2020 CFA®

PROGRAM EXAM PREP

SchweserNotes™ Level III

Fixed Income and Equity

eBook 3

KAPLAN SCHWESER

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LEARNING OUTCOME STATEMENTS (LOS)

STUDY SESSION 7

The topical coverage corresponds with the following CFA Institute assigned reading:

18. Overview of Fixed-Income Portfolio Management

The candidate should be able to:

a. discuss roles of fixed-income securities in portfolios. (page 1)
b. describe how fixed-income mandates may be classified and compare features of the mandates. (page 4)
c. describe bond market liquidity, including the differences among market sub-sectors, and discuss the effect of liquidity on fixed-income portfolio management. (page 5)
d. describe and interpret a model for fixed-income returns. (page 8)
e. discuss the use of leverage, alternative methods for leveraging, and risks that leverage creates in fixed-income portfolios. (page 12)
f. discuss differences in managing fixed-income portfolios for taxable and tax-exempt investors. (page 15)

The topical coverage corresponds with the following CFA Institute assigned reading:

19. Liability-Driven and Index-Based Strategies

The candidate should be able to:

a. describe liability-driven investing. (page 21)
b. evaluate strategies for managing a single liability. (page 22)
c. compare strategies for a single liability and for multiple liabilities, including alternative means of implementation. (page 30)
d. evaluate liability-based strategies under various interest rate scenarios and select a strategy to achieve a portfolio's objectives. (page 36)
e. explain risks associated with managing a portfolio against a liability structure. (page 42)
f. discuss bond indexes and the challenges of managing a fixed-income portfolio to mimic the characteristics of a bond index. (page 44)
g. compare alternative methods for establishing bond market exposure passively. (page 47)
h. discuss criteria for selecting a benchmark and justify the selection of a benchmark. (page 49)
i. describe construction, benefits, limitations, and risk–return characteristics of a laddered bond portfolio. (page 50)

STUDY SESSION 8

The topical coverage corresponds with the following CFA Institute assigned reading:

20. Yield Curve Strategies

The candidate should be able to:

a. describe major types of yield curve strategies. (pages 62, 63)
b. explain how to execute a carry trade. (pages 62, 67)
c. explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity. (pages 62, 63, 65)
d. formulate a portfolio positioning strategy given forward interest rates and an interest rate view. (page 70)
e. explain how derivatives may be used to implement yield curve strategies. (pages 63, 72)
f. evaluate a portfolio's sensitivity to a change in curve slope using key rate durations of the portfolio and its benchmark. (page 76)
g. discuss inter-market curve strategies. (page 78)
h. construct a duration-neutral government bond portfolio to profit from a change in yield curve curvature. (page 76)
i. evaluate the expected return and risks of a yield curve strategy. (page 82)

The topical coverage corresponds with the following CFA Institute assigned reading:

21. Fixed-Income Active Management: Credit Strategies

The candidate should be able to:

a. describe risk considerations in investment-grade and high-yield corporate bond portfolios. (page 90)
b. compare the use of credit spread measures in portfolio construction. (page 93)
c. discuss bottom-up approaches to credit strategies. (page 97)
d. discuss top-down approaches to credit strategies. (pages 97, 101)
e. discuss liquidity risk in credit markets and how liquidity risk can be managed in a credit portfolio. (page 106)
f. describe how to assess and manage tail risk in credit portfolios. (page 107)
g. discuss considerations in constructing and managing portfolios across international credit markets. (page 108)
h. describe the use of structured financial instruments as an alternative to corporate bonds in credit portfolios. (page 109)

STUDY SESSION 9

The topical coverage corresponds with the following CFA Institute assigned reading:

22. Overview of Equity Portfolio Management

The candidate should be able to:

a. describe the roles of equities in the overall portfolio. (page 121)
b. describe how an equity manager's investment universe can be segmented. (page 123)
c. describe the types of income and costs associated with owning and managing an equity portfolio and their potential effects on portfolio performance. (page 126)
d. describe the potential benefits of shareholder engagement and the role an equity manager might play in shareholder engagement. (page 129)
e. describe rationales for equity investment across the passive–active spectrum. (page 131)

The topical coverage corresponds with the following CFA Institute assigned reading:

23. Passive Equity Investing

The candidate should be able to:

a. discuss considerations in choosing a benchmark for a passively managed equity portfolio. (page 137)
b. compare passive factor-based strategies to market-capitalization-weighted indexing. (page 140)
c. compare different approaches to passive equity investing. (page 142)
d. compare the full replication, stratified sampling, and optimization approaches for the construction of passively managed equity portfolios. (page 143)
e. discuss potential causes of tracking error and methods to control tracking error for passively managed equity portfolios. (page 145)
f. explain sources of return and risk to a passively managed equity portfolio. (page 146)

STUDY SESSION 10

The topical coverage corresponds with the following CFA Institute assigned reading:

24. Active Equity Investing: Strategies

The candidate should be able to:

a. compare fundamental and quantitative approaches to active management. (page 151)
b. analyze bottom-up active strategies, including their rationale and associated processes. (page 152)
c. analyze top-down active strategies, including their rationale and associated processes. (page 152)
d. analyze factor-based active strategies, including their rationale and associated processes. (page 157)
e. analyze activist strategies, including their rationale and associated processes. (page 162)
f. describe active strategies based on statistical arbitrage and market microstructure. (page 164)
g. describe how fundamental active investment strategies are created. (page 167)
h. describe how quantitative active investment strategies are created. (page 168)
i. discuss equity investment style classifications. (page 173)

The topical coverage corresponds with the following CFA Institute assigned reading:

25. Active Equity Investing: Portfolio Construction

The candidate should be able to:

a. describe elements of a manager's investment philosophy that influence the portfolio construction process. (page 183)
b. discuss approaches for constructing actively managed equity portfolios. (page 186)
c. distinguish between Active Share and active risk and discuss how each measure relates to a manager's investment strategy. (page 188)
d. discuss the application of risk budgeting concepts in portfolio construction. (page 194)
e. discuss risk measures that are incorporated in equity portfolio construction and describe how limits set on these measures affect portfolio construction. (page 200)
f. discuss how assets under management, position size, market liquidity, and portfolio turnover affect equity portfolio construction decisions. (page 202)
g. evaluate the efficiency of a portfolio structure given its investment mandate. (page 204)
h. discuss the long-only, long extension, long/short, and equitized market-neutral approaches to equity portfolio construction, including their risks, costs, and effects on potential alphas. (page 205)

The following is a review of the Fixed-Income Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #18.

READING 18: OVERVIEW OF FIXED-INCOME PORTFOLIO MANAGEMENT

Study Session 7

EXAM FOCUS

This reading provides a good overview of issues covered in more detail in subsequent readings, so don't obsess about exact nuances of terminology. Take in what is said and move on to the rest of fixed income to see what we are going to do with these ideas and concepts. Do take the time to understand the model for projecting or decomposing bond return.

We make reference to historical results such as return, standard deviation, and correlation in this reading. They reflect results reported in the CFA reading. The numbers are to suggest typical relationships. They are not to be memorized and do not dictate what can happen in any specific period.

MODULE 18.1: ROLE OF FIXED INCOME

Video covering this content is available online.

LOS 18.a: Discuss roles of fixed-income securities in portfolios.

CFA® Program Curriculum, Volume 4, page 6

Fixed income is the largest segment of world financial markets. (Real estate may be larger but is not being treated as a financial market in this comment.) The fixed-income market is highly varied. It includes publically traded securities such as bond and money market securities as well as nonpublic instruments such as loans and private placement securities. It varies by maturity and credit quality segments. There are structure differences such as straight bonds without embedded options, instruments with embedded prepayment options, variable coupon structures, and inflation adjustment features.

As an asset class used in a portfolio, fixed income may provide:

1. *Diversification*. In general, fixed income has low correlation to equity markets. Adding an asset class to an existing portfolio with a correlation of less than +1 means the same expected return can be generated with lower standard deviation and the standard deviation of the portfolio will be less than the weighted average standard deviation of the assets held in the portfolio. The lower the correlation, the greater the diversification benefit. Specific correlation numbers vary by time period and type of instrument used. For 2003 to 2015, the correlations of various fixed-income indexes to the S&P 500 equity index fell within a range of –0.35 to +0.36.

   In general, various U.S. investment grade (IG) segments had relatively high correlation with each other. International IG was less correlated to U.S. IG and offered additional

diversification within fixed income. High yield [(HY) means below investment grade] and emerging market fixed income had low correlation to investment-grade fixed income and offered significant diversification within fixed income, but they were also the most correlated to equity markets and so provided the least diversification benefit if it were the only fixed income added to equity portfolios. (There was still a diversification benefit, just less pronounced.)

These correlations are not always stable over time. A particular problem is flight to quality. During periods of market stress, all lower-quality and riskier assets may tend to decline together (correlation approaching +1) as investors sell these assets and buy high-quality developed-market government bonds for safety. Thus, correlation of these government bonds to riskier assets declines during periods of stress and may be negative.

While correlation is an important component of reducing portfolio risk, so is the standard deviation of the assets added. In general, bonds have lower standard deviation than equity, and that also reduces the overall risk of the portfolio. However, the same caveat exists, that bond volatility may increase during market crises.

2. *Regular cash flow.* Most fixed income provides regular, predictable cash flow that investors can use to meet expected future obligations. This is convenient for an individual needing regular living expenses or specific periodic expenditures such as college tuition payments. Institutions such as insurance companies that must make periodic payments to policyholders could structure and dedicate a portfolio of bond assets to meet these payouts. Investors could also build a buy-and-hold laddered portfolio of bonds to provide regular cash flow. Buy and hold means no sales or trading are planned, and laddered means a somewhat equal amount of par comes due periodically. Implicit in this discussion is that there is no significant credit risk and that all payments will be made on the bonds.
3. *Inflation hedge.* While not the first thing most investors would think of, some types of bonds do provide forms of inflation protection. Standard fixed-coupon (nominal rate) bonds do not. For simplicity, assume the bonds are purchased at par so that initial yield is the coupon rate. The purchase yield and coupon reflect nominal compensation for an expected future rate of inflation and a real return above that rate of inflation. If inflation increases, the coupon cash flow is fixed and the investor suffers on an inflation-adjusted basis. Looked at another way, the yield a new investor would want increases and the price of the bond must decline.
    - Inflation-linked (also called real rate or real return) bonds provide direct protection for the effect of inflation. Like regular bonds, the coupon payment amount is the coupon rate × par. But unlike regular bonds, the par adjusts for inflation. If 1 million par is purchased and inflation is 5%, the par increases by 5% to 1.05 million. (For later comparison with floating-coupon bonds, assume the previous inflation rate was 3%, though this does not directly affect the calculations for the inflation-linked bond.) That leads the coupon payment amount to increase by 5% as well. For example, if the real rate were 0.5%, the first (annualized) coupon payment is 5,250 (1,050,000 × 0.005). This adjustment continues every period to compensate for cumulative inflation over the life of the bond. At expiration, inflation-adjusted par is paid to the investor. Thus, both coupon payments and par are inflation protected.

- Floating-coupon (floating-rate) securities also provide inflation protection. The coupon rate is set by a formula such as LIBOR + 100 basis points. If inflation and LIBOR are initially 3.0% and 3.5%, the first (annual) coupon payment on 1 million par would be 45,000 [1,000,000 (0.035 + 0.01)]. If inflation then increases by 2% to 5.0%, it is likely LIBOR will also increase by 2% to 5.5% and the next coupon payment will increase to 65,000 [1,000,000 (0.055 + 0.01)]. No adjustment is made to the par amount. Thus, it is said the coupons are inflation protected but not the principal.

Figure 18.1: Summary of Inflation Protection

	Coupon	Par
Fixed-coupon bonds	Not protected	Not protected
Inflation-linked bonds	Protected	Protected
Floating-coupon bonds	Protected	Not protected

PROFESSOR'S NOTE

It is easy to misunderstand this material. In theory, both inflation-linked and floating-coupon securities provide full inflation protection but do so in different ways. Imagine fixed-coupon nominal rate (NR), inflation-linked, and floating-coupon bonds from the same issuer with the same maturity. In a fully efficient market, all three would be priced to reflect the same consensus expectations for inflation and have the same expected return. (Because they respond to inflation risk differently, there could be small differences.) If the actual rates of inflation turn out to higher (lower) than initial consensus expectations, the actual returns for the inflation linked and floating coupon would be superior (inferior) to the NR bond. Between the inflation linked and floating coupon, one or the other may end up being best depending on the actual path of future inflation. Notice in the earlier example with inflation increasing from 3% to 5% the par and coupon payment amount for the inflation-linked bond increased by 5% while the par of the floating coupon was unchanged, but the coupon payment amount went from 45,000 to 65,000, an increase of 44.4%.

The bottom line is to accept the conclusions as presented in the reading; they are correct. You can come back and develop spreadsheet models to test various scenarios after you have the charter. If you like bonds, it is fun to do so.

FIXED-INCOME MANDATES

LOS 18.b: Describe how fixed-income mandates may be classified and compare features of the mandates.

CFA® Program Curriculum, Volume 4, page 11

PROFESSOR'S NOTE

This LOS is a brief introduction to topics to be covered in depth in later readings. Read it and move on. You will see more details of these techniques as you continue in fixed income.

Liability-based mandates are portfolio assets that are managed solely to meet expected future liability payouts. All asset cash flows are reinvested until paid out to meet the liabilities. This is often referred to as immunization. There are several forms and variations of **immunization**.

- **Cash-flow matching** is the simplest form of immunization. The assets are selected so that cash flows occur when and in the size needed to meet the liability payouts.

- **Duration matching** matches the duration of the assets and liabilities so the two will fluctuate at the same percentage rate as interest rates change, such that their ending values will remain matched.
- **Contingent immunization** (CI) is a hybrid of active management and immunization. The portfolio is initially funded with more money than required to meet the future liability payouts. The present value of the assets (PVA) exceeds the present value of the liabilities (PVL). The difference is the surplus. As long as the surplus is positive, the portfolio can be managed in any way the manager believes will add value. If CI succeeds, the surplus will grow and the ultimate cost of CI will be less than that of initially immunizing. If the active management is unsuccessful and the surplus declines to zero, the portfolio must be immediately immunized and the ultimate cost of CI will be more than that of initial immunization but by a known amount.
- **Horizon matching** is another hybrid approach, combining cash-flow and duration matching to fund multiple future liabilities. Shorter-term liabilities are cash-flow matched, and longer-term liabilities are duration matched. Cash-flow matching is more restrictive in the assets that can be used but safer as it provides more certainty the funds will be there. Duration matching is more complex and somewhat riskier but gives the manager more flexibility in asset selection; that flexibility is likely to lead to an ability to find assets with higher yield and therefore to require a smaller initial investment to meet the future liabilities.

Figure 18.2: Comparison of Liability-Based Strategies

	Initial funding required (PVA)	Risk and complexity	Expected realized return if successful
Cash-flow matching	(3)	Lowest (1)	Lowest (1)
Horizon matching	(2)	(2)	(2)
Duration matching	Lowest (1)	(3)	(3)
Contingent immunization	Highest (4)*	Highest (4)	Highest (4)

* This reflects the requirement to initially overfund with a surplus.

Therefore, the horizon matching should cost less than pure cash-flow matching, with minimal additional risk.

Total return mandates do not seek to fund future liabilities but may target an absolute rate of return or, more commonly, seek to equal or outperform (relative return versus) an index or some other set of specified assets. The key metrics to evaluate such portfolios are **active return** (portfolio return less return of the relevant benchmark, also called value added or alpha) and volatility of that active return (standard deviation of active return, also called **active risk**, **tracking error**, or **tracking risk**). Total return mandates include the following:

- **Pure indexing,** which attempts to replicate the performance of a bond index. It targets zero active return and risk. Unlike the equity market, the large number of individual bonds in most indexes and their potential lack of liquidity makes literal duplication of the index (holding every issue in the same weight as in the index) impractical. Most pure bond indexing instead seeks to exactly match all the risk factors of the index (such as duration, credit or quality, sectors, and prepayment risks) while still allowing the manager some leeway on the individual bonds selected. The turnover (trading) in the portfolio should be low and similar to the turnover in the index.

- **Enhanced indexing** allows some additional flexibility in constructing the portfolio and seeks to add some modest active return (perhaps 20 to 30 bps with active risk below 50 bps). Typically, duration (interest rate risk) is still matched to the index, but some risk mismatches such as modest over- or underweighting of sectors and quality are allowed. Somewhat higher portfolio turnover is likely.
- **Active management** allows much larger deviations from the risk factors of the index and seeks greater active return (perhaps +50 bps). Duration can also be mismatched and portfolio turnover can be much higher.

BOND LIQUIDITY

LOS 18.c: Describe bond market liquidity, including the differences among market sub-sectors, and discuss the effect of liquidity on fixed-income portfolio management.

CFA® Program Curriculum, Volume 4, page 19

Liquidity is the ability to make transactions in relatively large size, quickly, and with minimal deviation from the market price of the asset. In the bond market, the most recently issued (on-the-run) developed-market government bonds are likely to be quite liquid and other bonds may be quite illiquid. Those other bonds may trade virtually never or at very wide bid-ask spreads. Issues leading to illiquidity include:

- The very large number of bond issues, each of which can be quite small, compared to the smaller number of stock issues in the equity market. A single issuer can have dozens or more separate bonds outstanding. Each can be unique in terms of maturity, coupon, and call features. Each issuer's bonds are heterogeneous (different), unlike the stock of the issuer, which is homogeneous. Most issuers have one class of common stock (and perhaps none, one, or a few issues of preferred stock).
- Bonds usually trade over the counter, which increases the search cost to find a counterparty to any transaction. This also makes transactions less transparent (it is harder to find information on past price and volume of transactions). Bond liquidity is usually higher for recently issued bonds as dealers may have an inventory of those bonds on hand. As time passes, the bonds are likely to become held in portfolios of investors with no plans to trade the bonds. When the issuer puts out a new issue of similar remaining maturity to a previous issue, the older issue becomes off-the-run and its liquidity decreases. The less liquid issues normally trade at a higher yield to maturity, offering a liquidity premium. These liquidity premiums can vary widely depending on specific circumstances.

PROFESSOR'S NOTE

Some authors refer to an illiquidity premium and others to a liquidity premium. They mean the same thing. The current Level III fixed-income readings call it a liquidity premium, meaning extra compensation in the form of higher yield for lack of liquidity. Remember that as liquidity and the ability to execute transactions at reasonable prices decrease, the liquidity (or illiquidity) premium and yield increase.

Liquidity varies widely by bond market subsector. Generally:

- Liquidity for on-the-run high-quality sovereign government debt is high and declines

somewhat for older off-the-run issues. These sovereign government bonds are usually large in size, more homogeneous, and often used as benchmarks for pricing other bonds and as collateral in the repo market (an issue discussed later).

- Corporate bonds are far more varied in credit quality and size of issue. Liquidity typically declines with lower quality as the bonds become riskier and with smaller size of the issue. Size can be an important factor as it takes roughly the same commitment of resources to analyze a large or small issuer, but with smaller issuers it is more difficult to acquire a large holding for the portfolio. Small issuers may also be excluded from bond indexes.

Effects of Liquidity on Bond Portfolio Management

- *Pricing data*. Historically bonds trade over the counter with past price and value information not reported. This makes it difficult to find pricing information. Some countries have moved towards centralized collection and reporting of this trade information, increasing market transparency. In the absence of such reporting or with infrequent trading of a bond issue, pricing information may be based on out-of-date trade prices. Instead of using old prices, bond pricing is often based on **matrix pricing**. Information is gathered on recent trades of bonds with similar features (maturity, quality, and coupon). The YTM of those trades is used to calculate the inferred market price of similar bonds. The presence of prepay features such as a call option makes finding appropriate YTM information more difficult, or such features may have been ignored, making the inferred price less accurate.
- *Portfolio construction*. Buy-and-hold investors have less need for liquidity as they have no plans to sell the bonds; thus, they may prefer to select less liquid bonds in exchange for higher yield. In contrast, active investors and traders will prefer more liquid bonds, reasoning their active management strategies will generate additional return and compensate for lower initial yield. Other investors who anticipate the possibility of needing to sell bonds before maturity to meet unexpected needs may tend to avoid less liquid bonds such as longer maturity and smaller issuers or private placements.
- The fact that most bond trading is done in dealer markets leads less liquid bonds to trade at higher bid-ask spreads. Dealers will reason that if they purchase such bonds, it will take longer to then resell them. Thus, dealers will widen the bid-ask to earn greater expected compensation for holding less liquid bonds in inventory.

Alternatives to Direct Investment in Bonds

PROFESSOR'S NOTE

There is no direct LOS on this next section, but you will recognize topics that are covered elsewhere, so we include a brief summary. These indirect investments are typically more liquid than the underlying bonds.

- Derivatives include bond futures and interest rate swaps. Futures are exchange traded, and interest rate swaps are over-the-counter. But in many countries, there have been changes to require margin posting, centralized swap settlement, and posted bid-ask pricing; all of which make the swap market more like an exchange-traded market.
- Exchange-traded funds (ETFs) are available and replicate many sectors of the fixed-

income market. The shares are easily traded and have high liquidity. Qualified institutions may conduct arbitrage between the underlying assets in the ETF and the ETF shares. This provides a mechanism that keeps ETF share price closely linked with the price of the underlying assets, benefiting all users of the ETFs.

MODULE QUIZ 18.1

To best evaluate your performance, enter your quiz answers online.

1. A credit analyst is evaluating the potential for fixed-income securities to provide an inflation hedge. Which of the following types of securities protects both the bond coupon and notional principal amounts from inflation?
   A. Fixed-coupon bonds.
   B. Inflation-linked bonds.
   C. Floating-coupon bonds.
2. A fixed-income portfolio manager is seeking to outperform the Barclays Capital Aggregate Bond Index. Which of the following statements *most accurately* describes a pure indexing strategy for achieving the total-return mandate? Pure bond indexing:
   A. allows large deviations from the risk factors of the index and seeks a high active return.
   B. matches duration to the index, but some risk mismatches of sectors and quality are allowed.
   C. seeks to exactly match all the risk factors of the index while allowing the manager some leeway on the individual bonds selected.
3. Regarding the varying liquidity characteristics among bond market subsectors, which of the following bond issues would typically lead to higher levels of liquidity?
   A. Issuing a small corporate bond issue.
   B. Issuing on-the-run sovereign government debt.
   C. Issuing a corporate bond that is below investment grade.

MODULE 18.2: MODELING RETURN

Video covering this content is available online.

LOS 18.d: Describe and interpret a model for fixed-income returns.

CFA® Program Curriculum, Volume 4, page 22

Expected fixed-income return can be viewed as having five components.
These components could be projected to calculate expected return or calculated after the fact to decompose sources of return actually earned. The following example explains this approach and the required calculations. While it appears formidable in aggregate, it is a combination of simple time value of money calculations and bond math concepts covered at earlier levels. For a bond portfolio, it uses aggregate portfolio data and that aggregation is provided. Otherwise, there is too much weighted average calculating to be practical without access to spreadsheets.

EXAMPLE: Expected return of a bond portfolio

A fixed-income strategist wishes to forecast the expected return of a bond portfolio for the next year. She gathers the following information and assumes no reinvestment of cash flow:

Par value (notional principal) in millions	50
Average coupon rate of portfolio	3.0%

Coupon frequency	Semiannual
Horizon analysis	1 year
Average bond price of portfolio	101.500
Projected bond price in one year if yield curve is unchanged	102.419
Average bond convexity (C) of portfolio	28
Average bond duration (modified duration or MD) of portfolio	5.60
Expected average yield and spread change of portfolio (ΔY)	–0.54%
Expected credit losses	0.06%
Expected gains or losses versus investor's currency	+1.57%

Projected return:

Component 1, **income yield**:

Annual coupon payment / current bond portfolio price = 3.0 / 101.50 = 2.956%.

Because this example assumes no cash-flow reinvestment, it does not matter that the coupons are paid semiannually. With a 3.0% annual coupon rate, 1.50 will be received in 6 and 12 months for total coupons collected of 3.00 per 100 par. Collected coupon amount divided by initial price is the current income return and what this component measures.

This could be converted to a periodic return for periods other than a year. Over 6 months it would be 2.956 / 2 = 1.478%. It would also be possible to assume a reinvestment rate on the cash flows. For example, if the average coupons were assumed to be paid semiannually with the first payment in 6 months and a 2% reinvestment rate, then ½ of 3% will be collected in 6 months and reinvested for 6 more months at 1% periodic rate (2% reinvestment / 2). That would provide another 1.5 × 0.01 = 0.015% of return. Note that such additional assumptions are less likely and distract from the basic analysis.

Component 2, **rolldown return**:

This is a bond pricing model projection of the bond prices in the portfolio assuming the yield curve is unchanged. For example, suppose the portfolio were made up only of a seven-year bond priced to yield 2.76% with a price of 101.50. Further assume the initial yield curve is upward sloping and the six-year bond yields 2.56%. A bond pricing model could be used to project the price of the seven-year bond in one year when it is a six-year bond priced at a 2.56% yield. (Note that this is not necessarily a simple analysis for a portfolio of bonds and would have to be done bond by bond and then aggregated. That is why it is a given value in the data provided). The rolldown return is the bond's:

> (end of horizon period projected price − beginning price) / beginning price = (102.419 − 101.50) / 101.50 = 0.905%

Note that if the yield curve is flat and a bond is initially priced at a premium (discount) to par, the projected price at end of period will be lower (higher) than start-of-period price as the bond's price is pulled to par at expiration. With a sloped yield curve that may not always be true in the shorter run (before maturity). It is true that if the yield curve is upward (downward) sloping, the rolldown return will be higher (lower) than the start-of-period YTM because the bond will decline in remaining term to maturity over the horizon period and be priced at a lower (higher) YTM at the end of that period.

Components 1 and 2 are sometimes combined and called the **rolling yield**: 2.956 + 0.905 = 3.86%.

Also be aware that it is common to use the terms *yield* and *return* interchangeably. If it matters, there will be sufficient context to determine what is meant.

Component 3, **expected price change** based on the investor's expected change in yield and spread:

Let's assume the projected price based on rolldown of 102.419 is in fact an aggregate portfolio yield (YTM) of 2.56%. The analyst then projects a general decline in interest rates of 50 basis points and a decline in credit spreads as well. Weighting the credit spread decline for the portion of the portfolio in credit risky bonds with the general 50 basis point decline, she projects a 54 basis point overall decline versus the 2.56% yield used in the rolldown calculation. Expected price change is calculated from the investor's expected change in yield and spreads using the portfolio's duration and convexity:

$$(–MD \times \Delta Y) + (½C \times \Delta Y^2) = (–5.6 \times –0.0054) + (½ \times 28 \times 0.0054^2) = 0.03024 + 0.00041 = 3.065\%$$

Notice that the convexity effect is very small and only adds 0.041% to the return. Convexity is a second order effect and often insignificant for option-free bonds unless the ΔY is very large. If the portfolio includes bonds with embedded options, then option adjusted D and C (also called effective D and C) must be used instead of modified D and C. Floating-rate securities would also complicate the analysis as their price sensitivity and D to a general change in rates is low (near 0), but they are sensitive to changes in spread.

Component 4, **credit losses**:

Estimate probability of default times expected loss severity. For example, the analyst estimates 0.071% of the portfolio's bond value will default and 15% of any defaulting value will be recovered, which means 85% of defaulting bond value will be lost, making the expected credit losses 0.071% × 0.85 = 0.060%.

Component 5, **expected gains or losses versus investor's currency**:

The portfolio is invested 40% in foreign denominated bonds, and the investor expects the foreign currencies (weight to reflect portfolio exposures) to appreciate 3.925%, giving her portfolio an expected gain of 3.925% × 0.40 = 1.570%.

Projected bond return is the sum of:

1. Yield income: Annual coupon amount / current bond price

   3.0 / 101.50 = 2.956%
2. Rolldown return: (projected ending bond price (BP) − beginning BP) / beginning BP; based on no change in the yield curve

   (102.419 – 101.50) / 101.50 = 0.905%
3. Price change due to investor yield change predictions: $(–MD \times \Delta Y) + (½C \times \Delta Y^2)$

   $(–5.6 \times (–0.0054)) + (½ \times 28 \times 0.0054^2) = 3.065\%$
4. Less credit losses: predicted default adjusted for recover rate

   0.071% × 0.85 = –0.060%
5. Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

   3.925% × 0.40 = 1.570%

   = expected total return for the year = 8.436%

   Rolling yield = #1 + #2

And rolling yield = 2.956 + 0.905 = 3.86%.

Except for yield income, this analysis is based on projections. Rolldown assumes the yield curve is unchanged. But techniques for plotting the yield curve vary. Plotting is often done using on-the-run government bond yields and then the curve is interpolated between those points. At times, the curve may be based on off-the-run government bond yields. Such bonds are more numerous, but the yields usually include a liquidity premium. Predicted price change is based on only duration and convexity projection. It does not include how individual bonds may shift in relative valuation. Credit losses and currency G/L are pure predictions.

MODULE 18.3: LEVERAGE AND TAX ISSUES

Video covering this content is available online.

LOS 18.e: Discuss the use of leverage, alternative methods for leveraging, and risks that leverage creates in fixed-income portfolios.

CFA® Program Curriculum, Volume 4, page 27

Leverage is a way to increase portfolio return and is particularly attractive in periods of lower interest rates (and expected return). (The return on the portfolio can also be called the return

on investor's investment or equity in the portfolio.) As long as funds can be borrowed (B) at rates below the return earned on the investments made ($r_I > r_B$), leverage will enhance portfolio return. Leverage also increases the exposure of the portfolio to interest rate risk and loses if interest rates increase above the return on portfolio assets ($r_I < r_B$). Borrowing is normally done at shorter-term interest rates, and those costs can increase faster than return on assets if interest rates increase. Said another way, the asset duration normally exceeds the liability duration in a leveraged portfolio.

The leveraged portfolio's return (return on investor equity) can be calculated as:

r_p = portfolio return (amount) / portfolio equity

$r_I + [(V_B / V_E) \times (r_I - r_B)]$

where:

r_p = return on portfolio

r_I = return on invested assets

r_B = rate paid on borrowings

V_B = amount of leverage

V_E = amount of equity invested

There are multiple ways to achieve leverage.

Repurchase agreements (repos) are an explicit way to borrow funds that could be used for leveraging. A securities owner "sells" a security for cash and simultaneously agrees to "buy" it back at a specified future date. The repo is functionally a way to borrow money, and the assets are the collateral for the loan. The loan term is often overnight, though the repo could be renegotiated the next day at a new interest rate. Longer repo terms are also possible. The borrowing nature of the transaction is even more evident in the details of the transaction. A securities dealer might enter an overnight $100,000,000 repo at a 2.5% repo rate. This means the dealer receives 100,000,000 and pays back 100,000,000 × [1 + (0.025 / 360)] the next day. (This is the normal calculation methodology for repo rates.)

The actual securities "sold" are not typically specified, and the money borrower can deliver any types previously agreed to. This is called general collateral. For example, any domestic government bonds can be delivered, and their market value must equal 102% of the repo amount, in this case $102 million. The 2% is a haircut amount and provides additional security to the money lender. The lender now holds collateral worth more than the funds lent. The collateral is returned the next day (for an overnight repo) when the loan is repaid. Other kinds of collateral can also be allowed to secure the loan, and the haircut would be larger for riskier and less liquid securities. In other words, the repo rate may not need to be adjusted based on the quality of the collateral because the amount of collateral is adjusted.

The repo can be bilateral with cash and collateral securities directly exchanged between the

two counterparties or tri-party. Tri-party repos use an intermediate third party (usually a bank) who holds the underlying collateral for the two counterparties and records the exchange of ownership. That is less costly than actually exchanging ownership between the two counterparties.

The above repo is cash driven and any collateral (previously agreed to by the parties to the repo) can be used. Repos can also be security driven. In a security driven repo, the money lender wants to have temporary possession of specific collateral. They may need it for some hedging or arbitrage reason and could offer a lower repo rate in exchange for delivery of a specific security. The repo is now a form of securities lending (and will be discussed later).

Futures contracts also provide leverage. Futures contracts can be purchased and require only a small initial margin deposit. The contract price times multiplier is the full price of the contract and the quantity of the underlying security now controlled. In other words, buying a bond contract at a full price of $105,607 requires only a small margin deposit but provides the upside and downside of buying that full amount of underlying bonds. The amount of leverage achieved can be calculated as:

leverage = (notional value of contract − margin amount) / margin amount

Swap agreements also provide leverage. Entering a 10,000,000 notional 5-year receive 4% fixed versus pay LIBOR swap is equivalent to buying 10,000,000 of 5-year 4% bonds and borrowing 10,000,000 at a floating rate of LIBOR. A receive-fixed swap increases the portfolio's exposure to the bond market and its duration with no explicit investment of funds. A receive-floating versus pay-fixed swap would have the opposite effect. Traditionally, swaps did not require posting of collateral and were largely unregulated and unreported; the 2008–09 financial crisis has led many swap users to settle swaps through a central clearinghouse, providing some of the benefits of standardization and exchange trading.

Structured finance instruments can also provide leverage. An inverse floater is one such product. Consider buying at par a GBP10 million 6-year (20% − (4 × LIBOR)) floater. This is equivalent to buying GBP50 million at par of a 4% 6-year bond and borrowing GBP40 million at a floating rate of LIBOR.

PROFESSOR'S NOTE

The reasoning and calculations behind this are not covered in or needed for the CFA program. You can see that GBP50 million of asset exposure is created with GBP40 million of borrowing and GBP10 million of investor capital. That creates the net coupon exposure of 5 × 4% = 20% less 4 × LIBOR paid, all for the same GBP10 million investment in the floater. This area of financial engineering is interesting, and you are welcome to explore it after the exam. Google would provide a number of relevant discussions.

Securities lending, as mentioned earlier, is closely related to the repo market, but the motivations are different. Securities lending often supports short-selling. Short-selling means selling a security that is not owned and receiving immediate payment for the security. In many cases, the security must be immediately delivered, so the short seller must borrow the security from someone else (and later return the security). A bilateral repo can be used to do this. The securities borrower specifies the desired security or securities to be received. The

lender of the securities will specify the amount and types of collateral that the securities lender will receive back.

The lender of the securities can specify receiving cash in exchange for the securities lent. The securities lender can then invest the cash (which is typically greater than the value of the securities lent) to earn interest and compensation. The securities lender could also agree to accept back general, high-quality government bonds as collateral. Suppose the securities lender lends 10 million of a specific bond and receives back 10.5 million of various government bonds in exchange. The securities lender earns the interest on that collateral. If those earnings are higher than the fair compensation for the securities lent, a portion might be rebated to the securities borrower. The rebate rate equals:

rebate rate = collateral earnings rate − security lending rate

PROFESSOR'S NOTE

Think of it as I need 50 million of bond X, you have it and will lend it to me if I compensate you. You will take back as collateral some larger amount (say 105%) of cash or general (not specific) government securities. You can use that collateral to find another way to make some money, and if I really need bond X could induce me to pay you other explicit fees. Obviously, this is a very specialized market used by a small number of large participants.

Unlike the repo market, security lending agreements are usually open ended. They do not have a specified maturity and continue until one counterparty requires settlement, reversing the transaction with return of the collateral. This can create additional risk if the other counterparty was not prepared to reverse his part of the transaction.

Ultimately, the earnings of the securities lender depend on how badly the securities borrower needs that specific collateral. If the need is high, the securities lender can demand an explicit fee. The securities lender can also demand more cash be posted as collateral or require more general collateral to be delivered. Either increases what the securities lender can earn.

Risks Created by Leverage

In addition to the obvious risk, if the costs of borrowing increase above the earnings on the portfolio assets, other risks are also created. If interest rates increase, the value of the leveraged portfolio and collateral will decline. This may induce money lenders to demand repayment and force liquidation of portfolio assets when they are down in value. This is referred to as a fire sale, selling under distressed conditions. If such liquidations are widespread, they can produce a vicious cycle as each round of sales drives down prices, leading other credit providers, repurchase participants, and securities lenders to demand repayment and/or stop lending.

MANAGING TAXABLE AND TAX-EXEMPT PORTFOLIOS

LOS 18.f: Discuss differences in managing fixed-income portfolios for taxable and tax-exempt investors.

Both tax-exempt and taxable investors should seek the highest possible risk-adjusted return net of fees and transaction costs, consistent with their objectives and constraints. This is more complex for taxable investors because taxes must also be taken into account to determine after-tax return and risk. Different types of tax issues arise and differ by tax jurisdiction around the world. The following are some examples:

- The two sources of bond return are usually taxed differently. Income may be taxed at a different rate from capital gains (price change). Both are usually taxed only when realized, but there are exceptions. For zero coupon bonds, imputed income (increase towards par) may be taxed each year as income even though there is no cash flow.
- In general, capital gains are only taxed at sale and at a lower tax rate than for interest income. Gains on securities held for a longer period may be taxed at a lower rate than on securities held for a shorter period.
- Capital losses may only be allowed to be used to offset capital gains, but not other income sources. But if capital losses exceed gains, they may be carried forward to offset future realized gains. (In some cases, the realized losses can be carried back to reduce taxes already paid for a previous year, generating a tax reduction or refund on the current tax return.)
- It may be possible to invest some portions of the portfolio in tax-sheltered or tax-advantaged accounts.

Strategies to use in managing taxable accounts include:

- Realize capital losses to offset gains. This can include selective tax loss harvesting for partial sales when the investment was acquired at multiple prices.
- Extend holding periods to realize long-term, rather than short-term, capital gains.
- Extend holding periods to defer taxes.
- Consider differentials in income versus gain tax rates when selecting investments.

PROFESSOR'S NOTE

The above is just a listing of issues from earlier readings. Review the earlier material if it seems unfamiliar.

Taxation of investments in mutual funds and other collective investment funds varies by country. Income on the underlying assets is usually taxable to the fund investors when it is earned by the fund, regardless of whether the income is paid out or reinvested in the fund. However, the taxation of gains realized within the fund varies.

- Some countries use pass-through taxation of gains. The fund investor is taxed when the fund realizes the gain and that tax payment subsequently reduces taxes on gains when the investor sells the fund shares.
- Other countries use deferred taxation of the gains realized within the fund and instead tax the investor on all gains when the fund shares are sold.

In contrast, when a client hires a manager to manage the client's portfolio directly (a separately managed account) all income, gains, and losses in the portfolio are normally

reported on the client's tax return and taxable to the client.

EXAMPLE: Taxable vs. tax-exempt portfolios

A manager must raise EUR5,000,000 to meet a client's need for funds. The client's portfolio is separately managed, and all tax issues are passed through and immediately taxable to the client. Income and capital gains tax rates are 38% and 15%, respectively. The manager is looking at two bonds and will sell all of one or of the other. Both have market value of EUR5,000,000 and have the same remaining maturity, coupon, and credit quality. Any taxes owed due to the sale are to be ignored in the analysis and covered by other client funds. Bond A has a significant unrealized gain, while bond B has a significant unrealized loss. The manager believes the bonds are substantially identical except bond B has a slightly higher yield.

Select the bond the manager will sell and **explain** why if the investor is 1) taxable, or 2) tax-exempt.

Answer:

1. Taxable: Sell bond B to avoid realizing a gain and paying a tax now.
2. Tax-exempt: Sell bond A to retain bond B and its slightly better yield.

MODULE QUIZ 18.2, 18.3

To best evaluate your performance, enter your quiz answers online.

1. Suppose that a bond portfolio has 25 million in notional principal. It has an average coupon rate of 5% and pays coupons on a semiannual basis. The average bond duration of the portfolio is computed as 8 and the average convexity of the portfolio is 0.5. If an investor in this portfolio expects the average yield and spread change of the portfolio to be 0.35%, the expected portfolio price change due to her forecast is *closest* to:
   A. –1.752%.
   B. –2.799%.
   C. –3.978%.
2. A credit investor is interested in using leverage in his portfolio to enhance return. Which of the following statements is *most correct* regarding the use of leverage and the risks that leverage creates when implemented in fixed-income portfolios?
   A. If interest rates increase, the value of the leveraged portfolio and collateral decline.
   B. Liability duration normally exceeds asset duration.
   C. As long as funds can be borrowed at rates above the return earned on the investments made, leverage will enhance portfolio return.
3. When managing fixed-income portfolios for taxable investors, which of the following strategies should *most likely* be applied?
   A. Realize capital gains to offset any losses.
   B. Shorten holding periods to realize long-term, rather than short-term, capital gains.
   C. Consider differentials in income versus gain tax rates when selecting investments.

KEY CONCEPTS

LOS 18.a

- Provide portfolio diversification with generally low correlation to equity.
- Provide regular cash flow.
- Floating-rate and inflation-indexed bonds provide forms of inflation protection.

LOS 18.b

Liability-based mandates dedicate portfolio assets and reinvest future cash flows to fund future liabilities:

- Cash-flow matching funds liabilities with coupon and par amounts received on the dates the liabilities are paid.
- Duration matching (immunization) matches asset and liability duration to achieve comparable results. Both are forms of immunization. Duration matching generally gives more flexibility in asset selection and therefore may meet the objective at a lower cost.
- Horizon matching is a hybrid of cash-flow matching nearer term liabilities and duration matching the longer-term liabilities.
- Contingent immunization is a hybrid of active management with potential immunization. The portfolio must initially be overfunded and can be actively managed. If successful (unsuccessful), the surplus will grow (be lost) and the ultimate cost will end up being lower (higher) than from immunization.

Total return mandates typically seek to match or exceed the return of a benchmark index:

- Pure indexing exactly matches the holdings of the index.
- Enhanced indexing allows modest deviations (but matches duration to control interest rate risk).
- Active management does not restrict deviations versus the index.

LOS 18.c

Liquidity in the bond market (ability to buy or sell on a timely basis at or near fair market value) is substantially lower than in equity markets.

- Most bonds do not trade or trade infrequently after issuance.
- The sheer number and variety of individual bond issues is immense.
- The market is mostly over-the-counter with trade price and volume not reported.
- Liquidity is highest for sovereign government, higher-quality, and most recently issued (on-the-run) bonds.
- Smaller issues are generally less liquid.

Effects:

- Bond pricing data is more difficult to obtain.
- Portfolio managers have to choose between more liquid bonds or less liquid bonds that may offer a liquidity premium.
- Derivatives and ETFs are generally more liquid and an alternative to direct investment in bonds.

LOS 18.d

Return can be projected (or actual return decomposed) as the sum of:

1. Yield income: annual coupon amount / current bond price
2. Rolldown return, assuming no change in yield curve: (projected ending bond price (BP) − beginning BP) / beginning BP
3. Price change due to investor yield change predictions: $(-MD \times \Delta Y) + (\frac{1}{2}C \times \Delta Y^2)$
4. Less credit losses: predicted default adjusted for recover rate
5. Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

Yield income + rolldown return may be referred to as rolling yield.

LOS 18.e

- Leveraged portfolio return can be calculated as $r_I + [(V_B / V_E) \times (r_I - r_B)]$.
- If r_I exceeds (is below) r_B, the leverage enhances (reduces) portfolio return.
- Repurchase agreements (and securities lending), futures contracts, swaps, and structured investments can all be used to leverage return.
- In addition to the detrimental effects if r_I is less than r_B, the lender of the funds can demand repayment, forcing liquidation of portfolio assets at fire sale prices, which can feed a financial crisis.

LOS 18.f

Taxes complicate portfolio management as managers seeking to maximize return must consider the different tax effects of each portfolio decision.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 18.1

1. **B** Inflation-linked bonds provide direct protection for the effects of inflation. They protect coupon payments from inflation and adjust par (i.e., principal) for inflation. Floating-coupon securities also provide protection from change in inflation, but the adjustment mechanism is different and only affects the coupon. Fixed-coupon bonds do not protect coupons or principal from the effects of inflation. (LOS 18.a)

2. **C** Pure indexing attempts to replicate the performance of a bond index. It seeks to exactly match all of the risk factors of the index while still allowing the manager some leeway on the individual bonds selected. Enhanced indexing allows some additional flexibility in constructing the portfolio and seeks to add some modest active return. Active management allows much larger deviations from the risk factors of the index and seeks greater active return. (LOS 18.b)

3. **B** Liquidity for on-the-run high-quality sovereign government debt is high and declines somewhat for older off-the-run issues. These government bonds are usually large in size and have a high level of credit quality. Liquidity among corporate bonds typically declines with lower quality as the bonds become riskier and with the size of the issue (i.e., smaller issuers are less liquid). (LOS 18.c)

Module Quiz 18.2, 18.3

1. **B** Expected price change is calculated from the investor's expected change in yield and spreads using the portfolio's duration and convexity as follows: $(–MD \times Y) + (½C \times Y^2) = (–8 \times 0.0035) + (½ \times 0.5 \times 0.0035^2) = –0.028 + 0.000003 = –2.7997\%$ (Module 18.2, LOS 18.d)

2. **A** If interest rates increase, the value of the leveraged portfolio and collateral decline. As long as funds can be borrowed at rates *below* the return earned on the investments made, leverage will enhance portfolio return. Asset duration normally *exceeds* the liability duration in a leveraged portfolio. The other statements are false because a typical leverage transaction involves borrowing at lower shorter-term rates (and therefore in a liability with low duration) to invest at longer-term higher rates (and therefore in an asset with higher duration). (Module 18.2, LOS 18.d)

3. **C** Strategies to use when managing taxable accounts include:
   - Realize capital *losses* to offset *gains*.
   - *Extend* holding periods to realize long-term, rather than short-term, capital gains.
   - Consider differentials in income versus gain tax rates when selecting investments.(Module 18.3, LOS 18.f)

The following is a review of the Fixed-Income Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #19.

READING 19: LIABILITY-DRIVEN AND INDEX-BASED STRATEGIES

Study Session 7

EXAM FOCUS

We now turn to the substantive discussion of liability-based and index-based fixed-income management approaches.

MODULE 19.1: LDI, BASICS

Video covering this content is available online.

LOS 19.a: Describe liability-driven investing.

CFA® Program Curriculum, Volume 4, page 46

Broadly speaking, **liability-driven investing** (LDI) is used when there are definable future liabilities to be paid from portfolio assets. It is classified as passive total return, but in this context, that does not mean nothing should be done—as many of these strategies require continual monitoring and adjustments. (In contrast, active management generally means managing to outperform a specified index or benchmark.) The specific LDI approach used depends on the nature of the liabilities. LDI is mostly used for institutional portfolios. There are some commonly used terms:

- **Asset-liability management** (ALM) means strategies that consider assets in relation to liabilities. It is appropriate when both the present value (PV) of the assets and liabilities change with changing interest rates.
- **Liability-driven investing** (LDI) or liability-based investing takes the liabilities as a given and manages the assets to meet those future liability values—for example, there is an insurance company or defined benefit (DB) pension plan that must fund future liability payouts. (Note that LDI is now being used in a more specific way than in the initial paragraph. The focus of this reading is on this more specific type of LDI investing, where the liabilities are taken as a given and the assets are managed in relation to those liabilities.)
- **Asset-driven investing** (ADI) takes the assets as a given and manages or adjusts the liabilities in relation to those assets. For example, a leasing company with specific types of floating- or fixed-rate financial assets may structure its liabilities to match the characteristics of those assets.

LDI can also apply to individuals, particularly when the goal is to accumulate sufficient funds to meet retirement. Consider a married individual who plans to retire in 12 years and is planning to use the value of his bond portfolio to fund the purchase of an annuity. He will

reinvest any cash flows from the bonds and could also plan to add a regular amount to the bond position every year to meet the goal.

Four types of liabilities exist:

1. **Known future amount(s) and payout dates(s), called Type I**. The issuer of an option-free fixed-rate bond has this type of liability. We will see that these are the easiest type of liability to model.
2. **Known future amount(s) but uncertain payout dates(s), called Type II**. The issuer of a callable or putable bond has this type of liability. An insurance company selling term life insurance also fits here. The amount of payout is known, but the date of payout on any single policy is not. (However, actuaries can apply the law of large numbers to estimate likely payout amounts in any given period with considerable accuracy.)
3. **Uncertain future amount(s) but known payout dates(s), called Type III**. Floating rate instruments and real rate bonds such as Treasury Inflation Protection Securities (TIPS) fall in this category.
4. **Uncertain future amount(s) and uncertain payout dates(s), called Type IV**. Property and casualty as well as some DB plan liabilities fall in this category.

Simple duration (Macaulay or modified) is adequate to model Type I liabilities. The others require effective duration—modeled to reflect the initial shape of the yield curve plus assumed upward and downward shifts in the yield curve to estimate the potential amount and timing of liability payouts.

IMMUNIZING A SINGLE LIABILITY

LOS 19.b: Evaluate strategies for managing a single liability.

CFA® Program Curriculum, Volume 4, page 50

Immunization is a fixed-income management process in which the portfolio is managed to minimize the variability of the rate of return earned over a specified time period. That means the future value (FV) of the portfolio can be confidently predicted, and if enough funds are invested initially, a known future liability can be funded.

Cash flow matching is the simplest but least flexible approach to immunizing. For a single liability, buy a zero-coupon bond with par and maturity matching the liability. With no cash flows to reinvest or bonds to sell, there is no cash flow or price risk. The bonds must also be default free.

Because a single liability is effectively a zero-coupon liability, its time to payment is also its Macaulay duration. Thus, a cash flow matched immunized portfolio will match the Macaulay durations of the assets and liabilities.

Macaulay duration is the weighted average time until the cash flows of an instrument are received. That is why Macaulay duration of a zero-coupon instrument is its maturity, but Macaulay duration of a non-zero-coupon instrument is less than its maturity. The weights are

based on each cash flow's PV as a percentage of the total PV of the instrument's cash flows (the latter being the price of the instrument).

Macaulay duration is also a balance point where price and reinvestment risk offset each other:

- **Price risk** is the uncertainty of proceeds if a bond must be sold before maturity.
- **Reinvestment risk** is the uncertain FV of any cash flows received and reinvested before the end of the holding period.

If it is assumed interest rates change only once, immediately, in parallel fashion, and by a small amount, then:

- If rates increase, higher earnings from reinvesting all cash flows will offset a loss on price at the end of the horizon period.
- If rates decrease, lower earnings from reinvesting all cash flows will offset a gain on price at the end of the horizon period.

The unreasonable nature of the assumptions will be dealt with soon.

Modified duration is Macaulay duration divided by 1 plus the periodic interest rate used to compute the cash flow PVs:

- Modified duration is the (slightly) more accurate measure of immediate price change of the instrument.
- Macaulay duration is the (slightly) more appropriate measure of time for some immunization techniques.

Computing portfolio statistics: Portfolio yield (meaning YTM), duration, dispersion of cash flows, and convexity are commonly computed as weighted averages based on market value weighting of each holding in the portfolio. **For ALM, these average computations are less accurate than portfolio statistics computed directly from the portfolio's aggregate cash flows.**

PROFESSOR'S NOTE

There is no LOS or indication that you should try and make these portfolio statistic calculations. They are provided, and your challenge is to understand how to apply them in immunization situations. The actual process would require access to computer spreadsheet tools. The process is summarized here for those interested.

1. Project the time to receipt (starting with the nearest to most distant) of every portfolio cash flow.
2. Determine the aggregate portfolio cash flow in each period. The analysis uses six-month periods.
3. Determine the portfolio IRR that equates future cash flows with the current market value of the portfolio.
4. Use that IRR to determine the PV of each future cash flow from step 2. (The sum of those PVs will be the current portfolio market value.)
5. Calculate the PV weight (w) to apply to each payment as its PV (step 4) divided by the sum of the PVs.
6. For each cash flow, multiply its *(w)* by its time until receipt *(t)*. The sum of the *(w)(t)*s is

the portfolio's Macaulay duration. Duration is normally expressed in years, so if the cash flow periods were in six-month increments, divide by 2 (two six-month periods in a year) for annual duration.

7. Portfolio dispersion is computed as the weighted average variance of when each cash flow is received around portfolio duration. (Remember, duration is just the weighted average of when all the cash flows are received).
8. Portfolio convexity can be computed by summing for each cash flow: *[(t)(t + 1)(w)]* and then divide this sum by $(1 + \text{portfolio IRR}_{\text{periodic}})^2$.

Here is what to focus on:

Portfolio statistics should be used for ALM work rather than traditional weighted average calculations based on each bond. The difference in the two approaches is determined by the shape of the yield curve:

- With a flat yield curve, there is no difference.
- In an upward-sloping yield curve, portfolio duration and IRR will be higher-than-average duration and YTM of the bonds because portfolio statistics reflect all cash flows (and return) to be received and the longer maturity bonds will impact the portfolio for a longer time.
- (Downward sloping curves are unusual and not discussed. In such a situation, you would build a spreadsheet and calculate all the numbers to see what happens. You cannot make such spreadsheet calculations on the exam.)

The goal of the immunized portfolio is to earn the initial portfolio IRR, not the average YTM of the bonds. Earning the IRR means the portfolio will grow to a sufficient FV to fund the liability.

PROFESSOR'S NOTE

Although we have just made the point that portfolio-level statistics based on aggregate portfolio cash flow and IRR should be used, be aware that it is not unusual to use simple weighted average date (such as YTM and duration) as approximations. That would add some error to the analysis.

The dispersion will be important because it is related to convexity and the convexity effect. Convexity matters because, when combined with modified duration, it provides a more accurate measure of estimated price change. Recall that $\%\Delta \text{ in value} = (-\text{MD} \times \Delta\text{Y}) + (\frac{1}{2}\text{C} \times \Delta\text{Y}^2)$.

But more specifically, in relation to immunization:

$$\text{convexity} = \frac{\text{Macaulay duration}^2 + \text{Macaulay duration} + \text{dispersion}}{(1 + \text{periodic IRR})^2}$$

The dispersion and convexity will indicate the risk exposure of the immunization strategy to structural risk from shifts and twists in the yield curve.

EFFECTS OF YIELD CURVE CHANGES

Assume that the portfolio is being used to immunize a single liability (sometimes called a bullet) due in five years, the portfolio and liability D are initially matched at the 5.0 medium

(M) duration of the liability, the initial value of the portfolio equals the discounted (at portfolio IRR) PV of the liability, and portfolio convexity exceeds convexity of the single cash flow liability. We can create an extreme situation to demonstrate the issues. Assume that the portfolio is made up of two bonds with a shorter (S) and longer (L) duration than the liability duration (M). This describes a barbell portfolio strategy, concentrating the assets in longer and shorter duration around the liability's single (bullet) duration.

