

Taxable Bond Investing:  
Bond Funds or Individual Bonds?  
Vanguard Investment Counseling & Research  
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Executive summary

For most taxable bond investors, bond mutual funds have a number of advantages over individual bond portfolios in terms of diversification, cash-flow treatment and portfolio characteristics, liquidity, and costs. Individual bonds do provide certain benefits compared with bond mutual funds, and these advantages revolve primarily around a preference for control over security-specific decisions in the portfolio. The cost of this advantage can be thought of as a "control premium" that is reflected in generally higher (or additional) transaction costs, lower liquidity, more limited return opportunities, and higher bond portfolio risk. The cost of the control premium is more pronounced for buyers of corporate bonds and mortgage-backed securities than for buyers of U.S. Treasuries.

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Introduction

Introduction  
1 portfolios of individual bonds, generally provide greater diversification; more regular cash flows that promote stability of portfolio characteristics; better liquidity; and lower transaction and operating costs. Second, we explore the unique advantages of a mutual fund portfolio in three discrete sectors of the taxable fixed income market: corporate bonds, mortgage-backed securities, and U.S. Treasury bonds.

The paper's final section describes the limited situations in which a portfolio of directly held bonds can provide advantages over a mutual fund. We characterize most of these advantages as "control" benefits, and refer to their potentially higher cost as the "control premium." This control becomes more limited when considering bonds with options, such as corporate and mortgage-backed securities.

It is important to note that the main areas in which a mutual fund exhibits advantages over a portfolio of directly held bonds are ones that have a marked impact on a bond portfolio's risk and return characteristics. For a portfolio of directly held bonds, on the other hand, the control advantage is primarily driven by preference.

To help frame some of the concepts discussed in this paper, we begin with a primer on bond pricing. We want to emphasize, first, the common misconception that there is a benefit to receiving principal back at maturity. If that principal is simply

reinvested and not used to fund a cash flow, there is no benefit in holding a bond to maturity. Consider that the total return of a laddered separate account with characteristics identical to those of an open-end mutual fund will deviate from the fund's return only by the transaction and operational cost differentials.

Bond pricing

Regardless of the type of bond, the pricing process uses the same formula:

$$P = \frac{CF}{(1+y)^1} + \frac{CF}{(1+y)^2} + \dots + \frac{CF}{(1+y)^n} + \frac{M}{(1+y)^n}$$

Where:

- P0 = Price of the bond;
- CF = Expected coupon interest (in \$) and principal repayment (in \$);
- M = Maturity value (in \$);
- n = Number of periods;
- y = Yield to maturity.

This formula outlines the factors that influence bond prices: the coupon (CF), the value at maturity (M), and the number of periods that the bond will earn interest (n). The price of any financial instrument is determined by the present value of the cash flows from the investment. Discounting back to the present value takes the time value of money into account and utilizes the market rate of return (represented by y in the above equation) for holding such financial instruments. For a bond, these cash flows are the periodic interest and principal payments plus the maturity value.

A bond's price is inversely related to the change in interest rates: When interest rates rise, a bond's price falls. This is because a bond's coupon payments are typically fixed at issuance, leaving the price as the only variable that can adjust to make an existing bond's yield competitive with that of newly issued bonds. Thus, when interest rates change, the price of each bond adjusts so that comparable bonds with different coupon rates provide the investor with the same yield to maturity. When evaluating bonds with the same characteristics but different coupon payments, it is therefore always best to compare the yield to maturity of each bond. This is illustrated in Table 1.

1 Portfolio structure in which approximately equal amounts of dollars are invested in individual bonds with increasingly longer maturities.

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Table 1. When evaluating bonds, compare the yields to maturity

Table 1. When evaluating bonds, compare the yields to maturity

Coupon (annual interest payment) 9% 6% 4% 0%

Price (percentage of face value) 129.14% 100% 80.58% 41.73%

Yield to maturity 6% 6% 6% 6%

Source: Vanguard Investment Counseling & Research.

If 15-year bonds are currently yielding 6%, the price of a 4% bond—to be competitive—must decline to a level that results in a 6% yield to maturity. In the example in Table 1, the price is 80.58% of face value (or \$805.80 per \$1,000 face value). The 4% bond would provide the same return as the 6% bond at par, but some of the return would come from the bond's appreciation from \$805.80 to its \$1,000 value at maturity, as opposed to the coupon payments.

