Asset Location for Retirement Savers

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ABSTRACT

This paper uses data on actual returns on taxable bonds, tax-exempt bonds, and a small sample of equity mutual funds over the 1962-1998 period to compare two asset location strategies for retirement savers who invest in equities through equity mutual funds. The first strategy, 'defer stocks first,' gives priority to holding equity mutual funds in a saver's tax-deferred account, while the second strategy, 'defer bonds first,' gives priority to holding fixed-income investments in the tax-deferred account. We consider high-income taxable individual investors who saved in each year and invested in one of the actively-managed funds in our sample. Over the thirty-seven year span that we consider, such investors would have accumulated a larger stock of wealth if they had held their actively-managed equity mutual fund in their tax-deferred account than if they had held the fund in a conventional taxable form. The explanation for this apparent contradiction of the often-stated 'bonds in the tax-deferred account' prescription has two parts. First, many equity mutual funds impose substantial tax burdens on their investors. This raises the effective tax rate on investing in equities through mutual funds rather than in a buy-and-hold personal portfolio. Second, taxable investors who wish to hold fixed income assets can do so either by holding tax-exempt bonds or by holding taxable bonds. The interest rate differential between taxable and tax-exempt bonds suggests that the effective tax rate on fixed income investments may be lower than the statutory tax rate for high-income investors.

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Asset allocation, the decision of how much of a portfolio to allocate to different types of securities, is one of the fundamental issues in financial economics. For taxable individual investors, the proliferation of tax-deferred opportunities for retirement saving, such as Individual Retirement Accounts, 401(k) plans, Keogh plans, and 403(b) plans, has added a new dimension to the traditional asset allocation problem. A taxable investor needs to make choices not just about the amount to hold in various types of assets, but also about where to hold these assets. If there are two asset classes, broadly defined as riskless and risky assets, the asset allocation problem facing a tax-exempt investor involves choosing the fraction of the portfolio to allocate to the risky asset. A taxable investor with a tax-deferred retirement saving account, however, faces a more complex problem, since he must decide how much of the risky asset to hold in his tax-deferred account, and how much to hold in his taxable account. Shoven (1999), Shoven and Sialm (2000), and Dammon, Spatt, and Zhang (2000) label the problem of deciding where to hold a given asset the asset location decision.

The rapid growth of assets in tax-deferred accounts has created a broad class of investors who face the asset location problem. Poterba, Venti, and Wise (2000) show that more than thirty million workers currently participate in 401(k) pension plans. Millions more have tax-deferred assets in Individual Retirement Accounts. Since virtually all 401(k) plans, and all IRAs, provide investors with substantial discretion in the set of assets that they hold, almost all of these account holders face asset location choices. These choices are likely to be most salient for middle and upper-middle income households for whom tax-deferred assets represent a substantial fraction, but not all, of their financial wealth. Current policy proposals to raise the limits on contributions to tax-deferred retirement saving plans could make the asset location decision more significant for households in higher income and wealth strata, since they would increase the total pool of assets that a household could accumulate in a tax-deferred setting.

How holding an asset in a taxable or tax-deferred account affects an investor's long-term wealth accumulation depends on the tax treatment of the asset in question, as well as on the menu of

other assets that are available. Given the set of assets that an investor wishes to hold, long-run wealth accumulation will generally be maximized by placing the most heavily taxed assets in the tax-deferred account (TDA), while holding the less heavily taxed assets in a taxable account. We refer to the latter as a conventional savings account (CSA).

The asset location problem is a practical question in applied financial economics, and it confronts many households as they save for retirement and other objectives. Yet much of the "conventional wisdom" on asset location for individual investors derives from research on a related problem confronting corporations. Nearly two decades ago, Black (1980) and Tepper (1981) studied the problem of asset allocation for a corporation that could choose to hold assets in the company's defined benefit pension plan, or in the company's taxable corporate account. These studies explored corporate asset location problems with respect to taxable bonds and corporate equities. Taxable bonds were assumed to generate heavily-taxed interest income, and corporate equities were assumed to generate lightly-taxed returns because capital gains are not taxed until they are realized. These studies concluded that because bonds are taxed more heavily than stocks, a firm could maximize its shareholders' after-tax cash flow by placing bonds in the pension account and stocks in the taxable corporate account. The pension account, in this setting, is equivalent to an individual investor's tax-deferred account. Something like this analysis underlies the suggestion, made by many financial advisors, that individual investors should hold taxable bonds in their tax-deferred account before holding them in their taxable account.

This common analysis neglects two important aspects of the investment decisions that face many taxable investors. First, heavily-taxed corporate or government bonds are not the only way for taxable investors to participate in the market for fixed-income securities. Taxable investors could also choose to hold tax-exempt bonds. Over the last four decades, the average yield on long-term tax-exempt bonds has exceeded the after-tax yield on comparably-risky taxable bonds for individual investors in the highest marginal tax brackets. Including the opportunity to hold tax-exempt bonds in

the portfolio selection problem therefore offers taxable investors the potential to hold fixed-income securities for which the "implicit tax rate" may be lower than the statutory tax rate on taxable bonds.

The second shortcoming of the standard asset location analysis is that it assumes that investments in corporate stock are lightly taxed. In practice, many taxable investors hold equities through equity mutual funds. Many equity funds, particularly actively managed funds, are managed in a fashion that imposes substantial tax burdens on taxable individual investors. Dickson and Shoven (1995), Dickson, Shoven, and Sialm (2000), Bergstresser and Poterba (2000), Arnott, Berkin, and Ye (2000), and others have computed before-tax and after-tax returns for equity mutual funds in the United States. These studies suggest that because such funds often realize capital gains more quickly than a tax-deferral strategy might dictate, the effective tax rate on equity investments through mutual funds is often substantially greater than that on a buy-and-hold equity portfolio.

Omitting tax-exempt bonds from the asset location analysis, and failing to recognize that actively managed equity mutual funds are the vehicles through which many investors hold their equities, combine to overstate the tax burden on fixed income assets relative to equities for many investors. In this paper, we investigate whether these two factors are important enough to reverse the conventional wisdom offered by financial advisors. We study whether investors would, historically, have accumulated more after-tax wealth by holding equity mutual funds in their tax-deferred account, and municipal bonds on taxable account, than by holding taxable bonds in their tax-deferred account and equity mutual funds on taxable account.

We use the historical performance of actual mutual funds to explore the asset location problem. Earlier work on asset location was either theoretical (Shoven and Sialm (2000)) or used hypothetical or simulated mutual funds (Shoven (1999) and Shoven and Sialm (1998)). While using historical data provides information on how investors following alternative investment strategies would have fared in past decades, may not describe the future. It is possible that in the future,

actively managed equity mutual funds may impose lower tax burdens on their investors than funds have done in the past.

We consider a stylized investor who made equal annual contributions to a tax-deferred account (TDA) and a conventional saving account (CSA) over the period 1962-1998. We assume that this investor rebalanced his portfolio each year to hold half of his total assets in equities, and half in fixed income investments. We assume that all equity investments are carried out through one of a set of equity mutual funds for which we collect historical returns, and that fixed-income investments can be made in tax-exempt as well as taxable bonds.

Our empirical analysis computes the investor's after-tax wealth at the end of 1998 under two different asset location strategies. The first, 'defer stocks first', specifies that investments in one of the equity mutual funds in our data set will be given a priority location in the tax-deferred account. Under this rule, if the total market value of the assets in the TDA is less than half of the combined market value of the assets in the TDA and the CSA, the investor holds only an equity mutual fund in his tax-deferred account. If the total amount that the investor could hold in the TDA were more than half of the combined value of the TDA and the CSA, then some of the TDA, as well as all of the CSA, would be held in fixed income instruments. This would involve holding taxable bonds in the TDA, and tax-exempt bonds in the CSA.

The second asset location strategy, 'defer bonds first,' reverses this priority. Fixed income assets are held in the TDA before any such assets are held in a taxable format. In this case, if the total value of the TDA assets were less than half of the combined value of the TDA and the CSA, the investor would hold only taxable bonds in his TDA.

The paper is divided into six sections. Section one describes a simplified one-period model of asset location and derives three results. First, tax-exempt bonds should not be held in a tax-deferred environment. Second, tax-exempt bonds rather than taxable bonds should be held in a taxable account if the implicit tax rate on tax-exempt bonds is smaller than the effective tax rate on

taxable bonds. Third, stocks should have a locational preference in the tax-deferred account if the effective tax rate of stocks is higher than the implicit tax rate on tax-exempt bonds. While clear results such as these can be found analytically in a one-period asset location problem, they are not available for the multi-period problem. That leads us to develop numerical results on the consequences of different asset location decisions for hypothetical multi-period investors.

The second section describes the data on equity mutual fund returns and bond returns that underlie our calculations. We collect data on the annual returns on twelve large equity mutual funds that have been continuously traded over the 1962-1998 period. Our calculations use the actual returns on these funds to evaluate the two asset location strategies. This section also describes our assumptions about the marginal tax rates facing the hypothetical taxable investors who we analyze.

Section three presents our core findings on the amount of wealth that investors would have accumulated if they had followed the two different asset location strategies over the 1962-1998 period. For virtually all of the actively managed mutual funds in our data set, an investor would have had more end-of-period wealth if he had allocated his mutual fund shares to his tax-deferred account before holding equity mutual funds in his conventional saving account. The differences in end-of period wealth between the two asset location strategies are substantial for all of the actively-managed funds in our data sample. The differences are much smaller for equity index funds. Our findings, which stand in contrast to much "convention wisdom," are due both to our recognition of the opportunity to hold tax-exempt bonds as well as taxable bonds, and to the higher tax burden on corporate stock that follows from holding equities through mutual funds rather than directly.

In section four, we explore the sensitivity of our findings to the particular pattern of equity and bond returns that have characterized the last four decades. We evaluate the robustness of our findings by drawing sequences of thirty-seven returns (with replacement) from each fund's empirical distribution of returns. Our results suggest that while the recent history of returns has been particularly favorable to "defer stocks first" strategy, for most random draws from the return

distribution for the last four decades, this strategy generates more after-tax wealth than the “defer bonds first" strategy.

In section five, we introduce inflation-indexed bonds such as Treasury Inflation Protected Securities (TIPS) that have been available in the United States since 1997. Investors can hold inflation-indexed bonds by purchasing TIPS directly, and by holding inflation-indexed Series I savings bonds. Our analysis assumes that inflation-indexed bonds with a four percent real return were available throughout the 1962-1998 period. We show that in this case, holding equity mutual funds in the TDA and inflation-indexed savings bonds in the CSA would have given investors a higher expected utility than holding equity mutual funds in their TDA and tax-exempt nominal bonds in their CSA. Finally, section six concludes with a summary of our findings.

1. Asset Location in a Simple Setting

We begin our analysis with a one period example that illustrates the effects of asset location on investor returns. Suppose that an investor can hold taxable bonds (B), tax-exempt municipal bonds (M), and stocks (S) in a conventional savings account (CSA) or in a tax-deferred account (TDA). The pretax returns of the three asset classes are r_B, r_M, and r_S, where the bond returns are non-stochastic and satisfy $0 < r_M < r_B$. The effective tax rate of stocks is assumed to be lower than the effective tax rate of taxable bonds: $\tau_S < \tau_B$. The implicit municipal bond tax rate equals $\tau_M = 1 - r_M/r_B$. For simplicity, we assume that the tax rates do not change over time, which means that the return of an investment in a TDA equals the before-tax return $r^{TDA} = r$. The after-tax return of taxable assets in a CSA equals $r^{CSA} = (1 - \tau)r$. We take the investor's total wealth in the TDA and the CSA as given, perhaps as a result of constraints on TDA contributions.

In this setting, it is never optimal to hold tax-exempt bonds in the tax-deferred account, because the taxable bond has a higher before-tax return than the tax-exempt bond. In addition,

taxable bonds should not be held in the taxable account if the implicit tax rate on municipal bonds τ_M is smaller than the tax rate of taxable bonds τ_B. In this case, the after-tax returns in the CSA would be higher if the investor held tax-exempt bonds.