If the yield curve shifts up or down in parallel fashion, the portfolio results will slightly exceed the amount required to pay the future liability. Duration matching alone would have led to meeting the future liability need, but the additional positive convexity of the assets will lead them to outperform duration results alone for large parallel shifts in the curve. (Recall the dispersion of cash flows and thus the convexity of the two-bond portfolio must exceed that of the single-point liability.)

- For a large parallel increase in the curve (Figure 19.1), the immediate decrease in portfolio value will be less than the decrease in the PVL due to the positive convexity effect. With the parallel increase, the new portfolio IRR will increase by basically the same amount as the increase in discount rate for the PVL. In other words, the future rate of increase in A and L are still the same, but starting from a new PVA that is relatively higher than the PVL, the FVA will exceed the FVL.
- For a large parallel decrease in the curve (Figure 19.2), the immediate increase in portfolio value will exceed the increase in the PVL due to the positive convexity effect. With the parallel decrease, the new portfolio IRR will decrease by basically the same amount as the decrease in discount rate for the PVL. In other words, the future rate of increase in A and L are still the same, but starting from a new PVA that is relatively higher than the new PVL, the FVA will exceed the FVL.

Figure 19.1: Parallel Yield Shift Up

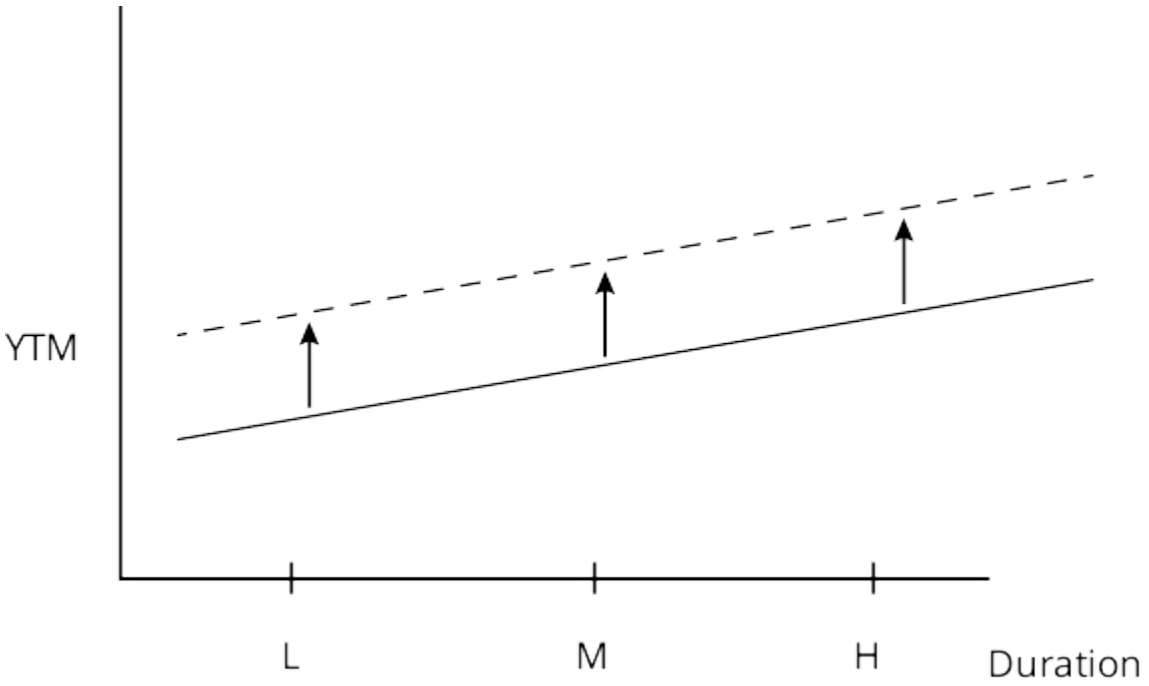
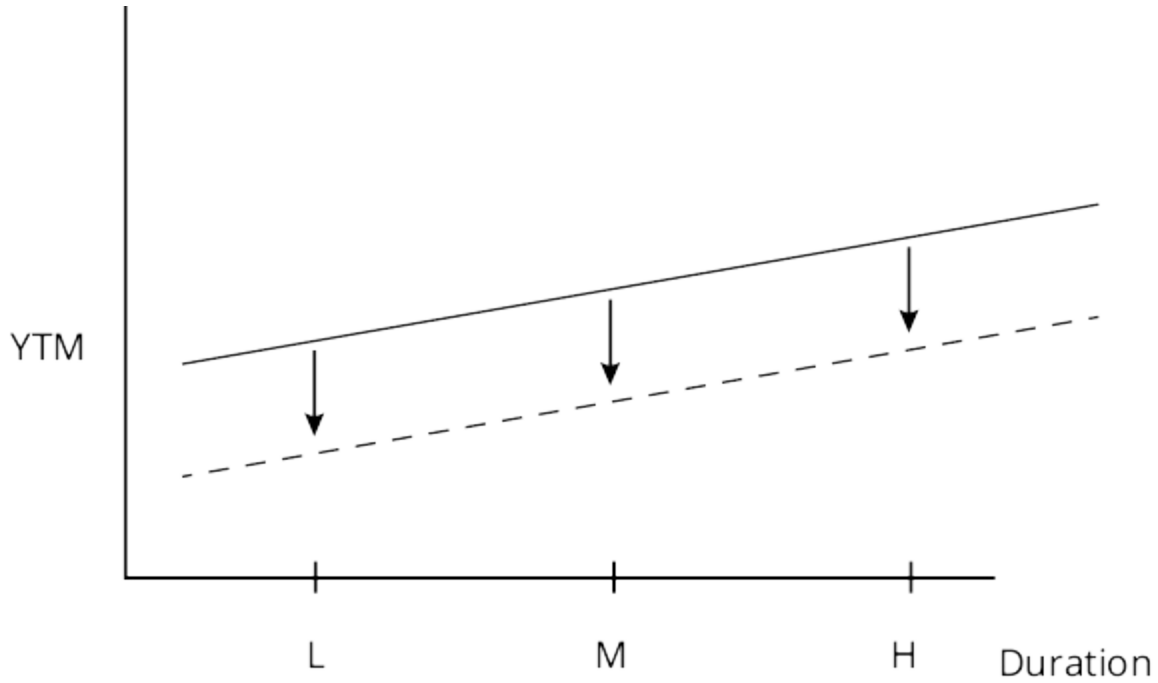


Figure 19.2: Parallel Yield Shift Down



The parallel shift analysis indicates that the duration (rather than cash flow) matching immunization strategy does have **structural risk**. The structural risk is due to creating portfolio duration with a different allocation of asset durations (L and H) versus the allocation of liability durations (M only). That can lead to differing performance of the assets and liabilities as the yield curve shifts. Fortunately, most interest rate changes can be described as roughly parallel, and by building the portfolio with an asset dispersion (hence, convexity) that exceeds the single liability payout date, the portfolio benefits from the structural risk.

The parallel shift analysis:

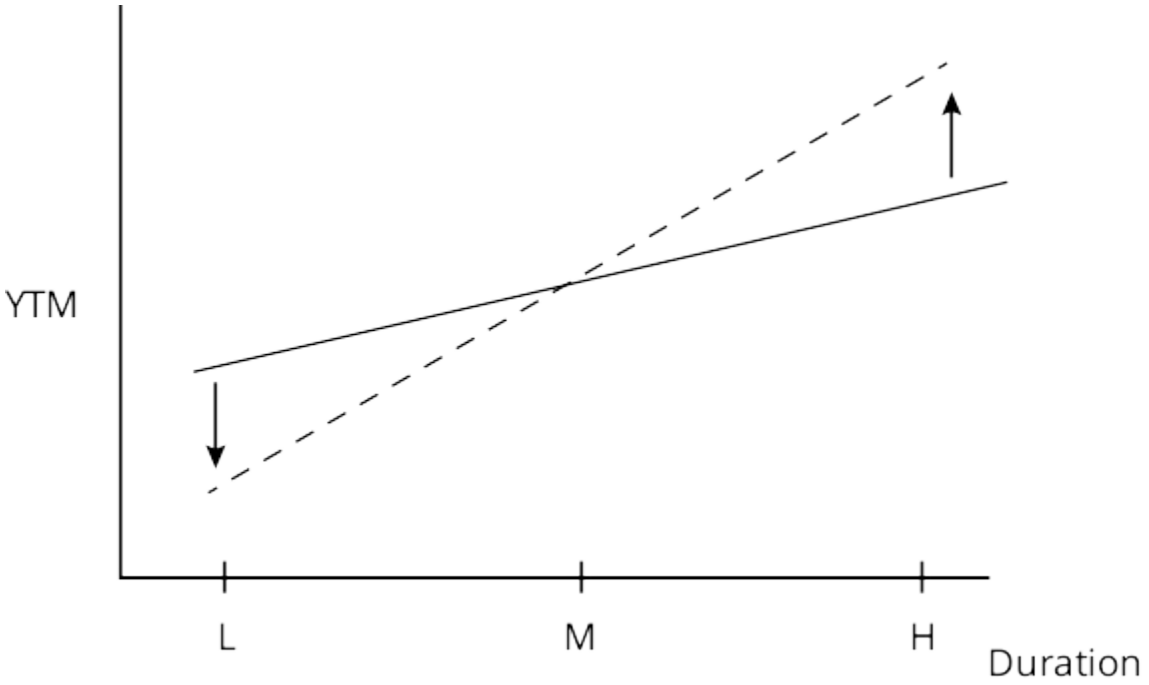
- Indicates that immunization can be described as *zero replication*. A single zero-coupon bond could have been used for a no-risk, perfect cash flow match. The changes in portfolio value and IRR have replicated (or done better due to positive convexity) the changes in yield and value of that replicating zero-coupon bond. In general, if the change in portfolio IRR matches change in yield of the replicating zero, the risks for the strategy are low.
- Does not indicate the strategy is always structurally risk free. Other kinds of yield curve reshaping may or may not cause the strategy to fail in meeting the future payout. These other reshapings are discussed shortly.
- Does indicate the parallel shift assumption is sufficient to lead the strategy to succeed —but it is not a necessary assumption because the strategy may still be successful in other conditions. It is *sufficient*, but not *necessary*.
- Does not mean the strategy is buy and hold. Coupon-bearing bond duration declines more slowly than maturity, while the bullet liability duration will decline linearly with the approaching pay date. To maintain the immunization, the portfolio assets must be continually rebalanced to continually match portfolio to liability duration as time or market conditions change; otherwise, the strategy is at risk.

If the curve either steepens or flattens, the analysis becomes more complex and the structural

risk increases. Assume for this discussion that rates do not change for the M duration liability, but move in roughly opposite directions for the L and H duration assets.

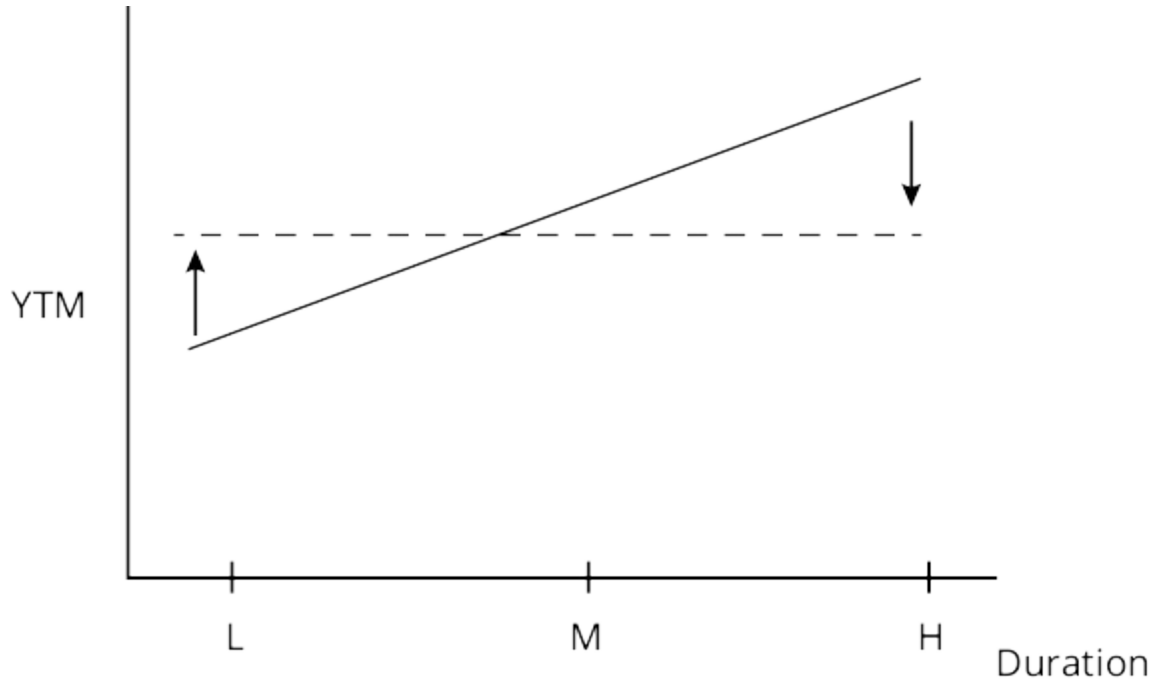
- Steepening twist (Figure 19.3): Yield L decreases while yield H increase relative to yield M. The portfolio market value will decrease because the decline in value of the longer duration bond will exceed the increase in the value of the shorter duration bond. PVL will be unchanged with no change in yield M. PVA is now below PVL. That, by itself, does not indicate the strategy will fail. If portfolio IRR increases sufficiently, the required FV might still be reached. (Recall that portfolio IRR would tend to increase above a single point M YTM with a steeper curve). This indicates that a steepening curve may create structural risk.

Figure 19.3: Steepening Twist



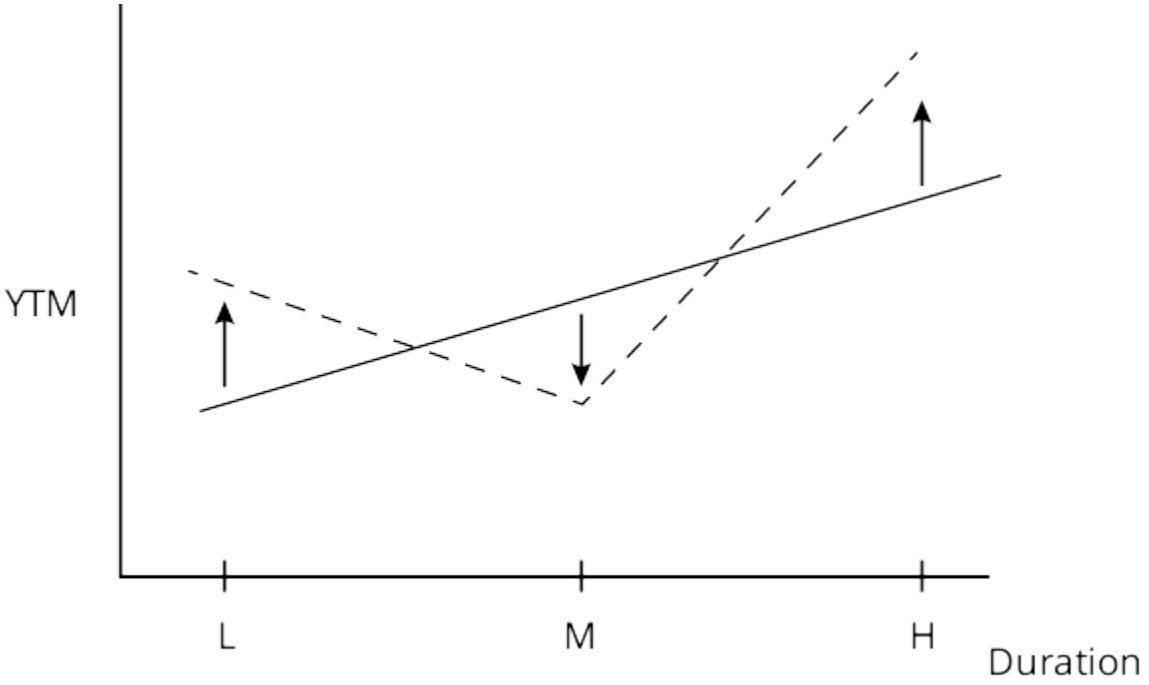
- Flattening twist (Figure 19.4): Yield L increases while yield H decrease relative to yield M. The portfolio market value will increase because the increase in value of the longer duration bond will exceed the decrease in the value of the shorter duration bond. PVL will be unchanged with no change in yield M. PVA is now above PVL. That, by itself, does not indicate the strategy will succeed. If portfolio IRR decreases sufficiently, the required FV of assets to meet the payout may not be reached. (Recall that portfolio IRR would tend to decrease below a single point M YTM with a flatter curve). This indicates that a flattening curve may create structural risk.

Figure 19.4: Flattening Twist



- Positive butterfly twist (Figure 19.5): Yield L and H increase while yield M decreases. The portfolio market value will decrease as both yield L and H increase. PVL will increase as yield M decreases. PVA is now below PVL. That is certainly detrimental, but it is possible the strategy could succeed if the portfolio IRR increases enough versus the decrease in liability discount rate. This indicates that the positive butterfly may create significant structural risk.

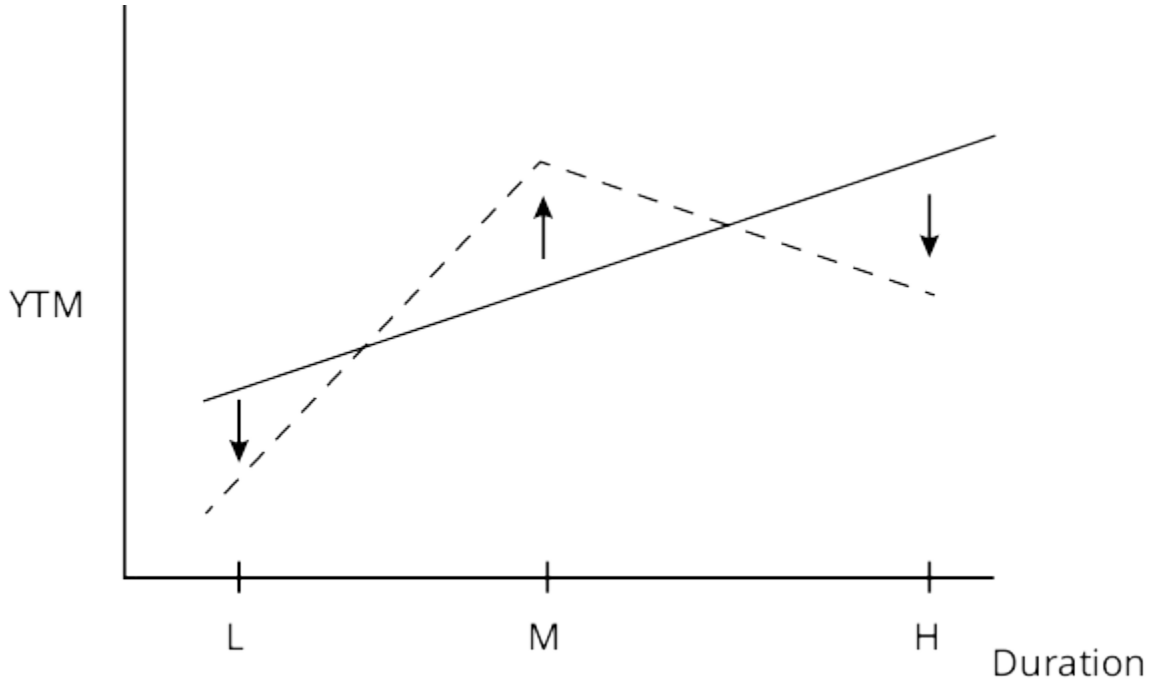
Figure 19.5: Positive Butterfly Twist



- Negative butterfly twist (Figure 19.6): Yield L and H decrease while yield M increases. The portfolio market value will increase as both yield L and H decrease. PVL will decrease as yield M increases. PVA is now clearly above PVL. That is certainly

favorable, but does not guarantee the strategy will succeed if the portfolio IRR decreases too much in relation to the increase in liability discount rate. It again indicates the possibility of significant structural risk.

Figure 19.6: Negative Butterfly Twist



The risk in immunization is higher when the change in portfolio IRR does not match the change in yield of the replicating zero or is insufficient to fund the liability at the new level of rates. This structural risk can be reduced by reducing the dispersion of asset cash flows around the liability cash flow. This is not surprising because if you make dispersion 0, you have a zero-coupon bond and a perfect cash flow match to the single liability. Now, recall the earlier equation for determining convexity from duration and dispersion; reducing dispersion is directly related to reducing convexity. This leads to the rules for immunizing a single liability:

1. Initial portfolio market value (PVA) equals (or exceeds) PVL. (There are exceptions to this for more complex situations where the initial portfolio IRR differs from the initial discount rate of the liability.)
2. Portfolio Macaulay duration matches the due date of the liability ($D = D_L$).
3. Minimize portfolio convexity (to minimize dispersion of asset cash flows around the liability and reduce risk to curve reshaping).
4. Regularly rebalance the portfolio to maintain the duration match as time and yields change. (But also consider the tradeoff between higher transaction costs from more frequent rebalancing versus the risk of allowing durations to drift apart.)

PROFESSOR'S NOTE

It may seem strange to require minimizing convexity of assets when +C is good for immediate price change. But that ignores the real issue of immunization, failing to reach the FV needed to pay the liability.

Money duration: The first two conditions of immunization can be combined by matching money duration of the assets and liability. Money duration is the money change in value of the assets or liability for change in interest rates. It can be calculated as modified duration (MD) multiplied by the value of the item multiplied by a specified change in yield of the item. It is common to express it as **basis point value** (BPV):

$$BPV = MD \times V \times 0.0001 = \text{price value of a basis point}$$

BPV is also referred to as *price value of a basis point* (PVBP) or value of an 01, meaning a 1 BP change in rates.

IMMUNIZING MULTIPLE LIABILITIES

LOS 19.c: Compare strategies for a single liability and for multiple liabilities, including alternative means of implementation.

CFA® Program Curriculum, Volume 4, page 62

Cash flow matching is the safest approach. In some cases, this may allow *accounting defeasance* where the assets are legally set aside and dedicated to meet the labilities—allowing both those assets and liabilities to be removed from the balance sheet of the organization responsible for paying the liability. The simplest cash flow match is to buy zero-coupon bonds in the amounts and due dates to meet each liability.

- Cash flow matching of a stream of liabilities may also be possible using coupon-bearing bonds. In concept, a bond is purchased due on and with par plus (+) final coupon to exactly fund the longest liability. Its earlier coupon payments can be used to partially meet the earlier liabilities. Then, in recursive fashion, the next-longest liability is funded by buying a bond due on and with par plus (+) final coupon to exactly fund that next-longest liability (after considering the coupon of the bond or bonds already purchased for the longer liability or liabilities).
- In practical terms, it is unlikely that the coupon-bearing bonds necessary for perfect cash flow matching will exist. A *cash-in-advance* constraint could be used, requiring the bond used to fund a specific liability to mature before the required payout date of the liability. This would expose the portfolio to reinvestment risk in an upward-sloping yield curve. The upward-sloping curve is anticipated to create reinvestment risk because as cash comes in to be reinvested for a short time period until payout, the reinvestment must be at the lower rates at the short end of the curve.

Duration matching is a more flexible and generally practical approach to funding multiple liabilities. Like immunizing a single liability, there must be sufficient assets to fund the liability, and Macaulay durations of assets and liabilities (in this case, the average liability duration) must match. However, matching money durations is the more common approach. Money duration is more useful when initial amounts and discount rates of assets and liabilities differ. The rules for immunizing multiple liabilities become the following:

1. Initial portfolio market value (PVA) equals (or exceeds) PVL. (There are exceptions to this for some situations where the initial portfolio IRR differs from the initial discount

rate of the liability.)

2. Portfolio and liability basis point values match (BPV = BPV_L)
3. Asset dispersion of cash flows and convexity exceed those of the liabilities. (But not by too much, in order to minimize structural risk exposure to curve reshaping).
4. Regularly rebalance the portfolio to maintain the BPV match of A and L as time and yields change.

EXAMPLE: U.K. bond company

A U.K.-based company has several option-free bond issues (liabilities) outstanding. The company would like to retire the bonds early, and has more than sufficient funds to do so. The company considers a bond tender offer (offer to repurchase the bonds from the public), but the bonds are widely distributed among buy-and-hold investors. The prices that would have to be paid are too high to make the tender desirable to the company.

The company could also establish a dedicated cash flow matched portfolio of U.K. government bonds and legally defease the bonds. In that case, both the company's bond liabilities and assets (the cash flow matching bond portfolio) could be removed from the company's balance sheet. The cost of the portfolio would be GBP475 million, and the company considers this too high.

The third alternative is to establish a duration matching portfolio; using high-quality corporate bonds, the cost will be less than for the government bond portfolio. While the portfolio will not qualify for defeasance, the company believes it will improve its credit rating and is the better choice.

The portfolio statistics for the company's liabilities and three proposed corporate bond portfolios are shown in the following table. All calculations are annualized and based on aggregate portfolio cash flows. Each portfolio is considered sufficient to pay the liabilities. Monetary amounts are in GBP:

Statistics	Company's Liabilities	Proposed Portfolios		
		A	B	C
Market value	457,780,900	Approximately 460,000,000		
Modified D	7.52	7.51	7.53	7.37
BPV	344,250	343,100	345,400	339,120
Convexity	45.12	35.14	46.29	65.97

1. **Select** the most appropriate portfolio (A, B, or C) to immunize the liabilities and **justify** your selection with *two* reasons.
2. If the company expects high volatility and the potential for very large parallel shifts in the yield curve, **select** the *one* other portfolio (A, B, or C) it would most likely consider and **explain** why.

Answers:

1. Portfolio B—because (1) its BPV closely matches, and (2) its convexity slightly exceeds that of the liabilities.
2. Portfolio C—while the BPV is not as good a match, it has much higher convexity, and this would increase return relative to change in liability values for large parallel shifts in the yield curve.

MODULE 19.2: MANAGING A DURATION GAP

Video covering this content is available online.

A **derivatives overlay** can be used to adjust the portfolio and maintain the duration match without the expense of adjusting the underlying assets. Futures contracts are often used.

In the United States, there are various Treasury futures contracts available based on the 30-year bond, as well as 2-, 5-, and 10-year Treasury notes. Each contract specifies a set of deliverable securities that the contract seller may deliver at contract expiration. The seller must deliver 100,000 par of a deliverable security [also called *most deliverable bond* or *cheapest to deliver* (CTD) bond]. The buyer must pay the seller the initial contract price multiplied by the conversion factor for that bond (CF_{CTD}) that the seller chooses to deliver.

In recent years, an Ultra 10-year contract was developed that specifies a much narrower range of deliverable notes. The purpose of this was to limit the deliverable items to ones that have a duration much closer to that of the 10-year note. The issue of which bond the seller chooses to deliver is important because the duration of that CTD determines the duration (price volatility) of the contract—hence, its BPV. The exact calculation of contract BPV is complex (not covered by CFA material), but is approximately:

$$\text{futures BPV} \approx \frac{\text{BPV}_{\text{CTD}}}{\text{CF}_{\text{CTD}}}$$

Calculating the number of contracts required to adjust the portfolio assets is simply the desired change in BPV divided by the BPV of the contract:

$$N_f = \frac{\text{BPV of liability} - \text{BPV of current portfolio}}{\text{BPV of futures}}$$

EXAMPLE: U.K. bond company revised

Suppose the U.K.-based company seeking to immunize its bond liabilities had instead chosen to immunize only a portion of its debt. The company selected an asset portfolio with a BPV of 217,525 to immunize a portion of the liabilities with a BPV of 217,512—a duration gap of only 13. After a modest increase in rates with a significant positive butterfly twist, the asset and liability BPVs are now 203,456 and 218,517 for a duration gap of 15,061.

Assume that there are government bond–based futures contracts based on 5- and 10-year notes, with features similar to U.S. Treasury–based futures contracts. Each contract specifies a range of deliverable government notes that the contract seller may select for delivery at contract expiration. Each deliverable note requires the seller to deliver 100,000 par and the buyer to pay initial contract price multiplied by the conversion factor for that bond (CF_{CTD}).

Figure 19.7: Characteristics of the CTD Note for the 5- and 10-Year Contracts; Per 100,000 Par

CTD Characteristics	5-Year Contract	10-Year Contract
YTM	1.71%	2.51%
Modified D	4.75	8.67
BPV of CTD	48.1650	86.7001
Conversion factor	0.9237	0.9169

1. **Determine** and **justify** if contracts will be bought or sold, assuming:
   i. the 5-year contract is used.
   ii. the 10-year contract is used.
2. **Calculate** contracts to use, assuming:
   i. the 5-year contract is used.
   ii. the 10-year contract is used.
3. If the liability duration is 8.99, **state** which contract is most likely to minimize structural risk based only on the information provided. You must choose either the 5 or 10 year, and not a combination of both. **Justify** your answer.

Answers:

1. To increase asset BPV to match liability BPV, buy contracts regardless of which contract is used.
2.
   i. Contract BPV ≈ 48.1650 / 0.9237 = 52.1436

      (218,517 − 203,456) / 52.1436 = buy 289 contracts

   ii. Contract BPV ≈ 86.7001 / 0.9169 = 94.5579

      (218,517 − 203,456) / 94.5579 = buy 159 contracts
3. The only available, relevant information is the liability duration. The 10-year contract is the better duration match. This closer match would likely minimize structural risk to nonparallel yield curve shifts.

PROFESSOR'S NOTE

You should be noticing that the PVA = PVL requirement is a bit of a misstatement. It will be true initially if the portfolio yield and liability discount rate are equal. Even then, it need not hold true after initiation, as the path of portfolio yield and liability discount rate can diverge. The strategy can still succeed if the changes in portfolio market value and yield track the path an immunizing, replicating zero-coupon bond could have followed. In other words, if the change in portfolio market value reflects a new portfolio yield, that will still reach the FVL desired. But even at initiation, PVA need not equal PVL if the portfolio yield and liability discount rate differ.

In practice, initially overfunding the portfolio with more market value than the strictly require PVA is common. If the surplus is significant, contingent immunization can be considered.

Contingent immunization (CI) is a hybrid active/passive strategy and requires a significant surplus. As long as that surplus is of sufficient size, the portfolio can be actively managed. At the extreme, assets could be invested in equity, commodities, real estate, or any other assets. If the assets earn more than the initially available immunization rate, the surplus will grow, and can eventually be returned to the investor. If the strategy is unsuccessful, the surplus will shrink, and the portfolio must be immunized before the surplus declines below zero. For example:

- Invest the entire portfolio in stocks.
- Invest only the surplus in stocks or in long stock options. Use the balance of the assets to construct an immunized portfolio. This approach allows fewer funds for active management, but is in some ways safer because only the surplus amount is at risk of loss, and an immunized portfolio is already in place.
- Use active bond management techniques. Returning to the previous U.K. example that required buying 159 of the 10-year note contracts, the manager could overhedge or underhedge based on a view of interest rates. Consider the 159 contracts to be a 100% hedge.
  - If the manager believes rates will increase, underhedge (<100%) and the losses on the contracts will be reduced, improving portfolio performance and increasing the surplus.
  - If the manager believes rates will decrease, overhedge (>100%) and the gains on the contracts will be increased, improving portfolio performance and increasing the surplus.

- Because the contract is based on 100,000 par, each 1/32 of change in price of 100 par will equate directly to a gain or loss on the contract of 31.25 [(1 / 32) × (100,000 / 100)].

CI approaches can be vulnerable to liquidity risk.

- If all of the assets (instead of just the surplus) are actively managed and the surplus declines, the assets must be quickly liquidated without further loss and converted to an immunizing portfolio before the surplus becomes negative.
- Even if only the surplus amount is actively managed, liquidity issues can still be a problem. If short option contracts were used, the downside risk is unlimited for calls and very large for puts (in excess of initial premiums received). Likewise, the potential losses on futures contracts are very large and could exceed the portfolio surplus.

MODULE QUIZ 19.1, 19.2

To best evaluate your performance, enter your quiz answers online.

1. A bond issuer is reviewing the four main categories of liabilities. He is interested in issuing a liability that can be managed easily and has known future amounts and payout dates. Which of the following types of liabilities *most likely* meets the issuer's demands?
   A. Callable bonds.
   B. Option-free fixed-rate bonds.
   C. Treasury inflation-protected securities.
2. An investor is looking to immunize a single liability, but is concerned with the impact from yield curve shifts and twists. When attempting to immunize this liability, which of the following rules should the investor apply?
   A. The portfolio Macaulay duration should match the due date of the liability.
   B. The dispersion of asset cash flows around the liability should be maximized.
   C. The present value of liabilities should exceed the initial portfolio market value.
3. Which of the following statements correctly describes contingent immunization?
   A. It uses Treasury futures contracts to adjust the portfolio and maintain duration matching.
   B. It constructs a portfolio of zero-coupon bonds that provide enough cash inflows to meet liabilities.
   C. It uses active bond portfolio management, as long as the present value of assets exceeds the present value of liabilities.

MODULE 19.3: ADVANCED STRATEGIES

Video covering this content is available online.

Pension funds can include complex Type IV liabilities where both the amount and timing of payouts may be uncertain.

PROFESSOR'S NOTE

We include a brief description of the complexities of projecting these liabilities. There is no direct LOS or questions for that issue. I suggest you briefly skim this note and move to the discussion of the various LDI strategies and issues.

Pension plan rules normally base benefit payouts on years of service, wages, and some multiplier. LDI strategies require estimates of those liabilities. Actuaries can develop models to estimate those

liabilities based on the following: initial years of service by employees to the company (G), current wage rate (W_0), wage growth rate and future wages (w and W_T), the multiplier (m), additional years of work until retirement (T), a discount rate (r) related to risk (a high-quality corporate bond rate is normally used), and an estimate of how many years the benefit will be paid (Z).

The liability projection can then be based on the accumulated benefit obligation (ABO), which is a lower number and represents the legal liability if the plan were closed now or a higher projected benefit obligation (PBO) of what is actually expected to be paid in an ongoing plan. Unless the plan is terminating, the higher PBO is generally the more realistic number.

The risk characteristics of the liability must also be estimated. This is normally done by assuming equal upward and downward shifts in the yield curve (Δcurve) to generate a lower PV_+ of the liabilities if rates move up, and higher PV_- if rates move down around the initial PV_0 of the liabilities. Such data can then be used to infer effective duration (and convexity, though that formula is not covered).

$$\text{effective D} = \frac{PV_- + PV_+}{2 \times \Delta\text{curve} \times PV_0}$$

More complex analysis may be needed to incorporate changing yield curve shape and path dependency issues such as effect on interest rate levels and time to retirement.

Typically, it is assumed there is no reliable, consistent relationship between other portfolio assets such as equity in the portfolio and interest rates. Their value may be affected by changing interest rates, but not in the same predictable way as fixed-income assets. In such cases, the duration of those other plan assets is assumed to be zero.

LOS 19.d: Evaluate liability-based strategies under various interest rate scenarios and select a strategy to achieve a portfolio's objectives.

CFA® Program Curriculum, Volume 4, page 76

As an example, assume an ongoing DB pension plan has a PBO of USD2.57 billion. The effective duration has been modeled as 9.35. The BPV of the liabilities is:

2.57 billion × 9.35 × 0.0001 = 2,402,950 BPV_L

The plan assets of $3.07 billion are 60% equity and 40% bonds. The manager chooses to hold a laddered bond portfolio of 1-to-5-year Treasury and investment grade corporate bonds; his reasoning is that these can be used to fund nearer-term plan distributions. While there is no cash flow match, the bonds are highly liquid and can be sold to meet distributions. The duration of the bonds is only 2.85. The BPV of the assets is:

3.07 billion × 0.40 × 2.85 × 0.0001 = 349,980 BPV_A

The duration gap is 2,402,950 − 349,980 = 2,052,970. The manager reasons he can use the Treasury bond contracts to eliminate the duration gap. The contract is based on 100,000 par. The CTD bond has a BPV of 128.98, duration of 13.53, and a conversion factor of 0.9436. The BPV of the contract is:

128.98 / 0.9436 = 136.6893 BPV_{futures}

Assuming the manager has no view on interest rates, he could construct a 100% hedge to remove the duration gap. He will buy contracts to increase the asset duration:

$$N_f \text{ for } 100\% \text{ hedge} = \frac{2{,}402{,}950 - 349{,}980}{136.6893} = 15{,}019 \text{ to buy}$$

Assume instead that the manager has discretion to overhedge or underhedge by 10%, and he believes that interest rates will decline. To profit by this, he will buy more contracts than required for a 100% hedge to set the asset duration above the liability duration. He will buy:

N_f for 110% hedge = 1.10 × 15,019 = 16,521 to buy

Now, assume instead that the manager believes that interest rates will increase. To profit by this, he will buy fewer contracts than required for a 100% hedge to set the asset duration below the liability duration. He would have bought:

N_f for 90% hedge = 0.90 × 15,019 = 13,517 to buy

Hedging with futures creates operational and practical risks. Margin must be posted and adjusted daily; that means all gains or losses on the contracts are posted in cash (or other securities) daily. Recall that each 1/32 change in price of the contract is a gain or loss on each contract of 31.25. If the hedge is successful, that G/L is an offset to changes in the value of the liability. But those are changes in unrealized value, not cash flow that must be posted in the margin account. In practice, these issues make 100% hedges rare in such situations. Partial hedges (< 100%) to reduce the duration gap are more common.

PROFESSOR'S NOTE

While not needed (and requiring data not provided in the discussion), the 1/32 value change of 31.25 per contract on an assumed starting par price and duration of 13.53 can be used to infer the change in rates needed to cause that percentage change in price: 31.25 / 100,000 = –13.53 Δr, making the Δr only about 0.2 basis points. Clearly, the margin cash flow issues can be substantial on some 15,000 contracts with even modest changes in rates.

Interest rate swaps are another way to adjust the duration gap. As OTC instruments, they may avoid the margin cash flow issues of futures. Recall that a receive-fixed swap is equivalent to buying more bond assets and will increase portfolio duration; it has positive (+) duration. A pay-fixed swap will reduce duration; it has negative (−) duration. The swap's net duration is calculated as the difference between fixed- and floating-rate bonds that would replicate the swap's future coupon flows.

Assume a 10-year swap is available and the manager has discretion to hedge 30%–70% of the duration gap, with a 50% hedge considered a neutral or normal position. The duration gap in BPV is still 2,402,950 − 349,980 = 2,052,970 with asset duration too low. The duration of the replicating fixed and floating sides of the swap are 9.18 and 0.25. The BPVs per 100 notional for each side of the net swap duration are:

fixed-side BPV = 100 × 9.18 × 0.0001 = 0.0918
floating-side BPV = 100 × 0.25 × 0.0001 = 0.0025
net swap BPV = +0.0918 − 0.0025 = 0.0893

The notional swap principal (NP) required to close the duration gap for a 100% hedge is the duration gap in BPV divided by the swap BPV per 1 NP. Note that the BPVs are per 100 NP and must be divided by 100 for BPV per 1 NP.

Enter a receive-fixed swap to increase asset duration:

$$\text{NP} = \frac{2{,}052{,}970}{(0.0893 \,/\, 100)} = 2.3 \text{ billion for a } 100\% \text{ hedge}$$

Assuming the manager expects rates to increase and given the hedging constraints, what hedge would be used?

> With increasing rates expected the manager will leave asset duration as low as permitted for a 30% hedge. He will enter a receive-fixed swap of 0.3 × 2.30 = 0.69 billion NP.

Assuming the manager just entered the 30% hedge and now believes rates will decline, what will he do?

> He will want to increase asset duration to the max allowed, a 70% hedge. He would want a receive-fixed swap of 0.7 × 2.30 = 1.61 billion NP. That will require an additional receive-fixed swap of 1.61 − 0.69 = 0.92 billion NP.

While historically swaps have not required margin posting, that has been an evolving issue. Many swaps now require periodic marking to market and posting of the gain or loss in margin or as a direct cash settlement. That reduces counterparty and credit risk, but introduces the same practical cash flow complications of exchange-traded futures.

An alternative to the swap is a swaption. The plan pays an initial premium for the right to enter a swap. The plan that needs to increase BPV of assets would purchase a receiver swaption, giving the plan the *right* to initiate a receive-fixed swap at a prespecified **swap fixed rate** (SFR); the swap's SFR may be called the *swaption strike rate*. The cost is limited to the initial premium paid. As time passes, comparing the SFR for new swaps (new SFR) to the SFR of the swaption determines if the swaption has value:

- If the new SFR declines, this right to receive a now above-market SFR has positive value and effectively increases the BPV of the assets. The value of the swaption is part of portfolio assets and increases the total value of plan assets.
- If the new SFR increases, this right to receive a now below-market SFR has no value, the swaption will not be exercised, and it would be allowed to expire worthless. Note that if a swap had been used instead of a swaption, the plan would suffer escalating losses on a receive-fixed swap.

EXAMPLE: Swap vs. swaption hedges

A U.S. pension plan has a 450,000 BPV duration gap with BPV of assets less than of liabilities. The plan uses a swap with a BPV per 100 notional of 0.2571 to construct a 50% hedge ratio. After setting up the 50% hedge, the manager forms the opinion that rates will increase, and would like to benefit if his view is correct, but be unaffected if he is wrong. The manager would be willing to adjust the hedge position by 15% to a 35% or 65% hedge. He checks and finds that both payer and receiver swaptions are available with a strike rate of 2.7%. The premiums for the payer and receiver swaptions are 55 and 75 basis points, respectively.

1. **State** the terms and **calculate** the notional principal of the 50% hedge ratio swap the manager would use.
2. **State** the terms and **calculate** the initial cost of the swaption the manager would buy or sell to adjust his hedge to a 35% hedge.
3. **Determine** the rate on new swaps and **state** whether new rates will have to be higher or lower than that rate to make exercising the swaption profitable.

Answers:

1. (450,000 × 0.50) / (0.2571 / 100) = 87.515 million NP of a receive-fixed swap.
2. 15% of the full hedge is (450,000 × 0.15) / (0.2571 / 100) = 26.254 million notional.

   The initial hedge is receive fixed, so to reduce the hedge, the manager will buy a payer swaption of 26.254 million NPl. The premium cost is 26.254 million × 0.0055 = 144,397.
3. If new SFRs are greater than the strike rate of 2.7%, the payer swaption and right to pay 2.7% is valuable and should be exercised.

PROFESSOR'S NOTE

This is hard material. You must know the terminology as well as be able to think clearly and logically to solve these questions.

Regarding Question 1, the assets have less BPV than the liabilities. If rates decline, the assets will increase less than the liabilities, and the plan will suffer. The correct swap is to receive fixed as that will increase duration and BPV of assets to reduce this loss if rates decline.

Regarding Question 2, if the manager wants the right to a smaller hedge position, he needs a pay-fixed swap to reduce his fixed inflow from the initial swap. Buying a payer swaption gives him the right to decide later if he wants to turn on the pay-fixed swap embedded in the swaption.

Regarding Question 3, economic logic dictates that his right to pay 2.7% and receive floating becomes valuable if new market conditions would require paying more than 2.7%. In that case, paying 2.7% is a bargain. The mechanics of how he captures this value are not covered, but there are a couple of possibilities: (1) He can exercise the swaption, pay the bargain SFR, and receive floating in this now higher interest rate environment. Of course, rates as well as the future floating rates received can change. (2) He could exercise the swaption and begin paying the 2.7% plus simultaneously enter into a new receive-fixed swap, receiving an SFR above the 2.7% he is paying. On each payment date, he will net the difference of 2.7% paid versus the higher SFR received for the life of the two swaps.

Note that the premium cost paid for the swaption is a sunk cost, and cannot be recovered. It does not affect the decision of whether the swaption is exercised. That premium is paid and gone regardless of whether the swaption is exercised.

The third alternative for the manager who needs to increase asset BPV is a swaption collar, which is a combination of buying one swaption and selling another.

- The manager would buy the receiver swaption to provide economic benefit if the SFR declines.
- To reduce the initial premium cost outlay, the manager sells a payer swaption. Note that this means the buyer of the payer swaption has the right to turn on a pay-fixed swap and the manager (seller) must accept that fixed rate. The buyer will do this if new SFRs exceed the payer swaption's strike rate. The sale of the payer swaption can limit the potential future benefits to the seller as the buyer will exercise and pay the SFR when rates increase (i.e., when unattractive to the seller of the swaption).

CHOOSING AN OPTIMAL STRATEGY

PROFESSOR'S NOTE

This material requires a solid understanding of terminology, swap diagrams, and the economic rationales of why swaptions are exercised. The discussion of *swaption seller* is tricky. The terms "payer swaption" and "receiver swaption" always refer to the fixed rate action of the *swaption buyer*. The *buyer of the payer swaption* will have positive value if new SFRs exceed the swaption strike rate the buyer would pay. That is negative value to the *seller of the payer swaption*, who must now accept and receive a below-market SFR.

But there is another issue here as well. The purpose of the hedge is to reduce risk. In this case, if rates go down, the assets—with lower BPV than the BPV of the liabilities—will increase in value less than the liabilities. In other words, hedging is to reduce or eliminate interest rate risk, which exists because no one can perfectly predict interest rates. But selecting the optimal hedge strategy will, as we'll see, require at least some ability to predict direction or magnitude of rate changes. Recognize that all three strategies work and reduce interest rate risk. But if you want optimal strategy, you need to predict interest rates to at least some degree.

The choice of optimal strategy will depend on the manager's view of interest rates. Consider the DB plan with a duration gap and a need to increase asset duration. In other words, the plan is currently at risk if interest rates decline because the assets would increase less than the liabilities increase, and the plan surplus would decline. The manager has three swap-based hedging choices:

1. Enter a receive-fixed swap versus pay LIBOR.
2. Buy a receiver swaption.
3. Enter a zero-cost collar composed of buying the receiver swaption and selling a payer swaption.

The swap notionals and payment frequency are the same. All floating payments are LIBOR. After consulting with the sponsor and the sponsor's accountants, the manager is instructed that all gain or loss on swaptions will be captured and reported on the sponsor's financial statements. In other words, she can evaluate the swaptions as if they are marketable securities for decision-making purposes. She is directed that she must use one of the hedges because the duration gap is too large and too risky to the plan surplus. All the hedges have the same effect on the duration gap. She cannot be unhedged. She gathers the following additional data:

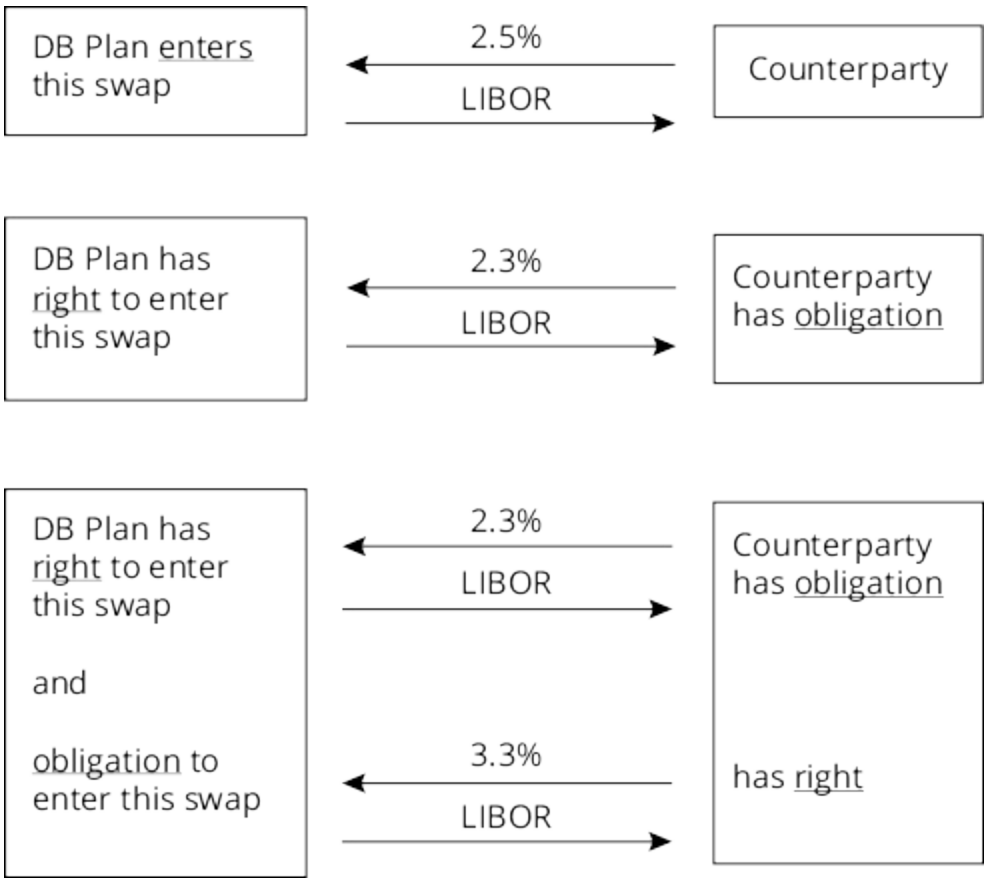
	Premium Cost
2.5% fixed-rate swap	None
2.3% receiver swaption	75 bp
3.3% payer swaption	75 bp

The receive 2.5% SFR swap is optimal if the *manager expects the new SFR will be at or below 2.5%*.

- This is equivalent to buying 2.5% fixed-rate bonds (financed by borrowing at LIBOR), increasing asset duration and BPV. The plan will benefit from the decline in rates.
- Buying the 2.3% receiver swaption is suboptimal because there is an initial cost, and the 2.3% fixed rate received by the plan is lower.
- The collar (buy the 2.3% receiver swaption; sell the 3.3% payer swaption) is

suboptimal because the 2.3% fixed rate received by the plan is lower. The payer swaption buyer has no rational reason to exercise his right with the new SFR below 3.3%.

Figure 19.8: Comparing Swap-Related Strategies



The collar is optimal if the *manager expects the new SFR will be above 2.5% but below 3.3%*.

- The collar (buy the 2.3% receiver swaption and sell the 3.3% payer swaption) has no intrinsic value, which is the best choice.
  - The right to receive 2.3% when rates are above 2.5% has no value.
  - The payer swaption buyer has no rational reason to exercise his right with new SFRs below 3.3%.
- The other hedges have negative value or zero value with an up-front cost.
  - The swap of receive 2.5% will have negative value when SFRs are above 2.5%.
  - The receiver swaption (right to receive 2.3%) has no value when new SFRs are above 2.5% and required an initial cost.

Buying the 2.3% receiver swaption is *optimal at some level of new SFRs above 3.3%*.

- The 2.3% receiver swaption has no intrinsic value with new SFRs above 3.3%. But there was an initial premium cost. This is the best case at some level of SFRs above 3.3%.
- The receive 2.5% swap has increasing negative value as new SFRs increase above 3.3%.

- The collar also begins to have increasing negative value as new SFRs increase above 3.3%.
  - The receive 2.3% swaption has no value.
  - The 3.3% payer swaption increases in value as SFRs increase above 3.3%, and this is negative value to the seller (the plan).
  - As SFRs increase, that negative value will at some point exceed the initial cost of the receiver swaption, and the receiver swaption would become optimal.
  - The breakeven rate to make the payer swaption optimal is above 3.3%.

PROFESSOR'S NOTE

Fortunately, the method of calculating breakeven above 3.3% is not even covered. We do not plan to respond to requests for, "But I just want to see how to do it."

MODULE 19.4: RISKS

Video covering this content is available online.

LOS 19.e: Explain risks associated with managing a portfolio against a liability structure.

CFA® Program Curriculum, Volume 4, page 86

- Hedge amounts are approximations based on assumed durations and ignore convexity. Convexity matters for large-rate movements.
- Duration assumes parallel shifts in the curve.
- Twists in the yield curve can create substantial structural risk, and immunization may fail to replicate the immunizing zero-coupon bond. Setting asset convexity (somewhat) higher than liability convexity creates net positive convexity (C of assets exceeds C of liabilities) while limiting the dispersion of asset cash flows in relation to liability flows to minimize structural risk.
- Model risk can be significant in some cases. See the earlier discussion of assumptions required to estimate DB plan liabilities, effective duration, and BPV.
- Measurement error when weighted average characteristics of the portfolio assets and liabilities are used instead of portfolio statistics based on portfolio cash flows and yield (IRR).
- Futures BPV calculations are based on an assumed CTD bond. That bond can change, changing the futures duration and BPV. Also, a more accurate estimate of futures BPV should adjust for accrued interest discounted at short-term rates (because accrued interest paid is recouped on the next coupon payment date).
- Portfolio yield and liability discount rate may differ, reflecting different risk levels. This creates spread risk (i.e., the risk the asset and liability discount rates and their PVs may shift in unexpected ways). Here are a few examples.
  - The liability discount rate may reflect corporate debt rates and assets government bond rates. Using Treasury contracts introduces this same potential spread risk.
  - Use of Treasury rates introduces a more subtle risk. The Treasury market is highly liquid and more likely to reflect frequent price change. That is reflected in higher reported volatility of Treasury rates. By definition, *higher volatility* means a higher rate of change in Treasury rates compared to other rates,

(i.e., nonparallel shifts).

- Using swaps also creates spread risk as swap rates directly reflect the LIBOR market.

- Traditionally, OTC derivatives have counterparty risk. The move toward requiring collateral reduces the counterparty risk, but creates cash flow risk. Counterparties must be prepared to meet the demands to post cash or other collateral. The same risks already exist for exchange-traded futures.
- Asset liquidity risk exists if positions cannot be quickly adjusted with reasonable transaction costs.

MODULE QUIZ 19.3, 19.4

To best evaluate your performance, enter your quiz answers online.

1. Assume that the BPV duration gap of a defined benefit pension plan is equal to $300,000. The pension fund manager would like to hedge 100% of this duration gap with a 10-year swap. The manager finds that the duration of the fixed side of the swap is 8.25 and the duration of the floating side of the swap is 0.5. What is the notional swap principal required to fully close the duration gap?
   A. $125 million.
   B. $387 million.
   C. $495 million.
2. A risk analyst is discussing the risks associated with managing a bond portfolio against a liability structure. She makes three statements regarding liability-driven investment risks. Which of her statements is *most likely* an indicator of spread risk?
   A. “Bond positions cannot be adjusted with reasonable transaction costs in a timely manner.”
   B. “Hedge calculations are approximated based on only the duration of the assets and liabilities.”
   C. “The liability discount rate may reflect corporate debt rates, and the asset discount rate may reflect government bond yields.”

MODULE 19.5: INDEX-BASED INVESTING

Video covering this content is available online.