This example also illustrates why investors holding discount bonds are wise not to try to "trade up" to current-coupon bonds. Since the 4% bond's price has already adjusted to compensate for the lower coupon, from that point forward the yield to maturity would be the same—6%—whether an investor holds the 4% bond to maturity or buys the 6% par bond. Since the yield-to-maturity calculation does not incorporate transaction costs, an investor's yield would actually be lower if the 4% bond were sold and replaced with the 6% bond than if the 4% bond were held to maturity. (Note: Investments in bond funds are subject to interest rate, credit, and inflation risk. Investors in any bond fund should anticipate fluctuations in price, especially for longer-term issues and in environments of rising interest rates.)

#### A mutual fund's structural advantages

Once an appropriate allocation to bonds has been determined, a decision must be made as to how to implement the investment strategy. The options include a professionally managed mutual fund, a professionally managed separate account, or a self-directed portfolio of individual bonds. The mutual fund structure generally provides an advantage over separate and self-directed accounts in terms of diversification, cash-flow treatment and portfolio characteristics, liquidity, and costs.

#### Diversification

Bond mutual funds typically provide broader diversification as to issuers, credit qualities, maturities, and bond characteristics (callable or noncallable, senior or subordinated debt, for example) than is possible with alternative account structures. This greater diversification is possible

because a bond fund generally has a larger pool of investable assets, along with the professional staff needed to conduct thorough analyses of individual securities and market characteristics, thus allowing a fund manager to diversify widely and cost-effectively. Although diversification can never eliminate the risks of investing, broad diversification reduces the nonsystematic (and, in theory, unrewarded) risk that comes from owning either too few securities or securities with similar characteristics.

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Cash-flow treatment and portfolio characteristics

Cash-flow treatment and portfolio characteristics

In a bond mutual fund, an investor can purchase a proportionate share of a completely constructed portfolio with a single transaction. An individual bond portfolio, by contrast, typically takes time to build. Mutual funds also allow the timely investment of additional cash flows (both income payments and new cash flow). Bond mutual funds pay monthly dividends to their shareholders based on each client's proportionate share of the interest received by the fund from the individual bonds that it owns. Investors can opt either to have these dividends paid out to them or to have them automatically reinvested into the fund. In a separate account or self-directed bond portfolio, cash from bond coupon payments (assuming reinvestment) or new investments may need to accumulate until it is sufficient for a round-lot purchase and/or until the bond of choice is available. Because the yield curve is typically upward sloping, bonds have historically produced higher returns than cash investments such as money market instruments (the most common "parking place" for money that can't yet be invested). A mutual fund's more timely investment of new cash and reinvestment of income can reduce the "cash drag" on performance.

As Figure 1 shows, reinvesting a bond portfolio's income is critical to maximizing its long-term total returns. From December 31, 1986, through December 31, 2005, the compounded total return earned on reinvested income for the Lehman Brothers Aggregate Bond Index accounted for a majority (53%) of the index's return for the period.

The actual income distributions provided the other major portion (45%) of the performance. The capital return on the original \$50,000 investment accounted for only a small amount (2%) of the performance. Therefore, NAV (net asset value), or price change, of a bond investment over a long time horizon is not significant. During this period, the maximum decline in capital was approximately 9%, and the maximum gain was about 13%.

An additional benefit of bond funds' more regular cash flows is that the funds can provide more stable risk characteristics (most important, that of duration—a measure of the sensitivity of bond prices to interest rate movements) than those of alternative structures. The duration of laddered individual bond portfolios drifts down over time and jumps back up as cash flows are reinvested. Because these portfolios typically hold fewer securities, a larger percentage of the portfolio matures less frequently and gets reinvested into the portfolio, potentially causing more dramatic changes in the portfolio's duration. As stated, a portfolio with fewer bonds, which may also include concentrated positions, is especially prone to this effect. In a diversified mutual fund, however, cash flows are reinvested more frequently, and each maturing bond returning principal represents a much smaller percentage of the overall portfolio. This keeps the fund's risk characteristics more stable over time.

Finally, a bond mutual fund also allows an investor to sell bond assets more cost-effectively, especially in the case of partial liquidations. Although liquidation of fund shares does not change a bond portfolio's overall risk profile, liquidations from an individual bond portfolio may require selling a whole bond, which does alter the portfolio's overall risk characteristics. To properly maintain the portfolio's risk profile, a small percentage of each bond would need to be sold—obviously not a viable solution. In addition, liquidating a portion of a position in a particular security can be expensive owing to bid-ask spreads and other transaction costs.