To analyze the optimal location of stocks in this one period model, suppose that an investor with $\tau_M < \tau_B$ holds tax-exempt bonds in the CSA, taxable bonds in the TDA, and stocks in both the TDA and the CSA. The following argument provides conditions under which it will be optimal to increase the stock exposure in the TDA and decrease the stock exposure in the CSA.

Consider increasing the holdings of stocks in the TDA by \$1 and reducing the holdings of taxable bonds in the TDA by \$1. At the same time, decrease the holdings of stocks in the CSA by $\$1/(1-\tau_S)$ and increase the holdings of tax-exempt bonds in the CSA by $\$1/(1-\tau_S)$. This transaction involves no net investment in total financial assets, and it leaves the investor with the same amount of exposure to risky equity as the initial portfolio.

Before the portfolio shift, the risky component of the portfolio at the end of the period, which we denote W_S , is

(1) $$W_S = I_{S,TDA}[1 + r_S] + I_{S,CSA}[1 + (1 - \tau_S)r_S]$$

where initial investments of stocks in the TDA and the CSA are denoted by $I_{S,TDA}$ and $I_{S,CSA}$, respectively. The riskless component of the initial portfolio is, which is the sum of the wealth held in taxable bonds (W_B) and tax-exempt bonds (W_M), is:

(2) $$W_B + W_M = I_{B,TDA}[1 + r_B] + I_{M,CSA}[1 + r_M].$$

Note that initial wealth is $W = W_S + W_B + W_M$.

After the suggested portfolio shift, the values of the risky and risk-free components are:

(3) $$W_S' = [I_{S,TDA} + 1][1 + r_S] + [I_{S,CSA} - 1/(1 - \tau_S)][1 + (1 - \tau_S)r_S] = W_S - \tau_S/(1 - \tau_S)$$

and

(4) $$W_B' + W_M' = [I_{B,TDA} - 1][1 + r_B] + [I_{M,CSA} + 1/(1 - \tau_S)][1 + r_M],$$

$$= W_B + W_M + \tau_S/(1 - \tau_S) + r_B[(\tau_S - \tau_M)/(1 - \tau_S)].$$

The total value of the portfolio after the shift equals:

(5) $$W' = W_S' + W_B' + W_M' = W + r_B[(\tau_S - \tau_M)/(1 - \tau_S)].$$

The suggested portfolio shift increases the wealth level at the end of the period if $\tau_S > \tau_M$. This portfolio shift does not involve any risk and individuals should take advantage of this profitable arbitrage opportunity until they reach borrowing or other constraints.

The foregoing argument shows that stocks have a preferred location in the TDA, "defer stocks first" in our terminology, if $\tau_S > \tau_M$. Stocks have a preferred location in the CSA if $\tau_S < \tau_M$. If stocks are highly taxed, then they should replace the taxable bonds in the TDA and if stocks are lightly taxed, then they should replace the tax-exempt bonds in the CSA.

Optimal asset location is considerably more complicated in a model with multiple periods, because asset location choices in one period will affect the amount in the tax-deferred account in future periods. In our one-period example, the terminal value of the TDA changes with the portfolio shift:

(6) $$W_{TDA}' = [I_{S,TDA} + 1][1 + r_S] + [I_{B,TDA} - 1][1 + r_B] = W_{TDA} + r_S - r_B.$$

In a multi-period setting, having a larger tax-deferred account is beneficial because it allows the investor to shelter a larger proportion of future wealth. Multi-period asset location choices have to consider the potential long-term effects of current asset location choices on future TDA values.

Simple results like the ones derived above are difficult to obtain analytically in the multi-period asset location problem. For that reason, we develop numerical results on the wealth that hypothetical investors would have built up, after many years of investment, if they had pursued various asset location strategies. The balance of this paper is devoted to developing these results. While the results are dependent on the time period that we study, they provide some evidence on how multi-period investors should analyze their asset location options.

2. Data on Asset Returns and Investor Tax Rates

Our analysis of the economic effects of different asset location choices relies on data from the 1962-1998 period. It also focuses on hypothetical investors who held equities through actively-managed equity mutual funds, rather than through direct equity holdings. We consider the returns to twelve actively managed equity mutual funds that were available to investors for the entire 37-year period. Table 1 summarizes the total asset values of the twelve funds in our dataset. The equity funds are sorted according to their total valuation in December 1961 and 1968 as listed by Johnson's Charts (1962, 1969). The first five funds ('Top-5-Funds') were the five largest equity funds at the end of December 1961. Selection and survivorship bias is important because, as Carhart (1997) notes, funds with above-average past performance tend to be larger and are less likely to be discontinued. Results using these five largest funds are not subject to these biases, whereas results using the other funds might be.

We also collected data for the ten largest equity funds on December 31, 1968, in Johnson's Charts (1969). We augmented this data sample with information on two other funds, the Fidelity Fund and Vanguard Windsor. Our whole sample represents 29.2 percent of the total value of mutual funds in 1961 and 33.6 percent in 1968. The sample becomes less representative over time, as a result of both increase in the total number of mutual funds and a sharp increase in inflows to equity mutual funds during the 1980s and 1990s. As these inflows were distributed across the funds in existence in those decades, many of which were new entrants that were not available in the 1960s, the share of assets in these "old" equity funds declined. In 1998, data from the Investment Company Institute (2000) suggest that our twelve actively managed mutual funds held only 2.2 percent of the assets invested in mutual funds. An important issue in interpreting our results is the degree to which the historical performance of the funds we consider is likely to provide guidance on the future performance of today's funds.

The data on the pretax returns and post-tax returns of the equity funds for the years prior to 1992 are taken from Dickson and Shoven (1995). Their dataset is updated using the Standard & Poor's Dividend Records (1993-1999) and the Moody's Dividend Records (1993-1999) for the distributions (dividends, short-, medium-, and long-term capital gains) and Interactive Data (part of Financial Times Information) for the net asset values of the funds. The annual total return is defined as the percentage change in the value at the end of the current year of one mutual fund share purchased at the end of the previous year. The returns are adjusted for splits as necessary. We assume that mutual fund distributions are re-invested on the 'ex-date'.

To model the taxable and tax-exempt fixed income investment options available to our hypothetical investor, we use the Vanguard Long-Term Bond Fund and the Vanguard Long-Term Municipal Bond Fund. The annual distributions and net asset values of the two bond funds are taken from Morningstar. Both bond funds pay monthly dividends and we assume monthly compounding when computing their annual returns. In addition to the twelve actively-managed funds that we consider, we have also constructed a time series of returns that we view as corresponding to a passively managed S&P 500 index fund. When they are available, we use the returns on the Vanguard Index 500 Fund for the index fund returns.

Unfortunately, data for the two bond funds and the index fund are only available after the mid-1970s. To indicate the type of returns that investors in such funds would have earned if such funds had been available during the first decade and a half of our sample period, we construct "synthetic funds." The returns on the synthetic bond funds are calculated from the year-end yields to maturity of long term corporate bonds (Moody's Aaa-rated bonds) and of long-term tax-exempt bonds (with an average rating of A1) as reported in the Statistical Release of the Federal Reserve. The synthetic bond funds are assumed to hold the bonds for one year. The interest income of the funds paid at the end of the year equals the yield to maturity at the issue date minus expenses of 50

basis points. Each year, we calculate the capital gain or loss for each bond fund by calculating the capital gain or loss on 20-year par bonds that were newly-issued at the beginning of the year.[1]

Positive capital gains in the synthetic mutual funds are distributed to the shareholders annually and capital losses are carried forward. To check whether the characteristics of the synthetic funds are similar to those of the actual funds, we computed returns on the synthetic funds for the 1979-1998 period, when we also had returns on the actual equity index fund and on the two bond funds. The performance of the synthetic fund did not differ much from the performance of the actual fund.[2]

We create a synthetic index fund corresponding to the Vanguard 500 Index Fund using the return data of the large stock index of Ibbotson Associates (2000). The synthetic fund distributes the dividends net of expenses, with expenses set to 25 basis points. The fund's turnover rate of 5 percent results in short- and long-term capital gains distributions, which are distributed if they are positive and carried forward if they are negative. The actual index fund and the synthetic index fund yield very similar returns during the period from 1979-1998.[3]

When we consider investor performance over the 1962-1998 period, we splice together the returns on our synthetic bond and index funds for the early part of our sample, with the actual returns on these funds in the later part of the sample. We label these "spliced funds."

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[1] The capital gain (*CG)* of the synthetic bond fund between time t and time t+1 is computed as the difference between the price of a 19-year bond at time t+1, p^{19}_{t+1}, and the price of a 20-year bond at time t, p^{20}_{t}. By convention, bonds are issued at par, so $p^{20}_{t} = 1$. We define the yield to maturity of a 20-year bond at time t, and a 19-year bond at time t+1, as y^{20}_{t} and y^{19}_{t+1}, respectively. We assume that yields at all maturities are equal, so that $y^{19}_{t+1} = y^{20}_{t+1}$. In this case,

$$CG_{t+1} = p^{19}_{t+1} / p^{20}_{t} - 1 = (y^{20}_{t} / y^{19}_{t+1})*[(1 - (1+ y^{19}_{t+1})^{-19}] + (1+ y^{19}_{t+1})^{-19} - 1.$$

The interest return at time t+1 of the synthetic bond fund is set equal to the coupon rate at time t, y^{20}_{t}.

[2] The synthetic bond funds have slightly higher mean returns (0.21 percent for the corporate bond fund and 0.43 percent for the municipal bond fund), and considerably higher standard deviations (3.14 percent for the corporate bond fund and 2.53 percent for the municipal bond fund) than the actual bond funds. The correlation coefficients between the returns of the actual and synthetic funds are 0.94 for the corporate bond fund and .99 for the municipal bond fund.

[3] The average return on the synthetic index fund is slightly higher (by 0.10 percent per year) than that on the actual index fund, and the standard deviation of the synthetic index fund return is 0.05 percent higher than that of the actual index fund return. The correlation between the returns on the actual and the synthetic index funds is 0.9997.

We translate the before-tax returns on the various mutual funds in our sample into after-tax returns using two sets of marginal tax rates for hypothetical high- and medium-tax individuals. We assume that the high-tax individual has taxable income that is ten times the median adjusted gross income (AGI), less the standard deduction for a married couple with three exemptions, in each year. The medium-tax individual has taxable income equal to three times this quantity. Median AGI is taken from the Statistics of Income of the Internal Revenue Service. The tax rates between 1962 and 1992 are taken from Dickson and Shoven (1995); we updated these using tax forms for the years 1993 to 1998. We assume that our medium-tax investor has an income roughly three times the median AGI because stock and bond investors, particularly those with the asset location problem we study, have much higher incomes than average households do. We use data on the short- and long-term capital gain distributions of the equity mutual funds in our sample, as well as on their dividend distributions, to compute after-tax returns. We also consider "medium term" capital gain distributions for the applicable years, 1997 and 1998. Figure 1 shows the evolution of marginal tax rates for our high-tax and medium-tax investors between 1962 and 1998.

Table 2 presents summary statistics on returns for the mutual funds in our sample. The twelve actively managed equity funds have an average nominal return of 12.7 percent over the 1962-1998 period, and an average standard deviation of the annual returns of 17.1 percent. Ibbotson Associates (2000) reports that the rate of consumer price inflation has a mean of 4.7 percent and a standard deviation of 3.2 percent. The nominal return on the corporate bond fund averages 7.4, which translates to an average real return of 2.7 percent.

The mean nominal returns and the standard deviations of the funds differ considerably during this period. The Van Kampen Enterprise Fund has the highest average nominal return (16.9 percent) and the highest standard deviation (28.8 percent). The IDS Stock Fund has the lowest average return (10.7 percent) and the Affiliated Fund has the lowest standard deviation (14.1 percent). The 'Top-5-

Funds' have a considerably lower mean return than the remaining seven funds (11.7 percent vs. 13.4 percent), possibly because of survivorship bias.