LOS 19.f: Discuss bond indexes and the challenges of managing a fixed-income portfolio to mimic the characteristics of a bond index.

CFA® Program Curriculum, Volume 4, page 90

Many bond indexes exist—providing varying exposures to duration, credit, and other risk factors. Investing in a bond market index fund provides low cost diversification and an alternative to active fixed-income management. Their goal is to minimize tracking error. Tracking error also called *tracking risk* or *active risk*. It is the standard deviation of the portfolio’s active return (portfolio return − benchmark return).

The **pure index** or **full replication approach** requires holding all the securities and weighting them as in the index. **Enhanced indexing** matches all the primary risk exposures of the index, but not all the holdings. The goal is more efficient tracking of the index by avoiding some of the overly costly transactions required for pure indexing.

Indexing for bonds is more difficult than for equity:

- Fixed-income markets are much larger, more bond issues are outstanding, and the characteristics of individual bonds vary widely. This generally makes full replication impractical.
- Any one issuer may have multiple bond issues outstanding. They may differ substantially in liquidity, making it appropriate to concentrate positions in the less-costly to trade, liquid issues.
- Most bond trading is done OTC through dealers, unlike stock traded on exchanges. Capital requirements have increased for dealers post-2008. The higher capital cost has reduced dealers' willingness to hold large bond inventories and increased the bid-ask spread charged by dealers. The result is that bond market liquidity has declined.
- Most individual bond issues do not trade in any given year. Many transactions that do occur are not publically reported, making reliable price and volume data more difficult to obtain. This also leads to valuation challenges in existing portfolios. Bond pricing for nontrade securities is based on **matrix** or **evaluated pricing**. The price of similar, traded bonds is captured and used to calculate YTM. That YTM is then used to infer the price of nontraded bonds. The more unusual the features of a bond, the more difficult it is to find an appropriate traded bond to use as the basis of such pricing.
- Bond index composition and characteristics can change fairly quickly as new bonds are issued and old bonds approach maturity or change in credit quality and other characteristics.

Matching the primary risk characteristics of the bond index is generally more practical than full replication. Matching primary risk factors includes:

- Matching modified duration (MD) to minimize tracking error due to parallel shifts in the yield curve. For bonds with embedded options, effective duration must be used instead:

  $\%\Delta \text{ value} = -\text{MD } \Delta y$
- Matching key rate durations to minimize tracking error due to nonparallel changes in the yield curve. There are multiple key rate durations, and each simulates the expected change in value if one single point on the yield curve shifts. For example, the price change if five-year rates shift is as follows:

  $\%\Delta \text{ value} = -\text{MD}_{\text{key rate n}} \Delta y_n$
- Match weighting exposure to the various bond sector and quality ratings of the index. For nongovernment securities, it is useful to distinguish price change due to a general change in rates (i.e., government bond yields) from spread change. MD measures change due to the general change in rates, and spread duration measures how the nongovernment bonds perform relative to government bonds when (credit) spread changes:

  $\text{MD} = \text{Macaulay duration} / (1 + \text{YTM}_{\text{periodic}})$

  $\%\Delta \text{ value} = -\text{MD } \Delta y$

  $\%\Delta \text{ relative value} = -D_S \Delta s$

  $\text{spread} = y_{\text{higher yield}} - y_{\text{government}}$
- Matching sector/coupon/maturity cell weights of the index. For example, if the index is 1.7% in A-rated corporates of 2–3 duration, match that weight. When there are bonds

with embedded options such as callable or mortgage-backed securities, match these weighting exposures as well. Doing so means effective duration and convexity will be matched.

- Matching issuer exposure weights to control for specific event risk affecting only that issuer, such as bankruptcy.

Another method of minimizing yield curve risk is matching **present value distribution of cash flows**. The following example demonstrates this and its relationship to bond price, duration, and key rate durations. They are all interrelated. The example is for a 4.0% semiannual pay three-year bond trading at par (4% YTM):

4.0% semiannual pay 3-year bond priced at 4% YTM*			**w = PV as % of total PV**	**Duration contribution = (t)(w)**
Cash flow due in time *t*	**Amount**	**PV**		
0.5	2.00	1.9608	0.0196	0.0098
1	2.00	1.9223	0.0192	0.0192
1.5	2.00	1.8846	0.0188	0.0283
2	2.00	1.8477	0.0185	0.0370
2.5	2.00	1.8115	0.0181	0.0453
3	102.00	90.5731	0.9057	2.7172
		100.0000	**1.0000**	**2.8567**
* for a periodic discount rate of:		2.00%		

- List the cash flows by six-month period (t). If there were embedded options, the cash flows would be the best estimates of amount and when the cash would be received.
- The bond's price is the discounted PV of its future cash flows using a 4%/2 semiannual periodic discount rate.
- Each weight (w) is computed as that PV as a percentage of total PV (the price).
- Each (t)(w) is the cash flow's contribution to duration and a key rate duration. The sum of the duration contributions (key rates) is the bond's duration.
- Matching the *w* of portfolio to the *w* of the index will also match their (t)(w). This matching of present value distribution of cash flows is also matching the duration contributions and key rate durations. These actions minimize exposure risk from changes in shape of the yield curve. They also match total duration and convexity.

The goal of matching all the risk factors is to minimize tracking error while avoiding some of the expense of full replication.

ALTERNATIVE METHODS OF OBTAINING PASSIVE BOND MARKET EXPOSURE

Passive index replication provides diversifying exposure to the fixed-income market without the expense of active management. As discussed earlier, the nature of the fixed-income markets generally makes full replication impractical. Enhanced indexing provides one acceptable alternative. **Stratified sampling** (**cell matching**) can be used to implement enhanced indexing. The manager first determines the most significant characteristics that need to be matched. For example, the manager could divide the index into three duration and sector groupings:

Index	Duration		
	1–5	5–10	10–15
Treasury	5.1%		
Corporate			
ABS			

In the cell grid for the index, only the data for 1–5 duration Treasuries is shown. To cell match, the manager will also hold 5.1% in bonds with these characteristics, but need not use all of the same bonds as in the index to do so. The manager will also need to collect and match the weights for the other eight cells.

Cell matching can incorporate **environmental, social, and corporate governance** (ESG) or socially responsible investing restrictions. ESG may prohibit or explicitly require securities with specific characteristics. For example, bonds of high carbon emission industries are prohibited, and bonds of clean energy industries are desired. The manager will seek to do both while still matching cell weights.

Relevant techniques to reduce the expense of pure indexing or add value include:

- Reducing fund expenses, including transaction costs.
- Overweighting undervalued and underweighting overvalued: securities, sectors, and portions of the yield curve; while still matching overall index characteristics. The basic principle is to avoid areas of spread widening and favor areas of spread narrowing.
- Over (under)weighting callable bonds for their typically higher yield, when interest rate volatility is expected to be low (high) and impact of the call feature on price (and effective duration) is more (less) predictable.

LOS 19.g: Compare alternative methods for establishing bond market exposure passively.

CFA® Program Curriculum, Volume 4, page 96

Indirect exposure is an alternative to investing directly in bonds through full or enhanced indexing. Indirect exposure can be gained with funds or synthetically through derivative strategies. These indirect approaches usually avoid the higher initial costs of directly trading in bonds, but incur ongoing expenses and other possible risks.

Bond index **mutual funds** may be particularly well suited for smaller investors. They provide broad market exposure with one investment and economies of scale. Aggregating the capital of many investors typically gives these funds access to more securities at better prices.

Open-ended fund shares can be redeemed or purchased at **net asset value** (NAV) once per day. However, such funds charge ongoing management fees and may also charge fees at purchase (front load) or sale (back load). Unlike bonds, they do not typically mature, plus the holdings and income stream change over time.

Exchange-traded funds (ETFs) provide some advantages in that the shares trade continuously on exchanges and investors can buy or sell continuously, rather than once per day. The typical investor cannot purchase or redeem shares directly with the fund. However, **authorized participants** can redeem shares in kind with a pro rata distribution of the

underlying fund assets. Those participants can also assemble a package of the underlying fund assets and trade them to the fund in exchange for new shares of the fund. This redemption and purchase in kind (with fund assets instead of cash) creates an arbitrage mechanism between the open-market price of fund shares and NAV. That benefits all investors in the fund. However, the arbitrage mechanism is less effective than in the equity market due to the illiquidity of many underlying bond assets; they are simply harder to buy or sell at the expected fair price.

Synthetic strategies seek to replicate the performance of bond indexes with OTC or exchange-traded derivatives. Such strategies include:

PROFESSOR'S NOTE

Most of these approaches are illustrated in more detail in the derivatives study session and will be covered there. This reading is essentially an overview of the derivatives approaches.

Total return swaps (TRS): The manager enters a swap to receive a desired bond market index total return (both income and price change) in exchange for paying LIBOR + spread. TRS are equivalent to buying the index and borrowing the funds needed for purchase at LIBOR + spread. If the index has a negative return in a given period, the index receiver pays that return to the index payer to replicate the loss in value that would have occurred if the index receiver had actually invested in the index:

- The investor could fully collateralize the swap by holding sufficient cash equivalents to have purchased the underlying index.
- If not fully collateralized, the TRS is effectively a leveraged investment in the index.
- The counterparty is normally a dealer with greater economies of scale who can replicate the index with lower transaction costs than the manager.
- The TRS has disadvantages compared to direct investment.
    - The user does not directly own the underlying securities. The TRS replicates the underlying return, but there is counterparty (credit) risk if the dealer cannot perform his side of the transaction.
    - The TRS is normally shorter term in nature, and there is rollover risk if it cannot be renewed or a new counterparty cannot be found at expiration of the initial TRS.
    - The specified return can be for a subset of the bond market or a sector where transaction and liquidity issues make direct investment impractical. However, the dealer must reflect these costs in the swap terms—typically increasing the spread to LIBOR paid by the TRS index return receiver.
    - Structural and regulatory changes have been increasing the costs and reducing the flexibility of TRS. Dealers are now required to hold more capital, increasing their costs and making the swap terms they can offer less attractive. Collateral and mark-to-market rules are removing some of the flexibility of these instruments.

Exchange-traded derivatives are another approach to synthetic positions. Structural and regulatory changes are also occurring here. Traditionally, exchange-traded instruments such

as futures and options were based on individual bonds (i.e., the CTD bond for Treasury futures and options on futures as well as money market instruments such as Eurodollar futures). Starting in 2006, the United States allowed futures contracts based on bond indexes, but they have not been particularly popular, with some contracts being delisted (no longer traded). Equity ETF futures contacts were introduced in 2005, but with limited liquidity and success. American-style exchange-traded options on interest rate–related ETFs, high yield bonds, corporate bonds, and inflation-protected securities have been more successful (i.e., are becoming more available).

BOND BENCHMARK SELECTION

LOS 19.h: Discuss criteria for selecting a benchmark and justify the selection of a benchmark.

CFA® Program Curriculum, Volume 4, page 102

Benchmark selection begins with defining the client's objectives and constraints, then determining the strategic asset allocation that will meet these requirements. The manager may be given tactical discretion to vary those asset class exposures.

Selecting suitable bond indexes can be more complicated than for equity. Here are examples:

- In a static (no changes) bond portfolio, duration will decline as the bonds age.
- New bond issuance may cause the characteristics of the index selected as a benchmark to change over time. For example, issuers may shift to shorter or longer security issuance, making a given index no longer appropriate for a given investor's desired duration.
- Value-weighted indexes give the greatest weight to the largest issuers, which may lead to the "bums problem." A bum is a less creditworthy issuer. There is often a negative correlation between amount of bonds issued and creditworthiness of the issuer; thus, the less creditworthy issuers tend to become an increasing percentage of the index.

A bond investor could start by defining the desired interest rate (duration) risk and sector exposures. That could lead to a custom index (instead of a broad market index) of desired sub-exposures, such as 50% in 5- to 10-year Treasuries and 50% in 1- to 3-year investment grade corporates as a benchmark. (See **credit barbell** in the next paragraph).

Smart beta rules could be used. This means identifying relatively simple, definable rules that can be followed to add value. The custom index explained previously is one such example, and is called a **credit barbell**. Longer-term Treasuries (with no credit or spread risk) are used to give the portfolio the desired duration exposure. Shorter-term corporate securities are used to add additional spread return. Those shorter-term securities will be less vulnerable to relative price underperformance if spreads widen.

MODULE 19.6: INTRODUCTION: BULLET, LADDER, BARBELL

Video covering this content is

LOS 19.i: Describe construction, benefits, limitations, and risk–return characteristics of a laddered bond portfolio.

available online.

CFA® Program Curriculum, Volume 4, page 105

A laddered portfolio is a common way to build a bond portfolio for individual clients. Roughly equal par amounts are purchased, and come due each year. The same duration could also be achieved by concentrating all the holdings in a single middle duration (a bullet portfolio) or in a shorter and longer duration (a barbell portfolio). If all three portfolios have the same duration, they all have roughly the same price sensitivity to a parallel yield curve shift. The advantages of the laddered portfolio include:

- The greatest practical advantage is natural liquidity, as some bonds come due each year. This is particularly significant if less liquid bonds such as corporates are used. The need to sell at large bid-ask spread to meet cash flow need is reduced. Alternatively, these now near-to-maturity bonds would be treated as less risky collateral, and could be used to borrow at favorable interest rates.
- There is the broadest diversification of cash flow across time and the yield curve—hence, less concentrated exposure to twists in specific points on the curve.
- There is diversification between price and reinvestment risk. Regarding price risk, some bonds mature each year (see natural liquidity). Regarding reinvestment risk, some bonds mature each year, so some proceeds will be reinvested at higher and some at lower rates. This creates a form of dollar cost averaging.
- The laddered portfolio will have more convexity than the bullet, a benefit if there are large parallel shifts. Recall that that distribution of cash flows is directly related to convexity.
- The duration contributions and key rate durations of the bullet, ladder, and barbell will also differ. So, the portfolios will respond differently to nonparallel twists in the curve. The ladder will typically fall in the middle of such curve risk exposure.

An alternative to building laddered bond portfolios with individual bonds is to use a laddered portfolio of **target-date** (fixed-maturity) bond ETFs. Each ETF has a designated year when it will mature and be paid off. It is passively managed to replicate the performance of a bond maturing in that year. For many investors, the ETF will offer cost advantages compared to purchasing individual bonds and have more liquidity if unanticipated sales are needed.

Laddered portfolios do have disadvantages. For some investors, an ongoing (no target date) passive index or active bond fund may be better. These ongoing funds are likely to be larger, provide greater diversification of credit risk, and be more liquid.

MODULE QUIZ 19.5, 19.6

To best evaluate your performance, enter your quiz answers online.

1. Using a full replication approach for bond indexing may be impractical, given the large size of the bond market and the varying characteristics of individual bonds. Instead, it may be easier to match the primary risk characteristics of the selected bond index. When reviewing specific risk characteristics, the risk factor that minimizes tracking error due to nonparallel shifts in the yield curve is associated with matching:

A. modified duration.
B. key rate durations.
C. issuer exposure weights.

2. A bond portfolio manager is looking to gain passive exposure to the bond market. Which of the following approaches would allow the manager to receive the return from a desired bond market index in exchange for paying LIBOR plus a spread?
   A. Total return swap.
   B. Exchange-traded funds (ETFs).
   C. Exchange-traded derivatives.
3. Which of the following statements regarding fixed income benchmarks is *most likely* false?
   A. If a static bond index is used as a benchmark, the duration will remain the same as the bonds age.
   B. New bond issuance may cause the characteristics of the selected benchmark to change over time.
   C. Issuers may shift to shorter or longer security issuances, making a given benchmark no longer appropriate for a given investor.
4. A client at RBI Funds would like to build a laddered bond portfolio. In terms of the construction and advantages of a laddered portfolio, which of the following statements is *most correct*?
   A. With a laddered portfolio, the investor is diversified between price and reinvestment risk.
   B. A laddered portfolio has more reinvestment risk in any single year compared to a barbell portfolio.
   C. The more distributed cash flows of a ladder portfolio compared to a bullet portfolio will provide less convexity.

KEY CONCEPTS

LOS 19.a

- Liability-driven investing is a form of asset-liability management (ALM) that manages the assets in relation to the characteristics of the liabilities. This is easier when the future liability payouts are known in amount and timing. The liabilities are essentially the benchmark for making decisions.
- Asset-driven investing is a less common form of ALM and adjusts the liabilities in relation to the characteristics of the assets.

LOS 19.b

Immunization can be used to fund liabilities with a high degree of certainty. The assets are dedicated to this purpose and all cash flows are reinvested until needed for payout.

Cash flow matching is without risk, assuming there are no defaults. Bonds are bought and held in sufficient amount and pay date to meet the liabilities. It is the most restrictive strategy, and so typically costs more (has lowest return).

Duration matching achieves similar results, but is less restrictive in the assets selected. Matching Macaulay duration of the assets to liabilities balances the exposure between price and reinvestment risk. Duration and other portfolio statistics should be based on portfolio yield (IRR). To immunize a single-period liability:

- Initial PVA equals (or exceeds) PVL. (There are exceptions to this for more complex situations where initial portfolio IRR differs from initial discount rate of the liability.)
- Match Macaulay durations ($D_A = D_L$).
- Minimize portfolio convexity.
- Rebalance the portfolio to maintain the duration match.

Immunization (duration matching) issues include the following:

- The assets have greater convexity than the single date liability; therefore, the portfolio benefits from large parallel shifts but is at risk from curve twists (nonparallel shifts). Minimizing convexity minimizes this structural risk.
- Immunization can be interpreted as zero replication, meaning a successful immunization will replicate the price and yield path of a zero-coupon bond that could have been used for a perfect cash flow match immunization.

LOS 19.c

Multiple liabilities can be cash flow matched with a portfolio of zero-coupon bonds or coupon-bearing bonds whose cash flows (P&I) most closely match the liability payouts. Duration matching can be done by matching the BPV of the assets and liabilities. The rules are as follows:

1. Initial PVA equals (or exceeds) PVL (see the caveat given under single liability rules).
2. $BPV_A = BPV_L$
3. Asset dispersion of cash flows and convexity exceed those of the liabilities. (But not by too much, in order to minimize structural risk exposure to curve reshaping).
4. Regularly rebalance the portfolio to maintain the BPV match.

Derivatives are often used to adjust the BPV of the assets and hedge or partially hedge the duration gap:

- Buying (selling) futures or receive (pay) fixed swaps increases (decreases) asset duration and BPV.
- Futures BPV $\approx BPV_{CTD} / CF_{CTD}$
  - BPV = MD × V × 0.0001
- N_f = (BPV of liability − BPV of current portfolio) / BPV of futures.
- NP for swap = (BPV of liability − BPV of current portfolio) / BPV of 1 NP for the swap.
  - BPV_{swap} is the difference in BPV of fixed and floating side.

Contingent immunization (CI) requires the portfolio be overfunded with a positive surplus (PVA > PVL). If the surplus is positive, the portfolio can be actively managed (not immunized):

- If active management is successful, the return will exceed the initially available immunization rate, the surplus will grow, and ultimate cost of the strategy will be less than immunizing.
- If active management fails, the surplus will decline to zero and the portfolio must be immunized. The ultimate cost will exceed that of immunizing.

LOS 19.d

A 100% hedge eliminates the duration gap (matches BPV of assets and liabilities). In the normal scenario of $BPV_A < BPV_L$, a manager who expects interest rates to:

- Increase will reduce the hedge size, leaving the BPV of assets less than of a fully hedged duration gap. Leaving the BPV of assets at a lower level means they will decline in value less as interest rates increase.
- Decrease will increase the hedge size, increasing the BPV of assets above that of a fully hedged duration gap. Increasing the BPV of assets means they will increase in value more as interest rates decrease.

Regarding the three swap methods of reducing a negative duration gap (increase BPV of assets):

- Entering a receive-fixed swap is generally optimal if interest rates in the future are below the swap's SFR.
- Using a zero-cost collar (buy receiver swaption and sell payer swaption) is generally

optimal if interest rates in the future are moderately higher (i.e., between the swap and payer swaption SFRs).

- Buying a receiver swaption is generally optimal if interest rates in the future exceed the payer swaption SFR by some amount.

LOS 19.e

Risks include:

- Hedge amounts are approximations based on assumed durations and ignore convexity.
- Duration assumes parallel shifts in the curve.
- Twists in the yield curve can create structural risk (risk due to curve reshaping).
- Multiple assumptions (model risk) are required to model the characteristics of complex liabilities, such as those in DB plans.
- Measurement error issues occur when weighted average characteristics are used instead of portfolio statistics based on portfolio yield (IRR).
- Futures base calculations are approximations based on an assumed CTD bond, and that CTD can change.
- Spread risk exists if the relationship between asset yield and liability discount rate changes.
- Traditionally, OTC derivatives have counterparty risk.
- Cash flow risk for exchange-traded and OTC derivatives requiring cash settlement of gain/loss or margin.
- Asset liquidity risk if positions cannot be quickly adjusted at near fair market value.

LOS 19.f

Bond index funds offer low cost diversification. Their goal is to minimize tracking error. But there are challenges (compared to equity):

- A much larger number of bond issues with diverse characteristics exists. This generally makes full replication impractical.
- Liquidity has declined post-2008, is often low, and varies by bond issue.
- Trading is OTC, and dealers have become less able to supply liquidity.
- Most individual bonds rarely trade, and price must be estimated based on matrix pricing.
- Bond index composition and characteristics can change.

Enhanced indexing matches the primary risk factors of the index. To minimize tracking error:

- Match modified duration—and effective duration if there are option features.
- Match key rate durations.
- Match weighting exposure to the various bond sectors, quality ratings, issuers, and all other material factors. Cell matching is a common technique used to do this.

LOS 19.g

Passive bond market exposure can be achieved with:

- A separately managed account that replicates the index.
- Index mutual funds, either open ended or ETFs.
- Synthetic strategies, including:
  - Total return swaps, receiving a bond index return.
  - Futures or options based on bond instruments.

LOS 19.h

Determine the client's objectives and constraints before finalizing the strategic asset allocation. Then, select a bond index that matches the objectives and constraints as well as the desired asset class characteristics. Selecting a suitable index is complicated by:

- The possible decline in index duration as the bonds age.
- The changing characteristics of many indexes over time as the holdings change.
- The "bums problem" in value-weighted indexes as the largest issuers become a greater percentage of the index, but large issuance is often associated with increasing leverage and declining credit quality.

LOS 19.i

Laddered portfolios:

- Provide diversification across the yield curve and natural liquidity as a portion of the bonds come due each year. In an upward sloping yield curve, this can also be desirable as each maturing bond is rolled over into the longest (and highest yielding) maturity used in the ladder.
- Have more convexity than a bullet portfolio because their cash flows are more distributed.
- Could be constructed with a sequence of target-date ETFs as an alternative to individual bonds.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 19.1, 19.2

1. **B** Type I liabilities have known future amounts and payout dates. The issuer of an option-free fixed-rate bond has this type of liability. These are the easiest to manage liabilities because their sensitivity to interest rate movements can be modeled using modified duration. Callable bonds have known future amounts, but uncertain payout dates (Type II). Real rate bonds, such as Treasury inflation-protected securities, have uncertain future amounts, but known payout dates (Type III). (Module 19.1, LOS 19.a, 19.b)

2. **A** Rules for immunizing a single liability include the following:
   - Initial portfolio market value (PVA) equals (or exceeds) PVL.
   - Portfolio Macaulay duration matches the due date of the liability (DA = DL).
   - Minimize portfolio convexity (to minimize dispersion of asset cash flows around the liability and reduce risk to curve reshaping).

   (Module 19.1, LOS 19.b)

3. **C** Contingent immunization is a hybrid active/passive strategy. It requires initially overfunding the portfolio with more assets than needed to immunize and meet the future liability. As long as that surplus is of sufficient size, the portfolio can be actively managed. A derivatives overlay uses Treasury futures contracts to adjust the portfolio. Cash flow matching creates a portfolio of zero-coupon bonds to match cash inflows with cash outflows. (Module 19.2, LOS 19.b)

Module Quiz 19.3, 19.4

1. **B** The basis point values (BPVs) per 100 notional for each side of the swap and the net swap duration are computed as:

   fixed-side BPV = $100 \times 8.25 \times 0.0001 = 0.0825$

   floating-side BPV = $100 \times 0.5 \times 0.0001 = 0.005$

   net swap BPV = $+0.0825 - 0.005 = 0.0775$

   The notional swap principal required to close the duration gap for a 100% hedge is the duration gap in BPV divided by the swap BPV per 1 NP.

   NP = \$300,000 / (0.0775 / 100) = \$387 million

   Note that the case never said if BPV of assets or liability is larger. Thus, we can compute the size of the swap, as asked, but not if it is a pay- or receive-fixed swap. (Module 19.3, LOS 19.d)

2. **C** An example of spread risk occurs when the portfolio yield and liability discount rate differ, which reflects different risk levels. If the spread between the two rates changes,

the change in rates of the two cannot match; their present values may not change in the expected ways. Using only duration will ignore convexity, which will result in some error. Not being able to adjust positions with reasonable transaction costs is an example of asset liquidity risk. (Module 19.4, LOS 19.e)

Module Quiz 19.5, 19.6

1. **B** Matching key rate durations minimizes tracking error due to nonparallel twists in the yield curve. Matching modified duration minimizes tracking error due to parallel shifts in the yield curve. Matching issuer exposure weights controls for specific event risk that affects only that issuer, such as bankruptcy. (Module 19.5, LOS 19.f)

2. **A** In a total return swap, a manager enters a swap to receive a desired bond market index total return (both income and price change) in exchange for paying LIBOR + spread. If the index has a negative return in a given period, the index receiver pays that return to the index payer to replicate the loss in value that would have occurred if the index receiver had actually invested in the index. (Module 19.5, LOS 19.g)

3. **A** In a static (no changes) bond portfolio, duration will decline as the bonds age. New bond issuance may cause the characteristics of the selected benchmark to change over time. Issuers may shift to shorter or longer security issuance, making a given index no longer appropriate for a given investor. (Module 19.5, LOS 19.h)

4. **A** With a laddered portfolio, the investor is diversified between price and reinvestment risk. Some bonds mature each year and can be reinvested if rates are high. This creates a form of dollar cost averaging over time. The ladder has less reinvestment risk in any single year versus the barbell (or bullet). The more distributed cash flows of the ladder compared to the bullet will provide greater convexity—benefiting performance for large changes in rates. (Module 19.6, LOS 19.i)

The following is a review of the Fixed-Income Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #20.

READING 20: YIELD CURVE STRATEGIES

Study Session 8

EXAM FOCUS

Now we turn to ways to add value by positioning portfolio exposures along the yield curve. You will see many concepts already discussed, such as bullet versus ladder versus barbell, adjusting convexity, and PVBP (which a previous reading referred to as BPV). Think of this as positioning on a credit risk-free government yield curve to add value. The next reading will focus on adding value through credit risk decisions.

MODULE 20.1: INTRODUCTION AND STRATEGIES FOR AN UNCHANGED CURVE

Video covering this content is available online.

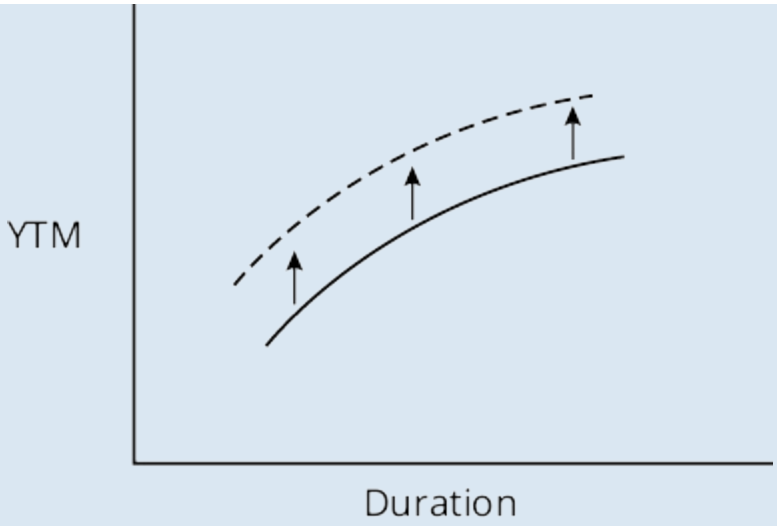
Active management requires the manager to have a view of what will happen. If the manager acts on this view, is correct, and the view was not already reflected in security prices, the actions can add value to the portfolio's performance.

A yield curve shows the yield as a function of maturity (or sometimes of duration) for otherwise comparable bonds. Yield curves are most typically plotted for credit risk-free government bonds because they are generally available for a wide range of maturities and do not introduce the additional complexity of changes in credit spread. The "yield" could be yield-to-maturity (YTM), spot rates, or even forward rates. For our purposes, the yield will be YTM unless clearly indicated otherwise. Thus, in the United States, the typical yield curve will be for YTM as a function of maturity for U.S. Treasury securities.

Yield curves are generally not stable but change over time. To determine how to profit from expected changes in the yield curve, it is helpful to view yield curve changes as resulting from three sources. Change in:

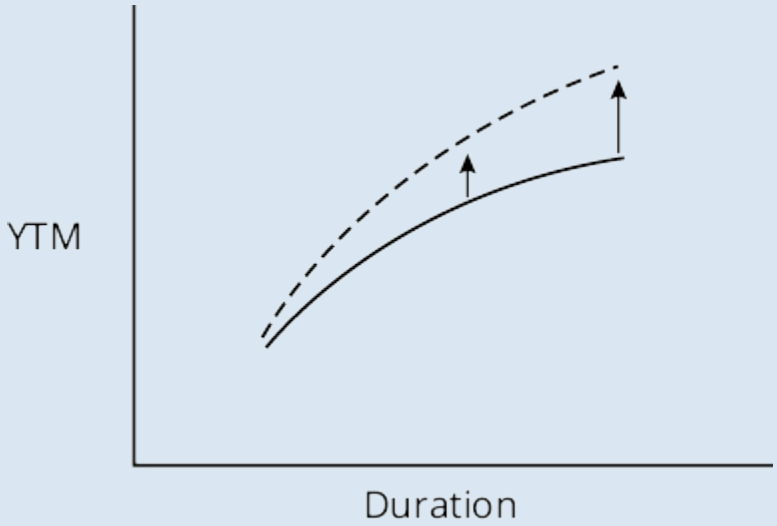
1. Level: A parallel shift where all yields shift up (or down) by the same amount.

> **EXAMPLE: An upward parallel shift**



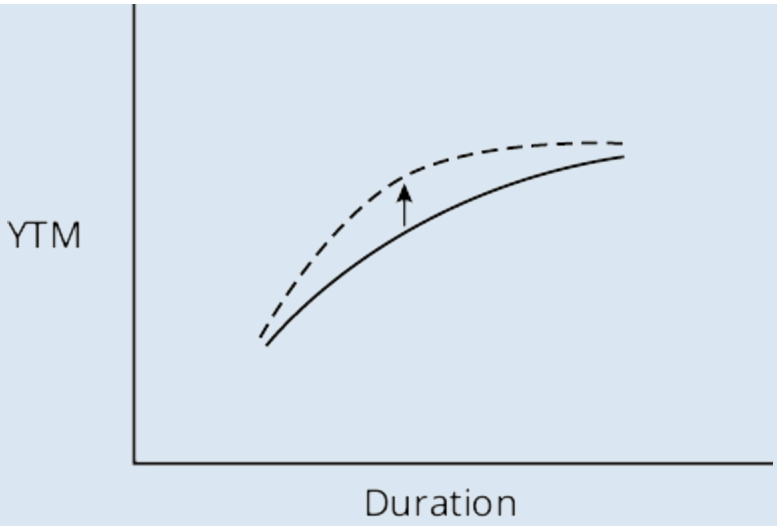
2. Slope: Where the curve becomes flatter or steeper.

EXAMPLE: A steepening



3. Curvature: Where the curve becomes more like a straight or curved line.

EXAMPLE: Increased curvature



In reality, most changes in the curve involve more than one source.

EXAMPLE 1: The three sources of change in the yield curve

A manager makes the following projection of change in level, slope, and curvature for the yield curve.

Maturity:	1 year	2 year	5 year	10 year	20 year
Yield today	1.1%	1.2%	1.3%	1.4%	1.4%
Projected yield in 3 months	1.2%	1.4%	1.6%	1.6%	1.6%

Discuss each of the *three* changes reflected in the manager's projection for the change in the curve.

Answer:

Level: All rates are projected to increase, which has elements of an upward shift.

Slope: Longer rates are increasing more than shorter rates, which has elements of a steepening.

Curvature: Intermediate (the 5-year) rates increase the most, which has elements of increasing curvature.

PROFESSOR'S NOTE

We are going to first look at simpler situations where the right strategy is fairly straightforward to determine. Then we move to more complex situations where determining the optimal strategy may require additional quantifiable assumptions and calculations.

All of the CFA text is premised on an upward sloping curve that is concave. That is true in the graphs of curve change in Example 1. This is the overwhelmingly normal situation. So, for exam purposes, confine your preparation to what we can conclude for upward sloping concave curves, unless clearly directed otherwise.

Also recall that:

$$\%\Delta V = -D\Delta r + \frac{1}{2}C\Delta r^2$$

$$C = \frac{\text{Macaulay duration}^2 + \text{Macaulay duration} + \text{dispersion}}{(1 + \text{periodic IRR})^2}$$

STRATEGIES FOR A STABLE CURVE

LOS 20.a: Describe major types of yield curve strategies.

LOS 20.b: Explain how to execute a carry trade.

LOS 20.c: Explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity.

CFA® Program Curriculum, Volume 4, pages 138 and 140

Buy and hold: In an upward sloping curve, extend maturity (and therefore duration) to earn a higher yield and expected return. Another advantage of this strategy will be low turnover and transaction costs. This strategy is not necessarily passive if it involves selecting a duration or exposure to points on the yield curve (where rates are expected to be stable) that differ from the portfolio's benchmark.

Ride the yield curve: This strategy is based on the fact that as time passes, the bond's remaining maturity and duration decrease. In an upward sloping curve, that means its yield will decline as time passes. It differs from buy and hold in that the manager will look to find the bond with a combination of higher duration and a position at the end of a relatively steep portion on the curve so that as time passes and its yield declines, the bond will offer the greatest increase in price. Then, after the yield declines, the manager sells the bond and rolls out the curve to repeat the process by buying another bond at the end of a steep segment of the curve. Buying bonds at the end of a steep segment of the curve also means they have an initially higher yield, which also adds to the return earned.

Use a carry trade: A carry trade is just another form of leverage. Return is enhanced by borrowing at a lower rate to invest the funds in an asset that will generate a higher rate of return. In a stable upward sloping curve, borrow at lower shorter-term rates to invest at higher longer-term rates. We will return to a further discussion of carry trades shortly.

Sell convexity: This means select bonds or a portfolio with lower convexity. By itself, positive convexity (+C) is beneficial. It means that if there is a large decline in interest rates, the increase in the bond's price will be greater than expected from duration alone. Or if there is large increase in interest rates, the decrease in the bond's price will be less than expected from duration alone. Thus, +C magnifies the upside and reduces the downside of price movement due to changes in rates. The changes in rates have to be rather large because convexity is a second order impact on price. That means +C has little impact on change in price unless the rate change is significant. Of course there is rarely any free lunch. Bonds or portfolios with higher +C normally have less yield. The conclusion is that if the curve is expected to be stable (little change in rates), there will be minimal or no benefit from +C and the lower yield will reduce return. Thus, it is better to "sell convexity" (reduce convexity) to receive higher yield and expected return. We will return to a further discussion of altering convexity shortly.

MODULE 20.2: STRATEGIES FOR CHANGING YIELD CURVES

Video covering this content is available online.

Strategies for a Parallel Shift in the Curve

LOS 20.a: Describe major types of yield curve strategies.

LOS 20.c: Explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity.

LOS 20.e: Explain how derivatives may be used to implement yield curve strategies.

CFA® Program Curriculum, Volume 4, pages 138, 140, and 147

Adjust Portfolio Duration: A parallel shift in the curve portfolios with the same duration are expected to have the same percentage change in value.

- If rates are expected to increase, decrease portfolio duration before this occurs to minimize the value lost.
- If rates are expected to decrease, increase portfolio duration before this occurs to maximize the value gained.

Of course all changes in duration must be consistent with the portfolio constraints.

Increase Portfolio Convexity: Greater convexity will:

- Increase the value gained if rates decrease.
- Decrease the value lost if rates increase.

The convexity effect will only be material if the rate change is significant and it will involve accepting less yield (assuming rational pricing of assets in the market).

Strategies for a Nonparallel Shift in the Curve

LOS 20.a: Describe major types of yield curve strategies.

CFA® Program Curriculum, Volume 4, page 138

The basic concept is simple. First, determine the appropriate duration for the portfolio. Within that constraint of meeting, target total duration:

- Increase exposure to those points on the curve where rates are expected to show a relative decrease in level.
- Decrease exposure to those points on the curve where rates are expected to show a relative increase in level.

The simplest way to implement this strategy is selection of a bullet versus barbell portfolio.

- The bullet portfolio concentrates exposure in the desired total portfolio duration point of the curve (denoted here as M for middle).
- The barbell portfolio concentrates exposure at shorter and longer points of the curve to achieve the same desired total portfolio duration (denoted here as S and L for shorter and longer).
- A laddered portfolio would distribute exposure more evenly along the curve between S and L.

EXAMPLE 2: Selection of curve strategy

Consider a portfolio with a benchmark that is laddered and has a duration of 10. The manager is considering three possible strategies:

1. Ladder: Match the benchmark which has an equal distribution of 1 to 19 duration bonds for portfolio duration of 10. The yield and convexity are 4.39% and 20.1 respectively.
2. Barbell: 50% in securities with a duration of 2 and 50% in securities with a duration of 18, for portfolio duration of 10. The yield and convexity are 4.30% and 24.7 respectively.
3. Bullet: 100% in securities with a duration of 10. The yield and convexity are 4.51% and 16.4 respectively.

A. **State** and **justify** the optimal strategy if the manager expects a small and very near term parallel upward shift in the yield curve.

B. **State** and **justify** the optimal strategy if the manager expects a large parallel and very near term upward shift in the yield curve.

C. **State** and **justify** the optimal strategy if the manager expects a large parallel downward shift in the yield curve over the next 12 months.

D. **State** and **justify** the optimal strategy if the manager expects an immediate steepening of the curve with short rates (duration of 1) decreasing 50 bp, no change in intermediate rates (duration of 10), and long rates (duration of 19) increasing 50 bp.

E. **State** and **justify** the optimal strategy if the manager expects an immediate steepening of the curve with short rates (duration of 1) decreasing 10 bp, intermediate rates (duration of 10) increasing 40 bp, and long rates (duration of 19) increasing 90 bp.

F. **State** and **justify** the optimal strategy if the manager expects an immediate flattening of the curve with short rates increasing 50 bp, no change in intermediate rates, and long rates decreasing 50 bp.

Answers:

A. There is no distinct advantage for any strategy. They all have the same duration and expected change in value for a parallel shift. The bullet has a yield advantage, but over a short time period that will not matter much. The barbell has more convexity but for a small change in rates that will not matter much. The ladder more closely matches the portfolio benchmark's duration distribution but has no material expected return advantage in this scenario.

B. The barbell. With a large increase in interest rates, the higher convexity of the barbell will produce the greatest cushioning of price decline.

C. There is no distinct advantage for any strategy. There are conflicting issues. They all have the same duration. The bullet has a yield advantage over the next 12 months. The barbell has more convexity which will increase its value gain for a large decrease in rates. The ladder more closely matches the portfolio benchmark's duration distribution but has no material expected return advantage in this scenario.

D. The bullet is best. With no change in intermediate rates, it will not decline in value. The manager has described a pivot in the curve. With long rates up 50 bp and high duration there will be a large decline in value. The 50 bp decrease in shorter rates with less duration will not produce as large a value gain. Thus the barbell will decline the most and the ladder will decline some.

E. The bullet is best for the same reasons it is best in part D. There is a steepening and that favors the bullet. There are also elements of a parallel upward shift, but all strategies have the same duration and respond the same to a parallel shift, ignoring the small convexity effect.

F. The barbell because it has the most exposure to long duration assets where rates will decrease. This will give it the largest value gain.

MODULE 20.3: ADJUSTING CONVEXITY

Video covering this content is available online.

LOS 20.c: Explain why and how a fixed-income portfolio manager might choose to alter portfolio convexity.

As we have seen previously and all else the same, it is beneficial to have greater convexity when large changes in rates are expected. The convexity will magnify value gain when rates decrease and cushion price loss when rates increase. However, there is likely to be a cost in the form of lower yield (and income from the portfolio). To adjust convexity, use the following:

Barbell vs. Bullet Structure

- To increase convexity, the more distributed future cash flows of a barbell will have higher convexity, but lower yield.
- To decrease convexity, the more concentrated future cash flows of a bullet will have lower convexity, but higher yield.

Generally, shifting between barbell and bullet structures has only a modest impact on convexity, holding total duration the same. Options can have a much more dramatic impact on convexity.

Options on Bonds

- Long call options on bonds (or on bond futures contracts) increase in value as the underlying increases. Thus they provide increased upside as bond prices increase and rates decline. More upside means more positive convexity.
- Long put options on bonds (or on bond futures contracts) increase in value as the underlying decreases. Thus they reduce the downside as bond prices decline and rates increase. Less downside means more positive convexity.

To adjust convexity using bond options:

- Buy call and/or put options to increase convexity. The premiums paid to buy the options effectively reduce the yield earned on the portfolio.
- Sell call and/or put options to decrease convexity. The premiums received from selling the options effectively increases the yield earned on the portfolio.

Many portfolios have constraints that restrict the use of options. The use of bonds with embedded options can be an alternative way to adjust convexity.

Bonds with Embedded Options

- Callable bonds can be decomposed as an option-free bond and a short call position on the underlying bond. If rates decline the issuer’s right to call the bond increases in value and the price upside of the bond is limited. Thus the callable bond has diminished in value given its negative convexity (at lower rates) compared to an otherwise equivalent option-free bond. Callable bonds have a higher yield than an equivalent option-free bond.
- Mortgage backed securities (MBSs) behave in a similar fashion to a callable bond. Although the behavior of a pool of borrowers in an MBS is typically more difficult to predict than the behavior of a callable bond issuer, if rates decline, the borrowers have an incentive to prepay the mortgages. This limits the price upside of the MBS as rates decline. MBSs offer a higher yield than other bonds for equivalent duration and credit

quality.

- Putable bonds are the economic opposite of callable bonds. They can be decomposed into an option-free bond and a long put position on the underlying bond. If rates increase, the owner of the bond can put the bond to the issuer. The owner's right to put the bond increases in value and reduces the price downside of the bond as rates increase. Thus the putable bond has increased positive convexity (at higher rates) compared to an otherwise equivalent option-free bond. Putable bonds have lower yield than an equivalent option-free bond.

To alter portfolio convexity:

- Increase holdings of callable bonds and MBSs and/or decrease holdings of putable bonds to decrease convexity (and increase yield).
- Decrease holdings of callable bonds and MBSs and/or increase holdings of putable bonds to increase convexity (and decrease yield).

MODULE 20.4: CARRY TRADES

Video covering this content is available online.

LOS 20.b: Explain how to execute a carry trade.

CFA® Program Curriculum, Volume 4, page 140

As previously stated, "a carry trade is just another form of leverage. Return is enhanced by borrowing at a lower rate to invest the funds in an asset that will generate a higher rate of return." There are many ways to implement a carry trade.

1. In a stable upward sloping curve, the carry trade can be implemented by **borrowing at lower shorter-term rates to invest at higher longer-term rates**. The expected stability of the curve is important because if shorter-term rates increase, the cost of borrowing can rise enough to make the trade unprofitable. An even greater risk is increasing longer-term rates which lower the value and return on the longer-term bond that was purchased.

   This carry trade is also a form of a yield curve trade in that the interest paid depends on shorter-term rates and the return on the asset purchased depends on longer-term rates.
2. Another approach is to **borrow in a lower interest rate and invest in a higher interest rate currency**. *This was covered in the currency readings and is a cross-border trade involving two currencies.* There is again a risk that the borrowing cost can increase or asset value and return can decline. Changes in exchange rates add another risk in a dual currency carry trade. If the value of the currency invested in declines, it will take more of those currency units to repurchase and pay off the currency borrowed. A sufficient decline in currency value could offset the net positive expected interest earnings on the trade.

   The currency risk in such carry trades cannot be hedged because interest rate parity dictates that the currency with the higher yield will trade at a forward discount to the lower yield currency. If the currency were hedged, it would offset the short-term interest rate differential in the two countries.

A currency swap provides another way to achieve the results of a cross-border carry trade. Consider a cross-border trade of borrowing in currency X at 2% to invest in currency Y at 5%. There is no initial net investment but there are future cash flows. An alternative is to enter a currency swap to pay 2% on currency X versus receive 5% on currency Y. There is again no initial net investment because while notional principals are exchanged, that is done at the initial spot exchange rate so it has no initial net economic value. In both cases, the notionals must be paid back at the end and that does create risk if the currency to be repaid has increased in value.

The use of swaps introduces even more flexibility to structure the trade. Consider simultaneously buying a longer-term bond in a higher yield currency at a perceived attractive longer-term bond interest rate while simultaneously using the bond as collateral for a repurchase transaction to finance the bond purchase. The investor owns the bond and earns its return denoted R_{BHY} for return on a higher yield longer-term bond. On the repo, the investor pays the shorter-term interest rate for that higher yield currency, denoted r_{STHY}. This is just a standard borrow shorter-term to invest longer-term single currency carry trade. To make it a cross-border trade, enter a currency swap to receive r_{STHY} versus pay a shorter-term rate in a lower yield currency, denoted r_{STLY}. The net result is earn R_{BHY} versus pay r_{STLY}. The net result is an ability to invest at the highest perceived LT rate and pay the best perceived ST rate.

There is a common misconception that the forward exchange rate should be used as a valid prediction of how the value of a currency will change over time. The empirical evidence generally refutes this. Generally, the higher interest rate currency appreciates in value and that adds to the return of the higher yield currency invested in.

There is still currency risk in dual currency carry trades. In a market crisis, the higher yield currencies may well collapse in value and produce significant losses on the carry trade. If the carry trade has become highly popular and widely used, that can itself contribute to the crisis. A highly popular carry trade once involved borrowing at low JPY interest rates to invest in higher USD interest rates. However, if the USD started to decline for any reason, the investors in the USD security were at risk. They may move to sell the USD securities, use the USD to buy JPY, and repay the JPY borrowing, closing out the carry trade. But selling the USD to buy the JPY will itself drive down the USD and drive up the JPY. Selling the USD securities also drives down their price for others trying to exit the carry trade. This mass effort to unwind a trade has been called crowding risk. Carry trades do best in stable markets and can be very risky in highly volatile markets.

EXAMPLE 3: Dual currency carry trades

A U.S.-based investment firm is expecting stable economic and interest rate conditions. The firm wants to use carry trades to enhance expected return. The firm collects yield curve information on the U.S. and two foreign markets. All rates are annualized with semiannual payments.

Table A: Swap Fixed Rates versus LIBOR Flat

	6 month LIBOR	1 year	2 year	3 year
USD	0.8%	1.4%	1.5%	1.7%
AUD	1.0%	1.3%	1.2%	1.1%
EUR	0.4%	1.0%	1.5%	1.9%

A. **Determine** the most profitable carry trade that can be executed in a single market and the expected return over a 6-month period. **Show** your calculations.

B. **Determine** the most profitable dual currency carry trade that borrows and lends at the same point on the yield curve. **Calculate** its expected simple annual return.

After considering a variety of additional factors, the firm decides on a new carry trade to borrow at 6-month U.S. rates and invest at 3-year EUR rates.

C. **Discuss** *three* risks in this new carry trade. Your answer must discuss *both* currency and interest rate risks.

D. **State** how to structure a currency swap that could have been used to provide the same results as this new carry trade. Assume the currency swap is the only transaction to be used.

Answer:

A. In EUR, borrow at 0.4% to invest at 1.9%. Expected 6-month return is (1.9 – 0.4) / 2 = 0.75%.

In USD, the return is (1.7 – 0.8) / 2 = 0.45%.

In AUD, the return is (1.3 – 1.0) / 2 = 0.15%. Note that the best long position for the AUD market is in the 1-year bond.

B. Borrow for 3 years at 1.10% in AUD and invest for 3 years at 1.9% in EUR for an expected spread return of 80 bp per year. (Note the *next best* trade is borrow for 6 months at 0.4% in EUR and invest for 6 months at 1.0% in AUD for an expected spread return of 60 bp per year.) It also assumes you can roll the trade over for a second 6-month period at the same rates.

C.

- The EUR can depreciate, in which case, more EUR will be required to pay off the USD borrowing.
- If 6-month USD interest rates increase, the cost of borrowing will increase over time.
- If 3-year EUR rates increase, the value and return earned on the EUR asset will decline.

D. Pay 6-month USD LIBOR versus receive a 1.9% EUR fixed rate. The swap term is 3 years.

MODULE QUIZ 20.1, 20.2, 20.3, 20.4

To best evaluate your performance, enter your quiz answers online.

1. A bond trader wishes to overweight short and long maturities along the yield curve, while reducing holdings in the middle maturity securities, relative to the benchmark portfolio. This yield curve strategy will outperform a laddered portfolio strategy when the yield curve:
   A. flattens.
   B. steepens.
   C. remains the same.
2. A fixed-income portfolio manager wishes to increase portfolio convexity in order to address interest rate volatility. Portfolio convexity can be increased by:
   A. increasing the portfolio weights at both the long and short ends of the yield curve.
   B. shifting to lower convexity securities relative to those in the benchmark portfolio.
   C. selling calls on portfolio bonds and selling puts on bonds that the manager would like to own.
3. Which of the following carry trades will involve both yield curve and currency risk for a U.S.-based investor?
   A. A 5-year swap of USD fixed-rate payments for JPY 6-month LIBOR received.
   B. A 7-year swap of EUR fixed-rate payments for GBP fixed-rate received.
   C. Buy 6-year JPY fixed-rate bonds and short 6-year fixed-rate GBP bonds.

MODULE 20.5: DETERMINING AN OPTIMAL STRATEGY

Video covering this content is available online.

LOS 20.d: Formulate a portfolio positioning strategy given forward interest rates and an interest rate view.

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In some cases, the optimal strategy is less obvious and requires further analysis. Let's consider an example based directly on the CFA® exhibits in this reading, examining a universe of five default-free government bonds. Assume the manager can use any long-only allocation and at most 100% can be invested in any single bond. The assumed holding period is one year. For simplicity, all bonds are annual pay and priced at par (100).

Figure 20.1: Approaches to Selecting the Optimal Bond Strategy, Based on CFA Exhibits 18 and 19

		Assume stable curve		Manager forecast: 60 bp upward parallel shift			Implied forward yields and change	
Maturity	Coupon	Rolldown price (1)	Holding period return (2)	Yield (3)	Price (4)	Return (5)	Implied forward yield (6)	Implied yield change (7)
1 year	1.50%	100.00	1.50%	2.10%	100.00	1.50%	2.33%	+83 bp
2 year	1.91%	100.40	2.31%	2.51%	99.81	1.72%	2.61%	+70 bp
3 year	2.23%	100.62	2.85%	2.83%	99.46	1.69%	2.85%	+62 bp
4 year	2.50%	100.78	3.28%	3.10%	99.06	1.56%	3.07%	+57 bp
5 year	2.74%	100.90	3.64%	3.34%	98.67	1.41%	3.27%	+53 bp

PROFESSOR'S NOTE

This analysis is based on a large quantity of underlying calculations. The CFA® text includes, in small print, a comment that "calculating…is not the focus."

Profitable Strategies

1. Assume Yield Curve Is Unchanged

Under this assumption and a 1-year holding period, the 5-year bond is the best performing asset with a projected return of 3.64%. This is based on the assumption that in one year, when it is a 4-year bond, it will trade at a yield of 2.50%.

2. Yield Curve Moves as Forecasted

Under this assumption and a 1-year holding period, the 2-year bond is the best performing asset with a projected return of 1.72%.

The first two approaches clearly indicate that this is active management. Predict what you

think interest rates will do and you can predict what you think the best performing bond will be. You can, of course, come up with other forecasts of the curve that will lead to other conclusions.

A variant of approach 2 is to compare the manager's forecast yield with the implied forward yield. This will reach the same conclusion as approach 2. The manager is forecasting today's 2-year bond will trade at a yield 60 bp higher than the current 1-year bond (2.10% versus 1.50%). Compare this to the implied forward rate of 2.33% for the then 1-year bond; the manager predicts a lower ending yield for the bond. Said another way, the manager projects a yield increase of 60 bp to 2.1% versus the implied forward yield increase of 83 bp to 2.33%. The manager predicts less increase in yield, so the manager predicts a better return (1.72%) for the 2-year bond than the return implied by the forward curve. The manager's projected return is also better than the 1.50% return of today's 1-year bond.

- We can estimate the manager's projected return on the 2-year bond using duration and the projected yield changes. The manager predicts the then-1-year bond to trade at a yield 23 bp lower than the implied forward rate (+60 bp versus +83). That differential multiplied by the projected ending duration is a better relative price return: $0.23 \times 0.979 = +0.23\%$. Add the return of today's 1-year bond, and that is the manager's approximate projected return of $1.72\% \approx 0.23 + 1.50$.

The same situation exists for today's 3-year bond. The manager projects a yield increase of 60 bp to 2.51% versus 1.91%. The implied forward yield increase is 70 bp to 2.61%. The manager predicts less increase in yield, so the manager predicts a better return for the 3-year bond than the return implied by the forward curve. The manager's projected return is also better than the 1.50% return of today's 1-year bond.

- We can estimate the manager's projected return on the 3-year bond using duration and the projected yield changes. The manager predicts the then-2-year bond to trade at a yield 10 bp lower than the implied forward rate (+60 bp versus +70 bp). That differential multiplied by the projected ending duration is a better relative price return: $0.10 \times 1.93 = +0.19\%$. Add the return of today's 1-year bond, and that is the manager's approximate projected return of $1.69\% \approx 0.19 + 1.50$.

The same analysis and similar results apply to the 4-year bond.

For the 5-year bond, the analysis applies but the situation and results are different. The manager projects a yield increase of 60 bp to 3.10% versus 2.50%. The implied forward increase is only 57 bp to 3.07%. The manager predicts more increase in yield, so the manager predicts a lower return for the 5-year bond than implied by the forward curve. The manager's projected return is now less than the 1.50% return of today's 1-year bond.