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- Vanguard Investment Counseling & Research > 5 Costs

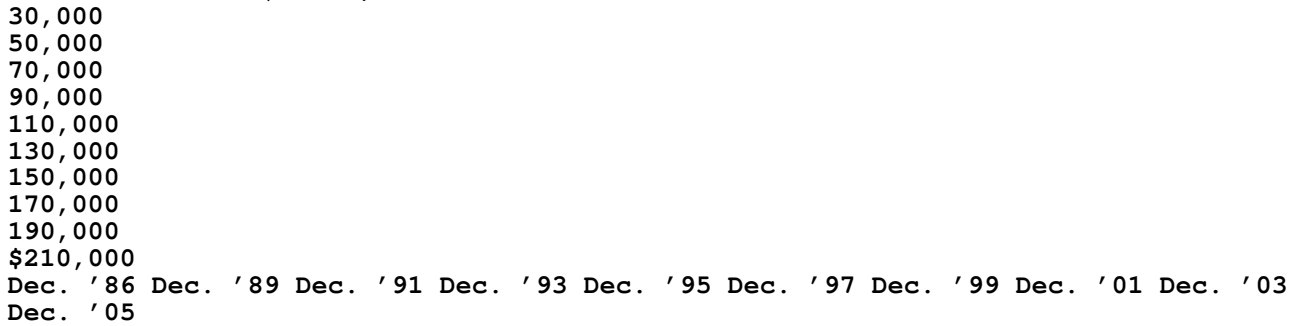
All bond portfolios incur costs. Mutual funds and professionally managed separate accounts bear operating and transaction costs. A self-directed bond portfolio incurs only transaction costs, but is subject to many other limitations that can be considered "opportunity" costs. These opportunity costs can also be a factor in separate accounts. Investment costs associated with taxable bonds primarily fall into two categories: management costs and transaction costs.

Management costs. Both bond mutual funds and professionally managed separate accounts charge ongoing fees to manage the portfolio. Bond funds charge an ongoing management fee (expense ratio) for fund-operating expenses. This expense ratio includes the cost not only of portfolio management but also of legal, accounting, custody, and recordkeeping services. While investment management cost is a widely recognized component of a fund's expense ratio, these additional operational expenses are also important, though less frequently understood.

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Separately managed accounts typically charge an investment management fee, as well as additional administrative fees for some of these same operational expenses. Because the cost of these services is shared over a large asset base, mutual funds can typically provide all of these services at proportionately lower costs than can separately managed accounts.

Figure 1. Growth of \$50,000 in Lehman Brothers Aggregate Bond Index (December 31, 1986-December 31, 2005)



July 31, 1989

Capital ending value \$49,014

Total income 11,028

Total interest on interest + 1,769

Ending value \$61,811

December 31, 2005

Capital ending value \$ 53,492

Total income 66,636

Total interest on interest + 77,704

Ending value \$197,832

Interest on interest total return = 155%; 53% of total index return

Income total return = 133%; 45% of total index return

Capital total return = 7%; 2% of total index return

Sources: Vanguard Investment Counseling & Research; derived from data provided by Lehman Brothers.

Past performance is not a guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

Table 2. Typical annual investment management fees for separate accounts  
Core investment-grade accounts— Annual fees by account size (in basis points)

|                                    |       |       |       |       |       |       |       |       |
|------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| U.S. fixed income (in \$ millions) | \$5   | \$10  | \$25  | \$50  | \$75  | \$100 | \$150 | \$250 |
| 10th percentile                    | 50 bp | 50 bp | 44 bp | 38 bp | 36 bp | 35 bp | 32 bp | 31 bp |
| 90th percentile                    | 30    | 30    | 25    | 22    | 21    | 19    | 17    |       |
| Average                            | 42    | 39    | 35    | 31    | 29    | 28    | 26    | 24    |
| Sample size                        | 106   | 189   | 235   | 258   | 265   | 266   | 266   | 266   |

Source: Global Investment Management Fee Study (Chicago: Mercer Investment Consulting, October 2004)

Table 3. Examples of separate-account program client-fee schedules (in basis points)

Fixed income accounts

Firm type Breakpoint 1 Breakpoint 2 Breakpoint 3 Breakpoint 4 Breakpoint 5

Wirehouse #1\* First \$500k Next \$500k Next \$4 million > \$5 million N.A.

125 bp 100 bp 80 bp flat rate or negotiable

Wirehouse #2\* First \$500k Next \$500k Next \$4 million > \$5 million N.A.

125 bp 110 bp 100 bp 80 bp

Regional\*\* First \$500k Next \$300k Next \$1 million > \$2 million N.A.

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150 bp 125 bp 100 bp 75 bp

Independent† First \$500k Next \$1.5 million Next \$2.5 million > \$2.5 million N.A.

260 bp 210 bp 160 bp 110 bp

Source: Cerulli Quantitative Update: Managed Accounts, 2005 (Boston: Cerulli Associates).