Table 2 describes the composition of returns received by investors, with particular attention to the division between dividends, realized capital gains, and unrealized gains. The twelve funds distributed on average 72.6 percent of their total return annually either as dividends or capital gains, and 30.4 percent of the total average returns were either dividends or short-term capital gains.[4] Capital gains that are not distributed are deferred until the investor sells the mutual fund shares. The most successful fund (Van Kampen Enterprise Fund) distributed only 43.8 percent of its total returns, whereas the relatively poorly performing United Accumulative Fund distributed 88.5 percent of its total return. The 'Top-5-Funds' tend to impose somewhat higher tax burdens on their investors than the other funds since they distribute a larger portion of their total returns and since a larger portion of their distributions do not qualify as long-term capital gains.

The passively managed "spliced" index fund has an average nominal return of 12.8 percent and a standard deviation of 15.9 percent. The average return on the index fund is similar to that for our whole sample of equity funds, and it is considerably higher than the average return on the bias-free 'Top-5-Funds'. The passively managed index fund exhibits a smaller difference between pre-tax and post-tax returns than the actively managed equity funds. Only 39.2 percent of its total nominal returns were distributed on average to shareholders, and only a small portion of those distributions resulted from the distribution of realized capital gains.

The "spliced" corporate bond fund has a mean nominal return of 7.4 percent and a standard deviation of 8.3 percent, while the "spliced" tax-exempt municipal bond fund has a lower mean nominal return (5.9 percent) and a higher standard deviation (11.2 percent). Both bond funds distribute most of their total returns as interest income.

3. Asset Location and Investor Returns: Historical Evidence

Our data make it possible for us to compute asset location results for the period 1962-98 for the twelve actively managed equity mutual funds as well as the three spliced funds. The investor is assumed to have made identical contributions (in constant dollars) each year to a tax-deferred pension account (TDA) and to a conventional taxable savings account (CSA). We use 1998 as our price level benchmark, so the actual 1998 contributions were 50 cents to each account, whereas the earlier contributions were less in nominal dollars. The total real investment over the 37-year period was $37 at 1998 prices.

We assume that half of each annual investment placed in the TDA and half in the CSA, and that the investor wants half of his or her total portfolio in stocks and half in bonds.[5] We assume that the initial 1962 investments are half to stocks and half to bonds. Thereafter, the investor annually adjusts the portfolio to maintain a 50 percent proportion in stocks and 50 percent in bonds. The necessary rebalancing is first accomplished by adjusting the composition of new investments. If necessary, assets are sold and bought in order to bring about the desired 50-50 stock-bond balance. At the end of the year, the investor is taxed on the taxable mutual fund distributions and the realized capital gains from selling fund shares in the taxable account. Realized losses are carried forward and subtracted from future capital gains. At the end of our sample period, the investor liquidates all assets and pays the necessary capital gains taxes as well as the ordinary income taxes on withdrawals from the TDA. The dollar figures shown in our tables thus represent retirement accumulations after the payment of all taxes.

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[4] The data sources do not always distinguish between short- and long-term capital gains. We assume that capital gains are long-term if the sources do not indicate the term of the gains. This results in an overstatement of the actual tax-efficiency of the mutual funds.

[5] When we compute the stock proportions we do not adjust the value of assets held in the two different accounts to reflect deferred taxes. There are at least two issues in this regard. First, the investor only owns (1-*t*) of the assets invested in the tax-deferred account, because the government will tax withdrawals from a tax-deferred account at the rate *t*. Second, the realized returns of assets in the CSA are taxed annually; this reduces their accumulation. Whether one invested in the TDA is more valuable than one dollar invested in a CSA depends on the investment horizon.

We evaluate two possible asset location rules. The first, 'Defer Stocks First', gives the equity mutual fund priority for placement inside the TDA. The corporate bond fund would be held in the TDA only if there is room after all of the investor's desired equity is in the TDA. Municipal bonds have a preferred location in the CSA. The second rule, 'Defer Bonds First', gives the corporate bond fund priority for placement inside the TDA. The equity mutual fund is given priority for placement in the CSA. If it is necessary to hold bonds in the CSA to maintain the desired 50-50 asset allocation, then the investor would hold the municipal bond fund.

Table 3 shows our basic asset location results. 'Defer Stocks First' yields higher terminal wealth values than 'Defer Bonds First' for all twelve of the actively managed equity mutual funds for the high-income, high-tax investor and for eleven of the twelve funds for the medium-income, medium-tax investor. The additional wealth accumulated by following the rule 'Defer Stocks First' can be quite large. For the twelve actively managed funds as a whole the average gain of first deferring the stocks is 8.9 percent for high-tax retirement accumulators. For the five largest funds in 1961, the gain averages 7.7 percent. For someone who contributed $10,000 ($1998) per year to both the CSA and the TDA in each year between 1962 and 1998, the 7.7 percent differential would translate to additional wealth of more than $140,000 in 1998.[6]

The equity mutual fund that gains the most from first deferring the stocks is the Vanguard Windsor fund. Its before-tax performance was better than average over the 1962-98 period, while it imposed a higher than average tax burden on its investors. With Vanguard Windsor, 'Defer Stocks First' results in more than 17 percent more retirement wealth than 'Defer Bonds First'. The actively managed fund for which the advantage of first deferring the stocks is the smallest is the Fundamental Investors Fund. Its before-tax performance was worse than average and its investor tax burden was

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One dollar invested in a CSA is more valuable at sufficiently short investment horizons and one dollar invested in a TDA is more valuable at sufficiently long horizons.

better than average. For high-income investors using Fundamental Investors in a 50-50 stocks-bonds asset allocation plan, 'Defer Stocks First' offers an advantage of less than 1 percent. For the medium-income investor using Fundamental Investors, 'Defer Bonds First' actually works better than 'Defer Stocks First', although the difference is extremely small. For the eleven other funds, "Defer Stocks First" yields between 1 and 17 percent more after-tax wealth than "Defer Bonds First."

Interestingly, when we consider the S&P 500 Index Fund, 'Defer Bonds First' yields the highest terminal wealth. The Index Fund had slightly better before-tax returns than the average actively managed fund, almost all due to its low expenses, and it imposes much lower tax burdens on its investors. In this case the advantage of deferring bonds instead of stocks is considerable. A high-tax investor holding an S&P 500 fund in the TDA and municipal bonds in the CSA would have ended up with 1.7 percent less retirement wealth than a similar investor who put corporate bonds in the TDA and held the index fund in the CSA. This result is important, because it suggests that the rise of relatively tax-efficient mutual funds in the 1990s may affect the applicability of our findings to investors who hold equities through these funds.

One reason that 'Defer Stocks First' yielded higher end-of-period wealth than 'Defer Bonds First' for most actively managed equity funds during our sample period is that equities have experienced higher rates of return than bonds, and thus would have generated higher tax bills in a taxable environment. This is related to the well-documented equity premium puzzle described by Mehra and Prescott (1985). One could ask whether 'Defer Stocks First' would still generate higher end-of-period wealth if the average return advantage of equities were lower. Table 4 answers this question for our high-tax, high-income investor. Each successive column presents results that are based on a 100 basis point reduction of realized fund returns, relative to those in the previous column. All fund distributions (dividends and capital gains) are reduced proportionally. Each

[6] While we have modeled people who choose a particular equity mutual fund and stick with it, many investors periodically switch funds. Such switching generates taxable capital gains in a CSA, which raises the relative wealth

additional 100 basis point reduction lowers the average advantage of first deferring stocks, but by decreasing amounts. Even an unrealistically high reduction of 500 basis points (i.e., eliminating the premium of equity funds over corporate bonds) would leave 'Defer Stocks First' generating higher end-of-period wealth than 'Defer Bonds First' for nine of the twelve actively managed funds. The results in Table 4 suggest that the relative wealth accumulation between the two location rules would be attenuated if the average return to stocks was lower than that in the 37-year period that we study.

The results in Table 4 are driven both by the fact that capital gain distributions on actively managed equity funds raise their effective tax burden, and by the fact that the implicit tax rate on tax-exempt bonds has been below the statutory marginal tax rate throughout our sample. Table 5 helps to indicate the relative importance of these two factors. It presents results in which investors do not take advantage of their option to hold municipal bonds. Instead, they invest in a single equity mutual fund and a corporate bond fund. The only location decision is between giving the equity fund preference in the TDA with the corporate bond fund having locational preference in the CSA or vice versa. Without the use of municipal bonds, 'Defer Stocks First' generates higher end-of-period wealth for only three of the twelve actively managed mutual funds for the high-income investor. For the other equity mutual funds, 'Defer Bonds First' produces more retirement wealth, often quite a bit more. The average gain of first deferring bonds for the twelve actively managed funds is 3.8 percent. 'Defer Stocks First' yields more attractive relative wealth values for the medium-income, medium-tax investor, producing more retirement wealth for six of the twelve actively managed equity funds. In fact, even without allowing municipal bonds, the average retirement wealth from following 'Defer Stocks First' is slightly greater than that from 'Defer Bonds First' for the medium-tax investor.

Our interpretation of Tables 3 and 5 is that the average actively managed mutual fund produces a higher effective tax rate for its high-income taxable holders than the implicit tax rate on municipal bonds. Hence, most of the actively managed funds would have gained more from being in

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accumulation from "defer stocks first" relative to "defer bonds first."

the TDA environment than would corporate bonds, given the availability of tax-exempt bonds for investments in the CSA. The only equity mutual fund that would have generated a significantly lower effective tax rate than the implicit tax rate on municipal bonds was the passively managed index fund. The presence of municipal bonds is less important for the medium-income investors, because the effective tax rate on the equity funds is lower (due to lower tax rates on ordinary income and capital gains) but the implicit tax rate on municipal bonds is the same. Tables 3 and 5 underscore the fact that the "conventional wisdom" that it is best to give preference to corporate bonds for placement in the TDA is based on analysis that does not consider the availability of municipal bonds.

One caution about our comparison of taxable and tax-exempt bond yields, and our calculation of implicit tax rates from these yields, should be noted. Investors in taxable and tax-exempt bonds may face somewhat different risks, and the yield differential between the yields on these bonds may reflect both tax considerations and the pricing of these risks. One particularly important risk, noted in Poterba (1989), is that of tax reform. Investors in tax-exempt bonds hold assets that could experience substantial valuation changes if the current income tax treatment of taxable and tax-exempt bonds were to change. Quantifying the price that investors demand for bearing this risk, and modifying the implicit tax rate accordingly, is very difficult.

The results in Tables 3 and 5 assume that the then-current tax laws applied to returns generated in each year during our data sample. Since marginal tax rates on dividend and interest income are lower now than at some points in our sample, this assumption may limit the prospective applicability of our findings. To address this concern, in Table 6 we present findings in which we apply the 1998 tax law to the 1962-98 returns generated by the CSA assets. Table 6 shows that the after-tax wealth from 'Defer Stocks First', relative to 'Defer Bonds First', would have been much lower if the 1998 tax law had been applied throughout the 1962-98 period, particularly for the high-income investors. Nonetheless, 'Defer Stocks First' would have still yielded a higher end-of-period

wealth for eight of the twelve actively managed mutual funds. The counterfactual tax assumption of Table 6 affects the results less for the medium-income investor, with 'Defer Stocks First' still generating more retirement wealth for ten of the twelve actively managed mutual funds.

Table 6 does not describe what actually would have happened if the 1998 tax code had prevailed over the entire 37-year period. We have not adjusted the implicit tax rate on municipal bonds even though it would have presumably dropped in the presence of lower marginal tax rates on the wealthy. Similarly, we have not adjusted the before-tax rates of return of any of the assets even though a significant tax change would presumably have substantial general equilibrium effects. It is also possible that with different tax rates, the composition of equity returns between dividends and capital gains would have differed from the historical values.

