = PV\,(T\,(1+\tilde{r}_A)) - PV\,(T\cdot 1)$, it follows that

$$\beta_{TAX}\,PV\,(T\tilde{r}_A) = \beta_A\,PV\,(T(1+\tilde{r}_A)) - \beta_1\,PV\,(T\cdot 1),$$

$$\text{so} \quad \beta_{TAX}\,\frac{Tr_f}{1+r_f} = \beta_A\,T, \qquad (11)$$

$$\text{or } \beta_{TAX} = \beta_A\,\frac{1+r_f}{r_f}.$$

The risk-adjusted rate for the forecasted tax Tr_A is, thus,

$$r_{TAX} = r_f + \frac{1+r_f}{r_f}\,\beta_A\,(r_m - r_f). \qquad (12)$$

It follows that

$$PV\,(T\tilde{r}_A) = \frac{T\tilde{r}_A}{1+r_f+\dfrac{1+r_f}{r_f}\,\beta_A\,(r_m-r_f)}$$

$$= \frac{Tr_A\,(r_f\,/\,(1+r_f))}{r_f+\beta_A\,(r_m-r_f)} \qquad (13)$$

$$= \frac{Tr_f}{1+r_f}.$$

Equation (12) shows that the tax liability is indeed risky: in fact, unless $\beta_A = 0$, $\beta_{TAX} > \beta_A$, making the tax liability riskier than the pre-tax return. This is due to the fact that the tax essentially acts like a leveraged investment. On the other hand, the after-tax return is less risky than the pre-tax return.

It is worth noting the following corollary to Myers' Theorem. If a corporation invests in a portfolio, then the present value of its after-tax return on that portfolio is given by

$$PV\ (1 + (1-T)\ \tilde{r}_A) = \frac{1 + (1-T)\ r_f}{1 + r_f}. \tag{14}$$

Since the total return expected on the investment is given by $1 + r_A$, the inclusion of taxes on the return r_A decomposes $1 + r_A$ into

$$1 + r_A = 1 + (1\text{-}T)r_A + Tr_A. \tag{15}$$

Taking present values and applying the theorem gives

$$PV\ (1+\tilde{r}_A) = PV\ (1 + (1-T)\tilde{r}_A) + PV\ (T\tilde{r}_A), \quad \text{or}$$

$$PV\ (1 + (1-T)\tilde{r}_A) = 1 - \frac{Tr_f}{1 + r_f} = \frac{1 + (1-T)\ r_f}{1 + r_f}. \tag{16}$$

Just as in the case of the tax liability, the present value of the after-tax risky return does not depend on the beta. Likewise, note that the less risky beta of the after-tax return is given by

$$\beta_{AFTER\text{-}TAX} = \frac{(1-T)\ (1+r_f)}{1 + (1-T)\ r_f}\ \beta_A \le \beta_A \tag{17}$$

$$\text{with equality only if } \beta_A = 0 \text{ or } T = 0.$$

It must be remembered that the after-tax return is also on a leveraged investment of $1\text{-}Tr_f/(1+r_f)$ but that leverage still produces returns that are generally less risky than the return on the portfolio as a whole. At this point it is also interesting to note that, precisely because of the leveraged investment, equation (17) implies

$$\beta_{AFTER\text{-}TAX} \neq (1\text{-}T)\beta_{PRE\text{-}TAX} \tag{18}$$

with the exception of the trivial cases of $T = 0$ or $\beta_A = 0$.

It may also be useful to see why this result works in the Myers-Cohn present value model. For that purpose, following Myers, consider the one-period insurance balance sheet at the time a policy is issued. Using the notation of Myers-Cohn, the balance sheet would follow the format shown in Table 4. The equity invested is equated on the balance sheet with the supporting surplus S. The after-tax present value of investing surplus and premium is

$$\begin{aligned} &PV\ [(S+P)\ (1+\tilde{r}_A) - T\ (S+P)\ [(1+\tilde{r}_A) - 1\ ]] \\ &= PV\ [(1-T)\ (S+P)\ (1+\tilde{r}_A) + T\ (S+P)] \\ &= (1-T)\ (S+P) + T\ (S+P)\ /\ (1+r_f) \\ &= (S+P) - Tr_f\ (S+P)\ /\ (1+r_f). \end{aligned} \tag{19}$$

Table 4

Balance Sheet (Market Values)