Notes: All firms' competitive information is presented in industry aggregate or nonspecific form, as proprietary survey information is never directly attributed to participants. Specific firm data are referenced using generic monikers (e.g., Wirehouse #1 or #2).

\*The largest group of full-service broker-dealer firms, all based in New York. These are Merrill Lynch, Smith Barney, Morgan Stanley, UBS PaineWebber, and Prudential Financial.

\*\*Full-service broker-dealer firms with a strong concentration of offices in one region of the United States—for example, A.G. Edwards, RBC Dain Rauscher, and Robert W. Baird.

†Broker-dealer firms that may be of any size, but most are small (fewer than 1,000 advisors). Advisors are affiliated independent contractors, rather than direct employees, and may switch broker-dealer firms at any time.

The annual expense ratio for the average taxable bond mutual fund is 0.65%,<sup>2</sup> with fund expense ratios ranging from 0.05% to 3.37%. Bond funds at the lower end of the cost spectrum are readily available. For example, for a \$10 million ladder Treasury mutual fund portfolio—constructed using low-cost, short-, intermediate-, and long-term share classes available—the annual expense ratio could be

as low as 0.15%, or \$15,000. As illustrated in Tables 2 and 3, investors commonly pay more for separate-account management. Table 2 reflects typical investment management fees (additional costs may exist for administrative expenses) for large institutional separate accounts, while Table 3 is more reflective of fees paid by individual investors in managed separate-account programs.

<sup>2</sup> Derived from Lipper Inc.; data as of June 30, 2006, representing the asset-weighted averages of the Short/Intermediate-Term U.S. Treasury and Government Funds, Short/Intermediate-Term Corporate Fixed Income Funds, and General Domestic Taxable Fixed Income Funds.

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It should be noted that, in specific instances, fees for some separate accounts may be negotiated lower. Tables 2 and 3, however, provide examples of fee schedules two to three times higher than those of low-cost professionally managed mutual funds. Considering that "real" (inflation-adjusted) bond returns historically have ranged from 2% to 3% annually, high costs can eat a large portion of those returns. For example, increasing the annual cost by 50 basis points would reduce a 2% historical "real" bond return by 25%. Regardless of the structure, costs are important because they directly reduce the total return of a bond portfolio.

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Figure 2. Performance distribution of intermediate-term investment-grade bond funds versus Lehman Aggregate Bond Index: Ten years ended December 31, 2005

0  
 10  
 20  
 30  
 40  
 50  
 60  
 70  
 80  
 Number of funds  
 3  
 51  
 67  
 16  
 12% Better (16 funds) 88% Worse (121 funds)  
 <-2 -2 to -1 -1 to 0 0 to 1  
 Return difference (in percentage points)  
 Number of funds Lehman Aggregate Bond Index

Sources: Lipper Inc., Lehman Brothers, and Vanguard Investment Counseling & Research.

Past performance is not a guarantee of future returns. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.

Table 4. Higher expenses tend to result in lower returns

|  | Median expense ratio (%) | Median return (%) |
|--|--------------------------|-------------------|
| Short-term corporate/government        |                          |                   |
| Quartile 1                             | 0.50                     | 4.94              |
| Quartile 2                             | 0.70                     | 4.55              |
| Quartile 3                             | 0.87                     | 4.66              |
| Quartile 4                             | 1.42                     | 4.14              |
| Intermediate-term corporate/government |                          |                   |
| Quartile 1                             | 0.48                     | 6.17              |
| Quartile 2                             | 0.73                     | 5.60              |
| Quartile 3                             | 0.95                     | 5.35              |
| Quartile 4                             | 1.59                     | 4.71              |



Source: Lipper Inc.

Note: Ten-year annualized returns ended May 31, 2006.

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Table 5. Option-adjusted spread of credit qualities in  
Lehman U.S. Credit Index (as of May 31, 2006)

Table 5. Option-adjusted spread of credit qualities in  
Lehman U.S. Credit Index (as of May 31, 2006)

Quality  
Aaa  
Aa  
A  
Baa  
Market-value  
percentage  
11.3  
20.6  
36.1  
32.0  
spread (relative  
to Treasuries)  
39 bp\*  
61 bp  
81 bp  
117 bp  
\*bp, basis points.