MODULE 20.6: USING DERIVATIVES TO IMPLEMENT A YIELD CURVE STRATEGY

Video covering this content is available online.

LOS 20.e: Explain how derivatives may be used to implement yield curve strategies.

Derivatives often provide a more liquid and less costly alternative to adjusting portfolio duration through the purchase and sale of actual bonds. Given the relatively short life of most derivatives, this makes particular sense when making a temporary adjustment. It can also achieve higher or lower (negative duration) than is possible with unleveraged long-only bond positions.

As is generally the case with derivatives, there are multiple ways to achieve any desired change in duration. All strategies that produce the same net change in duration will be expected to perform the same way for a parallel shift in the curve. However the strategies may achieve the desired total change in duration using instruments tied to different points on the yield curve and they would not all perform the same for nonparallel shifts in the curve. **In general, the optimal strategy to profit from nonparallel shifts will:**

- Take long positions tied to points on the curve expected to show a relative decline in rates.
- Take short positions tied to points on the curve expected to show a relative increase in rates.
- Maintain the desired target total duration.

Changing Portfolio Duration With Futures:

- Buy fixed-income (bond) futures contracts to increase portfolio duration.
- Sell fixed-income (bond) futures contracts to decrease portfolio duration.

The number of contracts to use is:

N_f = desired change in PVBP / PVBP of the futures contract

PVBP (price value of a basis point) = value × MD × 0.0001

PROFESSOR'S NOTE

Whenever you see a reference to modified duration, the assumption is there are no embedded (or explicit) options. If the portfolio or bonds include option positions, then modified duration will not provide accurate estimates of price change and effective duration must be used. That means if you are given both modified and effective duration (and they are not the same) there are option positions present and you use the effective duration.

You may also see PVBP calculated as value × (MD / 10,000). This is the same thing mathematically and both calculate change in value for a 1 basis point change in interest rates. Additionally, you may see CFA authors calculate money duration as value × (MD / 100) which is equivalent to value × MD × 0.01. Either indicates change in value for a 1% change in interest rates.

Changing Portfolio Duration With Swaps:

- Enter a receive fixed (versus pay floating) swap to increase portfolio duration.
- Enter a pay fixed (versus receive floating) swap to decrease portfolio duration.

The notional principal of the swap to use is:

NP = desired change in PVBP / PVBP of the swap

PVBP of the swap is the difference between the fixed- and floating-side PVBPs

While any bond futures contract or swap can be used to adjust the portfolio duration, the duration of the contract or swap will determine what specific point on the yield curve the derivative will subsequently respond to. In other words, there is also an effect on exposure along the yield curve.

EXAMPLE 4: Adjusting duration with futures or swaps

Consider a $50 million portfolio with a modified duration of 7.27 and effective duration of 7.00. The manager wants to increase duration to 8. Because the portfolio contains bonds with embedded options, the manager focuses on effective duration and calculates the required increase in PVBP as (8 – 7) × 50 million × 0.0001 = 5,000.

The manager collects the following data on futures contracts and swaps:

Futures	Duration	PVBP of contract	
Bond contract	7.5	75.00	
Note contract	2.5	25.00	
Swap*	Fixed Side PVBP*	Floating Side PVBP*	Net PVBP*
5 year	0.0478	0.0025	0.0453
20 year	0.1561	0.0025	0.1536

* All swap PVBP are per 100 notional.

A. **Calculate** the number of note futures contracts (duration of 2.5) to buy to increase the portfolio duration to 8.

B. *If the manager expects the yield curve to flatten*, **explain** which futures contract will be optimal to use.

C. **State** whether to enter a pay or receive fixed swap to increase the portfolio duration to 8 and **calculate** the notional amount in millions. *Answer this question assuming the manager still expects the yield curve to flatten and will select the optimal swap to benefit from that view.*

D. **Calculate** the amount to borrow to increase the portfolio duration to 8 if the manager uses term (not overnight) repos with a duration of 0.25 and uses the repo funds to purchase bonds with a duration of 4.

Answers:

A. 5,000 / 25 = 200 to buy

B. Longer duration rates will decline relative to shorter duration rates increasing. That makes it better to buy the bond contract and be exposed to the relative decline in longer interest rates.

C. Receive fixed and use the 20-year swap to benefit from the manager's expectation of a relative decline in longer interest rates.

NP = 5,000 / 0.1536 = 32,552 hundreds = 3.255 million

D. The duration increase requires adding 5,000 in PVBP. Each dollar of new purchase adds duration of 4 partially offset by a dollar of liability with duration of 0.25. The net effect each dollar borrowed and invested is net 3.75 duration. On a 1 million purchase, that is a money duration addition of 1,000,000(4 – 0.25)(0.0001) = 375. To add 5,000 to portfolio PVBP, purchase (financed by borrowing) 5,000 / 375 = 13.333 million of bonds.

Changing Portfolio Convexity With Options

As we have already covered:

- Buying call options on bonds will increase portfolio upside if rates decline, thus increasing the portfolio's convexity.
- Buying put options on bonds will decrease portfolio downside if rates increase, thus increasing the portfolio's convexity.

- Selling call options on bonds will decrease portfolio upside if rates decline, thus decreasing the portfolio's convexity.
- Selling put options on bonds will increase portfolio downside if rates increase, thus decreasing the portfolio's convexity.

Any such strategy will normally involve keeping portfolio duration the same. To keep total PVBP the same, the par (value controlled) of the option will equal the par of the bond multiplied by the ratio of the PVBPs of the bond and option. Any excess cash or cash required is assumed to earn a short-term cash return with no duration.

EXAMPLE 5: Adjusting convexity with options

Assume the manager wants to increase portfolio convexity. The portfolio already owns 30-year Treasury bonds with a PVBP of 0.193 and has call options with a PVBP of 0.136.

A. **State** the transactions the manager will make using the two assets already in the portfolio and **calculate** the *ratio* of par amounts to be used in each of the two positions.

B. **Explain** why the manager will want interest rate volatility to increase or decrease and whether this needs to occur quickly or not.

Answers:

A. Sell the bonds and buy the calls. To keep duration the same, the par (controlled) of options purchased will be 0.193/0.136 × the par of bonds sold. Note that option premiums are small in relation to the bond value controlled so the net excess funds from the bond sale will be invested in cash.

B. Volatility must increase to make the options purchased more valuable and the sooner (more quickly) that occurs the less income will be lost from not owning the bonds.

MODULE QUIZ 20.5, 20.6

To best evaluate your performance, enter your quiz answers online.

1. A manager calculates the implied forward rate to exist in one year for today's 5-year bond to be 5.19%. That same 5-year bond yields 4.85% today and the 1-year bond today yields 3.5%. The manager's opinion is that interest rates will decrease and that in one year, 4-year bonds will yield 5.0%. Assume for simplicity that all the bonds and interest rates are zero coupon. The return that will be earned on the 5-year bond over the next year if the manager is correct is *closest to*:
   A. 2.75%.
   B. 4.25%.
   C. 5.00%.
2. A high-net-worth investor has a $25 million bond portfolio with a modified duration of 10. He would like to decrease the duration of his portfolio to 8. Assume that bond futures contracts needed for adjusting this duration have a price value of a basis point (PVBP) of $50. What is the amount of futures contracts needed to buy or sell to lower this portfolio's duration?
   A. Sell 50 bond futures contracts.
   B. Sell 100 bond futures contracts.
   C. Buy 100 bond futures contracts.

MODULE 20.7: USING KEY RATE DURATIONS TO DETERMINE OPTIMAL STRATEGY

Video covering this content is available online.

LOS 20.f: Evaluate a portfolio's sensitivity to a change in curve slope

using key rate durations of the portfolio and its benchmark.

CFA® Program Curriculum, Volume 4, page 151

Key rate durations (KRD) are also called **partial durations**. Like duration, they measure the sensitivity of change in value to yield change. Each KRD measures a bond's change in value for a change in a specific point on the yield curve. Like duration, KRD can also be expressed as PVBP, sometimes called a **partial** or **partial key rate PVBP**. Summing a bond or portfolio's KRDs and partial PVBPs closely approximates the bond or portfolio total KRD and PVBP.

Key rate durations are calculated for a variety of maturities, such as 2 years, 5 years, 7 years, 10 years, 20 years, and 30 years. If, for example, the seven-year key rate duration of a bond is 5.65, a 1% increase in the seven-year yield will result in a 5.65% decrease in the value of the bond.

Given a set of expectations of changes in yields across maturities, key rate durations can be used to calculate the effect on portfolio value if those expectations are correct. An expected change in the curvature of the yield curve is an example of a situation where the use of key rate durations would be advantageous.

The change in yield expected in each segment of the yield curve can be multiplied by each segment's key rate duration (with a negative sign) for that segment, and then by the value of the bonds in each segment, to get the effect of the expected yield change for each segment of the curve on portfolio value. Summing these will provide the overall impact of the expected yield curve changes on the portfolio. We could also use the PVBP based on the key rates at each maturity to obtain the same result.

DURATION-NEUTRAL CURVE TRADES

LOS 20.h: Construct a duration-neutral government bond portfolio to profit from a change in yield curve curvature.

CFA® Program Curriculum, Volume 4, page 175

Consider three portfolios with the same duration of 7 constructed from three government bonds with durations of 3, 7, and 11.

- An equal weighted ladder of 3, 7, and 11 duration bonds.
- A bullet with only the 7 duration bond.
- An equal weighted barbell of the 3 and 11 duration bond.

PROFESSOR'S NOTE

Unless there are specific changes in rates provided, assume a steepening and flattening curve refer to equal magnitude, but opposing relative changes in the shorter and longer end of the curve. For example, a steepening could be 3, 7, and 11 duration bond yields increasing 0, 40, and 80 bp respectively. A flattening could be 3, 7, and 11 duration bond yields decreasing 0, 40, and 80 bp respectively.

- Steepening Curve: The bullet is the best with no exposure to the relative large increase in rates for the higher duration bond. The barbell is the worst with the greatest relative exposure to the large increase in rates for the higher duration bond.
- Flattening Curve: The barbell is the best with the greatest exposure to the relative large decrease in rates for the higher duration bond. The bullet is the worst with no exposure to the relative large decrease in rates for the higher duration bond.

Now consider an increase or decrease in bond curvature with the intermediate rate increasing or decreasing relative to the longer and shorter rate.

- Increasing curvature: The barbell is the best with no exposure to the relative increase in intermediate rates. The bullet is the worst with 100% exposure to the relative increase in intermediate rates.
- Decreasing curvature: The bullet is the best with 100% exposure to the relative decrease in intermediate rates. The barbell is the worst with no exposure to the relative decrease in intermediate rates.

Butterfly trades are a leveraged way to capture value when curvature changes. They involve taking a long and offsetting short position in the bullet and offsetting barbell. The short position funds the long position so no investor capital is required. The long and short duration cancel each other for a 0 net duration. Butterfly trades profit primarily from change in curvature.

A butterfly portfolio shorting intermediate-term bonds (borrowing at intermediate rates) and investing the proceeds in the barbell portfolio is like a super barbell. This can be called short the body (intermediate) and long the wings (barbell).

- It profits from increasing curvature.
- It also has net positive convexity and profits from high volatility. Recall the barbell with more disperse cash flow will have greater convexity than the concentrated cash flow short bullet position. Thus, long the barbell convexity less short the bullet convexity will be net positive convexity.

A butterfly portfolio shorting the barbell portfolio (borrowing at a combination of shorter and longer rates) and investing the proceeds in intermediate-term bonds is like a super bullet. This can be called short the wings and long the body.

- It profits from decreasing curvature.
- It also has net negative convexity and profits from having higher yield. Recall that in a rational market the compensation for giving up convexity is higher yield, all else the same.

Condor trades work the same and are evaluated the same as butterfly trades. The only modification is that two positions with relatively close duration are used for the bullet. For example, a super bullet butterfly could be constructed as long the 7 duration and short the 3 and 11 duration wings. A condor is similar but could use an equal weighted combination of long the 6.5 and 7.5 duration instead of a single long 7 duration position. The wings would

remain as short the 3 and 11 duration.

MODULE QUIZ 20.7

To best evaluate your performance, enter your quiz answers online.

1. Which of the following statements regarding the use of key rate durations to evaluate a portfolio's sensitivity to yield curve changes is *least correct*?
   A. Key rate durations are often used with barbell and bullet strategies.
   B. Key rate durations are advantageous when there is a nonparallel shift in the yield curve.
   C. The sum of all key rate durations must be less than the effective duration of the bond or portfolio.
2. A manager must construct a portfolio using government bonds with durations of 3, 5, and 7. Her default portfolio is an equally weighted ladder of the three bonds with a portfolio duration of 5. She can also use bullet, barbell, and butterfly portfolios, as long as the duration is still 5. Her forecast is that intermediate-term (duration of 5) rates will increase relative to the shorter and longer ends of the yield curve. She would *most likely* conclude:
   A. a barbell portfolio will outperform the bullet.
   B. the greater convexity of the ladder will lead it to outperform the bullet.
   C. a butterfly portfolio long in the body and short in the wings will outperform the ladder.

MODULE 20.8: INTER-MARKET CURVE STRATEGIES AND CONCLUSION

Video covering this content is available online.

LOS 20.g: Discuss inter-market curve strategies.

CFA® Program Curriculum, Volume 4, page 179

A manager can examine multiple markets and expected changes in each curve to select the optimal strategy. Such strategies may also be constrained to zero duration and zero net cash invested long/short approaches. Basic inter-market strategies include:

- Using a swap with payments made in the portfolio's domestic currency. This will avoid currency risk. (Note: the swap rate has embedded in it the hedged foreign currency risk from the forward currency market. That is why there is no currency risk.) For a swap based approach, you would generally:
  - Receive the rate at the end of a steeper segment of a yield curve. This would maximize initial yield and expected roll down return. (Alternatively, the manager can make some other set of assumptions to project and select the highest expected return.)
  - Pay floating based on the rate at a lower flatter segment of the yield curve.

  This would be a simple carry trade. If either or both rates are not based on the portfolio's domestic yield curve, this becomes an inter-market curve trade.

- Alternatively, use bond positions:
  - Buy a bond in one market at the end of a steeper segment of a yield curve to maximize initial yield and expected roll down return.

- Short (borrow and pay the floating rate) in another market at a lower flatter segment of that yield curve.

Such bond-based trades will earn the local market (RFC) return of each market and also be exposed to changes in value of the foreign currency/currencies. That currency risk and return (RFX) can be hedged in the forward currency market or left unhedged.

PROFESSOR'S NOTE

The CFA text includes ample warnings that inter-market trades can be very complex to analyze and that real world application can differ in details from what is presented in the CFA text. As the number of markets and points on the curve being considered are increased, the solutions can only be found using optimization software. Despite these caveats, the basic concepts you should know are covered in the following inter-market curve trade example. You should also quickly see the optimal strategy depends on the assumptions made.

EXAMPLE 6: Inter-market curve trade

A U.S.-based portfolio manager examines the following information regarding the yield curve in three markets. All yields are annualized and coupons are assumed to be semiannual.

	6 month LIBOR	1 year	3 year	5 year
U.S. (USD)	1.20%	1.40%	1.50%	1.50%
U.K. (GBP)	1.40%	1.80%	2.00%	2.10%
Germany (EUR)	–0.4%	0%	0.1%	0.2%

The manager expects the GBP and EUR to appreciate 1% and 0.75% respectively against the USD over the next 6 months.

A. For a USD-based portfolio, **state** which of the following unhedged currency carry trades will have the expected highest return for a 6-month holding period. **Show** your calculations. Assume any bonds trade at their initial YTM at the end of the 6-month holding period.

1. Buy the U.S. 3 year and borrow at the most appropriate German rate.
2. Buy the U.S. 5 year and borrow at the most appropriate U.S. rate.
3. Buy the U.K. 5 year and borrow at the most appropriate German rate.

B. For the same USD portfolio and using the same data the manager now considers duration and currency neutral long/short trades, **determine** the optimal trade. **Show** your calculations on an annualized basis. Again, assume any bonds trade at their initial YTM at the end of the holding period.

C. The manager now revises the assumptions regarding what will happen to the 5-year U.K. bond. It is projected interest rates in the U.K. will decline from the initial bond YTM of 2.1% and the 5-year bond (when it is a 4.5-year bond) will trade to yield 1.8%. It is initially a par bond with a coupon of 2.10, so its price 6 months later when it is a 4.5-year bond at a 1.8% YTM will be 101.29 (this can be calculated as: n = 2 × 4.5 = 9, FV = 100, PMT = 2.1 / 2 = 1.05, i/y = 1.8 / 2 = 0.9). All other factors are the same. **Calculate** the currency hedged and currency unhedged return of the three markets. Assume the only position is long the 5-year bond. You must calculate return for all three markets both with and without a currency hedged. Assume interest rate parity applies and determines the currency hedged position. **Show** your calculations for a 6-month holding period.

Answer:

A. The carry for #1 over half of a year is (1.5 – (–0.4)) / 2 = +0.95%. The best German borrowing rate is the lowest rate of –0.4%. However, the USD-based portfolio is short the EUR as the EUR borrowing must be repaid and will lose the 0.75% appreciation in the EUR. Currency change is a periodic projected return, not an annualized number. That makes the projected return +0.95 – 0.75 = 0.20%.

The carry for #2 over half of a year is (1.5 – (1.2)) / 2 = +0.15%. There is no currency exposure so that is the projected return.

The carry for #3 over half of a year is (2.1 – (–0.4)) / 2 = +1.25%. The best German borrowing rate is the lowest rate of –0.4%. However, the USD-based portfolio is short the EUR as the EUR borrowing must be

repaid and will lose the 0.75% appreciation in the EUR. The portfolio is also long the GBP in the U.K. bond owned and will gain the appreciation in the GBP of 1.0%. That makes the projected return +1.25 – 0.75 + 1.0 = 1.50%.

Trade 3 is best at an expected return of 1.5%.

B. To be duration and currency neutral, the manager will buy at the longest point and sell at the shortest point of the steepest curve to maximize carry. Buy the U.K. 5 year at 2.1% and borrow at the U.K. 6-month rate of 1.4%. The carry is 70 bp. There is no net currency exposure with a long and short GBP position, but there is a net long duration position.

To neutralize duration exposure, buy at the shortest point and sell at the longest point of the flattest curve to minimize the carry lost while also netting to zero duration on the four positions. (Note that the CFA material is making the reasonable assumption that bonds with the same maturity but in different markets have the same duration.) The U.S. curve is the flattest at +30 bp so sell the U.S. 5 year at 1.5% and buy the U.S. 6 month at 1.2%

Net annualized carry is: +2.1 + 1.2% –1.4 – 1.5 = 0.4%. This question directed to work in annualized results.

C.

U.S.: With the bond continuing to trade at the initial YTM, half the initial YTM is the 6-month local market return: 1.5 / 2 = 0.75%. There is no currency return for a U.S. portfolio.

U.K.: Projected local market return is the 6-month coupon + ending price divided by beginning price: ((2.1 / 2) + 101.29) / 100 = 2.34%. If the currency is unhedged, it is assumed to appreciate 1.0% for a total return of 3.34%.

- The GBP with a higher 6-month interest rate of 1.4% versus the U.S. rate of 1.2% will trade at a forward discount. The periodic forward discount is (1.4 – 1.2) / 2 = 0.1%. The total currency hedged return will be 2.34 – 0.10 = 2.24%.

Germany: Projected local market return for 6 months is half the initial YTM = 0.2 / 2 = 0.1%. If the currency is unhedged, it is assumed to appreciate 0.75% for a total return of 0.85%.

- The EUR with a lower 6-month interest rate of –0.4% will trade at forward premium of (1.2 – (–0.4)) / 2 = 0.8. The total currency hedged return will be 0.1 + 0.8 = 0.9%.

PROFESSOR'S NOTE

An easy way to keep the forward premium or discount rate effect straight is that you lose the interest rate of the currency sold forward and gain the interest rate of the currency bought forward. That is not literally what happens, but it is mathematically correct when interest rate parity applies because the difference between the forward and spot exchange rates will reflect the difference in the two interest rates. The interest rates to use are the periodic rates that apply to the term to expiration of the forward.

Also the CFA text does include negative interest rates as you see in our discussion. We have illustrated how to handle such rates. The underlying mechanics are that:

- Paying a negative rate means receive that rate.
- Earning a negative rate means pay that rate.

EVALUATING EXPECTED RETURN FOR A YIELD CURVE STRATEGY

LOS 20.i: Evaluate the expected return and risks of a yield curve strategy.

CFA® Program Curriculum, Volume 4, page 201

A general framework for analyzing the effect of expected changes in the level, slope, and

curvature of the yield curve can be developed by focusing on the three sources of portfolio return over a horizon period. A one-year analysis period is commonly used. Project the following:

1. Interest income.
2. The price returns from securities rolling down the current yield curve for one year.
3. The price returns from the expected (manager-predicted) changes in the yield curve.

In some cases, returns from exchange rate changes and the returns from changes in credit ratings must also be considered.

By summing these returns for securities in the benchmark portfolio and for those in a manager's portfolio and comparing them, we can estimate the relative performance of the manager's portfolio over the next year.

MODULE QUIZ 20.8

To best evaluate your performance, enter your quiz answers online.

1. A bond investor purchases a 10-year bond paying a 5% coupon rate on an annual basis with a current bond price of $100. Over the next year, the rolldown return from rolling down the yield curve to the expected yield curve is computed as 2.1%. In addition, the expected change in price based on the investor's yield view is –0.35%. What is the total expected return from this yield curve strategy?
   A. 6.75%.
   B. 7.10%.
   C. 7.45%.
2. A manager examines the yield curves in multiple countries and calculates the spread in each market between the 10-year and 6-month interest rate. Those spreads are:

	10-year – 6-month rate
U.S.	45 bp
Germany	77 bp
Japan	63 bp
Australia	81 bp

   Which of the following is part of the *most likely* trade the manager will use to implement a duration and currency neutral long/short trade?

   A. Buy a German 10-year bond.
   B. Enter a 10-year swap to pay the U.S. fixed rate.
   C. Short the Japanese 10-year bond.

KEY CONCEPTS

LOS 20.a

Active Strategies When the (Upward Sloping) Yield Curve Is Expected to Be Stable

- Buy and hold—extend duration to get higher yields.
- Roll down the yield curve—portfolio weighting highest for securities at the long end of the steepest yield curve segments, maximizes price gains on securities from declines in yield as time passes.
- Carry trade—borrow at lower rates to purchase securities with higher rates.
- Sell convexity—reduce portfolio convexity to increase yield.

Active Strategies for Anticipated Changes in Yield Curve Level, Slope, or Curvature

- Duration management—increase (decrease) portfolio duration if rates are expected to decrease (increase).
- For nonparallel shifts in the curve—increase (decrease) portfolio exposure to key rate durations where relative decreases (increases) in key rates are expected.
- Buy convexity—increase portfolio convexity; decreases yield but improves price performance for larger changes in rates.
- Bullet and barbell structures—security durations are concentrated around portfolio duration (bullet) or concentrated at the ends of the yield curve (barbell). Barbells tend to have higher convexity but lower yield and tend to outperform if curvature increases.

LOS 20.b

To execute a carry trade in an upward sloping yield curve:

- Borrow at shorter-term lower rates and invest at longer-term higher rates.
- Enter a swap to pay floating versus receive fixed.

For a basic cross-border carry trade with a duration mismatch:

- Borrow in a lower interest rate currency to invest in a higher interest rate currency, keeping duration the same in both markets. (Note there is still a risk the interest rate changes in the two positions could differ even though the durations are the same.)
- Use a currency swap to pay the lower rate and receive the higher rate.

LOS 20.c

Convexity matters more for larger changes in rates. When a manager is correct in expecting yield volatility to be greater (less) than current market expectations, increasing (deceasing) portfolio convexity will improve portfolio performance.

Portfolio convexity can be increased (decreased) by shifting to a barbell (bullet) strategy by buying (selling) call options on bonds. Convexity can also be decreased by replacing straight

bonds with MBSs and callable bonds to increase yield.

LOS 20.d

To select the optimal bond off the yield curve:

- Project ending (manager's projected) yield of each point on the curve and use the ending yield of each bond to project its ending price.
- Project holding period return as the percent change in price + coupon yield.
- This is pure active management; select the bond with highest projected holding period return.

Projected holding period return for each bond can be approximated as:

(–ending effective D × manager's forecasted change in YTM) + beginning YTM

Comparing the manager's forecast of YTM to the implied forward rate is also useful. When the manager's forecast is:

- Lower, the bond will outperform.
- Higher, the bond will underperform.

LOS 20.e

Price value of a basis point (PVBP) = 0.0001 × duration × portfolio value. PVBP may be divided by 100 for PVBP per hundred of portfolio value.

Portfolio duration can be increased by adding bond futures to the portfolio.

$$\text{number of futures contracts to buy} = \frac{\text{target portfolio PVBP} - \text{current portfolio PVBP}}{\text{PVBP futures contract}}$$

Taking the pay-floating side of an interest rate swap increases duration. It is equivalent to borrowing at a short-term rate and buying fixed-rate bonds.

Adding bond call options to a portfolio will increase both its duration and convexity.

Convexity can be decreased by selling bond calls or by replacing portfolio bonds with MBSs because the embedded prepayment option in MBSs gives them negative convexity.

LOS 20.f

Key rate durations are similar to duration, but measure expected price change if only one point on the yield curve changes. The effect of expected change in the slope or curvature of the yield curve can be modeled using key rate durations. Multiply each key rate duration by expected change in each key interest rate by portfolio value at each key interest rate. The sum of these calculations is the expected change in value of the portfolio. The manager can repeat this exercise for different portfolio compositions and then implement the composition with the best expected return.

LOS 20.g

Inter-market carry trades can be implemented by:

- Borrowing in a lower interest rate currency to invest in a higher interest rate currency.
- Using a currency swap to pay that lower rate and receive that higher rate.
- In the market with higher rates, borrowing at shorter lower rate end of the curve to invest at the longer higher rate end of the curve. Plus, enter an FX swap to receive the same shorter-term rate (being paid on the borrowing) versus pay the rate of a lower interest rate currency.

To avoid having a currency risk exposure on the inter-market trade:

- Use swaps and enter a receive fixed versus pay floating in the steeper yield curve market. Plus, enter an offsetting swap to receive floating versus pay fixed in the flatter yield curve market.
- Use bonds to replicate the economic exposures of the four positions taken with the two swaps.
- Buy bond futures in the steeper curve market and sell note futures in the flatter curve market. (If the contracts settle in the investor's currency, there is no currency exposure.)

LOS 20.h

These strategies presume portfolio duration is kept the same. To increase portfolio return when yield curve curvature will:

- Increase, use a barbell strategy.
  - A butterfly portfolio, short intermediate-term bonds and long the barbell will be even better.
- Decrease, use a bullet strategy.
  - A butterfly portfolio, short the barbell and long intermediate-term bonds will be even better.

LOS 20.i

A general framework for analyzing the effect of expected changes in the level, slope, and curvature of the yield curve focuses on projecting three sources of portfolio return over an analysis period. A one-year horizon analysis is common. Project the following:

1. Interest income.
2. The price returns from securities rolling down the current yield curve for one year.
3. The price returns from the expected (manager-predicted) changes in the yield curve.

Repeat the process for both the portfolio and benchmark; the difference in the two projected returns is the expected value added by active management.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 20.1, 20.2, 20.3, 20.4

1. **A** This is a barbell strategy of overweighting short and long maturities while reducing holdings in middle maturity securities, relative to the benchmark portfolio. The higher duration of longer securities will produce large relative gains in value if longer-term rates decline. A flattening curve is the best environment for a barbell. A yield curve flattens when long maturity yields decline relative to short maturity yields. (Module 20.2, LOS 20.a)

2. **A** Portfolio convexity can be increased by shifting to higher convexity securities relative to those in the benchmark portfolio. Alternatively, a manager can increase the portfolio weights at both the long and short ends of the yield curve (a barbell strategy). One way to decrease portfolio convexity is to sell calls on portfolio bonds and sell puts on bonds that the manager would like to own. (Module 20.3, LOS 20.c)

3. **A** The 5-year swap has curve risk with a 5-year rate versus a floating 6-month rate. That is yield curve risk. One side of the swap is in JPY so there is currency risk for the U.S. investor.

   The 7-year swap is fixed for fixed (and both fixed rates will reflect the 7-year term of the swap) so there is not yield curve risk. Note that the 7-year rates in the two countries could change by differing amounts, but that is considered a spread risk and not a duration mismatch (curve position) risk.

   The 6-year bond trade is also fixed for fixed, so no yield curve risk, though again there is spread change risk. (Module 20.4, LOS 20.b)

Module Quiz 20.5, 20.6

1. **B** If implied forward rates occur, all bonds will earn the same return over the forward period being analyzed. In this case, that period is one year, so the return will equal the return of today's one year bond (i.e., 3.5%). The manager projects the yield of today's 5-year bond when it is a 4-year bond will be 5% and not the implied forward rate of 5.19. This 19 bp lower rate will increase the bond's return. It will then have a duration of approximately 4, so the return increase is 19 × 4 = 76 bp. That makes the projected return approximately 3.5 + 0.76 = 4.26%. (Module 20.5, LOS 20.d)

2. **B** The PVBP of the current portfolio (duration of 10) is 0.0001 × modified duration × portfolio value = 0.0001 × 10 × 25 million = $25,000.

   The PVBP of the adjusted portfolio (duration of 8) is 0.0001 × 8 × 25 million = $20,000.

   Therefore, we need to sell: $5,000 / $50 = 100 bond futures contracts to decrease the bond PVBP from $25,000 to $20,000. (Module 20.6, LOS 20.e)

Module Quiz 20.7

1. **C** The sum of all key rate durations must be approximately equal to the effective duration of the bond or portfolio. Key rate durations are often used to identify barbell and bullet strategies. An expected change in the curvature of the yield curve is an example of a situation where the use of key rate durations would be advantageous. (LOS 20.f)

2. **A** The barbell will have no exposure to the 5 duration where rates are relatively increasing. It should outperform the bullet, which is all 5 duration.

   While it is true the ladder will have more convexity than the bullet, that is only a benefit for large changes in the overall level of rates. This is not the forecast. The ladder will have less exposure to the 5 duration and will outperform the bullet due to the forecast reshaping; but in this case, it is not convexity that would lead the ladder to outperform the bullet. A butterfly can be used, but the one offered is precisely the wrong butterfly. Going long in the body creates relative losses when the 5 duration rate relatively increases, and going short in the wings creates more relative losses when the 3 and 7 duration rates relatively decrease. Remember, rates down, price up, which is a loss to a short position. Note that a butterfly of short the body and long the wings is likely the optimal strategy in this environment. (LOS 20.h)

Module Quiz 20.8

1. **A** Expected return can be computed as yield income + rolldown return + E(change in price based on yield view). Yield income is computed as annual coupon payment / current bond price. Therefore, the total expected return = 5 / 100 + 2.1% – 0.35% = 5% + 2.1% – 0.35% = 6.75%. (LOS 20.i)

2. **B** To maximize the expected profit of this cross-border carry trade, the manager will do the following: buy the Australian bond and finance at 6-month Australian rates (Australia, at 81 bp, has the steepest curve), while selling the U.S. bond and invest at the 6-month U.S. rate (the U.S., at 45 bp, has the flattest curve). The manager is net long and short each currency, as well as long and short the 6-month and 10-year points on the curves. The expected return is +81 – 45 = 36 bp.

   Buying a German bond is not part of the strategy. Neither is shorting a Japanese bond. However, a 10-year swap to pay the U.S. fixed rate is economically equivalent to shorting (or borrowing) at the 10-year U.S. rate and that is part of the strategy. (LOS 20.g)

The following is a review of the Fixed-Income Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #21.

READING 21: FIXED-INCOME ACTIVE MANAGEMENT: CREDIT STRATEGIES

Study Session 8

EXAM FOCUS

Last, we turn to ways to add value by altering exposure to credit risky positions.

MODULE 21.1: IG VS. HY AND MEASURING SPREAD

Video covering this content is available online.

The *credit market* refers to all securities where credit risk is an important issue. High-quality government bonds from well-developed countries are generally assumed to have no credit risk and are excluded from the credit portfolio. The remaining credit risky instruments may be public or private issues. Publicly traded issues include corporate bonds, other sovereign, and non-sovereign government and supranational (international agencies with powers delegated by governments) bonds as well as money market instruments such as commercial paper. Non-public issues include loans and private placements. Structured instruments such as mortgage and asset-backed securities and collateralized debt obligations may be public or private.

Investment-grade (IG) bonds are defined as ratings above BB. These would be Moody's investment ratings of Aaa to Baa3. Standard & Poor's and Fitch use AAA to BBB-. Such bonds generally have lower credit and default risk as well as lower yield and yield spread.

High-yield (HY) bonds are all bonds rated below investment-grade. They are also called *speculative grade* or *junk bonds*.

Although the public rating agencies are a good starting point for credit analysis, individual analysts normally make their own assessments and may reach different conclusions. Even so, the portfolio constraints often specify minimum credit quality requirements, based on the public ratings. In particular, many portfolios are prohibited from owning below investment grade bonds.

Both the rating agencies and analysts typically follow a similar approach to credit evaluation, assessing the four Cs. These are *capacity* to pay, *collateral* that can be claimed if the bonds default, *covenants* that restrict the actions of the issuer, and *character*, which is the quality and integrity of the issuer. The *capital* behind the issuer may be considered a fifth C.

LOS 21.a: Describe risk considerations in investment-grade and high-yield corporate bond portfolios.

The specific forms of risk exposures in any specific bond can vary substantially. The major risks are the following:

Credit risk is narrowly defined here as loss caused by a counterparty's or debtor's failure to pay. It has two components: **default risk** and **loss severity** (or **loss given default**). Default risk is the probability that an issuer will not make timely payment of principal and interest, and loss severity is the percent of par not paid if there is a default. For example, if a group of bonds has an annual 2% probability of default and a 40% loss severity, the annual credit risk loss estimate would be $0.02 \times 0.40 = 0.8\%$.

Spread risk refers to decline in price relative to credit risk free bonds due to spread widening. **Credit migration risk** refers to the risk a bond can decline in credit quality and bond rating. It should be obvious that these terms are interrelated; as credit quality declines, rating is likely to decline, spread is likely to widen with probability of default and likely losses increasing.

Credit risk is often used as a broad term to refer to all of these issues. Recall some earlier formulas that indicate why general interest rate and spread change are important:

- $\%\Delta \text{ value} = -\text{MD } \Delta y$
- $\%\Delta \text{ relative value} = -D_S \Delta s$
- $\text{spread} = y_{\text{higher yield}} - y_{\text{government}}$

Analysts and managers generally use interest rate risk to refer to changes in default-free (risk-free) government bond yields that are used as the reference rates to determine spread. An option-free bond's modified duration measures its change to general interest rate movement while its **spread duration** measures its price change if only spread (due to credit risk) has changed. The two concepts allow decomposing two sources of change in a bond's price as its yield changes due to risk-free rate and spread change.

For most bonds, modified duration and spread duration are the same. The important exception is floating rate securities, which have little duration but can have high spread duration. Consider an issuer with a 10-year fixed coupon bond and a 10-year floating rate bond.

- The 10-year fixed coupon bond has modified and spread duration of 9.1. If either risk-free rates or spread increase by 20 bp, the bond's price is expected to decline 1.82%. The effect is the same because future cash flows of the bond are fixed, regardless of why the yield changed.
- The 10-year floating rate bond has modified and spread duration of 0.25 and 9.1 respectively. If risk-free rates increase by 20 bp, the bond's price is expected to decline only 0.05%. The price is insensitive to the rate change because the future coupons adjust upward with the rate increase. (The duration is tied to the next coupon reset date when the bond should trade at par as the coupon rate adjusts.) In contrast, if spread increases by 20 bp, the bond's price is expected to decline 1.82%. The reason is the coupons only adjust for general change in rates and not for specific spread change related to this issuer. The coupon spread can only be renegotiated when the bond

matures, so spread duration is tied to final maturity, not coupon reset.

In theory, IG and HY would respond similarly to credit and interest rate risk, but in practice their sensitivity is quite different. The different behavior is due to a large differential between the credit risk and spread of IG versus HY, and a generally negative correlation between risk-free rates and spread.

- In a study by Moody's covering 1983 to 2015, annual credit losses in IG were only 0.06% versus 2.55% for HY. The annual loss in IG ranged between 0.00% and 0.42%. For HY, the annual loss range was between 0.42% and 7.61%.
- Because spread reflects compensation for taking credit risk, the much higher credit risk in HY is reflected in much higher spread. In a Barclays Capital study covering 2001 to 2015, spread for IG was typically well below 200 bp, spiking to +400 bp in the 2008 to 2009 financial crisis. In contrast, spread for HY was much higher and more volatile, reaching a low of 200 bp in 2007 and a high of over 1600 bp in the financial crisis.

It has also been observed that risk-free rates and spread often move in opposite directions (i.e., are negatively correlated). This makes sense because stronger economic conditions often lead to increasing risk-free rates but decreasing risk of default, increasing credit ratings, and lower spreads. The lower spreads increase bond price. Weaker economic conditions often lead to decreasing risk-free rates but increasing risk of default, decreasing credit ratings, and wider spreads. The higher spreads decrease bond prices. This canceling effect is most pronounced for HY, and as a result, their price change is driven more by spread change than the changes in risk-free interest rates.

This effect is captured in differences between effective and empirical duration.

- Effective duration is based on how the PV of a bond's future cash flows (i.e., its price) should change as the bond's yield (i.e., discount rate applied to the future cash flows) changes. For option free bonds, this is the modified duration. For bonds with embedded option, it is option adjusted duration that takes into account the most likely future cash flows of the bond.
- **Empirical duration** is based on regression of actual bond price and interest rate changes.

A Barclays Capital and Wellington Management study showed the two measures are not equal and the difference was most pronounced for HY bonds.

- For IG, the empirical durations were lower than effective durations and the difference increased moving down in credit rating from Aaa to Baa.
- For HY, the differences increased dramatically with empirical duration near 0 for Ba and B rated bonds. For Caa rated bonds empirical duration was negative. That means that a general increase in interest (risk-free) rates was associated with such large declines in spread that the yield on such bonds declines and their prices increased as other interest rates increased and other bond prices declined.

The conclusions are that the IG investors are primarily exposed to interest rate risk, with secondary exposure to credit and spread risk. In contrast, HY investors face little interest rate

risk (as measured by modified or effective duration) but are much more exposed to credit and spread risk. Despite the general conclusions, both groups need to be aware of both risks. For example, IG investors who fail to broadly diversify credit risk could be exposed to significant credit risk if one holding defaults or experiences spread widening. The HY investor needs to recall that the general observation of spread and interest rate changes offsetting is not an absolute relationship and does not hold in all periods. For example, if spreads were already narrow and the economy continues to improve, spread is unlikely to change any more and risk-free rates are likely to increase, causing both IG and HY bond yield to increase and price to decrease.

Liquidity risk is generally defined as the ability to buy or sell quickly at near fair market value. Liquidity and trading risks in IG and HY differ and all of the relevant factors indicate more risk for HY. Those factors include the following:

- Bid-ask spread is wider for HY because the size of the bond issues and overall market is smaller.
- Regulatory and risk management issues are greater for HY, resulting in dealers being less willing to hold HY positions in inventory.

As a result, it is more costly to trade and therefore turnover is lower in HY portfolios. This also affects starting new portfolios. A manager with existing HY portfolios who starts a new portfolio is often unable to replicate the same existing holdings and must find substitute bonds. This is also true for IG portfolios, but to a lesser degree.

These differences affect how bond prices are quoted. The price for an IG bond is normally given as a spread to benchmark government bonds. For example, the bond is offered at the Treasury yield +75 bp. That YTM is then converted to price paid. In contrast HY bonds are generally quoted as a price [e.g., 97.50 (per 100 par)].

CREDIT SPREAD MEASURES

LOS 21.b: Compare the use of credit spread measures in portfolio construction.

CFA® Program Curriculum, Volume 4, page 252

As already discussed, bond price change can be differentiated into change due to general changes in interest rates (risk-free rates) and credit spread change. There are several ways to measure credit spread.

Benchmark spread is the difference in YTM of a bond and a similar duration credit risk-free benchmark bond. The on-the-run government bond is typically used. Generally, there are only a limited number of such government bonds and a straight line interpolation of YTM is made between the two closest bracketing duration government bonds. That interpolated yield is used as the benchmark and the resulting spread is called the **G-spread**. The G-spread is useful because it directly reflects how to hedge the interest rate risk and retain the credit spread of the bond. It is not useful when the bonds have embedded options.

EXAMPLE: G-spread

A manager gathers the following information on three bonds. He plans to buy 1 million par of the corporate bond.

	Price	Yield (YTM)	Maturity	Effective D
7-year corporate bond	101.50	3.77%	6.7	6.1
5-year government bond	99.96	1.90%	4.9	4.7
7-year government bond	99.56	2.20%	7.0	6.5

The manager is aware that there is some controversy in the industry regarding whether it is best to compute G-spread by matching maturity or duration. Maturity has often been used and is regarded as simpler. Some theoretical arguments favor an interpolation based on duration as more accurate. The analyst has determined the difference in the two methods is not generally large and favors the more traditional "use maturity" approach.

1. **Calculate** the initial benchmark (G-spread) of the corporate bond based on interpolated maturity matching.
2. **Calculate** the hedge position to eliminate interest rate risk for the 1 million par of the corporate bond and **calculate** the expected return on the hedged position.

   After buying the corporate bond, the yield of the 5- and 7-year government bonds increase 10 and 15 bp respectively, while the corporate bond's yield spread declines 3 bp.
3. **Estimate** the new price of the corporate bond.

Answers:

1. Determine the weight of the two government bonds; the weight in the 5-year government bond is denoted as w:

   $6.7 = w(4.9) + (1 – w)(7.0)$

   $6.7 = 4.9w – 7.0w + 7.0$

   $0.3 = 2.1w$

   w = 14.3% in 5-year government bond and 85.7% in 7-year government bond

   That makes the benchmark yield: 0.143(1.90%) + 0.857(2.20%) = 2.16% and spread: 3.77 – 2.16 = 1.61%
2. Cost of the purchase is 1 million × 101.50 / 100 = 1,015,000.

   Short the 5-year and 7-year government bonds (market value amount) equal to 14.3% and 85.7% of 1,015,000 respectively.

   Expected return: yield purchased – yield shorted = 3.77 – 2.16 = 1.61%
3. Expected change in benchmark yield = 0.143(10) + 0.857(15) = +14.3 bp

   Expected change in corporate bond yield = 14.3 – 3 bp = +11.3 bp

   Estimated price change of corporate = –6.1(0.00113) = –0.0069 = –0.69%

   Estimated new price: (1 – 0.0069)(101.50) = 100.80

The **I-spread** is computed and used the same way as the G-spread but is based on swap fixed rates as the benchmark yields. The advantages are a smoother yield curve because swap fixed rates (SFR) are quoted for many different maturities compared to only a few on-the-run government yields. There can be disadvantages. First, spread is intended to be a comparison

to a credit risk free benchmark rate. SFRs normally reflect very high quality (but not fully credit risk free) rates. Under normal economic conditions the SFR serves as a reasonable proxy for risk free, but in periods of crisis this may not hold. Second, SFRs are not the same as government bond yields and so I- and G-spread are not identical. When government bonds are used to hedge the interest rate risk, I-spread will not directly measure the expected hedged return.

Benchmark, G-spread, and I-spread are all forms of nominal spread and differences in YTMs. When there are embedded option features they are misleading and other spread measures are needed.

Z-spread (zero-volatility spread) is a trial and error calculation to determine a single spread that if added to the implied initial spot rate curve of credit risk-free bonds could then be used to discount the bond's future cash flows to its current market value. While it uses the on-the-spot rate curve instead of a single YTM benchmark, it still does not consider embedded option features. If there are no embedded options, Z-spread will closely approximate the other nominal spread measures.

OAS (option adjusted spread) is a more complex derivative of Z-spread and does reflect the impact of options on expected return. It explicitly requires an assumption of interest rate volatility to build an interest rate tree of possible forward interest rates. Future cash flows are based on these possible future interest rates. The OAS is then a trial and error calculation to determine a single spread that if added to every node of the interest rate tree of credit-risk-free bonds would discount the bond's future cash flows to its current market value. It is the expected average incremental return that would be earned if the interest rate risk of the bond were hedged, assuming no defaults. OAS is the most widely used measure of incremental return for credit risk but it can be misleading because it measures a simulated *average result*. In any one time period, rates will follow a single path, the option will or will not be exercised, and actual results can be (considerably) higher or lower than the OAS (average).

When a portfolio includes bonds both with and without embedded options, market value weighted average OAS is the best measure of credit exposure. If there are no embedded options, market value weighted average of the other spread measures is sufficient.

Credit spread can be viewed as incremental return above the benchmark used in calculating the spread. If spread is not expected to change, the excess return (XR) is approximately the spread (s) earned over the projected time period (t). In more complex situations a change in spread (Δs) and spread duration (SD) are also relevant. Spread widening (narrowing) leads to reduced (increased) performance due to relative price decline (increase) by the spread assets. This approach can be further expanded to incorporate loss in excess return due to probability of default (p) and severity of loss (L) during the time period. Because credit default is binary (it happens or does not) when default loss estimates are included it is common to refer to the excess as estimated excess return (EXR). Annualized data are normally used in these calculations.

$$\text{XR or EXR} = (s \times t) - (\Delta s \times SD) - (t \times p \times L)$$

EXAMPLE: Using credit spread data

A manager has collected data on both a bullet (no embedded options), callable, and putable bond of the same issuer. The bonds are similar in all other regards.

Bond	A	B	C
G-spread	425	423	426
I-spread	429	426	429
Z-spread	435	434	434
OAS	351	503	434
Price	95.00	97.00	99.00
Accrued interest, per 100 par	0.60	1.10	0.75

1. Based on the data provided, **determine** which bond is most likely option free and **explain** why.
2. **Determine** which bond is most likely the putable bond and **explain** why its OAS is similar to, higher, or lower than it's Z-spread. Your answer must also **discuss** direction in interest rate movement that would make the put feature relevant.
3. If 3 and 2 million par of bond A and C are purchased, **calculate** the most relevant measure of portfolio spread.

Answers:

1. Bond C, with no embedded option, Z-spread and OAS should be the same.
2. Bond B, the OAS exceeds the Z-spread because it captures the potentially favorable impact of the put feature on the investor's return. If rates increase, the investor can redeem the bond early and reinvest at those higher rates, increasing the return earned. Said another way, the put price establishes a floor on the value of the bond and increases the investor's return if rates increase.
3. Because bonds with embedded options are being used, OAS is the best spread measure. Market weights are needed to compute the portfolio spread and full price with accrued interest should be used). For example for bond A, 95 + 0.60 = 95.60.

   Market value A = (3,000,000 / 100) × (95.60) = 2,868,000; w = 59.0%

   Market value C = (2,000,000 / 100) × (99.75) = 1,995,000; w = 41.0%

   Portfolio market value = 4,863,000

   Portfolio OAS = 0.590(351) + 0.410(434) = 385 bp

MODULE QUIZ 21.1

To best evaluate your performance, enter your quiz answers online.

1. A manager is considering the addition of investment-grade bonds and high-yield corporate bonds into one of his client's portfolios. The client expressed interest in gaining exposure specifically to investment-grade bonds, but not to high-yield bonds due to risk concerns. What is the primary risk exposure for investment-grade bonds?
   A. Credit risk.
   B. Spread risk.
   C. Interest rate risk.
2. Assume a bond portfolio contains a collection of bonds with embedded options and bonds without embedded options. Which type of spread measure would be *most suitable* for measuring the credit exposure of this portfolio?
   A. I-spread.
   B. G-spread.
   C. Option-adjusted spread.

MODULE 21.2: TOP-DOWN AND BOTTOM-UP

Video covering this content is available online.

LOS 21.c: Discuss bottom-up approaches to credit strategies.

LOS 21.d: Discuss top-down approaches to credit strategies.

CFA® Program Curriculum, Volume 4, pages 259 and 268

Either approach or a combination of both can be used to manage a credit portfolio.

- It may be easier to gain an information advantage with bottom-up because the manager can focus on only the least efficient sectors of the market to identify individual over- or undervalued securities. Bottom-up analysis works best when comparing bonds with fairly homogeneous credit risk exposure; such as within IG or HY. The problem is macro factors such as portfolio duration and interest rate change can overwhelm value added with individual security valuation changes.
- Top down has an advantage in that it focuses directly on those macro factors that drive interest rates, average credit spreads, and default losses. The problem is these same factors are examined by many others and it may be harder to gain an information advantage.
- To combine approaches, the bottom-up manager can build the portfolio by overweighting undervalued and underweighting overvalued securities; then monitor and adjust as needed for the macro factor risk exposures such as duration (interest rate risk) and portfolio credit risk. The top-down manager can begin with macro factors to identify the most attractive sectors of the bond market and then use individual security analysis within those sectors.

BOTTOM-UP IN DETAIL

The bottom-up manager would start with identifying the universe of bonds to consider, then divide that universe into sectors such as auto-related and mortgage-backed securities (MBS). Typically the manager is being measured against a benchmark and would match benchmark weights but over- or underweight individual securities or issuers. The manager should determine if the sector divisions in the benchmark are reasonable. For example, the manager may believe MBS is too broad a sector and differentiating government versus privately backed MBS will reveal important differences in risk or expected return.

The manager then looks for relative misvaluation within each sector to determine individual securities to select. The evaluation must weigh compensation (expected excess return) versus credit risks (credit spread, credit migration, default, and liquidity risks). For example:

- A manager views bond D and E as having similar credit risk exposures, but D has a higher spread and expected excess return; he would select D.
- A different manager believes D has higher credit risk than E, but given its higher spread she is indifferent between the two bonds.

Gathering information to assess the credit risks is critical. This can include historical default rates (p) and loss rates (L) as well as charting past spread relationships. For example, a

particular auto company's bonds trade at spreads that are wider than the issuer's average and wider than other auto companies. As long as the analyst is convinced there are no unaccounted for risk differences, overweight that company's bonds.

The previous excess return model can be used in this analysis:

$$XR = (s \times t) - (\Delta s \times SD) - (t \times p \times L).$$

Assuming the analyst does not expect spreads to change, this issue becomes comparing the incremental spread earned versus estimated default losses. This is complicated because the factors are interrelated; bonds with higher expected default losses (a negative) usually have higher spread (a positive). Typically, the manager will select the bonds with highest XR but there are exceptions to this. The portfolio may already be overweighted in that issuer and need to diversify into less attractive XR bonds. The manager may also need to select bonds with lower XR to emphasize high liquidity or to meet an overall portfolio duration constraint.

EXAMPLE: Selecting bonds based on relative value

A manager gathers information on three bonds. She plans to purchase one of the bonds and anticipates a 9-month holding period.

Bond	Spread Duration	Yield %	Z-spread bp	Credit rating	Est. default rate based on rating	Bid ask spread	Projected Liquidity
1	7	5.50	350	B	3.59%	6/32	Low
2	6	3.70	150	Aa	0.22%	4/32	High
3	3	3.60	200	A	0.34%	4/32	High

All the bonds are recent issues and available for purchase at the yield stated in the table. Default rates are annualized and based on historical data for similarly rated bonds. She assumes 30% of par value will be recovered in any default. Liquidity is based on the manager's estimate of ability to buy or sell at reasonable cost and is projected liquidity 3 months from now and once the bonds are fully placed with long term investors.

1. **Recommend** the best bond based on expected excess return and assuming no change in spread. **Show** your calculations.
2. **Recommend** the best bond based on expected excess return and assuming all spreads narrow (decline) by 60 bp. **Show** your calculations.
3. **Explain** conceptually (no calculations) how rating, bid ask, and liquidity would affect this manager's decision process. **Discuss** *each* item individually.

Answers:

1. Bond 1: 3.50(.75) − 0(7) − 0.75(3.59)(0.70) = 2.625 − 0 − 1.885 = +0.740%

   Bond 2: 1.50(.75) – 0(6) – 0.75(0.22)(0.70) = 1.125 – 0 – 0.116 = +1.009%

   Bond 3: 2.00(.75) – 0(3) – 0.75(0.34)(0.70) = 1.500 – 0 – 0.179 = +1.321%

   Select bond 3.

   Note that the data was given in a mixture of bp and percent. All relevant data must be in the same units. Percent data was used in the solution. And 30% was given as the recovery rate; that is why 0.70 was used as the loss severity.

2. Bond 1: 3.50(.75) − (–0.6)(7) − 0.75(3.59)(0.70) = 2.625 + 4.200 − 1.885 = +4.940%

   Bond 2: 1.50(.75) – (–0.6)(6) – 0.75(0.22)(0.70) = 1.125 +3.600 – 0.116 =

   4.609%

   Bond 3: 2.00(.75) – (–0.6)(3) – 0.75(0.34)(0.70) = 1.500 +1.800 – 0.179 =

   3.121%

   Select bond 1.
3. Rating: Bond 1 is well below investment grade so the manager should verify it is consistent with account constraints

   Bid-ask is not relevant because the facts state all the bonds can be purchased at the YTM stated in the table and used in the evaluation.