Asset Value	Present Value of Expected Losses and Expenses
(Premium Plus Equity Invested)	Present Value of Underwriting Tax
	Present Value of Investment Tax
	Equity
Total Value	Total Value
	Balance Sheet Parameters
P	$L/(1+r_L)$
S	$T\ (P/(1+r_f) - L/(1+r_L))$
	T PV (Taxable Investment Income)
	S
Total Value	Total Value

Thus, the present value of the tax on the investment income from any portfolio choice for the investment balance (S+P) is

$$PV\ (\text{Investment Tax}) = (S+P)\ Tr_f\ /\ 1+r_f. \tag{20}$$

Using the Myers Theorem, the present value of the investment tax term can be evaluated using an estimate of the risk-free rate and an effective tax rate for an appropriate investment portfolio. I next turn to the establishment of a framework in which to consider the question of an effective tax rate.

A Framework for the Appropriate Effective Tax Rate

The effective tax rate for the investment income on an asset is, by definition, one minus the ratio of the after-tax yield on the asset to the yield on a fully taxable asset of comparable risk and maturity. For example, for tax-exempt bonds,

$$\text{Effective Tax Rate} = 1 - (r_{EXEMPT}/r_{CBOND}),$$

where CBOND is a fully taxable (corporate) bond that has the same risk and maturity as the exempt bond. However, since tax-exempt yields respond directly to real or perceived changes in the tax codes while taxables may not respond at all, there may be no such comparable taxable and tax-exempt securities. Another example would be a preferred stock. In that case,

$$\text{Effective Tax Rate} = (1 - 0.895\ r_{PREFSTK}/r_{CBOND}),$$

where CBOND is a fully taxable corporate bond with the same risk and maturity characteristics as PREFSTK, the preferred stock.

Given the nature of preferred stocks, a truly comparable corporate bond also may be in reality impossible to find. These simple examples assume no capital gains or proration.[12] The tax rate on preferred stocks is assumed to be 35 percent after the exclusion of 70 percent of the dividend and is thus 0.105.

The Myers Theorem can be interpreted as follows. The present value of the tax liability on investment income from a risky portfolio held by a corporation is independent of the risk level of the portfolio and depends only on the effective portfolio tax rate and the risk-free rate of interest. The insurance ratemaking question ultimately comes down to two choices: Which portfolio of assets should be used and how can the effective tax rate of that portfolio be calculated?

Under the Myers-Cohn model, equation (1) above, premiums are reduced by an estimate of the anticipated after-tax income that may be earned from the investment of premiums from the time premiums are received until the ultimate payment of losses or expenses. The net present value model assumes that the sum of this anticipated investment income plus premiums will be sufficient to pay all claims and expenses and provide reasonable profits to the insurers. A postulate of this procedure is that the policyholder purchases insurance to eliminate underwriting risk, not to assume investment risk.

One technique to eliminate investment risk is to use the yields on a portfolio of Treasury securities, whose maturities are matched to the expected loss payment patterns. This was the investment portfolio of the regulatory standard company introduced in Massachusetts rate regulation in 1976 (Derrig, 1990, pp. 7-9). The use of Treasury securities is assumed to eliminate call and default risk, while the matching of maturities is assumed to eliminate holding period or interest rate risk.[13] If this regulatory standard company portfolio is assumed for modeling purposes, then the effective investment tax rate calculation is simple. All income from Treasury securities is fully taxable at the 35 percent marginal corporate rate.

Another technique is to assume some portfolio of risky assets. The Myers Theorem allows present value calculations to use the risk-free equivalent yield on that portfolio, but the theorem does not provide a usable tax rate. In a world without taxes, most sensible asset pricing theories will demand that the

[12] Proration was introduced for property-liability insurers by the Tax Reform Act of 1986 and consists of an additional tax on 15 percent of the tax preferences (e.g., tax-exempt income). See Cummins and Grace (1994).

[13] Maturity matching was a first approximation to the more correct duration matching. "Holding period risk" refers to the risk associated with holding long maturity bonds to meet short maturity liabilities. One aspect of such risk is the risk of price fluctuations in such bonds as interest rates change, sometimes called *price risk*. Another aspect is the risk of not being able to reinvest the interest on the bonds at the same rate as the original bond, sometimes called *reinvestment risk*. The two types of risk are characteristic of fixed income investments, and together they are sometimes called *interest rate risk* (see Reilly and Sidhu, 1980, for a clear summary).

present value of any investment adjusted for risk will be the same. This is the principle used in the proof of the Myers Theorem.

