CFA® 2019 PROGRAM EXAM PREP

SchweserNotes™ Level III

Equity Portfolio Management, Alternative Investments, Risk Management, and Derivatives

eBook 4

KAPLAN SCHWESER

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LEARNING OUTCOME STATEMENTS (LOS)

STUDY SESSION 13

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

26. Introduction to Equity Portfolio Management

The candidate should be able to:

a. describe the roles of equities in the overall portfolio. (page 1)
b. describe how an equity manager's investment universe can be segmented. (page 3)
c. describe the types of income and costs associated with owning and managing an equity portfolio and their potential effects on portfolio performance. (page 6)
d. describe the potential benefits of shareholder engagement and the role an equity manager might play in shareholder engagement. (page 9)
e. describe rationales for equity investment across the passive–active spectrum. (page 11)

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

27. Passive Equity Investing

The candidate should be able to:

a. discuss considerations in choosing a benchmark for a passively managed equity portfolio. (page 17)
b. compare passive factor-based strategies to market-capitalization-weighted indexing. (page 20)
c. compare different approaches to passive equity investing. (page 21)
d. compare the full replication, stratified sampling, and optimization approaches for the construction of passively managed equity portfolios. (page 22)
e. discuss potential causes of tracking error and methods to control tracking error for passively managed equity portfolios. (page 24)
f. explain sources of return and risk to a passively managed equity portfolio. (page 25)

STUDY SESSION 14

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

28. Active Equity Investing

The candidate should be able to:

a. compare fundamental and quantitative approaches to active management. (page 31)
b. analyze bottom-up active strategies, including their rationale and associated processes. (page 32)
c. analyze top-down active strategies, including their rationale and associated processes. (page 32)
d. analyze factor-based active strategies, including their rationale and associated processes. (page 37)
e. analyze activist strategies, including their rationale and associated processes. (page 41)
f. describe active strategies based on statistical arbitrage and market microstructure. (page 44)
g. describe how fundamental active investment strategies are created. (page 47)
h. describe how quantitative active investment strategies are created. (page 48)
i. discuss equity investment style classifications. (page 53)

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

29. 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 61)
b. discuss approaches for constructing actively managed equity portfolios. (page 64)
c. distinguish between Active Share and active risk and discuss how each measure relates to a manager's investment strategy. (page 66)
d. discuss the application of risk budgeting concepts in portfolio construction. (page 72)
e. discuss risk measures that are incorporated in equity portfolio construction and describe how limits set on these measures affect portfolio construction. (page 78)
f. discuss how assets under management, position size, market liquidity, and portfolio turnover affect equity portfolio construction decisions. (page 80)
g. evaluate the efficiency of a portfolio structure given its investment mandate. (page 82)
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 83)

STUDY SESSION 15

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

30. Alternative Investments Portfolio Management

The candidate should be able to:

a. describe common features of alternative investments and their markets and how alternative investments may be grouped by the role they typically play in a portfolio. (page 108)

b. explain and justify the major due diligence checkpoints involved in selecting active managers of alternative investments. (page 108)

c. explain distinctive issues that alternative investments raise for investment advisers of private wealth clients. (page 109)

d. distinguish among types of alternative investments. (page 110)

e. discuss the construction and interpretation of benchmarks and the problem of benchmark bias in alternative investment groups. (page 115)

f. evaluate the return enhancement and/or risk diversification effects of adding an alternative investment to a reference portfolio (for example, a portfolio invested solely in common equity and bonds). (page 114)

g. describe advantages and disadvantages of direct equity investments in real estate. (page 115)

h. discuss the major issuers and suppliers of venture capital, the stages through which private companies pass (seed stage through exit), the characteristic sources of financing at each stage, and the purpose of such financing. (page 117)

i. compare venture capital funds and buyout funds. (page 118)

j. discuss the use of convertible preferred stock in direct venture capital investment. (page 118)

k. explain the typical structure of a private equity fund, including the compensation to the fund's sponsor (general partner) and typical timelines. (page 119)

l. discuss issues that must be addressed in formulating a private equity investment strategy. (page 119)

m. compare indirect and direct commodity investment. (page 129)

n. describe the principal roles suggested for commodities in a portfolio and explain why some commodity classes may provide a better hedge against inflation than others. (page 130)

o. identify and explain the style classification of a hedge fund, given a description of its investment strategy. (page 122)

p. discuss the typical structure of a hedge fund, including the fee structure, and explain the rationale for high-water mark provisions. (page 123)

q. describe the purpose and characteristics of fund-of-funds hedge funds. (page 124)

r. discuss concerns involved in hedge fund performance evaluation. (page 124)

s. describe trading strategies of managed futures programs and the role of managed futures in a portfolio. (page 132)

t. describe strategies and risks associated with investing in distressed securities. (page 134)

u. explain event risk, market liquidity risk, market risk, and “J-factor risk” in relation to investing in distressed securities. (page 135)

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一、SVIP资料包括以下内容：【所有课程均有配套课件讲义】

前导课程：考试介绍、数量基础、金融英语、金融市场与产品的介绍，为学员建立考试框架，打牢基础；

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五、2018年部分会员PASS报喜截图：【限于篇幅，随机抽取】

STUDY SESSION 16

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

31. Risk Management

The candidate should be able to:

a. discuss features of the risk management process, risk governance, risk reduction, and an enterprise risk management system. (page 153)

b. evaluate strengths and weaknesses of a company's risk management process. (page 155)

c. describe steps in an effective enterprise risk management system. (page 155)

d. evaluate a company's or a portfolio's exposures to financial and nonfinancial risk factors. (page 155)

e. calculate and interpret value at risk (VaR) and explain its role in measuring overall and individual position market risk. (page 159)

f. compare the analytical (variance–covariance), historical, and Monte Carlo methods for estimating VaR and discuss the advantages and disadvantages of each. (page 160)

g. discuss advantages and limitations of VaR and its extensions, including cash flow at risk, earnings at risk, and tail value at risk. (page 163)

h. compare alternative types of stress testing and discuss advantages and disadvantages of each. (page 164)

i. evaluate the credit risk of an investment position, including forward contract, swap, and option positions. (page 167)

j. demonstrate the use of risk budgeting, position limits, and other methods for managing market risk. (page 172)

k. demonstrate the use of exposure limits, marking to market, collateral, netting arrangements, credit standards, and credit derivatives to manage credit risk. (page 173)

l. discuss the Sharpe ratio, risk-adjusted return on capital, return over maximum drawdown, and the Sortino ratio as measures of risk-adjusted performance. (page 175)

m. demonstrate the use of VaR and stress testing in setting capital requirements. (page 176)

STUDY SESSION 17

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

32. Risk Management Applications of Forward and Futures Strategies

The candidate should be able to:

a. demonstrate the use of equity futures contracts to achieve a target beta for a stock portfolio and calculate and interpret the number of futures contracts required. (page 196)

b. construct a synthetic stock index fund using cash and stock index futures (equitizing cash). (page 206)

c. explain the use of stock index futures to convert a long stock position into synthetic cash. (page 209)

d. demonstrate the use of equity and bond futures to adjust the allocation of a portfolio between equity and debt. (page 200)

e. demonstrate the use of futures to adjust the allocation of a portfolio across equity sectors and to gain exposure to an asset class in advance of actually committing funds to the asset class. (page 203)

f. explain exchange rate risk and demonstrate the use of forward contracts to reduce the risk associated with a future receipt or payment in a foreign currency. (page 210)

g. explain the limitations to hedging the exchange rate risk of a foreign market portfolio and discuss feasible strategies for managing such risk. (page 212)

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

33. Risk Management Applications of Option Strategies

The candidate should be able to:

a. compare the use of covered calls and protective puts to manage risk exposure to individual securities. (page 225)

b. calculate and interpret the value at expiration, profit, maximum profit, maximum loss, breakeven underlying price at expiration, and general shape of the graph for the following option strategies: bull spread, bear spread, butterfly spread, collar, straddle, box spread. (page 230)

c. calculate the effective annual rate for a given interest rate outcome when a borrower (lender) manages the risk of an anticipated loan using an interest rate call (put) option. (page 243)

d. calculate the payoffs for a series of interest rate outcomes when a floating rate loan is combined with 1) an interest rate cap, 2) an interest rate floor, or 3) an interest rate collar. (page 249)

e. explain why and how a dealer delta hedges an option position, why delta changes, and how the dealer adjusts to maintain the delta hedge. (page 255)

f. interpret the gamma of a delta-hedged portfolio and explain how gamma changes as in-the-money and out-of-the-money options move toward expiration. (page 260)

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

34. Risk Management Applications of Swap Strategies

The candidate should be able to:

a. demonstrate how an interest rate swap can be used to convert a floating-rate (fixed-rate) loan to a fixed-rate (floating-rate) loan. (page 269)
b. calculate and interpret the duration of an interest rate swap. (page 271)
c. explain the effect of an interest rate swap on an entity's cash flow risk. (page 272)
d. determine the notional principal value needed on an interest rate swap to achieve a desired level of duration in a fixed-income portfolio. (page 273)
e. explain how a company can generate savings by issuing a loan or bond in its own currency and using a currency swap to convert the obligation into another currency. (page 278)
f. demonstrate how a firm can use a currency swap to convert a series of foreign cash receipts into domestic cash receipts. (page 279)
g. explain how equity swaps can be used to diversify a concentrated equity portfolio, provide international diversification to a domestic portfolio, and alter portfolio allocations to stocks and bonds. (page 281)
h. demonstrate the use of an interest rate swaption 1) to change the payment pattern of an anticipated future loan and 2) to terminate a swap. (page 283)

The following is a review of the Equity Portfolio Management principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #26.

READING 26: INTRODUCTION TO EQUITY PORTFOLIO MANAGEMENT

Study Session 13

EXAM FOCUS

These introductory readings cover the role of equity in the portfolio, common approaches to equity investing, and shareholder engagement.

MODULE 26.1: EQUITY INVESTMENT ROLES

Video covering this content is available online.

LOS 26.a: Describe the roles of equities in the overall portfolio.

CFA® Program Curriculum, Volume 4, page 296

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** 主题投资 **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 26.b: Describe how an equity manager's investment universe can be segmented.

CFA® Program Curriculum, Volume 4, page 301

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 to these metrics. An example is shown in Figure 26.1.

Figure 26.1: 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 sub-sector/sub-industry. As an example, consider the segmentation method shown in Figure 26.2 for the GICS Consumer Staples sector.

Figure 26.2: 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 26.1

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.

   correlation up，limit diversification

2. Assume an investor is segmenting the equity investment universe by economic activity. **Describe** *two* advantages for applying this segmentation approach.

   diversification
   benchmark

MODULE 26.2: PORTFOLIO INCOME AND COSTS, SHAREHOLDER ENGAGEMENT, PASSIVE/ACTIVE MANAGEMENT

Video covering this content is available online.

LOS 26.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 307

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[1] 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[2] quality of the borrower and the borrower's ability to return the securities. The borrower must also[3] compensate the lender for any dividend payments that occur during the period of the loan. The lender generally[4] 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 26.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 312

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 26.e: Describe rationales for equity investment across the passive–active spectrum.

CFA® Program Curriculum, Volume 4, page 315

Passive investors seek to reach 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 26.2

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.

   more research
   more transaction cost

2. **Explain** how shareholder engagement can benefit investors who are not actively involved in company issues.

   free riders: benefit from rising stock price

3. **Identify** two disadvantages of shareholder engagement activities.

   short-term goal
   MNI, insider trading
   conflicts of interest

pm am

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.

am pm

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.

reputation risk
key person risk
high turnover -> tax burden

KEY CONCEPTS

LOS 26.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 26.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 26.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 26.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 26.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 26.1

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 26.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 26.b)

Module Quiz 26.2

1. Such funds require more investment analysis and portfolio turnover than passively managed funds. (LOS 26.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 26.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 26.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 26.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 26.e)

The following is a review of the Equity Portfolio Management principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #27.

READING 27: PASSIVE EQUITY INVESTING

Study Session 13

EXAM FOCUS

This reading focuses on the issues associated with and approaches to passive equity management; including the causes of and approaches to reducing tracking error. Many of the issues covered in this reading are also covered elsewhere.

MODULE 27.1: BENCHMARKS

Video covering this content is available online.

LOS 27.a: Discuss considerations in choosing a benchmark for a passively managed equity portfolio.

CFA® Program Curriculum, Volume 4, page 328

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 exposure, and (2) identifying the methods used in constructing and maintaining the index.

Determining the Desired Market Exposure

The choice of market exposure depends on the return objectives and risk constraints (e.g., risk tolerance, liquidity constraints, and legal considerations) from the investor's investment policy statement, as well as geographical location. The investor can make choices along one or more of the following dimensions:

- Market segment: For example, the investor has a choice of broad market exposure versus focused exposure to certain sectors, between domestic or international exposure, and among developed, emerging, or frontier markets.

- Capitalization (also known as the size factor): Markets are also segmented by capitalization, typically large-cap, mid-cap, and small-cap. Small-cap stocks generally have higher risk and higher expected returns than large-cap stocks.
- Growth versus value (the style factor): Investors can choose exposure to growth stocks (high price-to-earnings (P/E) and high price-to-book (P/B) ratios) or value stocks (low P/E and low P/B ratios).
- Other risk factors include the momentum factor, the liquidity factor, the volatility factor, and the quality factor.

Identifying the Methods Used in Constructing and Maintaining the 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; the CRSP U.S. Total Market Index is an example), or it can be *selective* (a subset of stocks within a universe; the S&P 500 is an example).

The **weighting method** of the stocks chosen for inclusion in the index can be (1) market-cap weighting, (2) price weighting, (3) equal weighting, or (4) fundamental weighting.

- *Market-cap weighting* includes each stock in the portfolio as a relative percentage of its market capitalization to the total capitalization of all the stocks in the index. The "market" portfolio in the CAPM is market-weighted, for example, and mean-variance efficient. Market-cap weighting reflects the strategy's investment capacity and can be thought of as liquidity-weighted because large-cap stocks, which tend to have higher liquidity, are more heavily weighted in market-cap weighted indexes. The most common market-cap weighting method is free-float weighting, which calculates the stocks' market caps excluding closely-held shares not available to market participants.
- *Price weighting* weights each stock by its price, so higher priced stocks are more heavily weighted in the index. This is not a common weighting method, however, as it mimics an investment strategy of holding an equal number of shares in the portfolio, which is not a common investment strategy. The Dow Jones Industrial Average is an example of a price-weighted index.
- *Equal weighting* weights each stock equally (e.g., a 10 stock index would weight each stock at 10%). This method reduces concentration risk and is slow to change sector exposures. It is factor-indifferent, so it randomizes factor mispricing. Because it has a small-cap bias relative to market-cap weighting, it is more highly volatile. The disadvantages of this method are that it requires regular rebalancing and it has limited investment capacity, because small-cap stocks, which have lower liquidity, are overweighted relative to market-cap weighted indexes.
- *Fundamental weighting* weights stocks by fundamental factors, such as sales, income, or dividends. The idea behind this method is that stock prices might be over or undervalued, but they eventually return to a level implied by their fundamental attributes.

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 is the number of stocks in the portfolio and w_i is the weight of stock i. HHI ranges from 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:

$$\text{effective number of stocks} = \frac{1}{\text{HHI}}$$

It can be interpreted as the effective number of stocks in an equally-weighted portfolio that mimics the concentration of the index.

For example, a market-cap weighted index with 500 stocks might have an HHI of 0.01 and an effective number of stocks of 100 (1 / 0.01). The effective number of stocks is less than the actual number because this was a *market-cap weighted* index and the 100 reflects the disproportionate effect of the large cap stocks on the index. An *equal weighted* index of 500 stocks would have an HHI of 0.002 and an effective number of stocks of 1 / 0.002 = 500.

Indexes must be adjusted regularly as stock prices (and market caps) change, as new stocks are issued and become publicly traded, and existing stocks cease to trade. **Rebalancing** is the process of updating the weights of the stocks in the index to reflect changes in market cap, while **reconstitution** is the process of removing and replacing stocks that no longer fit the index market exposure. For example, as a small-cap stock's market price and market cap increase, it might eventually become a mid-cap stock, and have to be removed and replaced in the small-cap index. Both processes create turnover in the portfolio and increase trading costs.

There are also market effects of reconstitution decisions: stocks that are added to an index generally increase in price as passively-managed funds add them to their portfolios. There is some empirical evidence to suggest that this can be arbitraged by predicting which stocks might be added to an index, particularly if the index uses objective rather than subjective reconstitution criteria.

LOS 27.b: Compare passive factor-based strategies to market-capitalization-weighted indexing.

CFA® Program Curriculum, Volume 4, page 335

A passive market-capitalization-weighted investment strategy involves creating a portfolio that tracks the benchmark index as closely as possible at a low cost by investing in all or a subset of the index stocks. Portfolio returns, however, can also be explained by factor models, so another way to replicate the return/risk characteristics of an index is to create a portfolio with the same exposures to a set of risk factors as the index. This strategy is often referred to as a **passive factor-based strategy** (also known

as **smart beta**). The goal of the strategy is to improve on the risk/return performance of the market-cap-weighted strategy by more than enough to offset the higher costs.

The most common equity risk factors, as mentioned earlier are the following:

- *Growth factor*: stocks with high P/E, high P/B and above-average net income growth.
- *Value factor*: stocks of mature companies with low P/E, low P/B, stable net income, and/or high dividend yield.
- *Size factor*: stocks with low floating-adjusted market caps.
- *Yield factor*: high dividend-yield stocks may provide higher excess returns in low interest rate environments like during the market collapse in 2008 and 2009.
- *Momentum factor*: stocks with recent above-average returns.
- *Quality factor*: stocks with consistent earnings and dividend growth, high cash flow-to-earnings and low debt-to-equity.
- *Volatility factor*: stocks with low standard deviation of returns.

Passive factor-based strategies frequently involve an element of active decision-making by altering the degree of factor exposure to identify and exploit "out-of-favor" factors and beat the return on market-cap-weighted strategies. Decisions regarding factor selection, weighting and rebalancing tend to be transparent, but the ability of other investors to mimic the strategy can reduce or eliminate the opportunity for higher return. The buy-sell actions of those investors will move prices and eliminate the opportunity.

There are three types of passive factor-based strategies: (1) return oriented, (2) risk oriented, or (3) diversification oriented.

- *Return-oriented strategies* include dividend yield, momentum and fundamentally-weighted strategies.
- *Risk-oriented strategies* include volatility weighting (where the weights are the inverse of price volatility) and minimum-variance investing (the traditional Markowitz framework), where portfolios are selected that minimize portfolio variance, subject to constraints (such as over or under weighted sectors). 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.
- *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. This increases tracking error.

The advantages of passive factor-based investing include that it is typically less costly than active management, but still offers the investor factor exposure based on the investor's view of the market (which is known as factor rotation). The disadvantages include that, relative to passive cap-weighted investing, management fees and trading commissions are higher.

MODULE QUIZ 27.1

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 27.2: APPROACHES TO PASSIVE INVESTING

Video covering this content is available online.

LOS 27.c: Compare different approaches to passive equity investing.

CFA® Program Curriculum, Volume 4, page 339

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 **exchange traded funds** (ETFs):

- The advantages of open-end mutual funds are the low costs and the convenience of the fund structure.
- The advantages of ETFs include that they can 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. The disadvantages include higher transaction costs from commissions and the bid-ask spread, as well as illiquidity in some ETF secondary markets.

Derivatives based strategies us 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.

The advantages of using equity index derivatives (options, futures and swaps) over cash-based portfolio construction techniques are that derivatives (1) can quickly, efficiently and cheaply adjust exposure of the portfolio, (2) trade in liquid markets, and

(3) make it easy to leverage the portfolio. Disadvantages include that (1) derivative positions have finite expirations 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 introduce counterparty risk, and (5) basis risk can increase tracking error.

Separately managed equity index-based portfolios hold all of 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 27.d: Compare the full replication, stratified sampling, and optimization approaches for the construction of passively managed equity portfolios.

CFA® Program Curriculum, Volume 4, page 348

Passively-managed index-based equity portfolios can be constructed by: (1) full replication (hold all of the securities in the index), (2) hold a sample of the securities based on stratified sampling, or (3) use 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 avoid the high cost of full replication, it often makes more sense for the manager to use **stratified sampling**, in which he holds a subset of the constituent stocks, with the sample selected in such a way as to replicate the index return/risk characteristics.

To implement stratified sampling, the manager creates strata 地层，岩层 across the constituent stocks that are mutually exclusive and exhaustive. The strata are often formed across multiple dimensions; for example, by industry and style (value vs growth). For multinational indexes, the stocks are first stratified by country. The more dimensions used, the smaller the tracking error. Tracking error measures 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 as the size of the sample is increased. The manager will naturally first purchase the most liquid, lowest cost stocks. But as more stocks are added and the portfolio approaches full replication; less liquid stocks are added, increasing transaction cost and tracking error.

Optimization

Optimization uses the tools of modern portfolio theory to address the problem of minimizing tracking error. The optimizer seeks the combination of stocks (based on historical data) that would have minimized tracking error and possibly maximized return. Other constraints may be added such as select 100 or fewer constituent stocks with market caps greater than $1 billion. As a blended approach optimization could be run within each cell of a stratified sample.

The obvious drawback of optimization is that it is based on historical relationships and those can change. Maintain the optimization as the data change can be costly. Another drawback is that it can create portfolios that are not mean-variance efficient relative to the benchmark. The solution is to add a constraint that total portfolio variance is equal to the volatility of the benchmark.

The advantages of optimization techniques is they typically exhibit lower tracking error, and that they explicitly account for the covariance among constituent stocks.

Blended Approach

Full replication is preferred for indexes with small numbers of liquid stocks, while stratified sampling or optimization is preferable for indexes with lots of heterogeneous, thinly traded stocks. For large indexes like the Wilshire 5000, the constituent stocks run the gamut from large and liquid to small and thinly traded. In that case a combination of two approaches, full replication and stratified sampling or optimization.

MODULE QUIZ 27.2

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.

+lidquid +illiquid

MODULE 27.3: TRACKING ERROR, RETURN AND RISK

Video covering this content is available online.

LOS 27.e: Discuss potential causes of tracking error and methods to control tracking error for passively managed equity portfolios.

CFA® Program Curriculum, Volume 4, page 353

Causes of Tracking Error

As already discussed, the size of the sample used to construct the portfolio will affect the tracking error. Tracking error initially declines as sample size increases because the manager first purchases the most liquid, lowest transaction cost stocks. But after a point, as less liquid stocks with higher transaction costs are added to increase the sample size, tracking error increases.

Expanding on this concept, the tracking error of an indexed equity fund increases with:

- Management fees charged to manage the fund.
- Paying commissions (or bid-asked spread) to execute trades.
- The addition of less liquid securities with higher transaction costs to the sample.
- The use of intra-day trading to manage the portfolio. Intra-day trading means making security transacts during the day at prices other than closing prices; while performance of the benchmark index is based on close of day pricing.
- **Cash drag** in the portfolio. The fund typically has some cash as funds flow in or to meet redemptions, but cash is in the long run the lowest return asset; while indexes are computed as the return of a fully invested portfolio with no cash drag.

Controlling Tracking Error

In a no cost world, full replication produces the lowest tracking error. But minimizing real world tracking error requires trade-offs between the benefits of larger sample size versus the increase in costs. Even a passive index fund must do some trading to manage cash flows. Derivative strategies (discussed elsewhere in the curriculum) can be used to minimize cash drag.

LOS 27.f: Explain sources of return and risk to a passively managed equity portfolio.

CFA® Program Curriculum, Volume 4, page 355

Attribution Analysis

The manager of a passively managed equity portfolio needs to understand the sources of returns from the index in order to effectively and efficiently manage a portfolio that replicates its performance. **Attribution analysis** can be used to help the manager identify and then hopefully reduce the sources of tracking error.

PROFESSOR'S NOTE

Attribution analysis will be covered in a later section of the curriculum.

Securities Lending

As discussed earlier, large passive portfolios can lend securities to generate addition income and return. A typical goal would be to earn enough to offset the costs of running the portfolio (i.e., generate zero rather than negative value added, reducing the tracking error).

Investor Activism

Investor activism and engagement between larger shareholders and corporate boards and management is a key function of active portfolio management. Passive investors can't sell shares if they are unhappy with the management and leadership of a company, so corporate governance matters to them as well. If activism improves the company's operations, its stock price goes up, the index increases, and investor returns increase. Even passive managers have a fiduciary duty to vote proxy shares in the best interests of their investors. This can be an expensive 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.

不离不弃
带指数一起飞

MODULE QUIZ 27.3

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

1. **Explain** what cash drag is and how it results in tracking error.

   cash flow in/out to meet redemption

2. **Explain** why tracking error is a better measure of a passive equity manager's skill than excess return.

   goal: track index, not excess return

3. **Explain** how securities lending can reduce tracking error in passively managed index portfolios.

   add value to offset the transaction cost

KEY CONCEPTS

LOS 27.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 the 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 27.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, or smart beta.

The most equity risk common factors are the growth factor, value factor, size factor, yield factor, momentum factor, quality factor, and volatility factor.

There are three types of passive factor-based strategies: (1) return oriented, (2) risk oriented, and (3) diversification oriented.

LOS 27.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 27.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 the three are also common.

LOS 27.e

Tracking error initially declines as sample size increases but then increases as costs (transaction, management, and illiquidity) increase. Intra-day 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 minimize the effects of cash drag.

LOS 27.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 is important for both passive and active investors.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 27.1

1. **B** An equity index that is suitable as a benchmark should be rules-based, transparent, and investable. (LOS 27.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 27.b)

Module Quiz 27.2

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 27.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 27.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 27.d)

Module Quiz 27.3

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 27.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 27.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 27.f)

The following is a review of the Active Equity Investing principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #28.

READING 28: ACTIVE EQUITY INVESTING

Study Session 14

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 28.1: FUNDAMENTAL VS. QUANTITATIVE APPROACHES

Video covering this content is available online.

LOS 28.a: Compare fundamental and quantitative approaches to active management.

CFA® Program Curriculum, Volume 4, page 376

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 28.b: Analyze bottom-up active strategies, including their rationale and associated processes.

LOS 28.c: Analyze top-down active strategies, including their rationale and associated processes.

CFA® Program Curriculum, Volume 4, pages 381 and 388

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.

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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	13.55	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 tw
- GARP nb
- Income investing to
- Relative value investing so

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 macro-economic environment and broad market variables rather than information relating to individual investments.

Top-down managers typically use broad market ETFs and derivatives to overweight (超配) 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 28.1

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 Generalised 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 sub-sectors of the energy and industrial goods sector that are likely to suffer due to changes to global climate change regulation.

MODULE 28.2: TYPES OF ACTIVE MANAGEMENT STRATEGIES

Video covering this content is available online.

Factor-Based Strategies

LOS 28.d: Analyze factor-based active strategies, including their rationale and associated processes.

CFA® Program Curriculum, Volume 4, page 391

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.

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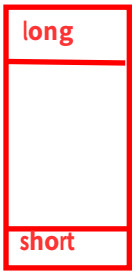
PROFESSOR'S NOTE

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.

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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 portfolio	Companies with higher quality earnings or improvement in sentiment are likely to outperform those with low quality earnings and deteriorating sentiment
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

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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 $ISurprise_t$:

$$f_{i,t} = \beta_{i,0} + \beta_{i,1} ISurprise_t + \varepsilon_{i,t}$$

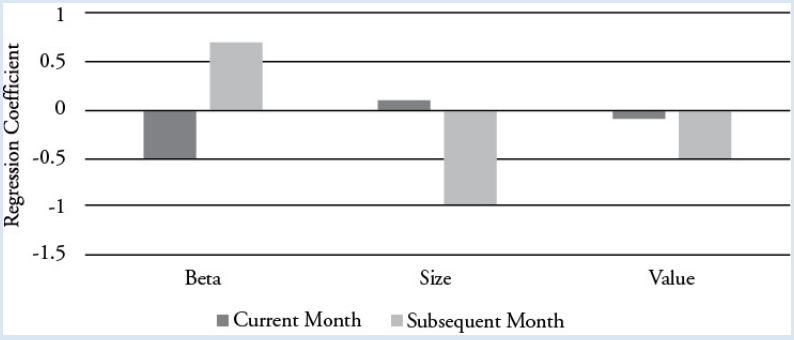
and:

$$f_{i,t+1} = \beta_{i,0} + \beta_{i,1} ISurprise_t + \varepsilon_{i,t}$$

where $f_{i,t}$ is the return of style factor *i* at time *t* and $f_{i,t+1}$ is the subsequent (next) month's return for style factor *i*.

The regression coefficients are presented in Figure 28.1:

Figure 28.1: Interest Rate Surprises and Style Factor Returns



Based on the data in Figure 28.1, 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 28.e: Analyze activist strategies, including their rationale and associated processes.

CFA® Program Curriculum, Volume 4, page 404

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

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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.

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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 28.2

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 28.3: OTHER STRATEGIES

Video covering this content is available online.

LOS 28.f: Describe active strategies based on statistical arbitrage and market microstructure.

CFA® Program Curriculum, Volume 4, page 411

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* to take an interest in. Your identification must be made from the following list:

- Activist investing. FC
- Distressed debt investing. B PLC
- Event driven investing. PSA
- 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 28.g: Describe how fundamental active investment strategies are created.

CFA® Program Curriculum, Volume 4, page 414

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

One more time, a discussion of behavioral biases that can lead even 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 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 28.h: Describe how quantitative active investment strategies are created.

The quantitative active investment process 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 -3
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 28.3

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 28.4: EQUITY INVESTMENT STYLE CLASSIFICATION

Video covering this content is available online.

LOS 28.i: Discuss equity investment style classifications.

CFA® Program Curriculum, Volume 4, page 427

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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

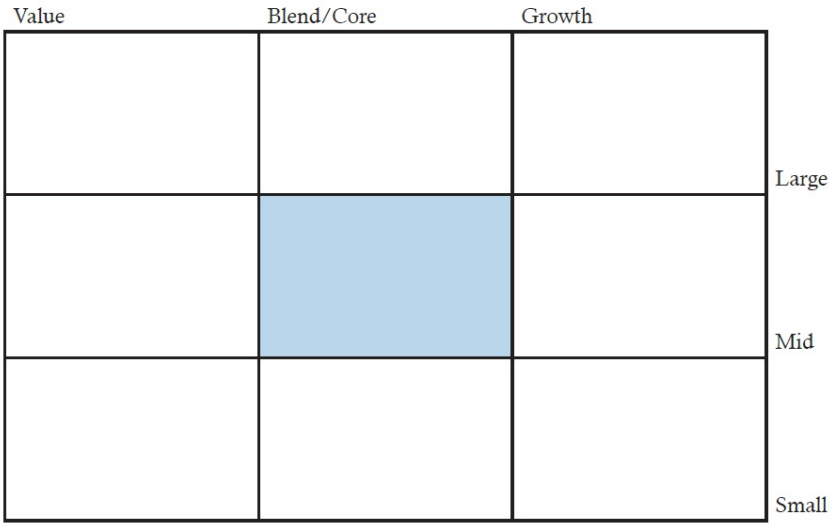
The two main approaches in style analysis are the **holdings-based** approach and the **returns-based** approach.