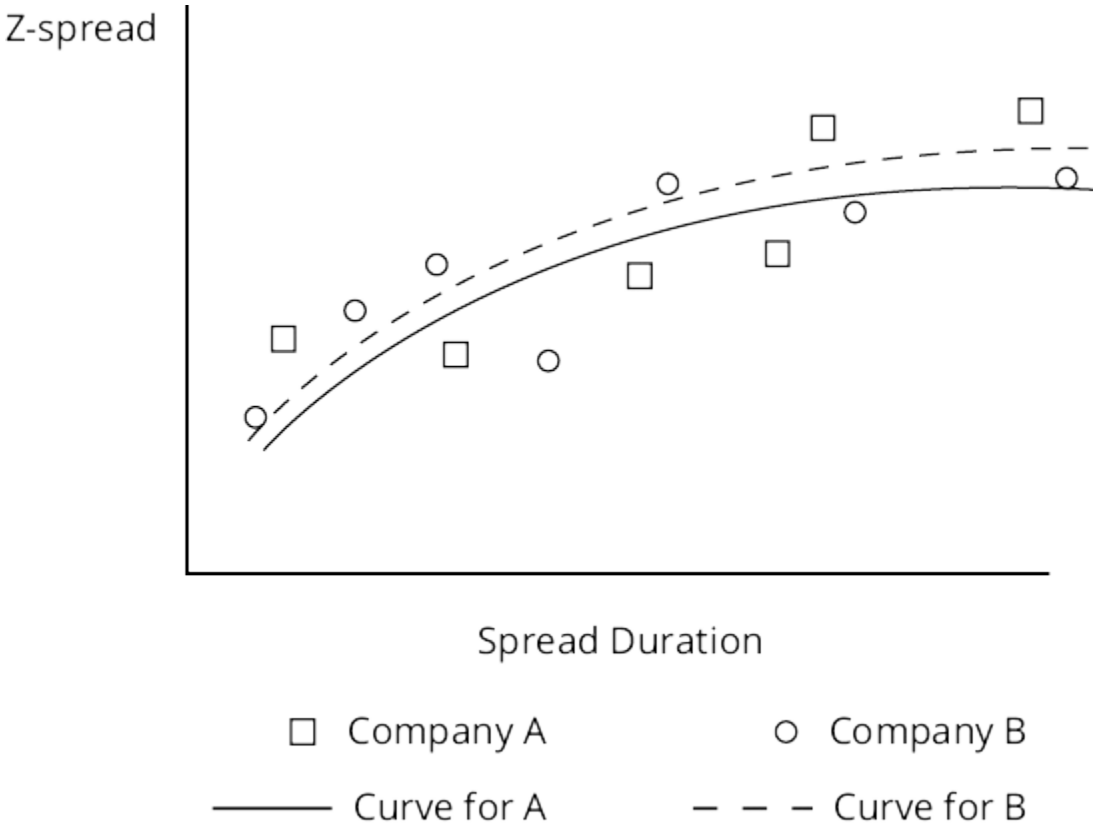
   Liquidity: Bond 1 becomes less attractive based on the 9-month holding period because it may be more costly to sell at the end of the period.

   Note that the information does not allow any final conclusions. That is why you were only asked to explain conceptually. You can make other comments if they are based on the reading and are equally relevant to this situation.

Spread Curves

Spread curves are another useful bottoms up tool. Figure 21.1 provides an example of how to use such curves.

Figure 21.1: Spread Curve for Two Companies



Based on Figure 21.1:

- In general, bonds of company B offer slightly higher spread. Assuming the two issuers are equal in all other regards, the B bonds offer better excess return and are more attractive.
- Both issuers have several available issues. Any specific bond issue that plots above (or below) the issuer's curve is potentially more attractive (or unattractive) for purchase.
- These are tentative conclusions and the bonds should be examined carefully for other considerations such as differences in:
    - Liquidity.
    - Date of issuance; older issues are generally less liquid.
    - Pending new supply; if the issuer is about to issue a new security of similar remaining maturity the older issue is likely to decline in liquidity.
    - Seniority in bankruptcy; subordinated debt is likely to experience greater loss (less recovery) in bankruptcy.
    - Size of issue and total issuance outstanding by issuer; generally larger individual issues and total issuance make it economical for more investors to analyze and follow the bonds. Therefore, the increased issuance is often associated with better liquidity and higher bond prices. However, there can be too much supply of a given issue and issuer, leading to the opposite effect. The supply may saturate the market demand, leading to less liquidity, wider bid-ask, and higher credit spreads. Excessive issuance could also be associated with too much leverage and declining credit quality.

Practical Considerations

Final credit portfolio construction involves identifying the optimal risk exposures and best relative value holdings, and is likely to involve compromise.

- In specifying exposure to credit risk, the manager should consider both spread duration and market value allocation.
    - Spread duration measures expected percent change in value from spread change. For example, if bond A has a spread duration of 3 and is 4% of the portfolio, its duration contribution is 3(0.04) = 0.12. If a similar issuer's bond has a spread duration of 6 and is 2% of the portfolio, its duration contribution is also 0.12. If the spread of both bonds widens by 100 bp, the effect on total portfolio value is the same: –3(0.04)(0.01) = –6(0.02)(0.01) = portfolio decline of 0.12% in value. Generally, for investment grade bonds and when default is not expected to be a significant factor, sensitivity of the portfolio to spread change is the most relevant measure of spread risk. This is best measured by SD and duration contribution.
    - In contrast, for HY and bonds where default risk is high, market value allocation is the more relevant measure of credit risk. Consider a simple example in which recovery for default is expected to be 0% and the loss 100%, bond A is twice as risky because the portfolio holds—and can therefore lose—twice as much.
- The manager must also be prepared to compromise in selecting best relative value. The first, second, or even third choice bond may turn out to be unavailable for purchase.

The manager can:

- Move down his relative value list and find the best available substitute bond.
- Temporarily invest in a suitable index fund (or use swaps or other derivatives to replicate such exposure) until the desired bonds are available.
- Temporarily hold cash and not have the desired bond market exposure until the desired bonds are available.

TOP-DOWN IN DETAIL

LOS 21.d: Discuss top-down approaches to credit strategies.

CFA® Program Curriculum, Volume 4, page 268

The top-down approach focuses on macro factors that are likely to affect the credit portfolio. Relevant factors include strength of economic growth and corporate profits. Stronger growth and profits are associated with decreasing spread and suggest moving down in credit quality for greater relative price gains. Top-down managers may use this relationship to identify when to focus on HY versus IG.

Top-down can also be used to identify sectors of the market most likely to improve (or deteriorate) and the manager can overweight (or underweight) those sectors. This analysis could also be used by the bottom-up manager to identify sectors for more targeted individual security analysis.

Top-down may focus on historical patterns such as the credit cycle and credit spread change. The credit cycle refers to variations in real economic growth and default rates. The two are negatively correlated in general, though it is not a perfect relationship.

The default rate and spreads are also highly correlated so the manager must generally be able to anticipate the next change in economic conditions to add value. For example suppose real growth is very low, defaults are high, and OAS for HY bonds is well above average; there is no particular opportunity because the high spread is compensation for high default losses. But if the manager has insight that the economy and growth rate are going to improve, it is an opportune time to move into HY.

The top-down manager would likely vary the portfolio's average credit rating upward to a higher (or downward to a lower) rating in anticipation of weaker (or stronger) than consensus expectations for economic growth. The manager should consider how the portfolio's average quality is calculated. Often, a numeric sequence is assigned to each rating (e.g., AAA = 1, AA+ = 2, AA = 3, AA– = 4). The portfolio's market value weighted average rating is then calculated. This approach can understate exposure to credit risk because default rates and losses tend to increase rapidly as the rating declines. Other more complex "non-arithmetic" scales assign a number that increases much more rapidly than 1, 2, 3, 4 as credit rating declines (e.g., 1, 10, 20, 40 is used by Moody's). Non-arithmetic portfolio averages will show that exposure to credit risk increases at a faster than linear rate, as bond rating declines.

Portfolio average OAS (or other spread) and spread duration are also calculated based on market value weighted average. A higher spread indicates the portfolio has greater exposure

to credit risky assets. But spread duration indicates how much the portfolio will change in value if spread changes. Combining the two as duration times spread (DTS) provides a more comprehensive indication of credit risk than either alone.

EXAMPLE: Top-down analysis

An investor with a 1-year holding period is analyzing 4 single rating indexes. Each index uses bonds that all have the same credit rating.

Index Rating (numeric value)	Current OAS, bp	Projected OAS, bp	Projected Credit Loss %, (p x L)*	Spread D
A (1)	275	250	0.01	4.5
BBB (2)	325	285	0.04	5.5
BB (3)	475	400	0.12	4.3
B (4)	625	499	0.37	5.8

* p = annualized expected probability of default
L = expected loss severity

The numeric value in parentheses after the letter rating is used by the investor to determine arithmetic weighted average portfolio credit value.

1. **Calculate** the expected annual excess return for a portfolio weighted 50/50 in Index BBB and BB.
2. **Calculate** average current OAS, spread duration, and duration times spread (DTS) for the portfolio in Question 1.
3. **Calculate** the average numeric credit rating for the portfolio in Question 1 as well as a portfolio weighted 50/50 in Index A and B.
4. **Discuss** the ways in which comparing the two average portfolio credit ratings in Question 3 to determine the portfolios exposure to credit risk is misleading and **state** three alternate ways to measure the credit risk exposure using the information provided. No calculations are required.

Answers:

1. Average portfolio starting OAS: 0.5(325) + 0.5(475) = 400 bp

   Average portfolio spread change: 0.5(285 − 325) + 0.5(400 − 475) = 58 bp decline

   Average portfolio credit losses: 0.5(4) + 0.5(12) = 8 bp loss

   Average portfolio spread D: 0.5(5.5) + 0.5(4.3) = 4.90

   Expected excess return: 1(400) + 4.9(58) – 8 = 676 bp
2. Average portfolio starting OAS: 0.5(325) + 0.5(475) = 400 bp

   Average portfolio spread D: 0.5(5.5) + 0.5(4.3) = 4.90

   Average portfolio duration times OAS: 4.9 (400) = 1960 bp
3. Portfolio BBB and BB: 0.5(2) + 0.5(3) = 2.5

   Portfolio A and B: 0.5(1) + 0.5(4) = 2.5
4. Credit risk typically increases at a more than linear rate as credit rating quality is lowered. That means portfolio A and B is likely risker than BBB and BB even though the average numbers are the same. Other ways to compare credit risk exposure are to compare:
   - Average OAS.
   - Average spread D.
   - Average D times spread (DTS).

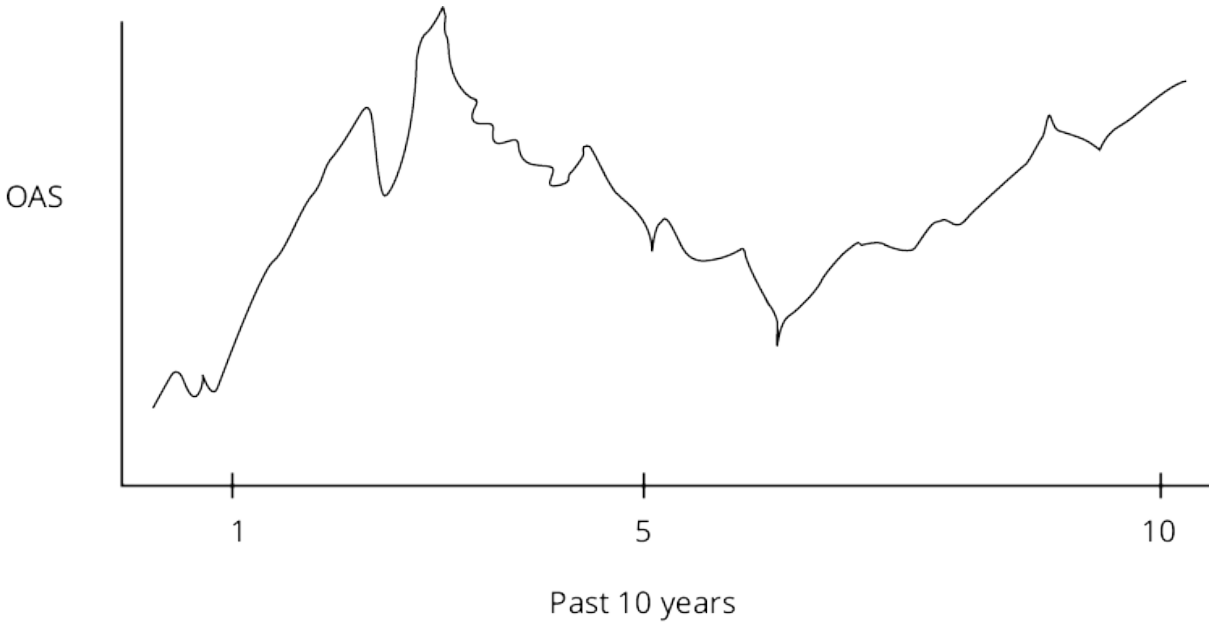
The credit portfolio manager can also use historical spread between credit risky sectors to

assess relative attractiveness.

- Suppose a manager examines Figure 21.2, believes the first 5 years of data are distorted by a major financial crisis, the last 5 years are relevant, and spread is mean reverting; that manager would find HY attractive because the spread differential is visually greater than the average of the last 5 years.
- Suppose another manager believes future economic conditions for the next few years will be much worse than consensus expectations; that manager would likely favor IG because the current spread reflects consensus views and economic deterioration should lead to spread widening. Spread widening is a more serious risk in HY than in IG.

Plotting the historical spread for other relationships is also useful. A manager could track the spread difference between 15- and 5-year A-rated bonds to gain perspective on the past relationship and as a starting point for developing a view on how the spread may change. If the manager sees the pick-up in yield for buying 15-year rather than 5-year bonds is average, but the manager forecasts a large increase in 15-year bond issuance, she may expect the spread to increase and overweight the 5-year sector now.

Figure 21.2: OAS for High-Yield Sector



ADJUSTING THE CREDIT PORTFOLIO'S INTEREST RATE RISK

Because top-down management focuses on macro factors such as interest rates, top-down managers are more likely to also actively manage interest rate risk in the credit portfolio. In contrast, bottom-up managers will generally just match interest rate exposure to that of their benchmark in order to focus on security selection issues.

PROFESSOR'S NOTE

Interest rate management techniques are more completely covered elsewhere. This reading coverage

is brief and reviews issues such as:

- Increase (or decrease) duration if interest rates are expected to decrease (or increase).
- Adjust key rate duration exposures to profit from expectations regarding nonparallel yield curve shifts.
- Adjust exposure to option features, increasing long (or short) call option positions if volatility is expected to increase (or decrease).
- Increase (or decrease) convexity before large increases (or decreases) in volatility.

It can be difficult to simultaneously manage interest rate and credit risk without derivatives. The available bonds to implement the views may not exist or be unavailable. For example:

- A manager who expects spreads to narrow and rates to increases would have difficulty implementing that view with bonds only. Long corporates would benefit from the spread narrowing but not from the general rate increase. Buying the corporates for increased spread exposure while selling bond futures to lower duration would be a better strategy.
- Adjusting exposure to options by buying or selling callable and putable bonds could be difficult. Buying or selling options on bond contracts is a more straightforward way to directly adjust exposure to option return and risk characteristics.
- Global investors can use currency forwards and bond futures to directly adjust currency and duration exposures, independent of the actual credit risky bonds selected.

ESG Considerations

Corporate bonds in particular and some other credit risky securities may violate environmental, social, and governance (ESG) portfolio constrains. For example, the bond issuer may be a high carbon emitter and that may be prohibited by ESG portfolio restrictions. Or an asset backed security may include loans originated by predatory lenders (i.e., lenders who are regarded by some as unfairly restricting credit or charging excessively high rates to some groups).

MODULE QUIZ 21.2

To best evaluate your performance, enter your quiz answers online.

1. A credit investor is researching three industries with the goal to directly invest in bonds issued by companies in those industries. The investor is hoping to outperform the benchmark that represents bonds issued from the industries in question. Which of the following credit strategies is *most appropriate* for this investor?
   A. The top-down approach.
   B. The bottom-up approach.
   C. The middle-out approach.
2. A portfolio is using a top-down approach to compute portfolio expected excess return. The index rating category under evaluation is rated BBB. The current option-adjusted spread (OAS) is equal to 330 bps and the expected OAS in one year is 180 bps. Also, the expected credit loss rate is 0.05% and the spread duration is 5.5. Given this information, what is the top-down excess return for the BBB index if the investor has a one-year holding period?
   A. 5.10%.
   B. 8.25%.

C. 11.5%.

MODULE 21.3: LIQUIDITY, TAIL, AND INTERNATIONAL RISKS

Video covering this content is available online.

LOS 21.e: Discuss liquidity risk in credit markets and how liquidity risk can be managed in a credit portfolio.

CFA® Program Curriculum, Volume 4, page 279

As we have already discussed, the credit markets are relatively illiquid compared to developed market government bonds, and liquidity in general has declined post 2008-2009 financial crisis.

- Average daily trading volume is down substantially.
- Credit spread is sensitive to flows of funds in the credit markets. For example, large flows out of HY (selling) and into IG (buying) would likely depress HY prices (increasing their yield) while bidding up IG prices (decreasing their yield). In other words, the spread of HY to IG will increase and HY relative performance will suffer. This problem is most likely to occur during periods of financial stress and have a larger impact on HY than on IG because the HY market is smaller and less liquid.
- The difference in bid-ask is often used as an indicator of liquidity but has become less reliable. Capital and risk considerations have reduced the size of the bond inventory dealers are able to support. Traditionally, dealers would buy and hold bonds for future sale, providing market liquidity.
- One favorable trend for liquidity has been a broader distribution of both IG and HY bonds. The percentage of each market held by the 10 largest funds has declined. Economic theory holds that a market with a greater number and dispersion of participants holding independent views will be more resilient and more liquid.

Credit portfolio managers have had to give more attention to managing liquidity risk. They can:

- Hold a larger percentage of the portfolio in cash.
- Hold a larger percentage of the portfolio in more liquid securities, even if they are outside the normal objectives (e.g., an IG manager who over weights more liquid Treasury securities or a HY manager who holds more liquid IG securities), even if this involves a lower expected return.
- Use liquid derivative instruments as an alternative to the underlying credit risky securities. For example there are regularly traded (though OTC) credit default swaps (CDSs). CDSs provide credit protection to the buyer. The seller of the protection receives funds and pays if a defined adverse credit event occurs. In other words, the CDS protection seller is taking on the credit risk that would have been incurred by buying credit risky securities. (These swaps trade under and may be referred to by various names such as CDX and iTraxx.)
- Use IG or HY ETFs as a temporary investment to gain market exposure and diversification until the desired underlying securities are available.

MANAGING TAIL RISK

LOS 21.f: Describe how to assess and manage tail risk in credit portfolios.

CFA® Program Curriculum, Volume 4, page 284

Tail risk refers to the fact that returns in many security markets experience more large declines than consistent with their standard deviation. These extreme large declines and sequences of consecutive large declines have been observed in credit portfolios as well. These types of events are difficult to model or anticipate. Managers can and should try to quantify the potential losses with the following:

- **Scenario analysis** makes assumptions to describe plausible but unusual conditions and then projects how the portfolio will behave.
- **Historical scenarios** assume conditions that have occurred in the past such as the 2008–2009 financial crisis or telecommunications industry problems in the early 2000s.
- **Hypothetical scenarios** make up possible combinations of extreme events that have not occurred before.

During severe adverse market conditions, correlations tend to move upward, diversification benefits decline, and downside risk is greater than expected. In such conditions, liquidity declines or virtually disappears; therefore, tail and liquidity risk become linked.

Managing tail risk is difficult:

- The manager should try to quantify the risk and hold adequate top quality securities that will retain liquidity during a crisis.
- Diversify the portfolio and specifically identify likely tail risks and hold securities that are likely to benefit if the risk occurs. The problem is, all risks cannot be identified ahead of time or be diversified.
- Use tail risk hedges to protect against extreme events. For example, suppose a manager is concerned about risk in a particular bond market sector and it is as impractical to avoid the sector. The manager could buy CDSs or credit spread options on that sector. The manager makes a one time or periodic payment and receives a defined payment if a defined adverse credit event occurs. The problem is, a cost is incurred at purchase and the more the marketplace believes the risk is likely to occur, the more expensive the protection. For managers who cannot use such credit derivatives, tail risk may be unavoidable.

INTERNATIONAL CREDIT RISKS

LOS 21.g: Discuss considerations in constructing and managing portfolios across international credit markets.

CFA® Program Curriculum, Volume 4, page 286

Investing in multiple markets and currencies offers opportunity and risks. But even investors who restrict holdings to one country should realize the bond issuers in that country may

generate significant revenue and profit in other countries, exposing the investor to global risks.

International investing offers greater relative value opportunities. For instance, new issuance of corporate bonds in one country may exceed desired demand, lowering prices of corporates relative to corporates in other countries. Or subtle quality differences may exist. HY bonds in country Z may have a higher percentage of the most speculative bonds compared to HY bonds in country Y. If credit risk is expected to decline the more speculative HY of country Z are likely to outperform, all else the same.

The size of the emerging market (EM) bond sector has been increasing and is now similar in size to the U.S. high-yield (HY) sector. Although both are high yield and high risk, there are differences. In the EM sector:

- Commodity and banking related businesses make up a much greater percentage of the bonds outstanding. That concentration is greater than it appears as much of EM banking is linked to those same commodity businesses.
- Direct government ownership or stakes in companies is high. This gives an explicit or implicit expectation of support if there are credit problems. The risk is the local governments may favor domestic over international creditors if there are problems with the bonds. Even the legal rights of the EM's foreign investors may be less clear.
- The rating on EM non-government bonds may in some cases understate true quality as rating agencies typically will not rate an issuer higher that the sovereign credit rating of the issuer's country.

In global bond portfolios:

- Liquidity is a greater concern. The United States is the most liquid market with transparency of trade volume and price (i.e., public reporting). In other markets, there is less or no reporting.
- Currency risk must be considered as a decline in value of the currency in which the bond is denominated reduces return to investors outside that country. This can be a bigger issue when interest rates of the bond are low, making changes in the value of the currency a bigger component of return for the foreign investor. Global managers may hedge the currency risk by selling forward or swapping the foreign currency for domestic currency of the investor.
- Legal risk can be greater with less familiar or less developed legal protections and bankruptcy law.

MODULE 21.4: STRUCTURED INSTRUMENTS

Video covering this content is available online.

LOS 21.h: Describe the use of structured financial instruments as an alternative to corporate bonds in credit portfolios.

CFA® Program Curriculum, Volume 4, page 289

PROFESSOR'S NOTE

These comments are largely focused on the U.S. market where structured finance is the most developed and largest.

Structured finance represents an alternative to corporate bonds in the credit portfolio. They offer some combination of:

1. Higher yield and expected return.
2. Tailored risk exposure through multiple tranches with varying levels of risk ranging from first tranche (often AAA) to mezzanine last tranche, which could be below investment grade and offer higher expected return.
3. Exposure to specific market sectors such as real estate, consumer credit, or bank loans that cannot be directly targeted with corporate bonds.
4. A diversification benefit. Adding structured finance instruments to a credit portfolio may leave returns unaffected but lower portfolio standard deviation.

There are multiple types of structured finance.

Mortgage-backed securities (MBSs) are pools of mortgage-backed loans. They can be government or privately backed with a range of credit quality and expected return. Compared to corporate bonds:

- Government agency backed MBSs can offer similar yields and spread with greater trading volume and liquidity.
- MBSs have tailored exposure to specific segments of the real estate market. Individual MBSs can be backed by residential or commercial property. (Although some regard certain types of REITS as providing similar exposure, REITS tend to act and be more correlated with the stock market.)
- MBSs are a means of adjusting portfolio exposure to interest rate volatility. Most mortgages and the resulting MBSs offer the borrower the right to prepay the loan. This is economically equivalent to the embedded short call option in a callable bond, but the MBS market is larger, more liquid, and often has less default risk. With decreasing (or increasing) interest rates or an expectation of higher (or lower) interest rate volatility this prepay option becomes more (or less) valuable. Adjusting the level of holdings in MBSs is a way to express a view on future interest rate volatility. This embedded call feature is a reduction in the value of the MBS so increase (or decrease) exposure to MBS if interest rate volatility is expected to decrease (or increase).
- MBSs offer a different exposure to credit risk from that of the corporate bond market. For example, CMBS (MBS backed by commercial real estate loans) are not government agency backed and have credit risk. Suppose OAS on CMBS is higher than normal compared to corporate bonds, and an investor believes real estate prices are likely to improve but corporate profits may be under pressure, it should be profitable to shift out of corporates and into CMBS.

Asset-backed securities (ABSs) are backed by non-mortgage (generally consumer) debt. The collateral can be automobile loans or leases, credit card receivables, student or other personal debt, and accounts receivable. ABSs offer a different source of return and portfolio diversification. Selecting specific types of ABSs (e.g., auto versus student loans) allows the manager to express a view on which sector will provide superior or inferior return.

Collateralized debt obligations (CDOs) are backed by various forms of debt obligations. The CDO collateral is normally some form of corporate debt and CDOs are normally structured in tranches. The most senior tranche is paid first proceeding down to the most junior subordinate tranche which is paid last. Credit quality descends and expected return increases as you move down the tranches. There is little diversification compared to corporate bonds, but the potential benefits include:

- Opportunities to identify relative value. For example, the manager may believe CDOs are cheap or expensive versus corporate bonds, higher or lower quality tranches are misvalued versus each other, or specific types of CDOs such as collateralized loan obligations (CLOs) versus CDOs are misvalued. CLOs are a type of CDO backed by leveraged loans (i.e., use leverage to buy more loans). CLOs generally have high credit quality due to over collateralization and the high quality of the loans held as assets; yet at times they have traded at very high yield.
- Opportunities to express a view on correlation within the underlying collateral. For example, if one manager believes there is +1 correlation between the collateral items then all collateral will default and no tranche can be paid or none will default and all will be paid. That manager should buy the lowest tier tranches to earn the higher expected return as the higher tier tranches are just as likely to default and not be paid. (For simplicity in discussion, collateral default is assumed to involve no recovery and 100% loss on default.) In contrast, a manager who assumes –1 correlation of defaults would buy the highest tier tranche because some collateral will pay and the top tranche will be paid, but some collateral will default and the bottom tranche will not be paid.
- Leveraged exposure to credit risk. The bottom tier tranches of a CDO are akin to a highly leveraged investment in the collateral. If everything works, the return will be high, but if there are losses in the collateral, they may have no value. These tranches may be called the *mezzanine* or *equity tranche*.

Covered bonds are bonds that are typically issued by a financial entity such as a bank. They are a form of collateralized debt (backed by specifically identified assets of the issuer) and also general obligations of the issuer. Because of this dual backing, they are considered a lower risk investment than the general bonds of the issuer.

MODULE QUIZ 21.3, 21.4

To best evaluate your performance, enter your quiz answers online.

1. A credit portfolio manager wishes to better manage liquidity risk in his clients' portfolios. What is an effective strategy for managing liquidity risk?
   A. Use derivative instruments, such as credit default swaps, as an alternative to underlying credit risky securities.
   B. Hold a larger percentage of the portfolio in lower-quality, higher-yield securities.
   C. Reduce holdings in cash-equivalent securities.
2. Shane Miller is an investment analyst who is aware of the importance of managing tail risk during periods of market turmoil. Appropriately managing tail risk includes all of the following actions except:
   A. holding an adequate amount of liquid securities.
   B. holding high-quality securities that produce returns that follow a normal distribution.

C. implementing a tail risk hedge, which seeks to provide protection against extreme events.

3. Constructing and managing a global bond portfolio has more considerations than managing a portfolio that restricts bond holdings to one country. Which of the following statements accurately represents one of these considerations?
   A. Liquidity is a greater concern in the U.S. market due to the greater volume of issuance.
   B. Legal risk can be a greater concern in international credit markets with less familiar or less developed legal protections and bankruptcy law.
   C. Currency risk must be considered given that a decline in value of the currency in which the bonds are denominated will increase the return to investors outside that country.
4. Mortgage-backed securities (MBSs) are structured financial instruments that can be used as alternatives to investing in corporate bonds. Compared to corporate bonds, MBSs will likely offer:
   A. similar exposure to credit risk.
   B. a means of adjusting portfolio exposure to interest rate volatility.
   C. different yields and spreads with less liquidity.

KEY CONCEPTS

LOS 21.a

Credit risk is narrowly defined as loss caused by a counterparty or debtor's failure to pay. It includes the probability of nonpayment (default risk) and the percentage of loss if there is default (1 − percentage of loss recovery). Credit risk is broadly used to also include:

- Spread risk as the spread bond will underperform in relative price change when spread widens.
  - %Δ value = –MD Δy
  - %Δ relative value = $-D_S \Delta s$
  - spread = $y_{\text{higher yield}} - y_{\text{government}}$
- Credit migration risk if credit quality is downgraded.
- Liquidity risk as lower credit quality bonds are typically more difficult to trade in a timely manner at close to fair value.

Generally, IG bonds are more affected by interest rate risk because their spread changes are more moderate than interest rate changes. HY bonds are more affected by spread risk because spread changes are the larger. There is also pronounced negative correlation between spread and risk-free interest rate changes for HY. These are generalizations and not inevitable in every situation.

LOS 21.b

Benchmark spread is the difference in YTM of a spread instrument and a comparable duration on-the-run government bond yield: (spread = $y_{\text{higher yield}} - y_{\text{government}}$). G-spread is the same but uses the interpolated duration matched government yield. I-spread is the same but uses swap fixed rates as the benchmark. All three are nominal spreads because they are based on differences in YTM.

Z-spread is the incremental amount that if added to the government bond spot rate curve would discount the bond's future cash flows to its price.

OAS is computed in a manner similar to Z-spread but uses an assumed volatility of interest rates to generate multiple future paths of interest rates and the bond's future cash flows. It is required when there are embedded option features in the bond and represents an "expected average" increment of return to the benchmark rates.

Excess return or expected excess return can be modeled as: XR or EXR = (s × t) − (Δs × SD) − (t × p × L).

LOS 21.c

Bottom-up focuses on identifying individual security misvaluation. The advantage is individual securities are more likely to be inefficiently priced. One way to implement bottom-up is:

- Identify the benchmark universe of bonds to consider and the relevant sector divisions of bonds to analyze.
- Use historical data and projections to determine expected excess return by bond.
- Consider any other relevant differences between the bonds and then decide which to over- or underweight.

LOS 21.d

Top-down focuses on macroeconomic factors that affect credit and interest rate risks. Such managers often look at historical patterns in credit risk changes and spreads. They are more likely to actively manage both interest and credit risk. (Bottom-up managers often just match the interest rate risk of their benchmark.)

LOS 21.e

Liquidity risk has become more of a problem following the 2008–2009 financial crises. Managing liquidity risk includes:

- Holding larger positions in cash and highest quality government securities.
- Using liquid derivatives as an alternative to less liquid underlying assets.
- Using ETFs for temporary changes in desired portfolio exposures.

LOS 21.f

Tail risk refers to the fact that extreme adverse market events are more common than consistent with a normal distribution of return. Scenario analyses can be used to quantify potential losses. Managing tail risk is difficult because these are unusual events but management includes:

- Quantifying the risk and holding sufficient highly liquid securities.
- Diversifying the portfolio and more particularly trying to identify securities that will do well under specific tail risk conditions.
- Using tail risk hedges for specific tail risks.

LOS 21.g

International credit markets offer additional opportunities to identify mispriced securities and diversify risk. The emerging market bond sector has been increasing in size. In quality it is compared to the U.S. high-yield sector, but there are differences:

- It has more exposure to the commodity and banking businesses.
- Explicit or implicit government guarantees are common. This is an advantage but the rights of non-domestic investors in bonds issued within the country can be unclear.
- A bond’s rating is generally limited to no higher than that of the rating of the government of the bond issuer’s country.
- Liquidity risk is greater and currency risk must be considered.

LOS 21.h

Structured finance may offer:

- Higher yield and expected return.
- Tailoring of risk exposure with various tranches.
- An efficient way to gain (or avoid) exposure to specific credit sectors such as real estate or auto loans.
- Diversification.

Structured finance includes MBS, ABS, collateralized debt such as CDO and CLO, and covered bonds.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 21.1

1. **C** Investment-grade investors are primarily exposed to interest rate risk, with secondary exposure to credit and spread risk. In contrast, high-yield investors face little interest rate risk, but are much more exposed to credit and spread risk. (LOS 21.a)

2. **C** When a portfolio includes bonds with and without embedded options, market value weighted average OAS is the best measure of credit exposure. If there are no embedded options, market value weighted average or the other spread measures is sufficient. (LOS 21.b)

Module Quiz 21.2

1. **B** The bottom-up approach is most appropriate in this case since the investor is evaluating the value of individual bonds and issuers relative to a benchmark. In contrast, a top-down approach would involve the investor first identifying attractive sectors and then selecting individual bonds from those sectors. (LOS 21.c)

2. **C** Excess return = $(0.0330 \times 1) - [(0.0180 - 0.0330) \times 5.5) - (1 \times 0.0005) = 0.033 + 0.0825 - 0.0005 = 11.5\%$ (LOS 21.d)

Module Quiz 21.3, 21.4

1. **A** CDS and other derivatives can be more liquid than the underlying securities. The manager who wants exposure to credit risky securities would sell credit protection to others. The return enhancement will be in premium income received as the seller.

   Holding more lower-quality securities will lower liquidity as liquidity declines with lower credit quality. Cash equivalents are generally highly liquid. (Module 21.3, LOS 21.e)

2. **B** Tail risks are extreme negative events that may occur more often than is consistent with a normal distribution. The problem with the statement is that you cannot assume the normal distribution applies. (Module 21.3, LOS 21.f)

3. **B** Legal risk can be greater with less familiar or less developed legal protections and bankruptcy law. Liquidity is a concern in global bond portfolios, but the United States has the most liquid market. Currency risk must be considered as a decline in value of the currency in which the bond is denominated reduces return to investors outside that country. (Module 21.3, LOS 21.g)

4. **B** MBSs are generally more liquid than the corporate bond market and include embedded prepayment options. Therefore, varying the allocation to MBSs will adjust the portfolio's convexity. MBS provide an exposure to different sources of credit risk and are usually more, not less, liquid. (Module 21.4, LOS 21.h)

TOPIC ASSESSMENT: FIXED INCOME

Use the following information for Questions 1 through 6.

John Wortek and Jack Benson are advisors with Pheifer Advisors, located in New York. Pheifer provides investment advice to wealthy investors and institutional investors and has been doing so for more than 10 years. Pheifer has a full staff of analysts, traders, portfolio managers, and economists.

The firm's chief economist is Paul Worthington. Based on his analysis of supply and demand as well as macroeconomic factors, he expects the U.S. economy to strengthen, corporate profits and stock prices to increase, and an extended period of increasing interest rates. He also forecasts that shorter-term rates will increase more than longer-term rates.

After considering Worthington's views, Wortek and Benson discuss possible yield curve strategies.

Statement 1: Wortek says that a buy-and-hold strategy for bonds cannot add value versus the benchmark. We need to adopt an active approach to yield curve positioning. We could allocate our weights to key rate durations differently from the weights of our benchmark.

Statement 2: Benson recommends a barbell strategy to outperform a laddered strategy. As long as we keep total portfolio duration the same, the barbell will outperform the laddered in both large upward and large downward parallel shifts that occur over a short period.

Statement 3: They both agree that the barbell should outperform a bullet in their expected flattening yield curve environment.

Wortek and Benson are also planning to meet with Jane Sumner, the portfolio manager of the defined benefit pension plan for Alpha Seed. Alpha has been a publicly traded firm for just three years and is concerned how its pension plan may affect their financial statement reporting. Sumner has asked for some help with managing the plan's duration gap. Wortek has determined the plan liabilities are $572 million with an effective duration of 12 years. Currently, Alpha's plan assets of $603 million consist of 60% large-cap U.S. stocks with a beta of 1.1 and 40% bonds with a duration of 4.50.

Sumner has suggested dedicating the fixed income to immunize the plan against interest rate risk. Wortek and Benson gather information on the Treasury bond contract to construct a suitable hedge. The contract is based on 100,000 par. The basis point value (BPV) of the CTD is 125.65 with a duration of 12.42 and a conversion factor of 0.9536. They also suggest Sumner take an active approach with a discretionary over- or underweighting of the full hedge by 10%.

1. Based on Worthington's forecast, the *most appropriate* strategy would be to:

A. buy call options on bond contracts.
B. enter into a pay fixed receive floating swap.
C. buy bond futures contracts on shorter maturity bonds.

2. Based on Worthington's forecast, he will *most likely* predict the best relative performance in long duration bonds will come from:
   A. the high quality U.S. government bond sector.
   B. the AA rated corporate bond sector.
   C. the C rated junk bond sector.

3. Regarding Wortek's and Benson's first two statements concerning yield curve strategies:
   A. only statement 1 is correct.
   B. only statement 2 is correct.
   C. both statement 1 and 2 are correct.

4. Regarding Wortek's and Benson's third statement that the barbell will should outperform a bullet in a flattening yield curve environment; the barbell's outperformance of the bullet will *most likely* be increased if:
   A. there is also a general downward shift in the curve.
   B. there is also a general upward shift in the curve.
   C. the amount of decline in long rates exceeds the amount of increase in short rates.

5. The BPV duration gap for Alpha Seed's pension plan is *closest* to:
   A. 415,050.
   B. 577,860.
   C. 637,528.

6. Assuming that new information has determined that the BPV duration gap is actually 600,000, Sumner applies the 10% discretionary band to the hedge, and interest rates are expected to increase. The number of futures contracts to buy is *closest* to:
   A. 4,100.
   B. 4,550.
   C. 5,000.

TOPIC ASSESSMENT ANSWERS: FIXED INCOME

1. **B** The expectation is for interest rates to increase. A pay fixed receive floating swap will benefit as the floating rate inflows increase. With rates increasing, bond prices will decline as will bond futures contracts and calls on the contract. The maturity of the bonds on which the contract is based will affect the rate of decline, but not the direction of movement. (Study Session 8, Module 20.6, LOS 20.e)

2. **C** The expected general increase in rates will lead to a general decline in bond prices. In this case, all the bonds are long duration, but they differ significantly in credit quality. The other key issue in Worthington's forecast is economic improvement that is associated with a decline in credit risk spreads. This will not affect Treasuries, but it will reduce the increase in interest rates on AA and C rated bonds. The offset is most pronounced for the lower-quality, C rated bonds. They have even been observed to increase in price when the general level of interest rates increases, due to significant narrowing of spread. (Study Session 8, Module 21.1, LOS 21.a)

3. **B** Wortek is wrong. Buy and hold can be an active yield curve strategy if the buy-and-hold allocation across the yield curve consciously differs from the allocation of the benchmark across the yield curve. Benson is correct because the barbell will have more convexity and convexity increases upside and decreases downside price change for large changes in interest rates. (Study Session 8, Modules 20.1 and 20.2, LOS 20.a)

4. **C** The barbell is expected to outperform the bullet in a flattening curve because of the differences in how the duration is achieved. The barbell will be exposed to higher duration bonds. The decline in longer-term rates applied to their higher duration will produce larger price gains. The barbell is also exposed to lower duration bonds. The increase in shorter-term rates applied to their lower duration will produce only smaller price losses. The same reasoning is also why a larger decline in longer-term rates and a smaller increase in shorter-term rates will further improve the performance of the barbell.

   The portfolios are duration matched, so a general upward or downward shift in rates has little effect on relative performance. There is a convexity effect, but that is relatively small and generally only apparent for large movement in rates. (Study Session 8, Module 20.2, LOS 20.a)

5. **B** The absolute duration gap in the pension plan is the difference between the basis point values (BPV) of liabilities and assets.

   $BPV_L = 572{,}000{,}000 \times 12 \times 0.0001 = 686{,}400$

   $BPV_A = 603{,}000{,}000 \times 0.4 \times 4.5 \times 0.0001 = 108{,}540$

   duration gap = 686,400 – 108,540 = 577,860

   (Study Session 8, Module 20.5, LOS 20.d)

6. **A** BPV of the Treasury futures contract:

CTD_{BPV} / conversion factor = 125.65 / 0.9536 = 131.7638.

100% hedge requires buying contracts to increase the BPV_A:

duration gap / $futures_{BPV}$ = 600,000 / 131.7638 = 4,554

Interest rates are projected to increase; using a smaller 90% hedge will leave the BPV_A lower and reduce the decile in the asset value, improving performance.

0.90 × 4,554 = 4,099

(Study Session 8, Module 20.5, LOS 20.d)

The following is a review of the Equity Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #22.

READING 22: OVERVIEW OF EQUITY PORTFOLIO MANAGEMENT

Study Session 9

EXAM FOCUS

These introductory readings cover the role of equity in the portfolio, common approaches to equity investing, and shareholder engagement.

MODULE 22.1: EQUITY INVESTMENT ROLES

Video covering this content is available online.

LOS 22.a: Describe the roles of equities in the overall portfolio.

CFA® Program Curriculum, Volume 4, page 306

Within the overall investment portfolio, equity securities play several beneficial roles. These roles include capital appreciation, dividend income, diversification, and the potential to hedge inflation.

Capital Appreciation

The main driver of long-term equity returns is capital (or price) appreciation. Capital appreciation results from investing in companies that are experiencing growth in cash flows, revenues, and/or earnings. These companies range from small technology companies that are focused on growth opportunities to large, well-established companies that are focused on value-added acquisitions and minimizing costs.

In the last 50 years, equity returns on average have been higher than bonds and bills. In general, equities tend to outperform other major asset classes during periods of strong economic growth, and underperform during periods of weak economic growth.

Dividend income: This is an important component of equity return. When companies generate excess cash flows, they can decide to either reinvest those cash flows in value-added projects or distribute them to investors in the form of *dividends*. Well-established companies often pay dividends to investors and those dividends may increase over time. However, dividend payments are not guaranteed to increase or even continue into the future. Typical recent annual dividend yields have been 1%–3%. Dividend yield tends to be more stable than return due to price change.

Diversification: Equity securities offer diversification benefits due to less than perfect (i.e., less than +1.0) correlation with other asset classes. When assets are less than perfectly correlated, portfolio standard deviation will be lower than the weighted sum of the individual

asset standard deviations.

However, the risk reduction is not constant. During a financial crisis correlations tend to increase, limiting the diversification benefit. In addition, asset class standard deviations could increase, further reducing the expected reduction in portfolio risk.

Inflation hedge: In some cases, individual equities or equity sectors may provide a hedge against inflation. A company that can charge its customers more when input costs increase (due to inflation), can provide an inflation hedge by increasing to cash flow and earnings as prices increase. Commodity-producing companies (e.g., oil producer) may also benefit directly from commodity price increases.

The general record for equities as an inflation hedge is mixed. Studies generally show positive correlation between equity real returns and inflation, but the relationship varies over time and by country. Other studies show that equities and inflation become negatively correlated during periods of hyperinflation. In addition, equity prices are typically a leading economic indicator while inflation is a lagging economic indicator; also suggesting a less than perfect correlation between equity return and inflation.

Client Investment Considerations

The decision to include equities or the kinds of equities to include in a portfolio also depends on client investment considerations as outlined in the investment policy statement (IPS). Clients with a high risk tolerance may prefer growth-oriented companies, while clients with a low risk tolerance may prefer stable, well-established companies that pay dividends.

Client constraints may include environmental, social, and governance (ESG) considerations and religious beliefs. Portfolio managers can address these constraints using the following:

- **Negative screening** (i.e., exclusionary screening), which excludes companies or sectors that do not meet client standards.
- **Positive screening** (i.e., best-in-class screening), which seeks to uncover companies or sectors that rank most favorably with clients.
- **Thematic investing**, which screens equities based on a specific theme, such as climate change. A related approach is **impact investing**, which aims to meet investor objectives by becoming more actively engaged with company matters and/or directly investing in company projects.

EQUITY INVESTMENT SEGMENTATION

LOS 22.b: Describe how an equity manager's investment universe can be segmented.

CFA® Program Curriculum, Volume 4, page 311

The three main **segmentation** approaches include size and style, geography, and economic activity. Using these approaches provides a better understanding of how equity investments integrate into the overall portfolio and enhance diversification benefits.

Size and Style

- Size, typically measured by market capitalization, can be categorized by large-cap, mid-cap, or small-cap companies.
- Style can be categorized by growth or value companies, or a mix of these two styles (sometimes referred to as *blend* or *core*). Investment style can be determined by analyzing company metrics, such as price-to-earnings ratios, price-to-book ratios, dividend yield, and earnings and/or book value growth.

A style box can be used to rank (or *score*) companies or portfolios among these metrics. An example is shown in Figure 22.1.

Figure 22.1: Equity Investment Style Box

		Style		
		Value	**Blend**	**Growth**
Size	**Large**	Large-cap value	Large-cap blend	Large-cap growth
	Medium	Mid-cap value	Mid-cap blend	Mid-cap growth
	Small	Small-cap value	Small-cap blend	Small-cap growth

It may be beneficial for portfolio managers to analyze exactly where each company falls within the nine size/style boxes (e.g., create a scatterplot of each investment within an equity index). For example, when comparing two equities within the large-cap value box, a scatterplot may reveal that one of these companies has a higher market cap and is solidly valued while the other may be closer to medium-cap and a blend investment style. Managers can also break the nine boxes into additional equity style classifications such as micro-cap growth.

Advantages to segmenting by size and style include:

- Portfolio managers can better address client investment considerations in terms of risk and return characteristics.
- The potential for greater diversification benefits by investing across different sectors or industries.
- The ability to construct relevant benchmarks for funds that invest in a specific size/style category.
- The ability to analyze how company characteristics change over time. For example, as a small-cap growth company matures it may move into the mid-cap or large-cap categories and shift towards blended from pure growth.

The last advantage is also a disadvantage in that the categories are not stable over time.

Geography

This approach categorizes international markets by stage of economic development, such as developed markets, emerging markets, and frontier markets. Examples for each economic development stage include the following:

- *Developed markets*: United States, United Kingdom, Germany, Australia, and Japan.

- *Emerging markets*: Brazil, Russia, India, China, and South Africa.
- *Frontier markets*: Argentina, Estonia, Nigeria, Jordan, and Vietnam.

The main advantage to geographic segmentation is that investors with significant domestic market exposure can better understand how to diversify across international markets. One disadvantage to this approach is that investing in international equity markets may subject investors to currency risk. Another disadvantage is an overestimation of the diversification benefit. For example, a domestic investor from a developed market purchases stock in large companies in a foreign market to diversify. But the companies may have already diversified their business internationally and may even derive much of their income from the investor's country.

Economic Activity

This approach groups companies into sectors or industries by applying either a market-oriented or a production-oriented approach. A *market-oriented approach* segments companies by markets served, how products are used by consumers, and how cash flows are generated. A *production-oriented approach* segments companies by products manufactured and inputs required during the production process. Note that applying either approach may lead to slightly different classifications. For example, a market-oriented approach may classify a coal company in the energy sector, while a production-oriented approach may classify that same company in the basic materials sector.

The four primary classification structures for segmenting companies by economic activity are:

- Global Industry Classification Standard (GICS).
- Industrial Classification Benchmark (ICB).
- Thomson Reuters Business Classification (TRBC).
- Russell Global Sectors Classification (RGS).

The GICS applies a market-oriented approach, while the remaining structures apply a production-oriented approach. Each of these structures starts with a broad sector/industry classification and then divides further by subsector/sub-industry. As an example, consider the segmentation method shown in Figure 22.2 for the GICS Consumer Staples sector.

Figure 22.2: GICS Classification Example

Sector	**Consumer Staples**
Industry Group	Food, Beverage, and Tobacco
Industry	Beverages
Sub-Industry	Soft Drinks

PROFESSOR'S NOTE

The four classification structures differ on their application of sector versus industry. For example, GICS, TRBC, and RGS refer to their top level as sectors and then subdivide into industries. In contrast, ICB starts with industries and then subdivides into sectors.

An advantage to economic activity segmentation is that it allows portfolio managers to analyze, compare, and construct performance benchmarks based on specific sectors/industries. In addition, diversification benefits are enhanced when investments span different sectors/industries. The main disadvantage to this approach is that some companies, especially larger firms, may have business operations that are not easily assigned to one specific sector or industry.

Equity Indices and Benchmarks

Equity market indices and equity portfolio benchmarks can be constructed based on a combination of size/style and geographic segmentation. For example, the MSCI Europe Large Cap Value Index and the MSCI China Small Cap Index combine elements from both size/style and geographic classifications. Economic activity can also be used to subdivide equity indices by sector or industry. For example, the MSCI World Energy Index and the S&P Global Natural Resources Index track global companies categorized by sector/industry. Equity indices can also track unique client considerations, such as ESG practices.

MODULE QUIZ 22.1

To best evaluate your performance, enter your quiz answers online.

1. Equities typically offer diversification benefits when combined with other major asset classes in a portfolio. **Discuss** *two* reasons an economic crisis may affect the risk reduction archived through diversification.
2. Assume an investor is segmenting the equity investment universe by economic activity. **Describe** *two* advantages for applying this segmentation approach.

MODULE 22.2: PORTFOLIO INCOME AND COSTS, SHAREHOLDER ENGAGEMENT, PASSIVE/ACTIVE MANAGEMENT

Video covering this content is available online.

LOS 22.c: Describe the types of income and costs associated with owning and managing an equity portfolio and their potential effects on portfolio performance.

CFA® Program Curriculum, Volume 4, page 317

There are several ways to earn (current) income from an equity portfolio.

Dividend income is the most obvious and often the largest. One additional consideration is how the dividends are taxed; they may be subject to income and/or withholding tax. Note that investors with a growth-oriented focus are less likely to seek portfolio income from dividends.

Some companies pay an **optional stock dividend**, which allows investors to choose between cash payments or stock dividends (i.e., new shares). This "option" between cash and stock dividends has value for the investor and can even be sold to another investor to immediately monetize the "option." On occasion some companies pay a **special dividend**, a one-time cash

payment to investors (as opposed to the more typical periodic regular dividend).

Securities lending is another way to generate current income. Securities lending is often part of short selling. A short sale is the sale of a security that is not owned. To make the short sale, the seller must typically borrow the security in order to deliver it to the buyer when the short sale is made. The lender of the security is typically paid a fee and may also receive collateral or cash on which they can also earn a return. The lender also receives back the security lent at a future date. Securities lending is not unusual in index funds large institutional portfolios such as pension funds and endowments.

Security or **stock lending** does introduce additional issues. Short selling (like any sale) tends to drive down the securities price, which is not particularly beneficial to the lender (who still owns) the security. This is more likely to concern an active manager who expects their holdings to outperform, as opposed to a passive index fund manager. The lender must also be concerned with the quality of the borrower and the borrower's ability to return the securities. The borrower must also compensate the lender for any dividend payments that occur during the period of the loan. The lender generally loses the right to vote the shares during the period of the loan.

Lenders typically collect a small fee, in the range of 0.2%–0.5% annually for developed markets. This fee can increase substantially for emerging market stock loans or stocks that are in high demand for borrowing, known as *specials*. As mentioned, lenders can also earn extra income by reinvesting the borrower's posted cash collateral. However, this reinvestment would be subject to various risks, such as market, credit, and operational risk. The reinvestment is likely to incur costs such as administration costs to keep track of everything.

Additional income strategies include:

- Writing options (i.e., selling options) to earn option premiums. A **covered call** strategy involves writing a call option on a stock owned. The writer then loses the upside of the security if the price increases above the strike price. Another option strategy is a **cash-covered put** (also known as a cash-secured put). This involves selling a put option on stock and setting aside sufficient cash equivalents to pay for the stock if the put option buyer exercises their right. The risk to the seller is the put buyer will only exercise the right if the stock declines in value.
- **Dividend capture** where an investor buys a stock right before its ex-dividend date, holds that stock through the ex-dividend date (entitling the investor to receive the dividend payment), and then sells the stock. The strategy is premised on and will be profitable if the stock price declines by less than the amount of the dividend. Theory says the stock should decline by the dividend amount but stock movements may differ from expectations given market forces (e.g., supply and demand) and/or income tax considerations.

Equity portfolios also incur fees and costs. These include:

- **Management** and **performance (incentive)** fees.
- **Administration** fees.
- **Marketing** and **distribution** fees.

- **Trading** costs.
- **Investment strategy** costs.

Management fees (i.e., ad-valorem fees) compensate the manager and pay research and analysis, computer hardware and software, compliance, and processing trades. These fees are typically based on a percentage of assets under management and are due at regular time intervals (e.g., annually). The management fees vary and are usually higher for actively managed portfolios due to higher levels of investment analysis and portfolio turnover.

Some managers also earn **performance fees** (i.e., **incentive fees**) when the portfolio outperforms a stated return objective. These fees are more common for hedge funds and alternative managers. For example, suppose a portfolio exceeds a threshold return, the manager may earn a performance fee in the range of 10%–20% based on any capital appreciation above the threshold. Incentive fees are often one sided; the manager shares in outperformance but is not penalized for underperformance.

To protect an investor from paying for performance twice, there may be a **high-water mark**. For example, assume a hedge fund earns a performance fee for outperforming its return objective and then the portfolio declines in value. The manager will only earn an incentive fee on future appreciation above the previous level that was already compensated for.

PROFESSOR'S NOTE

We are about to briefly discuss various types of fees and costs associated with equity (and other) assets. Managers may charge one management fee that covers all of these. In other cases the manager may break out some or all of these and present them as separate fees. Other managers may not provide some of these services and a separate third party provides and charges for them. The bottom line is that services are not free and must be paid for. The way the bill is presented varies and investors need to consider all the costs in total.

Portfolios may be subject to **administration fees** associated with corporate activities, such as measuring risk/return and voting on company issues. The manager may include these services in the basic management fee; however, if these functions are conducted by external parties, administration fees will likely be separate from management fees. Additional administrative type fees include the following:

- *Custody fees*: charged for having a custodian hold assets independent of the portfolio manager.
- *Depository fees*: charged to assist custodians with segregating portfolio assets and for verifying portfolio compliance with investment limits, such as leverage and cash requirements.
- *Registration fees*: charged for registering ownership of mutual fund shares.

Some firms also charge separate **marketing** and **distribution** fees to cover:

- Employing marketing, sales, and client services teams.
- Advertising investment products and services.
- Sponsoring and presenting at relevant conferences.

- Developing and distributing marketing materials (e.g., brochures).
- Fees from online platforms that offer multiple fund options (i.e., platform fees).
- Sales commissions from financial intermediary services (e.g., financial planners or brokers).

Trading costs (i.e., transaction costs) refer to costs associated with buying and selling securities. These transaction costs can be either explicit or implicit. *Explicit costs* include broker commissions, stock exchange fees, and taxes. *Implicit costs* include bid-ask spreads, price impact from the transaction, and delay costs (i.e., slippage costs) from not completing an entire trade due to illiquidity.

Investment strategy costs are an implicit cost related to the chosen investment strategy. As mentioned earlier, actively managed funds that require more investment analysis and transactions will have higher fees/costs than passively managed funds. However passive funds like index funds may be subject to hidden costs from *predatory trading*. This additional cost stems from predatory traders purchasing (selling) shares that are soon to be added (removed) from an equity index. These transactions will create price impact costs for the fund and a profit for the predatory trader.

Strategies may demand or provide liquidity. For example, momentum strategies tend to demand liquidity by buying shares in an increasing market and selling shares in a decreasing market. This is likely to create high market impact costs. Contrarian strategies are the opposite and tend to supply liquidity by buying shares in a decreasing market and selling shares in an increasing market. This is likely to create low market impact costs. Passive index replication strategies are likely to fall in the middle.

SHAREHOLDER ENGAGEMENT

LOS 22.d: Describe the potential benefits of shareholder engagement and the role an equity manager might play in shareholder engagement.

