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The Optimal Allocation of Pension Fund Assets: An Individual's Perspective

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This study asks which assets an individual should hold indirectly in a pension in order to maximize total portfolio return, where the total portfolio consists of assets held directly outside of pensions plus the pro rata share of pension assets. The answer depends upon whether the individual actively or passively manages the nonpension portion of the total portfolio. Most individuals should place high-yield stocks in the pension fund. But active investors should place low-yield growth stocks in the pension, while very passive investors should place bonds in the pension fund. Reinstatement of capital gains exclusion would usually make corporate bonds the optimal pension asset.

I. Introduction

What is the optimal allocation of pension fund assets? The answer depends in part upon the objective function. Bicksler and Chen (1985), Black (1980), Tepper (1981), and Sharpe (1976) take the perspective that it is to optimize the share price of the sponsoring corporation. Others look to achieve a mean-variance efficient portfolio.

This study takes the broader perspective of an individual or employee who considers pension assets as only part of a total portfolio of pension and nonpension assets. Tax structures influence the allocation of assets between pension and nonpension portions of the portfolio. The pension tax structure is almost always the preferred structure. However, penalties for withdrawing funds from pensions before retirement and limitations on the amount of funds that can be tax-deferred discourage individuals from placing all assets in pension tax structures. Most individuals must decide which assets best utilize the pension tax structure. The critical decision for these individuals is whether to hold common stocks or bonds in the pension fund.

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The answer depends upon whether *the individual* actively or passively manages the nonpension portion of the total portfolio. Most individuals should place stocks, especially high-yield stocks, in their pension fund. Active investors should place low-yield growth stocks in their pensions, and very passive investors should place bonds in the pension fund.

II. Basics of Tax Structures

Pension tax structures generally have three advantages and one potential disadvantage when compared to nonpension tax structures. The first advantage is the tax-deferral of the investment amount until withdrawal.[1] The second is the tax deferral until withdrawal of investment return—interest, dividends, and capital gains. The third advantage stems from the common expectation that individuals will be in lower tax brackets upon retirement.

A potential disadvantage is present due to a possible reinstatement of a capital gains exclusion; under a pension tax structure all capital gains are taxed upon withdrawal, while capital gains realized outside of a pension could benefit from the exclusion.

III. The Setting

We assume that at any time there is an optimal allocation of each individual's total portfolio among debt, stocks, real estate, and other assets, and that all funds are to be held for post-retirement use. The allocation of funds varies among individuals according to risk-return preferences, desired investment horizons (Reichenstein, 1986), and other factors. Given this asset allocation decision and government constraints that effectively prevent all assets from being held in pensions, the question becomes which assets should be held indirectly in pension funds. The optimal strategy is defined as the one that maximizes total portfolio after-tax return. The pension should contain assets that maximize the difference between assets' after-tax returns if held in pensions and after-tax returns if held in nonpension accounts.

Three factors that influence the size of this after-tax returns differential include: the annual before-tax return on the asset, the proportion of the annual returns in the form of capital gains, and the speed with which capital gains are realized. The last two factors are important when one considers that unrealized capital gains do not benefit from the pension tax structure. Consider, for example, a long-term investment in gold that is held passively until retirement. The tax on returns is identical whether the asset is held in a pension account or not. Thus unrealized capital gains in a nonpension account have the same tax advantages as a pension asset.[2]

This raises the question whether debt or equity best captures the advantages of the pension tax structure. Do higher returns on stocks more than offset the fact that part of their returns can be in the form of unrealized capital gains?

The analysis in this paper indicates that most individuals maximize total portfolio after-tax returns by placing common stocks, especially high-yield stocks, in the pension fund. The higher returns on high-yield stocks compared to debt are expected to more than offset the fact that some of the return can be in the form of unrealized capital gains. Exceptions to this rule would be individuals who either very actively or very passively manage the common stock portion of their nonpension portfolio.

IV. Models of Pension and Nonpension Tax Structures

Ferris and Reichenstein (1988) present a flexible model of the after-tax value of an investment that is based on earlier work by Doyle (1984). By changing parameters, the model can reflect after-tax returns on the same asset whether held in a pension or nonpension account. The asset that maximizes the difference between these annual returns is the one that benefits most from the pension tax structure.

