

The Effect of Income Taxes on Optimal Portfolio Selection

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The advantages of investing in tax-deferred retirement plans are well known. The ability to defer income tax on both the periodic contributions and the annual returns to assets in the plan provides a significant wealth-building advantage over nontax-deferred investments (Simonds [1986]). In addition, it often is suggested that income and the marginal income tax rate may be lower in the retirement years, thus offering another advantage. However, given aggressive investing and a continuation of historic rates of return, it is possible that both income during the retirement years and the effective income tax rate will be higher than in the working years. Consequently, part of the additional expected return to taking greater risk may be lost due to higher marginal tax rates.

This article demonstrates that efficient (i.e., utility-maximizing) portfolio design must consider the potential of higher average and marginal income tax rates in retirement; failure to do so may result in a below-optimal mix of investment assets. In particular, such failure may lead to overinvestment in higher-risk assets, such as common stock. Equivalently, the investor could improve his economic welfare position by reducing the risk and the expected return on his qualified plan assets.

This issue has received little attention in the financial literature. Randolph and Rogers [1995] argue that uncertainty surrounding tax policy is inevitable but often ignored. While their focus is on the uncertainty about the tax

structure itself, our focus is on the impact of ignoring what taxable income will be in the future, and, hence, the effect of what marginal tax rate from a given tax structure will apply. Chang's study [1996] of the differential sensitivity among income classes to the 10% tax penalty for not rolling over pension distributions is only tangentially related, but does emphasize the role of tax structure in investment decision-making.

TAX CONSIDERATIONS FOR INVESTING IN QUALIFIED PLANS

This section sets the stage for demonstrating that 1) average and marginal tax rates easily could be higher during the retirement-withdrawal period than during the work-accumulation period, and 2) if these higher tax rates are not anticipated, the structure of the investment portfolio during the accumulation period may not be efficient. The analysis is made in the context of a self-employed, high-income individual investing within the framework of a money purchase Keogh plan. Such plans limit annual contributions to the smaller of \$30,000 or 25% of a self-employed person's annual compensation.¹ Assuming the maximum contribution, an annual net income of \$160,000 will generate a \$30,000 Keogh plan investment. Assume the investor is married with, say, two children and has \$15,000 in itemized deductions; total taxable income will be \$97,356,² and, thus, the marginal federal

income tax rate for 1999 on the last \$54,306 of taxable income is 28%. Had the Keogh contribution not been made, the taxable income is \$127,356 and \$23,306 would be taxed at 31%.

Consider a zero inflation world where the expected rate of return on a long-term, fixed-income investment (i.e., bonds) is 4% per year and the expected return on common stock (with commensurately greater risk) is 7%. Further assume that real income remains constant, the \$30,000 contribution is made each year beginning at age 30, and the plan assets are all invested in common stock. By age 60, the expected accumulation is \$2,833,824, and at 65 the fund is expected to reach \$4,147,106. At retirement, the entire amount is switched to bonds; based on a 20-year payout, the expected annual retirement payment is \$181,399 if retirement occurs at age 60 and \$305,151 for retirement at 65.³

Assuming the current federal income tax structure remains the same, by age 65, the marginal tax rate on these payments will be at least 36% on the lower annual benefit and 39.6% on the higher payment. For most at this stage in life, the children are grown, the mortgage is paid off, and if retirement has taken place, the Keogh contribution is no longer being made; therefore, not only is income higher in the retirement years, but taxable income can be expected to be a significantly higher proportion of total income. Further, it is likely that other income-producing assets have been accumulated and that Social Security payments are being received; thus, total family income would be greater than just the annual Keogh benefit.

Thus, under these assumptions, during the accumulation period the marginal dollar of income contributed to the qualified plan is being sheltered from a tax rate of 31%, but that marginal dollar will be taxed at 36% or 39.6% when it is withdrawn during the distribution period. It is submitted that some, perhaps many, do not realize this,⁴ and, therefore, may not have an appropriate mix of assets in their retirement portfolio.

Furthermore, potential estate taxes also must be considered. In the event of death, a surviving spouse can receive an unlimited estate free of taxes, but if the spouse is no longer living, the entire estate (less the exclusion) is subject to estate taxes ranging from 37% to 55% and includes all assets remaining in any tax-deferred plan, which also are subject to income tax upon their distribution. On an estate of over \$3 million, such as that in the example, the marginal estate tax rate is 55%.⁵ When the income tax is added, the overall tax rate on that part of the estate in a qualified plan easily could be 75%. In

that case, most or all of the higher returns associated with risk-taking will have been lost.