CFA® Program Curriculum, Volume 4, page 322

Shareholder engagement refers to investors and managers interacting with companies in ways to potentially favorably impact the stock price. Engagement also benefits the company with improved corporate governance. Engagement includes participating in calls with the company and/or voting on corporate issues at general meetings (i.e., general assemblies). Such meetings may discuss:

- *Corporate strategy*: Company objectives, constraints, growth opportunities, and resources. Additional items may include company research, culture, products, competitive environment, and sustainability. Prioritizing stakeholder interests and balancing short-term obligations with long-term goals may also be items of interest for shareholders.
- *Capital allocation*: Selection process for new projects that add value, and strategy for potential mergers and acquisitions. Shareholders may also be interested in capital expenditures, use of leverage, payment of dividends, and equity financing.

- *Corporate governance*: Internal controls and functions of the company's audit and risk committees. Additional items include how the company manages regulatory and political risks.
- *Compensation structures*: Top management remuneration, incentives, and alignment with shareholder interests. Larger shareholders may influence future compensation structures.
- *Composition of the board of directors*: The board's experience, competence, diversity, culture, and effectiveness. Additional items include succession planning to address departing board members.

Shareholder engagement is not free because it requires an investment of time and resources.

- Active managers are more likely to do so in order to influence the company in ways they expect will improve performance.
- Passive managers are more likely to focus on minimizing these costs for themselves and for the companies they invest in.
- Larger investors can more easily absorb these costs as they spread the costs over a large amount of assets.
- Successful engagement benefits all shareholders, including "free riders." Free riders do not engage but reap the same benefit from any increase in the stock price.
- Engagement can also be used to address nonfinancial concerns (e.g., ESG issues), though such benefits may be harder to quantify.
- Other stakeholders such as employees, customers, creditors, regulators, and governments are also impacted by shareholder engagement outcomes. After engagement activities, these stakeholders may have more or less influence on a given company. For example, decisions to reduce company costs may impact employee compensation. The act of shareholder engagement can also be influenced by external factors, such as academic research or media coverage.

Beyond the issues of time, cost, and free riders; shareholder engagement has other limitations. Engagement may:

- Focus on short-term goals such as increasing cash flows or stock prices at the expense of the company's long-term goals.
- Lead to the acquisition of material, non-public information; increasing the risk of insider trading.
- Create potential conflicts of interest. For instance, an engaged portfolio manager may support company management because the management also invests in the manager's fund.

Equity managers play a key role in engagement and may assign specific employees responsibility for this task. Firms may also consult with outside experts for advice on shareholder voting and monitoring corporate governance issues. Some countries set legal and regulatory requirements and require firms to establish written documentation for how to meet these obligations.

Activist investing takes engagement even further. Activist investors may:

- Propose shareholder resolutions and launch media campaigns to influence the vote.
- Seek representation on the company's board of directors.
- Launch proxy fights to win to achieve their goals. A proxy fight means seeking to persuade other shareholders to support their proposals.

ACTIVE/PASSIVE MANAGEMENT FOR EQUITY PORTFOLIOS

LOS 22.e: Describe rationales for equity investment across the passive–active spectrum.

CFA® Program Curriculum, Volume 4, page 325

Passive investors seek to replicate an equity market index or benchmark. Active managers seek to outperform the benchmark and add value. While the distinction seems clear, the reality is strategies may blur this distinction, such as closely track the index with limited deviations allowed to add some value. Active investing is riskier as the manager could also underperform the benchmark. Rationales for shifting to active management include:

- Confidence the manager has the expert knowledge and skill to add value.
- Client preferences—unless enough investors are interested, the manager will not be able to attract enough funds to cover the costs of active investing. Growth strategies are often seen as more likely to benefit from active management while value style may be more passive.
    - Managers must also manage the investor's expectations for what to reasonably expect from the strategy; investors with unreasonable expectations are more likely to become dissatisfied.
    - However, strategies that become too popular can also be a problem. Too much capital flowing in may make it harder to find opportunities to add value.
    - Managers must also select an appropriate benchmark that investors will be interested in. The benchmark should contain a broad range of underlying equities with sufficient liquidity to support active management. Narrow limited benchmarks don't give the manager much room to deviate and are likely to support a more passive approach.
- Mandates from clients to invest in certain companies (e.g., ESG considerations) may require a more active approach as the manager may need to use screening and other techniques to meet the mandates.

The results of active management are less certain and the costs are higher. Active management is also subject to other potential risks:

- *Reputation risk* results from violations to rules, regulations, client agreements, or moral principles.
- *Key person risk* results from individuals who are essential to the success of the fund leaving the investment firm.

- *Higher portfolio turnover* which can lead to higher tax burdens. Active funds could be structured to limit tax consequences, but the techniques used to do this can themselves be costly and risky. Managers who use such techniques need additional knowledge to navigate the applicable tax regulations, which of course vary by country and situation.

MODULE QUIZ 22.2

To best evaluate your performance, enter your quiz answers online.

1. **Explain** why actively managed portfolios are typically subject to higher fees and costs than passively managed portfolios.
2. **Explain** how shareholder engagement can benefit investors who are not actively involved in company issues.
3. **Identify** two disadvantages of shareholder engagement activities.
4. A client is concerned with low fees, seeks substantial value added versus their benchmark, has numerous ESG restrictions, and has selected a narrowly defined benchmark made up of large companies. Based on the client's concerns, **explain** *two* reasons the client should favor a passive approach and *two* reasons the client should favor an active approach.
5. Compared to passively managed funds, active funds tend to have higher research and trading costs. **Identify** and **describe** *two* additional types of risk for active managers and investors.

KEY CONCEPTS

LOS 22.a

The roles of equities in a portfolio include capital appreciation, dividend income, diversification benefits, and the potential to hedge inflation.

The allocation to equity must be consistent with the client's investment objectives and constraints. For investors with environmental, social, and governance (ESG) considerations, portfolio managers may apply negative or positive screening approaches to select appropriate companies or use thematic or impact investing techniques.

LOS 22.b

The equity investment universe can be segmented by:

- Size (market capitalization) and style (growth, value, or blended).
- Geographic segmentation (which includes developed markets, emerging markets, and frontier markets).
- Economic activity segmentation by sectors or industries. Classification can be based on a market-oriented or a production-oriented approach.
- Or combinations of the previous can be used.

LOS 22.c

Income can be generated from:

- Dividends, mostly in the form of regular dividends received.
- Lending securities for a fee and earning funds on cash collateral received.
- Writing options for the premium received.
- Dividend capture through buying a stock just before and selling it just after it goes ex-dividend.

Managers typically charge regular and some charge performance-based management fees. Some managers cover all services in the management fee. Others also charge additional fees for specific additional services, or coordinate with third-party providers who provide and charge fees for specific services. The bottom line is to determine the total fees regardless of how they are broken down.

Other costs to consider are:

- Transaction and trading costs, which may be explicit or implicit.
- Strategy costs—generally active strategies will have higher cost. Passive strategies may incur hidden costs such as predatory pricing when others anticipate and trade ahead of the passive investor.
- Liquidity demands—momentum strategies that buy in up or sell in down markets demand liquidity and typically pay high market impact costs. Contrarian strategies are

the opposite.

LOS 22.d

Shareholder engagement refers to shareholders and managers seeking to influence the companies they invest in through calls and/or shareholder voting. Engagement benefits the company with improved corporate governance. It may benefit shareholders through higher stock price. Free riders who don’t incur the costs of engagement also benefit.

Activist investors take this further and propose resolutions to be voted on and seek the support of others or engage in proxy flights to achieve their goals.

LOS 22.e

Equity portfolios are often characterized as being actively or passively managed. However, in practice, portfolios may exhibit characteristics from both investment strategies. Rationales for equity portfolios to span across the passive–active spectrum include manager confidence, client preferences, benchmark selection, client mandates, active management costs/risks, and taxes.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 22.1

1. Risk reduction is likely to be less than expected.
   - The correlations are likely to move upward towards 1.0.
   - The volatility of the assets is likely to increase.

   (LOS 22.a)

2.
   - It allows portfolio managers to analyze, compare, and construct performance benchmarks based on specific sectors or industries.
   - Diversification benefits are enhanced when investing across sectors or industries.

   (LOS 22.b)

Module Quiz 22.2

1. Such funds require more investment analysis and portfolio turnover than passively managed funds. (LOS 22.c)
2. They can earn a free ride, benefiting from the activities of others to increase the stock price without the time and cost of engagement. (LOS 22.d)
3. (1) The cost and time commitment from shareholders and management, (2) the desire to influence cash flows or stock prices in the short term, at the expense of long-term goals, (3) the potential for insider trading violations, and (4) the potential for conflicts of interest. (LOS 22.d)
4. Passive: (1) Passive managers can charge lower fees; (2) The narrowly defined benchmark of presumably efficient large cap stocks is not going to provide the opportunity for active managers to find ways to add value.

   Active: (1) Active management is required to meet the desired value added; (2) The ESG restrictions will require an active manager who uses various screening and other techniques to simultaneously meet this constraint *and* the overall objectives. This client sounds highly unrealistic in their objectives, but that was not the question asked. (LOS 22.e)

5.
   - Reputation risk results from violations to rules, regulations, client agreements, or moral principles.
   - Key person risk results from essential individuals leaving the investment firm. (LOS 22.e)

The following is a review of the Equity Portfolio Management (1) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #23.

READING 23: PASSIVE EQUITY INVESTING

Study Session 9

EXAM FOCUS

Video covering this content is available online.

This is the second of four equity readings. The first one is an introduction, the current reading discusses passive management, and the last two discuss active equity portfolio management. This reading starts by covering benchmarks and methods used in constructing indexes along with index rebalancing and reconstitution. The reading then shifts to discussing different approaches to investing passively (e.g., pooled investments such as ETFs). The focus then shifts to the construction of passively managed portfolios from full replication to optimization. The reading ends with a discussion on tracking error and attribution analysis.

MODULE 23.1: BENCHMARKS

LOS 23.a: Discuss considerations in choosing a benchmark for a passively managed equity portfolio.

CFA® Program Curriculum, Volume 4, page 338

An equity index used as a benchmark for equity investment strategies must be (1) rules-based, (2) transparent, and (3) investable.

Rules-based: The rules for including and excluding stocks in the portfolio, the weighting scheme, and the rebalancing frequency must be consistent, objective, and predictable so investors can replicate the investment performance of the index.

Transparent: The rules underlying the index are public, clearly stated, and understandable to investors.

Investable: Investors can replicate the return and risk performance of the index.

Considerations in choosing a benchmark include (1) determining the desired market and risk exposures, and (2) identifying the methods used in constructing and maintaining the index.

Market and Risk Exposures

The choice of portfolio exposure includes the choice of which markets to invest in as well as the various risks the portfolio will be exposed to. Overall, these choices depend on the investor's risk and return objectives and portfolio constraints identified in the investment policy statement.

Some examples of **market exposure** choices are:

- Choosing between broad market exposure and focused exposure to certain sectors.
- Choosing between domestic or international exposure.
- Choosing among developed, emerging, or frontier markets.

The **risk factor exposure** of a passive portfolio refers to the expected sensitivity of portfolio returns to various risk factors. Recall that a multifactor model of returns uses multiple risk factors, while the CAPM is based on a single-factor market risk. Examples of risk factors used in portfolio construction include market risk (beta), firm size, style (e.g., growth vs. value), and prior returns (momentum). Other factors considered include the liquidity, volatility, and firm "quality." We examine portfolio risk factors in greater detail later in this review.

Identifying the Methods Used in Constructing and Maintaining an Index

The construction of an index starts with the method of identifying stocks to include; this method can be **exhaustive** (every stock in a defined universe; e.g., the CRSP U.S. Total Market Index) or **selective** (a subset of stocks within a universe; e.g., the S&P 500 Index or the Dow Jones Industrial Average [DJIA]).

Methods of index-weighting include (1) market-cap weighting, (2) price weighting, (3) equal weighting, and (4) fundamental weighting.

Market-cap weighting refers to weighting each portfolio stock by its total market capitalization as a percentage of the total capitalization of all the stocks in the index. The market portfolio in the CAPM and many indexes, such as the S&P 500, are market-cap weighted. The most common market-cap weighting method in practice is based on each stock's free-floating shares (i.e., outstanding shares that are not closely held and, therefore, available for trading by market participants).

Price weighting refers to weighting each portfolio stock by its price. This can be achieved with a portfolio that holds an equal number of shares of each index stock, which gives stocks with higher share prices larger index weights. The DJIA is an example of a price-weighted index.

Equal weighting refers to investing equal amounts in each portfolio stock. Equal weighting reduces concentration risk, especially compared to market-cap weighting for the large-cap segment where capitalizations vary widely. For example, the weight of the five largest firms in the S&P 500 Index in 2018 was greater than the weight of the 250 smallest firms in the index. Equal weighting also reduces changes in sector exposures as market prices change compared to market-cap weighting. Equal weighting is factor-indifferent; it randomizes factor mispricing and, because of its small-cap bias relative to market-cap weighting, returns are more volatile than for market-cap weighting. Equal weighting can produce marginally better returns before transaction costs when stock prices vary around their intrinsic values.

Fundamental weighting refers to weighting index stocks by their proportions of the total index value of a fundamental factor, such as sales, income, or dividends. For example, a stock of a firm that pays 3% of all the dividends paid by index companies will have a 3% weight in a dividend-weighted index.

Stock concentration is a key concern in the selection of the appropriate index. Concentration can be captured using the concept of "effective number of stocks," which can be measured using the **Herfindahl-Hirschman index** (HHI). HHI is the sum of the squared weights of the individual stocks in the portfolio:

$$HHI = \sum_{i=1}^{n} w_i^2$$

where:

n = number of stocks in the portfolio

w_i = weight of stock *i*

HHI ranges from $\frac{1}{n}$ (an equally weighted portfolio) to 1 (a single stock portfolio), so as HHI increases, concentration risk increases.

The *effective number* of stocks is the reciprocal of the HHI:

$$\text{effective number of stocks} = \frac{1}{\text{HHI}}$$

For example, a market-cap weighted index with 500 stocks might have an HHI of 0.01 and, therefore, an effective number of stocks of $\frac{1}{0.01}$ = 100. The fact that 100 is less than the number of stocks in the portfolio reflects the disproportionate effect of the largest capitalization stocks in the index. An *equal weighted* index of 500 stocks would have an HHI of 0.002 and an effective number of stocks of $\frac{1}{0.002}$ = 500.

Rebalancing is the process of adjusting portfolio weights as index weightings change. For an equal weighted index, portfolio weights are no longer equal as soon as prices change. Price-weighted index weights change in response to stock splits and stock dividends. Market-cap-weighted portfolio weights require rebalancing when index firms issue new shares or repurchase shares in a significant amount. Rebalancing incurs trading costs (and possibly tax costs) and will decrease returns. To reduce such costs, rebalancing is often done only periodically, often quarterly.

Reconstitution is the process of removing and replacing stocks that no longer fit the desired market exposure of an index. For example, if a small-cap stock's capitalization increases, it may become a mid-cap stock and have to be removed from and possibly replaced in a small-cap index. Rebalancing will also reduce index portfolio returns as trading costs are incurred.

Two practices are used to reduce trading costs associated with migration of a stock between indexes on reconstitution dates. **Buffering** refers to the practice of establishing a threshold level for the change in a firm's capitalization rank that must be met before moving it from one index to another on a reconstitution date. Consider a large-cap index comprising the

stocks of the 200 largest firms in a market and a mid-cap index of the next 300 stocks in capitalization rank. If a firm in the mid-cap index increases in capitalization so that it is one of the largest 200 firms, it is not actually moved into the large-cap index until its rank increases beyond the *buffer zone*—for example, until it has reached the size rank of 150 or higher at the next reconstitution date.

An alternative method of reducing the transaction costs of stock migration among indexes is termed **packeting**. With packeting, when a mid-cap company's capitalization increases so that it qualifies as large-cap stock, half of the portfolio position is moved to the large-cap index on the reconstitution date. If the stock still meets the criteria for inclusion in the large-cap index at the next reconstitution date, the remainder of the position is moved from the mid-cap to the large-cap index.

LOS 23.b: Compare passive factor-based strategies to market-capitalization-weighted indexing.

CFA® Program Curriculum, Volume 4, page 345

The CAPM is a single-factor model in which the only risk factor that drives returns is the return on the market portfolio, and the risk of individual securities is measured by their beta (market risk). Multifactor models consider multiple risk factors, and returns on individual securities are the result of their exposures to, and the returns to, these risk factors. Fama and French (2015) identify five risk factors that can be used to explain the variation in (total) returns across equity securities. These five factors are:

- Market risk (based on beta, standardized covariance of returns with the return on the market).
- Firm size (market value of equity).
- Book-to-market value (shareholders' equity divided by market value of equity).
- Operating profitability (operating income divided by beginning shareholders' equity).
- Investment intensity (growth rate of total assets).

Indexes with a high exposure to a specific risk factor are created to allow investors to augment or replace a market-cap-weighted index based on their beliefs about future returns to the various risk factors. Available indexes with greater or less exposure to a factor than broad-based index funds are typically structured as **exchange-traded funds** (ETFs).

Factor-weighted portfolios are rules-based, so they have lower operating costs than traditional actively managed funds but typically have higher costs than large-cap-weighted index funds. Factor-based index funds themselves are considered passive, as they are rules-based and typically transparent and replicable. However, emphasizing some factors and de-emphasizing others relative to the overall market portfolio is a form of active portfolio management.

Returns-oriented indexes and strategies include the following:

- Momentum-based indexes typically overweight stocks that have outperformed a benchmark index over the most recent period of a specified length.

- Dividend yield strategies often overweight stocks with relatively high dividends, or dividend growth rates.
- Fundamental-weighted index strategies are based on company fundamentals such as dividends, sales, and income.

Passive factor-based strategies frequently involve an element of active decision-making by altering the risk factor exposures and exploiting out-of-favor factors in an attempt to increase returns relative to a market-cap-weighted portfolio. Decisions regarding factor selection, weighting, and rebalancing tend to be transparent, allowing other investors to mimic the strategy. This can reduce or eliminate the opportunity for higher returns. The buy-sell actions of investors may move prices and reduce or eliminate the opportunity for increased factor returns.

There are three types of passive factor-based strategies: (1) return oriented, (2) risk oriented, and (3) diversification oriented.

Return-oriented strategies include dividend yield, momentum, and fundamentally weighted strategies, as noted previously.

Risk-oriented strategies include volatility weighting (where the weights are the inverse of price volatility) and minimum-variance investing (using the traditional Markowitz framework), where portfolios are selected that minimize portfolio variance, subject to constraints (such as maximum or minimum sector or country weights). The advantages of risk-oriented strategies are that they are simple and provide risk reduction. However, they are based on past return data, and as such may not reflect future conditions and outcomes.

Diversification-oriented strategies include equally weighted portfolios (as discussed previously) and maximum diversification strategies (achieved by maximizing the ratio of the weighted average volatility of the individual stocks to the portfolio volatility).

Passive factor-based strategies often use multiple benchmarks, including both factor-based and market-cap-weighted indexes, which can increase tracking error.

The advantage of passive factor-based investing is that it is typically less costly than active management but still allows for different factor exposures based on the investor's view of future factor returns. A disadvantage is that, relative to passive cap-weighted investing, management fees and trading commissions are typically higher.

MODULE QUIZ 23.1

To best evaluate your performance, enter your quiz answers online.

1. Which of the following is a necessary characteristic for an equity index to have in order to use it as a benchmark for a passively managed equity portfolio?
   A. Selective.
   B. Investable.
   C. Flexible.
2. A small-cap, high P/E factor-based investment strategy is *best* classified as:
   A. risk oriented.
   B. return oriented.

C. diversification oriented.

MODULE 23.2: APPROACHES TO PASSIVE INVESTING

Video covering this content is available online.

LOS 23.c: Compare different approaches to passive equity investing.

CFA® Program Curriculum, Volume 4, page 349

Three common approaches to passive equity investing involve the use of (1) pooled investments, (2) derivatives-based strategies, and (3) separately managed index-based portfolios.

Pooled investments include open-end mutual funds and ETFs. The advantages of open-end mutual funds are low transaction costs and the convenience of the fund structure. The advantages of ETFs are that they trade intraday (not just at market close each day) and they do not have to sell stocks in response to shareholder redemption requests. This eliminates taxable gains from portfolio stock sales that shareholders are exposed to with open-end mutual funds. The disadvantages include higher transaction costs from commissions and the bid-ask spread, as well as possible illiquidity in some ETF secondary markets.

Derivatives-based strategies use derivatives (options, futures, and swap contracts) to recreate the risk/return performance of an index. Derivative positions used to adjust the existing portfolio risk and return exposures may be called *overlay positions*, reflecting that they are used to modify the underlying portfolio positions. *Completion overlays* can move the portfolio back to the risk exposure of the index, for example, by adjusting the portfolio's beta to match the index beta. *Rebalancing overlays* can efficiently and cheaply match the reconstitution of the index as securities are added and dropped. *Currency overlays* adjust the foreign exchange risk of portfolio holdings denominated in a foreign currency.

Advantages of using equity index derivatives (options, futures, and swaps) over cash-based portfolio construction techniques are that derivatives:

- Can be used to quickly adjust a portfolio's factor exposures at low cost.
- Trade in liquid markets.
- Make it easy to leverage the portfolio.

Disadvantages include:

- Derivative positions have finite expirations, so they must be rolled over at or near expiration.
- Some contracts have position limits.
- Specialty portfolio needs might not be met by the existing offerings of exchange-traded derivative contracts.
- OTC derivatives introduce counterparty risk.
- Basis risk can increase tracking error.

Separately managed equity index-based portfolios hold all the constituent stocks in the index or a representative sample. They require regularly updated data on the index; sophisticated trading and accounting systems; well-established broker relationships to facilitate program trading and lower trading commissions; and compliance systems to ensure compliance with laws, regulations, and internal company policies.

LOS 23.d: Compare the full replication, stratified sampling, and optimization approaches for the construction of passively managed equity portfolios.

CFA® Program Curriculum, Volume 4, page 358

Passively managed index-based equity portfolios can be constructed by (1) full replication (hold all of the securities in the index), (2) holding a sample of the securities based on stratified sampling, or (3) using more complex optimization to maximize desirable characteristics while minimizing undesirable characteristics. In practice, a blend of these approaches may be used.

Full Replication

Full replication can be costly when there are large numbers of stock and liquidity is limited. The portfolio must be regularly reconstituted and rebalanced. The advantage of full replication is that it closely matches the index return (before transaction costs).

Stratified Sampling

To reduce the costs of full replication but still approximate the factor exposures of the underlying index, a manager may use **stratified sampling**. With stratified sampling, index stocks are divided into strata (subsets) based on key risk characteristics. Random samples of stocks within each strata are selected for inclusion in the portfolio. The weight of the stocks selected for each strata are such that the portfolio risk factor exposures match those of the index portfolio.

The strata of the constituent stocks must be mutually exclusive and exhaustive. The strata are often formed across multiple dimensions; for example, one strata may contain large capitalization stocks that have high-dividend yields and low momentum. Industry sector and country of domicile are also candidates for the characteristics of strata. The more criteria used in constructing strata, the smaller the tracking error—the degree to which the portfolio performance deviates from the index.

The manager must consider size of the sample used (i.e., how closely to approach full replication). Initially, tracking error declines as the size of the sample is increased. The manager will naturally first purchase the largest, most liquid, lowest cost stocks. But as more stocks are added and the portfolio approaches full replication, the added stocks will be less liquid, increasing the effect of transaction costs on tracking error.

Optimization

Optimization uses mean-variance analysis to minimize tracking error. The optimization

typically maximizes a desirable result (e.g., returns) or minimizes an undesirable characteristic (e.g., variance), subject to one or more constraints. For an index portfolio, optimization seeks to minimize tracking error relative to the underlying index, and constraints may include a minimum number of stocks, a style tilt that matches that of the underlying index, or a minimum capitalization, among other possibilities. Optimization can be combined with stratified sampling, with optimization performed on each strata of a stratified sample.

A drawback of optimization is that it is based on historical relationships, which will change over time. Maintaining the optimal weights as these relationships change can be costly. Additionally, minimization of tracking error can result in portfolios that are not mean-variance efficient.

The advantages of optimization techniques are reduction of tracking error relative to stratified sampling and that they explicitly account for the covariances of constituent stock returns, rather than relying on a characteristic, such as industry sector, in constructing the portfolio.

Blended Approach

Full replication is preferred for indexes with small numbers of similar liquid stocks, while stratified sampling or optimization is preferable for indexes with many heterogeneous, thinly traded, small-capitalization stocks. For indexes with a large number of stocks—ranging from large and liquid to small and thinly traded, such as the Wilshire 5000—the manager may use a blended approach, with full replication for large liquid index stocks and stratified sampling or optimization for index stocks that are thinly traded.

MODULE QUIZ 23.2

To best evaluate your performance, enter your quiz answers online.

1. **Discuss** *two* advantages and *two* disadvantages of using equity index derivatives versus cash-based strategies for passive equity investing.
2. **Discuss** the advantages and disadvantages of using ETFs to implement a passive equity investing strategy.
3. As the number of constituent stocks in an index increases, the tracking error of a passively managed portfolio that uses the index as a benchmark will *most likely*:
   A. increase.
   B. decrease.
   C. first decrease and then eventually increase.

MODULE 23.3: TRACKING ERROR, RETURN, AND RISK

Video covering this content is available online.

LOS 23.e: Discuss potential causes of tracking error and methods to control tracking error for passively managed equity portfolios.

CFA® Program Curriculum, Volume 4, page 363

Causes of Tracking Error

Tracking error refers to the standard deviation of the differences between index portfolio returns and published index returns. Differences between portfolio returns and index returns are caused by:

- Management fees.
- Commissions on trades.
- Sampling—compared to full replication, sampling typically increases tracking error.
- Intraday trading, because index returns are based on closing prices.
- Cash drag—index funds may hold cash balances that reduce returns in rising markets and increase returns in falling markets, as cash returns differ from index returns.

Controlling Tracking Error

Reducing tracking error involves a tradeoff between the higher trading costs of full replication and the increased potential for tracking error that comes with sampling. Even a passive index fund must do some trading in response to cash inflows and outflows and to reinvest dividends. Derivative positions in index futures can be used to reduce cash drag.

LOS 23.f: Explain sources of return and risk to a passively managed equity portfolio.

CFA® Program Curriculum, Volume 4, page 365

Attribution Analysis

The manager of a passively managed equity portfolio needs to understand the sources of index returns in order to effectively manage a portfolio intended to replicate index returns. **Attribution analysis** can be used to help the manager identify the sources of tracking error and hopefully reduce them.

PROFESSOR'S NOTE

Attribution analysis is covered in more detail in a separate section of the curriculum.

Securities Lending

As discussed earlier, large passive portfolios can lend securities to generate additional income, which can offset management fees (and other costs as well if management fees are quite low), thereby reducing tracking error.

Proxy Voting

Even passive managers have a fiduciary duty to vote the proxies of portfolio stocks in the best interests of their investors. By voting in ways that improve operations, better manage risk, or provide better board oversight and corporate governance, returns to index stocks may be increased. Voting proxies effectively can be a costly undertaking for a passive manager who must research a myriad of corporate issues across a broad portfolio of companies. Because of that, many passive managers use proxy-voting services.

MODULE QUIZ 23.3

To best evaluate your performance, enter your quiz answers online.

1. **Explain** what cash drag is and how it results in tracking error.
2. **Explain** why tracking error is a better measure of a passive equity manager's skill than excess return.
3. **Explain** how securities lending can reduce tracking error in passively managed index portfolios.

KEY CONCEPTS

LOS 23.a

An equity index as a benchmark for equity investment strategies must be (1) rules-based, (2) transparent, and (3) investable.

Considerations in choosing a benchmark include (1) determine the desired market exposures, (2) be consistent with the client's objectives and constraints, and (3) identify the method used for constructing the index.

Constructing and maintaining an index involves the following:

- The weighting method to construct the index: (1) market-cap weighting, (2) price weighting, (3) equal weighting, or (4) fundamental weighting.
- Considering the level of stock concentration. The effective number of stocks can be determined as the reciprocal of the Herfindahl-Hirschman index (HHI).

  $$HHI = \sum_{i=1}^{n} w_i^2$$

  effective number of stocks = $\frac{1}{\text{HHI}}$
- The frequency of rebalancing (updating the weights of the stocks in the index) and reconstitution (removing and replacing stocks that no longer fit the index market exposure).

LOS 23.b

The return/risk characteristics of an index can be replicated by creating a portfolio with the same exposures to a set of risk factors as the index. This strategy is called a passive factor-based strategy.

Common factors are growth, value, size, yield, momentum, quality, and volatility.

There are three types of passive factor-based strategies: (1) return oriented, (2) risk oriented, and (3) diversification oriented.

LOS 23.c

Three common approaches to passive equity investing involve the use of (1) pooled investments, such as open-end mutual funds and ETFs, (2) derivatives-based strategies, and (3) separately managed index-based portfolios.

LOS 23.d

The three methods of constructing passively managed index-based equity portfolios are (1) hold and match the weights of all the securities in the index (full replication), (2) select a more liquid sample of securities to replicate the index (stratified sampling, often based on cell matching), (3) use a more technical and quantitative approach (optimization) to maximize desirable characteristics, and/or (4) minimize undesirable characteristics. Blended approaches

using a combination of these methods are also common.

LOS 23.e

Tracking error initially declines as sample size increases but then increases as costs (transaction, management, and illiquidity) outweigh the gains of increasing sample size. Intraday trading and cash drag also create tracking error.

Reducing tracking error requires a continuing evaluation of the tradeoff between the benefits of larger sample size and increasing costs. Derivatives can be used to reduce the effects of cash drag.

LOS 23.f

Attribution analysis is a key tool in helping the manager identify the sources of tracking error.

Securities lending can generate fee income to offset some of the costs of managing the portfolio and reduce tracking error.

Corporate governance and investor activism are important for both passive and active investors.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 23.1

1. **B** An equity index that is suitable as a benchmark should be rules-based, transparent, and investable. (LOS 23.a)

2. **B** Fundamentally weighted factor exposure strategies are considered to be return oriented because such strategies focus on the factors that have determined differences in return. (LOS 23.b)

Module Quiz 23.2

1. Advantages: Derivatives are (1) a quick, efficient, and cheap way to adjust exposure and (2) trade in liquid markets.

   Disadvantage: Derivatives (1) have finite expirations and so have to be rolled over, (2) some contracts have position limits, (3) specialty portfolio needs might not be met by the existing offering of exchange-traded derivative contracts, (4) OTC derivatives have counterparty risk, and (5) basis risk can increase tracking error. (LOS 23.c)

2. Advantages: ETFs handle shareholder redemptions more cheaply and efficiently than open-end mutual funds through in-kind delivery of stock. This reduces taxable gains and losses that would otherwise be passed on to shareholders.

   Disadvantages: Transaction costs from commissions and the bid-ask spread as well as illiquidity in some ETF secondary markets. (LOS 23.c)

3. **C** Adding to the sample size with liquid stocks first reduces tracking error; but as less liquid stocks are added, the costs and tracking error increase. (LOS 23.d)

Module Quiz 23.3

1. Even passive portfolios have some cash flows and some cash holdings, while indexes represent theoretical fully invested performance. Over time the cash is a low return asset, reducing the passive portfolio's return. The underperformance increases tracking error. (LOS 23.e)

2. The goal is to consistently match the index's performance and zero (or low) tracking error indicates a perfect (or close) match. (LOS 23.e)

3. Passive portfolios can lend their portfolio stocks to generate fee income (or return on collateral) and cover portfolio expenses. This can produce a better match of index performance, lowering tracking error. (LOS 23.f)

The following is a review of the Equity Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #24.

READING 24: ACTIVE EQUITY INVESTING: STRATEGIES

Study Session 10

EXAM FOCUS

This reading focuses on active equity management strategies. It covers factor-based, activist, statistical arbitrage, fundamental, and quantitative strategies. It concludes with style classification based on holdings-based versus returns-based analysis. You will need to know the vocabulary and be able to understand the output, pros, and cons of the processes covered here.

MODULE 24.1: FUNDAMENTAL VS. QUANTITATIVE APPROACHES

Video covering this content is available online.

LOS 24.a: Compare fundamental and quantitative approaches to active management.

CFA® Program Curriculum, Volume 4, page 386

Active equity investing seeks to outperform a passive benchmark. At the broadest level these approaches can be divided into two categories: *fundamental* and *quantitative*.

Fundamental approaches are *subjective in nature*, relying on analyst discretion and judgment. An analyst will carry out and collate research on companies, markets, and economies; then using their skill and experience to estimate the intrinsic value of securities. The research will typically use the company's financial statements as well as insight into its business model, management team and industry positioning to establish a valuation of the company's shares.

These fundamental insights are used to generate forecasts. Higher conviction ideas will receive a larger weight in the portfolio, subject to risk parameters set out in fund mandates. Compared to the quantitative approach, there are likely to be fewer positions in the portfolio and the allocation to each will be larger. Risks to the strategy lie at the individual company level if the analyst has misestimated intrinsic value, or that the market fails to recognize the mispricing and the security remains mispriced. The fundamental manager continuously monitors stock positions and rebalances at any time according to their current opinion.

Quantitative approaches are *objective in nature*, relying on models that generate systematic rules to select investments. Expertise is required in statistical modeling, typically using large amounts of data. Historical data is analyzed to identify relationships between equity returns and variables (called *factors*) that have predictive power. These variables could relate to

valuation (e.g., P/E ratio), size (e.g., market capitalization), financial strength (e.g., debt-to-equity ratio), and industry sector or price related attributes (e.g., price momentum).

Quantitative managers focus on identifying relationships between returns and factors across a large group of securities, spreading their factor bets across smaller positions in a larger number of holdings. Portfolio optimization is used to set weights in the portfolio that maximize expected portfolio alpha or information ratio. Risks to the strategy lie at the portfolio level if the factors do not deliver the performance as predicted by the model. The quantitative manager automatically rebalances according to the systematic rules of the strategy at predetermined intervals such as monthly or quarterly.

PROFESSOR'S NOTE

Do not be overly rigid with these definitions. A fundamental manager could use quantitative techniques such as free cash flow modeling, screening, or regression to help establish their opinion. Likewise, quantitative models can be based on data relating to fundamental company information found in their financial statements. The key takeaway is that when it comes to the decision to invest, fundamental investing is based more on an opinion and quantitative investing is based more on rules derived from data driven modeling.

TYPES OF ACTIVE MANAGEMENT STRATEGIES: BOTTOM-UP VS. TOP-DOWN

LOS 24.b: Analyze bottom-up active strategies, including their rationale and associated processes.

LOS 24.c: Analyze top-down active strategies, including their rationale and associated processes.

CFA® Program Curriculum, Volume 4, pages 391 and 398

Both fundamental and quantitative managers can be further categorized as either bottom-up or top-down strategies.

Bottom-up strategies use information about individual companies such as profitability or price momentum to build portfolios by selecting the best individual investments. **Top-down strategies** use information about variables that affect many companies such as the macroeconomic environment and government policies to build portfolios by selecting the best markets or sectors.

Managers can use a blend of bottom-up and top-down approaches. For example, a top-down strategist sets target country or sector weights, and then bottom-up portfolio managers select the best investments consistent with these weights. Or the bottom-up managers could drive the portfolio construction process through selecting the best individual investments, with a top-down-based *derivatives overlay* added to remove unintended macro exposures.

Bottom-Up Strategies

Quantitative bottom-up managers look for quantifiable relationships between company-level information (e.g., P/E ratio) and expected return that will persist into the future.

Fundamental bottom-up managers incorporate both quantifiable and qualitative characteristics of individual companies into their analysis (e.g., business model and branding, competitive advantage, and quality of company management and corporate governance).

PROFESSOR'S NOTE

The key takeaway is that fundamental bottom-up managers are looking for companies with strong business models, high brand quality and loyalty, strong competitive advantage and good management teams with solid corporate governance, because these companies may be best positioned to outperform their peers in the future.

Types of bottom-up strategies include both **value-based** and **growth-based** approaches, the sub-styles of which are summarized below:

Value-based approaches attempt to identify securities that are trading below their estimated intrinsic value. Sub-styles of value investing include the following:

- **Relative value**: Comparing price multiples such as P/E and P/B to peers. An undervalued company has an inexplicably low multiple relative to the industry average.
- **Contrarian investing**: Purchasing or selling securities against prevailing market sentiment. For instance, buying the securities of depressed cyclical stocks with low or negative earnings.
- **High-quality value**: Equal emphasis is placed on both intrinsic value and evidence of financial strength, high quality management, and demonstrated profitability (the "Warren Buffet" approach).
- **Income investing**: Focus is on high dividend yields and positive dividend growth rates.
- **Deep-value investing**: Focus is on extremely low valuations relative to assets (e.g., low P/B), often due to financial distress.
- **Restructuring and distressed debt investing**: Investing prior to or during an expected bankruptcy filing. The goal is to release value through restructuring the distressed company or through the company having sufficient assets in liquidation to generate appropriate returns.
- **Special situations**: Identifies mispricings due to corporate events such as divestures, spin-offs, or mergers.

Growth-based approaches attempt to identify companies with revenues, earnings, or cash flows that are expected to grow faster than their industry or the overall market. Analysts will be less concerned about high valuation multiples and more concerned about the source and persistence of the growth rates of the company. Focus could be on:

- Consistent long-term growth.
- Shorter-term earnings momentum.
- **GARP** (growth at a reasonable price); looking for growth at a reasonable valuation. Often this strategy will use the P/E-to-growth (PEG) ratio, which is calculated as the stock's P/E ratio divided by expected earnings growth in percentage terms.

EXAMPLE: Bottom-up strategy securities selection

Company	Share Price	Price to Book Value Ratio	Price to 12-Month Forward EPS	5-Year EPS Growth Forecast	Dividend Yield	Sector Average P/E
TW	3	0.75	1.5	–10%	–0.00%	8
NB	15	7.50	15.0	10%	1.0%	12
SO	30	10.00	20.0	2%	2.0%	30
TO	12	3.00	13.6	4%	9.0%	14

Based on the information in the table, determine which bottom-up investment strategy would most likely select each security. You must choose from the following list and each choice must be used only once.

- Deep value (of assets) investing
- GARP
- Income investing
- Relative value investing

Solution:

TW has the lowest P/B ratio 0.75. This low valuation of assets suggests a deep value approach would be appropriate, provided the analyst addresses reasons for the low valuation.

NB has the lowest PEG ratio of 15 / 10 = 1.5, which is substantially lower than the PEG ratio of the other stocks with positive earnings. This suggests GARP strategies might select this security.

SO has the lowest P/E of 20 versus its sector average of 30; a ratio of only 0.67. This suggests a relative value strategy might select this security, provided there are no obvious reasons why the valuation discount might exist. Note that TW has an even lower P/E versus its sector average P/E at 1.5 / 8 and would also appeal to a relative value strategy. But TW is the only security trading at a P/B below 1 and would be the only security likely to appeal to a deep discount strategy. TW must be selected for deep discount to meet the direction to use each strategy only once.

TO has the highest dividend yield of 1.08 / 12 = 9% which is substantially higher than the other securities. This suggests this company is a good candidate for income investing approaches.

Top-Down Strategies

Both fundamental and quantitative managers could use a top-down approach focusing on the overall macroeconomic environment and broad market variables rather than information relating to individual investments.

Top-down managers typically use broad market ETFs and derivatives to overweight the best markets and underweight the least attractive markets according to the following dimensions:

- Country/geography.
- Industry sector.
- Volatility: Volatility trading can be conducted through VIX futures, variance swaps, or option volatility strategies such as straddles.
- Thematic investment strategies: Focus on opportunities presented by new technologies, changes in regulations, and economic cycles. Themes could be long term and structural such as the shift to cloud computing, blockchain technology, or clean energy. Themes might also be shorter term in nature such as the impact on the value of a currency of a major political vote.

PROFESSOR'S NOTE

Recognize that the CFA curriculum will often list terms with no further explanation. Unless a term is discussed in detail, you are not responsible for researching that term. On the other hand, straddles are discussed in derivatives, which is located near the end of the Level III curriculum, so of course you will want to be familiar with the basics of how a straddle works, by exam day.

The top-down allocation to country/geography and industry sector could be complemented by further insights from a fundamental bottom-up approach, which values a market through aggregation of the individual companies.

The proliferation over recent years of structured products and focused ETFs has provided managers with greater flexibility in implementing passive factor investing (sometimes referred to as 'smart beta' products), allowing the manager to target a specific style or sector at a time when they believe it will outperform.

PROFESSOR'S NOTE

Smart beta is just another example of a new term for an old idea. In original CAPM theory, beta is the systematic risk of the market, and investors should earn a return based on their level of systematic risk exposure. Then CAPM expanded to include other priced risk factors such as market cap and value/growth. Now, smart beta expands that idea by suggesting you identify factors (betas) that are related to systematic return and rotate your portfolio exposures into those betas (factors) that are expected to outperform. So, a smart beta approach is a form of top-down that identifies basic drivers of return as opposed to a bottom-up approach of identifying individual security misvaluations.

MODULE QUIZ 24.1

To best evaluate your performance, enter your quiz answers online.

1. Screening stock markets to identify companies with low price-to-book ratios for subsequent in-depth analysis is a process that could be used by:
   A. quantitative managers only.
   B. fundamental manager only.
   C. both fundamental and quantitative managers.
2. An active bottom-up manager aims to identify companies that have securities that are undervalued relative to the amount that would likely be received in a bankruptcy liquidation situation. This manager's strategy can be *best* described as:
   A. relative value.
   B. restructuring and distressed debt investing.
   C. deep value.
3. Which of the following active equity fund managers is *least likely* following a top-down investment approach?
   A. A manager that uses generalized autoregressive conditional heteroskedasticity (GARCH) models to forecast the volatility of U.S. market with the aim of buying options in times of low implied volatility and selling options in times of high implied volatility.
   B. A manager that aims to identify growth at a reasonable price (GARP) for individual components of the S&P 500.
   C. A manager that aims to identify subsectors of the energy and industrial goods sector that are likely to suffer due to changes to global climate change regulation.

MODULE 24.2: TYPES OF ACTIVE MANAGEMENT STRATEGIES

Video covering this content is available online.

Factor-Based Strategies

LOS 24.d: Analyze factor-based active strategies, including their rationale and associated processes.

CFA® Program Curriculum, Volume 4, page 401

A *factor* is a variable or characteristic with which asset returns are correlated. Typical examples are the size and value factors introduced by Fama and French (1993) in their multifactor model. They noticed that smaller companies tend to offer higher returns than larger companies (the *size* factor), and stocks with higher book values relative to market values tended also tended to outperform (the *value* factor). When such factors are identified, they can be used to rank stocks for investment with the aim of predicting future returns or risks.

Factors that are shown to have a positive association with a long-term positive risk premium are referred to as *rewarded* factors. Care must be taken when identifying factors to avoid factors that do not offer a persistent return (so-called *unrewarded* factors). It is very important that a factor makes intuitive sense. If not, aggressive backtesting of historical data will likely find spurious relationships that will not persist into the future.

PROFESSOR'S NOTE

These factors are the raw ingredients of quantitative (rule-driven) strategies but are also key ideas behind fundamental (judgment based) approaches we have already discussed. Once again, remember that the difference between the fundamental and quantitative approaches is not the rationale for outperformance, but how the decision to invest is made: fundamental is more subjectively driven by the managers and analysts, while quantitative is driven more by rules derived from historical data.

Identifying Factor Performance: The Hedged Portfolio Approach

Pioneered by Fama and French, the hedged portfolio approach follows the following process:

- Rank the investable stock universe by the factor (e.g., for the size factor, rank by market capitalization).
- Divide the universe into quantiles. A quantile is a defined percentage proportion of the universe. For example, the top 10% quantile for the size factor comprise the smallest 10% companies. Typical quantiles are deciles (10%) or quintiles (20%).
- Form a long/short portfolio by going long the best quantile and shorting the worst quantile. For the size factor based on deciles, this portfolio would buy the smallest 10% of the stock universe and short sell the largest 10% of the stock universe.
- The performance of this long/short portfolio is tracked over time and represents the performance of the factor.

Drawbacks to the hedged portfolio approach include:

1. The information in middle quantiles is lost in this approach. It could be that the best performing companies are not in the top quantile, but in a middle quantile. By going long and short the extreme quantiles this would be overlooked in construction of the factor.
2. It is assumed that the relationship between the factor and stock return is linear. In other words, as the factor increases, expected returns increase by a constant amount. Any nonlinear relationship between factors and performance will not be captured by the approach.
3. Portfolios can appear diversified when the manager uses multiple factors to select securities. But if the factors are highly correlated with each other, the diversification is likely to be less than expected.
4. The approach assumes the manager can short stocks to create the hedged portfolio.
5. The hedged portfolio is not a "pure" factor portfolio because it will typically have significant exposures to other risk factors.

A *factor mimicking portfolio* is a theoretical long/short portfolio that is dollar neutral with a unit (i.e., one-for-one) exposure to a chosen factor and an exposure of zero to other factors. These theoretical portfolios tend to be spread across a broad array of stocks. Managers may encounter liquidity and short selling constraints when attempting to construct them.

Investors who are restricted to long-only positions can tilt the portfolio toward factors that are expected to outperform the overall benchmark. If the tilts are modest the portfolio will still have low tracking error and could be considered an enhanced indexing strategy.

Types of Style Factor

Remember that factors can be constructed in any way that the manager chooses. The real value added is in identifying which factors will be predictive of the future.

Factor	Construction	Rationale for Risk Premium
Size	Long: small cap stocks Short: large cap stocks	Small companies at more risk of failure than large established companies
Value	Long: cheap; stocks with high book values to market values, high cash flows and/or low-price multiples Short: expensive companies with the opposite attributes	Could be explained by cheaper companies being more likely to be in financial distress—could also be explained by behavioral biases of market participants
Price momentum	Long: stocks that have recently outperformed Short: stocks that have recently underperformed	Behavioral biases such as belief in momentum that lead to an expectation that recent performance trends will continue
Growth	Long: companies with high historical or expected growth rates in earnings, revenues, and/or cash flows Short: companies with the opposite low growth prospects	Higher than average growth considered an indicator for strong future stock price performance
Quality	Long: companies with high quality earnings, evidenced by low non-cash accrual earnings and/or measures relating to changes in debt levels, profitability, stability or management efficiency measures; market sentiment measures based on analyst revisions could also be used; recent developments include natural language processing (NLP), which gauges sentiment through analysis of the type of language used in news stories Short: companies with low earnings quality with the opposite attributes to the long	Companies with higher quality earnings or improvement in sentiment are likely to outperform those with low quality earnings and deteriorating sentiment

	portfolio	
Unstructured data	Uses big data, which includes both conventional market data and new forms of alternative unstructured data (e.g., satellite images, textual data, credit card data, or social media comments) An example is the customer-supplier-chain factor Long: companies with the largest customers that have the best trailing one-month stock price return. Short: companies with the largest customers that have the worst trailing one-month stock price return	Various rationales exist based on the nature of the big data used

Factor Timing

A common subcategory of factor investing is *equity style rotation*, where the manager believes that different factors work well at different times. These strategies allocate to portfolios that represent factor exposures when that particular style is expected to outperform.

Having constructed factors of interest, an analyst might want to investigate what market conditions lead to the factor outperforming. This could involve regressing factor performance against a variable, which is suspected to be a key driver of factor performance. This process is considered in the next example.

EXAMPLE: Establishing drivers of style factor performance

A quantitative manager is investigating whether central bank interest rate decision surprises are a key variable in driving equity style factor performance. They are particularly interested in the three factors of the Fama and French model: market risk, size, and value.

The manager collects monthly performance data for the three style factors and regresses these factor returns against a custom defined variable, $ISurprise_t$ that measures the extent of the surprise of an interest rate decision in a given month *t*. The variable is calculated by comparing the actual interest rate decision of the central bank with the expectations priced into Eurodollar futures contracts the day before the decision.

- A high value for ISurprise_t indicates that the central bank decision was to target rates that were higher than that expected by market participants.
- A low value of ISurprise_t indicates the central bank announced a target policy rate that was below market expectations.

The analyst explores possible contemporaneous and lagged relationships by performing two regressions using the current month's and the next month's factor returns respectively against the variable ISurprise_t:

$$\text{f}_{\text{i,t}} = \beta_{\text{i,0}} + \beta_{\text{i,1}}\text{ISurprise}_{\text{t}} + \varepsilon_{\text{i,t}}$$

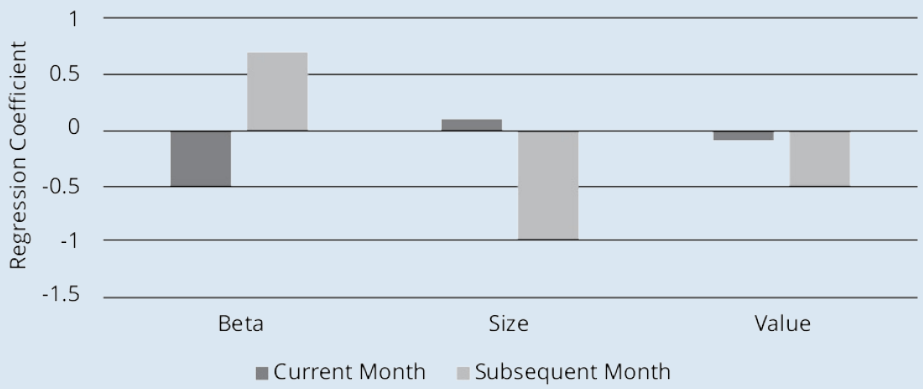
and:

$$\text{f}_{\text{i,t+1}} = \beta_{\text{i,0}} + \beta_{\text{i,1}}\text{ISurprise}_{\text{t}} + \varepsilon_{\text{i,t}}$$

where $\text{f}_{\text{i,t}}$ is the return of style factor *i* at time *t* and $\text{f}_{\text{i,t+1}}$ is the subsequent (next) month's return for style factor *i*.

The regression coefficients are presented in Figure 24.1:

Figure 24.1: Interest Rate Surprises and Style Factor Returns



Based on the data in Figure 24.1, answer the following questions:

1. **Discuss** the main factor rotation timing implications from the regression.
2. **Discuss** practical issues in using the model to time factor rotation.

Solutions:

1. For the current month:
   - The negative regression coefficient of 0.5 indicates that higher beta stocks underperform in the month of an upward surprise in interest rates, or outperform for a downward surprise.
   - Size and value provide no meaningful signal.

   For the subsequent month:
   - The strongest effect is the negative 1.0 regression coefficient indicating small companies underperform the month after higher than expected interest rates. Value companies also underperform for an upward surprise in rates while high beta stocks outperform with a roughly 0.7 positive regression coefficient.
2. Further analysis is needed in relation to the timing of the beta effect because the coefficient is negative for the current but positive for the subsequent month. For example, suppose there is a positive (upward surprise in rates) on the 20th of the month. How long will the negative effect on high beta stock performance last and when will it turn positive?

ACTIVIST STRATEGIES

LOS 24.e: Analyze activist strategies, including their rationale and associated processes.

CFA® Program Curriculum, Volume 4, page 414

Activist investors specialize in taking stakes in listed companies and pushing for companies to make changes that are expected to enhance the value of the activist's stake. The changes could be nonfinancial in nature (e.g., related to environmental, social, or governance issues). One prominent activist is American hedge fund manager Carl Icahn, who has taken high-profile stakes in U.S. technology and pharmaceutical companies in recent years.

Typical Activist Investing Process

The investment process of an activist investor typically involves:

- Screening and analysis of activist opportunities.

- Buying an initial stake in the target company (typically less than 10% of voting rights).
- Submitting a public proposal for changes to the company, usually in the form of an open letter to the company.
- If no agreement, threatening a *proxy contest* (a proxy contest is a shareholder vote to force the proposed changes on the company).
- If no agreement, launching a proxy contest.
- Continuing to negotiate with management, but with no agreement eventually taking the matter to a proxy contest.

Popularity of Shareholder Activism

The foundations of activism go back to *corporate raiders* in the 1970s and 1980s who took large stakes in companies in order to influence operations and enhance value. Activist investing as a hedge fund style has seen assets under management more than double between 2007 and 2015. The number of public announcements of activist campaigns has increased four-fold in this period.

Tactics Used by Activists

These include:

- Seeking board representation (once attained this can be used to change management).
- Writing open letters to management detailing the changes, meeting with management and engaging with other shareholders to court support in a proxy contest.
- Proposing changes at an annual general meeting (AGM).
- Proposing financial restructuring including increased dividends and share buybacks.
- Reducing extravagant management compensation.
- Launching legal proceedings against management for breach of fiduciary duties.
- Launching a media campaign against existing management.
- Breaking up a large inefficient conglomerate.

The typical defenses that are used by management resisting the activist's proposed changes include:

- Use of multi-class share structures, which grant multiple votes to founders.
- "Poison pill" clauses, which allow existing shareholders to purchase more shares in the target company at a discount, diluting the stake of the activist.
- Staggered board provisions, which mean the board is re-elected partially each year, and hence, cannot be replaced simultaneously.

Target Companies

Target companies tend to feature slower earnings and revenue growth than the market, negative share price momentum, and weak corporate governance. This poor track record is evidence that changes need to be made and makes it more likely the activist will garner

support from other disgruntled shareholders in a proxy contest.

Impact

Studies show that activism does lead to improvements in growth, profitability, and corporate governance; however, it also leads to higher debt levels. The added performance of activist funds has been modest with hedge fund data showing Sharpe ratios slightly above the broad stock market.

Investors have generally reacted positively to activism announcements; data shows positive stock price outperformance for periods leading up to the announcement, with strongest outperformance on the day of the announcement, and modest outperformance over the follow month.

MODULE QUIZ 24.2

To best evaluate your performance, enter your quiz answers online.

1. An analyst is attempting to construct a hedged portfolio to represent the value factor in their domestic stock market. They use the following process:
    1. Rank securities in the domestic market in order of book value of equity in relation to market value of equity (book-to-market ratio).
    2. Purchase the quartile of securities with lowest book-to-market, short sell the quartile of securities with highest book-to-market ratio to create a dollar-neutral portfolio.
    3. Track the performance of the long/short portfolio over time.

    Which of the following statements *most accurately* describes an error in this process?

    A. Stage 1 is incorrect because price-to-book ratio should be used instead of book-to-market ratio.
    B. Stage 2 is incorrect because the top and bottom deciles of securities should be used to construct the dollar-neutral portfolio instead of the top and bottom quartile.
    C. Stage 2 is incorrect because the long/short portfolio should be constructed by purchasing the securities with the highest book-to-market and short selling the securities with the lowest book-to-market.
2. Which of the following strategies would *least likely* be used as part of the investment process of an activist investor?
    A. Buying a majority stake in the company to enforce value-enhancing changes on company management.
    B. Submit public proposal for changes to investee company, usually in the form of an open letter to the company.
    C. Launch a proxy contest against the current management team.