The model assumes an initial $1 investment of after-tax funds and i percent annual before-tax return on investment, with g percent of the i percent returns in the form of capital gains.[3] The proportion of capital gains realized annually is p. We assume a tax rate of t in all years before withdrawal, t_w in the year of withdrawal, an n-year investment horizon, and deposit and withdrawal of funds on January 1.

The after-tax value of an original $1 investment in an asset held in a nonpension account, V_n, is:

$$V_n = (1 + r)^n - t_w(1 - p)g_i[\{(1 + r)^n - 1\}/r] \tag{1}$$

where $r = (1 - t_p)g_i + (1 - t)(1 - g)i$.

The investment grows at r percent annually for n years. The product $(1 - g)i$ is the current income (dividends or interest) of the asset, so $(1 - t) \cdot (1 - g)i$ represents the after-tax amount of current income. The capital gains portion of annual returns is g_i. Tax on realized annual returns is thus $t_p g_i$, and the after tax amount of realized and unrealized capital gains is $(1 - t_p)g_i$. Thus r is the sum of the after-tax returns in the form of current income and capital gains.

The product to the right of the first minus sign in Equation 1 represents taxes upon withdrawal in year n on the accumulation of unrealized capital gains. The product g_i is the capital gains portion of annual returns, and the dollar amount of each year's unrealized capital gains is the product of $(1 - p)g_i$ and

the beginning-of-year investment amount. Unrealized gains are $\$(1 - p)g_i$ in year 1, and grow with the beginning-of-year investment amount at r percent annually. The expression in brackets is based on the future value of an annuity formula.

Average annual after-tax returns on a nonpension asset are

$$R_n = V_n^{1/n} - 1 \tag{2}$$

Returns on a pension asset are tax-deferred until withdrawal. The after-tax value of an asset in a pension account, V_p, is

$$V_p = (1 + i)^n - t_w[(1 + i)^n - 1] \tag{3}$$

The asset accumulates tax-free at the before-tax rate i until withdrawal in n years. The amount to the right of the minus sign represents taxes at rate t_w on accumulated returns, which is the full amount of the withdrawal less the original \$1 investment.

Average annual returns on the pension asset are

$$R_p = V_p^{1/n} - 1 \tag{4}$$

The tax advantage of holding an asset in a pension account over holding it in a nonpension account is negatively related to the unrealized capital gains on the asset. When all returns are in the form of capital gains ($g = 1$) and no gains are realized until retirement ($p = 0$), there is no advantage to holding the asset in a pension; that is, Equations 1 and 3 are identical for assets with $p = 0$ and $g = 1$. The difference between the returns on pension and nonpension assets ($R_p - R_n$) is positively related to the before-tax return i and the asset turnover rate p, and negatively related to the capital gains proportion g.

V. Analysis

The optimal assets to place in the pension fund vary with the assumed asset turnover rates p in the nonpension portfolio. First we consider an investor with perhaps "typical" asset turnover rates, then investors practicing more active and more passive nonpension portfolio management strategies.

Average Investor

Table 1 indicates the additional returns many investors can expect from holding assets in a pension instead of a nonpension account. The before-tax expected returns on Treasury and corporate bonds are the approximate yields-

TABLE 1.
Returns Differentials for "Typical" Investors

				$R_p - R_n$		
Asset	i	g	p	$n = 5$	$n = 15$	$n = 30$
Treasury bond	0.087	0.00	*	0.0067	0.0114	0.0158
Corporate bond	0.100	0.00	*	0.0081	0.0140	0.0191
High-yield stock	0.129	0.38	0.6	0.0098	0.0172	0.0227
Average-yield stock	0.150	0.81	0.5	0.0085	0.0151	0.0195
Zero-yield stock	0.163	1.00	0.4	0.0064	0.0115	0.0146
Gold	0.131	1.00	0.00	0.0000	0.0000	0.0000

Assumption: $t = 0.28$, $t_w = 0.23$

Notes: * Any asset turnover rate p produces the same result.

The returns differential, $R_p - R_n$, is the difference between the n-year average annual after-tax returns from holding an asset in a pension tax structure versus a nonpension structure. Before-tax annual returns are i, and g percent of the i percent returns is assumed to be in the form of capital gains. The annual portfolio turnover rate is p. The tax rate in the year in which funds are withdrawn from the pension is t_w, and t is the tax rate in prior year.

to-maturity at the time of this writing. The expected returns on high-yield stocks, average-yield stocks, and zero-yield stocks are based on a 6.3 percent market risk premium and average Value Line betas of 0.67 for utility stocks, 1.0 for average stocks, and 1.2 for zero-yield stocks.[4] Expected returns on gold are based on an average beta of 0.70 for gold stocks.