4. Asset Location and Investor Returns: Simulation Evidence

The foregoing asset location results show the performance of different strategies using historic data over the period from 1962-1998. This time-period was in many respects unrepresentative; equity returns were relatively high, the rate of inflation was high and very volatile, and marginal tax rates changed considerably. To determine whether our results are robust, we run some bootstrap simulations. Each simulation proceeds in two steps: we first randomly select one mutual fund from our sample, and we then draw a random sequence of years with replacement. For each year selected, we draw the selected fund's return, as well as the returns of two bond funds, the inflation rate, and the tax rate. We compute the wealth levels of investors making constant real annual contributions to the CSA and TDA for 37 years, just as described above. All the simulations are repeated 10,000 times.

Our bootstrap returns only address the issue of the sequencing of returns during the 1962-1998 period. They do not address what is likely a more important source of uncertainty, namely the

possibility that future returns will be generated from a different return distribution than the one observed in the last four decades.

Figure 2 shows the probability distributions of the real wealth levels at retirement of the two asset location strategies for a high-tax individual choosing from the set of the five largest mutual funds in December 1961. 'Defer Stocks First' outperforms 'Defer Bonds First' at all probability levels except for the four lowest simulations out of 10,000. This means that the probability of reaching a particular wealth level or higher is almost always higher with 'Defer Stocks First' than with 'Defer Bonds First.'

Table 7 shows numerical values corresponding to several points in the probability distribution shown in Figure 2. The real wealth level of 'Defer Stocks First' exceeds that for 'Defer Bonds First' by 3.7 percent at the first percentile, by 6.1 percent at the median, and by 16.4 percent at the 99th percentile. The portfolio selection of this investor is quite risky. There is a more than 20 percent probability that the real wealth level accumulated at retirement does not exceed the 37 real dollars invested and there is a more than 20 percent probability that retirement wealth under 'Defer Stocks First' exceeds twice the total real investments (74 real dollars).

The median wealth level at retirement with 'Defer Stocks First' equals $51.81. This is considerably lower than the $86.46 from Table 3 that was computed using the actual history as opposed to the simulated returns. A realization of $86.46 would be an outcome at the 87th percentile in our bootstrap simulations. The main reason for this discrepancy is the ordering of the returns between 1962-1998. The ordering of the identical returns has a substantial effect on the wealth levels at retirement for investors making contributions over many years to their savings accounts. The arithmetic average of the real returns of the S&P 500 Index was 2.2 percent during 1962-1979 and 13.9 percent during 1980-1998. The computations that used actual historical returns had the low returns in the first half of our investment horizon (when the accumulated contributions were relatively small) and the high returns in the second half (when the accumulated contributions were

large). These back-loaded returns generate higher wealth levels at retirement compared to the distribution of returns which occurs in the bootstrap simulations.[7]

If we let history run backwards (i.e., the 1998 returns occur first, the 1997 second, and the 1962 returns last), then we accumulate a real wealth level of $32.70 under 'Defer Stocks First', which corresponds to the 15th percentile of the bootstrap distribution. This is because the low returns occur then when the investor has a large accumulated asset balance.

Table 7 also summarizes the distribution for investors who randomly choose funds from the whole set of twelve actively managed equity funds and who choose the "spliced" index fund. 'Defer Stocks First' outperforms 'Defer Bonds First' at all indicated points of the cumulative distribution for the actively managed equity funds. The probability distribution function for the whole sample of twelve funds usually lies to the right of the one for the 'Top-5-Funds', because the five largest funds did not perform as well as the other seven funds. Figure 3 shows that the distributions of the two location strategies are quite close if an investor holds a passively managed index fund; this underscores our earlier point that asset location is less important in this case than in the case of actively managed funds.

To facilitate the comparison between the different cases we summarize the whole probability distribution of the 10,000 simulations by computing the certainty equivalent wealth level of an individual with a Constant-Relative-Risk-Aversion (CRRA) utility function. The expected utility of real wealth EU=E[U(W)] of the investor is defined as:

(7) $$EU=E[U(W)]= n^{-1}\Sigma_i[W_i^{1-\alpha}/(1-\alpha)].$$

[7] The ordering of the returns r_t is irrelevant if investors make only a single investment to an account. In this case the final wealth level is simply the product of the return relatives $W_0=\Pi^T_{i=0}(1+r_i)$. The ordering has a significant effect on accumulated wealth levels for investors making multiple contributions to an account. We can think of the portfolio with multiple contributions as the sum of a sequence of single-contribution portfolios with decreasing maturities $\Sigma^T_{t=0}[W_t]= \Sigma^T_{t=0}[\Pi^T_{i=t}(1+r_i)]$. The returns during the last years affect most of these single-contribution portfolios, whereas the returns during the first years only affect a few of these single-contribution portfolios.

Simulations are indexed by i, the real wealth level is W_i, and we denote the risk-aversion coefficient by α and the total number of bootstrap simulations by n. The certainty equivalent wealth level is the certain wealth level that makes an individual indifferent to the outcome of the random 10,000 simulations. We assume that income from assets accumulated in the CSA and the TDA is the only source of income during retirement. The certainty equivalent is given by:

(8) $$CE(EU)=U^{-1}(EU)=[(1-\alpha)EU]^{1/(1-\alpha)}.$$

Table 8 summarizes the certainty equivalents for five levels of risk-aversion. The values with a risk-aversion of $\alpha=0$ equal the expected wealth levels. Most economists think that coefficients of relative risk-aversion between 1 (log-utility) and 5 are plausible. The average real wealth level at retirement for investments in the five largest mutual funds using 'Defer Stocks First' equals $58.09. Investing in all the twelve mutual funds and in the index fund results in considerably higher average wealth levels. All the certainty equivalents for the actively managed equity funds are larger by first deferring stocks instead of bonds. 'Defer Stocks First' results in a 5.2 percent higher certainty equivalent for an individual with a risk-aversion of 3 investing in the 'Top-5-Funds'. However, 'Defer Bonds First' yields higher certainty equivalents for intermediate levels of risk-aversion if investors hold the index fund. The index fund has a higher certainty equivalent than the actively managed funds. These results confirm the deterministic results above.

Figure 4 shows the relationship between the real wealth levels of the two location strategies using exactly the same simulation results as in Figure 2. The 45-degree line represents the cases where the wealth levels are identical for the two location strategies. There are 7,116 points (out of 10,000) below the 45-degree line and 2,884 points above. Thus, 'Defer Stocks First' outperforms 'Defer Bonds First' 71.2 percent of the time. The distribution of the relative wealth levels of the two strategies is summarized in the third row of Table 7. 'Defer Stocks First' outperforms 'Defer Bonds

First' in 64.0 percent of the simulations if investors choose between all twelve funds and in 48.5 percent of the cases with the index fund.

The previous results analyzed the optimal asset location choice for an asset allocation of 50 percent stocks and 50 percent bonds. This 'rule-of-thumb'-allocation is not necessarily optimal. Moreover, the optimal stock proportion for an investor might depend on his location strategy, since the two strategies have different effective stock exposures. To provide some illustrative calculations of the expected utilities associated with different stock-bond allocations, we perform bootstrap simulations for eleven different target stock proportions (0.0, 0.1, ..., 1.0) and compute the corresponding certainty equivalents of the two location choices. Figure 5 plots the results for high-tax individuals with risk-aversions of 3 and 5 investing in the five large actively managed mutual funds. Note that asset location is irrelevant in the cases in which the investor holds either only bonds or only stocks, since the same assets are held in both locations.

We find that the certainty equivalent of 'Defer Stocks First' is usually higher than that of 'Defer Bonds First'. At a risk-aversion of 3, the certainty equivalent is maximized at a stock proportion of between 80 and 100 percent with 'Defer Stocks First' and 100 percent with 'Defer Bonds First'. At stock proportions this high, the effect of optimal asset location is smaller than when the stock proportion is 50 percent.

Asset location is more important if investors have a risk-aversion of 5 than if they are more risk tolerant. Asset location increases the certainty equivalent by 4.9 percent (the maximal certainty equivalent wealth level with 'Defer Stocks First' is 37.21 and with 'Defer Bonds First' is 35.46). A 100 percent stock portfolio has a higher certainty equivalent than a 100 percent bond portfolio for both levels of risk-aversion.

5. Asset Location with Inflation-Protected Bonds

The corporate and municipal bond funds in the asset allocation and asset location analysis of the previous sections are exposed to at least three risks that can be reduced with recently introduced government securities. These risks are (1) default risk of individual issues, (2) inflation risk, and (3) reinvestment risk. Reinvestment risk results from the fact that the bond or bond fund investor cannot be sure of the terms on which future interest payments can be reinvested. The inflation risk results from the fact that corporate and municipal bonds are nominal contracts. While investing in high-grade securities can control default risk, corporate and municipal borrowers are usually considered riskier than the U.S. federal government.

Since 1997, the U.S. government has issued inflation-indexed bonds which essentially eliminate all of the risks just described. There are two forms of inflation-indexed bonds. The first are Treasury Inflation Protected Securities (TIPS). These are U.S. government bonds with fixed maturities (so far 5, 10, and 30 year bonds have been issued), with real interest payments, and with the principal amount adjusted to reflect CPI inflation. Both the interest payment and the adjustment in the principal amount are fully taxable if TIPS are held in conventional savings accounts, but these considerations are not relevant in a TDA. TIPS essentially eliminate the default and inflation risks of corporate and municipal bonds, but they still are subject to reinvestment risk. Investors may also bear some risk associated with potential redefinition of the Consumer Price Index. The real return on TIPS is currently near 4.0 percent.

The other U.S. government inflation indexed security is the Series I savings bond. I Bonds are savings bonds issued in denominations from $50 to $10,000. Like all savings bonds, I bonds are zero-coupon instruments with taxation deferred until redemption. Like all federal notes, bills and bonds, the interest on I bonds is exempt from state and local income taxation. I bonds are non-transferable and non-marketable, but are redeemable at par at any time. There is a forfeiture of 3 months interest if the bonds are redeemed in less than 5 years. Interest is compounded monthly and

accrues for up to 30 years. Investors are limited to purchasing $30,000 of Series I savings bonds per year. They have one other unusual feature which they share with Series EE savings bonds. The interest realized upon redemption can be exempt from taxation if it is used for college tuition expenses. This tax-free redemption possibility is available to households with adjusted gross income less than roughly $80,000. After that, the tax-free possibility is phased out until it is completely eliminated for AGIs above roughly $110,000.

The features of various forms of bonds are listed in Table 9. The primary advantage of I bonds for retirement accumulators using bonds in a CSA is their tax deferred nature. The combination of zero-coupons (and therefore no reinvestment risk) and redeemability at par at any time up to 30 years are also advantages. It should be noted that neither TIPS nor I bonds are completely inflation protected when they are held in a CSA environment. That is because the taxable interest increases with inflation and therefore the after-tax real return is lower at higher rates of inflation. In a TDA, either TIPS or I bonds offer a true inflation-indexed real return. Currently I bonds yield 40 basis points less than TIPS. Given this modest interest rate discount, I bonds (with their tax deferred feature) would result in more long-term wealth accumulation than TIPS for investors holding bonds in a CSA, while TIPS could generate greater long-term wealth accumulation in a TDA. Holding I bonds in a TDA would render the tax deferral feature of these bonds worthless.

We repeat the asset location computations with the historic returns used above by replacing the municipal bonds in the taxable CSA with Series I bonds and the corporate bonds in the TDA by TIPS.[8] We assume in the base case a real return of 3.6 percent for I bonds and a 4 percent real return for TIPS, which corresponds closely to the current real yields. We should be careful when we compare the results in the earlier sections with the results of this section. The previous sections used the actual real returns of bonds, whereas this section uses hypothetical real returns for inflation-

protected bonds, and holds this return at its current level for the entire sample period. Corporate bonds had a real return of only 2.7 percent between 1962-1998, while the simulations that we report here assume that indexed bonds offer a four percent real return.

