Fabozzi Bond Markets and Strategies Sixth Edition CHAPTER 22

ACTIVE BOND PORTFOLIO MANAGEMENT STRATEGIES

CHAPTER SUMMARY

This chapter and the two that follow discuss bond portfolio management strategies. We begin with an overview of the investment management process and the factors to consider in the selection of a portfolio strategy, distinguishing between active portfolio strategies and structured portfolio strategies. Active strategies are discussed in this chapter, and structured portfolio strategies are the subject of the next two chapters.

OVERVIEW OF THE INVESTMENT MANAGEMENT PROCESS

Regardless of the type of financial institution, the investment management process involves the following five steps: (i) setting investment objectives, (ii) establishing investment policy, (iii) selecting a portfolio strategy, (iv) selecting assets, and (v) measuring and evaluating performance.

Setting Investment Objectives

The first step in the investment management process is setting investment objectives. The investment objective will vary by type of financial institution.

Establishing Investment Policy

The second step in investment management is establishing policy guidelines for meeting the investment objectives. Setting policy begins with the asset allocation decision so as to decide how the funds of the institution should be distributed among the major classes of investments (cash equivalents, equities, fixed-income securities, real estate, and foreign securities).

Selecting a Portfolio Strategy

Selecting a portfolio strategy that is consistent with the objectives and policy guidelines of the client or institution is the third step in the investment management process. Portfolio strategies can be classified as either **active strategies** or **passive strategies**. Essential to all active strategies is specification of expectations about the factors that influence the performance of an asset class. Passive strategies involve minimal expectational input.

Strategies between the active and passive extremes have sprung up that have elements of both extreme strategies. For example, the core of a portfolio may be indexed, with the balance managed actively. Or a portfolio may be primarily indexed but employ low-risk strategies to enhance the indexed portfolio's return. This strategy is commonly referred to as **enhanced indexing** or **indexing plus**.

In the bond area, several strategies classified as **structured portfolio strategies** have commonly been used. A structured portfolio strategy calls for design of a portfolio to achieve the performance of a predetermined benchmark. Such strategies are frequently followed when funding liabilities. When the predetermined benchmark is the generation of sufficient funds to satisfy a single liability, regardless of the course of future interest rates, a strategy known as **immunization** is often used. When the predetermined benchmark requires funding multiple future liabilities regardless of how interest rates change, strategies such as immunization, cash flow matching (or dedication), or horizon matching can be employed.

Given the choice among active, structured, or passive management, the selection depends on (i) the client or money manager's view of the pricing efficiency of the market, and (ii) the nature of the liabilities to be satisfied.

Selecting Assets

After a portfolio strategy is specified, the fourth step is to select the specific assets to be included in the portfolio, which requires an evaluation of individual securities. It is in this phase that the investment manager attempts to construct an efficient portfolio.

Measuring and Evaluating Performance

The measurement and evaluation of investment performance is the fifth and last step in the investment management process. This step involves measuring the performance of the portfolio, then evaluating that performance relative to some benchmark. The benchmark selected for evaluating performance is called a **benchmark** or **normal portfolio**. The benchmark portfolio may be a popular index such as the S&P 500 for equity portfolios or one of the bond indexes.

TRACKING ERROR AND BOND PORTFOLIO STRATEGIES

Before discussing bond portfolio strategies, it is essential to understand an important analytical concept. When a portfolio manager's benchmark is a bond market index, risk is not measured in terms of the standard deviation of the portfolio's return. Instead, risk is measured by the standard deviation of the return of the portfolio relative to the return of the benchmark index. This risk measure is called tracking error. Tracking error is also called active risk.

Calculation of Tracking Error

Tracking error is computed as follows:

Step 1: Compute the total return for a portfolio for each period.
Step 2: Obtain the total return for the benchmark index for each period.
Step 3: Obtain the difference between the values found in Step 1 and Step 2. The difference is referred to as the active return.
Step 4: Compute the standard deviation of the active returns. The resulting value is the tracking error.

The tracking error measurement is in terms of the observation period. If monthly returns are used, the tracking error is a monthly tracking error. If weekly returns are used, the tracking error is a weekly tracking error.

Two Faces of Tracking Error

Calculations computed for a portfolio based on a portfolio's actual active returns reflect the portfolio manager's decisions during the observation period. We call tracking error calculated from observed active returns for a portfolio **backward-looking tracking error**. It is also called the ex-post tracking error and the actual tracking error.

The portfolio manager needs a forward-looking estimate of tracking error to reflect the portfolio risk going forward. The way this is done in practice is by using the services of a commercial vendor or dealer firm that has modeled the factors which affect the tracking error associated with the bond market index that is the portfolio manager's benchmark. These models are called **multi-factor risk models**.

Given a manager's current portfolio holdings, the portfolio's current exposure to the various risk factors can be calculated and compared to the benchmark's exposures to the factors. Using the differential factor exposures and the risks of the factors, a **forward-looking tracking error** for the portfolio can be computed. This tracking error is also referred to as predicted tracking error and ex-ante tracking error.

Tracking Error and Active Versus Passive Strategies

We can think of active versus passive bond portfolio strategies in terms of forward-looking tracking error. In constructing a portfolio, a manager can estimate its forward-looking tracking error. When a portfolio is constructed to have a forward-looking tracking error of zero, the manager has effectively designed the portfolio to replicate the performance of the benchmark.

Risk Factors and Portfolio Management Strategies

Forward-looking tracking error indicates the degree of active portfolio management being pursued by a manager. Therefore, it is necessary to understand what factors (referred to as risk factors) affect the performance of a manager's benchmark index.

The risk factors affecting the Lehman Brothers Aggregate Bond Index have been investigated. Risk factors can be classified into two types: systematic risk factors and nonsystematic risk factors. **Systematic risk factors** are forces that affect all securities in a certain category in the benchmark index. **Nonsystematic factor risk** is the risk that is not attributable to the systematic risk factors.

Systematic risk factors, in turn, are divided into two categories: term structure risk factors and nonterm structure risk factors. **Term structure risk factors** are risks associated with changes in the shape of the term structure (level and shape changes). **Nonterm structure risk factors** include sector risk, quality risk, optionality risk, coupon risk, MBS sector risk, MBS volatility risk, and MBS prepayment risk.

Sector risk is the risk associated with exposure to the sectors of the benchmark index. Quality risk is the risk associated with exposure to the credit rating of the securities in the benchmark index. Optionality risk is the risk associated with an adverse impact on the embedded options of the securities in the benchmark index. Coupon risk is the exposure of the securities in the benchmark index to different coupon rates.

The last three risks are associated with the investing in residential mortgage pass-through securities. The first is MBS sector risk, which is the exposure to the sectors of the MBS market included in the benchmark. MBS volatility risk is the exposure of a benchmark index to changes in expected interest-rate volatility. MBS prepayment risk is the exposure of a benchmark index to changes in prepayments.

Nonsystematic factor risks are classified as nonsystematic risks associated with a particular issuer, issuer-specific risk, and those associated with a particular issue, issue-specific risk.

Determinants of Tracking Error

Once we know the risk factors associated with a benchmark index, forward-looking tracking error can be estimated for a portfolio. The tracking error occurs because the portfolio constructed deviates from the exposures for the benchmark index.

A manager provided with information about (forwarding-looking) tracking error for the current portfolio can quickly assess if (i) the risk exposure for the portfolio is one that is acceptable and (ii) if the particular exposures are being sought.

ACTIVE PORTFOLIO STRATEGIES

Armed with an understanding of the risk factors for a benchmark index and how to gauge the risk exposure of a portfolio relative to a benchmark index using forward-looking tracking error, we can discuss various active portfolio strategies that are typically employed by managers.

Manager Expectations Versus the Market Consensus

A money manager who pursues an active strategy will position a portfolio to capitalize on expectations about future interest rates.

Interest-Rate Expectations Strategies

A money manager who believes that he or she can accurately forecast the future level of interest rates will alter the portfolio's sensitivity to interest-rate changes.

A portfolio's duration may be altered by swapping (or exchanging) bonds in the portfolio for new bonds that will achieve the target portfolio duration. Such swaps are commonly referred to as **rate anticipation swaps**.

Although a manager may not pursue an active strategy based strictly on future interest-rate movements, there can be a tendency to make an interest-rate bet to cover inferior performance relative to a benchmark index. There are other active strategies that rely on forecasts of future interest-rate levels.

Yield Curve Strategies

The yield curve for U.S. Treasury securities shows the relationship between their maturities and yields. The shape of this yield curve changes over time. **Yield curve strategies** involve positioning a portfolio to capitalize on expected changes in the shape of the Treasury yield curve.

A shift in the yield curve refers to the relative change in the yield for each Treasury maturity. A parallel shift in the yield curve is a shift in which the change in the yield on all maturities is the same. A nonparallel shift in the yield curve indicates that the yield for maturities does not change by the same number of basis points.