Investment horizons of 5, 15, and 30 years are considered to represent individuals with short-, intermediate-, and long-term investment horizons before the funds will be withdrawn from pension accounts. The planned investment horizon depends upon the time before funds will be withdrawn, which usually will exceed the years before retirement. A 55-year old investor expecting to withdraw funds uniformly between ages 65 and 75 has a 15-year average investment horizon.

The 28 percent tax rate in years before withdrawal reflects current marginal federal tax rates for many individuals. The 23 percent rate upon withdrawal is slightly below tax rates in prewithdrawal years and offers some tax timing benefit for all pension assets and the unrealized capital gains on nonpension assets.

The proportion of returns in the form of capital gains g varies from zero, which reflects most debt instruments, to 1.0, which reflects investments in zero-yield stocks, gold, coins, art, and many other real assets.[5] The capital gains proportions for high-yield and average-yield stocks are based on Value Line expected dividend yields on utility stocks and the average stock, respectively.

Table 1 uses turnover rates that may reflect those of an average investor. Financial theory and empirical evidence indicate that the presence of unrealized capital gains tends to lock an investor into an asset.[6] The tax structure has encouraged a slower realization of gains on assets with substantial capital gains benefits, and elimination of the 60 percent long-term capital gains exclusion will only strengthen this tendency. The structure of secondary markets for most low-yield assets—e.g., art, coins, real estate—also contributes to the negative association between g and p. The values of the asset turnover rates p in the tables reflect these influences.

Table 1 indicates for this "typical" investor that the advantages of the pension tax structure are greatest for high-yield stocks, followed by average-yield stocks and corporate bonds. Higher returns on high-yield and average-yield stocks compared to bonds are expected to more than offset the fact that part of the returns is in the form of unrealized capital gains. The order of asset preference is not affected by the investment horizon, but the relative advantage of high-yield stocks over bonds increases with the length of the investment horizon.

Assets with low current yields and/or slow turnover rates such as gold, art, undeveloped real estate, and, to a lesser degree, low-yield stocks do not receive as large a benefit from the pension tax structure. The gold example confirms that passively held assets ($p = 0$) yielding no current income ($g = 1.0$) do not benefit from the pension tax structure. Individuals should keep assets with a substantial portion of return expected to accrue as unrealized gains in the nonpension portion of their portfolio.

Active Investor

We have noted that the decision on the optimal assets to place in the pension fund depends in part on the speed with which capital gains in the nonpension portfolio will be realized. Consider the extreme example of an individual with very actively managed stocks and bonds in the nonpension portfolio, i.e., $p = 100$ percent. The top half of Table 2 shows that this individual maximizes the total portfolio expected return by holding the highest return, and thus highest risk, securities in the pension fund. High risk stocks are the optimal pension asset for this individual; in the table, these are zero-yield (e.g., growth) stocks, reflecting the negative correlation between dividend yields and beta risk.[7]

The bottom half of Table 2 shows that an investor practicing a 70 percent annual stock turnover rate should hold stocks instead of bonds in the pension fund. The highest differential $R_p - R_n$ exists for the riskiest zero-yield stocks, but the differentials for all the stock categories are roughly comparable. The major conclusion to be drawn from Table 2 is that active investors should place stocks, especially higher risk growth stocks, in the pension fund.

TABLE 2.
Returns Differentials for Active Investors

				$R_p - R_n$		
Asset	*i*	*g*	*p*	*n = 5*	*n = 15*	*n = 30*
Treasury bond	0.087	*	1.0	0.0067	0.0114	0.0158
Corporate bond	0.100	*	1.0	0.0081	0.0140	0.0191
High-yield stock	0.129	*	1.0	0.0114	0.0201	0.0266
Average-yield stock	0.150	*	1.0	0.0141	0.0249	0.0322
Zero-yield stock	0.163	*	1.0	0.0158	0.0279	0.0357
Treasury bond	0.087	0.00	*	0.0067	0.0114	0.0158
Corporate bond	0.100	0.00	*	0.0081	0.0140	0.0191
High-yield stock	0.129	0.38	0.7	0.0102	0.0179	0.0237
Average-yield stock	0.150	0.81	0.7	0.0107	0.0191	0.0246
Zero-yield stock	0.163	1.00	0.7	0.0112	0.0198	0.0253

Notes: * Any value produces the same result.