Transaction Costs. Because the size of a mutual fund trade usually exceeds that of a separately managed account, mutual funds have more opportunity to minimize the negative impact of transaction costs. For example, the bid-ask spread, a transaction cost, tends to vary by trade size and bond sector, and the size of these spreads is typically larger for small transactions. Bond funds buy and sell a large amount of bonds, with trades routinely exceeding \$1 million. The larger transactions can command higher selling prices and lower prices on buys. So long as bid-ask spreads are inversely related to purchase lot size, the entity with more resources (scale) will have an advantage. The benefits of scale are most significant in non-Treasury sectors of the bond market, and are less so (but still important) among Treasuries.<sup>3</sup> On balance, fewer separate-account managers boast comparable scale. However, at times, professional separate-bond-account managers and large institutions can trade in a size similar to that of mutual funds and therefore receive bid-ask spreads similar to those of mutual funds.

Scale can also influence the opportunity costs incurred in different account structures. For example, a smaller separate account or a self-directed investor can easily reduce transaction costs by purchasing fewer securities, but this seemingly sensible decision produces an opportunity cost: potentially lower returns and reduced diversification. If a portfolio doesn't have

sufficient assets to diversify widely, the most obvious way to reduce default risk is by concentrating in bonds of the highest quality, thus sacrificing the potentially higher returns normally available from lower-quality issues. A large mutual fund, by contrast, can hedge default risk by diversifying widely across lower-quality bonds, minimizing the effect of any one default while capturing the returns available from lower-quality securities. Table 5 outlines the option-adjusted spread (relative to Treasuries) for the Lehman U.S. Credit Index as of May 31, 2006. As the table indicates, the difference in the option-adjusted spread between Aaa and Baa credits was 78 basis points.

The basic decision comes down to this: Does the mutual fund expense ratio detract less from the portfolio's total return than either: (1) the return surrendered by the credit-quality bias, if chosen?

(2) the default risk if the quality bias is not chosen? or (3) the additional transaction costs? It would be a rare occasion for the mutual fund expense ratio (particularly for a lower-cost bond fund) to be larger than either of the other costs.

As shown in Table 6, the mutual fund structure primarily provides advantages regarding diversification, more regular cash flows that promote stability of portfolio characteristics, better liquidity, and lower transaction and operating costs. Individual bond ownership (either in a professionally managed portfolio or self-directed) mainly provides an advantage in a greater ability to directly control various aspects of the portfolio.

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The impact of trade size on transaction costs is also noted in several recent studies, including: Amy K. Edwards, Lawrence E. Harris, and Michael S. Piwowar, 2004, Corporate Bond Market Transparency and Transaction Costs (Working Paper, Social Science Research Network); and Sugato Chakravarty and Asani Sarkar, 2003, Trading Costs in Three U.S. Bond Markets, Journal of Fixed Income 13: 39-48.

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Table 6. Summary of structural advantages of taxable bond funds versus individual bonds

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1. Diversification Diversification advantage

a. Among issuers, credit quality, and term structure. +

2. Cash-flow treatment and portfolio characteristics Cash-flow/characteristics advantage

a. Timely initial and periodic investments. +

b. Maintenance of portfolio risk characteristics (cash flows/duration). +

c. Ease of partial liquidations. +

3. Costs Cost advantage

a. Management fees. + +

(Versus professionally (Self-directed) managed separate accounts)

- b. Transaction. +
- 4. Direct control of the portfolio Control advantage
  - a. Non-inflation-adjusted liability funding. +
  - b. Security selection (credit-quality target, etc.). +
  - c. Principal at maturity. +

Notes: A plus sign (+) indicates which alternative has the advantage. Some of the bond fund advantages cited in the table are more pronounced for corporate bonds and mortgage-backed securities than for Treasury bonds. These advantages are addressed in more detail in this paper.

Mutual fund structural advantages  
specific to corporate, mortgage-backed,  
and U.S. Treasury bond markets

Owing to their structural advantages, mutual funds can offer unique benefits in different sectors of the bond market. This section explores advantages of mutual funds in the corporate bond, mortgage-backed securities, and Treasury bond markets.

#### Diversification

Corporate bonds. In the corporate bond market, the dynamic nature of bond credit risk makes it essential to diversify nonsystematic risk. Corporate bonds are particularly sensitive to changes in their credit

ratings. The price volatility that results from a change in an issue's credit rating is typically asymmetrical: The magnitude of the decrease in a bond's value in anticipation of or in response to a credit downgrade is usually much greater than the increase in value for an upgrade. Therefore, for investors in corporate bonds, the penalty for choosing a bond that is downgraded is usually greater than the reward for choosing a bond that gets upgraded. As a result, credit analysis is an essential part of corporate bond investment strategy.