Historically, two types of nonparallel yield curve shifts have been observed: a twist in the slope of the yield curve and a change in the humpedness of the yield curve. A flattening of the yield curve indicates that the yield spread between the yield on a long-term and a short-term Treasury has decreased; a steepening of the yield curve indicates that the yield spread between a long-term and a short-term Treasury has increased. The other type of nonparallel shift, a change in the humpedness of the yield curve, is referred to as a butterfly shift.

In portfolio strategies that seek to capitalize on expectations based on short-term movements in yields, the dominant source of return is the impact on the price of the securities in the portfolio. This means that the maturity of the securities in the portfolio will have an important impact on the portfolio's return. The key point is that for short-term investment horizons, the spacing of the maturity of bonds in the portfolio will have a significant impact on the total return.

In a **bullet strategy**, the portfolio is constructed so that the maturities of the securities in the portfolio are highly concentrated at one point on the yield curve. In a **barbell strategy**, the maturities of the securities in the portfolio are concentrated at two extreme maturities. In a **ladder strategy** the portfolio is constructed to have approximately equal amounts of each maturity.

For two portfolios with the same dollar duration, greater convexity means a greater performance for a bond or a portfolio when yields change. What is necessary to understand is that the larger the dollar convexity, the greater the dollar price change due to a portfolio's convexity.

Even if the yield curve shifts in a parallel fashion, two portfolios with the same dollar duration will not give the same performance. The reason is that the two portfolios do not have the same dollar convexity. Although with all other things equal it is better to have more convexity than less; the market charges for convexity in the form of a higher price or a lower yield. The benefit of the greater convexity depends on how much yields change.

The key point is that measures (such as yield, duration, or convexity) reveal little about performance over some investment horizon because performance depends on the magnitude of the

change in yields and how the yield curve shifts. Therefore, when a manager wants to position a portfolio based on expectations as to how the yield curve is expected to shift, it is essential to perform total return analysis.

Yield Spread Strategies

Yield spread strategies involve positioning a portfolio to capitalize on expected changes in yield spreads between sectors of the bond market. Swapping (or exchanging) one bond for another when the manager believes that the prevailing yield spread between the two bonds in the market is out of line with their historical yield spread, and that the yield spread will realign by the end of the investment horizon, are called intermarket spread swaps.

Individual Security Selection Strategies

There are several active strategies that money managers pursue to identify mispriced securities. The most common strategy identifies an issue as undervalued because either (i) its yield is higher than that of comparably rated issues, or (ii) its yield is expected to decline (and price therefore rise) because credit analysis indicates that its rating will improve. A swap in which a money manager exchanges one bond for another bond that is similar in terms of coupon, maturity, and credit quality, but offers a higher yield, is called a **substitution swap**.

Strategies for Asset Allocation within Bond Sectors

The ability to outperform a benchmark index will depend on the how the manager allocates funds within a bond sector relative to the composition of the benchmark index. The incremental return over Treasuries depends on the initial spread, the change in the spread, and the probability of a rating change. For all rating sectors and maturity sectors, expected incremental returns are less than the initial spread.

THE USE OF LEVERAGE

If permitted by investment guidelines, a manager may use leverage in an attempt to enhance portfolio returns. A portfolio manager can create leverage by borrowing funds in order to acquire a position in the market that is greater than if only cash were invested. The funds available to invest without borrowing are referred to as the “equity.” A portfolio that does not contain any leverage is called an unlevered portfolio. A levered portfolio is a portfolio in which a manager has created leverage.

Motivation for Leverage

The basic principle in using leverage is that a manager wants to earn a return on the borrowed funds that is greater than the cost of the borrowed funds. The return from borrowing funds is produced from a higher income and/or greater price appreciation relative to a scenario in which no funds are borrowed.

The return from investing the funds comes from two sources. The first is the interest income and

the second is the change in the value of the security (or securities) at the end of the borrowing period.

There are some managers who use leverage in the hopes of benefiting primarily from price changes. Small price changes will be magnified by using leveraging. For example, if a manager expects interest rates to fall, the manager can borrow funds to increase price exposure to the market. Effectively, the manager is increasing the duration of the portfolio.

Thus the risk associated with borrowing funds is that the security (or securities) in which the borrowed funds are invested may earn less than the cost of the borrowed funds due to failure to generate interest income plus capital appreciation as expected when the funds were borrowed.

Leveraging is a necessity for depository institutions (such as banks and savings and loan associations) because the spread over the cost of borrowed funds is typically small. The magnitude of the borrowing (i.e., the degree of leverage) is what produces an acceptable return for the institution.

Duration of a Leveraged Portfolio

In general, the procedure for calculating the duration of a portfolio that uses leverage is as follows:

Step 1: Calculate the duration of the levered portfolio.
Step 2: Determine the dollar duration of the portfolio of the levered portfolio for a change in interest rates.
Step 3: Compute the ratio of the dollar duration of the levered portfolio to the value of the initial unlevered portfolio (i.e., initial equity).
Step 4: The duration of the unlevered portfolio is then found as follows:

$$\text{ratio computed in Step 3} \times \frac{100}{\text{rate change used in Step 2 in bps}} \times 100.$$

How to Create Leverage via the Repo Market

A manager can create leverage in one of two ways. One way is through the use of derivative instruments. The second way is to borrow funds via a collateralized loan arrangement.

A **repurchase agreement** is the sale of a security with a commitment by the seller to buy the same security back from the purchaser at a specified price at a designated future date. The price at which the seller must subsequently repurchase the security for is called the repurchase price, and the date that the security must be repurchased is called the repurchase date.

There is a good deal of Wall Street jargon describing repo transactions. To understand it, remember that one party is lending money and accepting a security as collateral for the loan; the other party is borrowing money and providing collateral to borrow the money.

Despite the fact that there may be high-quality collateral underlying a repo transaction, both parties

to the transaction are exposed to credit risk.

Repos should be carefully structured to reduce credit risk exposure. The amount lent should be less than the market value of the security used as collateral, thereby providing the lender with some cushion should the market value of the security decline. The amount by which the market value of the security used as collateral exceeds the value of the loan is called **repo margin** or simply **margin**.

There is not one repo rate. The rate varies from transaction to transaction depending on a variety of factors: quality of collateral, term of the repo, delivery requirement, availability of collateral, and the prevailing federal funds rate.

The more difficult it is to obtain the collateral, the lower the repo rate. To understand why this is so, remember that the borrower (or equivalently the seller of the collateral) has a security that lenders of cash want, for whatever reason. Such collateral is referred to as hot or special collateral. Collateral that does not have this characteristic is referred to as general collateral.

ANSWERS TO QUESTIONS FOR CHAPTER 22

(**Questions** are in bold print followed by answers.)

1. Why might the investment objective of a portfolio manager of a life insurance company be different from that of a mutual fund manager?

The first step in the investment management process is setting investment objectives. The investment objective will vary by type of financial institution. The objectives of a life insurance company and a mutual fund company are different with a life insurance company generally focusing more on safer fixed income investments that are needed to match its liabilities.

For institutions such as life insurance companies, the basic objective is to satisfy obligations stipulated in insurance policies and generate a known profit. Most insurance products guarantee a dollar payment or a stream of dollar payments at some time in the future. The premium that the life insurance company charges a policyholder for one of its products will depend on the interest rate that the company can earn on its investments. To realize a profit, the life insurance company must earn a higher return on the premium it invests than the implicit (or explicit) interest rate it has guaranteed policyholders.

For investment institutions such as mutual funds, the investment objectives will be set forth in a prospectus. With the exception of mutual funds that have a specified termination date (called target term trusts), there are no specific liabilities that must be met. Typically, the fund establishes a target payout even though it has no liabilities that guarantee dollar payments.

2. Explain how it can be possible for a portfolio manager to outperform a benchmark but still fail to meet the investment objective of a client.

An index or benchmark may produce low or even negative returns over a period of time. Thus, even if a manager outperforms the benchmark, the objectives of a particular fund (such as meeting required liabilities) may not be met. As discussed below, there are ways managers can overcome this problem.

Portfolio strategies can be classified as either **active strategies** or **passive strategies**. Passive strategies involve minimal expectational input. One popular type of passive strategy is indexing, whereby the objective is to replicate the performance of a predetermined index or benchmark.

Although indexing may be a reasonable strategy for an institution that does not have a future liability stream to be satisfied, consider the circumstances in which pension funds operate. If a pension fund indexes its portfolio, the fund's return will be roughly the same as the index return. Yet the index may not provide a return that is sufficient to satisfy the fund's obligations. Consequently, for some institutions, such as pension funds and life insurance companies, structured portfolio strategies--such as immunization or dedication--may be more appropriate to achieve investment objectives. Within the context of these strategies, an active or enhanced return strategy may be followed.

3. What is the essential ingredient in all active portfolio strategies?

Selecting a portfolio strategy that is consistent with the objectives and policy guidelines of the client or institution is the third step in the investment management process. Portfolio strategies can be classified as either **active strategies** or **passive strategies**. Essential to all active strategies is specification of expectations about the factors that influence the performance of an asset class. In the case of active equity strategies, this may include forecasts of future earnings, dividends, or price/earnings ratios. In the case of active bond management, this may involve forecasts of future interest rates, future interest-rate volatility, or future yield spreads. Active portfolio strategies involving foreign securities will require forecasts of future exchange rates.