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 28.2:

Figure 28.2: 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.

LC
MC
SC

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 28.3.

Figure 28.3: 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 a core. **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 return-based style analysis based on historical returns would capture this average exposure automatically through regressing historical returns. return based更容易发现历史暴露

MODULE QUIZ 28.4

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 28.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 28.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 28.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 28.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 28.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 28.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 28.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 28.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 28.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 28.1

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 28.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 28.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 28.c)

Module Quiz 28.2

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 28.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 28.e)

Module Quiz 28.3

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 28.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 28.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 28.h)

Module Quiz 28.4

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 28.i)

The following is a review of the Active Equity Investing principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #29.

READING 29: ACTIVE EQUITY INVESTING: PORTFOLIO CONSTRUCTION

Study Session 14

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 29.1: BUILDING BLOCKS OF ACTIVE EQUITY PORTFOLIO CONSTRUCTION

Video covering this content is available online.

LOS 29.a: Describe elements of a manager's investment philosophy that influence the portfolio construction process.

CFA® Program Curriculum, Volume 4, page 447

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 is the return from security *i*

ΔW_i is the 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:

$$R_A = \sum (\beta_{pk} - \beta_{bk}) \times F_k + (\alpha + \varepsilon)$$

where:

β_{pk}	=	the sensitivity of the portfolio to each rewarded factor (k)
β_{bk}	=	the sensitivity of the benchmark to each rewarded factor
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-orientated 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**:

$$\mathrm{E}(\mathrm{R_A}) = \mathrm{IC}\sqrt{\mathrm{BR}}\sigma_{\mathrm{R_A}}\,\mathrm{TC}$$

where:

$E(R_A)$	=	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 29.b: Discuss approaches for constructing actively managed equity portfolios.

CFA® Program Curriculum, Volume 4, page 458

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 29.1.

Figure 29.1: Approaches and Their Use of Building Blocks

	Top-Down	
Systematic	■ Emphasizes macro rewarded factors ■ Factor timing possible but rare ■ Diversified across broad universe ■ Formal portfolio optimization used ■ Few managers in this category	■ Emphasizes macro rewarded factors ■ Most likely to use Factor timing ■ Diversified across broad universe or concentrated on smaller subset of securities ■ Less formal portfolio construction
	■ Emphasizes security-specific factors ■ No factor timing ■ Diversified across broad universe ■ Formal portfolio optimization used	■ Emphasizes security-specific characteristics or factors ■ Potential factor timing ■ Diversified across broad universe or concentrated on smaller subset of securities ■ Less formal portfolio construction
	Bottom-Up	**Discretionary**

(Based on Exhibit 6 in CFAI Reading 29)

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 29.2:

Figure 29.2: Objective Functions and Constraints of Portfolio Construction

	Absolute Framework	**Relative Framework**
Objective	Maximize Sharpe Ratio	Maximize Information

Function	Maximize Sharpe Ratio	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 29.1

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%. 0.1 * sqrt (120) * 5% * 0.5
   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 29.2: ACTIVE SHARE AND ACTIVE RISK

Video covering this content is available online.

LOS 29.c: Distinguish between Active Share and active risk and discuss how each measure relates to a manager's investment strategy.

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, $\textbf{Active Share} = \frac{1}{2}\sum_{i=1}^{n}|W_{p,i} - W_{b,i}|$ 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:

$$\text{activerisk}\left(\sigma_{R_A}\right) = \sqrt{\frac{\sum_{t=1}^{T}\left(R_{At}\right)^2}{T-1}}$$

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.

corr

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:

$$\sigma_{R_A} = \sqrt{\sigma^2\left(\sum\left(\beta_{pk} - \beta_{bk}\right) \times F_k\right) + \sigma_e^2}$$

含

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.

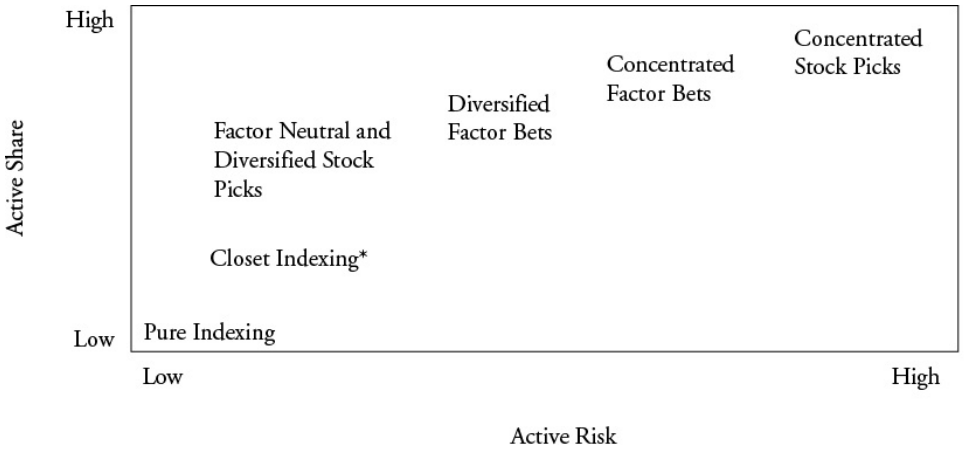
Distinguishing Between Different Portfolio Management Approaches

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 29.3

Figure 29.3: 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** 行业轮动 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 29.2

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

1. A manager that substitutes a benchmark holding in their portfolio for 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 29.3: ALLOCATING THE RISK BUDGET

Video covering this content is available online.

LOS 29.d: Discuss the application of risk budgeting concepts in portfolio construction.

CFA® Program Curriculum, Volume 4, page 474

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 (CVi) is given by the equation:

$$\text{CV}_\text{i} = \sum_{j=1}^{n} w_i w_j C_{ij} = w_i C_{ip}$$

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 $= \sum_{j=1}^{n} w_j C_{ij}$

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:

$$\mathbf{CAV_i = (w_{pi} - w_{bi})RC_{ip}}$$

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 29.4:

Figure 29.4: 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	CAV	
Index A	50%	35%	15%	6%	1.00	–1.00	–0.72	0.000233	18%
Index B	50%	35%	9%	6%	–1.00	1.00	0.72	0.000233	–18%
Cash	0%	30%	0.25%	12%	–0.72	0.72	1.00	0.001296	100%
Total				3.60%	–0.72	0.72	1.00	0.001296	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.

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:

$$R_g = R_a - \sigma^2/2$$

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 29.5 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 29.5: 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 29.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 486

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 29.3

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 29.4: IMPLICIT COST-RELATED CONSIDERATIONS IN PORTFOLIO CONSTRUCTION

Video covering this content is

LOS 29.f: Discuss how assets under management, position size, market liquidity, and portfolio turnover affect equity portfolio construction decisions. available online.

CFA® Program Curriculum, Volume 4, page 506

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 29.4

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 29.5: THE WELL-CONSTRUCTED PORTFOLIO

Video covering this content is

LOS 29.g: Evaluate the efficiency of a portfolio structure given its investment mandate. available online.

CFA® Program Curriculum, Volume 4, page 499

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 29.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 504

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 correlations with other types of strategy. 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 discussed in detail previously.

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 discussed previously.

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 29.5

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. advantage of long/short
   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 29.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:

$$\mathrm{E}(\mathrm{R_A}) = \mathrm{IC}\sqrt{\mathrm{BR}}\sigma_{\mathrm{R_A}}\,\mathrm{TC}$$

LOS 29.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 29.c

Active Share measures the degree to which the number and sizing of the positions in a manager's portfolio differ to 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):

$$\text{Active Risk}\left(\sigma_{R_A}\right) = \sqrt{\frac{\sum_{t=1}^{T}\left(R_{At}\right)^2}{T-1}}$$

$$= \sqrt{\sigma^2\left(\sum\left(\beta_{pk} - \beta_{bk}\right) \times F_k\right) + \sigma_e^2}$$

LOS 29.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

$$CV_i = \sum_{j=1}^{n} w_i w_j C_{ij} = w_i C_{ip}$$

- The contribution of factor i to absolute portfolio variance

$$= CV_i = \sum_{j=1}^{n} \beta_i \beta_j C_{ij} = \beta_i C_{ip}$$

- 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 29.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 29.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 29.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 29.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 29.1

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 × $\sqrt{120}$ × 5% × 0.5 = 2.74%. (LOS 29.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 29.b)

Module Quiz 29.2

1. **A** By substituting a benchmark holding for 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 29.c)

Module Quiz 29.3

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 29.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 29.e)

Module Quiz 29.4

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 29.f)

Module Quiz 29.5

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 29.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 29.h)

TOPIC ASSESSMENT: EQUITY PORTFOLIO MANAGEMENT

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.

Question 7 has three parts for a total of 15 minutes.

7. Thom Johansson is a fund-of-funds manager. He is in the initial stages of selecting a large-cap value manager and has gathered the data in Figure 5. The data is based on requests for information sent to each manager. Each manager is long only.

Figure 5: Self-Reported Data From Each Manager

Manager	Albright	Fulbright	Robinson
Average price momentum for the trailing 6 months	+12.7%	+1.4%	–22.9%
Dividend yield	1.2%	4.6%	7.3% (1)
Forward P/E	16.4	9.2	9.3 (2)
Bond rating	A+	AA–	B–
Forecast 5-year EPS growth	7.7%	4.8%	22.0%
P/B	2.3	1.1	1.7 (3)

(1) Excluding stocks that have suspended dividend payments.

(2) Excluding stocks with negative earnings.

(3) Excluding stocks with negative book value.

Johansson later expands his search for the most promising large-cap value manager. He summarizes his notes regarding two of those managers:

Manager J:

- An initial universe of 767 stocks is screened.
- Securities are ranked by P/E, P/B, and proprietary measures based on public data.

- The typical portfolio will hold 250 stocks.
- Our portfolio management team is small but our data bases are extensive.
- Portfolios are rebalanced every six months.

Manager S:

We employ a large staff of analysts who continually monitor and revise estimates for changes in market and company situation. The portfolio manager relies on these inputs and experience to continually adjust the portfolio for optimal performance. Both market sector and individual security weights are adjusted. We typically weight individual positions at 2%–5% of the portfolio.

A. Based on the information in Figure 5, **select** the manager Johansson will be most likely follow up with in his search for a large-cap value manager. **Justify** your identification with *three* reasons.

(6 minutes)

B. If Johansson is interested in a factor-based approach, **justify** the manager (J or S) that would be selected.

(5 minutes)

Some years later, Johansson has increased his focus on managers who use factor analysis. One of those managers shares the following table which details the regression of factor W with subsequent six-month stock performance of a relevant industry group. The manager is reluctant to share exact details on factor W and the related group but does explain it is based on advanced search of satellite imagery to detect changes in infrared spectrum reflected light. Such changes signal vegetation changes and related shifts in product demand for the group of companies.

The manager is excited about the opportunities to enhance performance by searching unconventional data sources such as imagery. He explains Figure 6 shows for a percentage increase in W-surprise, a –0.43 regression coefficient for stock price performance over the following six months. Starting one month after the surprise, the regression coefficient for the next following 6 months is –0.57.

Figure 6: W-Surprise and Subsequent Stock Group Performance Over a Six-Month Period

Current month		+1	+2	+3	+4	+5	+6	+7	+8	+9	+1(
W-Surprise	–0.43	–0.57	–0.36	–0.61	–0.43	–0.02	+0.09	+0.05	–0.01	+0.02	+0.(

C. Assuming a positive W-surprise, **describe** and **justify** the actions the manager would take to initiate a portfolio position that will profit and when the manager would close the positions.

(4 minutes)

Question 8 has three parts for a total of 19 minutes.

8. Johansson Analytics Group (JAG) is a large portfolio consulting group providing investment advice to institutional portfolios. Petra Nichols has recently joined the firm as a fund analyst. Her manager has assigned her the task of analyzing three funds that JAG is considering recommending to clients. As a first step in her analysis, Nichols meets with each fund manager and compiles the following notes:

   Fund A is managed by a very large investment firm. The firm is in the top 10 for assets under management. The fund typically holds at least 500 large-cap stocks. The fund managers aggressively rotate there exposures to the industries and geographic locations considered to offer the most undervalued factor exposure. Basket trades are often used to implement strategies.

   Fund B is managed by a small group (12 professionals) who specialize in thoroughly researching securities to identify significant undervaluation. While there is no specific market cap weight criteria, most holdings are small-cap. About 50 to 60 securities of varying position size are normally held. Positions are continually reviewed and changes are made whenever appropriate; however the typical holding period for an investment exceeds three years.

   Fund C is managed by an even smaller group than Fund B. However the group is part of another top ten in assets under management firms. That allows the small group to draw on extensive quantitative data bases to identify rewarded factors. A small number of securities (25 to 35) are held in the portfolio.

   Nichols's manager also provides the data in Figure 7 relating to another fund, Fund D.

Figure 7: Data for Fund D

Factor	Market	Value	Momentum
Coefficient	0.97	+0.15	–0.26

Variance of the market factor return and covariance with the market factor return	0.0025	–0.0032	0.0045

Portfolio's quarterly standard deviation of returns: 6.57%

A. **State** (circle your selection) and **justify** which fund places the greatest emphasis relative emphasis on each of the three building blocks of portfolio construction:

A. Factor weightings

B. Alpha skill

C. Sizing positions

Each fund may only be selected once.

(9 minutes)

Which fund places the greatest emphasis on: (each fund may only be selected once)	**State** (circle your selection)	**Justify**
Factor weightings	A B C	
Alpha skill	A B C	
Sizing positions	A B C	

B. **Calculate** the portion of Portfolio D's total risk that due to the market factor.

(5 minutes)

After further research, Nichols adds Portfolio D's manager in the list of managers approved for use by JAG. One of the appeals of manager D was the manager's use of paired trades. For example, in the most recent quarter the manager had in place a pairs trade between an industrial and a consumer durables stock. The industrial was overweighted by 1.5% and the consumer

durable was underweighted by 1.5% versus the portfolio's benchmark. The trade was not successful and the manager reversed the trade by restoring both positions to an equal weight versus the benchmark. In its place the manager initiated a new pairs trade between two different consumer staples companies. This time the over and underweights were only 1.0%.

C. **Determine** whether the active risk of Manager D *most likely* increased or decreased as a result of the two pairs trade actions taken. **Justify** your answer.

(5 minutes)

TOPIC ASSESSMENT ANSWERS: EQUITY PORTFOLIO MANAGEMENT

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 13, Module 26.2, LOS 26.c, 26.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 13, Module 26.2, LOS 26.c, 26.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 13, Module 27.1, LOS 27.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	Difference
Industrials	–1.3%	35%	25%	–45.5 bp	–32.5 bp	–13.0 bp
Finance	4.4%	20%	25%	88.0 bp	110.0 bp	–22.0 bp
Consumer	4.4%	30%	25%	132.0 bp	110.0 bp	+22.0 bp
Energy	4.5%	15%	25%	67.5 bp	112.5 bp	–45.0 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 13, Module 27.3, LOS 27.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 13, Modules 27.2 and 27.3, LOS 27.d, 27.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 13, Module 27.1, LOS 27.b)

7. A. Fulbright best matches the characteristics of a value manager.
   - The dividend yield is high and P/E is low.
   - The low forecasted growth rate and P/B are also indicative of a value manager.
   - Superficially Robinson has some characteristics of a value manager but the notes regarding exclusion of suspended dividends and negative earnings and book value stocks as well as the high-yield bond rating indicate a distressed securities investor. (Study Session 14, Module 28.1, LOS 28.b)

   Candidate discussion: 3 points for identifying Fulbright. 1 point each for *three* reasons. The acceptable reasons will focus on Fulbright's high dividend yield and/or low forecast earnings growth, P/B, and P/E. The Robinson data makes the question a bit trickier so pointing out why it is not value style also work to support Fulbright. You could also point out Albright appears to be growth style. Price momentum and bond rating are not directly relevant to classifying Fulbright as

value style. There is no information to directly indicate the market cap used by the managers.

B. Manager J exhibits the characteristics of a factor-based approach:

- Screening a large number (767 stocks) to build a widely distributed portfolio (250 stocks).
- Basing selection on objective public data such as P/E and P/B.
- An emphasis on big data.
- A standardized approach to rebalancing. (Study Session 14, Module 28.2, LOS 28.d)

Candidate discussion: No points for identifying J and 2 points each for three supporting reasons. The question did not specify the number of reasons so use the rule-of-thumb that if you really know the material you can write an answer in ½ the allotted time. You will still have to select Manager J to get credit for the reasons. You could also point out Manager S is fundamental security analysis (not factor-based). However it is preferable to give affirmative reasons to support Manager J is **fact**or-based, unless clearly directed otherwise.

C. The regression coefficient is negative so a positive surprise should result in the stock group underperforming. The manager would short the group. The regression coefficient remains strongly negative for another four months for a total of five months; signaling a further six months of underperformance, after the signal ends. So the short positions should last for 11 months. (Study Session 14, Module 28.2, LOS 28.d)

Candidate discussion: This is actually a very easy question, provided you are able to look at the output of statistical analysis and draw the correct conclusion for how to implement a trade that will profit, assuming the past relationships continue to hold in the future. Everything needed was provided in the case information. 1 point for short the stock group and 1 point for justifying a short position by discussing the negative sign on the regression coefficient. 1 point for 11 months and 1 point if it is clear you totaled 5 + 6 to get to the 11 months.

8. A.

Which fund places the greatest emphasis on:	**State** (circle your selection)	**Justify**
Factor weightings	A	■ The managers aggressively rotate to obtain exposure to the most undervalued factors ■ Basket trades and the large number of holdings indicate it is factor exposures being sought and not individual security exposure
Alpha skill	B	■ The managers search for significant undervaluation and then take significant position is a small number of securities
Sizing positions	C	■ The fund uses the smallest number of securities, making position size most important for Fund C

(Study Session 14, Module 29.1, LOS 29.a)

Candidate discussion: 1 point for each correct determination and then 2 points for each correct justification.

The direction that you can only use each fund once is critical in solving this question. It is also important you start with the clearest situation because, like in most portfolios, more than one building block is present in a given portfolio.

Fund C is one of the clearer choices. It takes the most concentrated positions with only 25 to 35 holdings. It will have the highest idiosyncratic risk and exposure to sizing positions. Fund B is clearly seeking alpha in the traditional undervalued security sense. Fund B does not focus on factor exposure. So Fund B must be alpha oriented and Fund A can certainly be called factor oriented.

If you start with analyzing Fund A, the situation is ambiguous because Fund A emphasizes both factor weights and alpha. The factor weights emphasis should be obvious because it is explicit that they are rotating to find exposure to the factors they expect to provide reward. But alpha is defined as both rotating factors to search for reward and seeking undervalued securities. So Fund A is also alpha seeking. To resolve that ambiguous situation, analyze C and B, and then classify A by process of elimination as factor weightings.

B.

Data for Fund D

Factor	Market	Value	Momentum
Coefficient	0.97	+0.15	–0.26
Variance of the market factor return and covariance with the market factor return	0.0024	–0.0032	0.0045

Portfolio's quarterly standard deviation of returns: 6.57%

First calculate the portion of portfolio variance due to the market factor. Hint, recall from quant that the coefficients (betas) are the exposure of portfolio return to that factor and therefore a weight to that factor, though in this case the weights do not have to add to 1.00. While the calculations are still intimidating, there is some relationship to something you have seen before. A portion of calculating portfolio variance involves weight^2 times variance. In this case that becomes beta times beta times variance or covariance. The calculation of contribution of the market factor to variance is:

$= (0.97^2 \times 0.0025) + (0.97 \times -0.15 \times (0.0032)) + (0.97 \times (-0.26) \times 0.0045)$

$= 0.00235 - 0.00047 - 0.00113 = 0.00075$

The second step is to divide this contribution by total portfolio variance (i.e., by the square of the portfolio's standard deviation):

$0.00075 / 0.0657^2 = 17.4\%$

(Study Session 14, Module 29.3, LOS 29.d)

Candidate discussion: 5 points for correctly determining 17.4%. If you do not get the final correct answer; 1 point of partial credit each for correctly setting up or calculating the three components [$(0.97^2 \times 0.0025)$, $(0.97 \times 0.15 \times (-0.0032))$, and $(0.97 \times (-0.26) \times 0.0045)$] of the first step. 1 point of partial credit for dividing step 1 results by the portfolio's variance, even if the step 1 result is incorrect.

C. The effect on active risk is unclear:

- Decreasing the over/underweights would decrease the active risk.
- But active risk is also affected by covariance within the pair and the covariance likely went up, increasing the active risk. The covariance (and correlation) should increase because the manager went from a pair of stocks in different sectors to a pair in one sector. (Study Session 14, Module 29.2, LOS 29.c)

Candidate discussion: 1 point for unclear or indeterminate. 2 points for discussing the reduction in over/under weights lowers active risk. 2 points for discussing why covariance went up and then explaining that increase would increase active risk. If you write out the active risk formula you still have to explain in words how it applies to solving this problem.

The following is a review of the Alternative Investments Portfolio Management principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #30.

READING 30: ALTERNATIVE INVESTMENTS PORTFOLIO MANAGEMENT[1]

Study Session 15

EXAM FOCUS

This reading opens with introductory LOS, which summarize some common characteristics of alternative investments (AI) and their resulting role in the portfolio. Then the focus of the reading shifts to coverage of the main issues and concerns associated with each AI type. **Beyond those first overview LOS, neither we nor the CFA text use the LOS order to cover this reading. Your focus should be on the main issues covered for each AI type.**

There is an immense amount of supporting detail for a simple topic that is usually about 5% of the exam. Throughout this reading, you will see data tables representing historical performance in specific time periods. Consider this raw data. Any one time period may well be distorted by random events in that period. The data tables generally support the final conclusions of the reading, *but not always*. Do not study the data tables. We recommend you read this section of the SchweserNotes and then watch the Video Lectures to solidify the key issues. The Schweser Weekly Class Workbook will also focus on the main issues.

MODULE 30.1: OVERVIEW

Video covering this content is available online.

LOS 30.a: Describe common features of alternative investments and their markets and how alternative investments may be grouped by the role they typically play in a portfolio.

CFA® Program Curriculum, Volume 5, page 7

Alternative investments offer diversification benefits and the potential for active management. There are six basic groups. Traditional alternative investments include *real estate*, *private equity*, and *commodities*. The more modern alternative investments include *hedge funds*, *managed futures*, and *distressed securities*.

Alternative investments can also be grouped by their role in portfolio management:

1. Real estate and long-only commodities offer exposure to risk factors and return that stocks and bonds cannot provide.

2. Hedge funds and managed futures offer exposure to special investment strategies and are heavily dependent on manager skill.
3. Private equity and distressed securities are seen as a combination of 1 and 2.

Alternative investments can be highly unique and there are differences of opinion on how to group them. But they do share some common features:

1. *Low liquidity*. Their general lack of liquidity requires careful attention to determine if they are suitable for a given investor. The alternative investment should also be associated with a liquidity premium and higher return.
2. *Diversification*. They generally have low correlation with and offer significant diversification to traditional stock and bond portfolios.
3. *Due diligence costs*. Costs associated with researching and monitoring alternative investments can be high. Specialized expertise and specific business skills are often required. These markets frequently lack transparency, making information difficult to obtain.
4. *Difficult performance evaluation*. The lack of transparency and unique features of many strategies make it difficult to identify appropriate valuation benchmarks.

DUE DILIGENCE CHECKPOINTS

LOS 30.b: Explain and justify the major due diligence checkpoints involved in selecting active managers of alternative investments.

CFA® Program Curriculum, Volume 5, page 10

The lack of transparency and unique strategies of many alternative investment managers makes due diligence in manager selection crucial:

1. *Assess the market opportunity offered*. Are there exploitable inefficiencies in the market for the type of investments in which the manager specializes? Past returns do not justify selecting a manager unless there are understandable opportunities available for the manager to exploit. (This one would have stopped anyone from investing with Bernie Madoff.)
2. *Assess the investment process*. What is the manager's competitive edge over others in that market? How does the manager's process identify potential opportunities?
3. *Assess the organization*. Is it stable and well run? What has been the staff turnover?
4. *Assess the people*. Meet with them and assess their character, both integrity and competence.
5. *Assess the terms and structure of the investment*. What is the fee structure? How does it align the interest of the manager with the investors? What is the lock-out period? Many funds do not allow withdrawals for an initial period. What is the exit strategy for redeeming the funds invested?
6. *Assess the service providers*. Investigate the outside firms that support the manager's business (e.g., lawyers, brokers, ancillary staff).

7. *Review documents*. Review the prospectus or private-placement memorandum, the audits of the manager's reports, and other available documents. Seek legal and other expert advice where needed.
8. *Write-up*. Document the above review process.

ISSUES FOR PRIVATE WEALTH CLIENTS

LOS 30.c: Explain distinctive issues that alternative investments raise for investment advisers of private wealth clients.

CFA® Program Curriculum, Volume 5, page 11

Institutional investors are presumed to be more knowledgeable and dispassionate 不动感情的 investors. Individuals can be less knowledgeable, more emotional, and have real issues that must be considered to determine suitability.

1. *Taxes*. Most individuals must pay taxes. Many alternative investments are structured as limited partnerships which require specialized tax expertise.
2. *Suitability*. Many alternative investments require that funds stay invested for a minimum time period. Is this compatible with the investor's time horizon and liquidity needs? What happens if the investor's situation changes? Individuals may have emotional feelings that draw them towards or repel them from some investments.
3. *Communication*. Discussing complex strategies with the client is not easy. When a client is excited about a unique opportunity, how do you make sure they really do understand a 10-year lock-out means they cannot get the money back for ten years? How do you explain the diversification benefit of a very complex strategy to someone with no investment training?
4. *Decision risk*. This could be defined as the risk of emotionally abandoning a strategy right at the point of maximum loss. Carefully communicating the expected ups and downs of a strategy and being prepared for the emotional response to the downside is hard. Some strategies offer frequent small returns but the occasional large loss. They maximize the chance of an emotional investor making the wrong decision to cash out after a loss. Other strategies offer wild swings between large gains and losses with an attractive long term average return.
5. *Concentrated positions*. Wealthy individuals' portfolios frequently contain large positions in closely held companies or private residences. Such ownership should be considered as a preexisting allocation before deciding to add additional private equity or real estate exposure. These existing positions may also have large unrealized taxable gains which add complexity to any rebalancing decision.

One approach to incorporating alternative investments into a traditional portfolio is *core-satellite*. The traditional core of the portfolio would remain as stocks and bonds to provide market exposure and return. However, it is difficult to add value in such efficient markets. More informationally inefficient alternative investments would be added to provide excess return (alpha) as the satellite.

ALTERNATIVE INVESTMENT CLASSES

LOS 30.d: Distinguish among types of alternative investments.

CFA® Program Curriculum, Volume 5, page 13

Real Estate

PROFESSOR'S NOTE

We provide a summary discussion of the major forms of alternative investments under this LOS. After this LOS, we begin a more in-depth discussion of each type.

One way to classify real estate investment is between *direct* and *indirect*. *Direct* real estate investment includes ownership of residences, commercial real estate, or agricultural land. The ownership involves direct management of the assets. *Indirect* investment in real estate generally means there is a well-defined middle group that manages the properties. Indirect real estate investments include:

- Companies that develop and manage real estate.
- Real estate investment trusts (REITs), which are publicly traded equity shares in a portfolio of real estate. Equity REITs own and operate properties while mortgage REITs hold mortgages on real estate. REITs can be purchased in small sizes and are liquid.
- Commingled real estate funds (CREFs), which are pooled investments in real estate that are professionally managed and privately held. They can be open-end and allow in new investors or closed-end and not allow in new investors after an initial offering period. They are restricted to wealthy investors and institutions.
- Separately managed accounts for wealthy investors are usually offered by the same managers who manage CREFs.
- **Infrastructure funds** specialize in purchasing public infrastructure assets (e.g., airports, toll roads) from cities, states, and municipalities. Because infrastructure assets typically provide a public service, they tend to produce relatively stable long-term returns. They tend to be regulated by local governments which adds to the predictability of cash flows. Their low correlation with equity markets means infrastructure assets provide diversification, and their long-term nature provides a good match for institutions with long-term liabilities (e.g., pension funds). Their relatively low risk, however, means that infrastructure returns are low.

The advantages of real estate investment typically include low correlation with stocks and bonds (providing a portfolio diversification benefit), low volatility of return, and often an inflation hedge. Real estate may also offer tax advantages and the potential to leverage return.

Disadvantages include high information and transaction costs, political risk related to the potential for tax law changes, high operating expenses, and the inability to subdivide direct investments. Real estate as an asset class and each individual real estate asset can have a large idiosyncratic risk component.

Private Equity

Private equity investment is an ownership interest in a non-publically-traded private company. Legal restrictions generally limit ownership to high-net-worth individuals or institutions. Often, the investing is done through pooling funds with other investors in a **private equity fund**. There are numerous subcategories of private equity. The two most important are **venture capital**, which provides funding to start or grow a private company, and **buyout funds**, which provide funds to buy existing public companies from their shareholders and then take the company private.

Two important segments of buyout funds are *middle-market buyout funds* and *mega-cap buyout funds*. Middle-market buyout funds concentrate on divisions spun off from larger, publicly traded corporations and private companies that, due to their relatively small size, cannot efficiently obtain capital. Mega-cap buyout funds concentrate on taking publicly traded firms private.

Buyout funds add value through some combination of: 1) restructuring company operations and management, 2) buying companies for less than intrinsic value, and 3) creating value by adding leverage or restructuring existing debt of the company. The exit strategies include selling the companies through private placements or IPOs or through *dividend recapitalizations*. In a dividend recapitalization, the company (under direction of the buyout fund) issues substantial debt and pays a large special dividend to the buyout fund and other equity investors. The debt effectively replaces some or most of the equity of the company, while allowing the investors to recoup some or all of their original investment. *Recapitalization* increases the company's leverage but does not change the owner. The buyout fund retains control but extracts cash from the company.