While many bonds are evaluated by industry credit-rating services (e.g., Standard & Poor's, Moody's Investors Service), and public access to bonds' current ratings is available, the market is more concerned with what a bond's rating will be in the future than

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with what it is currently. Frequently, a majority of a bond's relative price decline (when a downgrade is involved) occurs prior to the actual downgrade. Credit diversification and effective credit analysis can help minimize a portfolio's exposure to issues that hamper a portfolio's returns. As bonds of lower credit quality are included in the portfolio, the importance of both broad credit diversification and credit analysis increases. These are significant factors, considering that about 68% of the bonds in the Lehman U.S. Credit Index were rated as either A or Baa (according to Moody's), the lowest two levels of investment-grade bonds, as of May 31, 2006.

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U.S. Credit Index.<sup>4</sup> Again, this assumes an "optimally" structured portfolio with yield-curve and sector and quality risks matched to the index. This would not be typical of a self-directed portfolio constructed by a nonprofessional; rather, such a portfolio is much more likely to be built by larger, more sophisticated, separate-account managers or professionally managed mutual funds. The 100 securities would represent the minimal diversification needed. This also does not account for the fact that bond investors must assume that during periods of bond market stress, volatility can be substantial. Therefore, an even larger number of securities might be warranted for adequate diversification. As a result, constructing such a portfolio would require a substantial dollar commitment by the investor: Investing \$50,000 in only 100 issues would require a \$5 million bond allocation. In contrast to the challenge of building a portfolio of individual corporate bonds, mutual funds provide readily available, diversified portfolios.

Mortgage-backed securities. In the mortgage-backed market, the need for diversification occurs not so much at the credit level as at the mortgage pool level. The credit quality of most mortgage-backed securities is generally considered second only to that of Treasuries, thus minimizing the need for credit analysis. However, diversifying the mortgage pools in a portfolio can be beneficial. The underlying mortgages in a pool are grouped by similar maturity dates and coupon rates. The varying characteristics of the pools that are constructed can cause them to react very differently to various market environments, potentially causing high price volatility. In addition, within a specific mortgage coupon and maturity, investors benefit by owning pools that contain numerous underlying loans, thus minimizing the negative impact of any single refinancing.

As with corporate bond investing, bond mutual funds provide readily available, diversified portfolios. Due to the larger minimums needed to invest in Government National Mortgage Association (GNMA) pools, a mutual fund of mortgage-backed securities provides investors with the ability to be well diversified and fully invested from the first dollar invested. Individual mortgage-backed portfolios, however, typically take time to build and usually do not have a large number of securities.

U.S. Treasury bonds. Mutual funds have little or no advantage over a Treasury bond ladder in terms of diversification, so long as the portfolio's value is significant enough to permit complete diversification across maturities in the ladder's term. As direct obligations of the U.S. government, Treasuries enjoy a degree of creditworthiness unequalled in the 4 Dynkin, J. Hyman, and V. Konstantinovskiy, May 2002, Sufficient Diversification in Credit Portfolios, Lehman Brothers Fixed Income Research.

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taxable bond world. As a result, they are generally considered immune from credit risk, and the cost of credit analysis is not rewarded. Also, Treasuries issued after 1985 are not callable, thus simplifying the bond-selection process and resulting in more certain principal reinvestment schedules.

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The typically lower management cost of a mutual fund compared with that of a professionally managed separate account—albeit higher than for a self-directed bond portfolio—may be an acceptable cost for most Treasury bond investors. Offsetting that cost are conveniences and benefits already described, such as professional management and the reinvestment of cash flows. (Note: While U.S. Treasury or government agency securities provide substantial protection against credit risk, they do not protect investors against price changes due

to changing interest rates. The market values of government securities are not guaranteed and will fluctuate.)

Cash-flow treatment and portfolio characteristics  
Mortgage-backed securities. The ability to implement an initial investment and then invest periodic cash flows—or liquidate an investment—in a timely manner is an especially important benefit in the mortgage-backed market. Individual mortgage-backed securities pay income and return a portion of principal on a monthly basis. These principal payments represent the principal paid down by homeowners on the mortgage loans held by the mortgage-backed securities pool. While an individual mortgage-backed security pays this principal directly to investors, a bond fund containing mortgage-backed securities automatically uses these payments to purchase more mortgage-backed pools. This automatic reinvestment of principal is one advantage of a mutual fund structure when investing in mortgage-backed securities.

Holders of individual mortgage-backed securities have another concern: uncertainty as to the duration and amount of their securities' monthly payouts. The interest income paid by mortgage-backed bonds drops as they age, because the loan's principal value is paid down and the security's constant coupon rate paid is being applied to a shrinking amount of principal in the mortgage pool. Moreover, as interest rates rise and fall, the amount of principal repayment falls and rises, respectively, introducing another level of uncertainty.