Thus, while saving and investing in qualified plans provides a significant tax shelter during the working years, it is clear that average and marginal income tax rates during the retirement period can be higher than during the working period. The usual notion that retirement income will be taxed at lower rates than working income simply is not true for the high-income person who invests aggressively and consistently in a tax-deferred plan. If the higher tax rate is not anticipated, the expectation of after-tax retirement income will be overestimated, and, as demonstrated below, the individual probably will not have invested in an efficient portfolio in the sense that more risk was assumed than was necessary.

INVESTMENT STRATEGY

The expected after-tax retirement income for a higher-risk portfolio will always be higher than that of the lower-risk portfolio. However, the investor should be aware that if higher average and marginal tax rates apply, a part of the return for taking additional risk may be lost to the higher tax rate. The effect is demonstrated in the following formalized example.

Consider an individual who makes a contribution (C) of \$30,000 each year for $T = 35$ years to a tax-deferred plan where there are two investment vehicles—a low-risk asset, A , with an expected annual real return of 4% (i.e., $r_A = 0.04$), and a high-risk asset, B , with an expected real return of $r_B = 0.07$. In the base case, all of the funds are invested in the low-risk asset. At the end of the accumulation period, the expected fund invested in asset A is

$$E(F_A) = C \left[\frac{(1 + r_A)^T - 1}{r_A} \right] = 30,000 \left[\frac{(1+0.04)^{35} - 1}{0.04} \right] = 2,209,567$$

This will generate an expected annual income of \$162,584 during an $N = 20$ -year distribution period, i.e.,

$$E(Y_A) = \frac{E(F_A)}{PVAF(N, r_A)} = \frac{\$2,209,567}{PVAF(20, 0.04)} = \$162,584$$

where $PVAF(N, r_A)$ is the appropriate present value annuity factor. For simplicity, assume this income represents total gross income for the family. The ordinary

EXHIBIT 1

Fund Balance, Annual Benefit, and Tax Effects of Alternative Investment Strategies

	Alternatives		
	A (Base)	B	C
Investment during accumulation period	Low-risk	High-risk	High-risk
—Rate of return	4.0%	7.0%	7.0%
Investment during distribution period	Low-risk	High-risk	Low-risk
—Rate of return	4.0%	7.0%	4.0%
Expectation of:			
—Fund at end of accumulation period	\$2,209,567	\$4,147,106	\$4,147,106
—Annual pretax income during distribution period	162,584	391,457	305,151
—Income tax	37,746	123,149	88,971
—Annual post-tax income during distribution period	124,838	268,308	216,180
—Average tax rate ^a	23.2%	31.5%	29.2%
—Marginal tax rate	31.0%	39.6%	39.6%
Ratio of:			
—Fund to base-case fund	1.00	1.88	1.88
—Pretax income during distribution period to base-case income	1.00	2.41	1.88
—Post-tax payment during distribution period to base-case income	1.00	2.15	1.73

^aIncome tax as a percentage of pretax income.

income tax on this amount based on the 1999 rate schedule is \$37,746 (assuming a joint return using the standard deduction and two personal exemptions),⁶ leaving a net after-tax income of \$124,838. The average and marginal tax rates are 23.2% and 31%, respectively. These data are summarized in Exhibit 1.

Alternatively, all the funds could be invested in the high-risk asset, and the expected fund value at the end of 35 years is $E(F_B) = \$4,147,106$. If the funds are maintained in the high-risk asset, during the withdrawal period, the expected annual withdrawal is $E(Y_B) = \$391,457$. This annual payment is higher than that in the base case by a factor of 2.41. This retirement income is subject to ordinary income tax of \$123,149, leaving an after-tax income of \$268,308, which is higher than that generated in the low-risk alternative by a factor of 2.15. Thus, taking additional risk through both the accumulation and distribution periods added 141% to pretax income but only 115% to after-tax income. (Again, these results are reported in Exhibit 1.)