Private equity is a highly diverse class that typically involves high risk with a significant number of investments that fail. The venture capitalist is often expected to bring not only funding but business expertise to operate the company. The entrepreneurs who start the company often lack the capital and management skills to grow the company. The company may employ agents to solicit private equity investors through a private placement memorandum which describes the business plan, risk, and many other details of the investment.

Commodities

Commodity investments can include *direct* purchase of the physical commodity (e.g., agricultural products, crude oil, metals) or the purchase of derivatives (e.g., futures) on those assets. *Indirect* investment in commodities can include investment in companies whose principal business is associated with a commodity (e.g., investing in a metal via ownership of shares in a mining company). Direct investment through derivatives is more common as indirect investment has not tracked well with commodity price changes and direct investment by buying the commodities creates issues to consider such as storage costs.

Investments in both commodity futures and publicly traded commodity companies are fairly liquid, especially when compared to many other alternative investments. Investments in commodities have common risk features such as *low correlation with stocks and bonds* and *business-cycle sensitivity*, and most have a *positive correlation*

with inflation. These risk characteristics are the reasons commodities provide good diversification to an investor's portfolio.

Hedge Funds

Hedge funds are a diverse group and the terminology used to describe them is flexible. Initially they were private pools of money that were both long and short the market. Hence, they were not exposed to market risk. Many hedge funds still target an absolute level of return that is not dependent on market returns. Hedge funds are generally structured to avoid regulation which also allows them to charge substantial incentive fees. Each fund is designed to exploit a perceived market opportunity, often taking both long and short positions on a leveraged basis. Many hedge funds describe themselves as exploiting arbitrage opportunities. In the case of hedge funds the term "arbitrage" is used very loosely to mean lower-risk and not to mean risk-free.

Hedge fund classifications include: *equity market neutral*, *convertible arbitrage*, *fixed-income arbitrage*, *distressed securities*, *merger arbitrage*, *hedged equity*, *global macro*, *emerging markets*, and *fund of funds (FOF)*.

Managed Futures

与HF相同点

Managed futures funds are sometimes classified as hedge funds. Others classify them as a separate alternative investment class. In the United States, they generally use the same limited partnership legal structure and base fee plus performance fee compensation structure as hedge funds. A 2% base fee plus a 20% share of the profits is a common fee structure. Like hedge funds, they are often considered to be skill based and not an asset class, per se; they depend on the skill of the manager to find and exploit opportunities and as such have no inherent return and risk characteristics of their own.

不同点

MF偏宏观玩指数

The primary feature that distinguishes managed futures from hedge funds is the difference in the assets they hold. For example, managed futures funds tend to trade only in derivatives markets, while hedge funds often trade in spot and futures markets. Also, managed futures funds generally take positions based on indices, while hedge funds tend to focus more on individual asset price anomalies. In other words, hedge funds tend to have more of a micro focus, while managed futures tend to have a macro focus. In some jurisdictions they are more regulated than hedge funds.

Investment in managed futures can be done through: *private commodity pools*, *managed futures programs as separately managed accounts* (called CTA managed accounts), and *publicly traded commodity futures funds* that are available to small investors. *Liquidity* will be lower for private funds than for publicly traded commodity futures funds.

Trading strategies and *classifications* used include:

- *Systematic trading strategies* follow rules. *Trend following rules* are common and may focus on short-, medium-, or long-term trends. *Contrarian strategies* exist but are less common.
- *Discretionary trading strategies* depend on the judgment of the manager and could be based on economic or other criteria.

- Managed futures may invest in all *financial* markets, *currency* markets only, or a *diversified* mix of derivatives and underlying commodities.

The *risk characteristics* of managed futures will vary, as they do for hedge funds. The standard deviation of managed futures is generally less than that of equities but greater than that of bonds. The correlation between managed futures and equities is low and often negative. With bonds, the correlation is higher but still less than 0.30.

SDfi<SDmf<SDeq

Distressed Securities

Distressed securities are securities of companies that are in or near bankruptcy. They are another type of alternative investment where the risk and return depend upon skill-based strategies. Some analysts consider distressed securities to be part of the hedge fund class or of the private equity class.

One way to construct subgroups in distressed securities is by structure, which determines the level of liquidity. The hedge fund structure for distressed security investment is more liquid. The private equity fund structure describes funds that are less liquid because they have a fixed term and are closed-ended. The latter structure is more appropriate when the underlying securities are too illiquid to overcome the problem of determining a net asset value (NAV).

MODULE QUIZ 30.1

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

1. All of the following are special issues for the private wealth client when investing in alternative investments except:
   A. tax issues.
   B. decision risk.
   C. return enhancement.

MODULE 30.2: REAL ESTATE

Video covering this content is available online.

LOS 30.f: Evaluate the return enhancement and/or risk diversification effects of adding an alternative investment to a reference portfolio (for example, a portfolio invested solely in common equity and bonds).

CFA® Program Curriculum, Volume 5, page 18

Real estate is an asset class as well as an alternative investment. High risk-adjusted performance is possible because of the low liquidity, large lot sizes, immobility, high transactions costs, and low information transparency that usually means the seller knows more than the buyer.

Real estate typically reacts to macroeconomic changes differently than other asset classes, and each investment has a large idiosyncratic (unsystematic) risk component. Because of both of these characteristics, real estate has provided diversification. Using data for the period 1996–2015, Figure 30.1 compares the returns of the indicated portfolios based on benchmarks for the indicated asset classes.

Figure 30.1: Portfolio Returns From 1996–2015

Portfolios[1]	A	B	C	D
Annual return	7.26%	7.70%	7.26%	7.69%
Annual standard deviation	7.83%	8.36%	8.11%	8.62%
Average return-to-volatility ratio[2]	0.93	0.92	0.89	0.89

1. Portfolio A = 50/50 stocks and bonds, Portfolio B = 10% REITs + 90% Portfolio A, Portfolio C = 75% stocks and bonds + 25% alternative investments (hedge funds, private equity, commodities, managed futures), Portfolio D = 10% REITs + 90% Portfolio C.

2. Risk-adjusted performance ratio of the mean return for the period divided by the standard deviation of return.

Some conclusions from Figure 30.1 and past data include:

- Comparing portfolios A and B: REITs provided no diversification benefits relative to a stock and bond portfolio due to the high volatility of REITs for the time period studied. (Later in the reading other alternative investments, e.g., hedge funds, will be shown to have provided diversification benefits to a stock and bond portfolio.)
- Comparing portfolios C and D: Real estate may become a redundant asset in the presence of other alternative investments.

REAL ESTATE EQUITY INVESTING

LOS 30.g: Describe advantages and disadvantages of direct equity investments in real estate.

CFA® Program Curriculum, Volume 5, page 20

Direct equity real estate investing has the following advantages and disadvantages.

Advantages:

- Many expenses are tax deductible.
- Ability to use more leverage than most other investments.
- Direct control of the properties.
- Ability to diversify geographically.

Disadvantages:

- Lack of divisibility means a single investment may be a large part of the investor's portfolio.
- High information costs.
- High commissions.
- High operating and maintenance costs plus hands-on management requirements.
- Special geographical risks, such as neighborhood deterioration.
- Political risks, such as changing tax codes.

ALTERNATIVE INVESTMENT BENCHMARKS

LOS 30.e: Discuss the construction and interpretation of benchmarks and the problem of benchmark bias in alternative investment groups.

CFA® Program Curriculum, Volume 5, page 15

PROFESSOR'S NOTE

There are two main types of RE indices (REIF and REIT). Plus, each has an "adjusted" version. You should notice that based on the previous discussion of direct versus indirect real estate, both REIF and REIT can be classified as indirect investment in RE. However, that is a trivial issue. The more important issue is that unsmoothed NCREIF provides the best data for representing the performance of direct investment in RE.

- **National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index:** These are the performance results of commingled portfolios making direct, unleveraged investment in real estate properties. However, that means the underlying properties are not regularly traded and, therefore, the reported results are biased by the smoothing problem discussed after this professor's note.
  - **Unsmoothed REIF** is adjusted to remove the distortions of smoothing. **Unsmoothed NCREIF is considered to provide the most accurate representation of the true investment characteristics of direct RE investing.**
- **National Association of Real Estate Investment Trusts (NAREIT) Index:** This is an index of traded stocks of companies that invest in RE or RE-related assets. **As such, it reflects blended characteristics of public equity and RE, not the true investment characteristics of direct RE investing.**
  - Like most public companies, those in the NAREIT use financial leverage on their balance sheet. This further distorts the data and makes NAREIT data less reflective of the underlying RE assets. **"Hedged" REIT** data removes the equity-like effects of leverage but still does not provide the best reflection of underlying RE characteristics because the REITs are still publicly traded companies.

Appropriate benchmarks for a given alternative investment manager can be difficult to establish. The following list describes the more common benchmarks available and some of the issues that arise.

- **Real estate** has the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index as its principal benchmark for *direct investments*. The NCREIF Index is a *value-weighted* index of commercially owned properties that uses samples based both on geographic location and type (e.g., apartment and industrial). The values are obtained periodically, usually by annual appraisal, so the volatility of the index is *downward biased*. The index is published quarterly.

  For *indirect* real estate investment, the primary benchmark is the National Association of Real Estate Investment Trusts (NAREIT) Index. The NAREIT Index is cap-weighted and includes all REITs traded on the NYSE or AMEX. Similar to other indices based upon current trades, the monthly NAREIT Index is "live" (i.e., its value represents current values).

  The biggest problem is the infrequent trading of most real estate investments and the resulting understatement of actual volatility. Various techniques have been

used to *unsmooth* or "correct" this bias. The unsmoothed data raises the standard deviation and reduces the Sharpe ratio of real estate, making real estate less attractive but still a valuable addition to stock and bond portfolios due to its low correlation. Another problem is that many real estate indices reflect leveraged investments. When leverage effects are removed, returns and Sharpe ratios are lower, but the low correlation with other asset classes still leaves real estate as an attractive addition to portfolios. Finally, in the case of REITs, the returns are more correlated with equity while other types of real estate investment are less correlated with equity, meaning REITs offer less of a diversification benefit.

MODULE QUIZ 30.2

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

1. Data smoothing is *likely* to:
   A. lead to overstated standalone risk.
   B. lead to an overestimate of the diversification benefit.
   C. occur in trend following managed futures strategies implemented with exchange traded futures and options.
2. Which one of the following statements comparing direct versus indirect real estate investing is *most likely* true?
   A. Direct investing has better liquidity.
   B. Direct investing has lower transaction costs.
   C. Direct investing has the potential for more leverage.

MODULE 30.3: PRIVATE EQUITY

Video covering this content is available online.

Venture Capital Investing

LOS 30.h: Discuss the major issuers and suppliers of venture capital, the stages through which private companies pass (seed stage through exit), the characteristic sources of financing at each stage, and the purpose of such financing.

CFA® Program Curriculum, Volume 5, page 27

In a typical sequence, the venture capitalist brings capital to start a company based on an attractive business plan and/or to fund and grow an existing private company. The typical exit plan involves an IPO (initial public offering) to sell stock to the public and pay off the early private investors. This can take years to execute.

There is an extensive vocabulary to describe venture capital. The issuers (companies seeking capital) of venture capital include *formative-stage companies* that are either new or young and *expansion-stage companies* that need funds to expand their revenues or prepare for an IPO.

The investors (suppliers) include:

- **Venture capitalists** are specialists who identify pools of capital available for investing in and find the promising private companies to invest in. They may pool investor's capital into **venture capital funds or trusts**.

- **Corporate venturing** refers to large companies that invest in venture capital opportunities in their own area of business expertise.
- **Angel investors** are considered to be knowledgeable, accredited individuals who are often the first outsiders (non-founders or relatives) who invest in the company.

公认，可信任

The **stages** through which private companies pass are early stage, expansion stage, and exit stage. The *early stage* includes *seed money* often put up by the entrepreneur or other family members to begin prototype work, then *start-up funds* to begin product development and marketing, and *first-stage funding* to begin manufacturing and sales.

The *expansion stage* can include very young companies with an established product looking to expand sales, more established companies seeking to fund growth, or even companies soon to launch an IPO. *Second-stage* financing supports further expansion of production and sales, while *third-stage* financing can support additional major expansion. *Mezzanine or bridge financing* is used to prepare for an IPO and may include both debt and equity capital.

The *exit stage* could involve an IPO, merger with another company, or acquisition by another company (which might be a venture capital fund specializing in such activity).

LOS 30.i: Compare venture capital funds and buyout funds.

CFA® Program Curriculum, Volume 5, page 40

In contrast to venture capital funds, **buyout funds** usually have:

- A higher level of leverage.
- Earlier and steadier cash flows.
- Less error in the measurement of returns as more of the return is from cash flow return.
- Less frequent losses.
- Less upside potential.

These differences are the natural consequence of buyout funds purchasing entities in later stages of development or established companies and corporate spin-offs, where the risks are lower.

CONVERTIBLE PREFERRED STOCK

LOS 30.j: Discuss the use of convertible preferred stock in direct venture capital investment.

CFA® Program Curriculum, Volume 5, page 34

Direct investors in private equity often use convertible preferred stock (CPS) rather than common stock. The CPS has first claim on cash flow ahead of the founder, who typically retains the common stock. CPS can be structured to receive a minimum return before the common shareholders are paid. It also has prior claim in bankruptcy if the company fails. The conversion to common feature provides upside participation.

There are typically subsequent financing rounds required, and these subsequent rounds may have priority over receiving cash flows before earlier financing rounds. Priority

induces the later investors to provide funds. With all other features the same, these later financing rounds with priority will be more valuable than earlier rounds.

PRIVATE EQUITY INVESTING

LOS 30.k: Explain the typical structure of a private equity fund, including the compensation to the fund's sponsor (general partner) and typical timelines.

CFA® Program Curriculum, Volume 5, page 34

Private equity funds usually take the form of **limited partnerships** or **limited liability companies** (LLCs). These legal structures limit the loss to investors to the initial investment and avoid corporate double taxation. For limited partnerships, the sponsor is called the *general partner*; for LLCs, the sponsor is called the *managing director*. The sponsor constructs and manages the fund and selects and advises the investments.

The **time line** starts with the sponsor getting commitments from investors at the beginning of the fund and then giving "capital calls" over the first five years (typically). This is referred to as the *commitment period*. The expected life of these funds is seven to ten years, and there is often an option to extend the life up to five more years.

The sponsor can receive *compensation* in several ways. First, the sponsor has capital invested that earns a return. This is usually required, as it helps keep the sponsor's interests in line with those of the limited partners. As a manager, the sponsor typically gets a *management fee* and *incentive fee*.

The **management fee** is usually 1.5%–2.5% and is based upon the *committed funds*, not just funds already invested. The percent may decline over time based upon the assumption that the manager's work declines over time.

The **incentive fee** is also called the *carried interest*. It is the share of the profits, usually around 20%, that is paid to the manager after the fund has returned the outside investors' capital—often after a minimum required return or hurdle rate has been paid on the cash from the outside investors. In some cases, the manager can receive early distributions based on expectations, but a *claw-back* provision may be in place that requires the manager to give back money if the expected profits are not realized.

PRIVATE EQUITY INVESTMENT STRATEGY

LOS 30.l: Discuss issues that must be addressed in formulating a private equity investment strategy.

CFA® Program Curriculum, Volume 5, page 42

Any strategy for private equity investment must address the following issues:

- *Low liquidity*: the portfolio allocation to this class should typically be 5% or less with a plan to keep the money invested for 7–10 years.
- *Diversification through a number of positions*: direct private equity is generally for very large portfolios. The total portfolio allocation may be only 5%, but each private equity position is large and multiple positions are needed for

diversification. Smaller portfolios for which private equity is otherwise suitable can consider private equity funds.

- *Diversification strategy*: knowing the unique aspects of a proposed private equity investment as they relate to the overall portfolio.
- *Plans for meeting capital calls*: committed funds are called as needed, and the investor needs to be prepared to meet the calls.

Private equity is less of a diversifier and more a long-term return enhancer. Private equity investments (both venture capital and buyout funds) are usually illiquid, require a long-term commitment, and have a high level of risk with the potential for complete loss. In addition, there is often a minority discount associated with the investment. Because of these issues, investors require a high expected internal rate of return (IRR). Venture capital investments have lower transparency than buyout funds, which can actually add to the potential for large profits.

The difference in transparency between venture capital funds and buyout funds is caused by the different natures of the investments. Venture capital, for example, is provided to new, non-public companies in need of capital for growth. By definition, the managers of firms receiving the funds have considerably more information on the true value of the firm than the investing public. This adds to the risk faced by venture capital funds but, at the same time, increases the possible return to venture capitalists, who make it a point to learn as much about the firm as possible before investing. Buyout funds, on the other hand, usually provide capital to managements and others to purchase the equity of publicly traded firms.

Private equity returns typically move with stock market returns. Computed correlations are often positive and low, but some attribute the low correlation to the infrequently updated (i.e., "stale") prices of the private equity. Each investment has a large idiosyncratic risk component, however, which can provide moderate diversification.

Because the primary benefit from private equity is return enhancement, Figure 30.2 gives the most important information for comparison. From the figure, we see that in the most recent years, venture capital funds had a lower return than Growth Equity, NASDAQ, and S&P 500. Over the longer 10- and 20-year periods, however, private equity had higher returns.

PROFESSOR'S NOTE

In our opening comments for this reading, we included a warning not to "overstudy" the data tables. The data tables represent historical performance in specific time periods. Consider this raw data. Any one time period may well be distorted by random events in that period. The data tables generally support the final conclusions of the reading, but not always. Do not study the data tables. We recommend you read this section of the SchweserNotes on alternative investments and then watch the OnDemand videos to solidify the main points for each alternative investment type. The Schweser Weekly Class Workbook will also focus on the issues to know by alternative investment type.

Figure 30.2: Returns to Private Equity and Equity Markets

Period	NASDAQ	S&P 500	Growth Equity	VC Multi-Stage Funds[1]

2011–2014	23.0	23.0	17.9	15.0
2009–2014	16.2	15.7	17.2	13.3
2004–2014	9.0	8.1	14.0	10.0
1994–2014	9.3	9.6	n/a	13.4

1. VC funds that comprise both early and late stage investments

Private equity indices are provided by Cambridge Associates, Preqin, and LPX. Indices are constructed for the buyout and venture capital (VC) segments of the private equity markets. Because private equity values are not readily available, the value of a private equity index depends upon events like IPOs, mergers, new financing, and so on to provide this information. Thus, the indices might present dated values as *repricing* occurs infrequently. Note that private equity investors also often construct custom benchmarks.

The primary problems are the lack of pricing data, forcing a heavy reliance on appraisal values for investments, and the resulting smoothing of returns and understatement of volatility. In addition, private equity shows a strong vintage year effect. The economic conditions of the year in which the fund was launched have a significant effect on subsequent performance for the life of the fund. As a result, comparisons are often made to other funds launched in the same year.

MODULE QUIZ 30.3

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

1. Which of the following represent private equity subgroups where the company invested in has not typically started generating revenues?
   A. Start-up companies only.
   B. Start-up companies and middle-market private companies only.
   C. Start-up companies, middle-market private companies, and private investment in public entities only.
2. The buyers of venture capital who are the first investors after the entrepreneur's family and friends would *most likely* be:
   A. vultures.
   B. angel investors.
   C. corporate venture capitalists.
3. Which of the following alternative investment asset classes is *most* suitable for an investor with a traditional stock and bond portfolio allocation whose primary objective is increasing the return?
   A. Real estate only.
   B. Managed futures.
   C. Commodities only.

MODULE 30.4: HEDGE FUNDS

Video covering this content is available online.

LOS 30.o: Identify and explain the style classification of a hedge fund, given a description of its investment strategy.

Hedge funds are classified in various ways by different sources. Because hedge funds are a "style-based" asset class, strategies can determine the subgroups. Within the strategies, there can be even more precise subgroups such as long/short and long-only strategies. The following is a list of nine of the more familiar hedge fund strategies.

1. *Convertible arbitrage* seeks to exploit mispricings or anomalies in the price of convertible securities such as convertible bonds, convertible preferred stock, or warrants. Both long and short positions are taken to hedge the risks. A common example is to buy undervalued convertible bonds and short the stock. The investor owns the convertible which includes a "call option" on the stock and shorts the stock which should leave the position hedged against changes in the stock price. Interest is earned from the bond coupons and from investing the proceeds of the short-sale. The strategy would benefit if stock volatility increases and the convertible rises in value. (The value of the embedded call option in the convertible should rise with increasing volatility.) If the yield curve is upward sloping, making the yield on the bond higher than short term borrowing rates, the strategy might also be leveraged to enhance returns.
2. *Distressed securities* are fundamentally different investments than conventional debt and equity investments. Many investors are not allowed to or do not want to deal with the legal complications for these securities. The resulting securities may be undervalued and offer superior returns. Distressed securities are generally illiquid, making it difficult or impossible to short the securities. These funds are generally long (not hedged) portfolios.
3. *Emerging markets* generally only permit long positions, and often there are no derivatives to hedge the investments.
4. *Equity market neutral* typically combines long and short positions in under-valued and over-valued securities (pairs trading) to eliminate systematic risk while capitalizing on mispricing.
5. *Hedged equity strategies* take long and short positions in under- and over-valued securities to exploit mispricings. Unlike market neutral funds, they do not seek to remove systematic risk. They might be net long, short, or hedged based on the manager's view of the markets.
6. *Fixed-income arbitrage* involves taking long and short positions in fixed-income instruments based upon expected changes in the yield curve and/or credit spreads.
7. *Global macro strategies* take positions in major financial and nonfinancial markets through various means (e.g., derivatives and currencies). The distinguishing feature is that they tend to focus on an entire group or area of investment instead of individual securities or classes of securities.
8. *Merger arbitrage* or *deal arbitrage* focuses on returns from mergers, spin-offs, takeovers, and so on. For example, if Company X announces it will acquire Company Y, the manager might buy shares in Y and short X.
9. *Fund of funds (FOF)* describes a hedge fund that invests in many hedge funds. The idea is to get diversification among hedge fund managers or styles, but there

is a fee paid to the manager of the fund of funds, as well as to the managers of the funds in the fund of funds.

As a skill-based investment class, the risk and return of a hedge fund depends heavily upon the skill of the manager. We can make a distinction concerning risk, however, in that styles that are mainly long-only (e.g., distressed securities) tend to offer less potential for diversification than long/short styles.

HEDGE FUND STRUCTURE

LOS 30.p: Discuss the typical structure of a hedge fund, including the fee structure, and explain the rationale for high-water mark provisions.

CFA® Program Curriculum, Volume 5, page 58

The most common **compensation structure** of a hedge fund consists of an *assets-under-management (AUM)* fee of about 1% to 2% and an *incentive fee* of 20% of profits. The definition of *profit* should be spelled out in the terms of the investment. It could be the dollar return over the initial investment, for example, or the dollar return above the initial investment increased by some hurdle rate.

High water marks (HWMs) are typically employed to avoid incentive fee double-dipping. For example, assume a fund is valued and opened for subscription on a quarterly basis. Each quarter, the increase in value over the previous quarter is determined and investors pay incentive and management fees accordingly. This is fine, as long as the fund's value is higher at each successive valuation. If the value of the fund is lower than the previous quarter, however, the manager receives only the management fee, and the previous high value of the fund (i.e., the last fund value at which incentive fees were paid) is established as a HWM. Investors are then required to pay incentive fees only if and when the value of the fund rises above the HWM. Note that HWMs are investor- and subscription-date specific. For those who subscribe while the fund value is below the previously established HWM, that HWM is not relevant. They will pay management fees each quarter, as well as incentive fees, for increases in value above the value at their subscription date.

A **lock-up period** is a common provision in hedge funds. Lock-up periods limit withdrawals by requiring a minimum investment period (e.g., one to three years) and designating exit windows. The rationale is to prevent sudden withdrawals that could force the manager to have to unwind positions.

Incentive fees are paid to encourage the manager to earn ever-higher profits. There is some controversy concerning incentive fees because the manager should have goals other than simply earning a gross return. For example, the manager may be providing limited downside risk and diversification. An incentive fee based upon returns does not reward this service.

Managers with good track records often demand higher incentive fees. The concern for investors is whether the manager with a good historical record can continue to perform well enough to truly earn the higher fees.

FUND-OF-FUNDS

LOS 30.q: Describe the purpose and characteristics of fund-of-funds hedge funds.

CFA® Program Curriculum, Volume 5, page 58

A **fund of funds** (FOF) is a hedge fund that consists of several, usually 10 to 30, hedge funds. The point is to achieve diversification, but the extra layer of management means an extra layer of fees. Often, an FOF offers more liquidity for the investor, but the cost is cash drag caused by the manager keeping extra cash to meet potential withdrawals by other investors. Despite the drawbacks, FOF are *good entry-level investments*.

An FOF may be a better indicator of aggregate hedge fund performance than the typical hedge fund index because it suffers from less survivorship and backfill bias. If an FOF includes a hedge fund that dissolves, it includes the effect of that failure in its return, while an index may simply drop the failed fund along with its historical performance.

An FOF can, however, suffer from style drift. This can produce problems because the investor may not know what she is getting. Over time, individual hedge fund managers may tilt their respective portfolios in different directions. Also, it is not uncommon for two FOF that claim to be of the same style to have returns with a very low correlation.

FOF returns have been more highly correlated with equity markets than those of individual hedge funds. This characteristic has important implications for their use as diversifiers in an equity portfolio.

HEDGE FUND PERFORMANCE EVALUATION

LOS 30.r: Discuss concerns involved in hedge fund performance evaluation.

CFA® Program Curriculum, Volume 5, page 62

The hedge fund industry views hedge fund performance appraisal as a major concern with many special issues and conventions to address. One special issue is that some claim that hedge funds are **absolute-return vehicles**, which means that no direct benchmark exists. Instead, the fund targets some absolute return per period. That target return is not really a benchmark because it is not investable. The question (and problem) is how to determine alpha. The problem is especially perplexing given that most performance evaluation techniques are based on long-only positions and hedge funds use various combinations of long and short positions and leverage. To create comparable portfolios, analysts might 1) use a single- or multi-factor model or 2) create tracking portfolios that have comparable return and risk characteristics. In either case, the resulting customized benchmark is used for subsequent evaluation.

Conventions to consider in hedge fund performance evaluation are the impact of performance fees and lock-up periods, the age of funds, and the size of funds. Empirical studies have found that:

- Funds with longer lock-up periods tend to produce higher returns than those with shorter lock-up periods.
- Younger funds tend to outperform older funds.

- Large funds underperform small funds.

Returns. By convention, hedge funds report monthly returns by comparing the ending value of the fund to the beginning value [i.e., $(V_1 / V_0) - 1$]. These simply-calculated monthly returns are then compounded to arrive at annual returns. Note that returns are often biased by entry into and exit from the fund, which are allowed on a quarterly or less frequent basis, and by the frequency of the manager's trading (i.e., cash flows).

To smooth out variability in hedge fund returns, investors often compute a *rolling return*, such as a 12-month moving average. A 12-month moving average is the average monthly return over the most recent 12 months, including the current month. The next moving average return is calculated by adding the next month and dropping the most distant month. In this fashion, the average return is always calculated using returns for 12 months.

Leverage. The convention for dealing with leverage is to treat an asset as if it were fully paid for (i.e., effectively "look through" the leverage). When derivatives are included, the same principle of *deleveraging* is applied.

Risk. Using standard deviation to measure the risk of a hedge fund can produce misleading results. For example, hedge fund returns are usually skewed with significant leptokurtosis (fat tails), so standard deviation fails to measure the true risk of the distribution (i.e., standard deviation does not accurately measure the probability of returns in the tails).

Downside deviation. Downside deviation measures only the dispersion of returns below some specified threshold return. The most common formula for downside deviation is:

$$\text{downside deviation} = \sqrt{\frac{\sum_{1}^{n}\left[\min(\text{return}_t - \text{threshold},\ 0)^2\right]}{n-1}}$$

The threshold return in the formula is usually either zero or the risk-free rate of return. If the threshold is a recent average return, then we call the downside deviation the **semivariance**. The point of these measures is to focus on the negative returns and not penalize a fund for high positive returns, which increases measured standard deviation.

The Sharpe Ratio

Annual hedge fund Sharpe ratios are calculated using annualized measures, as discussed earlier:

$$\text{Sharpe}_{\text{HF}} = \frac{\text{annualized return} - \text{annualized risk-free rate}}{\text{annualized standard deviation}}$$

In addition to concerns associated with the way returns are calculated, the Sharpe ratio has the following *limitations* with respect to hedge fund evaluation:

- *Time dependency*: The annual Sharpe ratio is typically estimated using shorter time periods. For example, to estimate the annual Sharpe ratio for a hedge fund using quarterly returns, the analyst multiplies the quarterly return by 4 and multiplies the quarterly standard deviation by the square root of 4. Thus, the *annualized* Sharpe ratio is biased upward by the square root of 4. The annualized Sharpe ratio can also be gamed (overstated) by compounding the sub-period

returns to annualize them by not changing the method of annualizing the standard deviation. Essentially, this compounds to annualize the return while using a multiplicative approach to annualize the risk.

- *Assumes normality*: Measures that incorporate standard deviation are inappropriate for skewed return distributions.
- *Assumes liquidity*: Because of infrequent, missing, or assumed return observations, illiquid holdings have upward-biased Sharpe ratios (i.e., downward-biased standard deviations).
- *Assumes uncorrelated returns*: Returns correlated across time will artificially lower the standard deviation. For example, if returns are trending for a period of time, the measured standard deviation will be lower than what may occur in the future. Serially-correlated returns also result when the asset is illiquid and current prices are not available (e.g., private equity investments).
- *Stand-alone measure*: Does not automatically consider diversification effects.

In addition to these statistical shortcomings, the Sharpe ratio has been shown to have little power for predicting winners (i.e., it uses historical data). Also, research has found evidence that managers can manipulate their reported returns to artificially inflate their Sharpe ratio.

Hedge Funds

In aggregate, hedge funds generated higher absolute returns compared to other asset classes with the exception of real estate over the period 1996–2015. The CISM Equal Weighted Hedge Fund Index return, standard deviation, and average return-to-risk ratio were 9.15%, 7.36%, and 1.24, respectively. Hedge funds had the highest average return-to-volatility ratio compared to other asset classes with the exception of bonds.