As interest rates fall, homeowners accelerate or refinance their mortgages, thereby repaying more principal on the old mortgages and causing the pool's monthly principal payment to rise. The opposite occurs when interest rates rise: Homeowners make their normal payments and do not attempt to pay down principal, causing the pool's monthly principal payment either to fall to a more normal level or stay

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 Figure 3. Unlike the broad bond market, GNMA duration moves drastically with interest rates

Figure 3. Unlike the broad bond market, GNMA duration moves drastically with interest rates

8  
6  
4  
2  
0

Duration and percentage yield

Dec. '89 Dec. '93 Dec. '01 Dec. '03 Dec. '05 Dec. '95 Dec. '97 Dec. '99 Dec. '91

30-year GNMA duration  
Lehman Aggregate Bond Index duration  
10-year Treasury yield

Sources:

Vanguard Investment Counseling & Research; derived from data provided by Lehman Brothers.

constant. Mutual funds are less subject to these gyrations in income streams, because these fluctuating principal payouts can be continually reinvested in new securities with different coupon rates. The income distributions from a mortgage-backed securities mutual fund tend to correlate more closely with interest rates than with the behavior of a specific mortgage-backed pool. The payout of an individual pool and security tends to be negatively correlated with interest rates.

Figure 3 illustrates how interest rate changes

can affect the duration of a single mortgage-backed security relative to a more diversified fixed income portfolio. For example, at the end of March 2004, the average duration for 30-year GNMA's was a little over 2 years; two months later, as the general level of interest rates rose and fewer homeowners refinanced their mortgage loans, the duration of 30-year GNMA pools rose to almost 4 years. Although this volatility also exists in a mutual fund, it is muted by the fund's ability to diversify across a range of mortgage pools with different maturities and characteristics.

A final complication caused by repayments of principal in an individual mortgage-backed security is that as the original principal amount shrinks, the security may become difficult to sell, given the minimal demand for so-called odd-lot bonds of small principal amounts. A mortgage-backed bond fund does not face these liquidity concerns, as the fund would simply allow these bonds to eventually liquidate themselves through monthly principal payouts. Any shareholder redemptions could be easily financed from the fund's ongoing cash flows.

Primary advantage of owning individual bonds

Direct control of portfolio

Although, as described here, the mutual fund structure boasts significant investment merits over self-directed individual bond portfolios and professionally managed separate accounts, these alternative structures offer one notable advantage over mutual funds: the ability to control security-specific portfolio decisions. The value of this benefit is most apparent in situations where an investor wishes to match the maturity and face value of a bond with a known nominal (before inflation) future liability. Bond mutual funds do not have a maturity date, so the value of the fund at any point in the future is uncertain. When an investor has a predetermined future spending need, however—particularly if it is a near-term need—an individual bond that matures when the money is required may be preferable to a bond mutual fund. As stated in the introduction to this paper, this control becomes much more limited for bonds with options, such as corporate and mortgage-backed securities.

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This cash-flow matching strategy (a form of asset-liability matching) involves purchasing individual bonds that carry coupon payments and par values at maturity precisely matching the value of liabilities coming due. Cash-flow matching is the most conservative and passive asset-liability-matching strategy. Once cash flows are matched, the asset portfolio need only be adjusted for changing liabilities. Cash-flow matching can be a very inflexible process, however, and is often costly to implement, because it requires that expected payment streams exactly match the cash flows of fixed income investments. One method of cash-flow matching is to build an asset portfolio of zero-coupon bonds that match liability maturities. Specifically, Treasury STRIPS, because of their lack of default risk, may be the most straightforward way to match liability cash flows. This cash-flow matching strategy (a form of asset-liability matching) involves purchasing individual bonds that carry coupon payments and par values at maturity precisely matching the value of liabilities coming due. Cash-flow matching is the most conservative and passive asset-liability-matching strategy. Once cash flows are matched, the asset portfolio need only be adjusted for changing liabilities. Cash-flow matching can be a very inflexible process, however, and is often costly to implement, because it requires that expected payment streams exactly match the cash flows of fixed income investments. One method of cash-flow matching is to build an asset portfolio of zero-coupon bonds that match liability maturities. Specifically, Treasury STRIPS, because of their lack of default risk, may be the most straightforward way to match liability cash flows.

One important limitation of cash-flow matching strategies is that they typically can't account for the effect of inflation on the liability amount. For example, if a general liability is \$30,000 today, what should be budgeted for the future value of that \$30,000 payment 15 years from now? Matching a \$30,000 liability with a \$30,000 bond does not take into consideration the fact that, owing to inflation, the liability may be higher when it becomes payable. Future inflation is difficult to estimate, but to forecast the idiosyncratic inflation rate associated with a particular liability (medical costs, construction) is even more problematic. Therefore, a passive approach (such as the purchase of a single bond or a bond ladder) usually results in the "real" (inflationadjusted) liability being either over-funded or underfunded, depending on the actual inflation rate experienced over the funding horizon.