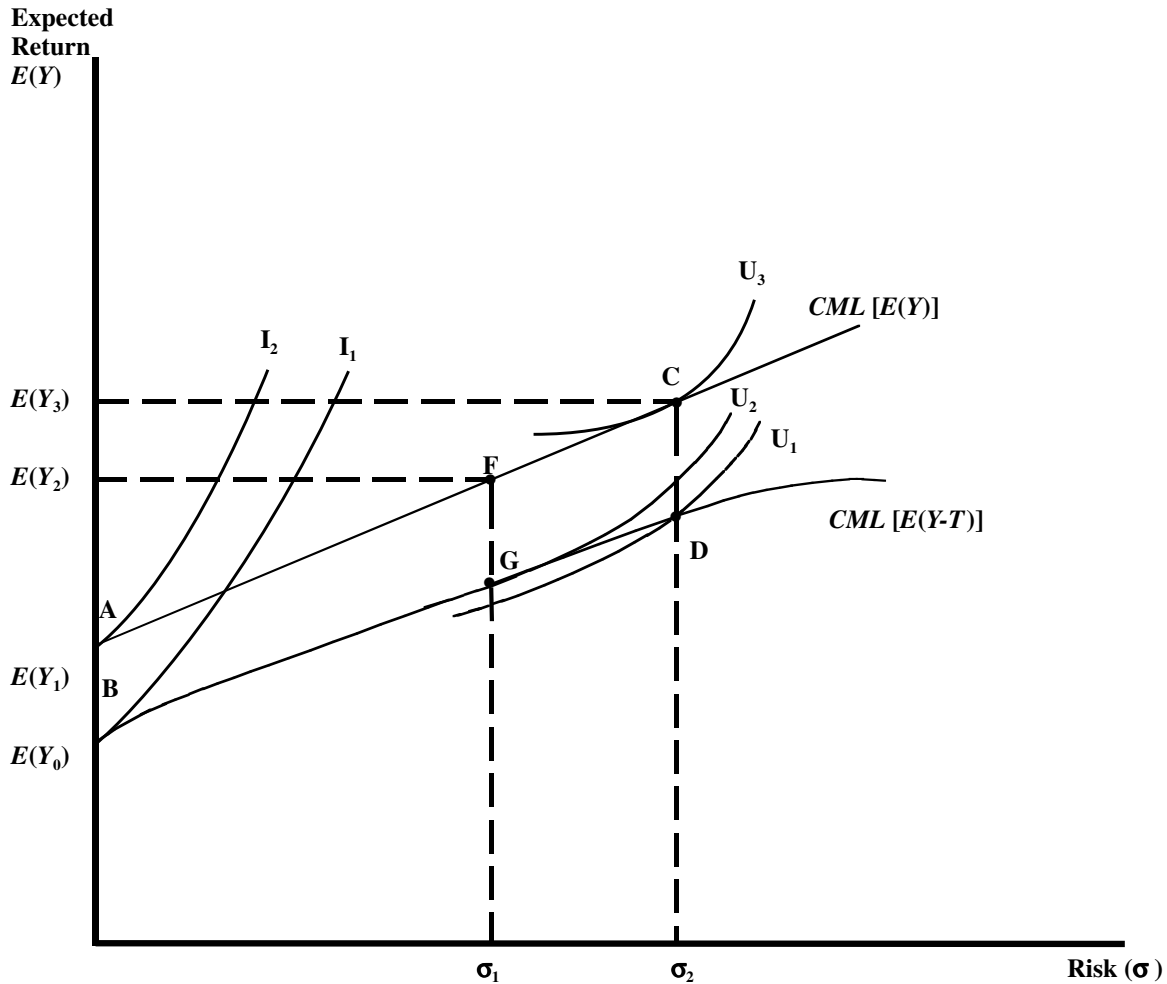
In the intermediate case (i.e., example C), the funds

are invested in the high-risk asset during the accumulation phase and then shifted to the lower-risk bond portfolio during the distribution phase. Here the \$4.1 million fund at retirement generates an annual pretax retirement payment of \$305,151, or 88% more than under the base alternative. However, after-tax income is \$216,180 per year, or 73% more than under the base case. Again, the difference in the pre- and post-tax ratio reflects the loss due to a higher marginal tax rate during the distribution phase.

THE CONCEPTUAL BASIS FOR OPTIMAL PORTFOLIO DESIGN

If the objective is maximization of expected after-tax retirement income, then all retirement funds should be invested in the high-risk asset. However, in the more general case, the objective is utility maximization with its explicit consideration of the trade-off between risk and return; in general, this will dictate a different mix of assets. Specifically, if marginal tax rates are progressive, part

EXHIBIT 2
The Effect of Income Taxes on the Optimal Portfolio



of the additional expected return to taking greater risk will be lost to higher marginal tax rates. For some aggressive, high-income investors, it can be shown that the efficient portfolio should be structured to involve less risk than if the higher tax rates tax did not apply.