In a world with taxes, the risky asset portfolio potentially includes both taxable and tax favored securities. An important question is how to treat the investment income on these two types of securities; that is, does a true tax advantage exist when *all* differences in risk are properly accounted for?[14] Stated differently, the question as Myers posed it in 1981 is whether some other portfolio with lower tax rates is actually superior in all relevant aspects to the regulatory standard portfolio, so that it confers additional value, before the fact, on a company holding such a portfolio. This question reduces to whether we can construct, in theory, a portfolio with tax preferences that produce an effective tax rate lower than 35 percent to the insurer, which also eliminates all investment risk, including risk arising from the tax code itself. If no such portfolio exists, the 35 percent marginal corporate rate must be used as the effective tax rate. If some portfolio with higher after-tax, after-risk adjustment yields can be found, then a tax rate lower than 35 percent can be used. The Tax Reform Act of 1986 plays a pivotal role in the evaluation of tax preferences.

Cummins and Grace (1994) analyzed property-liability insurer tax-exempt bond holdings as part of a larger study of tax management policy. Their analysis of 40 stock property-liability insurers' investments from 1981 through 1989 provides evidence that insurers behave as if they perceive a yield advantage for longer maturity tax-exempt bonds. The authors point out that this supports the joint hypothesis that insurers are rational investors and that implicit tax rates on tax-exempt bonds are low enough to make these assets attractive. If a true yield advantage exists, it could be due to a tax clientele effect (e.g., Dybvig and Ross, 1986) implying that the marginal tax rate of the marginal buyer of tax-exempt bonds is smaller than the insurers' 35 percent rate less their 5.1 percent minimum proration and AMT tax rate.[15] However, another explanation for the Cummins-Grace findings is that insurers' perceptions of a yield advantage emanating from the tax code are not correct; that is, there is no yield advantage because taxable and tax-exempt bonds cannot be found with the same risk characteristics at all maturities. This critical assumption of perfect substitution of taxable and tax-exempt bonds (except for taxes) at the margin ignores or minimizes the risk premium demanded by long-term tax-exempt bond buyers for the uncertainty of tax code provisions in the (distant) future. Such a risk premium would be reflected in lower perceived implicit tax rates

[14] Rational investors seek after-tax yields. They therefore seek tax-advantaged securities. Investor demand should drive up the prices of such securities and thus decrease their yields until the yields are in equilibrium with the yields on equivalently risky securities with high statutory tax rates. The existence of true tax advantages implies that investors are not rational, or that the market is not efficient, or that it is segmented in a way that permits tax advantages to persist.

[15] Equivalently, the tax clientele effect implies a marginal buyer with a marginal tax rate of less than 29.9 percent (35 - 5.1). This is possible if the tax code risk premium is small, the marginal investor is an individual investing directly or through mutual funds, and the insurer can expect to avoid the AMT tax of 15.75 percent on tax-exempt income.

in long tax-exempt bond yields (Skelton, 1983a). If there are no perfect substitutes, then the replacement of a taxable by a tax-exempt bond (or vice-versa) must change the risk profile of the portfolio contrary to the optimization goal. Insurers may correctly perceive an acceptable tax code risk with the apparent yield advantage as the expected reward for that risk, leaving the true implicit tax rate equal to the marginal corporate rate.

Additionally, the taxation of capital gains on tax-exempt bonds at full personal or corporate rates suggests that investors expect to have their total returns (interest and capital gains) on tax-exempt securities taxed at some rate (ignoring other tax effects) larger than zero but less than the marginal rate. Cummins and Grace's (1994) tax management modeling takes into account both the timing and the tax rate of capital gains on stocks but not on bonds. Their empirical work, however, includes a model with realized capital gains for both bonds and stocks. That model produces an approximately one-for-one relationship between underwriting loss tax shelters and taxable income including realized capital gains. Indeed, the expected taxing of capital gains may explain part of the differing implicit tax rates across maturities.[16]

According to Walker (1991, pp. 78-82), although the explicit tax rate on U.S. property-liability insurers rose from zero in pre-reform years to about 20 percent in 1987-1988, the effective investment tax rate adjusted for tax preferences in tax-exempt bonds, preferred and common stocks rose from an average of about 29 percent pre-reform to 34.5 percent post-reform. Walker's results point toward an effective investment tax rate for ratemaking (at least post-Clinton) of the marginal rate of 35 percent. We look to the capital markets, especially the tax-exempt bond market, for a portfolio which might, after adjusting for all risk, produce higher after-tax yields and thus have a true tax advantage over a portfolio of Treasury securities. If such an advantage does indeed exist, the additional question of the amount of the advantage that should be passed onto policyholders in the fair premium must also be confronted.[17] Finally, the crude nominal investment tax rates shown in Table 2, which include the tax preferences, suggest effective tax rates closer to the