MODULE 24.3: OTHER STRATEGIES

Video covering this content is available online.

LOS 24.f: Describe active strategies based on statistical arbitrage and market microstructure.

Two other active equity strategies discussed are **statistical arbitrage** and **event-driven** strategies. Both are usually quantitative strategies, though they could incorporate judgment from a fundamental manager.

Statistical Arbitrage

Statistical arbitrage, or "stat arb" strategies, make extensive use of technical stock price and volume data to exploit pricing inefficiencies. Typically, they aim to profit from mean reversion in related share prices or by taking advantage of opportunities created by market microstructure issues.

Pairs trading is an example of a popular statistical arbitrage strategy. Pairs trading identifies two securities in the same industry that are historically highly correlated with each other and aims to profit from taking advantage of a temporary breakdown in this relationship. The strategy buys the underperforming security while shorting the outperforming securities. The strategy profits from mean reversion if the long (previous underperform) now outperforms, while the short (previous outperformer) now underperforms. The risk is that the breakdown of the observed previous relationship is long term in nature, there is no mean reversion, and in fact the long continues to underperform the short position in the pairs trade.

A simple pairs trading strategy might use the logarithm of the ratio of two related stock prices to generate trading signals, referred to as the *spread* (the logarithm is taken simply to make the signal more stable). This spread is deemed to be high when it is more than two standard deviations above its moving average, and low when it is more than two standard deviations below its moving average. The strategy would sell the spread when it is high, and buy the spread when it is low looking to profit from mean reversion.

PROFESSOR'S NOTE

Don't worry too much about the technical detail here. Converting the ratio to log value simply places more emphasis on the larger and presumably more profitable deviations in the ratio. The primary issue is that the spread generates a sell signal when it is high and a buy signal when it is low, and the strategy relies on the spread reverting to its mean.

Market microstructure-based arbitrage strategies take advantage of mispricing opportunities occurring due to imbalances in supply and demand that are expected to only last for a few milliseconds. Investors with the tools to analyze the limit order book of an exchange, and the capability for high-frequency trading are in a position to capture such opportunities.

Event-Driven Strategies

Even-driven strategies exploit market inefficiencies that may occur around corporate events such as mergers and acquisitions, earnings or restructuring announcements, share buybacks, special dividends, and spin-offs.

PROFESSOR'S NOTE

These events look a lot like the changes that activists may push for. The key difference here is that

the event-driven manager simply tries to find pricing anomalies due to the event—the manager doesn't engage in activism to bring the event about.

The **risk arbitrage**, or "risk arb" strategy associated with merger and acquisition (M&A) activity is an example of an event-driven strategy.

In a cash merger, the risk arb manager will buy the shares of the target company after the deal has been announced. Due to the risk that the deal will be blocked for regulatory reasons or due to lack of shareholder approval, the stock price will be slightly below the deal price until the deal closes. The risk arb manager, therefore, will earn a profit when the deal closes. In a share-for-share transaction, the risk arb manager will simultaneously short sell the shares of the acquirer and purchase the shares of the target company in the same ratio as the proposed share exchange of the deal. Once again, the manager profits from the deal completing. The risk to the risk arb strategy is that the deal fails to close, which could cause large losses to the manager.

The key expertise of a risk arb manager is the ability to accurately estimate the risk of the deal failing and estimating deal duration and associated annualized premiums offered by stock prices.

EXAMPLE: Identifying opportunities

Jessica Nguyen, a portfolio analyst for Bridgeriver Associates, is reviewing several investment opportunities, as detailed in the following:

- Formby Corp is a large cap multinational technology company headquartered in the United States that designs consumer electronics and sells online computer services. After a decade of stellar growth, the company has accumulated significant cash balances, but growth in core markets has slowed and recent product launches have missed expectations. The company currently doesn't pay a dividend.
- Parmeon SA is a large French retailer with a well-known brand. Competition from the internet has been strong in recent years and the company has experienced slow growth and declining margins. Parmeon has recently announced its intent to acquire another well-known retailer. Parmeon will issue one share of its stock for one share of the acquired company. The deal is likely to attract the attention of regulators because it will create the largest retailer in the sector.
- Baron PLC is a commodity trading and services company based in the United Kingdom. Recent moves in commodity prices and tightening up of credit conditions has led to the company issuing several profit warnings, with management being replaced and the new team announcing a focus on selling assets to raise liquidity. Analysts are questioning whether the company can continue to service its debt. The correlation coefficient of Baron and the largest company in the sector has historically been very strong but has recently broken down.

For *each* investment opportunity (Formby, Parmeon and Baron), **identify** the active equity strategy you would *most likely* take an interest in. Your identification must be made from the following list:

- Activist investing.
- Distressed debt investing.
- Event-driven investing.
- Pairs trading.

For *each* opportunity **discuss** how the active equity strategy might be applied in that opportunity.

Answer:

Formby Corp: Activist investing—invest in the shares and advocate for cash payouts to shareholders rather than investing in projects with sub-par profitability. The payout could be in the form of regular or

special dividends, or a share buyback program.

Parmeon: Event-driven investing—the high uncertainty around the approval of the deal by regulators could lead to misvaluation. For example, if the deal has a higher probability of completion than is assumed by the market, the target company's stock price is likely to be relatively undervalued. Buy the target company and short sell Parmeon in the same proportion as the share-for-share proposed exchange.

Baron: Distressed debt investing—if the manager believes the market is too pessimistic, buy the bonds. The company might recover and the bonds would increase in value or in a restructuring swapping it for equity. **Note that a pairs trade is not appropriate for Baron.** The breakdown in the historical correlation of Baron to its competitor appears to be based on fundamental changes in the management and strategy of Baron. It is not appropriate to assume mean reversion to the past relationship and mean reversion is the underlying assumption in a pairs trade.

CREATING A FUNDAMENTAL ACTIVE INVESTMENT STRATEGY

LOS 24.g: Describe how fundamental active investment strategies are created.

CFA® Program Curriculum, Volume 4, page 424

The fundamental active investment process will likely include the following steps:

1. Define the investment universe in accordance with the fund mandate.
    - Define the market opportunity (investment thesis) and explain why it is there.
2. Prescreen the investment universe to obtain a manageable set of securities for detailed analysis.
    - For example, a value manager might screen to remove stocks with high P/E multiples.
3. Analyze the industry, competitive position and financial reports of the companies.
4. Forecast performance, most commonly based on cash flows or earnings.
5. Convert forecasts to valuations.
6. Construct a portfolio with the desired risk profile.
    - Incorporate any top-down views or constraints on sectors/markets.
7. Rebalance the portfolio as needed.

The process will most likely also include stock sell disciplines involving target prices to take profits and pre-defined stop loss levels to exit unsuccessful positions and mitigate behavioral biases that may bias the manager to hold on to losing positions.

Pitfalls in Fundamental Investing

Pitfalls in fundamental investing include the following.

Behavioral biases can affect the human judgment that fundamental strategies use for their insights into profitable investments. These biases include confirmation bias, the illusion of control, availability bias, loss aversion, overconfidence, and regret aversion bias.

PROFESSOR'S NOTE

Another discussion of behavioral biases that can lead generally rational people to, on occasion, make expensive mistakes.

A **value trap** where a stock that appears to be attractive because of a significant price fall, may in fact be overvalued and decline further. For example, a value manager who buys stocks based only on low P/E ratios risks buying securities of companies that are fundamentally deteriorating and may fail. Value managers need to also determine the stock is trading below intrinsic value given the company's future prospects and identify the trigger that will lead to upward revaluation of the stock.

A **growth trap** where the favorable future growth prospects are already reflected, or over-reflected, in the price. For example, the market price could reflect very aggressive growth of 15% and the price could decline if only above-average growth of 12% is realized. The trap is that growth stocks generally trade at a high P/E and even modest shortfalls in growth can lead to significant declines in P/E and stock price.

CREATING A QUANTITATIVE ACTIVE INVESTMENT STRATEGY

LOS 24.h: Describe how quantitative active investment strategies are created.

CFA® Program Curriculum, Volume 4, page 430

The quantitative active investment strategy has a well-defined process:

1. Define the market opportunity.
2. Acquire and process data.
3. Back-test the strategy.
4. Evaluate the strategy.
5. Construct the portfolio.

Each one of these steps is discussed in more detail in the following paragraphs.

Define the Market Opportunity (Investment Thesis)

Quantitative managers use publicly available information to predict future returns of stocks, using factors to build their return-forecasting models. It is up to the manager to identify the opportunity.

Acquire and Process Data

This is the most time-consuming step. This involves building databases, mapping data from different sources, understanding data availability, cleaning up the data, and reshaping the data into a usable format. The categories of most commonly used data are:

- **Company mapping**: Tracking many companies over time and across data vendors. This will process company mergers, bankruptcies and map different unique stock identifiers across different data vendors.
- **Company fundamentals**: Collect company demographic, price, and other financial data from vendors such as Bloomberg.

- **Survey data**: Details on corporate earnings and forecasts, macroeconomic variables, sentiment indicators, and information on fund flows.
- **Unconventional data**: Unstructured data including satellite images, measures of news sentiment, customer-supplier chains, corporate events, and many other types of information. Recent developments in *machine learning* have supported the ability to examine more and less conventional data, leading to improvements in strategy performance.

Backtesting the Strategy

This involves applying the strategy to historical data to assess performance. The correlation between factor exposures and subsequent portfolio returns for a cross section of securities is used as a measure of factor performance in back-tests. The idea is that if there is a strong relationship between factor exposure and subsequent performance then the factor has high predictive power. This correlation coefficient is known as the factor's information coefficient (IC). *There will be two variations on the IC calculation.*

PROFESSOR'S NOTE

You should read this full section along with Example: Pearson Correlation Coefficient IC and Spearman Rank IC. The example elaborates on and further explains these issues.

Earnings yield (E/P) is a type of valuation factor. An analyst who believes the market undervalues earnings yield could go long securities with high earnings yield and short securities with low earnings yield to gain exposure to, and earn returns from, the factor. Backtesting is used to determine if historical data supports the analyst's belief. To perform the back test, the analyst could:

1. Obtain a sample of historical data on a cross section of stocks.
2. Calculate earnings yield and subsequent performance of each stock.
3. Rank the stocks by earnings yield (factor score). Factor score is measured as a standardized distance away from the average earnings yield. Suppose the average earnings yield is 3% and the standard deviation of earnings yield across stocks is 5% then a stock with an earnings yield of 7% would have a standardized factor exposure of (7% – 3%) / 5% = 0.8.
4. Calculate the IC. Assuming a linear relationship between the factor exposure and holding period return, IC is the correlation between the factor exposure and holding period return. This is called the **Pearson IC**. Like any correlation, the IC will range between +1 and –1 or +100% and –100% if expressed as a percentage. A monthly value of even 5% to 6% is considered very strong.
5. The Pearson IC of the raw data is sensitive to even a few outliers (extreme high or low historical return). The **Spearman Rank IC** addressees this issue and is often considered more robust (superior). The Spearman Rank IC is the IC of the rank of the factor scores and rank of subsequent performance.

PROFESSOR'S NOTE

This calculation of a standardized factor exposure is simply an application of the idea of *z*-values

from basic quant. We are not interested in absolute earnings yield, but how far our earnings yields are away from the average earnings yield in terms of standard deviations. If this is related to the future performance of securities, then the factor has predictive power.

EXAMPLE: Pearson Correlation Coefficient IC and Spearman Rank IC

An analyst collects a cross section sample of nine stocks and calculates the E/P factor score for each stock. The factor scores and subsequent month's return are shown in the table.

Stock	Factor Score	Subsequent Month's Return (%)	Rank of Factor Score	Rank of Return
A	–1.57	10.06%	9	1
B	–1.01	–0.60%	8	9
C	–0.73	–0.50%	7	8
D	–0.40	–0.48%	6	7
E	–0.01	1.20%	5	6
F	0.65	3.00%	4	5
G	0.75	3.02%	3	4
H	0.90	3.05%	2	3
I	1.43	5.20%	1	2
Mean	0.00	2.66%		
Standard Deviation	1.00	3.43%		
Pearson IC		–0.99%		
Spearman Rank IC				40%

Based on the table:

1. **Discuss** whether the earnings yield factor exhibits predictive power for this dataset. In your discussion, **comment** on both the Pearson and Spearman Rank IC.
2. **Calculate** the performance of a long/short factor portfolio with an equal weighting of the three most extreme factor scores.
3. Based on these results, **discuss** what should be done next.

Answer:

1. The Pearson IC of –0.99% is very small. It suggests an insignificant negative relationship between E/P and return.

   However, the Pearson IC was distorted by a nonlinear relationship between factor and subsequent return. Stock A had a negative score and by far the highest positive return. Spearman Rank IC shows a strong +40% IC and does support that high E/P is associated subsequent strong performance.
2.
   - The long position will equal weight G, H and I: (3.02% + 3.05% + 5.20%) / 3 = 3.76
   - Funded by an equal weighted short position in A, B and C: (10.06% – 0.6% – 0.5%) / 3 = 2.99%
   - Hence, the long/short factor portfolio would return 3.76% – 2.99% = 0.77%
3. A sample of nine stocks is not very large. The data supports the belief that high E/P is associated with favorable performance but also shows results can be significantly affected by outliers. Another larger sample, a different time period, and additional testing is appropriate.

Having considered individual factors, managers would then consider which factors to include in a **multi-factor model**. Managers can select and weight each factor using either a qualitative or systematic process. Factors could be treated like asset class weights and mean-variance optimization techniques used to decide optimal exposures. Investors should be aware that although factors appear effective individually they may not add material value to a model if they are correlated with the other factors in the model.

Evaluating the Strategy

Out-of-sample testing, where the model is applied to data different to those that were used to

build the model, is conducted to confirm model robustness. Managers would look at both returns generated and risk measures such as VaR and maximum drawdown.

Portfolio Construction

The following aspects are particularly relevant to quantitative investing when constructing portfolios:

- **Risk models:** Used to estimate the risk of the portfolio by considering individual variance of positions and correlation across positions. Managers generally rely on commercial risk model vendors for these data.
- **Trading costs:** Both explicit (e.g., commissions) and implicit (e.g., market impact cost) costs are considered. If two stocks have the same expected returns, the one with the lower trading costs will be selected.

Pitfalls in Quantitative Investing

Pitfalls in fundamental investing include the following:

- **Survivorship bias:** If back-tests are only applied to existing companies, then they will overlook companies that have failed in the past, and this will make the strategy look better than it actually is.
- **Look-ahead bias:** Results from using information in the model to give trading signals at a time when the information was not available. An example would be using December financial accounting data to generate trading signals for the following January. It is likely that the accounting data was not known by the market until the company issued its financial accounts well into the year, and therefore was not actually available to act as a trading signal in January.
- **Data-mining/overfitting**: Excessive search analysis of past financial data to find data that shows a strategy working. This should not be construed as proof that the strategy works because data was mined until data was found that suggested the strategy worked. This is not rigorous statistical testing, but simply testing lots of data until the analyst finds what they are looking for.
- **Turnover**: Constraints on turnover may constrain the manager's ability to follow a strategy.
- **Lack of availability of stock to borrow:** For short selling, this may also constrain a manager's ability to follow a strategy.
- **Transaction costs:** This can quickly erode the returns of a strategy that looked good in backtesting.

Another risk of quantitative strategies is *quant overcrowding*, which can occur if many quantitative managers are following similar strategies. Once a strategy becomes crowded, there is the risk that a period of poor performance could cause many managers attempt to exit their positions at the same time. This rush for the exit could exaggerate losses and lead to margin calls from lenders forcing managers to further liquidate their positions at unfavorable prices. This is the most likely explanation for a meltdown in equity quant strategies in the relatively serene market of August 2007. Indicators such as short interest and price

momentum can be combined to estimate the potential overcrowding of markets. A high correlation between short interest (that is, number of declared short positions) and price momentum could indicate a short trade that could suddenly unwind aggressively.

MODULE QUIZ 24.3

To best evaluate your performance, enter your quiz answers online.

1. High-frequency trading techniques are *most likely* used by:
   A. pairs-trading strategies.
   B. market microstructure strategies.
   C. event-driven strategies.
2. The *value trap* is *best* defined as:
   A. a stock that is trading at low multiples justified by deteriorating fundamental business conditions.
   B. a stock that is trading a low price multiples without justification.
   C. a stock that is trading at high price multiples justified by high expected earnings growth rates.
3. When backtesting a quantitative active investment strategy, a manager concerned about outliers in data is *most likely* to conclude that a factor has predictive power when:
   A. the information coefficient of factor scores versus contemporaneous returns is significantly different from zero.
   B. the Spearman Rank correlation coefficient of factor scores and subsequent returns is significantly different from zero and positive.
   C. the Pearson correlation coefficient of factor scores versus contemporaneous returns is significantly different from zero.

MODULE 24.4: EQUITY INVESTMENT STYLE CLASSIFICATION

Video covering this content is available online.

LOS 24.i: Discuss equity investment style classifications.

CFA® Program Curriculum, Volume 4, page 437

An investment style classification process is designed to split a stock universe into subgroups of stocks that represent the styles discussed in this reading (i.e., size, value, etc.). These groups should contain stocks that have a high correlation with each other (because they are part of the same style), but correlation between groups should be lower indicating that styles are distinct sources of risk and return. This process is useful for classifying the style of a portfolio and benchmarking managers.

Approaches to Style Classification

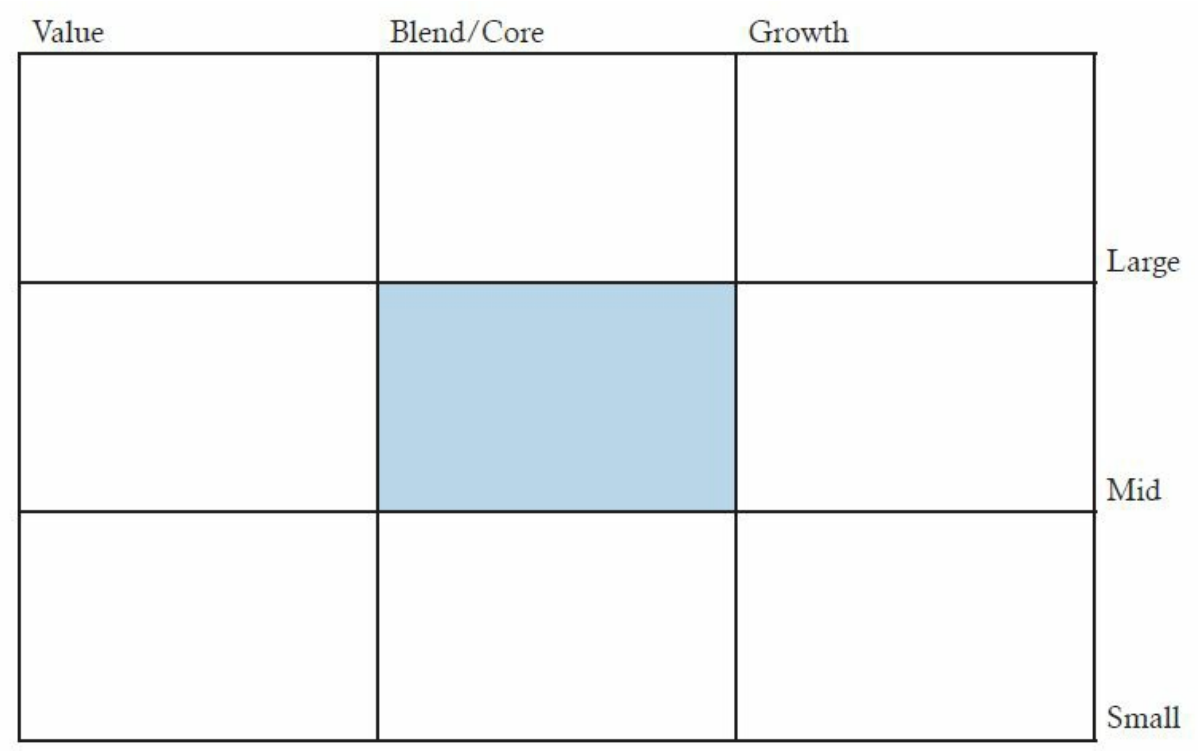
The two main approaches in style analysis are the **holdings-based** approach and the **returns-based** approach.

Holdings-Based Style Analysis

The holdings-based approach looks at the attributes of each individual stock in a portfolio and aggregates these attributes to conclude the overall style of the portfolio.

A common application of this idea is the *Morningstar Style Box*. In a style box, two factors—value and size—are each split into three groups, as shown in Figure 24.2:

Figure 24.2: Morningstar Fund Style Box



There is no consensus on the definition of large, mid, and small cap. One practice is to define large cap stocks as the top 70% of market capitalization of the universe, with mid-cap stocks represented by the next 20% of market capitalization, and small cap stocks the rest.

The style box approach aims to classify approximately the same number of stocks in each of the value, blend, and growth groups, essentially distributing the market value of each row evenly across the grid.

The classification of stocks into value/blend/growth involves assigning a *style score* to each individual stock. For example, to assign a value score, the dividend yield may be used. Stocks would be ranked according to their dividend yield and a score allocated to a stock based on their percentile of the market value of their particular group. If the stock is at the lower end of the dividend yield range, it will receive a low score close to 0, if it is at the high end of the dividend yield range, it will receive a high score close to 100. A comprehensive scoring model would use many indicators of value and combine them together in a pre-determined weighting.

PROFESSOR'S NOTE

The actual process of allocating a style score is complicated and omitted from the curriculum, and therefore, beyond the scope of the exam. The key takeaway here is that stocks are allocated a style score between 0 and 100 in a way designed to distribute rows evenly across the columns of the grid.

The same process can be done for growth attributes such as earnings growth, revenue growth

and cash-flow growth to establish a growth factor score for each security. Once again, this score will be a number between 0 and 100. The indicators used by Morningstar and the weightings given to them in the value and growth style scores are displayed in Figure 24.3.

Figure 24.3: Morningstar Value and Growth Scoring Scheme

Value Score Components and Weights		Growth Score Components and Weights	
Forward-looking measures	**50.0%**	*Forward-looking measures*	**50.0%**
*Price to projected earnings		*Long-term projected earnings growth	
Historical measures	**50.0%**	*Historical measures*	**50.0%**
*Price to book	12.5%	*Historical earnings growth	12.5%
*Price to sales	12.5%	*Sales growth	12.5%
*Price to cash flow	12.5%	*Cash flow growth	12.5%
*Dividend yield	12.5%	*Book value growth	12.5%

Once a security has both a value score and a growth score, the difference can be taken as a net style score. If the net style score is strongly negative, the stock is classified as value. If the net style score is strongly positive then the stock is classified as growth. If the net style score is close to zero then the stock will be classified as core.

PROFESSOR'S NOTE

Morningstar classifies **stocks** without a strong value/growth bias score. **Funds** without a strong value/growth bias are classified as blend. These are just two different technical terms for the same idea—an investment without a strong value/growth bias.

Once constructed for a stock universe, the grid can be used as a visual aid to help categorize and track managed investment portfolios. At a glance, an investor can see where a manager is positioned on the grid, and, if historical data exists, how this style has changed over time.

Note that the Morningstar Style Box approach acknowledges that a single security can exhibit both value and growth characteristics at the same time. A simpler classification system might assign a style score as a fraction of a stock's market cap to value and the complement to growth—for example, a system may assign a value score of 0.6 to a security indicating that 60% of the market cap of the company will be allocated to a value index and 40% allocated to a growth index.

Returns-Based Style Analysis

A returns-based style analysis aims to identify the style of a fund through regression of the funds returns against a set of passive style indices. By imposing a constraint on the regression that the sum of the slope coefficients should sum to a value of 1, the slope coefficients can be interpreted as the manager's allocation to that style during the period.

For example, a return-based style analysis might conduct a regression of fund returns versus four passive indices as follows:

$$R_p = a + b_1 SCG + b_2 LCG + b_3 SCV + b_4 LCV + \varepsilon$$

where:

R_p = returns on the manager's portfolio

a = a constant often interpreted as the value added by the fund manager

b_i = the fund exposure to style *i*

SCG = returns on a small-cap growth index

LCG = returns on a large-cap growth index

SCV = returns on a small-cap value index

LCV = returns on a large cap value index

ε = residual return not explained by styles used in the regression

giving an output of:

$b_1 = 0$, $b_2 = 0$, $b_3 = 0.15$, and $b_4 = 0.85$

From the values of the regression coefficients, we would conclude that the manager's portfolio has no exposure to growth stocks ($b_1 = 0$ and $b_2 = 0$), and that the manager is a value manager with primary exposure to large cap value ($b_4 = 0.85$) and a small exposure to small cap value ($b_3 = 0.15$).

Manager Self-Identification

The fund's investment strategy is usually self-described by the manager. Comparing that self-description with returns-based and holdings-based style analysis will either confirm a consistent identification or indicate a need for further investigation and analysis to explain the discrepancy. Some styles such as equity long/short, equity market neutral and short bias do not fit traditional style categories and the manager's description and fund prospectus becomes the key source of information on style of such funds.

Strengths and Limitations of Style Analysis

A summary of the advantages and disadvantages of returns-based vs. holdings-based style analysis is displayed in the following:

Advantages of Returns-Based Analysis	**Advantages of Holdings-Based Analysis**
Does not require information on holdings.	Generally more accurate because it uses actual portfolio holdings.
Can be easily and universally applied.	Assesses each individual holding's contribution to style.
Disadvantages of Returns-Based Analysis	**Disadvantages of Holdings-Based Analysis**

Constraints on outputs can limit detection of extreme styles.	Requires the availability of all portfolio constituents and style attributes of each. Limited derivatives data may hinder analysis if derivatives are used. Different systems with different definitions of style will classify the same portfolio in different ways.

A holdings-based analysis pinpoints the current exposure of a fund. This is an advantage if the analyst wishes to know the most up-to-date positioning of a manager. However, if the analyst wishes to assess the average exposure a manager takes over time, then historical holdings-based analyses need to be available. A returns-based style analysis based on historical returns would capture this average exposure automatically through regressing historical returns.

MODULE QUIZ 24.4

To best evaluate your performance, enter your quiz answers online.

1. The use of derivative overlay strategies with limited information is *likely* to hinder style analysis performed by which of the following approaches?
   A. Holdings-based analysis only.
   B. Returns-based analysis only.
   C. Both holdings-based and returns-based analyses.

KEY CONCEPTS

LOS 24.a

Active equity managers can be broadly divided into two groups: fundamental managers, which use discretionary judgment and quantitative managers, which use rules-based (systematic) data-driven models. The main differences between the approaches are the following:

	Fundamental	**Quantitative**
Style	Subjective	Objective
Decision-making	Discretionary	Systematic
Primary resources	Human skill, experience, judgment	Expertise in statistical modeling
Information used	Research	Data and statistics
Analyst focus	Conviction of insight into small number of investments	Application of rewarded factors over large number of securities
Purpose of analysis	Forecast future corporate performance	Find historical relationships between factors and performance likely to persist
Portfolio Construction	Judgment and conviction within portfolio risk parameters	Optimization
Monitoring and Rebalancing	Continuous monitoring: rebalancing according to views	Automatic systematic periodic rebalancing

LOS 24.b

Bottom-up strategies analyze information at the company level to generate investment ideas. Bottom-up strategies can be divided into value and growth styles. Value sub-styles include relative value, contrarian, high-quality value, income investing, deep-value, restructuring and distressed debt, and special situations.

LOS 24.c

Top-down strategies focus on the macroeconomic environment, demographic trends, and government policies to make investment decisions. Top-down strategies could focus on geography, industry, equity style rotation, volatility-based strategies, or thematic investment

ideas.

LOS 24.d

Quantitative strategies often use factor-based models, which aim to identify factors that drive performance historically and are likely to continue to do so in the future. Factors can be based on fundamental characteristics such as value and growth, and price momentum, or on unconventional data.

LOS 24.e

Activist investors specialize in taking meaningful stakes in listed companies and then publicly pushing for changes to the management, strategy, or capital structure of the company that they believe will enhance value.

LOS 24.f

Statistical arbitrage funds look to profit from anomalies in technical market data (i.e., prices and volumes), for example, pairs trading. Event-driven strategies exploit market inefficiencies that may occur around mergers and acquisitions, earnings announcements, bankruptcies, share buybacks, special dividends, and spin-offs.

LOS 24.g

The fundamental active investment process consists of the following steps:

1. Define the investment universe in accordance with the fund mandate.
    - Define the market opportunity (investment thesis) and explain why it is there.
2. Prescreen the investment universe to obtain a manageable set of securities for detailed analysis.
    - For example, a value manager might screen to remove stocks with high P/E multiples.
3. Analyze the industry, competitive position, and financial reports of the companies.
4. Forecast performance, most commonly based on cash flows or earnings.
5. Convert forecasts to valuations.
6. Construct a portfolio of profitable investments with the desired risk profile.
    - Incorporate any top-down view on sectors/markets at this stage.
7. Rebalance the portfolio with buy and sell disciplines.

Pitfalls in fundamental investing include behavioral biases, the value trap, and the growth trap. Behavioral biases include confirmation bias, illusion of control, availability bias, loss aversion, overconfidence, and regret aversion.

LOS 24.h

The quantitative active investment process includes the following steps:

- Define the market opportunity.
- Acquire and process data.
- Back-test the strategy.

- Evaluate the strategy.
- Portfolio construction.

Pitfalls in quantitative investing include look-ahead and survivorship biases, overfitting, data mining, unrealistic turnover assumptions, transaction costs, and short availability.

LOS 24.i

The two main approaches used in style analysis are holdings-based and returns-based. Holdings-based approaches aggregate the style scores of individual holdings, while returns-based approaches analyze the investment style of portfolio managers by regressing historical portfolio returns against a set of style indexes.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 24.1

1. **C** Screening is a process that can be used by both fundamental and quantitative active managers. It is how the final investment decision is made that determines whether the manager is classified as quantitative or fundamental. If the decision is made based on systematic rules rigidly applied to company data, then the manager would be classified as quantitative. If the investment decision is made based on the manager's opinion using their skill and experience, then the manager is deemed to be fundamental. (LOS 24.a)

2. **B** Identifying securities that are undervalued versus the amount received in bankruptcy liquidation is a form of distressed debt investing. Answer A is incorrect because a relative value manager would be searching for companies with low price multiples such as P/E without the need for a distressed situation that could lead to bankruptcy filing. Answer C is incorrect because a deep value manager looks for companies with low valuation relative to assets such as price-to-book, once again without the need for a distressed situation that could lead to bankruptcy filing. (LOS 24.b)

3. **B** A top-down investment approach focuses on broad macroeconomic variables to identify opportunities at the broad market level based on geography, industrial sector or thematic investing data. Manager B is least likely to be classified a top-down manager because they are using data relating to individual components of the S&P 500 rather than looking at data relating to the aggregate market. Managers A and C are looking at broad market or sector data in order to identify investment opportunities, making them top-down managers. (LOS 24.c)

Module Quiz 24.2

1. **C** Stages 1 and 3 are correct. It is up to the analyst's discretion as to what proportion of the stock universe is bought and sold to create the dollar neutral portfolio, hence using quartiles is not an error. The error is in Stage 2 where high book-value to market-value companies should be purchased because these are cheap companies, and low book-value to market-value companies should be sold because these represent expensive companies. (LOS 24.d)

2. **A** Activist investors do not take controlling majority stakes (greater than 50%) in companies they invest in. They usually take a significant but minority position of less than 10% and look to garner support from other shareholders in a proxy context to enforce the value-enhancing changes they want to occur. (LOS 24.e)

Module Quiz 24.3

1. **B** Market microstructure-based arbitrage strategies take advantage of mispricing opportunities occurring due to imbalances in supply and demand that are expected to only last for a few milliseconds. Investors with the tools to analyze the limit order book of an exchange, and the capability for high-frequency trading are able to capture such

opportunities. (LOS 24.f)

2. **A** A value trap is a company that is trading with low price multiples due to deteriorating fundamental business conditions. This security looks cheap due to its low price multiple, however, the valuation comes from the market correctly anticipating a further deterioration in business conditions and hence an improvement in share price is unlikely. (LOS 24.g)

3. **B** A manager would conclude that a factor has predictive power when a cross section of securities' factor scores is positively correlated with subsequent returns. When based on the Pearson correlation coefficient this is referred to as the information coefficient, hence, answers A and C are saying the same thing. They are incorrect choices because the manager would need to see non-zero correlation between factor scores and *subsequent* market returns, not contemporaneous market returns. Answer B is the best choice here—a manager would use the Spearman Rank correlation coefficient when concerned about outliers in the data causing the Pearson correlation coefficient to be biased. (LOS 24.h)

Module Quiz 24.4

1. **A** A manager performing holdings-based analysis may come to erroneous conclusions about manager style if they do not have details regarding derivative overlay strategies used to change the exposure of the fund. This is less likely to be a problem for returns-based analysis because the regression of historical returns carried out under this method will likely pick up the impact of any derivatives overlay strategies being used by the manager. (LOS 24.i)

The following is a review of the Equity Portfolio Management (2) principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #25.

READING 25: ACTIVE EQUITY INVESTING: PORTFOLIO CONSTRUCTION

Study Session 10

EXAM FOCUS

This reading focuses on issues related to the active management of equity portfolios. It begins with the building blocks of active equity portfolio construction and how they relate to the sources of active return. It covers Active Share, active risk, and how they are related to various strategies. Risk budgeting and associated calculations are covered, as are issues related to the scalability of asset management approaches. The reading concludes with issues related to the use of short positions.

MODULE 25.1: BUILDING BLOCKS OF ACTIVE EQUITY PORTFOLIO CONSTRUCTION

Video covering this content is available online.

LOS 25.a: Describe elements of a manager's investment philosophy that influence the portfolio construction process.

CFA® Program Curriculum, Volume 4, page 463

Active equity portfolios aim to outperform a benchmark after all costs. In the simplest terms, the excess return above a benchmark (**active return**) will be positive if the manager overweights securities that outperform the benchmark, and underweights securities that underperform the benchmark, because active returns are driven by differences in weights between the active and benchmark portfolios:

$$R_A = \sum_{i=1}^{N} \Delta W_i R_i$$

where:

R_i = return from security *i*

ΔW_i = active weight, the difference between portfolio and benchmark weight for security *i*

Sources of Active Returns

Active returns come from three sources:

1. The level of strategic long-term exposures to **rewarded factors**.
    - Rewarded factors are risks that are widely accepted as offering long-term

positive risk premiums [market risk (beta), size, value, liquidity, etc.]

2. Tactical exposures to **mispriced** securities, sectors, and rewarded risks that generate *alpha* (return that cannot be explained by long-term exposure to rewarded factors). Alpha is directly related to manager *skill*.
3. **Idiosyncratic risk** (from concentrated active positions) that generates returns related to *luck*. It is labeled *luck* in the sense that it is not due to market risk exposure or value-added alpha.

Different managers will generate different proportions of their active returns from each source.

The decomposition of realized (*ex post*) active return can be seen in the next equation:

$$\mathrm{R_A} = \sum \left(\beta_{\mathrm{pk}} - \beta_{\mathrm{bk}}\right) \times \mathrm{F_k} + (\alpha + \varepsilon)$$

where:

β_{pk} = the sensitivity of the portfolio to each rewarded factor (k)

β_{bk} = the sensitivity of the benchmark to each rewarded factor

$\mathrm{F_k}$ = the return of each rewarded factor

$(\alpha + \varepsilon)$ = the return not explained by exposure to rewarded factors—alpha (α) is the active return attributable to manager skill, and ε is the idiosyncratic return—noise or luck (good or bad) (In practice it is very difficult to distinguish between α and ε)

Building Blocks Used in Portfolio Construction

The three main building blocks of portfolio construction are:

1. **Factor weightings.**
2. **Alpha skills.**
3. **Position sizing.**

These three building blocks are integrated into a successful portfolio construction process through a fourth component: **breadth of expertise**. Each component is considered in detail in the following.

First Building Block: Overweight/Underweight Rewarded Factors

This relates to the manager taking exposures to rewarded risks that differ from those of the benchmark. This can be thought of as active return due to differences in *beta*, where beta refers to sensitivity to a rewarded risk factor such as the market risk of CAPM, or the market, size, and value factors of the Fama and French model. With exposures to rewarded factors

increasingly accessible via rules-based index products, simple static exposure to rewarded factors is no longer widely considered a source of alpha. Irrespective of the manager's approach, whether they explicitly target factor exposures or target individual securities, their performance can in part be attributed to sensitivity to these beta factors. This building block relates primarily to active return source number one: differences in exposures to long-term rewarded factors.

Second Building Block: Alpha Skills

Alpha skills are excess returns related to the unique skills and strategies of the manager. A manager can generate alpha through *factor timing*, which is skill in identifying when a factor might outperform/underperform its average return. This could apply to a rewarded factor, (e.g., correctly determining when value stocks will outperform growth stocks), but it could also apply to *unrewarded* factors, such as correctly timing geographical or industry sector exposures, commodity prices, or even security selection (a discretionary manager might refer to these as *thematic exposures*). This building block relates primarily to active return source number two: identifying mispricings.

Third Building Block: Sizing Positions

Position sizing balances managers' confidence in their alpha and factor insights while mitigating idiosyncratic risks coming from concentrated positions. Position sizing will affect all three sources of active risk, but the most dramatic impact will be on idiosyncratic risk. The general rule is that smaller positions in a greater number of securities will diversify away idiosyncratic risk and lead to lower portfolio volatility.

A factor-oriented manager who spreads their portfolio across many assets is likely to minimize the impact of idiosyncratic risk. A stock-picker is likely to hold more concentrated positions based on their insights into individual securities, and hence, deliberately assume a higher degree of idiosyncratic risk.

Integrating the Building Blocks: Breadth of Expertise

Success at combining the three building blocks is a function of a manager's breadth of experience. A manager with broader expertise is more likely to generate consistent active returns. This can be seen in the **fundamental law of active management**:

$$\mathrm{E}\left(\mathrm{R_A}\right) = \mathrm{IC}\sqrt{\mathrm{BR}}\sigma_{\mathrm{R_A}}\mathrm{TC}$$

where:

$\mathrm{E}(\mathrm{R_A})$ = expected active return of the portfolio

IC = expected information coefficient of the manager, calculated as the correlation between manager forecasts and realized active returns

BR = breadth—the number of truly independent decisions made by the manager each year

TC	= transfer coefficient, a number between 0 and 1 that measures the level to which the manager is constrained—TC will take a value of 1 if the manager has no constraints, and 0 if the manager is fully constrained
σ_{R_A}	= the manager's active risk (the volatility of active returns)

This equation clearly shows that there is a direct link between breadth and expected outperformance—a larger number of independent decisions (higher breadth) should lead to higher active return.

A manager who considers a single factor defined by a single metric is unlikely to be making truly independent decisions, because all investment decisions are being driven by the same dimension, and therefore, are likely to have low breadth. A manager who uses multiple factors and multiple metrics for each factor is likely to make more independent decisions when constructing their portfolio, and hence, have higher breadth.

APPROACHES TO PORTFOLIO CONSTRUCTION

LOS 25.b: Discuss approaches for constructing actively managed equity portfolios.

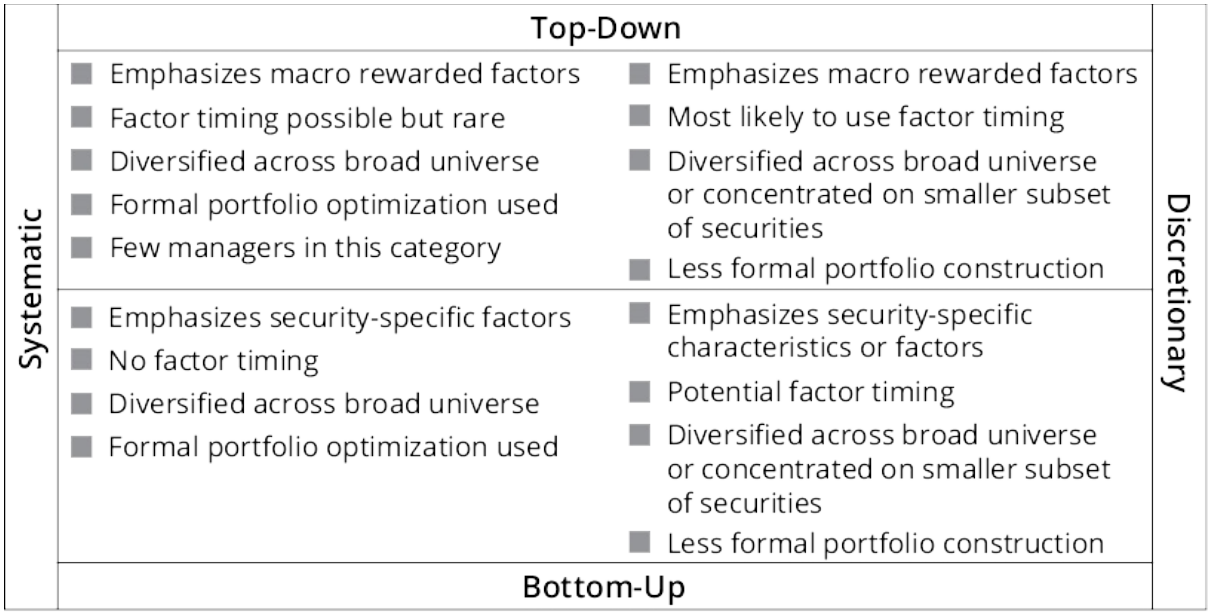
CFA® Program Curriculum, Volume 4, page 474

The majority of investment approaches can be classified as:

- *Systematic or discretionary*: The degree to which the manager follows a set of systematic rules, rather than using discretionary judgment.
- *Bottom-up or top-down*: The degree to which the manager uses bottom-up stock-specific information, rather than macroeconomic information.

These approaches, and their use of the building blocks, are summarized in Figure 25.1.

Figure 25.1: Approaches and Their Use of Building Blocks



(*Based on Exhibit 6 in CFAI Reading 25*)

The Implementation Process: The Objectives and Constraints

Portfolio construction can be viewed as an optimization problem with a goal (the objective function) and a set of constraints. Objectives and constraints may be stated in absolute terms or relative to a benchmark; examples are given in Figure 25.2:

Figure 25.2: Objective Functions and Constraints of Portfolio Construction

	Absolute Framework	Relative Framework
Objective Function	Maximize Sharpe Ratio	Maximize Information Ratio
Constraints		
Sector/security weights	Maximum size in portfolio	Maximum deviation from benchmark
Risk	Maximum portfolio volatility specified as multiple (e.g., 0.9) of benchmark volatility	Maximum tracking error (active risk)
Market capitalization	Maximum/minimum set by mandate	Maximum/minimum set by mandate

Other approaches to optimization include:

- Specifying objectives in terms of *risk* (e.g., minimizing portfolio volatility, downside risk, or drawdowns).
- Maximizing exposure to rewarded factors (e.g., maximizing exposure to the size, value, and momentum factors).
- Maximizing exposure to securities having specific characteristics custom-defined by a discretionary manager [e.g., a custom-defined metric representing deep value (significant undervaluation)].
- Heuristic approaches that use less scientific methods, such as basing weighting on the ranking of securities with respect to a specified desired characteristic (e.g., low price to book).

MODULE QUIZ 25.1

To best evaluate your performance, enter your quiz answers online.

1. An active equity manager makes 10 independent decisions per month with an information coefficient of 0.1, active risk of 5% and a transfer coefficient of 0.5. The expected active annual return of this manager is *closest* to:
   A. 0.8%.
   B. 2.5%.
   C. 2.7%.
2. Which of the following managers is *most likely* to use an approach which uses factor timing techniques?
   A. Systematic bottom-up.
   B. Discretionary bottom-up.
   C. Discretionary top-down.

MODULE 25.2: ACTIVE SHARE AND ACTIVE RISK

Video covering this content is available online.

LOS 25.c: Distinguish between Active Share and active risk and discuss how each measure relates to a manager's investment strategy.

CFA® Program Curriculum, Volume 4, page 478

In addition to the dimensions discussed previously, investment approaches can also vary according to whether the manager is highly *benchmark-aware* or is *benchmark-agnostic* (i.e., pays little attention to the benchmark). Each manager will specify the acceptable levels of deviation from the benchmark, and quantify this deviation in terms of *Active Share* and *active risk.*

Active Share measures the degree to which the number and sizing of the positions in a manager's portfolio are different from those of a benchmark, and is given by the following equation:

$$\text{Active Share} = \frac{1}{2}\sum_{i=1}^{n}|W_{p,i} - W_{b,i}|$$

where:

n = total number of securities in the benchmark or the portfolio

$W_{p,i}$ = weight of security *i* in the portfolio

$W_{b,i}$ = weight of security *i* in the benchmark

The vertical line brackets indicate that we take the absolute value of the weighting difference, irrespective of whether it is positive or negative.

Active Share takes a value between 0 and 1. If a manager holds a portfolio of stocks that are not in the benchmark, their Active Share equals 1, whereas if they hold the benchmark weights in their portfolio their Active Share will be 0. If a portfolio has an Active Share of

0.5, we can conclude that 50% of the portfolio is identical to that of the benchmark and 50% is not.

PROFESSOR'S NOTE

Some simple numerical illustrations may help clarify the interpretation of Active Share:

Assume a universe of six stocks—A through F, with 25% of the benchmark invested in each of A, B, C, D.

The extreme cases:

Extreme Case 1: Portfolio matches benchmark (100% overlap), Active Share = 0

	Weighting			
Stock	**Portfolio**	**Benchmark**	**Under**	**Over**
A	0.25	0.25	0	0
B	0.25	0.25	0	0
C	0.25	0.25	0	0
D	0.25	0.25	0	0
E	0	0	0	0
F	0	0	0	0
	1	1	0	0
Active Share 0				

Extreme Case 2: No overlap between portfolio and benchmark, Active Share = 1

	Weighting			
Stock	**Portfolio**	**Benchmark**	**Under**	**Over**
A	0	0.25	0.25	0
B	0	0.25	0.25	0
C	0	0.25	0.25	0
D	0	0.25	0.25	0
E	0.4	0	0	0.4
F	0.6	0	0	0.6
	1	1	1	1
Active Share 1				

Two cases that fall between the extremes:

	Weighting			
Stock	**Portfolio**	**Benchmark**	**Under**	**Over**
A	0	0.25	0.25	0
B	0.1	0.25	0.15	0
C	0.3	0.25	0	0.05
D	0.6	0.25	0	0.35
E	0	0	0	0
F	0	0	0	0
	1	1	0.4	0.4
Active Share 0.4				

	Weighting			
Stock	**Portfolio**	**Benchmark**	**Under**	**Over**
A	0.05	0.25	0.2	0
B	0	0.25	0.25	0
C	0.3	0.25	0	0.05
D	0.2	0.25	0.05	0
E	0.35	0	0	0.35
F	0.1	0	0	0.1
	1	1	0.5	0.5
Active Share 0.5				

Per the equation, Active Share = $\frac{1}{2}\sum_{i=1}^{n}|W_{p,i}-W_{b,i}|$ In words, it is the average of the total degree of overweighting and the total degree of underweighting (ignoring the minus sign for underweighting). Because, inevitably, total overweighting = total underweighting, Active Share = total overweighting or total underweighting (as seen previously).

(1 – Active Share) can be interpreted as the percent overlap between the portfolio and the

benchmark. For example, in the upper example, the holdings in common are 0.1 in B, 0.25 in C, and 0.25 in D, a total of 0.6 (= 1 – 0.4). The lower example illustrates Active Share = 0.5 (50% overlap).

If two portfolios with the same benchmark invest only in benchmark securities, the portfolio with the *fewer* securities and therefore higher degree of concentration in positions will have a *higher* level of Active Share.

Active Share is used by many investors to assess the fees paid per unit of active management. For example, a fund with an Active Share of 0.2 would be considered expensive versus a fund with an Active Share of 0.5 if both funds were charging the same fees.

Active risk, also called *tracking error*, is the standard deviation of active returns (portfolio returns minus benchmark returns). As an equation:

$$\text{active risk}\left(\sigma_{R_A}\right) = \sqrt{\frac{\sum_{t=1}^{T}\left(R_{AT}\right)^2}{T-1}}$$

where R_{At} is the active return at time *t*, and *T* is the number of return periods.

PROFESSOR'S NOTE

Simply put, active risk measures how consistent is/was the portfolio's performance relative to the benchmark.

There are two different measures of active risk: *realized* active risk, which depends on historical returns, and *predicted* active risk, which requires forward-looking estimates of correlations and variances.

Active risk is affected by the degree of cross-correlation between securities, whereas Active Share is not. For example, underweighting a pharmaceutical stock in order to overweight another pharmaceutical stock will certainly increase Active Share because the weights of the portfolio will be different to the weights in the benchmark. However, if the two pharmaceutical stocks are highly correlated, the portfolio will not behave markedly different from the benchmark, hence active risk is not likely to substantially increase. On the other hand, underweighting a pharmaceutical company and overweighting a security with a low correlation to the pharmaceutical company, such as a consumer discretionary company, will likely increase both Active Share and active risk.

A portfolio manager can completely control Active Share because they control the weights of the securities in the portfolio. However, a manager cannot completely control active risk because predicted active risk depends on estimations of correlations and variances of securities that may be different from those actually realized.

Decomposition of Active Risk

Given the earlier decomposition of active return into returns to factors, alpha, and idiosyncratic risk, it is possible to show that active risk is a function of the variance due to factor exposures and the variance due to idiosyncratic risk:

$$\sigma_{R_A} = \sqrt{\sigma^2 \left(\sum \left(\beta_{pk} - \beta_{bk}\right) \times F_k\right) + \sigma_e^2}$$

PROFESSOR'S NOTE

The variance of the skill of the manager (alpha) is deemed to be part of the idiosyncratic risk component here.

Research conclusions on the composition of active return include:

- High net exposure to a risk factor leads to high level of active risk.
- A portfolio with no net factor exposure will have active risk attributed entirely to Active Share.
- Active risk attributable to Active Share is inversely proportional to the number of securities in the portfolio.
- Active risk increases as factor and idiosyncratic risk levels increase.

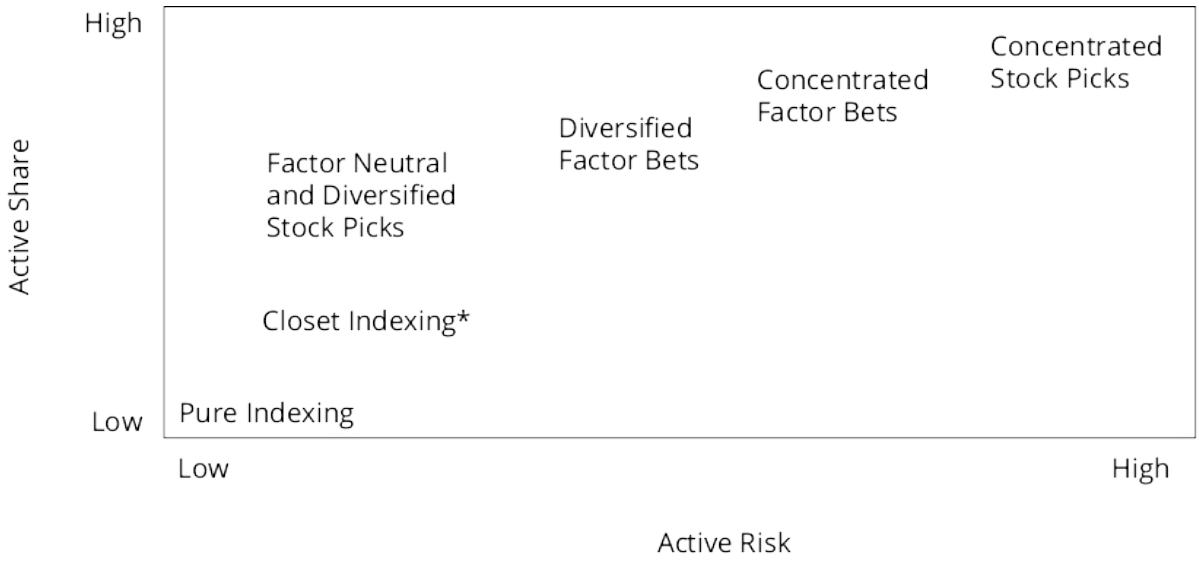
Distinguishing Between Different Portfolio Management Approaches

Active risk and Active Share can be used to discriminate between different portfolio management approaches, with respect to their factor exposures and level of diversification. The types of approaches, in order of increasing Active Share and active risk, can be broadly summarized as follows:

Investment Style	Description	Active Share and Active Risk
Pure indexing	No active positions: portfolio is equal to the benchmark	Zero Active Share and zero active risk
Factor neutral	No active factor bets—idiosyncratic risk low if diversified	Low active risk—Active Share low if diversified
Factor diversified	Balanced exposure to risk factors and minimized idiosyncratic risk through high number of securities in portfolio	Reasonably low active risk—high Active Share from large amount of securities used that are unlikely to be in the benchmark
Concentrated factor bets	Targeted factor bets—idiosyncratic risk likely to be high	High Active Share and high active risk
Concentrated stock picker	Targeted individual stock bets	Highest Active Share and highest active risk

This spectrum of manager styles and the approximate expected relationship with Active Share and active risk is displayed in Figure 25.3

Figure 25.3: Approaches and Their Use of Building Blocks



*A *closet indexer* is defined as a fund that advertises itself as being actively managed but is substantially similar to an index fund in its exposures.

PROFESSOR'S NOTE

It may be helpful to remind ourselves here of the differences between the three terms: Active Share, factor bets, and active risk.

Active Share (a number between 0 and 1) measures how similar the portfolio is to the benchmark in terms of its stock holdings; the lower the value of Active Share, the closer the portfolio is to the benchmark.

A manager makes **factor bets** when their portfolio's exposure to one or more risk factors differs from that of the benchmark. Taking factor bets necessarily involves increased Active Share, whereas a higher value of Active Share does not necessarily imply that factor bets have been taken (for example, a manager might hold stock A instead of stock B, but the two stocks may have identical factor exposures).

Active risk measures the extent to which the active return (portfolio return minus benchmark return) varies from period to period. It can be seen as a consequence of Active Share and factor bets.

Manager styles can also be identified through observing their sector and security-specific constraints. For example, a **sector rotator** would need to have large permitted deviations in sector weights, while a stock picker would need to have large permitted deviations in individual security weights. A diversified multi-factor investor would not need such large deviations from index weights, but would still need some flexibility in order to generate a moderate level of active risk and return.