A 45/45/10 stock/bond/hedge fund portfolio had a higher return and lower standard deviation than the 50/50 stock/bond portfolio over 2001–2015 period.

Hedge funds vary widely, however, so the benefits of investing in one of any given style will differ. Figure 30.3 provides a representative list of the best and worst performing funds with their correlations with the S&P 500 and the Bloomberg Barclays US Aggregate Bond Index. The last two rows in Figure 30.3 indicate how a lower correlation of each index's return with stocks and bonds added diversification over the period 1996–2015.

Figure 30.3: Hedge Fund (HF) Strategy and Traditional Assets Index Performance 1996–2015

Measure (annualized)	Global Macro HF	Merger Arbitrage HF	Equity Long/Short HF	Equal Weighted HF	S&P 500	Bloomberg Barclays US Aggregate Bonds
Return	6.29%	7.12%	8.88%	9.15%	8.51%	5.37%
Standard deviation	3.93%	3.26%	7.47%	7.36%	15.31%	3.47%

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Average return-to-volatility ratio	1.60	2.19	1.19	1.24	> 0.56	1.55
Correlation with S&P 500	0.39	0.58	0.75	0.74	1.0	-0.01
Correlation with bonds	0.22	0.02	-0.06	0.00	-0.01	1.0

Given the wide variety of results and often high risk, the primary role of hedge funds in a portfolio is the potential for higher return.

Hedge Fund Benchmarks

Hedge fund benchmarks vary a great deal in composition and even frequency of reporting. Also, there is no consensus as to what defines hedge fund strategies and this leads to many differences in the indices, as style classifications vary from company to company. The following points summarize the ways index providers compose their respective indices.

- *Selection criteria* can vary, and methods include assets under management, the length of the track record, and the restrictions imposed on new investment.
- *Style classification* also varies as to how they classify a fund by style and whether it is included in a given index.
- *Weighting schemes* are usually either equally weighted or based upon assets under management.
- *Rebalancing rules* must be defined for equally weighted indices, and the frequency can vary from monthly to annually.
- *Investability* often depends upon frequency of reporting (e.g., daily reporting allows for investability while monthly reporting tends not to). Some indices are not explicitly investable, but independent firms modify the index to produce an investable proxy.

Some indices explicitly report the funds they include in the composition of the index, and some do not. Some indices report monthly and some report daily. Of the major index providers only the Hedge Fund Research (HFR) provides a daily return series.

The following lists providers of *monthly indices* with a few of their general characteristics:

- *CISDM*: several indices that cover both hedge funds and managed futures (equally weighted).
- *Credit Suisse*: provides various benchmarks for different strategies and uses a weighting scheme based upon assets under management.
- *EACM Advisers*: provides the EACM100® Index, an equally weighted index of 100 funds that span many categories.
- *Hedge Fund Intelligence*: provides a wide range of equally hedge fund indexes including those that invest in Europe and Asia.

- *HedgeFund.net*: provides an equally weighted index that covers more than 40 strategies.
- *HFR*: provides the HFRI equally and asset weighted composite hedge fund indexes and equally weighted sub-indexes based on managers' reporting of their hedge fund returns. FOFs are reported in a separate index.
- *Morningstar MSCI*: indexes are classified according to 5 basic categories including a composite index. Within each category, indexes are separated according to geographical region and asset class. Equally weighted and asset weighted indexes are available.

Hedge fund benchmark selection includes several issues:

- **Relevance of past data** may be questionable. If hedge funds are a reflection of manager skill, then past returns for indices is less relevant to future returns since hedge fund indices frequently change composition and thus managers within the index. The empirical evidence shows that funds within a particular style do have similar returns and that individual managers do not consistently beat their style group. The data also suggests volatility of past returns tends to persist even when return does not. This makes selection of the relevant comparison benchmark very important.
- **Popularity bias** can result if one of the funds in a value-weighted index increases in value and then attracts a great deal of capital. The inflow of investment to that fund will have a misleading effect on the index. Research has shown that indices can easily suffer from a popularity bias of a particular style, which is caused by inflows and not the actual return on investment. Even without the popularity bias, a dramatic increase in one style can bias an index. The problem with equally weighted indices is that they are not rebalanced often and effectively. This lowers their investability.
- **Survivorship bias** is a big problem for hedge fund indices. Indices may drop funds with poor track records or that fail, causing an upward bias in reported values. Studies have shown that the bias can be as high as 1.5–3% per year. The degree of survivorship bias varies among the hedge fund strategies. It is lower for event-driven strategies and higher for hedged equity strategies.
- **Stale price bias** varies depending on the markets used by the hedge fund. If the fund operates in markets with infrequent trading, the usual issues of appraisal or infrequent pricing and the resulting understatement of volatility can arise. The evidence suggests this is not a large problem.
- **Backfill or inclusion bias** is a similar problem but arises from filling in missing past data. It tends to be directionally biased, as only managers who benefit from the missing data have an incentive to supply the data. It seems to be an issue with some indices.

MODULE QUIZ 30.4

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

1. Which of the following is a common problem encountered when evaluating the

data on hedge fund performance?

A. Misuse of the Sharpe ratio.
B. Overstated measures of risk.
C. Understated returns in the available universe of peer group managers.

MODULE 30.5: COMMODITIES AND MANAGED FUTURES

Video covering this content is available online.

COMMODITY INVESTING

LOS 30.m: Compare indirect and direct commodity investment.

CFA® Program Curriculum, Volume 5, page 45

Direct commodity investment entails either purchasing the actual commodities or gaining exposure via derivatives. **Indirect commodity investment** is the purchase of indirect claims (e.g., shares in a corporation) that deal in the commodity.

Direct investment gives more exposure, but cash investment in commodities can incur carrying costs. Indirect investment may be more convenient, but it may provide very little exposure to the commodity, especially if the company is hedging the risk itself.

The increase in the number of investable indices in commodities and their associated futures is indicative of the advantages of investing via derivatives. These indices also make investing in commodities available to smaller investors.

COMMODITIES AND INFLATION

LOS 30.n: Describe the principal roles suggested for commodities in a portfolio and explain why some commodity classes may provide a better hedge against inflation than others.

CFA® Program Curriculum, Volume 5, page 53

Commodities generally provide a diversification benefit to traditional portfolios. Some commodities also provide specific diversification and protection against unexpected increases in inflation. Two factors affect whether a commodity is a good hedge against unexpected inflation: *storability* and demand relative to *economic activity*.

Whether a commodity is *storable* is a primary determinant in its value providing a hedge against unexpected inflation. For example, the values of storable commodities such as industrial metals (e.g., zinc, aluminum, copper), are positively related to unexpected changes in inflation. That is, they tend to increase (decrease) in value with unexpected increases (decreases) in inflation. They have provided good diversification against unexpected inflation.

Another factor to consider with respect to inflation hedging capability is whether the commodity's demand is linked to economic activity. Those that enjoy a more or less constant demand regardless of the level of economic activity, for example, seem to provide little hedge against unexpected changes in inflation. Those commodities that are most affected by the level of economic activity tend to be better hedges.

Commodities

Commodities chiefly offer *diversification* to a portfolio of stocks and bonds. Correlations of commodity indices with stocks have been moderately positive and with bonds have been low and even slightly negative. Most commodity indices have a positive correlation with inflation. That is a benefit to the investor because they provide a hedge against unexpected inflation, while bonds are hurt by inflation.

The returns on commodities have generally been lower than stocks and bonds over the period 1996–2015, both on an absolute and risk-adjusted basis. The poor performance of the energy subgroup had a negative impact on the S&P GSCI over the time period shown due to the heavy weighting of energy related futures in the index. Figure 30.4 gives the statistics for 1996–2015.

Figure 30.4: Index Returns From 1996–2015

Stock, Bond, and Commodity Index Performance	S&P 500	Bloomberg Barclays US Aggregate[1]	S&P GSCI TR[2]
Annual return	8.51%	5.37%	–1.01%
Annual standard deviation	15.31%	3.47%	22.79%
Average return-to-volatility ratio[3]	0.56	1.55	–0.04
Correlation with commodity index	0.25	-0.01	1.0

1. Market capitalized weighted intermediate term index of US traded investment grade bonds which includes: Treasuries, government agency, MBS, corporate bonds, and some foreign.

2. S&P Goldman Sachs Commodity Index total return (long commodity futures with collateral invested at the risk free rate).

3. Risk-adjusted performance ratio of the mean return for the period divided by the standard deviation of return.

Figure 30.5 shows the role commodities played in a portfolio context over the 1996–2015 time periods.

Figure 30.5: Portfolio Returns From 1996–2015

Portfolios[1]	A	B	C	D
Annual return	7.26%	6.65%	7.92%	7.22%
Annual standard deviation	7.83%	7.91%	8.38%	8.50%
Average return-to-volatility ratio[2]	0.93	0.84	0.94	0.85

1. Portfolio A = 50% S&P 500 and 50% Bloomberg Barclays US Aggregate Bond Index, Portfolio B = 10% commodity index + 90% Portfolio A, Portfolio C = 25% alternative investments (hedge funds, private equity, CTA, real estate) + 75% Portfolio A, Portfolio D = 10% commodity index + 90% Portfolio C.

2. Risk-adjusted performance ratio of the mean return for the period divided by the standard deviation of return.

The results show that over the time period studied when commodities were added to a portfolio (Portfolios B and D) they underperformed US equity and bond markets both on an absolute and risk adjusted basis. Due to the low correlation of the returns of the S&P GSCI with the S&P 500 (0.25) and negative correlation with the Bloomberg Barclays US Government Bond Index (–0.10) we would expect to see diversification benefits with improving average return-to-volatility ratios but the results do not support those conclusions.

PROFESSOR'S NOTE

The overall conclusion in the CFA text is that commodities offer diversification benefits due to their low correlation with stocks and slightly negative correlation and bonds even though the results of the time period studied suggests otherwise.

Commodity markets have many indices for use as benchmarks. Most of them assume a futures-based strategy. For example, the Reuters/Jefferies Commodity Research Bureau (RJ/CRB) Index, the S&P Goldman Sachs Commodity Index (GSCI), and the Bloomberg Commodity Index (BCOM) represent returns associated with passive long positions in futures.

The indices include exposures to most types of commodities and are considered *investable*. They can vary widely, however, with respect to their purpose, composition, and method of weighting the classes. Given the zero-sum nature of futures, the indices cannot use a market-cap method of weighting. Two methods of weighting are 1) basing weights on world production of the underlying commodities and 2) basing weights on the perceived relative worldwide importance of the commodity. The various indices use either arithmetic or geometric averaging to calculate component returns.

MANAGED FUTURES

LOS 30.s: Describe trading strategies of managed futures programs and the role of managed futures in a portfolio.

CFA® Program Curriculum, Volume 5, page 85

Managed futures programs are typically run by **Commodity Pool Operators** (CPOs). CPOs can themselves be **commodity trading advisors** (CTAs) or will hire CTAs to actually manage all or part of the pool. In the United States, both must be registered with the U.S. Commodity Futures Trading Commission and the National Futures Association.

Managed futures (CTAs) are typically classified by style, the markets in which they specialize, or by strategy. Because they often seek performance in major markets, managed futures are sometimes thought of as a subset of global macro hedge funds that specialize in trading derivatives.

CTA strategies can be described as systematic or discretionary. CTAs that specialize in **systematic trading strategies** typically apply sets of rules to trade according to short-, intermediate-, and/or long-term trends. They may also trade counter to trends in a contrarian (against the trend) strategy.

A **discretionary trading strategy** is much as it sounds. The strategy is based on the discretion of the CTA (commodity trading advisor), in the same way that any active manager seeks value.

Managed futures can also be classified according to the markets in which they trade. They apply systematic or discretionary trading strategies in financial markets, currency markets, or diversified markets.

In *financial markets*, they trade in financial (i.e., interest rate) and currency futures, options, and forward contracts. Those that specialize in *currency markets* trade exclusively in currency derivatives. A fund that trades in *diversified markets* trades in all the financial derivatives markets described as well as commodity derivatives.

Role in the Portfolio

The primary benefit to managed futures is the diversification potential (i.e., improved average return-to-risk ratios) due to their low correlation (0.00) with a portfolio of stocks and bonds. Research has shown the performance of managed futures is investment-vehicle dependent. In particular, private funds seem to add value whereas publicly traded funds have performed less well, both stand-alone and in portfolios.

In selecting a CTA to include in the portfolio, the manager should consider risk. For example, even though CTAs often exhibit negative correlations with equities, correlations among CTAs themselves can range anywhere from significantly positive (i.e., close to 1.0) to only modestly positive. In addition, the beta that relates the performance of an individual CTA to a fund of CTAs can be a good indicator of future risk-adjusted performance. Just as equity beta relates the volatility (risk) of an individual equity security or portfolio to the overall equity market, the CTA beta measures the risk of the individual CTA relative to a fund of CTAs.

Managed Futures

Managed futures are usually considered a category of hedge funds and are usually compared to stocks and bonds, but their record has been similar to that of hedge funds. Over the period 1996–2015, the equal-weighted index of separately managed accounts (CISDM CTA EW) had a return, standard deviation, and average return-to-volatility ratio equal to 7.2%, 8.5%, and 0.85, respectively, which is about the same as stocks but with a better average return-to-volatility ratio. They also had a higher return than bonds but with a lower average return-to-volatility ratio.

During the major equity market collapse of 2008 the CISDM CTA EW Index far outperformed all other asset classes studied including stocks and bonds. During that time period the CISDM CTA EW index return was 21.8% with a standard deviation of 10.6% compared to the S&P 500 return of –37.0% and standard deviation of 21.0% while the Bloomberg Barclays US Aggregate Bond Index return was 5.2% with a standard deviation of 6.1%.

For the 1996–2015 period, a portfolio comprising 10% CISM CTA EW Index and equal weights S&P 500 and Bloomberg Barclays US Aggregate Bond Index, outperformed a similar portfolio comprised of equal weights S&P 500 and bond index on an absolute and risk adjusted basis. Likewise, when adding 10% CISM CTA EW Index to a

portfolio constructed of equal weights stocks and bonds plus 25% alternative investments (hedge funds, commodities, private equity, and real estate), this outperformed a similar portfolio constructed of stocks, bonds, and alternative investments.

Note that actively managed separate accounts are those where the managers seek to take advantage of mispricing opportunities. There is some evidence that short-term momentum and other strategies can produce excess returns. Managed futures seem to provide unique returns and diversification benefits. This is made evident from the zero correlation (0.00) between the index of separately managed accounts and a 50/50 stock/bond fund.

Managed futures have several investable benchmarks. Some common benchmarks, such as the Mount Lucas Management Index (MLMI), replicate the return to a *mechanical, trend-following strategy*. The strategies usually include utilizing both long and short positions using trading rules based upon changes in technical indicators. Other benchmarks, such as the BarclayHedge and CISDM CTA, are indices based upon *peer-group commodity trading advisors (CTAs) using equal-weighted* returns from databases of separately managed accounts. The Barclay Traders indices are benchmarks based upon the level of discretionary management and the underlying market, as well as systematic strategies.

MODULE QUIZ 30.5

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

1. One likely result of a "high water mark" in an incentive compensation plan is to:
   A. reduce the compensation of the manager.
   B. incent the manager to work harder after *significant* declines in fund value.
   C. require investors to maintain their investment in the fund for longer periods.

MODULE 30.6: DISTRESSED SECURITIES

Video covering this content is available online.

LOS 30.t: Describe strategies and risks associated with investing in distressed securities.

CFA® Program Curriculum, Volume 5, page 94

The major types of **distressed securities investing strategies** are long-only value investing, distressed debt arbitrage, and private equity.

Long-only value investing basically tries to find opportunities where the prospects will improve and, of course, tries to find them before other investors do. *High-yield investing* is buying publicly traded, below-investment grade debt. *Orphan equities investing* is the purchase of the equities of firms emerging from reorganization. The reason these present a market opportunity is that some investors cannot participate in this market and many do not wish to do the necessary due diligence.

Distressed debt arbitrage is the purchasing of a company's distressed debt while short selling the company's equity. The investment can earn a return in two ways: 1) if the firm's condition declines, the debt and equity will both fall in value; the equity should

decline more in value, though, because debt has seniority; and 2) if the company's prospects improve, because of the priority of interest over dividends, the returns to bondholders should be greater than that of equity holders, including dividends paid on the short position. The possibility of returns from the two events provides a good market opportunity.

Private equity is an "active" approach where the investor acquires positions in the distressed company, and the investment gives some measure of control. The investor can then influence and assist the company as well as acquire more ownership in the process of any reorganization. By providing services and obtaining a strategic position, the investors create their own opportunities. *Vulture funds*, which specialize in purchasing undervalued distressed securities, engage in this type of strategy.

CONCERNS OF DISTRESSED SECURITIES INVESTING

LOS 30.u: Explain event risk, market liquidity risk, market risk, and "J-factor risk" in relation to investing in distressed securities.

CFA® Program Curriculum, Volume 5, page 99

Distressed securities can have event risk, market liquidity risk, market risk, J-factor risk, and other types of risk.

- **Event risk** refers to the fact that the return on a particular investment within this class typically depends on an event for the particular company. Because these events are usually unrelated to the economy, they can provide diversification benefits.
- **Market liquidity risk** refers to low liquidity and the fact that there can be cyclical supply and demand for these investments.
- **Market risk** from macroeconomic changes is usually less important than the first two types mentioned.
- **J-factor risk** refers to the role that courts and judges can play in the return, and this involves an unpredictable human element. By anticipating the bankruptcy court judge's rulings (the J-factor), the distressed security investor knows whether to purchase the distressed company's debt or equity.

Distressed Securities

Distressed security returns have had a relatively high average return but a large negative skew, so the comparisons using averages and Sharpe ratios can or average return-to-volatility ratios be misleading. Based on comparisons of the average return and average return-to-volatility ratio, the HFRX Distressed/Restructuring Index for the 1995–2015 period underperformed both stocks and bonds, both on an absolute and on a risk-adjusted basis. The returns are often event-driven, so they are uncorrelated with the overall stock market.

Distressed securities funds are often considered a hedge fund subgroup. Most of the index providers for hedge funds have a sub-index for distressed securities. Benchmarks in this area have the same characteristics as long-only hedge fund benchmarks.

MODULE QUIZ 30.6

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

1. Purchasing of a company's distressed debt while selling the company's equity short is called:
   A. market neutral.
   B. preferred arbitrage.
   C. distressed debt arbitrage.
2. The strategies of convertible arbitrage, equity market neutral, and fixed-income arbitrage are *most likely* categories of which alternative investment class?
   A. Hedge funds.
   B. Commodities.
   C. Distressed security.

KEY CONCEPTS

LOS 30.a

Common features of alternative investments include:

- Low liquidity.
- Good diversification potential.
- High due diligence costs.
- Difficult to value.
- Limited access to information.

Alternative investments can provide:

- Exposure to asset classes that stocks and bonds cannot provide.
- Exposure to special investment strategies (e.g., hedge and venture capital funds).
- Special strategies and unique asset classes (e.g., funds that invest in private equity and distressed securities).

LOS 30.b

- Assess the market opportunity offered. Are there exploitable inefficiencies in the market for the type of investments in which the manager specializes?
- Assess the investment process. Does the manager seem to have a competitive edge over others in that market?
- Assess the organization of the manager and its operations. Is it stable and well run? What has been the staff turnover?
- Assess the people by meeting with them and assessing their character.
- Assess the terms and structure (amount and time period) of the investment.
- Assess the service providers (i.e., lawyers, brokers, ancillary staff, etc.) by investigating the outside firms that support the manager's business.
- Review documents such as the prospectus or private-placement memorandum and the audits.

LOS 30.c

- Taxes. Tax issues can be unique to the individual because the characteristics of private-wealth clients and their investments can vary greatly. For individuals, there can be partnerships, trusts, and other situations that make tax issues complex.
- Suitability. Time horizons and wealth of individuals can vary a great deal. With individuals, there is also the emotional aspect, like preferences for, or aversion to, certain types of assets.
- Communication. Communication with the client helps determine suitability of recommendations and the overall management process.
- Decision risk. Decision risk is the risk of irrationally changing a strategy. For example, the adviser must be prepared to deal with a client who wants to get out

of a position that has just declined in value.

- Concentrated positions. Wealthy individuals' portfolios frequently contain large positions in closely held companies. Such ownership should be considered with the overall allocation to alternative investments, like private equity.

LOS 30.d

Real estate can be broken down into direct and indirect investment. Examples of direct investment in real estate include ownership of residences, commercial real estate, or agricultural land, and it involves direct management of the assets. Indirect real estate investments include:

- Companies that develop and manage real estate.
- Real estate investment trusts (REITs).
- Commingled real estate funds (CREFs).
- Separately managed accounts.
- Infrastructure funds.

Private equity subgroups include start-up companies, middle-market private companies, and private investment in public entities. A direct investment in private equity is when the investor purchases a claim directly from the firm (e.g., preferred shares of stock). Indirect investment is usually done through private equity funds, which include venture capital (VC) and buyout funds.

Commodity investments can also be grouped into direct and indirect subgroups. Direct investment is either through the purchase of the physical commodity or the purchase of derivatives (e.g., futures) on those assets. Indirect investment in commodities is usually done through investment in companies whose principal business is associated with a commodity (e.g., investing in a metal via ownership of shares in a mining company). Many commodities have a low correlation with stocks and bonds and a positive correlation with inflation.

Managed futures funds share many characteristics with hedge funds. The primary feature that distinguishes managed futures from hedge funds is the difference in the assets they hold. Managed futures funds tend to trade only in derivatives markets, while hedge funds tend to trade in spot markets and use futures for hedging. Also, managed futures funds generally take positions based on indices, while hedge funds tend to focus more on individual asset price anomalies. In other words, hedge funds tend to have more of a micro focus, while managed futures tend to have a macro focus.

Buyout funds are the largest segment of the private equity market. Middle-market buyout funds concentrate on divisions spun off from larger, publicly traded corporations and private companies that, due to their relatively small size, cannot efficiently obtain capital. Mega-cap buyout funds concentrate on taking publicly traded firms private. In either case, the target represents an investment opportunity through the identification of under-valued assets, the ability to restructure the debt of the firm, and/or improved (i.e., more efficient) management and operations.

Infrastructure funds specialize in purchasing public infrastructure assets (e.g., airports, toll roads) from cities, states, and municipalities. Distressed securities are securities of companies that are in or near bankruptcy. As with managed futures, analysts often

consider distressed securities to be part of the hedge fund class of alternative investments. It may also be part of the private equity class.

LOS 30.e

Real Estate: *Benchmarks*: NCREIF, NAREIT. *Construction:* NCREIF is value weighted, NAREIT is cap weighted. *Biases:* Measured volatility is downward biased. The values are obtained periodically (annually).

Private Equity: *Benchmarks:* Provided by Cambridge Associates, Preqin, and LPX. *Construction:* Constructed for buyout and venture capital. Value depends upon events. Often construct custom benchmarks. *Biases:* Repricing occurs infrequently, which results in dated values.

Commodities: *Benchmarks:* S&P GSCI, BCOM, and RJ/CRB Index. *Construction:* Assume a futures-based strategy. Most types considered investable. *Biases:* Indices vary widely with respect to purpose, composition, and method of weighting.

Managed Futures: *Benchmarks:* MLMI, CTA Indices include the CISDM, BarclayHedge, and Barclay Traders. *Construction:* MLMI replicates the return to a trend-following strategy. CTA Indices use equal-weighted returns. *Biases:* Requires special weighting scheme.

Distressed Securities: *Benchmarks:* Characteristics similar to long-only hedge fund benchmarks. *Construction:* Weighting either equally weighted or based upon assets under management. Selection criteria can vary. *Biases:* Self-reporting, backfill or inclusion bias, popularity bias, and survivorship bias.

LOS 30.f

Over the 1996–2015 time period, adding managed futures to a portfolio of stocks, bonds, and other alternative investments (commodities, private equity, real estate, hedge funds) increased the return and the average return-to-volatility ratio. During the equity market collapse of 2008, managed futures far outperformed all other asset classes studied. Private equity provided return enhancement over the long term. Hedge funds have been found to provide both diversification and return enhancement.

LOS 30.g

Advantages of direct equity real estate investing:

- Many expenses are tax deductible.
- Ability to use more leverage than most other investments.
- Provides more control than stock investing.
- Ability to diversify geographically.

Disadvantages of direct equity real estate investing:

- Lack of divisibility means a single investment may be a large part of the investor’s portfolio.
- High information cost, high commissions, high operating and maintenance costs, and hands-on management requirements.
- Special geographical risks, such as neighborhood deterioration and the political risk of changing tax codes.

LOS 30.h

Venture capital issuers include formative-stage companies and expansion-stage companies.

Venture capital buyers include angel investors, venture capitalists, and large companies (i.e., strategic partners).

A private company typically goes through the following stages.

- The early stage consists of three phases:
  - Seed.
  - Startup.
  - First stage.
- The later stage occurs after revenue has started and funds are needed to expand sales.
- The exit stage is the time when the venture capitalist realizes the value of the investment. It can occur through a merger, an acquisition, or an IPO.

LOS 30.i

In contrast to venture capital funds, buyout funds usually have:

- A higher level of leverage.
- Earlier and steadier cash flows.
- Less error in the measurement of returns.
- Less frequent losses.
- Less upside potential.

These differences are the natural consequence of buyout funds purchasing entities in later stages of development or even established companies where the risks are lower.

LOS 30.j

Convertible preferred stock is a good vehicle for direct venture capital investment. Preferred stock has first claim on company cash flow while operating and in bankruptcy. The conversion feature provides upside potential. Later financing rounds may have priority and be more valuable.

LOS 30.k

Private equity funds usually take the form of limited partnerships or limited liability companies (LLCs). These legal structures limit the loss to investors to the initial investment and avoid corporate double taxation. For limited partnerships, the sponsor is called the general partner; for LLCs, the sponsor is called the managing director.

The time line starts with the sponsor getting commitments from investors at the beginning of the fund and then giving “capital calls” over the first five years (typically), which are referred to as the commitment period. The expected life of these funds is 7–10 years, and there is often an option to extend the life up to five more years.

The sponsor can receive compensation in several ways. First, the sponsor has capital invested that earns a return. This is usually required as it helps keep the sponsor’s

interests in line with those of the limited partners. As a manager, the sponsor typically gets a management fee of around 2% and an incentive fee of about 20% of the profits.

LOS 30.l

Any strategy for private equity investment must address the following issues:

- Low liquidity: Portfolio allocation to this class should be 5% or less with a plan to keep the money invested for 7–10 years.
- Diversification through a number of positions: Only very large portfolios have sufficient funds to support diversified, direct PE investing. Other portfolios can consider PE funds.
- Diversification strategy: Know how the proposed private equity investment relates to the overall portfolio.
- Plans for meeting capital calls: Committed funds are only called as needed, and the investor needs to be prepared to meet the calls.

LOS 30.m

Direct commodity investment entails either purchasing the actual commodities or gaining exposure via derivatives. Indirect commodity investment is the purchase of indirect claims (e.g., shares in a corporation) that deal in the commodity.

Direct investment gives more exposure, but cash investment in commodities can incur carrying costs. Indirect investment may be more convenient, but it may provide very little exposure to the commodity, especially if the company is hedging the risk itself.

The increase in the number of investable indices in commodities and their associated futures is indicative of the advantages of investing via derivatives. These indices also make investing in commodities available to smaller investors.

LOS 30.n

It appears that whether a commodity is *storable* is a primary determinant in its value providing a hedge against unexpected inflation. For example, the values of storable commodities such as industrial metals, are positively related to unexpected changes in inflation. That is, they tend to increase (decrease) in value with unexpected increases (decreases) in inflation.

Another factor to consider with respect to inflation hedging capability is whether the commodity's demand is linked to economic activity. Those that enjoy a more or less constant demand regardless of the level of economic activity, for example, seem to provide little hedge against unexpected changes in inflation.

LOS 30.o

Hedge funds are classified in various ways by different sources. Because hedge funds are a "style-based" asset class, strategies can determine the subgroups. The following is a list of nine of the more familiar hedge fund strategies.

1. Convertible arbitrage commonly involves buying undervalued convertible bonds, preferred stock, or warrants, while shorting the underlying stock to create a hedge.
2. Distressed securities investments can be made in both debt and equity; because the securities are already distressed, shorting can be difficult or impossible.

3. Emerging markets generally only permit long positions, and often there are no derivatives to hedge the investments.
4. Equity market neutral (pairs trading) combines long and short positions in under-valued and over-valued securities, respectively, to eliminate systematic risk while capitalizing on mispricing.
5. Fixed-income arbitrage involves taking long and short positions in fixed-income instruments based upon expected changes in the yield curve and/or credit spreads.
6. Fund-of-funds describes a hedge fund that invests in many hedge funds to get diversification; there is a fee paid to the manager of the fund-of-funds, as well as to the managers of the funds in the fund-of-funds.
7. Global macro strategies take positions in major financial and nonfinancial markets through various means (e.g., derivatives and currencies), focusing on an entire group or area of investment instead of individual securities.
8. Hedged equity strategies (i.e., equity long-short) represent the largest hedge fund classification in terms of assets under management. These strategies take long and short positions in under- and over-valued securities, respectively. Hedged equity strategies do not focus on balancing the positions to eliminate systematic risk and can range from net long to net short.
9. Merger arbitrage (i.e., deal arbitrage) focuses on returns from mergers, spin-offs, takeovers, and so on.

LOS 30.p

The most common compensation structure of a hedge fund consists of an assets-under-management (AUM) fee of about 1% to 2% and an incentive fee of 20% of profits.

High water marks (HWMs) are typically employed to avoid incentive fee double-dipping. For example, each quarter the increase in value over the previous quarter is determined, and investors pay incentive and management fees accordingly. If the value of the fund is lower than the previous quarter, however, the manager receives only the management fee, and the previous high value of the fund is established as a HWM.

A lock-up period limits withdrawals by requiring a minimum investment period (e.g., one to three years), preventing sudden withdrawals that could force the manager to have to unwind positions.

Incentive fees are paid to encourage the manager to earn ever higher profits. There is some controversy concerning incentive fees because the manager should have goals other than simply earning a gross return.

LOS 30.q

A fund-of-funds (FOF) consists of approximately 10 to 30 hedge funds. The point is to achieve diversification, but the extra layer of management means an extra layer of fees. Often, an FOF offers more liquidity for the investor, but the cost is cash drag. Despite the drawbacks, FOF are *good entry-level investments* because the manager of the FOF exercises due diligence.