---

[16] The favorable Cummins and Grace empirical result using realized capital gains from both stocks and bonds suggests that a revised theoretical model with capital gains on bonds as an explicit variable may be more appropriate. The general tenor of the results are not likely to change, but the effect on the tax management strategy of bond trading and call provisions may prove useful. Note that the large amount of capital gains realized in 1992 (see Table 2) to fund the catastrophes included those gains on bonds resulting from the general decline in interest rates.

The expected tax rate (apart from proration and AMT-type effects) on tax-exempt bond total income I is the expected tax on capital gain income divided by the expected value of I. This expected tax liability should rise from zero as the maturity of the bond increases. That rising expected tax liability is consistent with a falling implicit tax rate (Skelton, 1983b), one that is less than the tax rate of the marginal investor.

[17] Property-liability insurers' tax-exempt bond durations far exceed their liability durations (see Cummins and Grace, 1994, Table 2). That fact suggests that not all of the perceived tax advantage of tax-exempt bonds can be realized within the expected time frame of the flow of policyholder funds. Some residual tax code risk must be borne by the insurer, and its expected reward (if any) must be attributable to the insurer not the policyholder.

marginal rate of 35 percent than to the lesser perceived effective rates. This empirical question should be the subject of additional research efforts.

Summary and Conclusion

This article has reported on recent developments that affect the estimate of the federal investment income tax burden appropriate for inclusion in the calculation of an economically derived fair premium. The major development is the Myers Theorem: that the present value of that tax burden is independent of the riskiness of the portfolio but depends upon the effective tax rate of the portfolio. The second development is the application of the Myers Theorem to calculate the betas of both the tax and the after-tax returns. In particular, it has been shown that the beta of the after-tax return is *not* one minus the beta of the pre-tax return.

Using the theoretical foundation of the Myers Theorem and its corollaries, the combined theoretical-empirical question of the appropriate effective tax rate is discussed. Two important aspects of that discussion are the concept of risk as it applies to tax-favored investments and the appropriate implicit tax rate for tax-exempt bonds. Both of these concepts require an examination of the U.S. market for tax-exempt bonds as the primary prototype of a tax-favored capital market in order to determine whether the effective investment tax for insurers is less *in fact* than the marginal rate, despite the fact that the insurers perceive it so.

A final observation is in order. It is one thing to seek refinements of financial models that have significant practical effects. It is quite another thing, however, to begin to believe that simplified financial models can fully reflect the markets. Derrig (1987, 1992) has shown that it is more important to estimate accurately the magnitudes of the loss and expense flows in calculating the insurance rates than it is to be absolutely precise in calculating parametric inputs to the underwriting profit models. Nevertheless, as we have shown here, the choice of the federal investment income tax rate within seemingly plausible ranges can, by itself, determine whether the insurer can expect to make a profit or a loss by issuing a policy.

References

A. M. Best Company, 1981-1993, *Income Statement and Policyholders' Surplus Accounts* (Oldwick, N.J.: A. M. Best).

A. M. Best Company, 1993, Industry Resources, *Best's Aggregates and Averages* (Oldwick, N.J.: A. M. Best), 144.

Automobile Insurers Bureau, 1993, Filing on Underwriting Profit Provision, D.O.I. Docket G93-25, Boston.

Biger, Nahum and Yehuda Kahane, 1978, Risk Considerations in Insurance Ratemaking, *Journal of Risk and Insurance,* 45: 121-132.

Brealey, Richard A. and Stewart E. Myers, 1988, *Principles of Corporate Finance,* Third Edition (New York: McGraw-Hill).

Brennan, M. J., 1975, Discussion, *Journal of Finance,* 30: 446-447.

Casualty Actuarial Society, 1979, Total Return Due a Property-Casualty, Call Paper Program (May), Colorado Springs.

Cummins, J. David, 1990a, Asset Pricing Models and Insurance Ratemaking, *ASTIN Bulletin,* 20(2): 125-166.

Cummins, J. David, 1990b, Multi-Period Discounted Cash Flow Ratemaking Models in Property-Liability Insurance, *Journal of Risk and Insurance,* 57: 79-109.

Cummins, J. David, 1991, Statistical and Financial Models of Insurance Pricing and the Insurance Firm, *Journal of Risk and Insurance,* 58: 261-302.