The returns differential, $R_p - R_n$, is the difference between the n-year average annual after-tax returns from holding an asset in a pension tax structure versus a nonpension structure. Before-tax annual returns are i, and g percent of the i percent returns is assumed to be in the form of capital gains. The annual portfolio turnover rate is p. The tax rate in the year in which funds are withdrawn from the pension is t_w, and t is the tax rate in prior year.

Yaari and Fabozzi (1985) are puzzled by the evidence that roughly half of equity funds under IRA or Keogh plans are in growth funds. This allocation is rational for active investors; the higher returns from these high risk stocks translates into larger expected tax benefits from the pension tax structure.

Passive Investor

Table 3 shows that investors practicing passive investment strategies in their nonpension portfolios should keep corporate bonds or high-yield stocks in their pension fund. The top half of the table indicates that extremely passive investors ($p = 0$) should place first corporate bonds followed by high-yield stocks and Treasury bonds in the pension fund. Average-yield stocks and low-yield stocks as well as gold, art, and undeveloped real estate should be held directly in the nonpension account.

The lower half of the table indicates that a relatively passive investor ($p = 0.3$) should place first high-yield stocks and then corporate bonds in the pension account. The $R_p - R_n$ values for high-yield stocks and bonds are roughly comparable. This investor should place real assets and low-yield stocks in the nonpension portfolio.

TABLE 3.
Returns Differentials for Passive Investors

				$R_p - R_n$		
Asset	i	g	p	$n = 5$	$n = 15$	$n = 30$
Treasury bond	0.087	1.00	*	0.0067	0.0114	0.0158
Corporate bond	0.100	1.00	*	0.0081	0.0140	0.0191
High-yield stock	0.129	0.38	0.0	0.0076	0.0127	0.0168
Average-yield stock	0.150	0.81	0.0	0.0027	0.0049	0.0063
Zero-yield stock	0.163	1.00	0.0	0.0000	0.0000	0.0000
Treasury bond	0.087	1.00	*	0.0067	0.0114	0.0158
Corporate bond	0.100	1.00	*	0.0081	0.0140	0.0191
High-yield stock	0.129	0.38	0.3	0.0093	0.0150	0.0198
Average-yield stock	0.150	0.81	0.3	0.0062	0.0111	0.0143
Zero-yield stock	0.163	1.00	0.3	0.0049	0.0087	0.0110

Notes: * Any asset turnover rate p produces the same result.

The returns differential, $R_p - R_n$, is the difference between the n-year average annual after-tax returns from holding an asset in a pension tax structure versus a nonpension structure. Before-tax annual returns are i, and g percent of the i percent returns is assumed to be in the form of capital gains. The annual portfolio turnover rate is p. The tax rate in the year in which funds are withdrawn from the pension is t_w, and t is the tax rate in prior year.

Critical Turnover Rates

Table 4 shows the asset turnover rate that equates $R_p - R_n$ for each stock category with $R_p - R_n$ for corporate bonds by investment horizon. Take the five-year investment horizon as an example. With a 19 percent annual turnover rate, the differential for high-yield stocks equals the corporate bond differential. This indicates that individuals should place corporate bonds in the pension portfolio instead of high-yield stocks only if they expect to realize less than 19 percent of the stocks' capital gains annually. The table shows that only the more passive individuals should keep corporate bonds instead of high-yield stocks in the pension fund.

Table 4 indicates furthermore that individuals practicing slower asset turnover rates (e.g., $p < 0.5$) generally will benefit more from placing bonds instead of average- or low-yield stocks in their pension fund. More active investors ($p > 0.5$) generally will benefit more by placing average- or low-yield stocks before corporate bonds in their pension fund.