4. What is tracking error?

When a portfolio manager's benchmark is a bond market index, risk is not measured in terms of the standard deviation of the portfolio's return. Instead, risk is measured by the standard deviation of the return of the portfolio relative to the return of the benchmark index. This risk measure is called **tracking error**. Tracking error is also called **active risk**.

Tracking error is computed as follows. First, compute the total return for a portfolio for each period. Second, obtain the total return for the benchmark index for each period. Third, obtain the difference between the return values for portfolio and index for each period. The difference for each period is referred to as the **active return** for that period. Finally, compute the standard deviation of the active returns. The resulting value is the tracking error.

One should not forget that the tracking error measurement is in terms of the observation period. If monthly returns are used, the tracking error is a monthly tracking error. If weekly returns are used, the tracking error is a weekly tracking error. Tracking error is annualized as follows. When observations are monthly: annual tracking error = monthly tracking error × $\sqrt{12}$. When observations are weekly: annual tracking error = monthly tracking error × $\sqrt{52}$.

5. Explain why backward-looking tracking error has limitations for estimating a portfolio's future tracking error.

A portfolio's backward-looking tracking error is computed based on actual active returns and reflects the portfolio manager's decisions during the observation period with respect to the factors that affect tracking error. Consequently, one limitation with using backward-looking tracking error in bond portfolio management is that it does not reflect the effect of current decisions by the portfolio manager on the future active returns and hence the future tracking error that may be realized. Another limitation is that the backward-looking tracking error will have little predictive value and can be misleading regarding portfolio risks going forward.

6. Why might one expect that for a manager pursuing an active management strategy that the backward-looking tracking error at the beginning of the year will deviate from the forward-looking tracking error at the beginning of the year?

The portfolio manager needs a forward-looking estimate of tracking error to reflect the portfolio

risk going forward. The way this is done in practice is by using the services of a commercial vendor or dealer firm that has modeled the factors that affect the tracking error associated with the bond market index that is the portfolio manager's benchmark. Given a manager's current portfolio holdings, the portfolio's current exposure to the various risk factors can be calculated and compared to the benchmark's exposures to the factors. Using the differential factor exposures and the risks of the factors, a forward-looking tracking error for the portfolio can be computed. Given a forward-looking tracking error, a range for the future possible portfolio active return can be calculated assuming that the active returns are normally distributed.

There is no guarantee that the forward-looking tracking error at the start of, say, a year would exactly match the backward-looking tracking error calculated at the end of the year. There are two reasons for this. The first is that as the year progresses and changes are made to the portfolio, the forward-looking tracking error estimate would change to reflect the new exposures. The second is that the accuracy of the forward-looking tracking error at the beginning of the year depends on the extent of the stability in the variances and correlations that commercial vendors use in their statistical models to estimate forward-looking tracking error.

These problems notwithstanding, the average of forward-looking tracking error estimates obtained at different times during the year can be reasonably close to the backward looking tracking error estimate obtained at the end of the year. The forward-looking tracking error is useful in risk control and portfolio construction. The manager can immediately see the likely effect on the tracking error of any intended change in the portfolio. Thus scenario analysis can be performed by a portfolio manager to assess proposed portfolio strategies and eliminate those that would result in tracking error beyond a specified tolerance for risk.

7. Answer the following questions.

(a) Compute the tracking error from the following information:

Month 2001	Portfolio A's Return (%)	Lehman Aggregate Bond Index Return (%)
January	2.15	1.65
February	0.89	–0.10
March	1.15	0.52
April	–0.47	–0.60
May	1.71	0.65
June	0.10	0.33
July	1.04	2.31
August	2.70	1.10
September	0.66	1.23
October	2.15	2.02
November	–1.38	–0.61
December	–0.59	–1.20

The tracking error is the standard deviation of the active returns where an active return is the portfolio A's return minus the benchmark's return for each month. The below exhibit has each

active return in the "Active Return" column.

[Note that when subtracting a negative index return from a portfolio return, the negative return is actually added to the portfolio return to get the active return. For example, for February, we have 0.89% – –0.10% = 0.89% + 0.10% = 0.99%).]

Month 2001	Portfolio A's Return	Lehman Aggregate Bond Index Return	Active Return	Differences Squared
January	2.15%	1.65%	0.50%	0.0707(%^{2})
February	0.89%	–0.10%	0.99%	0.5713(%^{2})
March	1.15%	0.52%	0.63%	0.1567(%^{2})
April	–0.47%	–0.60%	0.13%	0.0109(%^{2})
May	1.71%	0.65%	1.06%	0.6820(%^{2})
June	0.10%	0.33%	-0.23%	0.2155(%^{2})
July	1.04%	2.31%	-1.27%	2.2625(%^{2})
August	2.70%	1.10%	1.60%	1.8655(%^{2})
September	0.66%	1.23%	-0.57%	0.6467(%^{2})
October	2.15%	2.02%	0.13%	0.0109(%^{2})
November	–1.38%	–0.61%	-0.77%	1.0084(%^{2})
December	–0.59%	–1.20%	0.61%	0.1413(%^{2})

Sum of Portfolio Returns =	2.81%
Mean Active Return =	0.2342%
Variance (sum of differences squared / 11) =	0.6947(%^{2})
Standard Deviation = Tracking Error =	0.8335%
Tracking error in basis points =	83.35
Tracking error in basis points annualized =	288.74

To compute the standard deviation of these active returns, we subtract the average (or mean) active return from each active return, and then square each difference. Each difference squared value is given in the exhibit above in the "Differences Squared" column. We then divide this sum by 12 – 1 = 11. We then multiply by 100 to convert to basis points. One basis point equals 0.0001 or 0.01%. We can then annualize the monthly basis points by multiplying by the square root of 12. At the bottom of the above exhibit we list details including the mean active return, variance, standard deviation or tracking error (in terms of both percentage and basis points), and the annualized tracking error (in terms of basis points).

(b) Is the tracking error computed in part (a) a backward-looking or forward-looking tracking error?

The tracking error computed in part (a) is backward-looking because it is calculated based on the actual active returns observed for a portfolio is prior periods. Calculations computed for a portfolio based on a portfolio's actual active returns reflect the portfolio manager's decisions during the observation period with respect to the factors that affect tracking error.

(c) Compare the tracking error found in part (a) to the tracking error found for Portfolios A

and B in Exhibit 22-1. What can you say about the investment management strategy pursued by this portfolio manager?

The tracking error found for our problem is greater especially compared to Portfolio A in Exhibit 22-1. A greater tracking error means greater deviation from the benchmark. This is seen if we compare active return values from our exhibit with the greater active return values found in Exhibit 22-1. For our problem, it appears the manager may be employing a high-risk strategy to enhance the indexed portfolio's return. This strategy is commonly referred to as **enhanced indexing** or **indexing plus**.

8. Assume the following:

benchmark index = Salomon Smith Barney BIG Bond Index
expected return for benchmark index = 7%
forward-looking tracking error relative to Lehman Aggregate Bond Index = 200 basis points

Assuming that returns are normally distributed, complete the following table:

Number of Standard Deviations	Range for Portfolio Active Return	Corresponding Range for Portfolio Return	Probability
1			
2			
3			

With an expected return of 7% and a standard deviation of 200 basis points or 2%, then a normal distribution implies there is about a **67%** probability that values will be found between one standard deviation of either side of the mean. Thus, for a standard deviation of 1, the range on either side of the mean for portfolio active return is 1 standard deviation times 2% = **2%**. The 2% deviation will be on both the left and right side of the 7% mean value. Thus, with a portfolio mean return of 7%, the corresponding range for portfolio return will be from **5%** (7% – 2% = 5%) left of the mean value to **9%** (7% + 2% = 9%) right of the mean value

Similarly, for a standard deviation of 2, the range on either side of the mean is 2 standard deviations times 2% = **4%**. With a portfolio mean active return of **7%**, the corresponding range for portfolio return will be from 7% – 4% = 3% to 7% + 4% = **11%**. A normal distribution implies there a **96%** probability that values will be found between two standard deviations of either side the mean.

Likewise, for a standard deviation of three, the range on either side of the mean is 3 standard deviations times 2% = **6%**. With a portfolio mean active return of 7%, the corresponding range for portfolio return will be 7% – 6% = **1%** and 7% + 6% = **13%**. A normal distribution implies there a **99%** probability that values will be found between two standard deviations of either side the mean.

The above values can all be found in the below exhibit.

Number of Standard Deviations	Range for Portfolio Active Return	Corresponding Range for Portfolio Return	Probability
1	2%	5%—9%	67%
2	4%	3%—11%	95%
3	6%	1%—13%	99%

9. At a meeting between a portfolio manager and a prospective client, the portfolio manager stated that her firm's bond investment strategy is a conservative one. The portfolio manager told the prospective client that she constructs a portfolio with a forward-looking tracking error that is typically between 250 and 300 basis points of a client-specified bond index. Explain why you agree or disagree with the portfolio manager's statement that the portfolio strategy is a conservative one.