This analysis is depicted in Exhibit 2, where expected return $[E(Y)]^7$ is shown on the vertical axis, and risk (σ) is measured on the horizontal axis. The straight line $CML [E(Y)]$ is the capital market line or CML , showing the linear relationship between portfolio risk and return on a pretax basis.⁸ Line $E(Y - T)$ shows the expected return after ordinary income tax (T) and is nonlinear to reflect the progressive nature of the income tax system.

Consider a very risk-averse investor for whom two indifference curves, I_1 and I_2 , are shown. This person only

invests in the risk-free asset (e.g., Treasury bills) and generates a relatively small fund and pretax retirement income, $E(Y_1)$, at point A and post-tax income $E(Y_0)$ at point B. Here the effect of taxes would not be a significant factor in the design of the optimal portfolio because the aversion to risk is so extreme that only the lowest-risk asset is purchased in any event.⁹

The analysis is more interesting and more general for the less risk-averse person whose indifference mapping is depicted by curves U_1 , U_2 , and U_3 . Assume here that the objective is utility maximization and that the investor is naive about the potential tax effects on retirement income (i.e., the possibility that expected average and marginal tax rates will be higher in the distribution phase than in the accumulation phase). He chooses to take risk (σ_2) , and

EXHIBIT 3

Comparison of Consumption^a During Work Period and Retirement Period for Various Combinations of Contribution Rate and Asset Mix

Contribution Rate to Qualified Plan	Asset Mix		
	100% Bonds	50% Bonds/ 50% Common Stock	100% Common Stock
0.0% (\$0)	\$124,760 ^b 0 ^c (0%) ^d	\$124,760 0 (0%)	\$124,760 0 (0%)
6.25% (\$10,000)	\$117,860 47,970 (40.7%)	\$117,860 69,553 (59.0%)	\$117,860 102,690 (87.1%)
12.50% (\$20,000)	\$110,960 87,143 (78.6%)	\$110,960 128,423 (115.7%)	\$110,960 188,239 (169.6%)
18.75% (\$30,000)	\$104,060 124,838 (120.0%)	\$104,060 182,286 (175.2%)	\$104,060 268,308 (257.8%)

^aConsumption is defined as income less federal income tax.

^bConsumption per year during work-accumulation period.

^cConsumption per year during retirement-distribution period.

^dReplacement ratio—retirement-period consumption relative to work-period consumption.

expects pretax income of $E(Y_3)$; that is, he expects to be at point C on indifference curve U_3 . But the effect of the ordinary income tax actually puts him at point D on U_1 . For this person, a higher level of utility (U_2) could be achieved by a less risky portfolio (i.e., one in which common stock accounted for a smaller share of the portfolio) that, on an after-tax basis, would put him at point G on U_2 . On a pretax basis, the optimal risk–return combination is at point F with risk of $(\sigma_1$ and expected pretax income $E(Y_2)$ and not the combination $(\sigma_2, E(Y_3))$. Failure to achieve the optimal risk–return portfolio stems from the failure to account for higher expected marginal tax rates.

TIME-PATH OF CONSUMPTION

For a given income level, the contribution rate to the qualified plan and the risk accepted in the portfolio determine the path of consumption over the lifetime. Given the same basic assumptions used above¹⁰ and apply-

ing the federal tax rates for 1999, the time–path of consumption is determined. The key data on annual consumption during the work years and the retirement years (and the replacement ratio at retirement) for various contribution rates are shown in Exhibit 3.

Clearly, the relative level of retirement consumption depends on the individual (or family) preference for risk combined with the contribution rate. Taking the most aggressive route by maximizing both the contribution rate and risk yields a retirement level of consumption that is more than 2.5 times the consumption during the work period. In contrast, the least aggressive approach where there is some contribution (6.25% of income or \$10,000 per year invested in bonds) yields a replacement ratio of 40.7%.

A more realistic alternative assumes that the individual wants to replace 75% to 90% of consumption during the work period. From the examples provided in Exhibit 3, this could be achieved with a 6.25% contribution rate and 100% investment in common stock (i.e.,

yielding an 87.1% replacement rate) or with a 12.5% contribution rate and a bond-only portfolio. For a portfolio split evenly between bonds and stock, a 9% contribution rate would generate an 85% replacement ratio.