An FOF may serve as a better *benchmark* because it suffers from less survivorship bias.

An FOF can suffer from style drift. Often two FOF that are classified as having the same style have a low correlation of returns.

FOF returns have been more highly correlated with equity markets than those of individual hedge funds. This characteristic has important implications for their use as a diversifier in an equity portfolio (i.e., as correlation increases, diversification decreases).

LOS 30.r

One special issue is that some claim that hedge funds are absolute-return vehicles, which means that no direct benchmark exists. The question (and problem) is how to determine alpha. Conventions to consider in hedge fund performance evaluation are the impact of performance fees and lock-up periods, the age of funds, and the size of funds.

- Funds with longer lock-up periods tend to produce higher returns than those with shorter lock-up periods.
- Younger funds tend to outperform older funds.
- Large funds underperform small funds.

By convention, hedge funds report monthly returns by comparing the ending value of the fund to the beginning value. These simply-calculated monthly returns are then compounded to arrive at annual returns. The convention for dealing with leverage is to treat an asset as if it were fully paid for. When derivatives are included, the same principle of deleveraging is applied.

Using standard deviation to measure the risk of a hedge fund can produce misleading results. Hedge fund returns are usually skewed with significant leptokurtosis (fat tails), so standard deviation fails to measure the true risk of the distribution.

Downside deviation is a popular hedge fund risk measure, as it measures only the dispersion of returns below some specified threshold return. The most common formula for downside deviation is:

$$\text{downside deviation} = \sqrt{\frac{\sum_{1}^{n}\left[\min(\text{return}_t - \text{threshold},\ 0)^2\right]}{n-1}}$$

The threshold return in the formula is usually either zero or the risk-free rate of return. Annual hedge fund Sharpe ratios are calculated using annualized measures as:

$$\text{Sharpe}_{\text{HF}} = \frac{\text{annualized return} - \text{annualized risk-free rate}}{\text{annualized standard deviation}}$$

The Sharpe ratio has the following limitations with respect to hedge fund evaluation:

- *Time dependency*. Annualized Sharpe ratios are biased upwards by a factor of the square root of time. The ratio can be further overstated by compounding the sub-period returns while using a multiplicative approach to annualize the risk.
- *Assumes normality*. Measures that incorporate standard deviation are inappropriate for skewed return distributions.
- *Assumes liquidity*. Illiquid holdings have upward-biased Sharpe ratios (i.e., downward-biased standard deviations).
- *Assumes uncorrelated returns*. Returns correlated across time will artificially lower the standard deviation.

- *Stand-alone measure*. Does not automatically consider diversification effects.

LOS 30.s

CTAs that specialize in systematic trading strategies typically apply sets of rules to trade according to or contrary to short-, intermediate-, and/or long-term trends. A discretionary CTA trading strategy generates returns on the managers' trading expertise, much like any active portfolio manager. CTAs can also be classified according to whether they trade in financial markets, currency markets, or diversified markets.

The primary benefit to managed futures is increased risk-adjusted performance and diversification, although the performance seems to be related to specific strategies and time periods. Private funds seem to add value; publicly traded funds have performed poorly both stand-alone and in portfolios. Even though CTAs often exhibit negative correlations with equities, correlations among CTAs themselves can range from significantly to modestly positive. The CTA beta (relative to other CTAs) can be a good indicator of future risk-adjusted performance.

LOS 30.t

- Long-only value investing attempts to find opportunities where the prospects will improve tries to find them before other investors do. *High-yield investing* is buying publicly traded, below-investment grade debt. *Orphan equities investing* is the purchase of the equities of firms emerging from reorganization.
- Distressed debt arbitrage is the purchasing of a company's distressed debt while short selling the company's equity. The investment can earn a return in two ways:
  - If the firm's condition declines, the debt and equity will both fall in value, but equity should decline more in value.
  - If the company's prospects improve, the returns to bondholders should be greater than that of equity holders.
- Private equity is an "active" approach where the investor acquires positions in the distressed company, and the investment gives some measure of control. The investor can then influence the company as well as acquire more ownership in the process of any reorganization.

LOS 30.u

Distressed securities can have several types of risk:

- Event risk refers to the fact that the return on a particular investment within this class typically depends on an event for the particular company. Because these events are usually unrelated to the economy, they can provide diversification benefits.
- Market liquidity risk refers to low liquidity and the fact that there can be cyclical supply and demand for these investments.
- Market risk from macroeconomic changes is usually less important than the first two types mentioned.
- J-factor risk refers to the unpredictable nature of bankruptcy court judges' rulings.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 30.1

1. **C** Return enhancement is certainly not a special issue. All the other choices are issues of concern for the private wealth client but generally not issues for the institutional client. (LOS 30.c)

Module Quiz 30.2

1. **B** Smoothing occurs when only infrequent pricing is available or used to calculate return and risk measures. The infrequent data points will appear to indicate low volatility and lead to a downward (not overstated) calculation for standard deviation. Standard deviation is a measure of standalone risk (i.e., before considering diversification and the impact on portfolio risk).

   Smoothed data will also appear uncorrelated (correlation closer to zero) with regularly priced traditional asset classes. Most risky assets have some degree of positive correlation (above zero) with each other. So, including an alternative asset class with smoothed data and apparently lower correlation will overstate diversification benefit.

   Any strategy using exchange-traded derivatives is going to have readily available pricing data and is not likely to be subject to smoothing. (LOS 30.g)

2. **C** High loan-to-value ratios are common in direct purchase of real estate properties. Note that indirect investing may or may not also use leverage, but when you examine the other statements, the other statements are even less true.

   The transaction costs to directly buy and sell the properties are high and liquidity is low. Indirect investing in real estate through large funds or partnerships is more likely to allow access to managers who negotiate lower transaction costs and may allow periodic withdrawals (liquidity). Indirect investing also includes REITs which are liquid shares of stock with stock transaction costs that are relatively low. (LOS 30.g)

Module Quiz 30.3

1. **A** Start-up companies, middle-market private companies, and private investment in public entities represent three subgroups of private equity. Middle-market private companies typically have revenues, as do public entities. The start-up companies are usually in a pre-revenue phase. (LOS 30.e)

2. **B** Angel investors are usually accredited investors and the first outside investors after the family and friends of the company founders. (LOS 30.h)

3. **B** Managed futures is an active management strategy. It can be quite aggressive and could be used by hedge funds. It is the only choice that might reasonably

target high return as an objective, though there is no guarantee of success. In contrast, real estate and commodities are generally used to provide diversification. Commodity investing typically uses *long only* futures positions and is an active management strategy unrelated to *managed* futures. (LOS 30.f)

Module Quiz 30.4

1. **A** One of the most obvious problems in using the Sharpe ratio is that returns often exhibit skew, making standard deviation (used in the Sharpe ratio) inappropriate.

   Another problem is that the reported risk is often *understated*, not overstated. Among other things, managers may use calculations that are multiplicative for risk but compounded for return, biasing up the reported return in relation to *understating the reported risk*.

   Return data is generally based on self-reporting and better managers are more likely to report, which *overstates return data* of the peer group. (LOS 30.r)

Module Quiz 30.5

1. **A** If a fund declines in value, a high water mark precludes the manager from earning an incentive fee until the fund recovers to its previous high, preventing the manager from earning a second incentive fee just to recover lost value. The intent is to protect the investor and it will limit the manager's compensation, compared to a fund without a high water mark.

   An unintended consequence of the high water mark is it can disincentivize the manager of a fund that has experienced a significant loss in value. The manager earns no incentive fee on the recovery in value. At the extreme, the manager could close the fund and start a new fund on which the manager could immediately start earning an incentive fee on any increase in value.

   Lock-up periods (not high water marks) require the investor to make a long-term commitment to the fund by preventing withdrawals, for specified time period. (LOS 30.p)

Module Quiz 30.6

1. **C** This is the definition of distressed debt arbitrage. (LOS 30.u)
2. **A** All three terms can refer to some of the many strategies used by hedge funds. Only the fixed-income arbitrage might also be used by distressed security investors. In fact distressed security may be considered a sub-category of hedge funds. The best answer choice is all *three* are forms of hedge fund strategies. (LOS 30.u)

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[1]The terminology used throughout this topic review is industry convention as presented in Reading 30 of the 2019 Level III CFA exam curriculum. Empirical results are referenced in that reading as well.

TOPIC ASSESSMENT: ALTERNATIVE INVESTMENTS PORTFOLIO MANAGEMENT

Use the following information for Questions 1 through 6.

Suzanne Harlan has a large, well-diversified stock and bond portfolio. She wants to try some alternative investments and has contracted with Laurence Philips, principal of Philips Finance, to help assemble a new portfolio.

Before agreeing to make recommendations for Harlan, Philips wants to determine whether she is a good candidate for alternative investments. He gives her a standard questionnaire that asks open-ended questions of all potential clients. Here are some of Harlan's comments:

- "I'm interested in higher returns. I'm not afraid of risk, and I'm investing this money for the benefit of my eventual heirs."
- "I pay several million dollars in taxes every year, and I want any additional investments to be tax-friendly."
- "While I expect risk on an individual-investment basis, I'd like to further diversify my portfolio and reduce overall risk."
- "I pay a lot of attention to expense and return data from my investments and track their performance closely."
- "I'm 65 years old and in excellent health."

After reading Harlan's responses and learning that she is a fairly sophisticated investor, Philips agrees to take her on as a client. Harlan has a lot of experience with investments and has some ideas what she'd like to do. She brings Philips the following ideas:

- "I have a colleague in the lumber business who says the furniture market is booming, and demand should increase in the year ahead. This will lead to increasing lumber prices and the price of lumber futures contracts."
- "Hedge funds are earning excellent returns, and I expect them to continue doing so. However, other investors have told me that the difficulty lies in assessing the quality of the funds, because they are not well regulated. So I'm interested in purchasing a fund-of-funds, so I can diversify my risk while potentially sharing in some outsized returns."
- "I already own a couple of REITs, but they represent a very small portion of my assets, and I'd like to increase my exposure to real estate. I've heard about pooled real estate funds, and I'm interested in one of those funds."
- "My neighbors founded Kelly Tool and Die, a machine-tool business, 20 years ago. I have contacts in the manufacturing business overseas who would be interested in acquiring Kelly's assets. My Asian colleagues are willing to pay about 60% of book value for the assets, and my neighbors are willing to sell me the company for about 50% of the book value of its assets."

Harlan then tells Philips that it is imperative that the returns of any investments he recommends must be in some way comparable to a benchmark.

Philips is not excited about the commodity idea and does not like funds- of- funds. However, he does know of several managers of individual hedge funds that might interest Harlan. He talks her out of the fund-of-funds idea and suggests she put her money in the Stillman Fund, which is run by one of his college friends. Fund manager Mark Stillman concentrates on spin-offs, generally buying the spun-off company and shorting the parent company.

1. Assuming that Philips accepts Harlan's ideas as being accurate, which pair of her proposed investments represent the *best* choice for her goal of increasing return and of diversification in her portfolio? Consider each goal separately.

Endowment Fund	Investment Company
A. Own assets	Assets pooled from investors
B. Assets pooled from investors	Assets pooled from investors
C. Own assets	Own assets

2. Based on her investment suggestions and survey answers, Harlan is *least* concerned with:
   A. inflation.
   B. liquidity.
   C. volatility.

3. In his attempt to talk Harlan out of investing in a fund-of-funds, Philips addressed the advantages of investing in individual funds. Which of the following is his *most* compelling argument?
   A. The lower expenses of individual funds.
   B. The lack of benchmarks for a fund-of-funds.
   C. The likelihood of style drift in a fund-of-funds.

4. The Stillman fund uses which strategy?
   A. Hedged equity.
   B. Relative value.
   C. Merger arbitrage.

5. Which of Harlan's responses is *most likely* to make Philips consider her a bad candidate for alternative investments?
   A. "I'm interested in higher returns. I'm not afraid of risk, and I'm investing this money for the benefit of my eventual heirs."
   B. "I pay several million dollars in taxes every year, and I want any additional investments to be tax-friendly."
   C. "I pay a lot of attention to expense and return data from my investments and track their performance closely."

6. If Harlan is truly concerned about benchmarks, she should avoid which of her suggested investments?
   A. Hedge funds.

B. Kelly Tool and Die.
C. None of them, benchmarks are available for all asset classes.

TOPIC ASSESSMENT ANSWERS: ALTERNATIVE INVESTMENTS PORTFOLIO MANAGEMENT

1. **A** Harlan has a specific view that lumber prices will increase, so purchasing the contracts will enhance return if she is correct. In contrast real estate is generally seen as primarily a way to diversify portfolio risk.

   The use of a fund-of-funds would provide diversified exposure to hedge funds and some portfolio diversification. In contrast, Kelly Tool and Die has high security specific risk and is less likely to provide diversification. Given Harlan's view that it is undervalued it could also be a return enhancer, but it was not offered as a choice for that goal. (Study Session 15, Module 30.4, LOS 30.r)

2. **B** While Harlan's comment about being willing to accept risk may suggest she is not concerned about volatility, she is most definitely concerned on a portfolio level, as evidenced by her desire to use alternative assets for diversification purposes. Nothing in the information presented offers any hint about Harlan's concerns about inflation. However, Harlan's stated desire to build wealth for her heirs suggests liquidity is not a concern. (Study Session 15, Module 30.1, LOS 30.a)

3. **A** The biggest disadvantage of the fund-of-funds is the extra layer of fees. Style drift could be an issue for both an individual hedge fund and a fund-of-funds, much as it is with traditional mutual funds. The issue with benchmarks is probably more troubling for individual funds than for funds-of-funds. (Study Session 15, Module 30.4, LOS 30.q)

4. **C** Merger arbitrage funds usually focus on mergers, spin-offs, or takeovers, buying one company in the transaction and shorting the other. (Study Session 15, Module 30.4, LOS 30.o)

5. **C** Alternative assets can provide high returns, and a high risk tolerance and low need for liquidity are positives for investors in alternative asset classes. And while many alternative assets are risky, they can provide a substantial diversification benefit when combined with mainstream investments. Many alternative investments are tax-friendly. However, most of the investments considered for this exam are not easy to value, and difficult to track closely over short periods of time. (Study Session 15, Module 30.1, LOS 30.a)

6. **C** Benchmarks are available for commodities, real estate, private equity, and hedge funds, though not all of them are easy to interpret. (Study Session 15, Modules 30.2, 30.3, 30.4, 30.5, LOS 30.e)

The following is a review of the Risk Management principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #31.

READING 31: RISK MANAGEMENT

Study Session 16

EXAM FOCUS

Risk management is a key component of investment management. Without risk, reward is unlikely; too much risk, failure looms. Be able to compare an enterprise risk management (ERM) system to a decentralized system of risk management as well as evaluate an existing ERM system. Value at risk (VaR) is an important topic. Be able to calculate VaR using different methods, know the pros and cons of various methods, and discuss other tools to measure or manage risk (including credit risk).

The focus of this material is on an overall organization. How does an investment firm or other organization manage risk?

MODULE 31.1: RISK MANAGEMENT

Video covering this content is available online.

LOS 31.a: Discuss features of the risk management process, risk governance, risk reduction, and an enterprise risk management system.

CFA® Program Curriculum, Volume 5, page 134

Investment managers should take necessary risks and those where they have information or another advantage in order to generate return. Other risks should be reduced, avoided, or completely hedged. **Risk reduction** refers to recognizing and reducing, eliminating, or avoiding those unnecessary risks.

The **risk management** process requires:

1. Top level management of the organization setting policies and procedures for managing risk.
2. Defining risk tolerance to various risks in terms of what the organization is willing and able to bear. For some risks tolerance will be high, for others it will be low.
3. Identifying risks faced by the organization. Those risks can be grouped as *financial* and *nonfinancial risks*. This will require building and maintaining investment databases for both types of risk.
4. Measuring the current levels of risk.
5. Adjusting the levels of risk—upward where the firm has an advantage and seeks to generate return to exploit an advantage, downward in other cases. As part of adjusting risk levels the firm must:

- Execute transactions to change the level of risk using derivatives or other instruments.
- Identify the most appropriate transaction for any given objective.
- Consider the cost of any transaction.
- Execute each transaction.

The risk management process is ongoing, data and analysis must be continuously updated. Once a risk to the firm has been identified, it may be necessary to determine appropriate models to quantify the risk and or evaluate possible ways to adjust the risk. If a firm faces risk in the value of option positions, the firm must select appropriate option pricing models, quantify needed inputs, and consider various approaches to modifying the option position used. For example, the firm could use dynamic hedging or take offsetting option positions in exchange traded or OTC options. The appropriate transactions must be executed and the risk measurement and management process must begin again.

Risk governance is a part of the overall *corporate governance system* and refers to the overall process of developing and putting a risk management system into use. The system must specify between centralized and decentralized approaches, reporting methods, methodologies to be used, and infrastructure needs. High quality risk governance will be 1) transparent, 2) establish clear accountability, 3) cost efficient in the use of resources, 4) and effective in achieving desired outcomes.

Senior management is responsible for the overall system and must determine whether the system will be **decentralized** or **centralized**.

- A *decentralized* risk governance system places responsibility for execution within each unit of the organization. It has the benefit of putting risk management in the hands of those closest to each part of the organization.
- The *centralized* system [also called an **enterprise risk management** (ERM) system] places execution within one central unit of the organization. It provides a better view of how the risk of each unit affects the overall risk borne by the firm (i.e., individual risks are less than perfectly correlated, so the risk of the firm is less than the sum of the individual unit risks). For example, individual units might take offsetting positions in global equity markets, and the offsetting effects of the trades can only be seen from the perspective of upper management. In addition, a centralized system locates responsibility closer to senior management who bear ultimate responsibility. Management must consider each risk in isolation but also the overall impact on the firm. The centralized system will offer economies of scale.

LOS 31.b: Evaluate strengths and weaknesses of a company's risk management process.

LOS 31.c: Describe steps in an effective enterprise risk management system.

CFA® Program Curriculum, Volume 5, page 138 and 140

In either the decentralized or centralized approach, senior management must find a way to assess the overall impact of risk on the organization. Those who measure and report

on risk levels must be independent of those who trade and take risk in the organization. The **back office**, which is responsible for processing transactions, record keeping, and compliance, must be independent from the **front office**, which generates transactions and sales in order to provide a check on the activities of the front office. The back office must also interact with third parties, such as custodians and trading partners, to verify all transactions are accounted for and reported correctly.

An effective system will:

- Identify each risk factor to which the company has exposure.
- Quantify the factor in measurable terms.
- Include each risk in a single aggregate measure of firm-wide risk. VaR will be the most commonly used tool.
- Identify how each risk contributes to the overall risk of the firm. This is an advantage of VaR.
- Systematically report the risks and support an allocation of capital and risk to the various business units of the firm.
- Monitor compliance with the allocated limits of capital and risk.

Risk management will involve costs but is essential. Regardless of whether the approach is centralized or decentralized, the system must centralize the data collection and storage used in the process in order to be technologically efficient.

EVALUATING RISK

LOS 31.d: Evaluate a company's or a portfolio's exposures to financial and nonfinancial risk factors.

CFA® Program Curriculum, Volume 5, page 140

A company faces both **financial** and **nonfinancial risks**. Financial risks arise from events external to the company and in the financial markets. Financial risks include:

- **Market risk** is related to changes in interest rates, exchange rates, equity prices, commodity prices, and so on. Each of these risks can be tied to changes in supply and demand in particular markets. Market risk is frequently the largest component of risk.

  It may be appropriate to measure market risk in terms of changing market value. In the case of defined benefit pension plans and other entities with definable liabilities, an asset liability approach (ALM) to measuring surplus may be required.
- **Credit risk** is frequently the second largest financial risk. It is defined here as the risk of loss caused by a counterparty's or debtor's failure to make a promised payment. Traditionally, credit risk was seen as binary—a payment is made or not. The evolution of trading in credit derivatives has allowed for more refined measurement of credit risk and for the ability to hedge credit risk.
- **Liquidity risk** is the possibility of sustaining significant losses due to the inability to take or liquidate a position quickly at a fair price. It can be difficult to measure

because liquidity can appear adequate until adverse events occur. A narrow **bid-ask spread** is usually taken as an indicator of good liquidity for traded securities but this spread normally applies only to small transactions. Another problem is that the valuation models used to value non-traded securities generally do not incorporate liquidity risk in estimating value. **Average** or **typical trading volume** may provide a better indication of liquidity. It is often assumed that derivatives can provide an alternative to transactions in the actual item, but in reality, derivative liquidity is generally linked to liquidity of the underlying item.

Nonfinancial risks are defined as all other risks and include:

- **Operational** or **operations risk** is a loss due to failure of the company's systems and procedures or from external events outside the company's control. Examples and solutions to operational risk include: computer failure which can be mitigated with backup systems and procedures, human failure which can be reduced by developing procedures to monitor actions, and terrorism or weather events for which insurance may be available.
- **Settlement risk** is present when funds are being exchanged to settle a transaction. One party could be making a payment while the other side of the exchange could be in the process of defaulting and fail to deliver on the transaction. This is also known as **Herstatt risk** after a bank that received swap payments and then defaulted without making payments. This level of risk varies. It is minimal for exchange trades when a clearinghouse assumes responsibility for the transaction. OTC transactions will have considerably more risk. On a swap where cash flows are exchanged, netting can be used to reduce the risk. Instead of each side making a payment and being at risk the other side will not pay, the smaller net difference in payments is computed and only that difference is sent. Many foreign exchange trades are now done through *continuously linked settlements* (*CLS*), which provide for settlement within a defined time window to reduce settlement risk.
- **Model risk** is present for many derivatives and non-traded instruments. Models are only as good as their construction and inputs (e.g., the assumptions regarding the sensitivity of the firm's assets to changes in risk factors, the correlations of the risk factors, or the likelihood of an event).
- **Sovereign risk** is a form of credit risk (financial risk) but has other elements as well. The analyst must consider financial issues (the ability of the government to pay) in addition to nonfinancial issues (the willingness of a sovereign government to repay its obligations). It can be difficult to collect if a sovereign government does not want to pay.

PROFESSOR'S NOTE

While the CFA text notes that sovereign risk has both financial and nonfinancial elements, it is discussed under nonfinancial, so if forced to choose, I'd put it there.

- **Regulatory risk** arises when it is not clear how a transaction will be regulated or if the regulations can change. Even if a transaction is unregulated, the parties to the transaction may be regulated, making the transaction indirectly regulated.

- **Tax, Accounting**, and **Legal/Contract risk** are similar to regulatory risk in that they refer to situations where the rules are unclear or can change. Such situations can also lead to costly litigation. **Political risk** refers to a change in government which could then lead to any of these types of changes and risks.

  Clearly derivatives are prime candidates for these risks. Many derivatives are new and subject to uncertain or changing rules. They can at times be politically unpopular.

Other risks include:

- **ESG (environmental, social, governance) risk** exists if company decisions result in environmental damage, human resource issues, or poor corporate governance polices and these decisions cause harm that results in a decline in the company's value.
- **Performance netting risk** can exist among multiple counterparties. Consider a case where A must pay B, B must pay C, and C must pay D. Default by A could trigger a chain of defaults.
- **Settlement netting risk** is different. It refers specifically to the liquidator of a counterparty in default changing the terms of expected netting agreements, such that the non-defaulting party now has to make payments (a payment that was expected to have been netted and therefore reduced) to the defaulting party.

Measuring Risks

Risk measurement is focused primarily on measuring market and credit risk. Traditionally, market risk has been measured with tools such as:

1. Standard deviation to measure price or surplus volatility.
2. Standard deviation of excess return. Excess return is the return minus the relevant benchmark return. The standard deviation of excess returns is also called **active risk** or **tracking risk**.

Tools exist to make simple, linear, first-order projections of the change in price for many securities: beta for stock, duration for bonds, and delta for options. Second-order techniques to measure change from straight line price projections exist for bonds (convexity) and options (gamma). Option price analysis can also incorporate the change in the option price for a change in time to expiration (theta) and the change in volatility (vega).

PROFESSOR'S NOTE

While the items just mentioned are discussed in the reading, VaR is considered a superior tool to aggregate and measure risk in an organization.

MODULE QUIZ 31.1

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

1. As risk manager for ABC Enterprises, J.Q. Smith is assessing the firm's various risk exposures to include in a regular semiannual report to upper management. ABC

is a medium-size import/export firm located in Charleston, South Carolina. Its primary sources for imports, which it sells in the United States, are located in China and Mexico. It has customers throughout the world, but more than half of its exports go to the Eurozone.[1] ABC customarily borrows to cover funds tied up in exports. **Discuss** risk exposures Smith should report.

2. **List** and **describe** three types of financial risk, and **offer** mitigating strategies.

3. **List** and **describe** five types of nonfinancial risk, and **offer** mitigating strategies.

4. While reading and entering return data into a performance evaluation model, the programmer transposed the number 0.10 to 0.01. As a result, the average return and maximum drawdown for the period were calculated incorrectly for that manager. The mistake was discovered only immediately before paying out bonuses and allocating capital for the coming year. **Discuss** the failure in the ERM system and possible remedies.

MODULE 31.2: VALUE AT RISK (VAR)

Video covering this content is available online.

LOS 31.e: Calculate and interpret value at risk (VaR) and explain its role in measuring overall and individual position market risk.

CFA® Program Curriculum, Volume 5, page 153

VaR gained prominence in the 1990s as a single aggregate risk measure applicable to many situations. VaR states at some probability (often 1% or 5%) the expected loss during a specified time period. The loss can be stated as a percentage of value or as a nominal amount. VaR always has a dual interpretation.

EXAMPLE: Interpreting VaR

A $100 million portfolio has a 1.37% VaR at the 5% probability over one week. Calculate what could be lost and explain what the loss means.

Answer:

Over one week, the portfolio could lose 1.37% of $100 million or $1.37 million. There is a 5% chance that more than this will be lost and a 95% chance that less than this will be lost.

Analysis should consider some additional issues with VaR:

- The VaR time period should relate to the nature of the situation. A traditional stock and bond portfolio would likely focus on a longer monthly or quarterly VaR while a highly leveraged derivatives portfolio might focus on a shorter daily VaR.
- The percentage selected will affect the VaR. A 1% VaR would be expected to show greater risk (meaning a larger loss or smaller gain) than a 5% VaR.
- The left-tail should be examined. *Left-tail* refers to a traditional probability distribution graph of returns. The left side displays the low or negative returns, which is what VaR measures at some probability. But suppose the 5% VaR is losing $1.37 million, what happens at 4%, 1%, and so on? In other words, how much worse can it get?

METHODS FOR COMPUTING VAR

LOS 31.f: Compare the analytical (variance–covariance), historical, and Monte Carlo methods for estimating VaR and discuss the advantages and disadvantages of each.

CFA® Program Curriculum, Volume 5, page 155

Three approaches are used in calculating VaR.

The Analytical VaR Method

The **analytical method** (or variance-covariance method) is based on the normal distribution and the concept of one-tailed confidence intervals.

EXAMPLE: Analytical VaR

The expected annual return for a $100,000,000 portfolio is 6.0% and the historical standard deviation is 12%. Calculate VaR at 5% probability.

Answer:

A CFA candidate would know that 5% in a single tail is associated with 1.645, or approximately 1.65, standard deviations from the mean expected return. Therefore, the 5% annual VaR is:

$$\begin{aligned} \text{VaR} &= \left[\widehat{R}_p - (z)(\sigma)\right] V_p \\ &= [6.0\% - 1.65\,(12.0\%)]\,(\$100{,}000{,}000) \\ &= -13.8\%\,(\$100{,}000{,}000) \\ &= -\$13{,}800{,}000 \end{aligned}$$

where:

$\hat{R}_p$ = expected return on the portfolio

V_p = value of the portfolio

z = *z*-value corresponding with the desired level of significance

σ = standard deviation of returns

The interpretation is that there is 5% probability that the annual loss will exceed $13.8 million and a 95% probability the annual loss will be less.

For the Exam: Be sure to know:

- 5% VaR is 1.65 standard deviations below the mean.
- 1% VaR is 2.33 standard deviations below the mean.
- VaR for periods less than a year are computed with return and standard deviations expressed for the desired period of time. For monthly VaR, divide the annual return by 12 and the standard deviation by the square root of 12. Then, compute monthly VaR. For weekly VaR, divide the annual return by 52 and the standard deviation by the square root of 52. Then, compute weekly VaR.
- For a very short period (1-day) VaR can be approximated by ignoring the return component (i.e., enter the return as zero). This will make the VaR estimate worse as no return is considered, but over one day the expected return should be small.

EXAMPLE: Computing weekly VaR

For the previous example compute the weekly VaR at 1%.

Answer:

The number of standard deviations for a 1% VaR will be 2.33 below the mean return. The weekly return will be 6% / 52 = 0.1154%. The weekly standard deviation will be $12\% / 52^{1/2} = 1.6641\%$

VaR = 0.1154% −2.33(1.6641%) = −3.7620%

Advantages of the analytical method include:

- Easy to calculate and easily understood as a single number.
- Allows modeling the correlations of risks.
- Can be applied to shorter or longer time periods as relevant.

Disadvantages of the analytical method are mostly related to its assumption that returns are normally distributed. Specific issues include:

- Securities may have skewed returns. Long option positions have positive skew with frequent small losses (lose the premium paid) and occasional large gains if the option moves deep in-the-money. Short option positions will have the opposite payoff and negative skew.
- Many securities exhibit a greater number of extreme return events than are consistent with the normal distribution. This is called leptokurtosis or more commonly “fat tails” and means the amount and frequency of losses is underestimated by the method.

One approach to dealing with the skewed return distribution of options is the **delta-normal method**. This mathematical trick continues to assume the returns of the underlying are normally distributed and then applies option delta to change in the underlying to estimate change in the option. Delta is a straight-line projection of how the option changes. The limitation is that delta is not stable and the greater the change in the underlying the more the actual change in the option will diverge from its delta projection. Adding the second order gamma effect improves the projection but further complicates the analysis.

The Historical VaR Method

The historical method for estimating VaR is sometimes referred to as the **historical simulation** method. One way to calculate the 5% daily VaR using the historical method is to accumulate a number of past daily returns, rank the returns from highest to lowest, and identify the lowest 5% of returns. The highest of these lowest 5% of returns is the 1-day, 5% VaR.