If the chosen benchmark is the desired norm, then greater deviation from the norm implies more risk taking, i.e., less conservatism. Regardless, it appears the manager is pursuing an active strategy that involves risk taking.

First, one would expect a higher tracking error over a longer horizon. Let's assume the forward-looking tracking error given in our problem (between 250 and 300 basis points of a bond index) is an annual tracking error. Even for this longer horizon, 250 to 300 basis points represent a large tracking error (especially compared to a zero tracking error which would be obtained if one just mimicked the benchmark). However, the tracking error is also unique to the benchmark used. If an improper benchmark is used then the tracking error measure may not be too meaningful.

Second, the strategy is not passive. When a portfolio is constructed to have a forward-looking tracking error of zero, the manager has effectively designed the portfolio to replicate the performance of the benchmark. If the forward-looking tracking error is maintained for the entire investment period, the active return should be close to zero. Such a strategy—one with a forward-looking tracking error of zero or very small—indicates that the manager is pursing a passive strategy relative to the benchmark index.

Third, when the forward-looking tracking error is large the manager is pursuing an active strategy. The larger the deviation from the chosen benchmark, the larger the tracking error, and thus greater risk taking can be inferred. Forward-looking tracking error indicates the degree of active portfolio management being pursued by a manager. Therefore, it is necessary to understand what factors (referred to as risk factors) affect the performance of a manager's benchmark index. The degree to which the manager constructs a portfolio that has exposure to the risk factors that is different from the risk factors that affect the benchmark determines the forward-looking tracking error.

10. Answer the following questions.

(a) What is meant by systematic risk factors?

Risk factors affecting an index can be classified into two types: systematic risk factors and nonsystematic risk factors. Systematic risk factors are forces that affect all securities in a certain category in the benchmark index. Nonsystematic risk factors are classified as risks associated with

a particular issuer, issuer-specific risk, and those associated with a particular issue, issue-specific risk.

(b) What is the difference between term structure and nonterm structure risk factors?

Systematic risk factors can be divided into two categories: term structure risk factors and nonterm structure risk factors. Term structure risk factors are risks associated with changes in the shape of the term structure (level and shape changes). Nonterm structure risk factors include sector risk, quality risk, optionality risk, coupon risk, MBS sector risk, MBS volatility risk, and MBS prepayment risk.

Sector risk is the risk associated with exposure to the sectors of the benchmark index. Quality risk is the risk associated with exposure to the credit rating of the securities in the benchmark index. Optionality risk is the risk associated with an adverse impact on the embedded options of the securities in the benchmark index. Coupon risk is the exposure of the securities in the benchmark index to different coupon rates. MBS sector risk is the exposure to the sectors of the MBS market included in the benchmark. MBS volatility risk is the exposure of a benchmark index to changes in expected interest-rate volatility. MBS prepayment risk is the exposure of a benchmark index to changes in prepayments.

(c) What are the systematic risk factors associated with investing in the residential mortgage-backed sector of a benchmark index?

MBS sector risk, MBS volatility risk, and MBS prepayment risk are associated with the investing in residential mortgage pass-through securities. MBS sector risk is the exposure to the sectors of the MBS market included in the benchmark. MBS volatility risk is the exposure of a benchmark index to changes in expected interest-rate volatility. MBS prepayment risk is the exposure of a benchmark index to changes in prepayments.

11. What is meant by tracking error due to systematic risk factors?

By tracking error due to systematic risk factors, we mean tracking error caused by factors that affect the return of securities in the benchmark in varying degrees.

When a portfolio manager's benchmark is a bond market index, risk is not measured in terms of the standard deviation of the portfolio's return. Instead, risk is measured by the standard deviation of the return of the portfolio relative to the return of the benchmark index. This risk measure is called **tracking error**. Tracking error is also called **active risk**.

Forward-looking tracking error indicates the degree of active portfolio management being pursued by a manager. Therefore, it is necessary to understand what factors (including systematic risk factors) affect the performance of a manager's benchmark index. The degree to which the manager constructs a portfolio that has exposure to the risk factors that is different from the risk factors that affect the benchmark determines the forward-looking tracking error.

The risk factors affecting the Lehman Brothers Aggregate Bond Index have been investigated by

various researchers. The risk factors can be classified into two types: systematic risk factors and nonsystematic risk factors. **Systematic risk factors** are forces that affect all securities in a certain category in the benchmark index. **Nonsystematic factor** risk is the risk that is not attributable to the systematic risk factors.

When we speak of tracking error due to systematic risk factors, we have two factors in mind because systematic risk factors can be divided into two categories: term structure risk factors and nonterm structure risk factors. Term structure risk factors are risks associated with changes in the shape of the term structure (level and shape changes). Nonterm structure risk factors include the following: sector risk, quality risk, optionality risk, coupon risk, MBS sector risk, MBS volatility risk, and MBS prepayment risk.

12. Suppose that the benchmark index for a portfolio manager is the Lehman Brothers Aggregate Bond Index. That bond market index includes only investment grade. Suppose that the portfolio manager decides to allocate a portion of the portfolio's fund to high-yield bonds. What would you expect would happen to the forward-looking tracking error due to quality risk?

Once we know the risk factors associated with a benchmark index, forward-looking tracking error can be estimated for a portfolio. The tracking error occurs because the portfolio constructed deviates from the exposures for the benchmark index.

In our problem, the portfolio manager is choosing to deviate from its benchmark in terms of selecting bonds of lower ratings (less quality) than found in the benchmark. Thus, we would expect the forward-looking tracking error to increase due to quality risk.

13. Answer the following questions.

(a) What is an active portfolio strategy?

Essential to all active strategies is specification of expectations about the factors that influence the performance of an asset class. In the case of active equity strategies, this may include forecasts of future earnings, dividends, or price/earnings ratios. In the case of active bond management, this may involve forecasts of future interest rates, future interest-rate volatility, or future yield spreads. Active portfolio strategies involving foreign securities will require forecasts of future exchange rates.

After a portfolio strategy is specified, the next step is to select the specific assets to be included in the portfolio, which requires an evaluation of individual securities. In an active strategy, this means identifying mispriced securities. In the case of bonds, the characteristics of a bond (i.e., coupon, maturity, credit quality, and options granted to either the issuer or bondholder) must be examined carefully to determine how these characteristics will influence the performance of the bond over some investment horizon.

A manager who uses an active strategy will position his or her investment to capitalize what the manager believes may be misvalued. For example, a money manager who pursues an active

strategy will position a portfolio to capitalize on expectations about future interest rates. But the potential outcome (as measured by total return) must be assessed before an active strategy is implemented. The primary reason for this is that the market (collectively) has certain expectations for future interest rates, and these expectations are embodied into the market price of bonds. The key to this active strategy is the capacity to forecast the direction of future interest rates.

There are other active strategies that rely on forecasts of future interest-rate levels. Future interest rates, for instance, affect the value of options embedded in callable bonds and the value of prepayment options embedded in mortgage-backed securities. Callable corporate and municipal bonds with coupon rates above the expected future interest rate will underperform relative to noncallable bonds or low-coupon bonds. This is because of the negative convexity feature of callable bonds.

(b) What will determine whether an active or a passive portfolio strategy will be pursued?

A determinant of whether or not to purse an active strategy concerns expectations about the factors that influence the performance of an asset class. If managers believe they have identified situations of misvaluation then they will be more inclined to pursue an active strategy. For example, there are several active strategies that money managers pursue to identify mispriced securities. The most common strategy identifies an issue as undervalued because either (i) its yield is higher than that of comparably rated issues, or (ii) its yield is expected to decline (and price therefore rise) because credit analysis indicates that its rating will improve.

An active strategy used in the mortgage-backed securities market is to identify individual issues of pass-throughs, CMO classes, or stripped MBS that are mispriced, given the assumed prepayment speed to price the security.

Another active strategy commonly used in the mortgage-backed securities market is to create a package of securities that will have a better return profile for a wide range of interest-rate and yield curve scenarios than similar duration securities available in the market. Because of the fragmented nature of the mortgage-backed securities market and the complexity of the structures, such opportunities are not unusual.

14. What are the limitations of using duration and convexity measures in active portfolio strategies?

Recall that duration is just a first approximation of the change in price resulting from a change in interest rates while convexity provides a second approximation. Below we discuss the limitation involved in using the measures of duration and convexity to estimate how portfolio values will be affected when interest rates change.

A money manager who believes that he or she can accurately forecast the future level of interest rates will alter the portfolio's sensitivity to interest-rate changes. As duration is a measure of interest-rate sensitivity, this involves increasing a portfolio's duration if interest rates are expected to fall and reducing duration if interest rates are expected to rise. For those managers whose benchmark is a bond index, this means increasing the portfolio duration relative to the benchmark

index if interest rates are expected to fall and reducing it if interest rates are expected to rise.

There are several limitations to achieve a change in a portfolio's duration. First, the client may limit the degree to which the duration of the managed portfolio is permitted to diverge from that of the benchmark index. Second, research does not support the notion that an active strategy can profit from the ability to forecast the direction of future interest rates. The academic literature argues that interest rates cannot be forecasted so that risk-adjusted excess returns can be realized consistently. It is doubtful whether betting on future interest rates will provide a consistently superior return.