Table 10 summarizes our findings when we use historic returns on equity mutual funds, and allow investors to hold inflation-protected bonds with three different assumptions about the real yields. Panel 3 shows the accumulated real wealth levels in the base case with a real return of 3.6 percent for I bonds and a 4 percent real return for TIPS. 'Defer Stocks First' outperforms 'Defer Bonds First' on average by 5.3 percent for a high-tax and by 6.1 percent for a medium-tax individual. These gains are similar to the ones in Table 3 with nominal bonds. With inflation-protected bonds, 'Defer Stocks First' is relatively more beneficial for medium-tax individuals than for high-tax individuals. The taxation advantage of I-bonds over stocks is greater for medium-tax investors than it is for high-tax investors. 'Defer Bonds First' is again superior for the index fund.

Panels 1 and 2 of Table 10 report the average wealth levels at retirement for different real yields of the inflation-protected bonds. The wealth levels decrease as the real yield decreases. However, 'Defer Stocks First' still outperforms 'Defer Bonds First' for all cases using actively managed mutual funds. The relative advantage of first deferring stocks increases slightly as the real yield of the bonds falls, because sheltering bonds in the tax-deferred account is less beneficial if bonds pay a lower yield. Holding the passively managed index fund in the CSA continues to generate higher after-tax wealth at the end of the period than other allocations using this fund.

The most significant benefit of TIPS and I bonds is their inflation-protection. To quantify this benefit we perform bootstrap simulations with these two real securities. The bootstrap simulations follow the same method that we used in the last section, although the randomization is irrelevant for the real yields on the inflation protected bonds since we assume that these yields are fixed.

[8] I-series bonds are currently only available with a maximum maturity of 30 years. Our computations assume that the tax on those bonds can be deferred until retirement. The benefits of holding I-series bonds would decrease if the

Figure 6 depicts the wealth distribution at retirement for a high-tax individual investing for 37 years in the largest five funds and following 'Defer Stocks First'. The figure shows the cumulative distribution functions for an environment with the historic nominal municipal and corporate bonds, and with the hypothetical inflation-protected bonds at two different real return levels. The high-return case assumes real returns of 3.6 percent for I bonds and 4 percent for TIPS, and the low-return case assumes real returns of 2.6 and 3 percent, respectively. The distribution function for the nominal bonds is exactly identical to the one in Figure 2. Introducing inflation-protected bonds increases the outcomes at the lower tail significantly. The cumulative distribution function shifts to the left if the bonds have lower real yields.

Table 11 summarizes the probability distribution of the two location strategies with inflation-protected bonds with real returns of 3.6 (TIPS) and 4 (I Bonds) percent. Comparing Panel 2 of Table 7 with the same panel in Table 11 shows that the wealth level increases with the rule 'Defer Stocks First' by 34.4 percent at the 1st percentile and by 23.9 percent at the 10th percentile. It is almost identical at the 90th percentile, and decreases by 11.8 percent at the 99th percentile.

Tables 8 and 12 show that the certainty equivalent of an investor with a risk-aversion of 3 investing in the top-5-funds increases by 19.4 percent when real rather than nominal bonds are available. Risk-averse investors value inflation-protection because they put a much higher weight on the lower tail of the probability distribution.

Panel 2 of Table 11 summarizes the probability distributions of the two location strategies for a high-tax individual investing in one of the 'Top-5-Funds'. The two functions are quite close at low wealth levels and 'Defer Stocks First' dominates 'Defer Bonds First' at higher wealth levels. 'Defer Stocks First' usually dominates 'Defer Bonds First' for the actively managed mutual funds but not for the passively managed index fund. The certainty equivalents from Table 12 indicate that first deferring stocks is preferable to first deferring bonds at all listed levels of risk-aversion for the

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taxation of the bond returns could only be deferred for 30 years.

actively managed mutual funds. The opposite holds for the index fund unless individuals are extremely risk-averse. By comparing Panel 3 with the other two panels, we once again see that using the index fund has usually a higher certainty equivalent outcome than a randomly selected actively managed fund.[9]

6. Conclusion

Our findings suggest that asset location decisions are very important for retirement accumulators who hold assets in both tax-deferred pension accounts and in taxable accounts. The improvement in the average or certainty equivalent outcome from following an optimal asset location strategy can be as high as 9 percent. With particular actively managed funds, the ex-post gain can be as high as 17 percent.

Our results suggest two conclusions regarding the after-tax wealth that high-income and medium-income investors would have accumulated over the 1962-1998 period, if they had invested in both stocks and bonds and held assets in both pension and taxable accounts. First, if an investor chose to use an actively managed equity mutual fund for stock investments, then after-tax wealth was maximized by holding as much of the equity mutual fund as possible in the pension account. Such an investor would hold corporate bonds in the pension account only if there is room for them, while holding municipal bonds in taxable accounts. Our results are based on a small sample of actively-managed equity mutual funds that were available for our entire sample, but we suspect that they would apply to most other actively managed funds available during the last four decades. Second, we find that an investor who used a passively managed equity index fund for stock investments

[9] In results not reported here, we explored the importance of asset location for investors with different desired stock-bond holdings in an environment with inflation-indexed bonds. As in the case with nominal bonds, optimal asset location is most important for an investor who is planning to hold a nearly equal mixture of bonds and stocks.

would have accumulated wealth most quickly by first locating corporate bonds in the tax-deferred account, and by holding the index fund in the taxable environment.

Our results show that the tax burden that equity mutual funds, particularly actively managed funds, impose on their investors, and the availability of both municipal bonds and inflation-protected Treasury securities as alternatives to corporate bonds, need to be factored into the asset location policy. At least historically, most actively managed equity funds imposed a higher effective tax rate on their shareholders than the implicit tax on municipal bonds. Therefore, the typical actively managed fund gains more from being in a tax-deferred pension environment than a corporate bond gains from being held in the TDA, as an alternative to a tax-exempt bond held in a taxable setting. This analysis is reversed with index funds, although it appears the stakes from optimal location are lower in this case. Passively managed index funds impose low enough tax burdens on their investors that they gain less from the pension environment than the premium of corporate bond yields over municipal bond yields.

Even though our purpose was not to enter the debate between actively-managed and passively managed equity funds, our simulations do shed light on the relative advantage of the two fund types for someone saving consistently over 37 years. Our bootstrap simulations indicate that a risk averse retirement accumulator would historically have fared better with an index fund, and an asset location strategy that held this fund in a taxable setting, than with a randomly chosen actively managed fund, held in the tax-deferred account. Of course, the historical pattern may provide only limited insight on future patterns of returns.

One important issue that arises in using our history-based results to predict the future concerns the extent to which actively managed funds will recognize the tax consequences that managerial decisions impose on taxable investors. If actively managed funds are more tax aware in the future, and the recent emergence of tax-managed funds and other financial products that are designed to reduce investor tax burdens suggests that they might be, then our findings may be

attenuated. Although the financial press today devotes some attention to the question of how taxes affect after-tax mutual fund returns for individual investors, "tax-managed" mutual funds currently account for less than one percent of the total assets held by equity mutual funds. If the tax-efficiency of a typical actively managed equity fund improves in the future, that could have important implications for the future applicability of our analysis.

While most of our analysis was done for someone following a rule-of-thumb 50-50 stocks-bonds asset allocation, we did look at the outcome for different allocations in our bootstrap simulations. Not surprisingly, an investor's optimal asset allocation is a function of his risk aversion. Still, given the well-known equity premium puzzle and the fact that even our bootstrap results were based on the realized returns from 1962-98, mildly risk averse retirement investors would have achieved their highest certainty equivalent outcomes by allocating substantially more than 50 percent of their portfolio to stocks. Whether such results will obtain going forward is not clear.

We also looked at the asset location issues associated with the relatively new inflation-protected Treasury bonds, such as TIPS and Series I Savings Bonds. TIPS are bonds with a real coupon rate and an inflation-adjusted principal amount. Both the coupon and the principal adjustment are taxable income. Series I bonds are zero-coupon inflation protected bonds with taxation deferred until sale. Given these features, the inflation-linked securities pose their own location question. Our results suggest that the solution depends on the type of equity mutual fund that the investor holds. If index bonds had been available for the last four decades, and their yields had been similar to those on current index bonds, then investors would have generated more wealth by holding actively managed funds in a pension account (with I bonds outside) than by following other strategies with such actively managed funds. Investors who wished to hold index funds, however, would have accumulated more wealth by holding such funds outside their retirement accounts, with TIPS in their pension accounts.

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Figure 1: Marginal Tax Rate
The time-series of the marginal income and long-term capital gains tax rates are depicted for high- and medium-income individuals. Taxable income for a medium- (high-) income individual is computed as three (ten) times the median adjusted gross income (AGI) and subtracting the standard deduction for married couples and three exemptions. Median AGI is taken from the Statistics of Income of the Internal Revenue Service. The values between 1962 and 1992 are taken from Dickson and Shoven (1995).

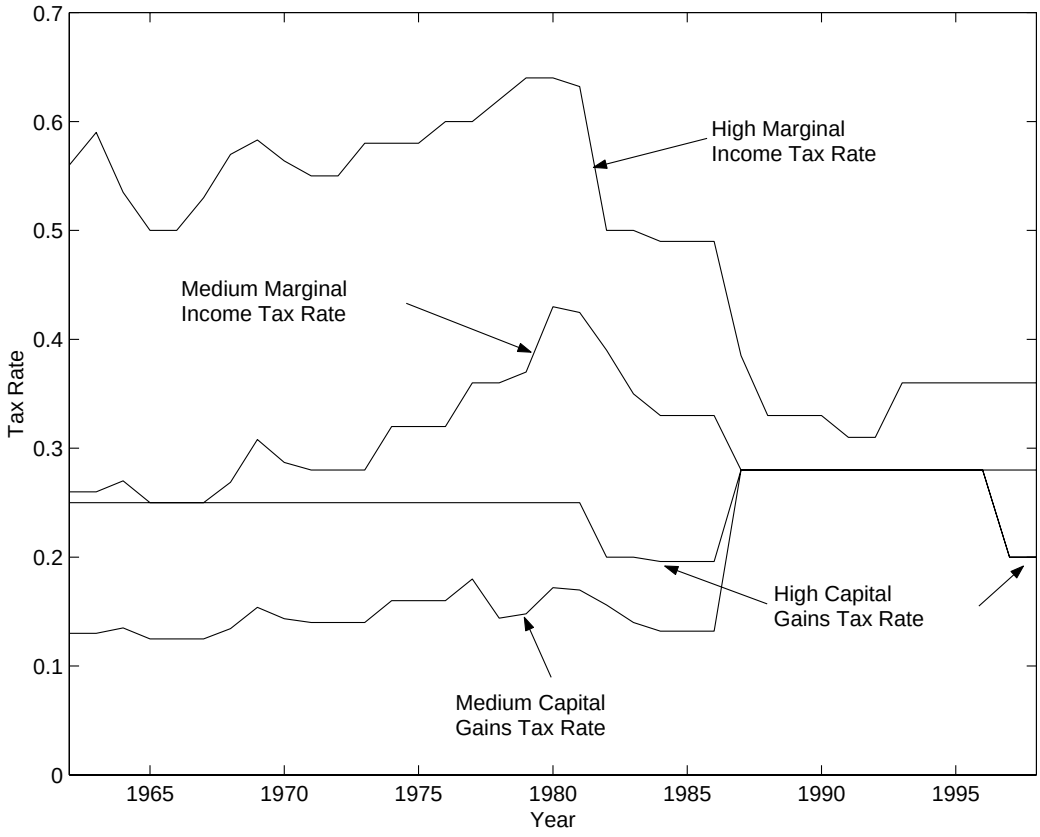

Figure 2: Wealth Distribution of the Two Asset Locations with Bootstrap-Simulations (Top 5 Funds)
The cumulative distribution of real wealth at retirement is depicted for the two asset location strategies. The investor chooses randomly among the five largest mutual funds in each of the 10,000 bootstrap simulations.