The length of the planned investment horizon has little effect on the asset that expects to benefit most from pension tax treatment. Of course, the effect of a given $R_p - R_n$ differential on retirement wealth increases with the planned investment horizon. This suggests that, other things the same, the tax benefits

TABLE 4.
Critical Asset Turnover Rates

	Planned Investment Horizon		
Asset	*5*	*15*	*30*
High-yield stock	0.19	0.17	0.23
Average-yield stock	0.47	0.44	0.48
Zero-yield stock	0.47	0.49	0.55

Note: A critical turnover rate is the annual turnover rate in the nonpension portfolio that equates the expected tax benefits of the pension tax structure for each stock category with the benefits for corporate bonds. If the annual turnover rate on the stock portion of the nonpension portfolio is expected to be less than the critical rate, corporate bonds are expected to benefit most from the pension tax structure. At higher turnover rates, stocks are expected to benefit most from the pension tax structure.

we point out are more important for individuals who are further from retirement.

Finally, Figure 1 illustrates the sensitivity of the returns differential to the nonpension portfolio turnover rate. The turnover rate is most important for zero- (or low-) yield stocks. This returns differential is zero for the extreme buy-and-hold strategy, $p = 0$. At the other extreme, $p = 1$, there are no unrealized gains and all returns are taxed annually. The high risk on low-yield stocks implies that active investors are expected to receive the largest tax advantage on low-yield stocks.

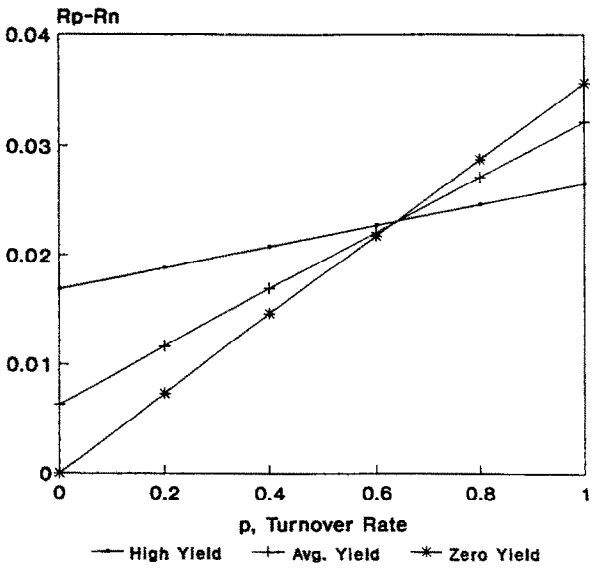

Figure 1. Sensitivity of returns diferentials to turnover rates. Assumptions: $t = 0.28$, $t_w = 0.23$, $n = 30$, and i and g values from table.

The slopes on the average- and high-yield stocks in the graph are positive but flatter than for zero-yield stocks. The slopes reflect the lower potential for unrealized capital gains due to both higher dividends and lower returns.

Sensitivity to Assumptions

The values in the tables are based on specific tax rates. Simulations not reported here, however, indicate that the investment implications prevail for a wide range of possible tax rates.

The table values also assume that an average stock will produce 6.3 percent higher before-tax returns than Treasury bonds, and 5 percent higher returns than corporate bonds. Reducing these assumed risk premiums would improve the relative position of bonds in the pension fund. Yet, there are reasons to believe that the average stock will promise more than a 5 percent risk premium over corporate bonds—the bonds discussed most prominently in the analyses. The 10 percent returns on corporate bonds assume no loss from default. If expected returns after allowance for default risk on corporate bonds equal the Treasury rate, then stocks almost always will be the preferred asset in the pension fund.[8]

Recent studies by Ferris and Reichenstein (1988) and Yaari and Fabozzi (1985) provide further evidence that high-yield stocks are often the optimal asset to place in the pension portfolio. They conclude that there exists a yield-tilted risk-return plane: high current yield assets offer higher before-tax returns for a given level of risk than low-yield assets. Ferris and Reichenstein argue that the capital gains tax advantages remaining after passage of the Tax Reform Act should produce the yield-tilt. They estimate this yield-tilt to be about half as strong as before elimination of the 60 percent capital gains exclusion. Yaari and Fabozzi also conclude that the risk-return plane is yield-tilted, but for different reasons.

If the risk-return plane is yield-tilted then the expected returns in the tables on high-yield stock, and to a lesser extent average-yield stock, are too low. Expected returns on bonds are based on yields-to-maturity and already reflect this premium, if it exists. This implies that the expected benefits of placing high-yield and average-yield stocks in the pension fund may be greater than the analysis in this paper suggests.