Another limitation concerns a portfolio with assets with varying maturities. The assumption made when using duration as a measure of how the value of a portfolio will change if market yields change is that the yield on all maturities will change by the same number of basis points. The key point is that two portfolios with the same duration may perform quite differently when the yield curve shifts.

Another limitation is that knowing duration and convexity is not always enough to insure that an active strategy will succeed even if managers are correct in their assessment about changes in interest rates. For example, suppose that a portfolio manager has a choice of investing in the bullet portfolio or the barbell portfolio. Which one should be chosen if the manager knows the following?

First, the manager knows that the two portfolios have the same dollar duration. Second, the manager knows the yield for the bullet portfolio is greater than that of the barbell portfolio. Third, the manager knows the dollar convexity of the barbell portfolio is greater than that of the bullet portfolio. However, even all of this information is not adequate in making the decision. This is because the decision depends not just on the direction of the interest rate change but on the amount by which yields change. Also, even if the yield curve shifts in a parallel fashion, two portfolios with the same dollar duration will not give the same performance. The reason is that the two portfolios do not have the same dollar convexity. However, even the benefit of the greater convexity depends on how much yields change.

In closing, the key point here is that looking at measures such as yield (yield to maturity or some type of portfolio yield measure), duration, or convexity reveals little about performance over some investment horizon because performance depends on the magnitude of the change in yields and how the yield curve shifts. Therefore, when a manager wants to position a portfolio based on expectations as to how the yield curve will shift, it is imperative to perform total return analysis. For example, in a steepening yield curve environment, it is often stated that a bullet portfolio would be better than a barbell portfolio. However, it is not always the case that a bullet portfolio would outperform a barbell portfolio. Whether the bullet portfolio outperforms the barbell depends on how much the yield curve steepens.

15. Below are two portfolios with a market value of $500 million. The bonds in both portfolios are trading at par value. The dollar duration of the two portfolios is the same.

Issue	Years to Maturity	Par Value (in millions)
Bonds Included in Portfolio I		
A	2.0	$120
B	2.5	$130
C	20.0	$150
D	20.5	$100
Bonds Included in Portfolio II		
E	9.7	$200
F	10.0	$230
G	10.2	$ 70

Answer the following questions.

(a) Which portfolio can be characterized as a bullet portfolio?

In a **bullet strategy**, the portfolio is constructed so that the maturities of the securities in the portfolio are highly concentrated at one point on the yield curve. Thus, Portfolio II can be characterized as a bullet portfolio because the maturities of its securities are concentrated around one maturity (ten years).

(b) Which portfolio can be characterized as a barbell portfolio?

In a **barbell strategy**, the maturities of the securities included in the portfolio are concentrated at two extreme maturities. Thus, Portfolio I can be characterized as a barbell portfolio because the maturities of its securities are concentrated at two extreme maturities (two years and twenty years).

(c) The two portfolios have the same dollar duration; explain whether their performance will be the same if interest rates change.

Even if the yield curve shifts in a parallel fashion due to changes in interest rates, two portfolios with the same dollar duration will not give the same performance if they have differences in dollar convexity. Although with all other things equal, it is better to have more convexity than less; the market charges for convexity in the form of a higher price or a lower yield. But the benefit of the greater convexity depends on how much yields change. As can be seen from the illustration in the second column of Exhibit 22-8, if market yields change by less than 100 basis points (up or down), the bullet portfolio--which has less convexity--will provide a better total return that the barbell portfolio.

The last two columns in Exhibit 22-8 illustrate the relative performance of a bullet portfolio and a barbell portfolio for a nonparallel shift of the yield curve. Specifically, the first nonparallel shift column assumes that if the yield on the bullet portfolio (consisting of the intermediate-term bond) changes by the amount shown in the first column, the short-term bond in the barbell portfolio will

change by the same amount plus 25 basis points, whereas the long-term bond in the barbell portfolio will change by the same amount shown in the first column less 25 basis points. Measuring the steepness of the yield curve as the spread between the long-term yield and the short-term yield, the spread has decreased by 50 basis points. Such a nonparallel shift means a flattening of the yield curve. As can be seen in the exhibit, for this assumed yield curve shift the barbell outperforms the bullet.

In the last column of Exhibit 22-8, the nonparallel shift assumes that for a change in the intermediate bond's yield, the yield on the short-term will change by the same amount less 25 basis points, whereas that on the long-term bond will change by the same amount plus 25 points: thus, the spread between the long-term yield and the short-term yield has increased by 50 basis points, and the yield curve has steepened. In this case the bullet portfolio outperforms the barbell portfolio as long as the yield on the intermediate bond does not rise by more than 250 basis points or fall by more than 325 basis points.

(d) If they will not perform the same, how would you go about determining which would perform best assuming that you have a six-month investment horizon?

To determine which portfolio would have the superior performance, we would want to look at the total return for the six-month investment horizon given expectations about change in yields and how the yield curve will shift.

It is important to note that measures such as yield (yield to maturity or some type of portfolio yield measure), duration, or convexity tell us little about performance over some investment horizon because performance depends on the magnitude of the change in yields and how the yield curve shifts. Therefore, when a manager wants to position a portfolio based on expectations as to how he might expect the yield curve to shift, it is imperative to perform total return analysis. For example, in a steepening yield curve environment, it is often stated that a bullet portfolio with the same duration as a barbell portfolio would perform better that the barbell portfolio. However, as can be seen from Exhibit 22-8, it is not the case that a bullet portfolio would outperform a barbell portfolio. Whether the bullet portfolio outperforms the barbell depends on how much the yield curve steepens. An analysis similar to that in Exhibit 22-8 based on total return for different degrees of steepening of the yield curve clearly demonstrates to a manager whether a particular yield curve strategy will be superior to another. The same analysis can be performed to assess the potential outcome of a ladder strategy.

16. Answer the following questions.

(a) Explain why you agree or disagree with the following statement: "It is always better to have a portfolio with more convexity than one with less convexity."

It is not always better to have a portfolio with more convexity than one with less convexity. This is illustrated if one examines the portfolios associated with Exhibit 22-8. Although with all other things equal it is better to have more convexity than less, the market charges for convexity in the form of a higher price or a lower yield. But the benefit of the greater convexity depends on how much yields change. As can be seen from the second column of Exhibit 22-8, if market yields

change by less than 100 basis points (up or down), the bullet portfolio, which has less convexity, will provide a better total return.

(b) Explain why you agree or disagree with the following statement: "A bullet portfolio will always outperform a barbell portfolio with the same dollar duration if the yield curve steepens."

One would disagree with the statement that a bullet portfolio will always outperform a barbell portfolio with the same dollar duration if the yield curve steepens. This is because the performance of a bullet portfolio compared to a barbell portfolio depends on how much the yield curve steepens.

To answer this question let us turn again to the illustration in Exhibit 22-8. First, we can look at what happens if the yield curve does not shift in a parallel fashion. The last two columns of Exhibit 22-8 demonstrate the relative performance of the bullet and barbell portfolios for a nonparallel shift of the yield curve. Specifically, the first nonparallel shift column assumes that if the yield on bond C (the intermediate-term bond) changes by the amount shown in the first column, bond A (the short-term bond) will change by the same amount plus 25 basis points, whereas bond B (the long-term bond) will change by the same amount shown in the first column less 25 basis points. Measuring the steepness of the yield curve as the spread between the long-term yield (yield on bond B) and the short-term yield (yield on bond A), the spread has decreased by 50 basis points. Such a nonparallel shift means a flattening of the yield curve. As can be seen in Exhibit 22-8, for this assumed yield curve shift, **the barbell outperforms the bullet**.

In the last column, the nonparallel shift assumes that for a change in bond C's yield, the yield on bond A will change by the same amount less 25 basis points, whereas that on bond B will change by the same amount plus 25 points: thus the spread between the long-term yield and the short-term yield has increased by 50 basis points, and the yield curve has steepened. In this case the **bullet portfolio outperforms the barbell portfolio** as long as the yield on bond C does not rise by more than 250 basis points or fall by more than 325 basis points.

The key point here is that looking at measures such as yield (yield to maturity or some type of portfolio yield measure), duration, or convexity reveals little about performance over some investment horizon, because performance depends on the magnitude of the change in yields and how the yield curve shifts. Therefore, when a manager wants to position a portfolio based on expectations as to how he might expect the yield curve to shift, it is imperative to perform total return analysis. For example, in a steepening yield curve environment, it is often stated that a bullet portfolio would be better than a barbell portfolio. As can be seen from Exhibit 22-8, **it is not the case that a bullet portfolio would outperform a barbell portfolio**. Whether the bullet portfolio outperforms the barbell depends on how much the yield curve steepens. An analysis similar to that in Exhibit 22-8 based on total return for different degrees of steepening of the yield curve clearly demonstrates to a manager whether a particular yield curve strategy will be superior to another.