Cummins, J. David and Elizabeth Grace, 1994, Tax Management and Investment Strategies of Property-Liability Insurers, *Journal of Banking and Finance,* 18: 43-72.

Derrig, Richard A., 1993, Price Regulation in US Automobile Insurance—A Case Study of Massachusetts Private Passenger Automobile Insurance 1978-1990, *Geneva Papers on Risk and Insurance,* 18: 158-173.

Derrig, Richard A., 1990, The Development of Property-Liability Insurance Pricing Models in the United States 1969-1989, *1st AFIR Conference Proceedings,* International Actuarial Association, May 23-26, Paris. [Reprinted in *CAS Actuarial Forum,* Fall 1991: 19-46.]

Derrig, Richard A., 1987, The Use of Investment Income in Massachusetts Automobile and Workers' Compensation Ratemaking, in: J. D. Cummins and S. E. Harrington, eds., *Fair Rate of Return in Property-Liability Insurance* (Norwell, Mass.: Kluwer Academic Publishers).

Dybvig, Philip H. and Stephen A. Ross, 1986, Tax Clienteles and Asset Pricing, *Journal of Finance,* 41: 751-762.

Fairley, William B., 1979, Investment Income and Profit Margin in Property-Liability Insurance: Theory and Empirical Results, *Bell Journal of Economics,* 10: 192-210. [Reprinted in J. David Cummins and S. E. Harrington, eds., *Fair Rate of Return in Property-Liability Insurance* (Boston: Kluwer Academic Publishers), 27-53.]

Haayen, Richard, 1983, *Report of the Advisory Committee to the NAIC Task Force on Profitability and Investment Income,* 3 Volumes (Northbrook, Ill.: Allstate Insurance Co.).

Hill, Raymond D., 1979, Profit Regulation in Property-Liability Insurance, *Bell Journal of Economics,* 10(1): 172-191.

Hill Raymond D. and Franco Modigliani, 1987, The Massachusetts Model of Profit Regulation in Non-Life Insurance: An Appraisal and Extension, in: J. David Cummins and Scott E. Harrington, eds., *Fair Rate of Return in Property-Liability Insurance* (Boston: Kluwer Academic Publishers), 27-53.

Homonoff, Richard, 1985, Private communication to the author, August 12.

Kraus, Alan and Stephen A. Ross, 1982, The Determinants of Fair Profits for the Property-Liability Insurance Firm, *Journal of Finance,* 37: 1015-1028.

Massachusetts Rating Bureau, 1987, *Underwriting Profit Filing for 1988 Automobile Rates* (Boston: MRB).

Myers, Stewart C. and Richard A. Cohn, 1987, A Discounted Cash Flow Approach to Property-Liability Insurance Rate Regulations, in: J. D. Cummins and S. E. Harrington, eds., *Fair Rate of Return in Property-Liability Insurance* (Boston: Kluwer-Nijhoff), 55-78.

Myers, Stewart C., 1984, Testimony prepared for the Massachusetts Automobile rate hearings, Massachusetts Rating Bureau Filing for 1985 Automobile Rates, Boston.

National Association of Insurance Commissioners, 1984, *Report of the Investment Income Task Force to the National Association of Insurance Commissioners* (Kansas City, Mo.: NAIC).

Quirin, G. D. and W. R. Waters, 1975, Market Efficiency and the Cost of Capital: The Strange Case of Fire and Casualty Insurance Companies, *Journal of Finance,* 30: 427-445.

Reilly, Frank K. and Rupinder S. Sidhu, 1980, The Many Uses of Bond Duration, *Financial Analysts Journal,* 36(4): 58-72.

Skelton, Jeffrey L., 1983a, Relative Risk in Municipal and Corporate Debt, *Journal of Finance,* 38: 625-634.

Skelton, Jeffrey L., 1983b, Banks, Firms, and the Relative Pricing of Tax-exempt Bonds, *Journal of Financial Economics,* 12: 343-355.

Taylor, Greg, 1994, Fair Premium Rating Methods and the Relations Between Them, *Journal of Risk and Insurance,* 61: 592-615 .

Walker, Robin, 1991, Do Taxes Matter? The Case of the Property-Casualty Insurance Industry, Ph.D. Dissertation, University of Texas at Austin.

Williams, C. Arthur Jr., 1983, Regulating Property and Liability Insurance Rates through Excess Profits Statutes, *Journal of Risk and Insurance,* 50: 445-472.