VI. Capital Gains Exclusion

The table values assume the absence of a long-term capital gains exclusion. Although this reflects the current tax code, there is discussion of reinstituting a capital gains exclusion. Nonpension assets enjoy the benefit, but assets held

TABLE 5.
Returns Differentials with Capital Gains Exclusion

				$R_p - R_{old}$		
Asset	i	g	p	$n = 5$	$n = 15$	$n = 30$
Treasury bond	0.087	0.00	*	0.0067	0.0114	0.0158
Corporate bond	0.100	0.00	*	0.0081	0.0140	0.0191
High-yield stock	0.129	0.38	0.6	0.0000	0.0107	0.0168
Average-yield stock	0.150	0.81	0.5	-0.0194	0.0003	0.0065
Zero-yield stock	0.163	1.00	0.4	-0.0262	-0.0064	-0.0004
Gold	0.131	1.00	0.0	-0.0306	-0.0101	-0.0060

Notes: * Any asset turnover rate p produces the same result.

The returns differential, $R_p - R_{old}$, is the difference between the n-year average annual after-tax returns from holding an asset in a pension tax structure versus a nonpension structure with 60 percent capital gains exclusion. Before-tax annual returns are i, and g percent of the i percent returns is assumed to be in the form of capital gains. The annual portfolio turnover rate is p. The tax rate in the year in which funds are withdrawn from the pension is t_w, and t is the tax rate in prior year.

in a pension do not receive this benefit. With this in mind, it is instructive to note how the exclusion affects the asset allocation decision. Table 5 shows returns differentials corresponding to Table 1, except that 60 percent of capital gains on nonpension assets are assumed to be tax free.

Addition of the capital gains exclusion produces several noteworthy changes. First, it becomes preferable to place corporate bonds instead of common stocks in the pension portfolio. Second, the exclusion tends to make the asset allocation decision more important than under the present tax structure; differences among returns differentials for bonds and stocks generally are substantially larger in Table 5 than under the current tax structure. Third, the pension tax structure is seldom the preferred structure for real assets, low-yield stocks, and average-yield stocks. Figure 2 illustrates this last point. For a 15-year investment horizon, it shows that the returns differential on zero-yield stocks is almost always negative, and the differential for average-yield stocks is negative for less active investors. A negative differential exists when the tax advantages of the capital gain exclusion exceed the advantages of the pension tax structure.

A comparison of the values in Tables 1 and 5 suggests that there may be a substantial increase in the demand for pension funds. Before the Tax Reform Act, many assets performed best under a nonpension tax structure. Under the current tax code, however, all assets we considered do at least as well, and often substantially better, if held in a pension fund.[9] In the absence of a capital gains exclusion, we expect substantial growth in tax-deferred annuities.

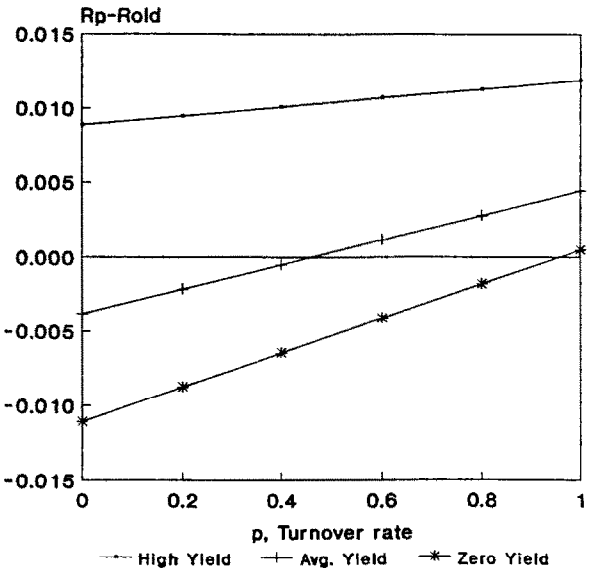

Figure 2. Returns differentials and turnover rates with 60 percent capital gains exclusions. Assumptions: $t = 0.28$, $t_w = 0.23$, $n = 15$ and i and g values from table.

VII. Summary and Implications

We have asked which assets an individual should hold indirectly in a pension in order to maximize total portfolio returns, where the total portfolio consists of assets held directly outside of pensions plus the pro rata share of pension assets. The answer depends upon whether the individual actively or passively manages the nonpension portion of the total portfolio.