Matching more certain nominal liabilities with known future dates can be done rather simply with little ongoing intervention. However, when liabilities are more volatile, less certain (due to inflation), and require matching on an infinite basis, an asset-liability matching strategy nearly always demands an active bond-management strategy, which can be extremely



costly and complex. As a result, using individual bonds to accommodate future "real" liabilities is more viable for the short-term than for the long-term. Similarly, short-duration mutual funds—such as money market or short-term taxable bond funds—that have historically experienced little fluctuation in principal (net asset value) might be used to meet these near-term liabilities.

Finally, an individual bond portfolio can be tailored for very specific objectives in which an investor has complete control over the selection of specific bonds or types of bonds. For instance, a specific credit-quality target (such as an all-Aaa portfolio), specific characteristics (no derivatives), or specific call-protection targets are some of the possibilities.

Although a cash-flow-matching strategy is a benefit in limited situations, it's important to reiterate that there is no economic value to receiving principal back at maturity if the principal is used not to fund a cash flow, but simply for reinvestment. As securities in a laddered portfolio mature, they are reinvested, just as they are in a mutual fund, producing the same return in each portfolio. Naturally, it would be very difficult for a separately managed account to achieve cost parity, cash-flow parity, and diversification similar to those of a mutual fund. In essence, when the principal paid at maturity or redemption is reinvested, rather than spent, a laddered portfolio functions similarly to a mutual fund, but with greater costs and less diversification.

5 STRIPS, for Separate Trading of Registered Interest and Principal of Securities, are bonds—usually issued by the U.S. Treasury—whose two components, interest and principal, are separated and sold individually as zero-coupon bonds.

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Figure 4. Hypothetical example of a bond's cumulative cash flow (6% coupon, 15 years to maturity, 3% expected inflation, 3% real interest rate)

Figure 4. Hypothetical example of a bond's cumulative cash flow (6% coupon, 15 years to maturity, 3% expected inflation, 3% real interest rate)

100,000  
80,000  
60,000  
40,000  
20,000

0

Year

Cumulative cash flow

\$85,800

\$77,898

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Inflation payment

Real interest-rate payment

Principal repayment

Annual need (3% inflation rate) Annual need (3% inflation rate first five years; 4% thereafter)

Sources:

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This hypothetical illustration does not represent the return on any particular investment.

The certain repayment of principal should not be a primary issue in a long-term investment strategy. Inflation—and the way it will affect the purchasing power of that principal by the time the bond matures—is the more important issue. Two factors affect whether or not the principal's purchasing power is maintained: (1) whether the investor spends the interest payments, and

(2) whether the forecast annual inflation rate is less than or equal to the actual annual inflation rate for the period. Figure 4 illustrates this point with a hypothetical example.

At the time of initial purchase, a bond's yield includes an assumption about the future inflation rate (including a risk premium tied to the level of uncertainty regarding future inflation). This portion of the yield (the "inflation payment") is compensation to offset the expected erosion of the purchasing power. Figure 4 depicts the cumulative cash flows of a bond, with the coupon divided into its inflation payment and real interest-rate payment, and the principal repaid at maturity. The bottom line of the figure illustrates the inflation-adjusted purchasing power of the principal. This hypothetical example starts with an inflation rate of 3%. If that rate continued unchanged, the goods and services that \$50,000 buys today would cost \$77,898 in 15 years.

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Figure 4 also demonstrates that if interest payments are being spent, the \$50,000 principal paid at maturity is far less than the \$77,898 needed to keep pace with inflation. In essence, 15 years from now, \$50,000 would purchase 36% less than it does today. To maintain purchasing power, therefore, only a portion of the interest payments should be spent (the portion representing their real rate), with the balance being reinvested.

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#### Conclusion

For the reasons described in this paper, the vast majority of investors in taxable bond portfolios are best served by low-cost mutual funds. Only those investors with the resources to achieve scale comparable to that of a mutual fund should consider putting certain control features ahead of a mutual fund's benefits. Mutual funds generally provide better diversification, more efficient management of cash flows and portfolio characteristics, better liquidity, and lower costs.

Although directly held bonds can provide certain advantages over bond mutual funds—primarily related to control over security-specific decisions—such control comes at a cost. To construct an individual bond portfolio, an investor must assign a very high value to the control aspect to justify the higher costs and additional risks involved.

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