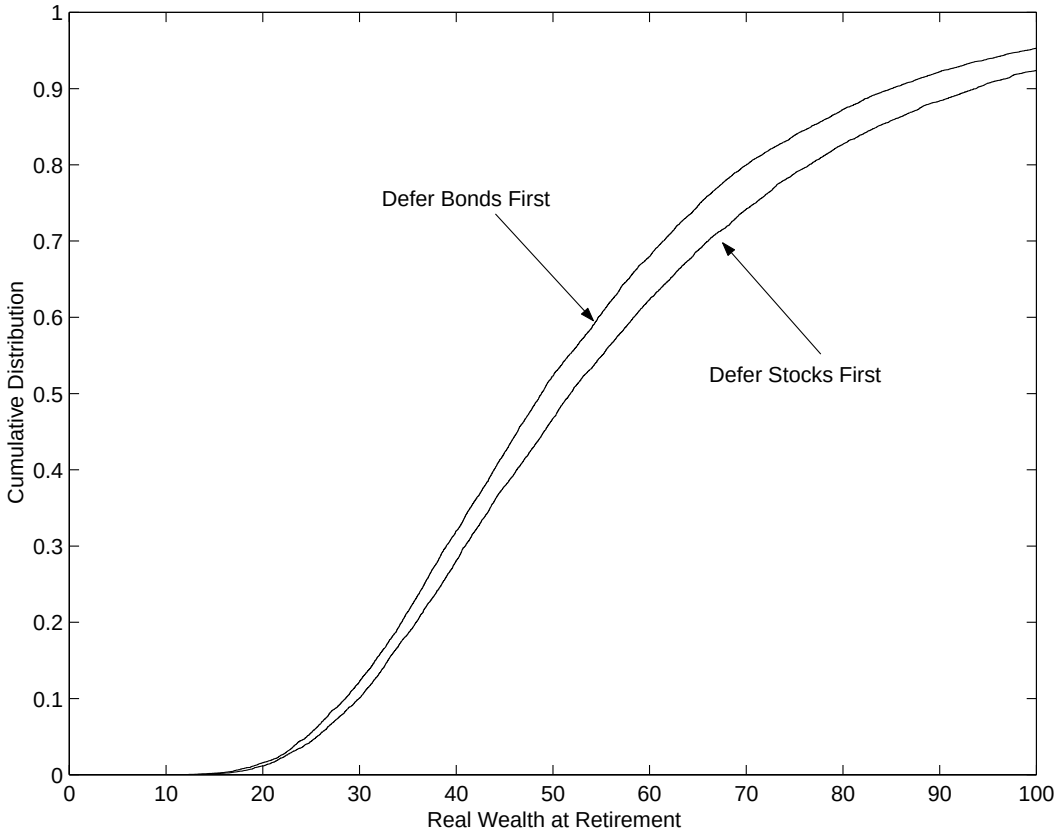

Figure 3: Wealth Distribution with Bootstrap-Simulations (Index Fund)
The cumulative distribution of real wealth at retirement is depicted for the two asset location strategies. The investor holds a 'spliced' Standard & Poor's 500 index fund.

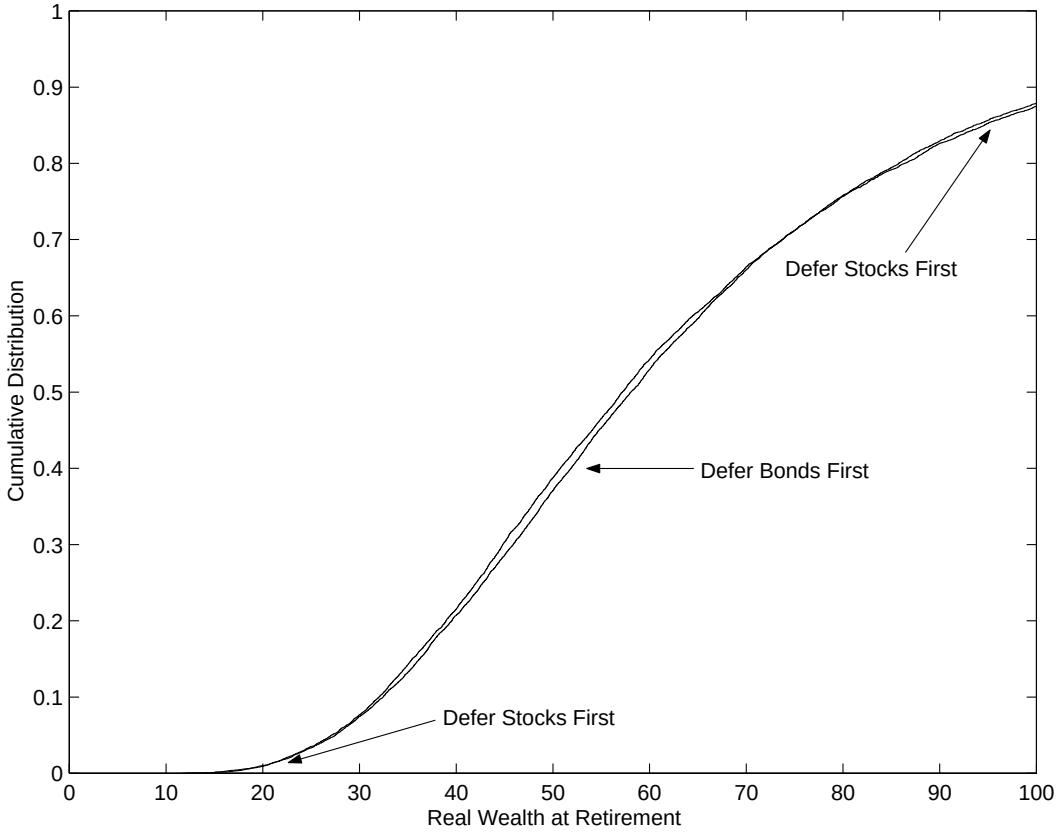

Figure 4: Relationship between the Wealth Levels of the Two Location Strategies (Top 5 Funds)
The relationship between real wealth levels at retirement between the two asset location strategies is depicted. The investor chooses randomly among the five largest mutual funds in each of the 10,000 bootstrap simulations. The simulation results are exactly identical to those in Figure 2.

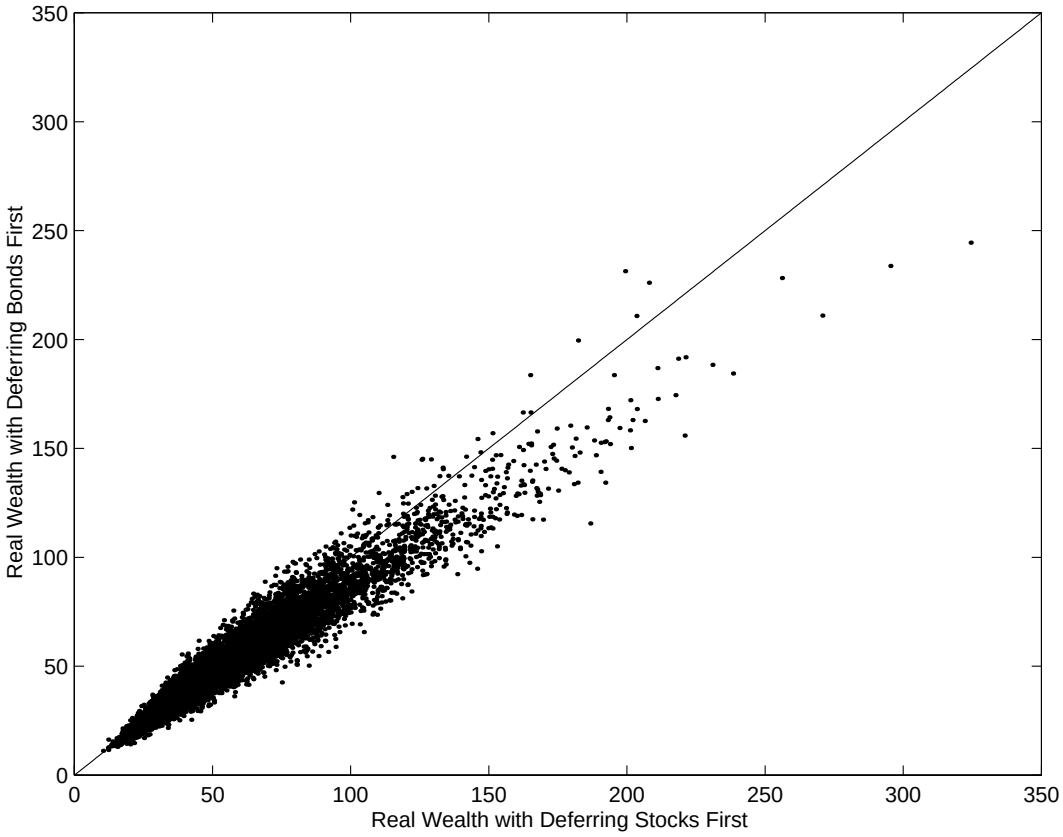

Figure 5: Certainty Equivalents of Different Asset Allocations
The certainty equivalent wealth levels are computed for different asset allocations (stock proportions range between zero and one hundred percent) and different asset locations (either the stocks or the taxable bonds are deferred first). The certainty equivalents are shown for coefficients of relative risk aversion (CRRA) of 3 and 5.

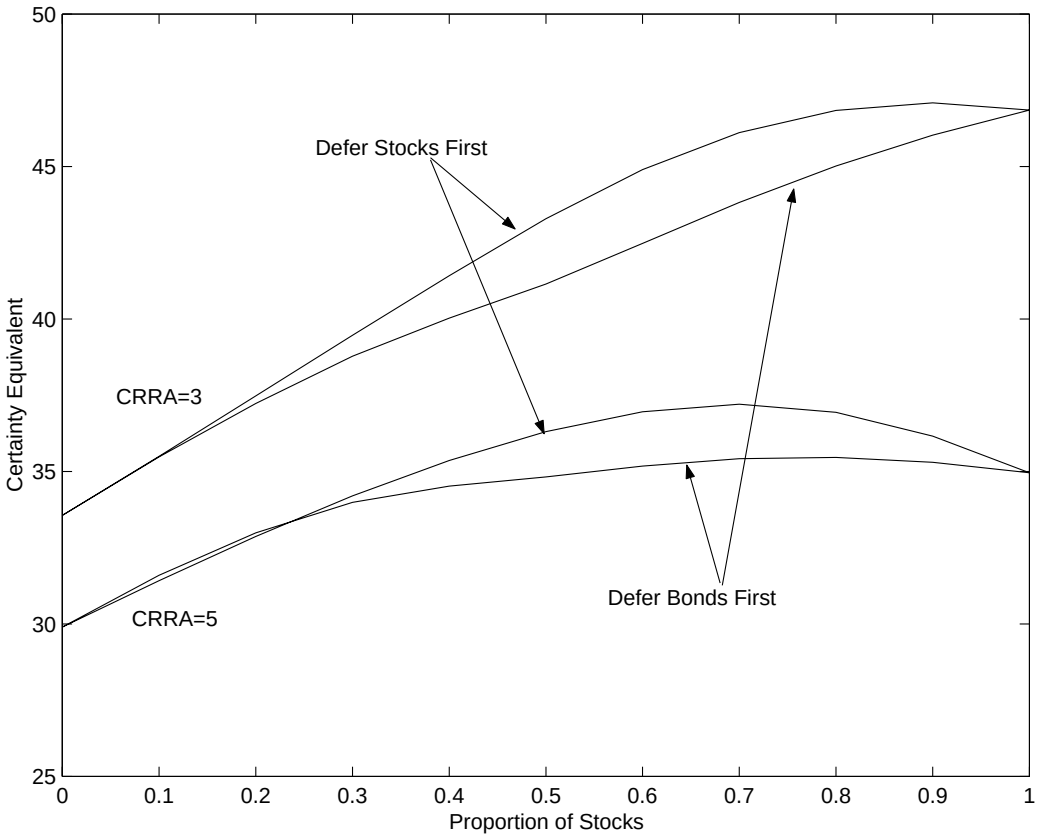

Figure 6: Wealth Distribution of Inflation-Protected and Nominal Bonds (Top 5 Funds; 'Defer Stocks First')
The cumulative distribution of real wealth at retirement using inflation-protected and nominal bonds is depicted. The investor chooses randomly among the five largest mutual funds in each of the 10,000 bootstrap simulations. Only the wealth levels of the strategy which defers stocks first are shown. The wealth levels with inflation-protected bonds are shown for real returns of RT=3% and RT=4% for TIPS and RI=2.6% and RI=3.6% for I-Series Bonds.