EXAMPLE: Portfolio construction—approaches and return drivers

Based on the following information regarding four managers benchmarked against the same index, **identify** and **justify** the manager most likely to be:

- A concentrated stock picker.
- A diversified multi-factor investor.
- A closet indexer.
- A sector rotator.

Use each category *only once* in your answer.

Manager Constraints:	A	B	C	D
Target active risk	8%	5%	1%	9%
Maximum sector deviations	20%	8%	2%	0%
Maximum risk contribution, single security	3%	1%	1%	6%

Answer:

The key to this type of question is to start with the most obvious identification. Of course not everyone will agree which is most obvious. The point is start where you find the issue to be most clear-cut based on the data available.

Manager A is a sector rotator because large deviations in sector weight are allowed.

Manager D is concentrated stock selection with large risk contributions (deviation in weighting) allowed by security but no deviation in sector weight allowed.

Manager C is the closet indexer with low targeted active risk and low deviations allowed.

Manager B is the diversified multi-factor investor with moderate (neither very high nor low) active risk and sector deviations. The low single security risk likely indicates a large number of positions (reflecting the use of multiple factors to select the holdings).

MODULE QUIZ 25.2

To best evaluate your performance, enter your quiz answers online.

1. A manager that substitutes a benchmark holding in their portfolio with a similar security not held in the benchmark will *most likely*:
   A. increase Active Share but not substantially increase active risk.
   B. increase active risk but not substantially increase Active Share.
   C. decrease Active Share and increase active risk.

MODULE 25.3: ALLOCATING THE RISK BUDGET

Video covering this content is available online.

LOS 25.d: Discuss the application of risk budgeting concepts in portfolio construction.

CFA® Program Curriculum, Volume 4, page 490

Risk budgeting is a process by which the total risk of a portfolio is allocated to constituents of the portfolio in the most efficient manner. It is an integral part of an effective risk management process. An effective risk management process has the following four steps:

1. Determine which *type* of risk measure is appropriate given the fund mandate.
   - **Absolute** risk measures are appropriate when the investment objective is expressed in terms of total returns (e.g., a long/short equity manager benchmarked against cash plus a margin).
   - **Relative** risk measures are appropriate when the investment objective is to outperform a market index.
2. Understand how each aspect of the strategy contributes to risk.
   - Does risk come from exposure to rewarded factors or allocations to sectors/securities?
3. Determine what level of *risk budget* is appropriate.
   - This is the overall level of risk targeted.
4. Properly allocate risk among individual positions/factors.

Causes and Sources of Absolute Risk

Absolute risk measures focus on the size and composition of absolute portfolio variance (i.e., without reference to any benchmark variance).

The contribution of asset i to portfolio variance (CV_i) is given by the equation:

$$CV_i = \sum_{j=1}^{n} w_i w_j C_{ij} = w_i C_{ip}$$

where:

w_j = asset *j*'s weight in the portfolio

C_{ij} = the covariance of returns between asset *i* and asset *j*

C_{ip} = the covariance of returns between asset *i* and the portfolio $\left(= \sum_{j=1}^{n} w_j C_{ij} \right)$

The portfolio variance is the sum of each asset's contribution to portfolio variance.

EXAMPLE: Absolute risk attribution

A portfolio has the following characteristics:

	Portfolio Weight	Standard Deviation
Asset A	20%	22%
Asset B	30%	12%
Asset C	50%	10%
Portfolio	100%	8.6%

	Covariance		
	Asset A	**Asset B**	**Asset C**
Asset A	0.050000	0.006700	0.001300
Asset B	0.006700	0.014400	0.002000
Asset C	0.001300	0.002000	0.009800

1. **Calculate** the absolute contribution to portfolio variance of asset A.
2. Given that the absolute contribution to portfolio variance of assets B and C are 0.001998 and 0.002880 respectively, **calculate** the relative contribution to portfolio variance of asset A.

Answers:

1. Covariance of returns between asset A and the portfolio:

   = weight of asset A × covariance of asset A with asset A

   + weight of asset B × covariance of asset A with asset B

   + weight of asset C × covariance of asset A with asset C

   = (0.20 × 0.050000) + (0.30 × 0.006700) + (0.50 × 0.001300)

   = 0.01 + 0.00201 + 0.00065

= 0.01266

Asset A's contribution to total portfolio variance = 0.2 × 0.01266 = 0.002532

2. Portfolio variance is the sum of the absolute contributions to variance:

   = 0.002532 + 0.001998 + 0.002880 = 0.00741

   Thus the relative contribution of asset A to portfolio variance = 0.002532 / 0.00741 = 0.34 or 34%.

Portfolio variance can be attributed to sectors, countries, or pools of assets representing factors (e.g., value vs. growth), in a similar manner. Analogous to the contribution to total variance of a single asset, the contribution to portfolio variance of a sector can be calculated as its weight in the portfolio multiplied by the covariance of the sector with the portfolio.

Portfolio variance can also be separated into variance attributed to factor exposures and unexplained variance. A manager that generates most of her returns from exposure to rewarded factors (such as a multi-factor diversified manager) would expect to see a large contribution to risk explained by rewarded factors and a low contribution to risk from unexplained idiosyncratic risks. The contribution to portfolio variance of a factor is analogous to the contribution to portfolio variance of an asset, with weights replaced by beta sensitivities and assets replaced by factors. The contribution of factor i to portfolio variance is given by the formula:

$$CV_i = \sum_{j=1}^{n} \beta_i \beta_j C_{ij} = \beta_i C_{ip}$$

where:

β_i = sensitivity of portfolio to factor i (regression coefficient)

C_{ij} = the covariance of factor i and factor j

C_{ip} = the covariance of factor i and the portfolio $\left(\sum_{j=1}^{n} \beta_j C_{ij} \right)$

The portfolio variance is the sum of each factor's contribution to portfolio variance.

EXAMPLE: Factor-based risk budgeting

The following table presents the risk-factor coefficients and variance/covariance matrix for a manager running a portfolio using a two-factor model (market and size).

		Variance/Covariance of Returns	
	Coefficients	**Market**	**Size**
Market	0.892	0.00178	0.00042
Size	–0.283	0.00042	0.00048

The standard deviation of the manager's return is 3.74%.

1. **Calculate** the proportion of the total portfolio variance explained by the market factor.
2. If the contribution to portfolio variance of the size factor is –0.00007, **calculate** the proportion of total portfolio variance that is unexplained.

Answers:

1. Variance attributed to the market factor (Factor 1):

   = coefficient of Factor 1 × coefficient of Factor 1 × covariance of Factor 1 with Factor 1

   + coefficient of Factor 1 × coefficient of Factor 2 × covariance of Factor 1 with Factor 2

= (0.892 × 0.892 × 0.00178) + (0.892 × –0.283 × 0.00042)

= 0.00131

Total portfolio variance is $0.0374^2 = 0.0013988$

So, proportion of total portfolio variance explained by the market factor = 0.00131 / 0.0013988 = 93.7%

2. Total variance explained by the factors:

   = contribution to variance of Factor 1 + contribution to variance of Factor 2

   = 0.00131 + (–0.00007) = 0.00124

   Unexplained variance = total portfolio variance – variance explained by factors = 0.0013988 – 0.00124 = 0.00016

   Hence proportion of total portfolio variance that is unexplained = 0.00016 / 0.0013988 = 11.4%

PROFESSOR'S NOTE

Note that the answers to parts 1 and 2 sum to more than 100%, because the size factor makes a negative contribution to total portfolio variance.

Causes and Sources of Relative/Active Risk

Relative risk is an appropriate measure when the manager is concerned with performance relative to a market index. Active variance, which is the variance of the differences between portfolio and benchmark returns, can be broken down in an analogous manner to absolute variance.

The contribution of asset *i* to portfolio *active* variance (CAV_i) is given by the equation:

$$CAV_i = (w_{pi} - w_{bi})RC_{ip}$$

where:

w_{pi} = weight of asset *i* in the portfolio

w_{bi} = weight of asset *i* in the benchmark

RC_{ip} = the covariance between the active returns of asset *i* and the active returns of the portfolio, which reflects the covariances between the active returns for asset *i* and the active returns for each of the *n* assets in the portfolio:

$$RC_{ip} = \sum_{j=1}^{n} (w_{pj} - w_{bj})\, RC_{ij}$$

Adding up the CAVs for all the assets in the portfolio will give the variance of the portfolio's active return (AV_p).

PROFESSOR'S NOTE

These formulas are analogous to those seen earlier for the contribution to absolute risk, but using active weight of the asset, and covariance of active returns. It is intuitively reasonable that an asset will contribute more to active variance if it has a higher active weight and if its active returns are related to overall portfolio active returns.

A simple example would be a benchmark composed of a 50/50 allocation to two equity indexes. The portfolio comprises allocations to these two indices and to a third asset, cash. Relevant information is displayed in Figure 25.4:

Figure 25.4: Relative Risk Attribution

	Benchmark Weight	Portfolio Weight	Standard Deviation	Active Risk	Correlation of Active Returns			Variance of Active Returns Attributed to Each Asset (%)
					Index A	Index B	Cash	
Index A	50%	35%	15%	6%	1.00	–1.00	–0.72	18%
Index B	50%	35%	9%	6%	–1.00	1.00	0.72	–18%
Cash	0%	30%	0.25%	12%	–0.72	0.72	1.00	100%
Total				3.60%	–0.72	0.72	1.00	100%

PROFESSOR'S NOTE

The formulas given have been used to compute $CAV_{Index\ A} = 0.000233$, $CAV_{Index\ B} = -0.000233$, and $CAV_{Cash} = 0.001296$, from which $AV_P = 0.001296$ and $\sigma_{AR} = \sqrt{0.001296} = 3.6\%$, as shown in the table. The rightmost column of the table gives each CAV as a percentage of AV_P. Note the calculation of CAV is not shown in the curriculum; thus, it will not be tested on the exam.

The important points to note are:

- Contribution to active variance is a function of active risk not absolute standard deviation. While cash has a very low standard deviation, it has an active risk twice that of the indexes comprising the benchmark due to the low correlation of cash versus the benchmark. This leads to cash contributing to 100% of the active variance.
- The correlation of the active returns of index A and index B is –1. This is because the benchmark is an equally weighted average of the two indices—when one is outperforming the benchmark (so has positive active returns) then the other must be underperforming the benchmark (giving negative active returns).

Similar to the absolute risk attribution of the previous section, relative risk attribution can be conducted on a country, sector or factor level.

Active portfolio variance can also be segmented into variance explained by active factor exposures, and unexplained active variance associated with idiosyncratic risks.

Determining the Appropriate Level of Risk

Practical considerations when considering the appropriate level of portfolio risk include:

1. *Implementation constraints*. Constraints on short positions or on leverage may limit the manager's ability to under/overweight. Liquidity issues may increase costs as a

manager increases active risk, which leads to a degradation of the information ratio as the extra costs weigh on active returns.

2. *Limited diversification opportunities*. We know from basic portfolio theory that increasing risk leads to decreasing marginal increases in expected returns (this gives rise to the concave efficient frontier of Markowitz). Portfolios with higher risk/return targets eventually run out of high-return investment opportunities and lose the ability to diversify efficiently, thereby reducing the Sharpe ratio.
3. *Leverage and its implications for risk*. While leverage could be used to solve issue number two in a single period (allowing the portfolio to move up the linear capital allocation line, rather than following the curved efficient frontier), too much leverage will eventually bring a reduction of expected compounded return in a multi-period setting. This comes from the fact that the geometric compounded returns (R_g) of a portfolio are approximately related to arithmetic non-compounded returns (R_a) and portfolio volatility σ as follows:

$$R_g = R_a - \frac{\sigma^2}{2}$$

Leverage increases both R_a and σ, but the squaring of σ in the expression means there will be a point where increasing leverage will lower expected geometric compounded returns over time.

PROFESSOR'S NOTE

Point three is related to the idea that geometric compounded returns over time fall as the volatility of a portfolio increases. For example, if a portfolio falls 2% and subsequently rises by 2% it will nearly return to its previous value (0.98 × 1.02 = 0.9996). However, if a portfolio falls by 20% and subsequently rises by 20% the portfolio value at the end of two periods will be lower (0.8 × 1.2 = 0.96). Both these portfolios have the same arithmetic uncompounded return of zero, yet the second has a lower compounded return over two periods because of its higher volatility.

Allocating the Risk Budget

An active manager should efficiently allocate their risk budget to sources that accurately represent their investment approach. Figure 25.5 compares sources of risk for a manager with balanced exposure to rewarded factors (Factor Diversified) versus a manager with concentrated sector and cash bets (Sector Rotator):

Figure 25.5: Comparative Sources of Risk, Drivers of Return

	Factor Diversified	Sector Rotator
Number of securities	High (in the hundreds)	Low (in the tens)
Position concentration	Low	High
Cash positions	Very low	High when allocated to cash
Market beta	Close to one (diversified)	Higher/lower than one depending on risk targets
Absolute risk	Lower	Higher, though tempered by large allocation to cash
Active risk	Lower	Higher due to large idiosyncratic risks coming from concentrated positions and sector bets
Active Share	Lower	Higher, consistent with higher security concentration
Average sector deviation	Lower	Higher, consistent with willingness to take sector bets
Source of risk: market	Higher	Lower, consistent with higher security concentration
Source of risk: sectors	Lower	Higher, consistent with sector bets
Source of risk: styles	Lower	Higher, consistent with concentrated positions

Source of risk: unexplained	Lower	Higher, consistent with sector rotation and concentrated positions

Additional Risk Measures

LOS 25.e: Discuss risk measures that are incorporated in equity portfolio construction and describe how limits set on these measures affect portfolio construction.

CFA® Program Curriculum, Volume 4, page 502

Risk constraints can be classified as *heuristic* or *formal*.

- **Heuristic risk constraints** are based on experience or general ideas of good practice. Examples include limits on exposure to individual positions, sectors or regions, limits on leverage, or measures designed to control the degree of illiquidity and turnover in the portfolio.
- **Formal risk constraints** are often statistical in nature. A key distinction between formal and heuristic risk measures is that formal risk measures require forecasts of return distributions, which introduces estimation error. Examples include limits on volatility, active risk, skewness, drawdowns, and VaR-based measures including:
  - Conditional VaR (CVaR)—the expected loss given VaR has been exceeded (also called expected tail loss or expected shortfall).
  - Incremental VaR (IVaR)—the change in VaR from adding a new position to a portfolio.
  - Marginal VaR (MVaR)—the impact of a very small change in position size on VaR.

PROFESSOR'S NOTE

VaR is discussed in detail in the section on risk management, where CVaR is referred to as Tail VaR (TVaR).

Other points of note regarding risk constraints include:

- *Leverage* magnifies the negative impact of incorrect risk estimations. Infrequent but high impact negative "tail events" such as the market crashes seen in the early 2000s and 2008 can force a leveraged manager to liquidate all or part of his portfolio in an unfavorable environment, crystallizing significant losses.
- Unexpected increases in *volatility* can also derail investment strategies. Managers may tighten risk controls in more volatile periods to protect the portfolio from losses.
- Risk measures used depend on the style of management. A benchmark-agnostic manager with an absolute return philosophy is less likely to be concerned with statistical measures such as active risk and more concerned with more practical measures such as portfolio drawdown. A market-neutral equity manager is more likely to target keeping absolute volatility within a specific range in order to deliver the promised market-neutral low-volatility returns to investors.
- Portfolios with fewer positions will have higher estimation errors due to the random specific risks of concentrated positions, hence using formal risk measures is likely to be more difficult.

MODULE QUIZ 25.3

To best evaluate your performance, enter your quiz answers online.

1. The contribution to total variance of a geographical country allocation is *best* defined as:
   A. the weight of the country in the portfolio multiplied by the covariance of the country returns with the global market portfolio returns.
   B. the weight of the country in the portfolio multiplied by the correlation of the country returns with the portfolio returns.
   C. the weight of the country in the portfolio multiplied by the covariance of the country returns with the portfolio returns.
2. Forecasting of return distributions is *most likely* required by:
   A. heuristic risk constraints only.
   B. formal risk constraints only.
   C. both heuristic and formal risk constraints.

MODULE 25.4: IMPLICIT COST-RELATED CONSIDERATIONS IN PORTFOLIO CONSTRUCTION

Video covering this content is available online.

LOS 25.f: Discuss how assets under management, position size, market liquidity, and portfolio turnover affect equity portfolio construction decisions.

CFA® Program Curriculum, Volume 4, page 522

The *market impact* cost of an investment strategy is an implicit cost related to the price movement caused by managers executing trades in the market. A manager buying securities may force security prices up, similarly a manager selling securities may force security prices down, thereby eroding the manager's alpha.

Factors that affect market impact costs include:

- Assets under management (AUM) versus market capitalization of securities:
  - The lower absolute level of trading volume for *smaller* cap securities can be a liquidity barrier to managers with *higher* AUM.
  - For example, assume a small cap investment has a market capitalization of $5 billion and that 1% of its capitalization trades each day on average, implying daily turnover of 0.01 × $5 billion = $50 million. A manager of a $1 billion fund may have a liquidity constraint of not holding more than 10% of the average trading volume of a security, which would limit the holding in the company to 0.1 × $50 million = $5 million. This implies the maximum position in the fund the manager can take in the investment is $5 million / $1 billion = 0.5%. This may not be a large enough position to allow the manager to execute their strategy, particularly if the strategy involves concentrated positions.
- Higher **portfolio turnover** and shorter **investment horizons** generally lead to higher market impact costs.
- Managers whose trades include "information" (where the trades act as a signal to the market that investment conditions have changed and encourage other market

participants to carry out similar trades) will likely have higher market impact costs.

The market impact cost of a single trade is often measured by "slippage." **Slippage** is defined as the difference between the execution price and the midpoint of the quoted market bid/ask spread at the time the trade was first entered. Estimates of slippage based on recent empirical data lead to four notable conclusions:

1. Slippage costs are usually higher than explicit costs.
2. Slippage costs are greater for smaller-cap securities than for large-cap securities.
3. Slippage costs are not necessarily greater in emerging markets.
4. Slippage costs are substantially higher in times of high market volatility.

For successful small-cap focused strategies, the ability of the manager to continue implementing the strategy as AUM grow may be impaired by increasing slippage costs. In this case, the manager should either close their funds to contributions from new investors or inform investors that their strategy may have to change. Investors should be wary of managers raising new funds on the back of a track record that cannot be scaled for higher AUM.

Due to the higher impact costs of smaller-cap securities, a fund with a focus on large-cap stocks can support a higher level of AUM than a similar-strategy fund focused on small-cap stocks. A firm focused on small-cap stocks must either limit its AUM, diversify, limit turnover, or adapt its trading strategy to cap impact costs as AUM grow.

EXAMPLE: Issues of scale

A diversified multi-factor fund has a size of $200 million and 350 individual positions. The benchmark is a large/mid cap index with 1000 constituents and total market cap of approximately $20 trillion. The smaller securities in the index trade about 1.5% of shares outstanding daily. The strategy has the following constraints:

1. No investment can be made in any security that has an index weight of less than 0.02%.
2. The maximum fund position percentage holding is equal to the lesser of 10 × index weight or index weight plus 100 bps.
3. Absolute position sizes cannot exceed 5% of the security's average daily trading volume (ADV) over the trailing 12 months.

Based on the three constraints listed previously, **calculate** the level of AUM, which the fund's ability to execute this strategy is likely to be impaired.

Answer:

The limit on the absolute size of a stock that can be held in the fund for the smallest cap position is set by Constraints 1 and 3.

Constraint 1 indicates the manager cannot invest in stocks whose market cap is below approximately 0.0002 × $20 trillion = $4 billion.

The ADV of this smallest cap holding would be about 0.015 × $4bn = $60 million.

Constraint 3 implies the maximum absolute position size for this smallest cap holding is therefore 0.05 × $60 million = $3 million.

The strategy has a maximum position size set by Constraint 2.

Constraint 2 implies the maximum position for the smallest cap security is the lesser of 10 × 0.02% = 0.2% and 0.02% + 100 bps = 1.02%. This means the maximum position size in the fund is 0.2%.

If the manager cannot hold up to 0.2% of the fund in the smallest capitalization position, then the ability to carry out the strategy is potentially impaired.

Given that Constraints 1 and 3 imply the manager cannot hold more than $3 million in the smallest capitalization holding, this means the ability to carry out the strategy is impaired by illiquidity when AUM reach $3,000,000 / 0.002 = $1.5 billion.

If the fund size is higher than this, the manager is constrained by the liquidity of small cap positions and cannot hold the maximum weight allowed by the strategy.

MODULE QUIZ 25.4

To best evaluate your performance, enter your quiz answers online.

1. All else equal, higher market impact cost is *most likely* associated with:
   A. lower AUM.
   B. investing in large cap securities.
   C. higher portfolio turnover.

MODULE 25.5: THE WELL-CONSTRUCTED PORTFOLIO

Video covering this content is available online.

LOS 25.g: Evaluate the efficiency of a portfolio structure given its investment mandate.

CFA® Program Curriculum, Volume 4, page 515

A **well-constructed portfolio** should deliver the characteristics promised to investors in a cost-efficient and risk-efficient way. This involves:

- A clear investment philosophy and a consistent investment process.
- Risk and structural characteristics as promised to investors.
- Achieving desired risk exposures in the most efficient manner.
- Reasonably low operating costs, given the strategy.

Funds aiming to deliver different required characteristics will have different well-structured portfolios. The following general points can be made about portfolios that have the same desired characteristics:

- Portfolios that can achieve desired risk exposures *with fewer positions* are likely to have more focus on risk management in the portfolio construction process. While this will not guarantee excess return, it does indicate risk efficiency is likely higher.
- If two portfolios have similar risk factor exposures, the product with the *lower absolute volatility and lower active risk* will likely be preferred (assuming similar costs).
- If two portfolios have similar active and absolute risks, similar costs, similar manager alpha skills, then the portfolio *with the highest Active Share* is preferable because this will leverage the alpha skill of the manager and have higher expected return.
- When selecting equity managers to create the equity allocation of a multi-asset fund, managers should be combined to create an overall equity allocation in the portfolio that is well-constructed. A risk factor exposure that is desired but not present in one manager could be compensated for by adding a different manager that specializes in

generating exposure to that risk factor.

LONG/SHORT, LONG EXTENSION, AND MARKET-NEUTRAL PORTFOLIO CONSTRUCTION

LOS 25.h: Discuss the long-only, long extension, long/short, and equitized market-neutral approaches to equity portfolio construction, including their risks, costs, and effects on potential alphas.

CFA® Program Curriculum, Volume 4, page 520

Short-selling securities is the process of borrowing securities and selling them in the market, with the intention of buying the securities back later at a lower price and returning them to the lender. Short-sellers therefore make profits from security prices falling.

Introducing the ability to short-sell securities allows investment managers to take advantage of negative insights gained through their investment research. **Long/short** is a general term used to describe any portfolio that can short-sell securities.

The Merits of Long-Only Investing

An investor's choice between following long-only or long/short strategies is influenced by several factors:

- **Long-term risk premiums**, such as the market risk premium, are earned by investors going net *long* securities. Investors that short-sell securities over the long term will therefore suffer negative returns. Investors that have *shorter* time horizons concerned about negative returns may prefer strategies that have short exposures.
- The **capacity and scalability** of a long-only strategy is set by the liquidity of the underlying securities. Capacity of short-selling strategies is set by the availability of securities to *borrow* to facilitate short-selling. This means the capacity of long/short strategies is likely to be lower than for long-only strategies, particularly those large-cap funds that face few long-only capacity issues.
- Due to **limited legal liability** laws, the maximum a long investor can lose is the amount they paid for the security (if the security falls to zero). The potential loss to a short-seller is unlimited, however, as they lose as stock prices *rise*, and stocks prices have no price ceiling. This makes "naked" short-selling with no hedging riskier than a long-only strategy.
- **Regulations** allow some countries to ban short-selling in the interests of financial market stability.
- **Transactional complexity** is higher for a long/short fund. A long-only investor need only instruct a broker to buy shares and subsequently sell them. A short-seller must source shares to borrow, provide collateral to the lender of the shares, and faces the risk the lender recalls the shares at an inopportune time. A short-seller usually appoints a prime broker to deal with stock borrowing and collateral functions, which introduces an extra layer of counterparty risk, because if the prime broker goes bankrupt collateral may be lost.

- **Costs** are likely to be higher for long/short funds than long-only funds both in terms of management fees and operational expenses.
- The **personal ideology** of an investor might cause them to object to short-selling. This may be because they find the concept of profiting from the failure of others morally wrong, or they believe the expertise to short-sell is not consistently available from managers. Investors may find the leverage involved in some long/short strategies unacceptable.

Long/Short Portfolio Construction

There are many different styles of long/short strategies, defined by their *gross* and *net exposure*. Gross exposure is the sum of the value of the long positions plus the absolute value of the short position, expressed as a percent of investor's capital. Net exposure is the difference between the value of the long positions and the value of the short positions, again expressed as a percentage of investor's capital.

For example, a long/short fund raises $100 million of capital from investors. They invest $80 million in long positions and short-sell $30 million of securities. Hence, the value of long positions is 80% and the value of short positions is 30%. Gross exposure is 110% (80% + 30%) and net exposure is 50% (80% – 30%). Note that this strategy will have a cash balance of $50 million comprising $20 million of uninvested capital on the long side ($100 million – $80 million), and $30 million of short-sale proceeds.

Specific types of long/short funds include *long extension* and *market-neutral* funds.

Long extension portfolios are long/short strategies typically constrained to have a net exposure of 100%. For example, a long extension portfolio might have a long position of 130% and a short position of 30% (referred to as a 130/30 fund). This is a constrained form of long/short fund, in that the manager has no real discretion over gross/net exposure. This would be preferred by investors that want 100% net market exposure but also wish to allow the manager to engage in some level of short-selling in order to benefit from negative views.

Market-neutral portfolios aim to remove market exposure through their long and short exposures. A simple example would be a fund that is long $200 million of assets with a market beta of 0.9 and short $150 million of assets with a market beta of 1.2, giving a net market beta of zero. If the long and short positions are of equal size (and thus have equal betas) then gross exposure will be twice the long position value and net exposure will be zero. These funds should have lower volatility than long-only strategies, and low correlation with other strategies. The objective will be to neutralize risks where the manager believes they have no comparative advantage in forecasting, allowing them to concentrate on their specific skills. Often market-neutral strategies are used for diversification purposes, rather than for the purpose of seeking high returns. Note that it is difficult in practice to maintain a zero beta, given that correlations between exposures change continually.

Market-neutral portfolios can be constructed through *pairs trading*, where the securities of similar companies are bought and sold to exploit perceived mispricings. Quantitative approaches to pairs trading are referred to as *statistical arbitrage* (stat arb).

PROFESSOR'S NOTE

Stat arb was previously discussed in detail.

The Benefits and Drawbacks of Long/Short Strategies

Long/short strategies offer the following *benefits*:

- Greater ability to express negative ideas than a long-only strategy. The most negative position a long-only manager can take is to not hold a security, meaning that maximum underweighting a long-only manager can take is set by the weight of the security in the benchmark. A long/short manager is not constrained in this way because they can short securities. This will increase the information ratio because lower constraints will increase the transfer coefficient of the manager (TC, measuring their ability to translate insights into investment decisions, as seen earlier in the fundamental law of active management).
- Ability to use the leverage generated by short positions to gear into high-conviction long ideas.
- Ability to remove market risk and act as a diversifying investment against other strategies.
- Greater ability to control exposure to risk factors. Because most rewarded factors (size, value, momentum, etc.) are obtained through a long/short portfolio, being able to short-sell allows managers to better control their exposure to these factors.

PROFESSOR'S NOTE

Long/short portfolios that are constructed to represent rewarded factors were previously discussed.

Long/short strategies contain the following *drawbacks:*

- Unlike a long position, a short position will cause the manager to suffer losses if the price of the security increases. This means potential losses are unlimited, because security prices are not bounded above. It also means the manager is reducing long-term exposure to the market risk premium.
- Some long/short strategies require significant leverage, which magnifies losses as well as gains.
- The cost of borrowing securities can become too high, particularly for securities that are difficult to borrow.
- Losses on the short position will increase collateral demands from stock lenders, particularly if leverage has been used. This may force the manager to liquidate positions at unfavorable prices. The manager may also be vulnerable to a *short squeeze*, where a sudden rise in the price of a heavily-shorted security forces short-sellers to cover positions, buy back shares and potentially force the share price higher. Lenders of securities could also recall shares at inopportune times causing disruption to the manager's strategy.

MODULE QUIZ 25.5

To best evaluate your performance, enter your quiz answers online.

1. If two portfolios have similar active and absolute risks, similar costs, and similar manager alpha skills, then:
    A. the portfolios must have equal Active Share.
    B. the portfolio with highest Active Share would be preferred.
    C. the portfolio with lowest Active Share would be preferred.
2. All of the following are potential drawbacks of long/short strategies except:
    A. the ability to use the leverage generated by short positions to gear into high conviction long ideas.
    B. the ability to gain exposure to long-term market risk premiums.
    C. the high leverage used by some market neutral strategies to generate investor returns.

KEY CONCEPTS

LOS 25.a

The three main building blocks of active return (excess return above a benchmark) for an active equity manager are:

- Active rewarded factor (beta) weightings (taking exposures that differ from the benchmark). Factor exposures include market, size, value, momentum, liquidity, et cetera.
- Alpha skills—timing rewarded and unrewarded factors, sectors, and securities. This primarily generates excess return through identifying mispricings.
- Position sizing—large positions affect all three sources of active returns, but will primarily generate high idiosyncratic risk (good/bad luck). It may be a required part of a concentrated manager's alpha-generating strategy.

Success at combining these building blocks comes from breadth of expertise, defined as the number of independent decisions the manager makes per year. Higher breadth implies higher ability to outperform benchmarks. We see this in the fundamental law of active management:

$$\mathrm{E}\left(\mathrm{R_A}\right) = \mathrm{IC}\sqrt{\mathrm{BR}}\sigma_{\mathrm{R_A}}\mathrm{TC}$$

LOS 25.b

Decision-making can be can be systematic (rule-driven) or discretionary (opinion-driven). Discretionary managers are more likely to engage in factor timing, hold concentrated portfolios, and are less likely to use formal portfolio optimization techniques. Information used can be top-down (relating to the macro environment) or bottom-up (relating to individual securities).

Objectives and constraints of managers can be absolute (e.g., maximize Sharpe ratio subject to maximum volatility) or relative (e.g., maximize information ratio subject to maximum active risk). Other constraints may focus on minimizing risk, maximizing exposures to desired factors, or heuristic approaches.

LOS 25.c

Active Share measures the degree to which the number and sizing of the positions in a manager's portfolio differ from those of a benchmark:

$$\text{Active Share} = \frac{1}{2}\sum_{i=1}^{n}|W_{p,i} - W_{b,i}|$$

Active Share falls between 0 and 1, and the lower the Active Share, the more similar are the portfolio's holdings to the benchmark. If a portfolio has an Active Share of 0.5, we can conclude that 50% of the portfolio is identical to that of the benchmark and 50% is not. A manager can completely control their Active Share because they completely control position sizes in the portfolio.

Active risk (tracking error), is the standard deviation of active returns (portfolio returns minus benchmark returns). A manager can not completely control active risk because it depends on estimates of covariances and variances of securities in the portfolio and the benchmark.

Active risk has two sources: active factor exposure (active beta) and idiosyncratic risk from concentrated positions (variance from both the skill and luck of the manager):

$$\text{active risk}\left(\sigma_{R_A}\right) = \sqrt{\frac{\sum_{t=1}^{T}\left(R_{AT}\right)^2}{T-1}} = \sqrt{\sigma^2\left(\Sigma\left(\beta_{pk}-\beta_{bk}\right)\times F_k\right)+\sigma_e^2}$$

LOS 25.d

Risk budgeting is the process by which the contribution to total risk of the portfolio is allocated to constituents of the portfolio in the most efficient manner. Contribution to portfolio variance can be calculated on an absolute or relative basis.

- The contribution of asset *i* to absolute portfolio variance

  $= \mathrm{CV_i} = \sum_{\mathrm{j}=1}^{\mathrm{n}} \mathrm{w_i w_j C_{ij}} = \mathrm{w_i C_{ip}}$

- The contribution of factor *i* to absolute portfolio variance

  $= \mathrm{CV_i} = \sum_{\mathrm{j}=1}^{\mathrm{n}} \beta_{\mathrm{i}}\beta_{\mathrm{j}} \mathrm{C_{ij}} = \beta_{\mathrm{i}} \mathrm{C_{ip}}$

- The contribution of asset *i* to relative portfolio variance

  $= CAV_i = \sum_{j=1}^{n}\left(w_{pi}-w_{bi}\right)\left(w_{pj}-w_{bj}\right)RC_{ij} = \left(w_{pi}-w_{bi}\right)RC_{ip}$

Practical considerations when considering the appropriate level of portfolio risk include:

- Implementation constraints (e.g., limits on position sizes) causing information ratio degradation as active risk increases.
- Limited diversification opportunities in higher risk investments.
- Leverage increasing volatility and causing lower geometric average compounded returns over multiple periods.

LOS 25.e

Risk constraints can be classified as heuristic (based on experience like arbitrary position limits) or formal (based on statistical measures such as VaR). Formal constraints require the estimation of return distributions which introduces estimation error. This estimation error can be magnified by leverage and the idiosyncratic risk of concentrated positions.

LOS 25.f

The market impact cost of an investment strategy is an implicit cost related to the price

movement caused by managers executing trades in the market. Managers with higher AUM, higher turnover and shorter time horizons, whose trades have a higher information content, dealing in smaller-cap less-liquid securities, will have higher market impact costs.

A firm focused on small-cap stocks must either limit its AUM, diversify, limit turnover, or adapt its trading strategy to cap impact costs as AUM grow.

LOS 25.g

A well-constructed portfolio should deliver the characteristics promised to investors in a cost-efficient and risk-efficient way. This involves:

- A clear investment philosophy and a consistent investment process.
- Risk and structural characteristics as promised to investors.
- Achieving desired risk exposures in the most efficient manner.
- Reasonably low operating costs given the strategy.

LOS 25.h

An investor's choice between following long-only or long/short strategies is influenced by several factors, including:

- Long-term risk premiums.
- Capacity and scalability.
- Limited legal liability.
- Regulation.
- Transactional complexity.
- Costs.
- Personal ideology.

Long extension portfolios guarantee investors 100% net exposure with a specified short exposure. A typical 130/30 fund will have 130% long and 30% short positions.

Market-neutral portfolios aim to remove market exposure through offsetting long and short positions. Pairs trading is a common technique in building market-neutral portfolios, with quantitative pair trading referred to as statistical arbitrage.

Benefits of long/short strategies include the ability to better express negative views, the ability to gear into high-conviction long positions, the removal of market risk to diversify, and the ability to better control risk factor exposures.

Drawbacks of long/short strategies include potential large losses because share prices are not bounded above, negative exposures to risk premiums, potentially high leverage for market-neutral funds, the costs of borrowing securities, and collateral demands from prime brokers. Being subject to a short squeeze on short positions is also a risk.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 25.1

1. **C** The manager will take 10 × 12 = 120 independent decisions per year. According to the fundamental law of active management the expected annual active return of the manager will be $0.1 \times \sqrt{120} \times 5\% \times 0.5 = 2.74\%$. (LOS 25.a)

2. **C** Factor timing techniques are difficult to use in a systematic rules-driven way and signals used to generate trading ideas are more often top-down verse bottom-up. (LOS 25.b)

Module Quiz 25.2

1. **A** By substituting a benchmark holding with a non-benchmark holding the manager will increase Active Share because Active Share measures the overall differences in weights between the portfolio and the benchmark. However, if the new security introduced into the portfolio behaves similarly to the benchmark security that has been substituted there may not be a significant increase in active risk of the portfolio because the substitution is unlikely to cause a major increase in the relative volatility of portfolio returns versus benchmark returns. (LOS 25.c)

Module Quiz 25.3

1. **C** Analogous to the contribution to total variance of a single asset, the contribution to portfolio variance of a geography can be calculated as its weight in the portfolio multiplied by the covariance of the country with the portfolio. (LOS 25.d)

2. **B** Heuristic risk constraints are rules of thumb that are deemed to be good practice but lack empirical evidence, such as maximum position size. Formal risk constraints are statistical in nature and usually involves statistical forecasting of return distributions. (LOS 25.e)

Module Quiz 25.4

1. **C** Answer A is incorrect; higher AUM will cause higher market impact costs because fund trades will be larger. Answer B is incorrect; larger cap securities are likely to be more liquid, and hence, offer lower impact costs. Higher portfolio turnover means the manager needs to trade more frequently, which implies a bigger market impact cost because some market impact cost will occur every time the manager trades. (LOS 25.f)

Module Quiz 25.5

1. **B** If two portfolios have similar active and absolute risks, similar costs, similar manager alpha skills, then the portfolio *with the highest Active Share* is preferable because this will leverage the alpha skill of the manager and have higher expected return. (LOS 25.g)

2. **A** The ability to use the leverage generated by short positions to gear into high

conviction long ideas is a benefit of long/short investing which should improve the manager's ability to earn alpha on the long portfolio. Answers B and C are drawbacks to long/short strategies. (LOS 25.h)

TOPIC ASSESSMENT: EQUITY

Use the following information for Questions 1 through 6.

Farat Asset Management (FAM) offers a global array of active and passive management styles. For smaller investors, FAM offers various funds. Four of those funds are described in Figure 1.

Figure 1: Description of Funds

Fund Name	Fund Description
Archie	Fully passive investment in a single, large developed market
Baxter	Passive with active tilt investing in multiple frontier and emerging markets
Carlie	Passive investment in global developed markets
Dunes	An active global portfolio covering all geographic sectors

Hanna Sole is a portfolio manager with FAM and collects the following notes on the funds in Figure 1.

Note 1: Archie is constructed with full replication, defined as a 98% match to the index.

Note 2: Baxter is constructed with optimization and utilizes security lending.

Note 3: Carlie is constructed with stratified sampling and also utilizes security lending.

Note 4: Dunes utilizes aggressive shareholder engagement strategies.

Note 5: All funds charge a single management fee that covers all costs to investors in that fund.

Sole is also interested in the degree of security specific risk diversification within FAM's portfolios. She asks the portfolio managers for the Herfindahl-Hirschman index (HHI) for each of three portfolios. Each portfolio use some form of market cap or free float weighting. The HHI results are shown in Figure 2.

Figure 2: HHI Calculations

Portfolio 1	0.0321
Portfolio 2	0.0027
Portfolio 3	0.0015

One of Sole's clients is a large endowment portfolio that uses multiple managers and strategies. The Board of Trustees for the Endowment relies on Sole and FAM for advice on manager and strategy allocation. The board asks Sole to evaluate the performance of one of their managers. To do so, Sole first collects the data in Figure 3.

Figure 3: Manager and Benchmark Data

		Weight by Sector	
Sector	**Sector Return**	**Manager Allocation**	**Benchmark Allocation**
Industrials	–1.3%	35%	25%
Finance	4.4%	20%	25%
Consumer	4.4%	30%	25%

Energy	4.5%	15%	25%

The board also asks Sole for advice regarding three new passive index managers they are considering and provides the data in Figure 4. All three managers use the same benchmark index.

Figure 4: New Managers

	Manager 1	Manager 2	Manager 3	Benchmark
Management fee	3 bp	11 bp	7 bp	
Cash allocation	1%	1%	2%	0%

At her next meeting with the board, Sole discusses the results of her analysis. As the meeting is breaking up one of the newest board members approaches her and ask about a new index manager he has heard of. The manager describes his process as focused on dividends, P/E, and a size factor. The board member says, "This sounds like an active manager and not a passive index manager." Cole promises to look into it before their next meeting.

1. Which of the following three funds in Figure 1 *most likely* charges the highest management fee?
   A. Carlie.
   B. Archie.
   C. Baxter.

2. Which of the following statements regarding the four funds in Figure 1 is *most likely* correct?
   A. Investors in Dunes are at greater risk of free riders than investors in Archie.
   B. Investors in Carlie are more likely to be charged an incentive management fee than investors in Baxter.
   C. If FAM restructure the investor fee schedule to separately charge for distribution expenses, total cost to investors in the funds would likely decline.

3. Based on the data regarding the HHI calculations, which of the following is *most likely* correct?
   A. Portfolio 3 holds more than 668 stocks.
   B. Portfolio 1 has the equivalent of 64 stocks.
   C. Portfolio 3 has more non-systematic risk that Portfolio 2.

4. Regarding the data in Figure 3, what one sector weighting decision added the *most* value to the manager's performance?
   A. Finance.
   B. Industrials.
   C. Consumer.

5. Which of the managers in Figure 4 is *likely* to have the lowest tracking error?
   A. Manager 1.
   B. Manager 2.
   C. Manager 3.

6. Regarding the manager who describes his process as "focused on dividends, P/E, and a size factor," Sole will *most likely* conclude that the manager:
   A. cannot be a passive index manager.
   B. could be using fundamental factors to replicate the index.

C. uses a blended indexing approach of optimization within cells.

Use the following information for Questions 7 through 12.

Winston Ling is the owner of a boutique investment management firm, Alpha Omega Funds. The firm's three largest funds, Abram Investments, Brawn Capital and Celino Partners, offer a variety of top-down and bottom-up investment styles with a range of investment approaches. Characteristics of the three funds are presented in Exhibit 1.

Exhibit 1: Fund Information for Abram, Brawn, and Celino

	Abram	Brawn	Celino
Target active risk	8%	5%	1%
Maximum sector deviation	2%	0%	2%
Maximum risk contribution to a single security	6%	1%	1%
Monthly arithmetic return	0.55%	0.75%	0.85%
Standard deviation of return	2.5%	3.8%	4.2%

Ling has been worried recently that his fund managers may be subject to some common behavioral biases. Commenting on these biases, Ling makes the following two statements:

1. "I noticed that one of the funds has been poorly diversified, with a large number of holdings in securities that haven't performed well over the last few years. I think this fund has excessive risk exposure."
2. "The manager of one of my funds has not sold his securities in a very long time with the expectation of strong returns, and as a result likely missed out on profitable new investment opportunities."

In addition to the funds managed by Alpha Omega, Ling wants to explore other types of active bottom-up investment management strategies. He has gathered information on three attractive companies which he is considering as potential investments. Information on the three companies is presented in Exhibit 2.

Exhibit 2: Company Investment Characteristics

	Company A	Company B	Company C
Leading price-earnings (P/E) ratio	15	9	25
3-year earnings growth	2%	12%	2%
Sector average P/E	15	9	48
Dividend yield	7%	1%	1%

7. Based on information in Exhibit 1, which of the funds is *most likely* to be a closet indexer?
   A. Abrams.
   B. Brawn.
   C. Celino.

8. Ling comments that some of the securities in the Brawn fund may be subject to a value trap. Ling is *most likely* implying that:
   A. the securities are overpriced because of their high price-earnings (P/E) ratio.
   B. the securities have low P/E ratios, but their future prospects may worsen.
   C. the securities' share prices already reflect the expectation of future growth.

9. Based on return and risk data in Exhibit 1, which manager's portfolio has the highest expected compound return using a leverage factor of 2?
   A. Abrams.
   B. Brawn.
   C. Celino.

10. Which two biases are *most* attributable to Ling's statements?

	Statement 1	Statement 2
1.	Confirmation	Regret aversion
2.	Overconfidence	Illusion of control
3.	Confirmation	Overconfidence

11. Based on the information in Exhibit 2, which company would be *most* suitable for investors who pursue a *relative value* investing approach?
   A. Company A.
   B. Company B.
   C. Company C.

12. Based on the information in Exhibit 2, which company would be *most* suitable for investors who pursue an *income investing* approach?
   A. Company A.
   B. Company B.
   C. Company C.

TOPIC ASSESSMENT ANSWERS: EQUITY

1. **C** Baxter is likely to be the most expensive fund to operate and therefore FAM will have to charge a higher fee to investors. Baxter involves some (undefined) active management elements and it operates in the least developed markets (emerging and frontier) where operating expenses are likely to be higher. Securities lending also adds complexity and increases costs for FAM. Archie is a fully passive approach to a single developed market and likely to have the lowest fee. Carlie should fall in between as a passive approach with allocations to multiple (global) developed markets. (Study Session 9, Module 22.2, LOS 22.c, 22.e)

2. **A** Dunes utilizes aggressive shareholder engagement, which seeks to actively influence company management in ways to increase shareholder value. Investors in Dunes will have to be charged higher fees to cover the costs of these activities by FAM. But all investors (including those in Archie) will benefit if the efforts in Dunes are successful. Note that Dunes is a global portfolio covering all geographic sectors, which will include the developed market in which Archie invests.

   Carlie and Baxter are both passive so an inventive fee is highly unlikely in either. While unlikely for both Baxter does have an undefined active tilt so an incentive fee could be slightly more likely for Baxter, not for Carlie.

   Distribution expenses are just another name for some of the costs involved in running a fund. Breaking the expense out separately does not increases costs to FAM in any meaningfully way and should not have a material impact on total costs to investors. Cynical candidates may argue (and perhaps correctly) that breaking up the expenses into components is a way to hide true costs and might lead to higher, not lower, total cost to investors. (Study Session 9, Module 22.2, LOS 22.c, 22.d)

3. **A** The equivalent number of equal weighted positions is the reciprocal of the HHI. They are:

Results of HHI Calculations		**Equivalent Number Of Stocks**
Portfolio 1	0.0321	1 / 0.0321 = 31.15
Portfolio 2	0.0027	1 / 0.0027 = 370.37
Portfolio 3	0.0015	1 / 0.0015 = 666.67

   From this we know Portfolio 1 has the equivalent of 31 stocks, not 62. However we also know the portfolios are not likely to be equal weighted as they use market cap or free float adjusted market cap weightings. Therefore, each will contain more than 1/HHI stocks. Portfolio 3 would contain more than 666.67 and almost certainly more than 668, making that the most likely correct statement. Given that the equivalent number of stocks in Portfolio 3 is almost double that of Portfolio 2, Portfolio 3 likely has greater diversification and less non-systematic risk, not more. (Study Session 9, Module 23.1, LOS 23.a)

4. **C** Value added by sector weight reflects the over or under weighting by sector times the return of that sector and can be calculated as:

Sector	Sector Return	Manager Allocation	Benchmark Allocation	Manager W × Return	Benchmark W × Return
Industrials	–1.3%	35%	25%	–45.5 bp	–32.5 bp
Finance	4.4%	20%	25%	88.0 bp	110.0 bp
Consumer	4.4%	30%	25%	132.0 bp	110.0 bp
Energy	4.5%	15%	25%	67.5 bp	112.5 bp

   The only good weighting decision was to overweight Consumer by 30 – 25 = 5% and Consumer had strong performance at +4.4% for the period. Note that attribution analysis will be covered more fully and in somewhat different form in a later reading. (Study Session 9, Module 23.3, LOS 23.f)

5. **A** Manager 1 because the manager has the lowest management fee and allocation to cash (so lowest cash drag). The benchmark does not incur a management fee and has no cash drag. (Study Session 9, Modules 23.2 and 23.3, LOS 23.d, 23.e)

6. **B** While not a conventional approach to index replication, it is possible this is an index manager who is replicating risk factors of the index in order to replicate index performance. Dividend (yield), P/E ratio, and size (market cap) are common equity risk factors. To say this cannot be passive is overstating things. A combination approach of optimization within each cell of cell matching is a combination approach but there is nothing to indicate the manager looks at cell weights of market cap versus value/growth. (Study Session 9, Module 23.1, LOS 23.b)

7. **C** Celino is likely a closet indexer, or a fund that claims to be actively managed but is essentially an index fund. The low active risk, low sector deviation, and low risk contribution indicate few active bets which are representative of a closet indexer. (Study Session 10, Module 25.2, LOS 25.c)

8. **B** A value trap indicated securities whose low P/E ratios may indicate attractive investments, but the securities' future prospects may actually worsen. As a result, these securities remain overpriced despite their current low P/E ratios.

   Securities whose share prices already reflect the expectation of future growth are called growth traps. These securities may have been already overpriced when purchased. (Study Session 10, Module 24.3, LOS 24.g)

9. **C** The expected compound return of an asset (Rg) is related to its expected arithmetic return (Ra) and its expected volatility (σ):

   $R_g = R_a - \sigma^2 / 2$

   With a leverage factor of 2, the expected compounded return for the three funds is:

   Abrams: $2 \times .0055 - (2 \times .025)^2 / 2 = .00975$ or 0.975%

Brawn: $2 \times .0075 - (2 \times .038)^2 / 2 = .01211$ or 1.211%

Celino: $2 \times .0085 - (2 \times .042)^2 / 2 = .01347$ or 1.347%

(Study Session 10, Module 25.3, LOS 25.d)

10. **A** *Confirmation bias* is the tendency by investors to only look at investment information that validates their beliefs and ignore information that may contradict it. This bias results in poorly diversified portfolios with unnecessary risk exposures, and large holdings of underperforming securities.

    Regret aversion bias causes investors to be overly cautious for fear of making bad decisions. This bias results in managers holding on to positions too long and missing out on potentially much more profitable investments.

    Answer B is not correct because *illusion of control* is a bias that investors can influence investment outcomes and as a result select outperforming securities. This may result in excessive number of trades or concentrated positions.

    Answer C is not correct because *overconfidence bias* is an emotional bias which causes investors to have too much faith in their own investment selection abilities, causing managers to underestimate risks and overestimate returns. (Study Session 10, Module 24.3, LOS 24.g)

11. **C** Company C's leading (forward looking) P/E ratio is 25, which is significantly below the P/E ratio of 48 of its sector peers. This makes it most suited for investors with a relative value investing approach.

    Answer A is not correct because Company A has similar P/E ratio than its sector peers, and has relatively low earnings growth. However, it has a comparatively high dividend yield. This makes it most suited for investors with an income investing approach.

    Answer B is not correct because Company B has a similar P/E ratio to its industry peers, but has the highest earnings growth rate. This makes it most suited for investors with a growth at reasonable price (GARP) investing approach. (Study Session 10, Module 24.1, LOS 24.b)

12. **A** Company A has a similar P/E ratio than its sector peers, and has relatively low earnings growth. However, it has a comparatively high dividend yield. This makes it most suited for investors with an income investing approach.

    Answer B is not correct because Company B has similar P/E ratio to its industry peers, but has the highest earnings growth rate. This makes it most suited for investors with a growth at reasonable price (GARP) investing approach.

    Answer C is not correct because Company C's leading (forward looking) P/E ratio is 25, which is significantly below the P/E ratio of 48 of its sector peers. This makes it most suited for investors with a relative value investing approach. (Study Session 10, Module 24.1, LOS 24.b)

FORMULAS

Yield income: annual coupon amount / current bond price

Rolldown return: (projected ending bond price (BP) – beginning BP) / beginning BP; based on no change in the yield curve

Price change due to investor yield change predictions: $(-MD \times \Delta Y) + (\frac{1}{2}C \times \Delta Y^2)$

Less credit losses: predicted default adjusted for recover rate

Currency G/L: projected change in value of foreign currencies weighted for exposure to the currency

Rolling yield = yield income + rolldown return

r_p = portfolio return (amount) / portfolio equity

Return for a leveraged portfolio: $r_I + [(V_B / V_E) \times (r_I - r_B)]$

where:

r_p = return on portfolio

r_I = return on invested assets

r_B = rate paid on borrowings

V_B = amount of leverage

V_E = amount of equity invested

leverage = (notional value of contract – margin amount) / margin amount

Rebate rate = collateral earnings rate – security lending rate

$$\text{convexity} = \frac{\text{Macaulay duration}^2 + \text{Macaulay duration} + \text{dispersion}}{(1 + \text{periodic IRR})^2}$$

BPV = MD × V × 0.0001 = price value of a basis point

$$\text{futures BPV} \approx \frac{\text{BPV}_{\text{CTD}}}{\text{CF}_{\text{CTD}}}$$

$$\text{N}_\text{f} = \frac{\text{BPV of liability} - \text{BPV of current portfolio}}{\text{BPV of futures}}$$

$$\text{effective D} = \frac{\text{PV}_- - \text{PV}_+}{2 \times \Delta\text{curve} \times \text{PV}_0}$$

In formulas that refer to MD, and if effective duration differs from MD, option positions are present and effective duration must be used instead of MD.

The notional swap principal (NP) required to close the duration gap for a 100% hedge is the

duration gap in BPV divided by the swap BPV per 1 NP.

%Δ value = $-\text{MD}_{\text{key rate n}}\,\Delta y_n$

MD = Macaulay duration / $(1 + \text{YTM}_{\text{periodic}})$

%Δ value = –MD Δy

%Δ relative value = $-\text{D}_\text{S}\,\Delta s$

spread = $y_{\text{higher yield}} - y_{\text{government}}$

Herfindahl-Hirschman index (HHI): $HHI = \sum_{i=1}^{n} w_i^2$

$\text{effective number of stocks} = \frac{1}{\text{HHI}}$

fundamental law of active management: $\text{E}\left(\text{R}_\text{A}\right) = \text{IC}\sqrt{\text{BR}}\sigma_{\text{R}_\text{A}}\text{TC}$

$\text{Active Share} = \frac{1}{2}\sum_{i=1}^{n} |W_{p,i} - W_{b,i}|$

$\text{active risk}\left(\sigma_{R_A}\right) = \sqrt{\frac{\sum_{t=1}^{T}\left(R_{AT}\right)^2}{T-1}} = \sqrt{\sigma^2\left(\Sigma\left(\beta_{pk} - \beta_{bk}\right) \times F_k\right) + \sigma_e^2}$

Contribution to portfolio variance calculated on an *absolute* or *relative* basis

- Contribution of asset *i* to *absolute* portfolio variance

  $= \text{CV}_\text{i} = \sum_{\text{j}=1}^{\text{n}} \text{w}_\text{i}\text{w}_\text{j}\text{C}_\text{ij} = \text{w}_\text{i}\text{C}_\text{ip}$

- Contribution of factor *i* to *absolute* portfolio variance

  $= \text{CV}_\text{i} = \sum_{\text{j}=1}^{\text{n}} \beta_\text{i}\beta_\text{j}\text{C}_\text{ij} = \beta_\text{i}\text{C}_\text{ip}$

- Contribution of asset *i* to *relative* portfolio variance

  $= CAV_i = \sum_{j=1}^{n}\left(w_{pi} - w_{bi}\right)\left(w_{pj} - w_{bj}\right)RC_{ij} = \left(w_{pi} - w_{bi}\right)RC_{ip}$

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