17. What is a laddered portfolio?

A laddered portfolio is constructed to have approximately equal amounts of each maturity. So, for

example, a portfolio might have equal amounts of securities with one year to maturity, two years to maturity, and so on.

18. A portfolio manager owns $5 million par value of bond ABC. The bond is trading at 70 and has a modified duration of 6. The portfolio manager is considering swapping out of bond ABC and into bond XYZ. The price of this bond is 85 and it has a modified duration of 3.5.

Answer the following questions.

(a) What is the dollar duration of bond ABC per 100-basis-point change in yield?

The price of bond ABC is 70 with a modified duration of 6, and bond XYZ has a price of 85 with a modified duration of 3.5. Because modified duration is the approximate percentage change per 100-basis-point change in yield, a 100-basis-point change in yield for bond ABC would change its price by about 6%. Based on a price of 70, its price will change by about 0.06(70) = $4.2 per $70 of market value. **Thus, for bond ABC, its dollar duration for a 100-basis-point change in yield is $4.2 per $70 of market value.**

[Similarly, for bond XYZ, its dollar duration for a 100-basis-point change in yield per $85 of market value can be determined. In this case it is 0.035(85) = $2.975. So if bonds ABC and XYZ are being considered as alternative investments in a strategy other than one based on anticipating interest-rate movements, the amount of each bond in the strategy should be such that they will both have the same dollar duration.]

(b) What is the dollar duration for the $5 million position of bond ABC?

For our problem, a portfolio manager owns $5 million of par value of bond ABC, which has a market value of (70 / 100)$5M = $3.5 million. The dollar duration of bond ABC per 100-basis-point change in yield for the $3.5 million market value is 0.06($3.5 million) = **$210,000**.

(c) How much in market value of bond XYZ should be purchased so that the dollar duration of bond XYZ will be approximately the same as that for bond ABC?

Mathematically, this problem can be expressed as follows: Let

$\$D_{ABC}$ = dollar duration per 100-basis-point change in yield for bond ABC for the market value of bond ABC held;

MD_{XYZ} = modified duration for bond XYZ; and

MV_{XYZ} = market value of bond XYZ needed to obtain the same dollar duration as bond ABC.

The following equation sets the dollar duration for bond ABC equal to the dollar duration for bond XYZ:

$$\$D_{ABC} = \frac{MD_{XYZ}}{100} \mathbf{MV}_{XYZ}.$$

Solving for MV_{XYZ} yields:

$$MV_{XYZ} = \frac{\$D_{ABC}}{\frac{MD_{XYZ}}{100}}.$$

Dividing by the price per $1 of par value of bond XYZ gives the par value of XYZ that has an approximately equivalent dollar duration as bond ABC.

In our illustration, $\$D_{ABC}$ is $210,000 and MD_{XYZ} is 3.5; then

$$MV_{XYZ} = \frac{\$210,000}{\frac{3.5}{100}} = \$6,000,000.$$

Thus, the market value of bond XYZ that should be purchased (so that the dollar duration of bond XYZ will be approximately the same as that for bond ABC) will be **$6,000,000**.

(d) How much in par value of bond XYZ should be purchased so that the dollar duration of bond XYZ will be approximately the same as that for bond ABC?

The market value of bond XYZ is 85 per $100 of par value, so the price per $1 of par value is 0.85. Dividing MV_{XYZ} (which is $6 million) by 0.85 indicates that the par value of bond XYZ that should be purchased. We have:

$$\frac{\$6 \text{ million}}{0.85} = \$7.0588235 \text{ million or about } \mathbf{\$7,058,824}.$$

19. Explain why in implementing a yield spread strategy it is necessary to keep the dollar duration constant.

When comparing positions that have the same dollar duration, it is critical to assess yield spread strategies. Failure to adjust a portfolio repositioning based on some expected change in yield spread so as to hold the dollar duration the same means that the outcome of the portfolio will be affected not only by the expected change in the yield spread but also by a change in the yield level.

Thus a manager would be making a conscious yield spread bet and possibly an undesired bet on the level of interest rates.

20. The excerpt that follows is taken from an article titled "Smith Plans to Shorten," which appeared in the January 27, 1992, issue of *BondWeek*, p. 6:

> When the economy begins to rebound and interest rates start to move up, Smith Affiliated Capital will swap 30-year Treasuries for 10-year Treasuries and those with average remaining lives of nine years, according to Bob Smith, Executive V.P. The New York firm doesn't expect this to occur until the end of this year or early next, however, and sees the yield on the 30-year Treasury first falling below 7%. Any new cash that comes in now will be put into 30-year Treasuries, Smith added.

What type of portfolio strategy is Smith Affiliated Capital pursuing?

Smith appears to be following an interest-rate expectation strategy. A manager who believes that he or she can accurately forecast the future level of interest rates will alter the portfolio's sensitivity to interest-rate changes. As duration is a measure of interest-rate sensitivity, this involves increasing a portfolio's duration if interest rates are expected to fall and reducing duration if interest rates are expected to rise. For those managers whose benchmark is a bond index, this means increasing the portfolio duration relative to the benchmark index if interest rates are expected to fall and reducing it if interest rates are expected to rise. The degree to which the duration of the managed portfolio is permitted to diverge from that of the benchmark index may be limited by the client.

If we can assume the remaining maturities or the same, it appears that Smith is following a substitution swap strategy. A swap in which a money manager exchanges one bond for another bond that is similar in terms of coupon, maturity, and credit quality, but offers a higher yield, is called a **substitution swap**. This swap depends on a capital market imperfection. Such situations sometimes exist in the bond market owing to temporary market imbalances and the fragmented nature of the non-Treasury bond market. The risk the money manager faces in making a substitution swap is that the bond purchased may not be truly identical to the bond for which it is exchanged. Moreover, typically, bonds will have similar but not identical maturities and coupon. This could lead to differences in the convexity of the two bonds, and any yield spread may reflect the cost of convexity.

21. The following excerpt is taken from an article titled "MERUS to Boost Corporates," which appeared in the January 27, 1992, issue of *BondWeek*, p.6:

> MERUS Capital Management will increase the allocation to corporates in its $790 million long investment-grade fixed-income portfolio by $39.5 million over the next six months to a year, according to George Wood, managing director. MERUS will add corporates rated single A or higher in the expectation that spreads will tighten as the economy recovers and that some credits may be upgraded.

What types of active portfolio strategies is MERUS Capital Management pursuing?

MERUS is increasing corporates in it long investment-grade fixed-income portfolio in the next months to one year. They are focusing upon investment-grade securities because they expect the spread will tighten and some issues will be given higher ratings thus increasing their value. Thus, now is the time to lock in a higher spread as well as investing in investment-grade securities that will be strengthened by a robust economy.

Thus, MERUS is employing a **yield spread strategy** that involves positioning a portfolio to capitalize on expected changes in yield spreads between sectors of the bond market. Swapping (or exchanging) one bond for another when the manager believes that the prevailing yield spread between the two bonds in the market is out of line with their historical yield spread, and that the yield spread will realign by the end of the investment horizon, are called **intermarket spread swaps**.

MERUS is also employing a **credit spread strategy**. Credit or quality spreads change because of expected changes in economic prospects. Credit spreads between Treasury and non-Treasury issues widen in a declining or contracting economy and narrow during economic expansion (which is MERUS's case). The economic rationale is that in a declining or contracting economy, corporations experience a decline in revenue and reduced cash flow, making it difficult for corporate issuers to service their contractual debt obligations. To induce investors to hold non-Treasury securities of lower-quality issuers, the yield spread relative to Treasury securities must widen. The converse is that during economic expansion and brisk economic activity, revenue and cash flow pick up, increasing the likelihood that corporate issuers will have the capacity to service their contractual debt obligations. Yield spreads between Treasury and federal agency securities will vary depending on investor expectations about the prospects that an implicit government guarantee will be honored.

22. This excerpt comes from an article titled "Eagle Eyes High-Coupon Callable Corporates" in the January 20, 1992, issue of *BondWeek*, p. 7:

> If the bond market rallies further, Eagle Asset Management may take profits, trading $8 million of seven-to 10-year Treasuries for high-coupon single-A industrials that are callable in two to four years according to Joseph Blanton, Senior V.P. He thinks a further rally is unlikely, however.
>
> Eagle has already sold seven- to 10-year Treasuries to buy $25 million of high-coupon, single-A nonbank financial credits. It made the move to cut the duration of its $160 million fixed income portfolio from 3.7 to 2.5 years, substantially lower than the 3.3-year duration of its bogey **. . .** because it thinks the bond rally has run its course**. . .**
>
> Blanton said he likes single-A industrials and financials with 9 1/2–10% coupons because these are selling at wide spreads of about 100–150 basis points off Treasuries.

What types of active portfolio strategies are being pursued by Eagle Asset Management?

Blanton may take profits by trading seven- to 10-year Treasuries for high-coupon single-A industrials that are callable in two to four years because the market rally will fade. This means Blanton believes the spread will stop decreasing and may even increase making these securities less desirable. By buying callable bonds, it is implied that interest rates may increase. Blanton has already sold some seven- to 10 year Treasuries to buy high-coupon single-A nonbank financial credits implying that he further believes interest rates will increase. In anticipation of interest rates increasing, Blanton has cut the duration of his portfolio so as not to be stuck with long-term

investments in securities paying low coupon rates relative to market yields. Finally, Blanton has shifted from Treasuries to industrial and financials where the spread are believed to be relatively high.