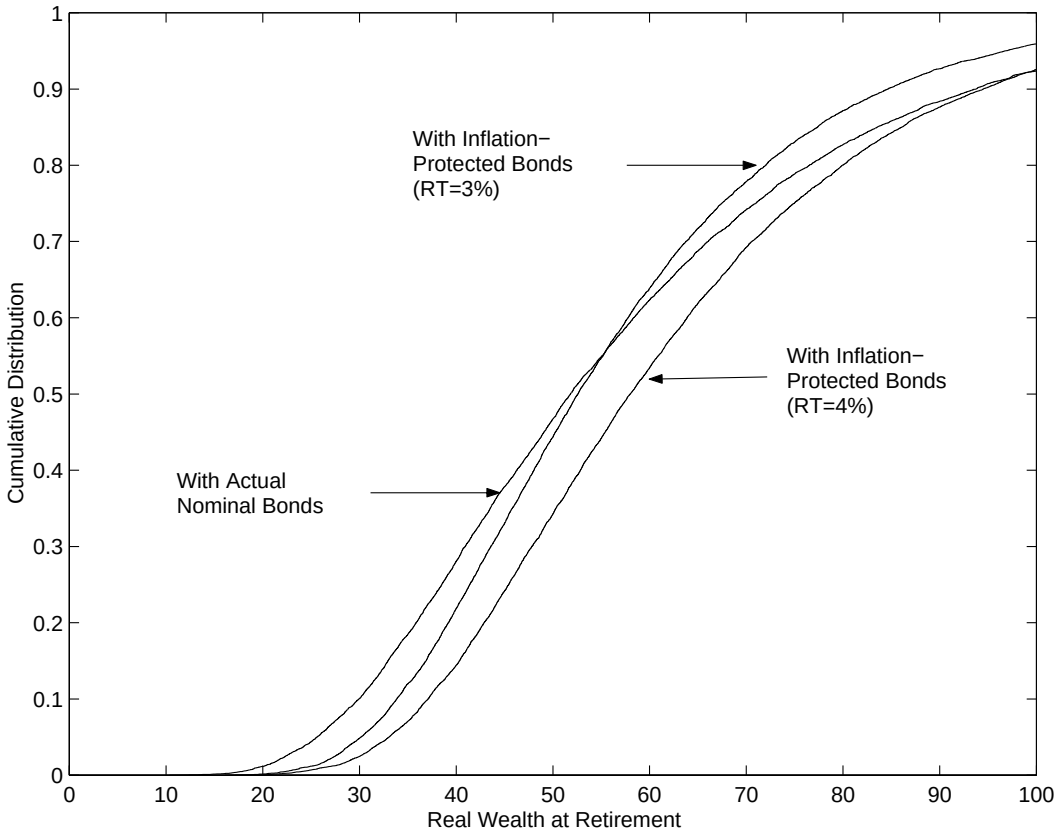

Table 1: Equity Mutual Funds in Dataset

The total asset values of the 12 equity funds in our dataset are summarized. The top 5 equity mutual funds correspond to the five largest equity funds at the end of 1961. The results of those 5 funds should not be subject to selection bias. Ten funds (all funds except Fidelity and Vanguard Windsor) were the ten largest equity funds at the end of 1968.

Name	Assets in Millions (Dec. 31, 1961)	Assets in Millions (Dec. 31, 1968)	Assets in Millions (Dec. 31, 1998)
01. MFS Mass Investors Trust	1800	2293	7142
02. IDS Stock	1025	2341	3257
03. Lord Abbett Affiliated	815	1805	8594
04. Fundamental Investors	733	1391	12,713
05. United Accumulative	601	1460	1864
06. MFS Mass Investors Growth	575	1264	3609
07. Fidelity Fund	487	898	10,563
08. Dreyfus	311	2666	2591
09. Investment Comp. of America	259	1056	48,498
10. Fidelity Trend	42	1346	1198
11. Van Kampen Enterprise	N.A.	953	2127
12. Vanguard Windsor	N.A.	225	18,188
Sum of Equity Funds	*6647*	*17,698*	*120,344*
Sum of Top 5 Funds (in 1961)	*4974*	*9290*	*33570*
Total Assets of All Mutual Funds	22,789	52,677	5,525,200
Total Number of Funds	170	240	7314

Source: Investment Company Institute, Mutual Fund Fact Book, Johnson's Charts

The Mass Investors Trust and Mass Investors Growth Funds changed their names to MFS Mass Investors Trust and Growth, respectively. Investors Stock changed to IDS Stock, Affiliated to Lord Abbett Affiliated, the Enterprise Fund to Van Kampen Enterprise, and Windsor to Vanguard Windsor. Investor's Mutual and the Wellington Fund were both larger than United Accumulative in 1961. Those two funds are not included in our dataset because they were balanced funds and held a significant portion of bonds. We excluded the Investors Mutual and the Investors Stock Fund because they were balanced mutual funds in 1968. Moreover we excluded the ISI Trust Fund, because this fund did not issue shares in 1968, but rather 10 year participating agreements.

Table 2: Summary Statistics of Mutual Funds (1962-1998)
This table reports the annual mean nominal returns, the standard deviations of the annual returns, and the distribution characteristics of the funds. Dividend-, ST-CG-, and LT-CG-Dist. are the returns that are distributed to shareholders as dividends, short-term, and long-term capital gains. The last two columns show the total proportions of the average returns that are distributed to shareholders as short-term distributions and as short- and long-term distributions. Unfortunately it is not possible to get long-run data on the S&P 500 Index Fund, taxable corporate, and tax-exempt municipal bond funds. Actual data are available for the Vanguard 500 Index fund after 1977 and for the Vanguard Long-Term Corporate Bond Fund and the Vanguard Long-Term Municipal Bond Fund after 1978. The synthetic funds use market data to replicate the payoffs of those funds before 1977 and 1978 and the data from the actual funds afterwards. CPI is the Consumer Price Index.

	Average Return	Standard Deviation	Dividend Dist.	ST-CG Dist.	LT-CG Dist.	Total ST Prop. Dist.	Total Prop. Dist.
Panel 1: Actively-Managed Equity Funds							
01. Mass Inv Trust	0.119	0.152	0.034	0.001	0.069	0.292	0.867
02. IDS Stock	0.107	0.149	0.034	0.003	0.052	0.345	0.833
03. LA Affiliated	0.127	0.141	0.045	0.001	0.059	0.362	0.824
04. Fund Investors	0.119	0.156	0.032	0.002	0.044	0.283	0.650
05. United Acc	0.110	0.150	0.031	0.017	0.049	0.437	0.885
06. Mass Inv Growth	0.125	0.195	0.015	0.007	0.072	0.175	0.754
07. Fidelity Fund	0.135	0.152	0.038	0.020	0.043	0.431	0.749
08. Dreyfus	0.113	0.142	0.031	0.014	0.048	0.395	0.823
09. Inv Co of America	0.140	0.147	0.034	0.000	0.048	0.247	0.586
10. Fidelity Trend	0.117	0.197	0.016	0.007	0.038	0.202	0.523
11. VK Enterprise	0.169	0.288	0.016	0.010	0.048	0.156	0.438
12. Vanguard Windsor	0.139	0.177	0.039	0.007	0.062	0.329	0.779
All Equity Funds:							
Mean	*0.127*	*0.171*	*0.031*	*0.007*	*0.053*	*0.304*	*0.726*
Std.Dev.	*0.017*	*0.042*	*0.010*	*0.007*	*0.011*	*0.096*	*0.144*
Top 5 Funds:							
Mean	*0.117*	*0.150*	*0.035*	*0.005*	*0.055*	*0.344*	*0.812*
Std.Dev.	*0.008*	*0.006*	*0.006*	*0.007*	*0.010*	*0.062*	*0.094*
Panel 2: Synthetic Funds							
S&P Index	0.128	0.159	0.036	0.001	0.013	0.288	0.392
Corporate Bonds	0.074	0.083	0.081	0.001	0.003	1.095	1.140
Municipal Bonds	0.059	0.112	0.061	0.001	0.006	1.054	1.154
Panel 3: Consumer Price Inflation							
CPI	0.047	0.032					

Table 3: Asset Location Results

The real wealth levels at retirement are reported for an individual making annual real contributions of $0.50 to both a tax-deferred account (TDA) and a conventional taxable savings account (CSA) during a period of 37 years (i.e., from 1962-1998). The investor annually adjusts the portfolio to maintain a 50% proportion of stock funds (the remaining 50% are allocated to either taxable corporate bonds or tax-exempt municipal bonds). Strategy 'Defer Stocks First' gives preference to stocks in the TDA and municipal bonds in the CSA and strategy 'Defer Bonds First' gives preference to corporate bonds in the TDA and stocks in the CSA.

Fund	High-Tax Individual			Medium-Tax Individual		
	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth
Panel 1: Actively-Managed Mutual Funds						
01. Mass Inv Trust	90.49	84.59	1.070	98.21	93.30	1.053
02. IDS Stock	79.91	74.94	1.066	86.30	83.15	1.038
03. LA Affiliated	91.75	81.20	1.130	99.61	91.93	1.084
04. Fund Investors	89.02	88.26	1.009	96.57	96.84	0.997
05. United Acc	81.11	73.07	1.110	87.68	82.91	1.058
06. Mass Inv Growth	92.70	89.60	1.035	100.72	98.02	1.028
07. Fidelity Fund	100.68	88.31	1.140	109.66	100.86	1.087
08. Dreyfus	74.18	64.56	1.149	79.83	73.73	1.083
09. Inv Co of America	101.03	96.08	1.052	110.05	106.39	1.034
10. Fidelity Trend	71.21	69.40	1.026	76.49	76.05	1.006
11. VK Enterprise	109.23	98.85	1.105	119.31	108.86	1.096
12. Vanguard Windsor	102.20	87.21	1.172	111.37	100.15	1.112
All Funds:						
Mean	*90.29*	*83.01*	*1.089*	*97.98*	*92.68*	*1.056*
Std.Dev.	*11.87*	*10.59*	*0.053*	*13.36*	*11.45*	*0.037*
Top 5 Funds:						
Mean	*86.46*	*80.41*	*1.077*	*93.67*	*89.62*	*1.046*
Std.Dev.	*5.53*	*6.39*	*0.047*	*6.22*	*6.28*	*0.032*
Panel 2: Index Fund						
S&P 500	96.28	97.91	0.983	104.72	106.91	0.980

Table 4: Sensitivity Analysis with Lower Equity Premia

This table reports the relative wealth levels of the two location strategies for a high-tax individual if the return of the equity funds is decreased. The distributions of the equity funds are adjusted proportionally. The first column corresponds exactly to the third column in Table 3.