> **EXAMPLE: Historical VaR**
>
> You have accumulated 100 daily returns for your $100,000,000 portfolio. After ranking the returns from highest to lowest, you identify the lowest five returns:
>
> –0.0019, –0.0025, –0.0034, –0.0096, –0.0101
>
> **Calculate** daily VaR at 5% significance using the historical method.
>
> **Answer:**
>
> Because these are the lowest five returns, they represent the 5% lower tail of the "distribution" of 100 historical returns. The fifth lowest return (–0.0019) is the 5% daily VaR. We would say there is a 5% chance of a daily loss exceeding 0.19%, or $190,000.

Advantages of the historical method include:

- Very easy to calculate and understand.
- Does not assume a returns distribution.
- Can be applied to different time periods according to industry custom.

The primary *disadvantage* of the historical method is the assumption that the pattern of historical returns will repeat in the future (i.e., it is indicative of future returns). This becomes particularly troublesome the more the manager trades. Also keep in mind that many securities (e.g., options, bonds) change characteristics with the passage of time.

The Monte Carlo VaR Method

The **Monte Carlo method** uses computer software to generate hundreds or thousands of possible outcomes from the distributions of inputs *specified by the user*. The user might specify normal distributions for some assets, skewed for others, leptokurtic for others, and complex shifting correlations over time. The runs of possible outcomes can be ranked from highest to lowest (just like historical outcomes) to determine the result at any given probability. The data could be shown graphically to provide a visual display of all outcomes and frequency.

EXAMPLE: Monte Carlo VaR

A Monte Carlo model has generated 100 runs of possible output over 1-week periods. The average return and standard deviation are 5.7% and 2.1%, respectively. The worst six outcomes are +0.5%, +1.5%, +1.6%, +0.3%, +0.7% and +0.5%. The portfolio is known to include extensive option positions.

Calculate the 1-week VaR at 5% significance for a beginning portfolio value of GBP 100 million.

Answer:

Option positions make the use of standard deviation inappropriate for calculating VaR. Based on the Monte Carlo simulations, the 5th percentile worst result is the 5th worst return of +1.5% for a GBP 1,500,000 gain in portfolio value over one week. 5% of the time the gain would be worse.

It appears this is a very conservative portfolio because the VaR is a gain. Typically, VaR is a loss but not in this case.

The primary *advantage* of the Monte Carlo method is also its primary disadvantage. It can incorporate any assumptions regarding return patterns, correlations, and other factors the analyst believes are relevant. For some portfolios it may be the only reasonable approach to use.

That leads to its downside: the output is only as good as the input assumptions. This complexity can lead to a false sense of overconfidence in the output among the less informed. It is data and computer intensive which can make it costly to use in complex situations (where it may also be the only reasonable method to use).

PROFESSOR'S NOTE

Both historical and Monte Carlo simulation (MCS) are similar in that they are based on selecting from a set of possible outcomes. You can use historical outcomes or, if that is unavailable or considered no longer appropriate, MCS essentially generates a "simulated history."

GENERAL ADVANTAGES AND LIMITATIONS OF VAR

LOS 31.g: Discuss advantages and limitations of VaR and its extensions, including cash flow at risk, earnings at risk, and tail value at risk.

CFA® Program Curriculum, Volume 5, page 168

VaR, whatever the method of computation, has several advantages over other risk measures:

- It has become the industry standard for risk measurement and is required by many regulators.
- It aggregates all risk into one single, easy to understand number.
- It can be used in capital allocation. For example, a firm willing to accept a maximum of $1,000,000 VaR is essentially saying it is willing to lose $1,000,000 of equity capital (at some probability level). Senior management could further allocate a maximum VaR to each business unit in the firm and evaluate each unit on the return generated for the VaR allowed. Generally, the total VaR by unit will be more than the $1,000,000 firm-wide VaR. When the correlation between units

is less than 1.0, the firm-wide VaR will be less than their simple summation. This is known as **risk budgeting**, how much risk can each unit take?

VaR also has clearly acknowledged limitations:

- Some of the methods (Monte Carlo) are difficult and expensive.
- The different computation methods can generate different estimates of VaR.
- It can generate a false sense of security. It is only as good as the inputs and estimation process. Even when done correctly it is probabilistic; things can always be worse.
- It is one-sided, focusing on the left tail in the return distribution, and ignores any upside potential.

VaR should not be used in isolation but in combination with other tools and actions:

- VaR projections should be continually **back-tested** to compare actual results across multiple time periods with projections. Does the pattern of results fit the probability and outcomes projected by VaR?
- **Incremental VaR** (IVaR) is the effect of an individual item on the overall risk of the portfolio. IVaR is calculated by measuring the difference between the portfolio VaR before and after an additional asset, asset class, or other aspect of the portfolio is changed.
- **Cash flow at risk** (CFAR) measures the risk of the company's cash flows. Some companies cannot be valued directly, which makes calculating VaR difficult or even meaningless. Even when VaR can be calculated, CFAR may offer additional information. CFAR is interpreted much the same as VaR, but substitutes cash flow for value. In other words, CFAR is the minimum cash flow loss at a given probability over a given time period.
- **Earnings at risk** (EAR) is analogous to CFAR only from an *accounting earnings* standpoint. Both CFAR and EAR are often used to add validity to VaR calculations.
- **Tail value at risk** (TVaR) is intended to give additional insight into what happens if VaR is exceeded. It is VaR plus the average of the outcomes in the tail. For example, if the 5%, 1-day VaR is $1 million and TVaR is $2.7 million, then 5% of the time losses exceed $1 million and the average lost is another $1.7 million beyond $1 million for a total average loss of $2.7 million.
- **Credit VaR** projects risk due to credit events. It will be discussed shortly.
- **Stress testing** is a complement to VaR.

STRESS TESTING

LOS 31.h: Compare alternative types of stress testing and discuss advantages and disadvantages of each.

CFA® Program Curriculum, Volume 5, page 171

Stress testing is often employed as a complement to VaR. It may reveal outcomes not reflected in the typical VaR calculation. For example, the manager might use the

historical standard deviation in estimating VaR, and if nothing unusual occurred during the measurement period, the estimated VaR will reflect only “normal” circumstances. Stress testing is just an extreme scenario.

Scenario Analysis

In a scenario analysis the user defines the events, such as interest rate movements, changes in currencies, changes in volatilities, changes in asset liquidity, and so on, and compares the value of the portfolio before and after the specified events. Multiple scenarios might consider both favorable and unfavorable scenarios.

Any scenario analysis is only as good as the accuracy of the assumptions made. Another problem is the sequence of events. Altering the sequence or having all events occur simultaneously can produce different results.

There are various forms of scenario analysis. With **stylized scenarios**, the analyst changes one or more risk factors to measure the effect on the portfolio. Rather than having the manager select risk factors, some stylized scenarios are more like industry standards. For example, in *Framework for Voluntary Oversight*,[2] the Derivatives Policy Group (DPG) identifies nine specific risk factors to include in stress testing.

> **For the Exam:** The following lists risk factors that might be modeled in a scenario analysis.
>
> 1. Parallel yield curve shifts.
> 2. Changes in steepness of yield curves.
> 3. Parallel yield curve shifts combined with changes in steepness of yield curves.
> 4. Changes in yield volatilities.
> 5. Changes in the value of equity indices.
> 6. Changes in equity index volatilities.
> 7. Changes in the value of key currencies (relative to the U.S. dollar).
> 8. Changes in foreign exchange rate volatilities.
> 9. Changes in swap spreads in at least the G-7 countries plus Switzerland.
>
> By providing guidelines, these stylized scenarios help managers avoid the “Oh no” syndrome, as in, “Oh, no! Why didn’t we think of that?”

Other forms of scenario analysis include **actual extreme events** and **hypothetical events**, which are quite similar. With the former, the analyst measures the impact of major past events, such as the market crash of 1987 or the 1990s technology bubble, on the portfolio value. Hypothetical events are extreme events that might occur but have not previously occurred. These tests are subject to the same weaknesses as other scenario analyses (e.g., incorrect assumptions and correlations, user bias).

Stressing Models

Stress testing and stressing models are just an extension of scenario analysis focusing on adverse outcomes. Stressing can be done as:

- **Factor push analysis** is a simple stress test where the analyst pushes factors to the most disadvantageous combination of possible circumstances and measures the resulting impact on the portfolio.

- **Maximum loss optimization** uses more sophisticated mathematical and computer modeling to find this worst combination of factors.
- **Worst-case scenario** is the worst case the analyst thinks is likely to occur.

For the Exam: Scenario analysis is discussed in multiple sections of the CFA material. Understand the concept, vocabulary, and be prepared to answer questions.

MODULE QUIZ 31.2

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

1. A portfolio contains two assets, A and B. The expected returns are 9% and 13%, respectively, and their standard deviations are 18% and 21%, respectively. The correlation between the returns on A and B is estimated at 0.50. **Calculate** the 5% (analytical) VaR of a $100,000 portfolio invested 75% in A and 25% in B. **List** a total of two advantages and/or disadvantages of analytical VaR.

2. Below are 40 monthly returns (in percent) for LMN Portfolio, ranked from highest to lowest. **Calculate** the 5% historical VaR for the $1,500,000 portfolio. **List** a total of two advantages and/or disadvantages of historical VaR.

6.147	2.377	1.594	0.993	–0.672	–1.523
5.875	2.232	1.320	0.989	–0.749	–1.726
3.660	2.064	1.189	0.962	–0.851	–2.024
3.432	2.059	1.148	0.901	–1.112	–2.250
3.376	1.839	1.128	0.353	–1.182	–3.359
2.510	1.652	1.054	–0.231	–1.313	
2.388	1.609	0.996	–0.550	–1.367	

3. Because VaR has certain limitations, managers will often back test their VaR models (i.e., check the accuracy of their VaR predictions after the fact). In addition, there are measures that can be used as supplements to the regular VaR measure (i.e., supplement the information provided by VaR). **List** and **describe**

two measures that can be used as supplements to VaR.

MODULE 31.3: CREDIT RISK

Video covering this content is available online.

LOS 31.i: Evaluate the credit risk of an investment position, including forward contract, swap, and option positions.

CFA® Program Curriculum, Volume 5, page 173

Credit risk exists when there is a possibility a counterparty to a transaction will not fulfill its responsibility. Credit risk is complicated to measure. Complicating the analysis is the fact that defaults are rare so there is little data available to assist in making estimates. Projecting credit losses is a function of:

1. The probability of a default event.
2. The amount of value lost if the default event occurs, which requires estimating the loss and any recovery after the initial loss.

Credit risk can be both immediate and potential. **Current credit risk** (also called **jump-to-default risk**) is the amount of a payment currently due. Because payments are only due on specific dates, current credit risk is zero on all other dates. **Potential credit risk** is associated with payments due in the future and exists even if there is no current credit risk. It will change over time. A firm can be currently solvent and able to make payment but that does not guarantee future payments will be made. Likewise, a firm could be in short-term financial difficulty but expected to recover if given time.

Credit risk can also be affected by **cross-default-provisions**. In most lending agreements, a debtor is considered in default of all obligations if it defaults on any one of its obligations. In addition to potential credit risk associated with their own receipts, therefore, creditors are exposed to potential credit risk from a debtor defaulting on an obligation to another creditor.

Credit VaR

Credit VaR (also called **credit at risk** or **default VaR**) is defined much like VaR as an expected loss (due to default) at a given probability during a given time period. However, it is more difficult to calculate and interpret than market VaR.

- It cannot be separated from VaR. If a security has little market value (for example, a bond with little value due to high interest rates) then there can be little credit VaR because there is little value to be lost if default occurs. While market VaR is called left-tail risk because it occurs when returns on the asset are low and market value is lost, credit VaR is right-tail risk as credit risk is greatest when returns and market value are highest.

- Even if the probability of default can be estimated, there is still the issue of estimating recovery rates.
- The pricing data of credit derivatives has provided additional insight into the market opinion of potential loss on securities. Option pricing models have also been applied to gain some insight. Like options, credit risk is one-sided, on a reasonable quality security upside is limited but default leads to substantial loss of value.
- Credit risk across multiple exposures is difficult to aggregate and would depend on the correlation of default between each pair of exposures.

Despite the difficulty of modeling and aggregating credit risk, at any one moment the potential credit risk of an investment is its current market value. That market value will be determined by 1) the remaining cash flows to be exchanged (and at risk) and 2) the degree to which market conditions have changed to create a gain or loss in value. The credit risk is one-sided, meaning the party with positive market value is at risk if the counterparty does not perform. The counterparty with negative market value has no potential credit risk. Under current conditions they are at a loss and would actually benefit if the transaction could somehow cease to exist. However, this does not mean potential credit risk will remain stable. As payments are made, the remaining cash flows at risk decrease which leads to a tendency for VaR to decrease. Additionally, market conditions can change, causing VaR to increase, decrease, or even reverse between the party with the gain and the party with the loss.

Forward Contracts

At the initiation of a standard forward contract, there is no exchange of cash and initial value is zero. As time passes, interest rates or prices have probably changed so that one of the counterparties will have a gain, putting that party at risk if the counterparty defaults. At any one point the potential credit risk is with the party who has a gain. At settlement of the contract the counterparty entitled to receive the payment faces *current credit risk*, as the payment is due immediately and the counterparty could default.

While at any future point in time the potential credit risk will be the current market value for the party with a gain, it can be anticipated that the potential credit risk will be highest in the middle to later part of the contract's life. All cash flow occurs at expiration so all cash flow remains at risk until expiration; the more time that passes from initiation of the contract, the greater the opportunity for conditions to change and create significant gain and credit risk for one counterparty.

> **EXAMPLE: Credit risk in a forward contract**
>
> Suppose a forward contract that expires in one year is available on an asset that is currently worth $100 and the risk-free rate is 4%; therefore, the forward price would be $100 × 1.04 = $104. It is now nine months later, and the asset is worth $101.50. **Determine** who bears the credit risk in the forward contract and **calculate** the amount of the credit risk.
>
> **Answer:**
>
> The holder of the long position in the contract is obligated to buy the asset for $104 in one year. The value to the long is:

$$\$101.50 - \frac{\$104}{1.04^{3/12}} = -\$1.4852$$

Because the value is negative, this means the long position would owe the short position this amount if the contract was settled today. The value to the short position is positive, representing a claim on the asset in this amount from the long; thus, the short bears the *potential* credit risk, and because the contract is not settled for another three months, there is no *current* credit risk.

EXAMPLE: Valuing the credit risk of a foreign exchange forward contract

As part of a foreign exchange hedging strategy, a U.S. portfolio manager has shorted a forward contract on 1,000,000 euros denominated in U.S. dollars with a forward price of $1.8095/€. With three months remaining on the contract, the spot rate is now $1.8038/€, the U.S. interest rate is 5.5%, and the foreign interest rate is 5.0%. **Determine** the value and direction of any credit risk.

Answer:

The value of the contract on the base currency (B) to the long position is:

$$\text{value to long} = \frac{S_t}{(1+B)^t} - \frac{F_0}{(1+P)^t}$$

In this case the exchange rates are given as direct quotes for the EUR (i.e., as USD/EUR). The USD is P (the pricing currency), and the EUR is B (the base currency). The contract position is short B, the EUR. The remaining contract term is three months or 0.25 of a year.

$$\frac{\$1.8038/€}{1.05^{0.25}} - \frac{\$1.8095/€}{1.055^{0.25}} = -\$0.003509/€$$

This is negative value to the long EUR position and positive value to our 1,000,000 short EUR position of €1,000,000 × ($0.003509/€) = $3,509. At this moment in time, the potential credit risk to the short position is its positive value of $3,509. Think of this as the value immediately lost if the counterparty immediately ceases to exist.

PROFESSOR'S NOTE

It is common to see this value formula shown with f for the B base currency and d for the P pricing currency. That works in this case because the contract is on the foreign currency from the investor's perspective and it is the base currency in the quotes.

Swaps

A swap should be thought of as a series of forward contracts. Following this analysis, the swap will have actual credit risk on each payment exchange date as well as potential credit risk throughout its life. So unlike the forward there is actual credit risk on multiple dates and on each of these dates, as cash flows are exchanged, subsequent cash flows to be exchanged in the future decrease. At any future point, potential credit risk is the value of the swap for the counterparty with a gain.

Unlike a forward, the credit risk of most swaps (such as *interest rate* and *equity swaps*) is expected to be highest somewhere around the middle of their life. Assuming the swap is correctly priced, the initial value and credit risk are zero. Then as some time passes and conditions change, one or both parties will have credit risk. If both parties are required to make payments, both will be at risk the other counterparty is unable to pay. In the more common netting of payment situation, the credit risk will be one–sided and to the party with the gain. As the swap nears its maturity and the number of remaining settlement payments decreases, the credit risk also decreases.

The exception to this is a *currency swap*. Because payments are in different currencies, netting of settlement payments is inappropriate and both parties can be simultaneously exposed to current credit risk on settlement dates. Also, due to the exchange of principals at inception and the return of principals on the maturity date, the credit risk of a currency swap is highest between the middle and final maturity of the agreement. The notional principal is very large in relation to the periodic cash flows and remains at risk until the last exchange.

Options

With an option, unlike a forward or swap contract, only the long position (the buyer) faces credit risk. The buyer decides whether to exercise the option and will only do so when there is positive value. Only the buyer is at risk the seller will be unable to perform.

For both American and European options, the buyer will have potential credit risk equal to the current market value of the option. Theoretically the American-style option value can be somewhat higher because it is never worth less than a European-style option. Neither style can have actual credit risk until it is exercised. With the American, that actual risk could occur prior to expiration if the owner chooses to exercise early (a rare event). The European-style option can only have actual credit risk on the expiration date.

Liquidity and Nonfinancial Risks

Liquidity is not considered in measuring VaR. Implicit in VaR is the assumption that positions can be sold at their trading or estimated market value. Thus, VaR can give an inaccurate estimate of the true potential for loss. Estimating liquidity is difficult. For example, due to a statistical anomaly and in spite of large bid-ask spreads, some infrequently traded securities have low historical volatility. Even if historical volatility is accurate, the inability to quickly adjust a position can lead to increased losses not caught in the VaR measure. The manager should take this into account and consider how large their position is in relation to past and likely future trading volume.

Nonfinancial risks are difficult to measure. Many are outlier events for which the insurance industry may offer insurance and have a data base from which estimates of loss, recovery, and probability could be made.

MODULE QUIZ 31.3

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

1. **List** and **discuss** three methods for managing credit risk.

2. A German portfolio manager entered a 3-month forward contract with a U.S. bank to deliver $10,000,000 for euros at a forward rate of €0.8135/$. One month into the contract, the spot rate is €0.8170/$, the euro rate is 3.5%, and the U.S. rate is 4.0%. **Determine** the value and direction of any credit risk.

MODULE 31.4: MANAGING THE RISKS AND ASSESSING RESULTS

Video covering this content is available online.

MANAGING MARKET RISK

LOS 31.j: Demonstrate the use of risk budgeting, position limits, and other methods for managing market risk.

CFA® Program Curriculum, Volume 5, page 182

Risk budgeting is the process of determining which risks are acceptable and how total enterprise risk is allocated across business units or portfolio managers. Through an enterprise risk management (ERM) system, upper management allocates different amounts of capital across portfolio managers. In this fashion, the amount of capital (and the associated VaR) allocated to portfolio managers (e.g., foreign currency, domestic and international bonds, equities) is based upon management's prior determination of the desired exposure to each sector.

An ERM system affords the ability to continuously monitor the risk budget so that any deviations are immediately reported to upper management. Another benefit of a risk budgeting system is the ability to compare manager performance in relationship to the amount of capital and risk allocated (i.e., measure risk-adjusted performance with **return on VaR**).

EXAMPLE: Return on VaR

Assume Manager A and B work for the same firm. Manager A has been allocated $100 million of capital and a weekly VaR of $5 million. Manager B has been allocated $500 million and a weekly VaR of $10 million. Over a given period, A earns a profit of $1 million, and B earns a profit of $3 million. Their combined capital and VaR are $600 million and $13.7 million.

Compare their results using *return on capital* and *return on VaR*. **Discuss** their combined capital and VaR.

Answer:

	A	B
Capital (funds that can be invested)	$100,000,000	$500,000,000
VaR	$5,000,000	$10,000,000

Profit	$1,000,000	$3,000,000
Return on capital	1%	0.6%
Return on VaR	20%	30%

By comparing the managers on return on capital, it appears that A outperformed B. When we measure return on VaR, however, Manager B outperformed Manager A on a risk-adjusted basis.

The capital position of each manager is a simple summation of capital positions. VaR is a more complex aggregation and will be less than a simple addition when correlation is less than 1.0.

In addition to VaR, methods for managing market risk include:

- **Position limits** that place a nominal dollar cap on a given position.
- **Liquidity limits** are related to position limits. In an effort to minimize liquidity risk, risk managers may set nominal position limits as some portion of typical trading volumes.
- A **performance stopout** sets an absolute dollar limit for losses to the position over a certain period. If the stopout level is hit, the position must be closed to limit further loss.
- In addition to a VaR allocation, the portfolio manager may be subject to individual **risk factor limits**. As the name implies, the manager must limit exposure to individual risk factors as prescribed by upper management.

Other measures include **scenario analysis limits**, which require the manager to structure the portfolio so as to limit the impact of given scenarios, and **leverage limits**, which limit the amount of leverage the manager can employ.

MANAGING CREDIT RISK

LOS 31.k: Demonstrate the use of exposure limits, marking to market, collateral, netting arrangements, credit standards, and credit derivatives to manage credit risk.

CFA® Program Curriculum, Volume 5, page 186

Credit VaR based on standard deviation is inherently difficult to apply to one-sided credit risk. Credit change for most traditional securities is on the downside with limited upside. While credit VaR may be considered, other methods to limit credit risk are extensively employed:

- **Limiting exposure** is a rational first line of defense against credit risk. It means limiting the amount of loans to any individual debtor or the amount of derivative transactions with any individual counterparty.
- **Marking to market** is employed with many derivative contracts in which the value to one party will be positive while the value to the other will be negative. The party whose value is negative pays this amount to the other party, and the contract is repriced.

EXAMPLE: Marking to market of a forward contract

Assume there is a 1-year forward contract at $106 with the risk-free rate of 5%, and it is three months into the life of the contract. If the current spot price is $104, **determine** the cash flows, assuming the parties have agreed to mark to market every three months.

Answer:

The market value to the long is as follows:

$$\$104 - \frac{\$106}{1.05^{9/12}} = \$1.8087$$

Therefore, the short owes the long this amount. The contract will be repriced at $104(1.05)^{9/12} = $107.876, and the two parties will mark to market again at the 6-month point.

- **Collateral** is often required in transactions that generate credit risk. For example, consider the typical home purchase where the homeowner must provide equity of 5% to 20% of the total value of the home. In business transactions, collateral can be business assets or liquid marketable securities.

  In derivatives markets, both parties are often required to post *margin*, and if the contract is marked to market, either side may be required to post additional margin (collateral).

- **Payment netting** is frequently employed in derivatives contracts that can generate credit exposure to both sides. When each side has credit risk, we value and *net* the two to determine which side has the greater obligation. If the contract has a mark-to-market clause, one side pays the other, and the contract is repriced at the new forward rate.

- **Closeout netting** is employed in *bankruptcy* proceedings. In this case, all the transactions between the bankrupt company and a single counterparty are netted to determine the overall exposure. When this is done, the bankrupt firm cannot claim assets equaling payments it is due while at the same time defaulting on its obligations.

- It is always wise to impose **minimum credit standards** on a debtor. The quality of the debtor—the debtor's creditworthiness—is sometimes hard to evaluate with any confidence. For example, commercial banks, the largest derivatives dealers, make loans to many types of debtors at the same time they are in countless derivatives contracts. Any time the dealer, or any counterparty for that matter, is simultaneously in numerous contracts, creditworthiness is difficult to ascertain.

  A lower credit quality entity can meet minimum credit standards by creating subsidiaries with the special purpose of entering into derivatives (or other) contracts. These **special purpose vehicles** (SPVs) and **enhanced derivatives products companies** (EDPCs) are completely separate from the parent companies and established with sufficient capital to ensure high credit ratings. By restructuring them this way, problems with the parent, such as credit downgrades, are not reflected in the ratings of the SPV or EDPC.

- Risk can be transferred to somebody else through **credit derivatives**, such as credit default swaps, credit forwards, credit spread options, and total return swaps.
  - In a **credit default swap**, the protection buyer (i.e., the asset holder) makes regular payments to the dealer and receives a payment when a specified credit event occurs.
  - A **credit spread forward** is also based upon a credit spread, but as with

other forward contracts, there will almost always be a payment by one of the parties. That is, there will be a payment unless the reference spread equals the spread specified in the contract.

- The holder of a **credit spread option** receives a payment when the rate on an asset exceeds a reference yield (such as LIBOR) by more than the specified spread. The payment partially compensates for the decline in the value of the asset. Note that because this is an option, it has value, and a payment is made only if it is in-the-money.
- In a **total return swap**, the asset owner agrees to accept a variable return from a dealer in exchange for the total return on an asset. When the asset is subject to capital gains and losses, the dealer accepts both the credit and interest rate risk. That is, if the asset increases in value, the owner passes the capital gain along to the dealer in the form of a cash payment. Likewise, if the asset decreases in value, the dealer makes a payment to the asset owner.

MEASURING RISK-ADJUSTED PERFORMANCE

LOS 31.l: Discuss the Sharpe ratio, risk-adjusted return on capital, return over maximum drawdown, and the Sortino ratio as measures of risk-adjusted performance.

CFA® Program Curriculum, Volume 5, page 189

The **Sharpe ratio** measures excess return (over the risk-free rate) per unit of risk, measured as standard deviation. The principal drawback to applying the Sharpe ratio as a measure of risk-adjusted return is the assumption of normality in the excess return distribution. This is particularly troublesome when the portfolio contains options and other instruments with non-symmetric payoffs. The formula for the Sharpe ratio is:

$$S_P = \frac{\overline{R}_P - \overline{R}_F}{\sigma_P}$$

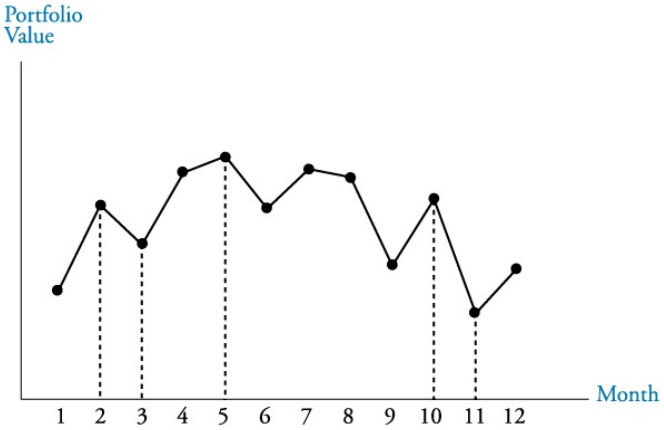
Risk-adjusted return on invested capital (RAROC). RAROC is the ratio of the portfolio's expected return to some measure of risk, such as VaR (see our earlier discussion of return on VaR). Management can then compare the manager's RAROC to his historical or expected RAROC or to a benchmark RAROC.

Return over maximum drawdown (RoMAD). RoMAD is the annual return divided by the fund or portfolio's largest percentage drawdown. Any single drawdown is the percent drop in valuation from a "high water" mark to a subsequent low. For example, the annual return is 17% with a maximum percentage decline of 25%. The RoMAD is 0.68.

$$\text{RoMAD} = \frac{\overline{R}_p}{\text{maximum drawdown}}$$

To demonstrate RoMAD, consider Figure 31.1.

Figure 31.1: Monthly Portfolio Values and Maximum Drawdown



Based only on the information in the chart, the portfolio rises to an initial high water mark at point 2, followed by a subsequent low at point 3. Suppose that is a 2.1% decline. The portfolio then rises to a new HWM at point 5 and declines to a subsequent low at point 11. Suppose this is a 9.7% decline. The maximum drawdown is 9.7%. Each decline starts with a high water mark until the next lowest low. If the portfolio rises above a previous HWM, a new drawdown analysis starts.

The **Sortino ratio** is the ratio of excess return to risk. Excess return for the Sortino ratio (the numerator) is calculated as the portfolio return less the *minimum acceptable portfolio return* (MAR). The denominator of the ratio is the standard deviation of returns calculated using only returns below the MAR. The motivation behind the downside measure of volatility utilized in the Sortino ratio is the sense that very good performance (high returns) can unfairly inflate the volatility measure (the standard deviation used as the risk measure).

$$\text{Sortino} = \frac{\overline{R}_p - \text{MAR}}{\text{downside deviation}}$$

SETTING CAPITAL REQUIREMENTS

LOS 31.m: Demonstrate the use of VaR and stress testing in setting capital requirements.

CFA® Program Curriculum, Volume 5, page 191

Firms have limited capital and will allocate that capital across units of the firm to maximize return to the firm at acceptable levels of risk. VaR and stress testing both lend themselves to a systematic process of capital allocation.

VaR measures downside risk and has the benefit of considering correlation and the potential risk reduction through diversification across business units. A firm could project the expected profit to VaR of each unit and allocate more capital to the higher return to risk units. The process would be more complex than simply allocating all capital to the highest return to risk because the capital must be spread across units in order to achieve diversification. Another benefit of using VaR for capital allocation is it can be integrated with a VaR-based risk management process.

Cons:

- VaR is only as good as the assumptions used in its calculation, and it does not consider all worst-case scenarios.
- VaR may not be well understood by the business units.
- Diversification issues can be counterintuitive. It may be appropriate to allocate capital to a very low return unit if the diversification benefit is large enough to allow an increase in allocation to a higher risk and return unit.

Stress testing is the natural complement to VaR as it can consider more extreme outlier events that may not be reflected in the VaR calculation.

Other Methods of Capital Allocation

Nominal, notional, or monetary position limits. These are easy to understand. For example, a firm might set a max capital allocation to two traders of $50,000,000 each. This fails to consider the correlation between the trader's positions and if it is less than +1, the true risk is generally less than $100,000,000. In addition, one or both traders may have large long and short positions that net to less than $50,000,000 of capital each. In other words, simple nominal limits do not consider correlation between and leveraging in the positions.

Max loss limits. VaR can be seen as a kind of max loss at a specified probability but, in addition, a unit could have an assigned max loss for that unit alone (ignoring correlation issues). In theory, adding all the max loss limits would be the most the firm can lose.