From the above, Blanton appears to be following a strategy to capitalize on differences in **spreads between callable and noncallable securities**. For example, Blanton has bought some callable securities. Spreads attributable to differences in callable and noncallable bonds and differences in coupons of callable bonds will change as a result of expected changes in (i) the direction of the change in interest rates and (ii) interest-rate volatility. An expected drop in the level of interest rates will widen the yield spread between callable bonds and noncallable bonds as the prospects that the issuer will exercise the call option increase. The reverse is true: the yield spread narrows if interest rates are expected to rise.

Next, Blanton is also involved in a credit spread strategy. For example, Blanton has already sold seven- to 10-year Treasuries to buy $25 million of high-coupon, single-A nonbank financial credits. Credit or quality spreads change because of expected changes in economic prospects. Credit spreads between Treasury and non-Treasury issues widen in a declining or contracting economy and narrow during economic expansion.

Additionally, Blanton is engaged in a strategy that involves changing his portfolio's duration. A money manager who believes that he or she can accurately forecast the future level of interest rates will alter the portfolio's sensitivity to interest-rate changes. As duration is a measure of interest-rate sensitivity, this involves increasing a portfolio's duration if interest rates are expected to fall and reducing duration if interest rates are expected to rise. For those managers whose benchmark is a bond index, this means increasing the portfolio duration relative to the benchmark index if interest rates are expected to fall and reducing it if interest rates are expected to rise. The degree to which the duration of the managed portfolio is permitted to diverge from that of the benchmark index may be limited by the client. A portfolio's duration may be altered by swapping (or exchanging) bonds in the portfolio for new bonds that will achieve the target portfolio duration. Such swaps are commonly referred to as **rate anticipation swaps**.

Further, it appears that Blanton is following is a **yield spread strategy**. Blanton is involved in positioning a portfolio to capitalize on expected changes in yield spreads between sectors of the bond market. For example, the excerpt states: "Blanton said he likes single-A industrials and financials with 9 1/2–10% coupons because these are selling at wide spreads of about 100–150 basis points off Treasuries." Swapping (or exchanging) one bond for another when the manager believes that the prevailing yield spread between the two bonds in the market is out of line with their historical yield spread, and that the yield spread will realign by the end of the investment horizon, are called **intermarket spread swaps**.

23. The following excerpt is taken from an article titled "W.R. Lazard Buys Triple Bs," which appeared in the November 18, 1991, issue of *BondWeek*, p. 7:

> W.R. Lazard & Co. is buying some corporate bonds rated triple B that it believes will be upgraded and some single A's that the market perceives as risky but Lazard does not, according to William Schultz, V.P. The firm, which generally buys corporates

rated single A or higher, is making the move to pick up yield, Schultz said.

What types of active portfolio strategies are being followed by W.R. Lazard & Co.?

Schultz wants to capitalize on what he believes are underpriced bonds rated triple B's and single A's. Thus, Schultz appears to be using a **credit spread strategy**.

Credit or quality spreads change because of expected changes in economic prospects. Credit spreads between Treasury and non-Treasury issues widen in a declining or contracting economy and narrow during economic expansion. To induce investors to hold non-Treasury securities of lower-quality issuers, the yield spread relative to Treasury securities must widen. Schultz wants to earn a higher spread for issues that are below AA because he thinks these spreads will be reduced.

Schultz's strategy can also be viewed as a **yield spread strategy** which involves differences in yields within the corporate sectors.

24. In an article titled "Signet to Add Pass-Throughs," which appeared in the October 14, 1991, issue of *BondWeek*. p. 5, it was reported that Christian Goetz, assistant vice president of Signet Asset Management, "expects current coupons to outperform premium pass-throughs as the Fed lowers rates because mortgage holders will refinance premium mortgages." If Goetz pursues a strategy based on this, what type of active strategy is it?

Goetz appears to be pursuing an active strategy that relies on forecasts of future interest-rate levels. Future interest rates, for instance, affect the value of options embedded in callable bonds and the value of prepayment options embedded in mortgage-backed securities. Callable corporate and municipal bonds with coupon rates above the expected future interest rate will underperform relative to noncallable bonds or low-coupon bonds. This is because of the negative convexity feature of callable bonds.

Goetz is also concerned with an active strategy used in the mortgage-backed securities market. This strategy involves identifying individual issues of pass-throughs, CMO classes, or stripped MBS that are mispriced, given the assumed prepayment speed to price the security. Another active strategy commonly used in the mortgage-backed securities market is to create a package of securities that will have a better return profile for a wide range of interest-rate and yield curve scenarios than similar duration securities available in the market. Because of the fragmented nature of the mortgage-backed securities market and the complexity of the structures, such opportunities are not unusual.

25. The following excerpt comes from an article titled "Securities Counselors Eyes Cutting Duration" in the February 17, 1992, issue of *BondWeek*, p. 5:

> Securities Counselors of Iowa will shorten the 5.3 year duration on its $250 million fixed-income portfolio once it is convinced interest rates are moving up and the economy is improving**. . . .** It will shorten by holding in cash equivalents the proceeds from the sale of an undetermined amount of 10-year Treasuries and adding a small amount of high-grade electric utility bonds that have short-maturities if their spreads

> widen out at least 100 basis points**. . . .** The portfolio is currently allocated with 85% to Treasuries and 15% to agencies. It has not held corporate bonds since 1985, when it perceived as risky the onslaught of hostile corporate takeovers**. . . .**

Answer the following questions.

(a) Why would Securities Counselors want to shorten duration if it believes that interest rates will rise?

Securities Counselors is planning for the possibility that interest rates will increase. The plan involves shortening its duration so that it can be in a position to reinvest funds in longer term investments. This is because a short duration implies investments will be maturing and thus these funds will be available to buy securities with a higher coupon rate if interest rates do increase.

(b) How does the purchase of cash equivalents and short-maturity high-grade utilities accomplish the goal of shortening the duration?

Cash equivalents and short-maturity high-grades utilities are very liquid and thus by nature will mature quickly. Ceteris paribus, these investments involve very short durations.

(c) What risk is Securities Counselors indicating in the last sentence of the excerpt that it is seeking to avoid by not buying corporate bonds?

A hostile takeover can involve retiring holdings making the duration very short. The risk is the unexpected nature of the takeover that would cause a portfolio manager to rearrange their portfolio and perhaps have to invest in securities that do not pay as high a rate of return.

26. The next excerpt is taken from an article titled "Wood Struthers to Add High-Grade Corporates," which appeared in the February 17, 1992, issue of *BondWeek*, p. 5:

> Wood Struthers & Winthrop is poised to add a wide range of high-grade corporates to its $600 million fixed-income portfolio**. . . .** It will increase its 25% corporate allocation to about 30% after the economy shows signs of improving **. . .** It will sell Treasuries and agencies of undetermined maturities to make the purchase **. . .** Its duration is 4 1/2–5 years and is not expected to change significantly **. . .**

Comment on this portfolio strategy.

As the economy improves, there will be less risk. This implies that corporate fixed-income investments may be upgraded. The upgrade will increase the value of these securities. If Wood Struthers & Winthrop (WS&W) increases its corporate allocation it will be in a position to increase its value due to price appreciation. By selling Treasuries and agencies, WS&W will be increasing its coupon payments and thus its value due to interest payments. In conclusion, WS&W will be in a position to profit through both price appreciation and increase fixed payments. This risk is inherent whenever shifting away from Treasuries to corporates is the greater probability of not receiving principal and interest payments in full.

27. Explain how a rating transition matrix can be used as a starting point in assessing how a manager may want to allocate funds to the different credit sectors of the corporate bond market.

A rating transition matrix can be a starting point because it provides a framework for how the credit quality for different sectors of the corporate bond market has changed historically. While the historical rating transition matrix is a useful starting point since it represents an average over a period of time, a manager must modify the matrix based on expectations of upgrades and downgrades given current and anticipated economic conditions.

28. What is the risk associated with the use of leverage?

A portfolio manager can create leverage by borrowing funds in order to acquire a position in the market that is greater than if only cash were invested. The funds available to invest without borrowing are referred to as the "equity." The basic principle in using leverage is that a manager wants to earn a return on the borrowed funds that is greater than the cost of the borrowed funds. The return from borrowing funds is produced from a higher income and/or greater price appreciation relative to a scenario in which no funds are borrowed. The risk associated with leverage (or borrowing funds) is that the securities in which the borrowed funds are invested may earn less than the cost of the borrowed funds due to failure to generate interest income plus capital appreciation as expected when the funds were borrowed. Generally speaking, borrowed funds create a legal responsibility on the part of the borrower and can lead to default if not paid back in a timely fashion.