As a reasonably consistent pattern of consumption over the lifetime may be a paramount goal, this can be achieved with a contribution rate of about 6% to 13%, depending on the mix of assets selected. Social security taxes and benefits have been ignored in this analysis, but obviously they would have the effect of reducing consumption during the work years and increasing it during the retirement period. Given the mix of contribution rates and risk just discussed, Social Security benefits could be expected to bring the replacement ratio to about 100%, thus providing an approximately constant level of real consumption over the entire lifetime.

SUMMARY

There is no question that investing for retirement in a qualified plan is a powerful wealth-building technique. The ability to shelter both current income and annual returns from both state and federal income taxes greatly increases the value of funds so invested over the use of after-tax income in nonsheltered accounts. High-income persons who invest in higher-risk assets can expect to accumulate large balances; indeed, for the aggressive high-income investor, it is not unusual for pretax retirement income to exceed working income at the normal retirement age.

However, all of the assets in a qualified plan ultimately will be subject to federal and state income taxes and, in some cases, estate taxes as well. These taxes are significantly progressive, and, effectively, they reduce the return to risk-taking. Failure to consider their ultimate effects probably will result in a suboptimal portfolio of assets during both the accumulation and distribution phases. In general, failure to consider these progressive taxes will result in the portfolio being overinvested in the high-risk asset.

Being able to reduce the current tax burden on income by sheltering the contribution and the future tax burden on returns on the investment until retirement is quite seductive. Clearly, a high marginal tax rate on current income is an incentive to seek out vehicles for tax avoidance and/or tax deferral. Historically, some have invested in high-risk tax shelter plans or schemes, including cattle feeding, oil drilling, and real estate development in order to take advantage of quirks in the tax code.

Many of these programs turned out to be poor investments, some were outright frauds, and more than a few ended up providing neither a return on the investment nor the tax deduction, as the latter subsequently was disallowed. While much of this has been eliminated by various tax law changes, the history does confirm a degree of irrationality among some investors who let tax considerations override good investment principles.

Thus, it is submitted that at least some investors either: 1) overestimate the tax advantages of a qualified plan; and/or 2) underestimate the tax rates that will apply to income during the retirement period. One probable result of either is to overinvest in the qualified plan and to overweight the investments with higher-risk assets.

The introduction of the Roth IRA, which allows for investing after-tax dollars in a retirement account with no taxation of returns in the future, adds a new dimension to the complexity of decision-making for many investors. As our focus is on high-income investors who would not be eligible to use the Roth vehicle, we have ignored this option. However, there is no question that its availability to other investors may offer a mechanism for hedging against the uncertainty of the effective tax rate on distributions from qualified retirement plans. Of course, not all uncertainty is removed; Congress could change the rules in the future, making all or part of the returns taxable!

ENDNOTES

¹The Roth IRA option is ignored because the income level for the hypothetical investor exceeds the IRS limit of approximately \$160,000.

²Based on 1999 law, taxable income would be \$160,000 less a personal exemption of \$2,750 per family member, itemized deductions of \$15,000, the \$30,000 Keogh contribution, and one-half of the self-employment tax on \$160,000 or \$6,644.

³The retirement benefit is calculated as the annual payment forthcoming from a fund of the specified size invested at 4% per year that will be exhausted at age 85.

⁴As indicated earlier, one reason for this is that retirement brochures often suggest that the income tax rate will be lower after retirement.

⁵Prior to the 1997 tax law changes, there was a tax penalty on excess accumulations in qualified plans upon the death of the owner. Specifically, for 1997, a 15% excise tax (above any other estate taxes that would be due) was imposed on amounts that exceeded the present value of a hypothetical life annuity of \$160,000. Further, no credits or exclusions that would otherwise reduce or eliminate the ordinary estate tax were allowed. The excise tax on a \$4 million accumulation depended on the current interest rate on Treasury securities;

in 1997, this excise tax would have been about \$412,000.

⁶The effect of the phaseout of the exemptions and standard deduction has been ignored.

⁷In the context of this article, expected return is defined as the annual payment generated at retirement.

⁸For more explanation, see Copeland and Weston [1988].

⁹For example, using the same factors as before, except that a real rate of return of 2% is assumed for a Treasury bill investment, the fund would be \$1,499,834 at the end of the 35-year accumulation period; this would generate an annual pretax and post-tax income of \$91,724 and \$71,397, respectively.

¹⁰That is, a 35-year worklife, 20 years of retirement, real rates of return of 7% on common stock and 4% on bonds, and an income level of \$160,000 per year.

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