Internal and regulatory capital requirements. Either firm management may desire or regulators may require the firm to have a specified minimum amount of capital to minimize the probability of bankruptcy. For example, if the firm has a 1 year 1% VaR of GBP 50M and the capital of the firm is GBP 55M, in a given year, there is a less than 1% chance losses could be large enough to deplete the firm's capital.

Behavioral conflicts. The ERM system must recognize the potential for incentive conflicts between management, which allocates the risk, and those who make the investment decisions, the portfolio managers. For example, once the portfolio is recognized to be headed for a loss for the period, the portfolio manager, whose salary and bonus are typically tied to positive performance, has little incentive to minimize risk. In fact, the manager might well have an incentive to increase risk in hopes of generating a profit. Recognizing this potential, the system and upper management must take steps to avoid it through monitoring or even in the structuring of performance incentives.

MODULE QUIZ 31.4

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

1. In her first semiannual review of the firm's ERM system, B. Jones, the new risk manager, comes across the following two statements in the risk management policies and procedures manual:
    - The performance of each of the firm's portfolio managers will be assessed annually, and managers will be ranked from highest to lowest total return. Managers who have added the most value to their portfolios will receive increased capital allocations for the following year.

- It is the responsibility of each portfolio manager to monitor and maintain the risk of the portfolio within normal, acceptable levels as described in the IPS.

State and **explain** whether the actions described in each of the statements is appropriate for an effective ERM system. In addition to your discussion on these two statements, **state** at least two other characteristics of a good ERM system.

2. One of your portfolio managers, Mort Van Sleet, has recently complained that by measuring risk-adjusted returns using the Sharpe ratio, he is placed at an unfair disadvantage. He has stated flatly that the standard deviation of his portfolio returns is artificially inflated. **Explain** how this can be true, and **offer** and **explain** a potential solution to the problem.

KEY CONCEPTS

LOS 31.a

Risk management is a continual process of:

- Identifying and measuring specific risk exposures.
- Setting specific risk tolerance levels.
- Monitoring the process and taking any necessary corrective actions.

Risk governance should originate from senior management, which determine the structure of the system [i.e., whether centralized (a single group) or decentralized (risk management at the business unit level)].

A decentralized risk governance system has the benefit of putting risk management in the hands of the individuals closest to everyday operations. A centralized system (also called an enterprise risk management system or ERM) provides a better view of how the risks of the business units are correlated.

LOS 31.b, 31.c

In evaluating a firm's ERM system, the analyst should ask whether:

- Senior management consistently allocates capital on a risk-adjusted basis.
- The ERM system properly identifies and defines all relevant internal and external risk factors.
- The ERM system utilizes an appropriate model for quantifying the potential impacts of the risk factors.
- Risks are properly managed.
- There is a committee in place to oversee the entire system to enable timely feedback and reactions to problems.
- The ERM system has built in checks and balances.

A risk management problem can be an event associated with a macro or micro factor, or even the ERM system itself. When a problem occurs:

- Identify the problem and assess the damage.
- Determine whether the problem is due to a temporary aberration or a long-term change in capital market structure or pricing fundamentals.
- If the problem is temporary, the best action may be none at all.
- If the problem is deemed a long-run change in fundamentals or comes from within the ERM system itself, corrective action is justified.
- If the problem stems from a risk factor that was previously modeled incorrectly, revisit the risk model.
- If the problem stems from a risk factor that was not originally identified and priced, management must determine whether to manage the risk or hedge it.
- A problem can also arise from reliance on an incorrectly specified risk pricing model (i.e., risk could be modeled using an incorrect metric).

LOS 31.d

- Financial, market risks are related to prices changes on traded securities or instruments (interest rates, exchange rates, equity prices, and commodity prices).
- Financial, but not market risks are those that have traditionally not had directly observable market pricing:
  - Liquidity risk if positions cannot be quickly changed at close to expected fair prices.
  - Credit risk from losses due to failure to pay by a counterparty. This risk is acquiring more market-like characteristics with the growth in credit derivatives.
- Nonfinancial risks:
  - Operations risk from failure of a firm's operating systems; including its ERM system, due to personal, technological, mechanical, or other problems.
  - Settlement risk when one side of a position is paying while the other is defaulting.
  - Model risk when improper models or assumptions are used to value items that lack market pricing.
  - Regulatory, tax, accounting, legal, and political risk have similar elements in that they refer to how rules can change. These risks can be more significant when dealing with new security types and instruments.
  - Sovereign risk has elements of credit risk but requires estimating not only the ability of a foreign government but also its willingness to pay.
  - Other risks include ESG, performance netting, and settlement netting risks.

LOS 31.e

VaR is an estimate of the minimum expected loss (alternatively, the maximum loss):

- Over a set time period.
- At a desired level of significance (alternatively, at a desired level of confidence).

For example, a 5% VaR of $1,000 over the next week means that, given the standard deviation and distribution of returns for the asset, management can say there is a 5% probability that the asset will lose a minimum of (at least) $1,000 over the coming week. Stated differently, management is 95% confident the loss will be no greater than $1,000.

VaR considers only the downside or lower tail of the distribution of returns. Unlike the typical *z*-score, the level of significance for VaR is the probability in the lower tail only (i.e., a 5% VaR means there is 5% in the lower tail).

LOS 31.f

The analytical method (also known as the variance-covariance method or delta normal method) for estimating VaR requires the assumption of a normal distribution. This is because the method utilizes the expected return and standard deviation of returns.

$$\text{VaR} = \left[\widehat{R}_p - (z)(\sigma)\right] V_p$$

where:

$\widehat{R}_p$ = expected return on the portfolio

V_p = value of the portfolio

z = z-value corresponding with the desired level of significance

σ = standard deviation of returns

Advantages of the analytical method include:

- Easy to calculate and easily understood.
- Allows modeling the correlations of risks.
- Can be applied to different time periods according to industry custom.

Disadvantages of the analytical method include:

- The need to assume a normal distribution.
- The difficulty in estimating the correlations between individual assets in very large portfolios.

The historical method for estimating VaR is sometimes referred to as the historical simulation method. The easiest way to calculate the 5% daily VaR using the historical method is to accumulate a number of past daily returns, rank the returns from highest to lowest, and identify the lowest 5% of returns. The highest of these lowest 5% of returns is the 1-day, 5% VaR.

Advantages of the historical method include:

- Easy to calculate and easily understood.
- No need to assume a returns distribution.
- Can be applied to different time periods according to industry custom.

The primary disadvantage of the historical method is the assumption that the pattern of historical returns will repeat in the future (i.e., is indicative of future returns).

The Monte Carlo method refers to computer software that generates hundreds, thousands, or more possible outcomes from the distributions of inputs specified by the user. After the output is generated it can be ranked from best to worst, just as in the historical method, to determine VaR at any desired probability.

The primary advantage of the Monte Carlo method is the ability to incorporate any returns distribution or asset correlation. This is also its primary disadvantage, however. The analyst must make thousands of assumptions about the returns distributions for all inputs as well as their correlations.

LOS 31.g

One primary *advantage* of VaR is the ability to compare the operating performance of different assets with different risk characteristics. A *disadvantage* of all methods for calculating VaR is that they suffer from the constant need to estimate inputs and make

assumptions, and thus the problem becomes more and more daunting as the number of assets in the portfolio gets larger.

Cash flow at risk (CFAR) measures the risk of the company's cash flows. CFAR is interpreted much the same as VaR, only substituting cash flow for value.

Earnings at risk (EAR) is analogous to CFAR only from an *accounting earnings* standpoint. Both CFAR and EAR are often used to add validity to VaR calculations.

Tail value at risk (TVaR) is VaR plus the expected value in the tail of the distribution, which could be estimated by averaging the possible losses in the tail.

Extensions of VaR: VaR can also be used to measure credit at risk, and efforts have been made to estimate a variation of VaR for assets with non-normal distributions.

LOS 31.h

Stress testing, which is typically employed as a complement to VaR, measures the impacts of unusual events that might not be reflected in the typical VaR calculation. Stress testing can take two forms: scenario analysis and stressing models.

Scenario analysis is used to measure the effect on the portfolio of simultaneous movements in several factors or to measure the effects of unusually large movements in individual factors.

Potential weaknesses in any scenario analysis include the inability to accurately measure by-products of major factor movements (i.e., the impact a major movement in one factor has on other factors) or include the effects of simultaneous adverse movements in risk factors.

Stressing models are extensions to the scenario analysis models and include factor push models, maximum loss optimization, and worst-case scenarios.

In factor push analysis, the analyst deliberately pushes a factor or factors to the extreme and measures the impact on the portfolio. Maximum loss optimization involves identifying risk factors that have the greatest potential for impacting the value of the portfolio and moving to protect against those factors. Worst-case scenario is exactly that the analyst simultaneously pushes all risk factors to their worst cases to measure the absolute worst case for the portfolio.

Because stressing models are just another version of scenario analysis, they suffer from the same potential problems; specifically, incorrect inputs and assumptions as well as the possibility of user bias.

LOS 31.i

Credit risk is the possibility of default by the counterparty to a financial transaction. The monetary exposure to credit risk is a function of the probability of a default event and the amount of money lost if the default event occurs.

At the settlement date for a forward contract, one or both parties will have to pay the other. The value of the forward contract (the associated credit risk) is the present value of any net payoff.

A swap should be thought of as a series of forward contracts, so the credit risk associated with a swap is *potential* until each settlement date. Likewise, the value of a swap is the present value of future settlement payments.

Unlike forward and swap contracts, the credit risk to an option is only borne by the long position. The credit risk to a *European* option, even if it is in-the-money, can only be potential until the date it matures. The credit risk of an American option will be at least as great as a similar European option.

LOS 31.j

Risk budgeting is the process of determining which risks are acceptable and how total enterprise risk is allocated across business units or portfolio managers. In addition to VaR, methods for managing market risk include:

- A position limit places a nominal dollar cap on a given position. Position limits are generally used by upper management to help maintain the desired level of firm wide diversification.
- Liquidity limits are related to position limits. In an effort to minimize liquidity risk, risk managers will set dollar position limits according to the frequency of trading volumes.
- A performance stopout goes beyond the VaR measure by setting an absolute dollar limit for losses to the position over a certain period.
- In addition to a VaR allocation, the portfolio manager may be subject to individual risk factor limits. As the name implies, the manager must limit exposure to individual risk factors as prescribed by upper management.

LOS 31.k

Due to the lack of historical data, measures such as VaR (which assumes a normal distribution) are very difficult, if not inappropriate, to use in managing credit risk. Several non-VaR measures have been developed to help control credit risk.

- Limiting exposure means limiting the amount of loans to any individual debtor or the amount of derivative transactions with any individual counterparty.
- Marking to market is employed with many derivative contracts.
- Collateral is often required in transactions that generate credit risk.
- Payment netting is frequently employed in derivatives contracts that can generate credit exposure to both sides. When each side has credit risk, we value and net the two to determine which side has the greater obligation.
- It is always wise to impose minimum credit standards on a debtor.
- Risk can be transferred to someone else through credit derivatives such as credit default swaps, credit forwards, credit spread options, and total return swaps.

LOS 31.l

The Sharpe ratio measures excess return (over the risk-free rate) per unit of risk, measured as standard deviation. The principal drawback to applying the Sharpe ratio as a measure of risk-adjusted return is the assumption of normality in the excess return distribution. This is particularly troublesome when the portfolio contains options and other instruments with non-symmetric payoffs.

$$S_P = \frac{\overline{R}_P - \overline{R}_F}{\sigma_P}$$

Risk-adjusted return on invested capital (RAROC). RAROC is the ratio of the portfolio's expected return to some measure of risk, such as VaR. Management can then compare the manager's RAROC to his historical or expected RAROC or to a benchmark RAROC.

Return over maximum drawdown (RoMAD). Drawdown is the difference between a portfolio's high water marks and subsequent lows during a measurement period. The maximum drawdown is the largest drawdown over the total period.

$$\text{RoMAD} = \frac{\overline{R}_p}{\text{maximum drawdown}}$$

The Sortino ratio is the ratio of excess return to risk. Excess return for the Sortino ratio (the numerator) is calculated as the portfolio return less the minimum acceptable portfolio return (MAR). The denominator of the ratio is the standard deviation of returns calculated using only returns below the MAR.

$$\text{Sortino} = \frac{\overline{R}_p - \text{MAR}}{\text{downside deviation}}$$

LOS 31.m

Firms naturally want to allocate capital across business units to maximize total return on total capital. VaR and stress testing are useful tools in this process. VaR can be interpreted as a maximum loss at a given probability. It has the benefits of capturing the diversification benefits between business units and can be integrated with the firm's risk management process.

Stress testing is a natural complement to VaR by allowing the firm to consider even more extreme events.

Other methods of allocating capital include:

- Nominal, notional, or monetary position limits.
- Max loss limits.
- Internal and regulatory capital requirements.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 31.1

1. In determining the risks to report, the credit manager should consider market, credit, liquidity, operational, model, settlement, regulatory, legal, tax, accounting, sovereign, and political risks.
   - Market risk pertains to interest rates, exchange rates, and stock and commodity prices. The manager should report ABC's exposures to interest rates (because it borrows to cover short-term cash needs) and exchange rates (because of exposures to international foreign currencies).
   - The manager should report exposure to credit risk because the firm's customers no doubt buy on credit.
   - Liquidity risk, which pertains to the ability to buy/sell securities quickly at a fair price, is probably not a concern for ABC, unless it utilizes forward contracts on foreign currencies.
   - The firm will face operational risk to the extent that its business activities are sensitive to operational difficulties (e.g., interruptions in the transportation of products).
   - The firm faces model risk if it values its exposures to foreign currencies and attempts to take offsetting positions. Some exposures may be very difficult to determine accurately because they deal with customers all over the globe, and small currencies may be difficult to model.
   - Settlement risk applies to transactions that include payments due to and receipts due from counterparties. There is not enough information to make a determination on whether the firm faces settlement risk.
   - They are exposed to regulatory risk in that foreign countries can change regulations on imports and exports.
   - Legal risk pertains to the enforcement of contracts. Different international laws can make enforcement of contracts somewhat challenging if a foreign counterparty disputes the terms of a contract.
   - Any business is subject to the possibility of changing tax laws. Global trade exacerbates this problem, also.
   - The company may be exposed to accounting risk if it deals with less-developed nations that follow different and possibly changing accounting rules. Changing accounting rules can affect the profitability (business risk) of those customers.
   - Sovereign risk generally pertains to governments, so unless the company deals with a foreign government, sovereign risk is probably not a concern. If it does sell to foreign governments, payment of bills is always subject to the government's willingness and ability to pay.

- Political risks pertain to changing political climate. Even if the firm faces little domestic political risk, it is definitely exposed to the risks associated with the political climate of its trading partners. (LOS 31.d)

2. Financial risks:
   - Market risk: Factors that directly affect firm or portfolio values (e.g., interest rates, exchange rates, equity prices, commodity prices, etc.).
   - Liquidity risk: The possibility of sustaining significant losses due to the inability to take or liquidate a position quickly at a fair price.
   - Credit risk: Default of a counterparty. This risk can be mitigated through the use of derivative products, such as credit default options.

   Mitigating strategies for financial risks will typically include the use of financial and credit derivatives including options, futures and/or forward contracts, futures options, and swaps. (LOS 31.d)

3. Nonfinancial risks:
   - Operations risk (nonfinancial risk). The potential for failures in the firm's operating systems, including its ERM system, due to personal, technological, mechanical, or other problems.
   - Model risk (nonfinancial risk). Models are only as good as their construction and inputs (e.g., the assumptions regarding the sensitivity of the firm's assets to changes in risk factors, the correlations of the risk factors, or the likelihood of an event).
   - Sovereign risk: There are elements of credit risk here, as changes in spread will affect bond prices, but the underlying issues are political. The country must choose economically viable policies to be able to repay and be willing to repay.
   - Regulatory risk (nonfinancial). Different securities in the portfolio can fall under different regulatory bodies. Also, synthetic positions (combinations of two or more securities to create the effect of a totally different asset) can be quite confusing.
   - Some other risks (all nonfinancial) include political risk, settlement risk, tax risk, and legal risk, which relate directly or indirectly to changes in the political climate.

   Due to the difficulties in predicting the occurrence and size of a loss due to nonfinancial risks, managers will often simply purchase insurance protection. (LOS 31.d)

4. This "failure" in the ERM system is part of the operational risk associated with implementing the performance evaluation model (risk-adjusted performance compared to some benchmark), not a problem with the model itself. The first step in reacting to any risk management problem is determining the value of any damage and whether the problem is transient or permanent. In this case, the occurrence in question is not permanent in nature, and any monetary damage can be quickly and easily rectified. The likelihood of a similar occurrence in the future

is high, however, so management should be sure a process is in place to help reduce the likelihood of future incorrect data entries. (LOS 31.a, 31.d)

Module Quiz 31.2

1. To calculate VaR, we need the portfolio expected return and standard deviation:

$$\hat{R}_P = 0.75(0.09) + 0.25(0.13) = 0.0675 + 0.0325 = 0.10$$

$$\sigma_P^2 = (0.75)^2(0.18)^2 + (0.25)^2(0.21)^2 + 2(0.75)(0.25)(0.18)(0.21)(0.50) = 0.02807$$

$$\sigma_P = \sqrt{\sigma_P^2} = 0.1675$$

then:

$$\text{VaR} = V_P\left[\hat{R}_P - Z(\sigma_P)\right], \text{where } Z = 1.65$$

$$\text{VaR} = \$100{,}000\left[0.10 - 1.65(0.1675)\right] = -\$17{,}637$$

The manager is 95% confident the maximum loss over the coming year will not be greater than $17,637. Alternatively, the manager can say there is a 5% probability of a loss greater than $17,637 (i.e., that $17,637 is the minimum loss).

Advantages of the analytical method include:

- It is easy to calculate and easily understood.
- It allows modeling the correlations of risks.
- It can be applied to different time periods according to industry custom.

Disadvantages of the analytical method include:

- The need to assume a normal distribution.
- The difficulty in estimating the correlations of very large portfolios.
- No indication of the size of potential losses in the tail. (LOS 31.f)

2.

6.147	2.377	1.594	0.993	–0.672	–1.523
5.875	2.232	1.320	0.989	–0.749	–1.726
3.660	2.064	1.189	0.962	–0.851	–2.024
3.432	2.059	1.148	0.901	–1.112	**–2.250**
3.376	1.839	1.128	0.353	–1.182	**–3.359**
2.510	1.652	1.054	–0.231	–1.313	
2.388	1.609	0.996	–0.550	–1.367	

Using the historical method, 5% VaR is determined using the highest return of the lowest 5% of historical returns. With 40 returns, the bottom 5% would be the 0.05(40) = 2 lowest returns (highlighted in the table above). Because –2.25% is the higher of the two, the 5% historical VaR is (–2.25%)(1,500,000) = –$33,750.

The manager could say she is 95% confident that the portfolio will not experience a loss greater than $33,750. Alternatively, the manager could say with 5% significance that the minimum loss will be $33,750 (5% probability of a loss greater than $33,750).

Advantages of the historical method include:

- It is easy to calculate and easily understood.
- There is no need to assume a returns distribution.
- It can be applied to different time periods according to industry custom.

The primary disadvantage of the historical method is the assumption that the pattern of historical returns will repeat in the future (i.e., is indicative of future returns). (LOS 31.f)

3. Supplements (additions) to VaR used to provide more confidence in the accuracy of the VaR calculation include:
   - Incremental VaR (IVaR). IVaR is the effect of an individual asset on the overall risk of the portfolio. IVaR is calculated by measuring the difference between the portfolio VaR with and without the asset.
   - Cash flow at risk (CFAR). Some companies cannot be valued directly, which makes calculating VaR difficult or even meaningless. Instead of using VaR, CFAR measures the risk of the company's cash flows.
   - Earnings at risk (EAR) is analogous to CFAR only from an *accounting earnings* standpoint.
   - Tail value at risk (TVaR). TVaR is VaR plus the expected value in the tail of the distribution, which could be estimated by averaging the possible losses in the tail. (LOS 31.g)

Module Quiz 31.3

1. Methods used to limit credit risk include:
   - Limiting exposure, which means limiting the amount of loans to any individual debtor or the amount of derivative transactions with any individual counterparty.
   - Marking to market is employed with many derivative contracts. Contracts are settled on a regular basis, which means that profits and losses are settled.
   - Collateral is often required in transactions that generate credit risk. In derivatives markets, both parties are often required to post margin, and if the contract is marked to market, either side may be required to post addition margin (collateral).
   - Payment netting is frequently employed in derivatives contracts that can generate credit exposure to either side. The party with the net payment due is the only party at risk. Netting is also employed in *bankruptcy* proceedings. In this case, all the transactions between the bankrupt company and a single counterparty are netted to determine the overall exposure. (LOS 31.i)

2. The German manager (short position) has contracted with a U.S. bank to sell dollars at €0.8135, and the dollar has strengthened to €0.8170. The value of the contract to the long position is:

$$V_{\text{bank (long)}} = \frac{€8{,}170{,}000}{(1.04)^{2/12}} - \frac{€8{,}135{,}000}{(1.035)^{2/12}} = €28,278$$

The U.S. bank has the long position and credit risk of EUR 28,278. The German manager has no credit risk at this point. Credit risk is the value of the contract to the party with a gain. This is sometimes denoted as potential credit risk. (LOS 31.i)

Module Quiz 31.4

1. "The performance of each of the firm's portfolio managers will be assessed annually, and managers will be ranked from highest to lowest total return. Managers who have added the most value to their portfolios will receive increased capital allocations for the following year."

   Inappropriate. Senior management should allocate capital (consistently) on a risk-adjusted basis.

   "It is the responsibility of each portfolio manager to monitor and maintain the risk of the portfolio within normal, acceptable levels as described in the IPS."

   Inappropriate. A functional ERM system should provide for performance monitoring by a risk management committee that reports directly to upper management.

   Other characteristics of an ERM system:

   - The ERM system properly identifies and defines all relevant internal and external risk factors.
   - The ERM system utilizes an appropriate model for quantifying the potential impacts of the risk factors.
     - Does the model include correlations of the risk factors to enable management to evaluate the firm's overall risk position from a portfolio perspective?
     - Does the model allow for potential combinations of risk factors simultaneously impacting the firm?
     - Does the model allow for changing factor sensitivities?
   - Risks are properly managed.
     - Has management identified risks for which it has sufficient experience, information, and tools to provide effective management?
     - Has management identified risks it is uncomfortable with and that should be reduced or eliminated (hedged)?
     - There is a committee in place to oversee the entire system to enable timely feedback and reactions to problems.

- The ERM system has built-in checks and balances.
  - Does it provide for continual monitoring and feedback on the risk factors?
  - Does it provide for continual monitoring and feedback on the risk management system itself?
  - Does it evaluate the ability of the risk model to accurately estimate and quantify the risks?
  - Does it have a mechanism for incorporating newly identified risks? (LOS 31.j)

2. In calculating the traditional standard deviation, all returns for the measurement period are used (e.g., all the positive and negative alphas). This is like looking at the entire normal distribution, with the benchmark return as the center of the distribution. Negative alphas would fall to the left of the benchmark return, and positive alphas would fall to the right.

   The manager is arguing that only negative alphas are relevant for measuring risk. This would be analogous to using only the left half of that normal distribution. Using the Sortino ratio compensates for this by only using returns below a designated level.

   Excess return for the Sortino ratio (the numerator) is calculated as the portfolio return less the minimum acceptable portfolio return (MAR). The denominator of the ratio is the standard deviation of returns calculated using only returns below the MAR. The motivation behind the downside measure of volatility utilized in the Sortino ratio is the sense that very good performance (high returns) can unfairly inflate the volatility measure (the standard deviation used as the risk measure). (LOS 31.l)

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1. Eurozone is the name given to 19 countries that have adopted the euro as currency. They include Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain.

2. *Framework for Voluntary Oversight*, Derivatives Policy Group, March 1995.

TOPIC ASSESSMENT: RISK MANAGEMENT

Use the following information for Questions 1 through 6.

Mark Stober is a partner in SRM, a pension consulting firm. One of his clients is Quality Car Part Manufacturing. Richard Smitherspoon oversees the management of Quality's defined benefit pension plan. Smitherspoon is a conservative manager who follows a long-term investment strategy with low portfolio turnover. He asks Stober for advice on implementing a more formal risk management process to evaluate Quality's risk exposure on a quarterly basis.

Smitherspoon explains that he has received various opinions regarding VaR and its meaning. The firm's risk department has reported that Quality's daily 5% VaR is $5 million.

Opinion 1:	"VaR is a probability measure and that means with 95% confidence, your maximum one-day loss is $5 million."
Opinion 2:	"VaR is a measure that combines probabilities over a certain time horizon with dollar amounts; in your case that means losing a minimum of $5 million during ten trading days out of every 200 trading days."

Smitherspoon also expresses some bewilderment at the different methods for determining VaR. "Can't you risk-management types formulate a method using mean and standard deviation. I need a VaR that I can get my arms around."

Smitherspoon asks Stober if it would be possible to calculate the VaR for each individual portfolio manager in the defined benefit plan as well as the overall fund VaR. Stober replies:

Response 1:	"We can calculate the total fund VaR using each manager's historical return history and expected return, the time frame you wish to use, and the desired level of significance."
Response 2:	"To calculate VaR at the 5% probability we examine the point that is 1.96 standard deviations below expected return."
Response 3:	"We can then sum each manager's VaR to calculate the fund VaR directly."

Smitherspoon also expresses his confusion regarding some other measures of risk management. "I know beta and standard deviation, but what is all this option Greeks stuff?" Stober explains that delta is the first derivative of the call-stock price curve, and that gamma is the relationship for how the option price changes with time to option expiration.

The following week, Stober visits the headquarters of TopTech, a communications firm. Their CFO is Ralph Long. Long considers himself an expert on everything and personally manages the firm's pension plan by spotting upcoming trends and timing the market. Long also believes that annual risk measurement for TopTech is more than sufficient. Stober calculates TopTech's pension surplus to be $10 million. Plan assets are $500 million with an assumed 5% rate of return. Plan liabilities are projected to be

$530 million in one year. Stober based his analysis on a VaR using 2.33 standard deviations. Stober believes Long substantially underestimates the risk being taken in the plan and intends to estimate the plan funded status in one year.

1. Regarding the two opinions of VaR, which is *most correct*?
   A. Both opinions are correct.
   B. Neither opinion is correct.
   C. Only one of the opinions is correct, but not both.
2. Regarding Smitherspoon's request for a VaR he can get his arms around, which of the following calculation methods is *most appropriate*?
   A. The historical method.
   B. The variance-covariance method.
   C. The Monte Carlo simulation method.
3. Which of Stober's responses regarding VaR is *most correct*?
   A. Response 1.
   B. Response 2.
   C. Response 3.
4. Regarding Stober's explanation of delta and gamma:
   A. neither explanation is correct.
   B. both explanations are correct.
   C. only one explanation is correct.
5. If an annual VaR is calculated for both Quality and TopTech's pension plans, which VaR is *more likely* to be accurate?
   A. Quality.
   B. TopTech
   C. There is insufficient information to make a decision.
6. Based only on Stober's current information, assumptions, and projections, what is the expected plan surplus for TopTech in one year?
   A. –$20 million.
   B. –$5 million.
   C. $10.5 million.

TOPIC ASSESSMENT ANSWERS: RISK MANAGEMENT

1. **A** Opinion 1 is correct. The 5% VaR also tells you the most (maximum) you should lose 95% of the time.

   Opinion 2 is also correct. The 5% VaR directly tells you the minimum you are expected to lose 5% of the time. In 200 trading days, 5% is 10 of those trading days. VaR is based on a specified probability and time horizon. It can be expressed as a percent or amount of loss. (Study Session 16, Module 31.2, LOS 31.g)

2. **B** The variance-covariance method is based on estimates of the mean and standard deviation of returns, which is what Smitherspoon requested. (Study Session 16, Module 31.2, LOS 31.f)

3. **A** Response 1 is correct because with that set of data it is possible to also calculate standard deviations of return and correlations among managers. Those can then be used to calculate portfolio VaR using the variance-covariance method.

   VaR is a one-tailed analysis and 5% in a single tail is 1.65 standard deviations below the expected return. Also, 1.96 standard deviations would only leave 2.5% in the single tail.

   The individuals VaRs would only add up if all risk exposures were perfectly correlated at +1, which is an unrealistic assumption. Given diversification effects, the total VaR will be less than the sum of the individual VaRs. (Study Session 16, Module 31.2, LOS 31.g)

4. **C** The delta comment is correct. Delta is the first derivate of the option's price as a function of the price of the underlying. Delta is change in the option for change in the underlying. The comment on time is incorrect. The relationship for how the option price changes with change in time to option expiration is called theta. Gamma measures change in value of the option as delta changes. (Study Session 16, Module 31.3, LOS 31.j)

5. **A** Smitherspoon is a conservative manager who follows a long-term investment strategy with low portfolio turnover. Therefore, the data used in calculating Quality's VaR is more likely to be relevant to future events. Long considers himself an expert on everything and personally manages the firm's pension plan by spotting upcoming trends and timing the market. Therefore, it will be hard to anticipate how he or the portfolio will actual behave. There is no guarantee but there is sufficient information to expect projections for Quality will be more reliable and VaR is just a projection of what may happen. (Study Session 16, Module 31.2, LOS 31.f)

6. **B** Current plan assets are 500 million with an assumed growth rate of 5%, giving a projected asset value of 525 million in one year. Projected liabilities are explicitly stated to be 530 million making the surplus projection –5 million. The statement

regarding 2.33 standard deviations is a distractor and cannot be used to solve this question. The case says Stober based his analysis on a VaR using 2.33 standard deviations. So, 2.33 standard deviations is already reflected in the case facts used to project a surplus of –5 million. To directly use the 2.33, we would have to know the standard deviation that goes with it. So, be careful not to become distracted by irrelevant and unusable data when solving any specific question. Note that it is reasonable to consider surplus a form of capital that is at risk of loss. (Study Session 16, Module 31.4, LOS 31.m)

The following is a review of the Risk Management Applications of Derivatives principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #32.

READING 32: RISK MANAGEMENT APPLICATIONS OF FORWARD AND FUTURES STRATEGIES

Study Session 17

EXAM FOCUS

Be able to perform any of the calculations using futures contracts to alter the beta of an equity portfolio, alter the duration of a bond portfolio, change the portfolio allocation among various classes of debt and equity, create synthetic positions, or preinvest an expected cash flow. Understand the basic concepts and risks involved.