Investors who practice annual common stock turnover rates of between about 20 and 50 percent can maximize the after-tax returns on the total portfolio by holding high-yield stocks, and then average-yield stocks and corporate bonds, in the pension portfolio. More active investors should place common stocks, especially low-yield growth stocks, in the pension fund. More passive investors should place high-yield stocks and corporate bonds in the pension fund, with the order of preference determined by their degree of passivity.

Reinstatement of a 60 percent capital gains exclusion would substantially change the optimal pension fund asset mix for most individuals by making corporate bonds the optimal pension asset. Further, the asset allocation decision generally would be more important than under the current tax code. Finally, in the presence of a capital gains exclusion many assets, especially real assets and low-yield stocks, prefer the nonpension tax structure.

Under the current tax code, almost all assets prefer the pension tax structure, and there is no regulatory limit on the amount of funds that can be

placed in tax-deferred accounts. What then stops individuals from placing (nearly) all their assets in tax-deferred accounts? One limiting factor is the 10 percent penalty tax on early withdrawals of pension funds. A second factor may be the failure by many individuals to recognize the comparative advantage of the pension tax structure in the absense of a capital gains exclusion. Unless a capital gains exclusion is reinstated, we expect substantial growth in the amount of funds in tax-deferred accounts.

It has been noted that pension managers are reluctant to purchase as much real estate and other real assets as their diversification benefits would suggest (Fogler, 1984; Brueggeman, Chen, and Thibodeau, 1984). We find in this study that this reluctance is well-justified. Individuals can take advantage of the current tax structure best by directly holding art, gold, real estate, and other assets with substantial capital gains potential in the nonpension portfolio. The relative absence of real estate in pension funds probably reflects fund managers' understanding that the major nonpension asset for most individuals is their personal residence.

Finally, our analysis supports the argument that individuals should be allowed to designate where funds in a defined contribution plan are invested. The optimal assets to place in the pension fund will depend upon individual characteristics, including individual risk-return preferences as well as individual management practices in the nonpension portfolio. There is no allocation of a defined contribution pension portfolio that will be optimal, or even approximately optimal, for all individuals.

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Notes

1. The portion of a withdrawal from a nondeductible IRA that represents repayment of the original investment is nontaxable.
2. This analysis ignores minor differences in the pension and nonpension tax structures. For example, the tax liability on the capital gain actually occurs at the withdrawal of funds from the pension, while it occurs with the sale of the nonpension asset. Second, the nonpension tax structure probably is preferable if an investor expects Congress to reinstitute a long-term capital gain exclusion for nonpension assets.
3. Pension investments usually are made with before-tax dollars, compared to the after-tax dollars invested in nonpension assets. The advantage of investing before-tax dollars is well documented, and, as a rule, individuals should take full advantage of this tax feature. For individuals who have maximized this benefit, however, there remains a valid question of which assets should be held indirectly in pensions. The model ignores some details of the tax code. For example, currently only $3,000 of net capital losses are deductible each year.
4. The 6.3 percent market risk premium is the approximate geometric average excess return of stocks less the Treasury bond rate since the mid 1920s. See Ibbotson and Sinquefield, 1982.

5. All returns from rolling over short-term debt and buying floating rate bonds are in the form of interest, $g = 0$. Bonds offer some capital gains benefits, but for the purposes of this analysis the assumption of $g = 0$ is a reasonable approximation.
6. Constantinides (1984) shows that the 60 percent long-term capital gains exclusion stimulated more rapid realization of long-term gains on volatile stocks. The remaining capital gains preferences since the Tax Reform Act will encourage slower realization of gains. The values of p in the table reflect the fact that the larger the unrealized capital gain, the greater the tendency to lock an asset into a portfolio. See, for example, Report to Congress on the Capital Gains Tax Reductions of 1978.
7. We exclude gold from the analysis because the secondary markets for gold and other low-yield real assets such as art, coins, and undeveloped real estate are not conducive to rapid turnover rates.
8. Historically, lower-rated bonds on average have produced a higher return net of default than highly-rated bonds. Despite this evidence, some financial economists argue that a bond's risk premium should be an unbiased estimate of the expected loss due to default.
9. An individual's personal residence is not one of the assets considered in this study, in part because it is illegal to hold it in a pension. Notice, however, that the one-time $125,000 capital gain exclusion and deductibility of interest favor holding it outside of a pension tax structure.

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