	Reduction in Equity Premium (in basis points)					
	0	100	200	300	400	500
Panel 1: Actively-Managed Mutual Funds						
01. Mass Inv Trust	1.070	1.048	1.031	1.018	1.008	1.000
02. IDS Stock	1.066	1.048	1.034	1.025	1.017	1.010
03. LA Affiliated	1.130	1.102	1.078	1.059	1.043	1.030
04. Fund Investors	1.009	0.994	0.984	0.978	0.975	0.974
05. United Acc	1.110	1.089	1.074	1.063	1.055	1.050
06. Mass Inv Growth	1.035	1.017	1.004	0.994	0.989	0.984
07. Fidelity Fund	1.140	1.113	1.091	1.072	1.056	1.045
08. Dreyfus	1.149	1.127	1.108	1.093	1.081	1.072
09. Inv Co of America	1.052	1.033	1.017	1.002	0.992	0.985
10. Fidelity Trend	1.026	1.019	1.014	1.013	1.016	1.020
11. VK Enterprise	1.105	1.091	1.076	1.065	1.055	1.045
12. Vanguard Windsor	1.172	1.147	1.125	1.106	1.089	1.074
All Funds:						
Mean	*1.089*	*1.069*	*1.053*	*1.041*	*1.031*	*1.024*
Std.Dev.	*0.053*	*0.049*	*0.045*	*0.041*	*0.037*	*0.034*
Top 5 Funds:						
Mean	*1.077*	*1.056*	*1.040*	*1.029*	*1.020*	*1.013*
Std.Dev.	*0.047*	*0.043*	*0.038*	*0.034*	*0.031*	*0.029*
Panel 2: Index Fund						
S&P 500	0.983	0.966	0.952	0.946	0.945	0.946

Table 5: Asset Location without Municipal Bonds
The results in this table differ from those of Table 3 by not allowing individuals to invest in municipal bonds. Corporate bonds are held both in the TDA and the CSA.

	High-Tax Individual			Medium-Tax Individual		
	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth
Panel 1: Actively-Managed Mutual Funds						
01. Mass Inv Trust	79.04	84.54	0.935	92.64	93.49	0.991
02. IDS Stock	69.72	74.89	0.931	81.46	83.25	0.979
03. LA Affiliated	80.99	81.21	0.997	94.85	91.75	1.034
04. Fund Investors	78.14	88.17	0.886	91.62	96.68	0.948
05. United Acc	70.99	73.07	0.972	83.06	82.87	1.002
06. Mass Inv Growth	80.87	89.54	0.903	94.80	98.20	0.965
07. Fidelity Fund	88.88	88.26	1.007	104.28	100.88	1.034
08. Dreyfus	64.85	64.47	1.006	75.53	73.71	1.025
09. Inv Co of America	89.62	94.68	0.947	105.07	105.58	0.995
10. Fidelity Trend	62.05	69.25	0.896	72.15	76.21	0.947
11. VK Enterprise	96.18	96.40	0.998	112.55	108.01	1.042
12. Vanguard Windsor	91.29	85.37	1.069	107.05	98.63	1.085
All Funds:						
Mean	*79.38*	*82.49*	*0.962*	*92.92*	*92.44*	*1.004*
Std.Dev.	*10.88*	*10.08*	*0.055*	*12.91*	*11.15*	*0.042*
Top 5 Funds:						
Mean	*75.77*	*80.37*	*0.944*	*88.73*	*89.61*	*0.991*
Std.Dev.	*5.08*	*6.37*	*0.042*	*6.04*	*6.23*	*0.032*
Panel 2: Index Fund						
S&P 500	84.48	97.77	0.864	99.15	106.95	0.927

Table 6: Asset Location Results with Taxes From 1998
The results in this table differ from those in Table 3 by using the tax rates from 1998 instead of the historical taxes from 1962-1998.

	High-Tax Individual			Medium-Tax Individual		
	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth
Panel 1: Actively-Managed Mutual Funds						
01. Mass Inv Trust	90.78	90.24	1.006	98.45	96.25	1.023
02. IDS Stock	80.18	79.20	1.012	86.52	85.29	1.014
03. LA Affiliated	92.01	87.60	1.050	99.84	94.61	1.055
04. Fund Investors	89.32	93.18	0.959	96.80	99.33	0.975
05. United Acc	81.41	76.66	1.062	87.89	84.24	1.043
06. Mass Inv Growth	93.02	94.49	0.984	100.97	100.02	1.009
07. Fidelity Fund	100.96	93.81	1.076	109.91	102.68	1.070
08. Dreyfus	74.41	68.74	1.083	80.03	75.48	1.060
09. Inv Co of America	101.29	101.63	0.997	110.28	108.23	1.019
10. Fidelity Trend	71.45	72.40	0.987	76.68	77.69	0.987
11. VK Enterprise	109.52	104.93	1.044	119.53	111.31	1.074
12. Vanguard Windsor	102.46	94.73	1.082	111.58	102.82	1.085
All Funds:						
Mean	*90.57*	*88.13*	*1.028*	*98.21*	*94.83*	*1.035*
Std.Dev.	*11.88*	*11.46*	*0.043*	*13.37*	*11.67*	*0.036*
Top 5 Funds:						
Mean	*86.74*	*85.37*	*1.018*	*93.90*	*91.94*	*1.022*
Std.Dev.	*5.53*	*7.13*	*0.041*	*6.22*	*6.78*	*0.031*
Panel 2: Index Fund						
S&P 500	96.57	101.86	0.948	104.97	108.43	0.968

Table 7: Wealth Distribution with Bootstrap-Simulations

The probability distributions of the real wealth levels of a high-income individual are shown for the two location strategies. Individuals randomly choose one equity fund and contribute as described in Table 3. The returns of the assets are bootstrapped 10,000 times.

	Cumulative Distribution						
	0.001	0.010	0.100	0.500	0.900	0.990	0.999
Panel 1: All Actively-Managed Funds							
Wealth 'Defer Stocks First'	14.80	20.31	31.16	55.87	107.53	195.71	343.71
Wealth 'Defer Bonds First'	13.81	19.65	30.13	53.65	101.00	186.57	312.93
Relative Wealth	0.686	0.780	0.885	1.050	1.228	1.397	1.577
Panel 2: Top 5 Actively Managed Funds							
Wealth 'Defer Stocks First'	14.55	19.46	29.94	51.81	93.73	155.08	211.14
Wealth 'Defer Bonds First'	13.81	18.76	28.55	48.82	84.98	133.24	188.42
Relative Wealth	0.762	0.820	0.920	1.069	1.24	1.411	1.579
Panel 3: Index Fund							
Wealth 'Defer Stocks First'	14.98	20.24	32.01	57.18	106.92	182.06	264.07
Wealth 'Defer Bonds First'	14.82	19.95	32.44	58.05	105.26	173.70	259.52
Relative Wealth	0.706	0.762	0.854	0.995	1.152	1.298	1.460

Table 8: Certainty Equivalents of Bootstrap Results

This table records the certainty equivalents of the bootstrap simulations of the two location strategies for a high-tax individual with a constant relative risk aversion (CRRA) utility function. The wealth resulting from the investment in the two accounts is the only income source at retirement. The returns are bootstrapped 10,000 times.

	Coefficient of Relative Risk Aversion				
	0	1	3	5	10
Panel 1: All Actively-Managed Funds					
CE 'Defer Stocks First'	64.86	57.20	45.96	38.02	26.11
CE 'Defer Bonds First'	61.64	54.67	44.23	36.67	25.46
Relative CE	1.052	1.046	1.039	1.037	1.026
Panel 2: Top 5 Actively Managed Funds					
CE 'Defer Stocks First'	58.09	52.46	43.30	36.31	24.90
CE 'Defer Bonds First'	53.78	49.11	41.16	34.82	24.73
Relative CE	1.08	1.068	1.052	1.043	1.007
Panel 3: Index Fund					
CE 'Defer Stocks First'	64.89	57.93	46.80	38.57	26.63
CE 'Defer Bonds First'	64.86	58.27	47.23	38.66	26.44
Relative CE	1.001	0.994	0.991	0.998	1.007

Table 9: Features of Various Types of Fixed Income Securities

	Corporate Bonds	Municipal Bonds	TIPS	Series I Bonds
Inflation Protection	No	No	Yes	Yes
Call Option	Callable	Callable	Non-Callable	Non-Callable
Coupon or Zero	Coupon and Zeros	Coupon and Zeros	Coupon	Zeros
Marketability	Market Traded	Market Traded	Market Traded	Nontransferable; Redeemable at Par
Maturity	Fixed	Fixed	Fixed	Flexible (up to 30 years)
Taxation	Federal, state and local taxation	Can be exempt from all taxation	Federal taxation only; Exempt from state and local tax	Tax Deferred; Exempt from state and local tax
Accumulation Limit	None	None	None	$30,000 per year
Special Features	None	None	None	Tax free if used for college tuition for qualifying households

Table 10: Asset Location Results with Inflation Protected Bonds

This Table reports the average wealth levels of the two location strategies if the real return of the bonds is changed. RT denotes the real return of TIPS and RI denotes the real return of I-Series bonds. The base case is summarized in Panel 3.

	High-Tax Individual			Medium-Tax Individual		
	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth	Wealth at Retirement 'Defer Stocks First'	Wealth at Retirement 'Defer Bonds First'	Relative Wealth
Panel 1: RI=2.6% RT=3.0%						
All Actively-Managed Funds	82.88	77.80	1.064	92.72	86.37	1.072
Top 5 Actively-Managed Funds	78.60	75.04	1.048	88.08	82.98	1.062
Index Fund	88.30	91.28	0.967	99.14	99.00	1.001
Panel 2: RI=3.1% RT=3.5%						
All Actively-Managed Funds	86.90	82.01	1.059	97.43	91.20	1.066
Top 5 Actively-Managed Funds	82.26	78.97	1.042	92.42	87.56	1.056
Index Fund	92.50	96.34	0.960	104.09	104.85	0.993
Panel 3: RI=3.6% RT=4.0%						
All Actively-Managed Funds	91.15	86.51	1.053	102.42	96.36	1.061
Top 5 Actively-Managed Funds	86.15	83.11	1.037	97.02	92.44	1.050
Index Fund	96.85	101.68	0.953	109.28	110.97	0.985

Table 11: Wealth Distribution with Inflation Protected Bonds
The probability distribution of the real wealth levels of a high-income individual is shown for the two location strategies. Individuals randomly choose one equity fund initially and contribute as described in Table 3. The returns of the assets are bootstrapped 10,000 times. The annual real return of I-Bonds is 3.6 percent and of TIPS is 4 percent.

	Cumulative Distribution						
	0.001	0.010	0.100	0.500	0.900	0.990	0.999
Panel 1: All Actively-Managed Funds							
Wealth 'Defer Stocks First'	20.54	27.26	38.31	63.01	111.28	198.80	377.03
Wealth 'Defer Bonds First'	20.15	26.63	38.47	62.05	101.29	182.25	323.20
Relative Wealth	0.742	0.807	0.900	1.018	1.202	1.35	1.444
Panel 2: Top 5 Actively Managed Funds							
Wealth 'Defer Stocks First'	20.81	26.15	37.10	58.00	94.50	136.87	173.80
Wealth 'Defer Bonds First'	19.92	25.06	37.04	57.01	85.26	115.59	138.19
Relative Wealth	0.800	0.844	0.922	1.026	1.194	1.312	1.391
Panel 3: Index Fund							
Wealth 'Defer Stocks First'	22.93	28.41	40.29	65.07	108.25	158.02	208.13
Wealth 'Defer Bonds First'	21.67	28.01	42.09	67.18	103.16	145.13	178.67
Relative Wealth	0.746	0.783	0.862	0.975	1.156	1.251	1.307

Table 12: Certainty Equivalents with Inflation Protected Bonds
This table summarizes the certainty equivalents of the bootstrap simulations for the two location strategies using a constant-relative-risk-aversion (CRRA) utility function.

	Coefficient of Relative Risk Aversion				
	0	1	3	5	10
Panel 1: All Actively-Managed Funds					
CE 'Defer Stocks First'	70.93	64.41	54.87	47.97	36.81
CE 'Defer Bonds First'	67.88	62.58	54.18	47.40	35.76
Relative CE	1.036	1.029	1.013	1.012	1.029
Panel 2: Top 5 Actively Managed Funds					
CE 'Defer Stocks First'	62.62	58.62	51.69	46.03	35.97
CE 'Defer Bonds First'	59.54	56.52	50.64	45.13	34.56
Relative CE	1.052	1.037	1.021	1.020	1.041
Panel 3: Index Fund					
CE 'Defer Stocks First'	70.52	65.57	57.036	50.25	39.04
CE 'Defer Bonds First'	70.62	66.50	58.56	51.26	38.35
Relative CE	0.992	0.986	0.974	0.980	1.018