29. Suppose that the initial value of an unlevered portfolio of Treasury securities is $200 million and the duration is 7. Suppose further that the manager can borrow $800 million and invest it in the identical Treasury securities so that the levered portfolio has a value of $1 billion. What is the duration of this levered portfolio?

The portfolio has a market value of $200 million, and the manager invests the proceeds in a bond with a duration of 7. This means that the manager would expect that for a 100-basis-point change in interest rates, the portfolio's value would change by approximately (7 / 100)$200 = $14 million. For this unlevered fund, the duration of the portfolio is 7.

Suppose now that the manager of this portfolio borrows an additional $800 million. This means that the levered fund will have $200 + $800 = $1 billion to invest, consisting of $200 million that the manager has available before borrowing (i.e., the equity) and $800 million borrowed. All of the funds are invested in a bond with a duration of 7. Now let's look at what happens if interest rates change by 100 basis points.

The levered portfolio's value will change by (7 / 100)($1 billion) = $70 million. This means that on an investment of $200 million, the portfolio's value changes by $70 million. The proper way to measure the portfolio's duration is relative to the unlevered amount or equity because the manager is concerned with the risk exposure relative to equity.

Thus, the duration for the portfolio is $70 million per $200 million or $35 per each $100 rendering a **duration of 35** because a duration of 35 will change the portfolio's equity value of $200 million by 35% or $35 million for a 100-basis-point change in rates.

In general, the procedure for calculating the duration of a portfolio that uses leverage is as follows:

Step 1: Calculate the duration of the levered portfolio.

Step 2: Determine the dollar duration of the portfolio of the levered portfolio for a change in interest rates.

Step 3: Compute the ratio of the dollar duration of the levered portfolio to the value of the initial unlevered portfolio (i.e., initial equity).

Step 4: The duration of the unlevered portfolio is then found as follows:

$$\text{ratio computed in Step 3} \times \frac{100}{\text{rate change used in Step 2 in bps}} \times 100.$$

To illustrate the procedure for our problem, the initial value of the unlevered portfolio is $200 million and the leveraged portfolio is $200 million equity plus $800 million borrowed = $1 billion.

Step 1: We are given that the duration of the levered portfolio is 7.

Step 2: Let's use a 50-basis-point change in interest rates to compute the dollar duration. If the duration of the levered portfolio is 7, then the dollar duration for a 50-basis-point change in interest rates is 7(0.05)($1 billion) = $35 million (7 times 0.5% = 3.5% change for a 50-basis-point move times $1 billion).

Step 3: The ratio of the dollar duration for a 50-basis-point change in interest rates to the $200 million initial market value of the unlevered portfolio is $35 million / $200 million = 0.175.

Step 4: The duration of the unlevered portfolio is:

$$\text{ratio computed in Step 3} \times \frac{100}{\text{rate change used in Step 2 in bps}} \times 100 = 0.75 \times \frac{100}{50} \times 100 = \mathbf{35}.$$

30. Suppose a manager wants to borrow $50 million of a Treasury security that it plans to purchase and hold for 20 days. The manager can enter into a reverse repo agreement with a dealer firm that would provide financing at a 4.2% repo rate and a 2% margin requirement. What is the dollar interest cost that the manager will have to pay for the borrowed funds?

With a reverse repo, the dealer agrees to buy the securities and sell them back later.

The dollar interest for $50 million in borrowed funds is given by:

$$\text{dollar interest} = (\text{dollar amount borrowed})(\text{repo rate})\ \frac{\text{repo term}}{360}.$$

Inserting our values, we get:

$$\text{dollar interest} = (\$50{,}000{,}000)(0.042)\ \frac{4}{360} = \mathbf{\$23{,}333.33}.$$

However, if the firm cannot borrow $50 million because of a margin requirement, then we have to adjust for the margin requirement. The amount by which the market value of the security used as collateral exceeds the value of the loan is called **repo margin** or simply **margin**. With a 2% margin requirement, the dollar amount borrowed will be adjusted by dividing by (1 + margin). Thus, we have: dollar amount borrowed = collateral / (1 + margin) = $50 million / (1 + margin) = $50 million / 1.02 = $49,019,607.84. We see that the collateral of $50 million exceeds the amount of the loan by 2%. For example, (1.02)$49,019,607.84 = $50 million.

For a repo margin requirement and dollar amount borrowed of $49,019,607,84, the dollar interest is now:

$$\text{dollar interest} = \$49{,}019{,}607.84(0.042)\ \frac{4}{360} = \mathbf{\$22{,}875.82}.$$

31. Two trustees of a pension fund are discussing repurchase agreements. Trustee A told Trustee B that she feels it is a safe short-term investment for the fund. Trustee B told Trustee A that repurchase agreements are highly speculative vehicles because they are leveraged instruments. You've been called in by the trustees to clarify the investment characteristics of repurchase agreements. What would you say to the trustees?

First, one could define a repurchase agreement or repo by stating that a repo is the sale of a security with a commitment by the seller to buy the same security back from the purchaser at a specified price at a designated future date. One could emphasize that a repo is a collateralized loan, where the collateral is the security sold and subsequently repurchased. From the customer's perspective, one could positively point out that the repo market offers an attractive yield on a short-term secured transaction that is highly liquid.

One could then add that although Treasury securities are often used as the collateral, the collateral in a repo is not limited to government securities. Money market instruments, federal agency securities, and mortgage-backed securities are also used. In some specialized markets, whole loans are used as collateral. Thus, the safety of the repo is a function of the riskiness of the collateral which is generally speaking secure.

One would next discuss the credit risk by stating that despite the fact that there may be high-quality collateral underlying a repo transaction, both parties to the transaction are exposed to credit risk. For example, assuming a government security is involved, if the dealer cannot repurchase the government securities, the customer may keep the collateral. If interest rates on government securities increase subsequent to the repo transaction, however, the market value of the

government securities will decline, and the customer will own securities with a market value less than the amount it lent to the dealer. If the market value of the security rises instead, the dealer will be concerned with the return of the collateral, which then has a market value higher than the loan.

Finally, one might point out that repos can be carefully structured to reduce credit risk exposure. The amount lent should be less than the market value of the security used as collateral, thereby providing the lender with some cushion should the market value of the security decline. The amount by which the market value of the security used as collateral exceeds the value of the loan is called repo margin. Another practice to limit credit risk is to mark the collateral to market on a regular basis. Marking a position to market means recording the value of a position at its market value. When market value changes by a certain percentage, the repo position is adjusted accordingly.

32. Suppose that a manager buys an adjustable-rate pass-through security backed by Freddie Mac or Fannie Mae, two government-sponsored enterprises. Suppose that the coupon rate is reset monthly based on the following coupon formula:

one-month LIBOR + 80 basis points

with a cap of 9% (i.e., maximum coupon rate of 9%).

Suppose that the manager can use these securities in a repo transaction in which (i) a repo margin of 5% is required, (ii) the term of the repo is one month, and (iii) the repo rate is one-month LIBOR plus 10 basis points. Also assume that the manager wishes to invest $1 million of his client's funds in these securities. The manager can purchase $20 million in par value of these securities because only $1 million is required. The amount borrowed would be $19 million. Thus the manager realizes a spread of 70 basis points on the $19 million borrowed because LIBOR plus 80 basis points is earned in interest each month (coupon rate) and LIBOR plus 10 basis point is paid each month (repo rate).

What are the risks associated with this strategy?

The return earned must be commensurate with the risk undertaken to determine if the strategy is viable. First, there is a cap on the adjustable-rate pass-through security that may cause problems and negate the current spread of 70 basis points.

Second, there is a credit risk involved for both parties in repo transaction. For example, if the dealer cannot repurchase the securities, the customer may keep the collateral. If interest rates on the securities increase subsequent to the repo transaction, however, the market value of the securities will decline, and the customer will own securities with a market value less than the amount it lent to the dealer. If the market value of the security rises instead, the dealer will be concerned with the return of the collateral, which then has a market value higher than the loan.

Also, another risk factor in structuring a repo is delivery of the collateral to the lender. The most obvious procedure is for the borrower to deliver the collateral to the lender or to the lender's clearing agent. In such instances, the collateral is said to be "delivered out." At the end of the repo

term, the lender returns the collateral to the borrower in exchange for the principal and interest payment. This procedure may be too expensive, though, particularly for short-term repos, because of costs associated with delivering the collateral. The cost of delivery would be factored into the transaction by a lower repo rate that the borrower would be willing to pay. The risk of the lender not taking possession of the collateral is that the borrower may sell the security or use the same security as collateral for a repo with another party.

33. Why is there credit risk in a repo transaction?

Despite the fact that there may be high-quality collateral underlying a repo transaction, both parties to the transaction are exposed to credit risk. Why does credit risk occur in a repo transaction? To answer this question, consider the example in the text in which the dealer uses $10 million of government securities as collateral to borrow. If the dealer cannot repurchase the government securities, the customer may keep the collateral; if interest rates on government securities increase subsequent to the repo transaction, however, the market value of the government securities will decline, and the customer will own securities with a market value less than the amount it lent to the dealer. If the market value of the security rises instead, the dealer will be concerned with the return of the collateral, which then has a market value higher than the loan.