MODULE 32.1: HEDGING WITH FUTURES AND FORWARDS

Video covering this content is available online.

The CFA curriculum includes a long section of optional material that has no Learning Outcome Statements and will not be tested directly. It does review how to calculate the number of contracts to modify duration of a fixed income position and you are responsible for those calculations. The formulas are consistent with those covered earlier in the fixed income lesson but are laid out in a different form. We will cover the calculations in this reading assignment and review the formulas needed.

Forward and futures contracts are effective tools for managing both interest rate and equity risks. Although very similar, however, one or the other may be preferred in some cases. The primary differences between the two are that forward contracts can be tailored to meet the specific needs of the counterparties but have higher default risk and less liquidity than futures. In contrast, futures contracts are standardized, so they are less likely to be exactly what the two parties need; however, they trade on an exchange, so the risk of loss from default is minimal.

ADJUSTING THE PORTFOLIO BETA

LOS 32.a: Demonstrate the use of equity futures contracts to achieve a target beta for a stock portfolio and calculate and interpret the number of futures contracts required.

CFA® Program Curriculum, Volume 5, page 227

To modify the beta of an equity portfolio with futures on an equity index, we need to know the beta of the equity portfolio to be hedged or leveraged, as well as the beta of the futures contract. Both betas would be measured with respect to the reference index.

You might ask, "Shouldn't the beta of the index futures contract equal one?" The answer is no, for two reasons. First, for an index like the S&P 500, it will probably be close to one, but for a more precise hedge, a manager should compute the beta. Second, as seen later, we may wish to adjust exposure with respect to a class of equity (e.g., small-cap stocks) where the beta will be very different from one.

Recall the formula for beta:

$$\beta_i = \frac{Cov(i,m)}{\sigma_m^2}$$

where:

$i =$ an individual stock, equity portfolio, or equity index

$Cov(i,m) =$ covariance of returns on asset i with the market

$\sigma_m^2 =$ variance of the market returns

Having computed our betas and selected a *target beta*, we can find the appropriate number of contracts to sell or buy to hedge or leverage the position (reduce or increase beta), respectively:

$$\text{number of contracts} = \left(\frac{\beta_T - \beta_P}{\beta_f}\right)\left(\frac{V_p}{P_f(\text{multiplier})}\right)$$

where:

β_T = desired portfolio beta

β_P = portfolio beta

β_f = equity futures contract beta

V_p = current value of the portfolio

P_f = futures price

PROFESSOR'S NOTE

If you recall the earlier fixed income hedging formula you should recognize this is essentially the same formula but using beta instead of duration as the risk measure. In addition, there is no yield beta for stock.

EXAMPLE: Adjusting portfolio beta

A manager of a $5,000,000 portfolio wants to increase the beta from the current value of 0.8 to 1.1. The beta on the futures contract is 1.05, and the total futures price is $240,000.

Calculate the required number of futures contracts to achieve a beta of 1.1.

Calculate the required number of futures contracts to achieve a beta of 0.0.

Answer:

target beta = 1.1

$$\text{number of contracts} = \left(\frac{1.1-0.8}{1.05}\right)\left(\frac{\$5{,}000{,}000}{\$240{,}000}\right)$$

$$= 5.95, \text{ buy 6 contracts at } \$240{,}000$$

Answer:

target beta = 0.0

$$\text{number of contracts} = \left(\frac{0-0.8}{1.05}\right)\left(\frac{\$5{,}000{,}000}{\$240{,}000}\right) =$$

$$-15.87, \text{ sell 16 contracts at } \$240{,}000$$

HEDGING IS RARELY PERFECT

It is highly unusual for the results of the risk adjustment to be perfect. Generically this is referred to as basis risk. Basis risk occurs whenever the item hedged (in the numerator of the hedge formula calculation) is not a perfect match for the hedging vehicle (in the denominator of the hedge formula) and, as a result, the two change in relationship to each other in unpredictably ways. The typical reasons for basis risk include:

- The numerator and denominator are not based on the same item. For example:
  - A stock portfolio hedged using a contract based on the S&P 500 Index.
  - A bond portfolio hedged with a Treasury bond contract based on a single deliverable Treasury bond.
- The betas and durations used in the hedge calculation do not reflect the actual subsequent market value changes of the portfolio or contract, a very common issue.
- The hedge results are measured prior to contract expiration and/or the hedge is closed prior to contract expiration. Alternatively, the hedge may need to be extended after the expiration of the initial contract position.
  - Note: If a contract is held to expiration, the contract price will converge and be equal to the spot price of the underlying at expiration, a relationship called convergence. This is not basis risk because it is a known change between spot and forward price. Holding contracts to expiration reduces basis risk.
- The number of contracts is rounded.
  - The exam convention is to round 0.5 or greater up to the closest whole number and round less than 0.5 down.
- The future and spot price are not fairly priced based on the cash and carry arbitrage model.

Effective beta of the position can be measured ex post (after the fact) as:

effective beta = % change in value of the portfolio / % change in the index

EXAMPLE: Ex Post Results Evaluation

Continuing the previous example, assume the unhedged portfolio increased in value 5.1% from $5,000,000 to $5,255,000, and the futures price also increased 5.1% from 240,000 to 252,240. One month remains to contract expiration. The market had a return of 5.2%. For each scenario, **compute** the i) hedged portfolio ending value, ii) the ex post beta, and iii) give two relevant reasons the ex post beta was not as expected.

Answers:

Scenario 1, target beta of 1.1 and 6 (not 5.95) contracts purchased:

i. hedged portfolio ending value = unhedged ending value + G/L on contracts

The contract price increased $12,240 for a gain on the long position of:

$12,240 × 6 = $73,440

hedged portfolio ending value = $5,255,000 + 73,440 = $5,328,440

hedged portfolio return = (5,328,440 / 5,000,000) – 1 = +6.57%

ii. The effective beta was: 6.57 / 5.2 = 1.26.

iii.

- The number of contracts was rounded up, which in a rising market, increased the gain and hedged portfolio percent return and effective beta of the hedged portfolio.
- The ex post valuation period was not at contract expiration. The relationship of futures and underlying prices can, therefore, change in unexpected ways.
- The performance of the portfolio and/or index may have been different from their ex ante betas. Given that the portfolio and contract increased by the same percent amount, they acted as if their betas were the same and did not reflect the initial estimates of beta.

Scenario 2, target beta of 0 and 16 (not 15.87) contracts sold:

i. hedged portfolio ending value = unhedged ending value + G/L on contracts

The contract price increased $12,240 for a loss on the short position of:

$12,240 × 16 = $195,840

hedged portfolio ending value = $5,255,000 – 195,840 = $5,059,160

hedged portfolio return = (5,059,160 / 5,000,000) – 1 = +1.18%

ii. The effective beta was: 1.18 / 5.2 = 0.23.

iii.

- The number of contracts sold was rounded up, which in a rising market, increased the loss on the short position and reduced the percent return on the hedged portfolio and its effective beta.
- The ex post valuation was not at contract expiration. The relationship of futures and underlying prices can, therefore, change in unexpected ways.
- The performance of the portfolio and/or index could have been different from their ex ante betas. Because ex post beta was higher than the target of zero, the portfolio beta must have been higher or futures beta less than expected. The portfolio could have acted as if its beta were more than 0.8 and/or the contract beta less than 1.05.

? ? ?

MODULE QUIZ 32.1

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

1. The duration of a bond portfolio is 6, and the duration of the most appropriate bond futures contract is 4. The size of the portfolio is 24 times the total futures price. The yield beta of the futures contract is 1. The *most appropriate* strategy to completely hedge the portfolio against changes in interest rates is:

A. short 1 futures contract.
B. go long 24 futures contracts.
C. short 36 contracts.

2. A manager of a $10,000,000 portfolio wants to decrease the beta from the current value of 1.6 to 1.2. The beta on the futures contract is 1.25, and the total futures price is $250,000. Using the futures contracts, **calculate** the appropriate strategy.

```
= (1.2-1.6) /1.25 * 1000w/25w=-12.8
```

MODULE 32.2: MORE APPLICATION

Altering Bond Exposure Using Contracts

Video covering this content is available online.

PROFESSOR'S NOTE

We are placing the LOS "out of numeric order" to move immediately into the use of futures to modify portfolio risk and return characteristics. This has been a well tested area and is a main focus of the reading.

We will return to the discussion of synthetic positions after that. Synthetic positions appear at first glance to be very complicated. In reality, they are a very small adjustment to basic hedging to achieve only one purpose: to force the beginning and ending value of the hedged position to more precisely replicate the beginning and ending value of positions if actual security trades had been made instead of using derivatives. Most users of futures contracts do not make this minor, "synthetic adjustment."

LOS 32.d: Demonstrate the use of equity and bond futures to adjust the allocation of a portfolio between equity and debt.

CFA® Program Curriculum, Volume 5, page 241

The same formula used to adjust equity beta can be used to adjust bond duration by using duration instead of beta in the calculation.

TARGET DURATION

The number of futures contracts needed to combine with a bond to achieve a targeted portfolio duration is:

$$\text{number of contracts} = (\text{yield beta})\left(\frac{MD_T - MD_P}{MD_F}\right)\left(\frac{V_p}{P_f(\text{multiplier})}\right)$$

where:

V_p = current value of the portfolio

P_f = futures price

MD_T = target (desired) modified duration

MD_P = modified duration of the portfolio

MD_F = modified duration of the futures

PROFESSOR'S NOTE

Superficially the formula looks different than one seen in fixed income. The results are the same.

$$\text{number of contracts} = \frac{(D_T - D_P)P_P}{D_{CTD}P_{CTD}}(\text{CTD conversion factor})$$

- If yield beta is not given, it is implicitly assumed to be 1.0 and irrelevant. If it is given, include it as a multiplier.
- One formula uses D, and one uses MD. This is just notation difference in the two readings. The duration of the CTD is the duration of the contract.
- P_f (multiplier) is the full value of the contract. The fixed income reading assignment gave that number directly and used it. This assignment shows you it is calculated as P_f (multiplier).
- This reading assignment uses the price of the futures contract while the fixed income assignment used price of the CTD and its conversion factor. The conversion factor is the link between these two prices, making the two formulas identical mathematically.

The bottom line is to know both formulas and use the one for which inputs are given.

EXAMPLE: Altering duration

A) The manager has a bond portfolio with a value of $103,630 and a holding period of one year. The 1-year total futures price is $102,510. The modified duration of the portfolio and futures contracts are 1.793 and 1.62, respectively. The yield beta is 1.2.

Calculate the number of contracts to reduce the portfolio duration to 0.

Answer:

$$\text{number of contracts} = (1.2)\left(\frac{0-1.793}{1.62}\right)\left(\frac{\$103{,}630}{\$102{,}510}\right) = -1.34$$

Sell one contract at 102,510. This is going to produce a rather significant rounding error.

B) Suppose the manager wants to change the portfolio duration from 1.793 to 3.0.

Calculate the number of contracts to increase duration to 3.

Answer:

$$\text{number of contracts} = (1.2)\left(\frac{3-1.793}{1.62}\right)\left(\frac{\$103{,}630}{\$102{,}510}\right) = 0.9$$

$$\rightarrow \text{buy one contract at } 102{,}510$$

ADJUSTING PORTFOLIO ASSET ALLOCATION

Adjusting asset allocation uses the same number of contracts formulas but requires multiple steps:

- Adjustments are often stated as percent allocations; however, the calculations require dollar or other nominal amounts (e.g., a 10% shift of a EUR 50M portfolio is a EUR 5M V_p).
- Changing an allocation requires selling contracts to remove one exposure and buying contracts to create a different exposure.

EXAMPLE: Altering debt and equity allocations

A manager has a $50 million portfolio that consists of 50% stock and 50% bonds (i.e., $25 million each).

- The beta of the stock position is 0.8.
- The modified duration of the bond position is 6.8.

The manager wishes to achieve an effective mix of 60% stock (i.e., $30 million) and 40% bonds (i.e., $20 million). Because the move is only temporary, and rather than having to decide which bonds to sell and which stocks to buy to achieve the desired mix, the manager will use futures contracts.

- The price of the stock index futures contract is $300,000 (including the multiplier), and its beta is 1.1.
- The price, modified duration, and yield beta of the futures contracts are $102,000, 8.1, and 1, respectively.

Determine the appropriate strategy.

Answer:

The desired shift is $5,000,000. Sell bond contracts to reduce duration to 0 on a $5,000,000 position:

$$\begin{aligned}\text{number of bond futures} &= (\text{yield beta})\left(\frac{\text{MD}_\text{T}-\text{MD}_\text{P}}{\text{MD}_\text{f}}\right)\left(\frac{\text{V}_\text{p}}{\text{P}_\text{f}(\text{multiplier})}\right)\\ &= (1)\left(\frac{0.0-6.8}{8.1}\right)\left(\frac{\$5{,}000{,}000}{\$102{,}000}\right) = -41.2\end{aligned}$$

Sell 41 bond contracts at 102,000.

Buy equity contracts targeting the desired beta of 0.8 on $5,000,000:

$$\begin{aligned}\text{number of equity index futures} &= \left(\frac{\beta_\text{t}}{\beta_\text{f}}\right)\left(\frac{\text{V}_\text{p}}{\text{P}_\text{f}(\text{multiplier})}\right)\\ &= \left(\frac{0.8}{1.1}\right)\left(\frac{\$5{,}000{,}000}{\$300{,}000}\right)\\ &= (0.727)\,(16.666) = 12.12\end{aligned}$$

Buy 12 equity contracts at 300,000.

ADJUSTING THE EQUITY ALLOCATION

LOS 32.e: Demonstrate the use of futures to adjust the allocation of a portfolio across equity sectors and to gain exposure to an asset class in advance of actually committing funds to the asset class.

CFA® Program Curriculum, Volume 5, page 245

The same process can be used to make any portfolio asset allocation, as long as the appropriate contracts to buy and sell are available.

EXAMPLE: Changing equity allocations

A manager of $20 million of mid-cap equities would like to move half of the position to small-cap equities. The beta of the mid-cap position is 1.1, and the average beta of small-cap stocks is 1.5. The betas of the corresponding mid- and small-cap futures contracts are 1.05 and 1.4, respectively. The mid- and small-cap futures total prices are $244,560 and $210,500, respectively. **Determine** the appropriate strategy.

Answer:

The desired reallocation is $10,000,000. Sell mid-cap contracts and buy small-cap contracts.

$$\text{number of contracts}_{\text{mid cap}} = \left(\frac{0-1.1}{1.05}\right)\left(\frac{\$10{,}000{,}000}{\$244{,}560}\right) = -42.84$$

Sell 43 mid-cap contracts at 244,560.

$$\text{number of contracts}_{\text{small cap}} = \left(\frac{1.5-0}{1.4}\right)\left(\frac{\$10{,}000{,}000}{\$210{,}500}\right) = 50.90$$

Buy 51 small-cap contracts at 210,500.

PREINVESTING

Preinvesting refers to buying contracts in anticipation of cash that will be received. Buying contracts does not require initial cash flow, which makes contracts a natural vehicle for such transactions. It is assumed the account has other assets that can be posted to meet margin requirements. Because this is hedging a future value amount, it is most appropriate to refer to this as a synthetic position.

EXAMPLE: Preinvesting

A portfolio manager knows that $5 million in cash will be received in a month. The portfolio under management is 70% invested in stock with an average beta of 0.9 and 30% invested in bonds with a duration of 4.8. The most appropriate stock index futures contract has a total price of $244,560 and a beta of 1.05. The most appropriate bond index futures have a yield beta of 1.00, an effective duration of 6.4, and a total price of $99,000. **Determine** the appropriate strategy to synthetically preinvest the $5 million in the same proportions as the current portfolio.

Answer:

The goal is to create a $3.5 million equity position (0.7 × $5 million) with a beta of 0.9 and a $1.5 million bond position (0.3 × $5 million) with a duration of 4.8:

$$\text{number of stock futures} = \left(\frac{0.9-0}{1.05}\right)\left(\frac{\$3{,}500{,}000}{\$244{,}560}\right) = 12.27, \text{ buy 12 contracts at 244,560}$$

$$\text{number of bond futures} = (1.0)\left(\frac{4.8-0}{6.4}\right)\left(\frac{\$1{,}500{,}000}{\$99{,}000}\right) = 11.36, \text{ buy 11 contracts at 99,000}$$

The manager should take a long position in 12 stock index futures and 11 bond index futures.

PROFESSOR'S NOTE

The anticipated $5,000,000 has no duration or beta.

MODULE QUIZ 32.2

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

1. A portfolio manager expects a large cash inflow in the near future and wishes to preinvest the cash flow to earn an equity market return. The *most appropriate* strategy is to take:
   A. a short position in a stock index futures contract today.
   B. a long position in a stock index futures contract today.
   C. a short position in a stock index futures contract when the cash is received.
2. Portfolio Management, Inc., (PMI) expects a cash flow of $10,000,000 in two months. The composition of the PMI portfolio is 40% large-cap equities, 40% small-cap equities, and 20% bonds. Using the following information, **determine** the appropriate strategy for PMI managers to synthetically preinvest the $10,000,000, so that it earns returns equivalent to those of their current positions.
   - Large-cap beta = 0.9; small-cap beta = 1.35; bond duration = 6.3; yield beta = 1.0.
   - Large-cap futures beta = 1.0; small-cap futures beta = 1.30.
   - Treasury futures duration = 5.8.
   - Large-cap futures price = $1,400, multiplier = $250; (= $350,000).
   - Small-cap futures price = $1,100, multiplier = $250; (= $275,000).
   - Treasury futures price = $100,000.

3. A manager has a $100 million portfolio that consists of 70% stock and 30% bonds. The manager wishes to achieve an effective mix of 50% stock and 50% bonds.
   - The beta of the stock position is 1.2.
   - The modified duration of the bond position is 4.0.
   - The price and beta of the stock index futures contracts are $225,000 and 1.0, respectively.
   - The price, modified duration, and yield beta of the futures contracts are $100,500; 5; and 1, respectively.

   Determine the appropriate strategy.

4. A manager of $10 million of large-cap equities would like to shift 25% of the position to mid-cap equities. The beta of the large-cap position is 0.8, and the average beta of mid-cap stocks is 1.2. The betas of the corresponding large and mid-cap futures contracts are 0.75 and 1.25, respectively. The large- and mid-cap total futures prices are $9,800 and $240,000, respectively. **Determine** the appropriate strategy.

MODULE 32.3: SYNTHETIC POSITIONS

LOS 32.b: Construct a synthetic stock index fund using cash and stock index futures (equitizing cash).

CFA® Program Curriculum, Volume 5, page 233

Video covering this content is available online.

Synthetic positions are based on the same formulas using beta or duration to modify portfolio risk. However, synthetic positions more precisely replicate the same initial investment and ending results that would have occurred if the replicated position had been owned instead. Synthetic equity or bond positions require purchasing contracts and holding sufficient cash equivalents earning the risk-free rate to pay for the contracts at expiration. Alternatively, synthetic cash positions involve holding the underlying and shorting contracts to hedge the position in such a way that the hedged position "earns" the risk-free rate over the hedging period.

In both cases, the number of contracts is computed using the previous risk modification formulas; however, the quantity to hedge (in the numerator of the hedging formula) is the FV of the amount to modify.

- If the objective is to create synthetic equity from cash and the desired β_T is the same as the β_F, then the first term in the calculation becomes $(\beta_T - 0) / \beta_F = 1.0$. Because it has no effect on the calculation, the betas can be "ignored."
- If the objective is to create synthetic cash from equity and the existing β_P is the same as the β_F, then the first term in the calculation becomes $(0 - \beta_P) / \beta_F = -1.0$. Because it has no effect on the calculation, the betas can be "ignored."
- In other cases, the existing or desired betas are not the same as the futures beta and will be given. In such cases, the betas are used and do affect the computation.

The cash equivalents in the synthetic position may be variously referred to as: cash equivalents, a bond or zero coupon bond, a risk-free bond or risk-free zero coupon bond, or any other equivalent terminology.

EXAMPLE: Synthetic Positions

Manager A holds $25,000,000 market value of 3-month Treasury bills yielding 1% and wishes to create $20,000,000 of synthetic S&P 500 stock exposure for three months. The S&P contract is priced at 1,750, the dollar multiplier is 250, and the underlying stocks have a dividend yield of 2.5%.

Calculate the number of contracts to buy or sell and the zero coupon position to take.

Answer:

Purchase 46 contracts. (Because no betas were given, it is presumed the desired beta is the same as the futures beta. Purely for illustration, assume they are both 1.07. They will have no effect.)

$$N_f = [(1.07 - 0)/1.07] \times \left[\left(\$20,000,000 \times 1.01^{3/12}\right) / (1,750 \times \$250)\right]$$

(FV)

$$= (1) \times (20,049,814/437,500) = 45.83 \approx 46$$

This is a full "purchase price" at expiration of: 46(1,750)($250) = $20,125,000

At 1% interest, the amount to invest in T-bills today is $20,125,000 / $1.01^{3/12}$ = $20,075,000. This is somewhat higher than the desired $20,000,000 because the number of contracts purchased was rounded

up.

Manager B has a large position in U.K. stocks that are similar to a major U.K. stock index. She wishes to create GBP 15,000,000 of synthetic cash earning 2.0% for a six-month period. The futures index contract is priced at 3,700 with a multiplier of 10. The stocks have a dividend yield of 3.0%.

Calculate the number of contracts to buy or sell and the amount of synthetic cash created.

Answer:

Sell 409 contracts. (Because no betas were given, it is presumed the portfolio beta is the same as the futures beta. Purely for illustration, assume they are both 0.95. They will have no effect.)

$$\begin{aligned} \mathbf{N_f} &= [(0.0 - 0.95)/0.95] \times \left[\left(15,000,000 \times 1.02^{6/12}\right)/(3,700 \times 10)\right] \\ &= (-1) \times (15,149,257/37,000) = -409.44 \approx -409 \end{aligned}$$

This is a full "price" at expiration of: 409(3,700)(10) = 15,133,000

At 2% interest, the present value invested today in risk-free assets is 15,133,000 / $1.02^{6/12}$ = GBP 14,983,903. This is somewhat less than the desired GBP 15,000,000 because the amount hedged (number of contracts sold) was rounded down.

WHY FUTURE VALUE (FV) IS USED IN THE SYNTHETIC CALCULATIONS

The use of the risk-free rate and FV would, in a perfect hedge, mean the synthetic position completely replicates the beginning and ending results that would have been obtained if the desired synthetic position had been actually held. This can be seen by evaluating the results achieved with the rounded number of contracts as either a theoretical delivery of the underlying (which may or may not be allowed by the contract) or by comparing the initial investment as well as ending gains or losses in the synthetic position with those from having held an actual position.

- For delivery analysis, it is expedient and acceptable to view the contract price as a price per share and the number of contracts × contract multiplier as the number of shares.
- Recall the contract price is based on the cash and carry arbitrage relationship studied at Level II. F_0 is the FV of S_0 minus the FV of any dividends to occur during contract life on the underlying.
- The dividend yield is, therefore, already "priced" into the contract price. Alternatively, the dividend yield would have been earned if the underlying were owned.
- The analysis must be based on the rounded number of contracts actually used because fractional contracts do not exist.

Performance of a Synthetic Position if Delivery is Allowed

To illustrate, return to the example of Manager A who wishes to create $20,000,000 of synthetic S&P 500 stock exposure for three months when the risk-free rate is 1%. The S&P contract is priced at 1,750, the dollar multiplier is 250, the underlying index has a

dividend yield of 2.5%, and it is priced at 1,756.461648 (6 decimals are used only to demonstrate the accuracy of the analysis).

The manager purchased 46 contracts, not the desired fractional number of 45.82.

This is conceptually equivalent to buying 46 × 250 = 11,500 shares at a forward price of 1,750.

This is a PV amount invested today of:

$$[46(1{,}750)(\$250)] / 1.01^{3/12} = \$20{,}125{,}000 / 1.01^{3/12} = \$20{,}075{,}000$$

That, of course, also means that if $20,075,000 were invested today at the risk-free rate of 1%, it will be worth $20,125,000 and it will have earned interest of $50,000. The ending amount can be used to pay the contracted price of 1,750 on 11,500 shares. The investor will then own 11,500 shares worth S_T.

Alternatively, the $20,075,000 could have been used to buy shares initially. If they were purchased, the dividends can then be reinvested in the purchase of more shares.

- The shares purchased today will be the contracted number of shares discounted by the dividend yield. This is $(46 \times 250) / 1.025^{3/12} = 11{,}429.227$
- A more direct way to calculate this is the initial investment amount divided by today's share price. This is: $20,075,000 / 1,756.461648 = 11,429.228
- The two approaches are equivalent because the spot and future price relationship reflects the initial dividend yield and risk-free rate. (Ignoring the small rounding discrepancy.)
- Reinvesting the dividends, this will be $11{,}429.227 \times 1.025^{3/12} = 11{,}500$ shares worth S_T at the end of the contract period.

The synthetic and actual ownership had the same initial investment, and both result in owning 11,500 shares worth S_T at contract expiration.

Performance of a Synthetic Position Based on G/L

PROFESSOR'S NOTE

The analysis of equivalence of synthetic and actual positions based on G/L or examples where both spot and futures price are given is not covered directly in the CFA text. It is included because we get questions from candidates about why the CFA text presumes delivery of the underlying items to settle the contract when this is generally not allowed. You may skip this entire note if you wish.

Assuming, as is done in the CFA text, that dividend yield and risk-free rates are compounded annual rates, then $F_0 = S_0 [(1 + r_f) / (1+ \text{dividend yield})]^T$. In the example, this is $1{,}750 = 1{,}756.461648(1.01 / 1.025)^{0.25}$.

For illustration, assume the ending stock and contract price are 1,900. They will be equal based on convergence.

The initial 11,429.227 shares at 1,756.461648 are worth $20,075,000. (Precision requires using infinite decimal places in all calculations). The ending shares (with dividend reinvestment) of 11,500 shares at 1,900 are worth $21,850,000. This is a gain of $1,775,000.

Recall the synthetic position holds cash equivalents and earns interest of $50,000. The futures price increases from the initial purchase price of 1,750 to 1,900 for a gain of (1,900 − 1,750)(46)(250) = 1,725,000, making the total gain $1,775,000.

Based on either delivery or G/L analysis, the synthetic and actual ownership produce the same result.

LOS 32.c: Explain the use of stock index futures to convert a long stock position into synthetic cash.

CFA® Program Curriculum, Volume 5, page 237

EXAMPLE: Synthetic Cash Position

Manager C holds equity positions similar to the Russell 2000 and wishes to synthetically convert $50,000,000 to cash equivalents for five months. He decides to use a contract overlay position rather than sell the stocks and then have to repurchase them. The Russell 2000 futures contract price is 1,135 with a multiplier of 500. The Russell Index dividend yield is 1.7%, and the zero coupon bond rate is 0.9%.

Calculate: i) the number of contracts for the position, ii) the effective beginning investment in cash equivalents, iii) the effective number of shares in the index converted to cash, and iv) assuming the index closes at 1,057, **demonstrate** the strategy is equivalent to having invested at the risk-free rate.

Answers:

i. The betas of the index and portfolio were not given, are assumed to be equal, and, therefore, do not affect the calculation. The number of contracts to sell is:

$$50{,}000{,}000(\underbrace{1.009^{5/12}}_{FV}) / (1{,}135)(500) = 50{,}187{,}010 / 567{,}500 = 88.44 \approx 88$$

ii. The effective initial amount of cash equivalents is:

$$[88(\$500)(1{,}135)] / 1.009^{5/12} = \$49{,}940{,}000 / 1.0037402 = \$49{,}753{,}910$$

iii. The effective number of shares converted to cash is:

$$88(500) / 1.017^{5/12} = 44{,}000 / 1.0070485 = 43{,}692.04$$

With dividends reinvested, this is ending shares of:

$$43{,}692.04(1.017^{5/12}) = 44{,}000$$

iv. At contract expiration, the index and contract price will converge to 1,057. The pay off on the short contract position is a gain because the contract price declined. The gain is:

$$(1{,}135 - 1{,}057)(88)(\$500) = \$3{,}432{,}000$$

The ending value of the shares is:

$$44{,}000(1{,}057) = \$46{,}508{,}000$$

This makes the total ending value $49,940,000 versus an initial synthetic cash position of $49,753,910 for an effective annual return:

$$(\$49{,}940{,}000 / \$49{,}753{,}910)^{12/5} - 1 = 0.9\%$$

This synthetic position produced a return equivalent to the initial risk-free rate of 0.9%.

MODULE QUIZ 32.3

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

1. A manager has a position in Treasury bills worth $100 million with a yield of 2%. For the next three months, the manager wishes to have a synthetic equity position approximately equal to this value. The manager chooses S&P 500 Index futures, and that index has a dividend yield of 1%. The futures price is $1,050, and the multiplier is $250. **Determine** how many contracts this will require and the initial *value* of the synthetic stock position.

MODULE 32.4: HEDGING CURRENCY

Video covering this content is available online.

LOS 32.f: Explain exchange rate risk and demonstrate the use of forward contracts to reduce the risk associated with a future receipt or payment in a foreign currency.

CFA® Program Curriculum, Volume 5, page 250

Three types of foreign exchange risk are:

1. **Transaction exposure:** This is when cash flow of one currency must be exchanged for another at a future date to settle a specific transaction. This risk can be hedged with derivatives. For example:
   - An exporter will receive foreign currency in payment for goods or services at a future date and is at risk if that currency depreciates. For example, a U.S. exporter has contracted sell EUR9 million to a European trade partner, exchange in 3 months. The spot exchange rate is USD1.10/EUR and the 3 month forward exchange rate is USD1.12/EUR. The spot market is not relevant because the EURs are not yet in hand. Fortuitously the forward rate of USD1.12 is more attractive and can be locked in by selling the EUR forward at USD1.12.
   - An importer must pay the foreign currency in exchange for goods or services at a future date and is at risk if that currency appreciates. For example, a U.K. company must pay CAD100 million in 6 months. The spot exchange rate is GBP0.51/CAD. and the 6 month forward exchange rate is GBP0.53/CAD. The cost of buying the CAD forward is higher than in the spot market but unfortunately the CAD are not yet needed. The forward market does allow the U.K. based company to lock in the GBP cost of the transaction at GBP0.53.
2. **Translation exposure:** This is when financial statements in one currency must be converted to a different currency. Accounting rules determine the translation method used and the effect on the parent company's financial statements. (Note

that the resulting gains or losses do not necessarily reflect real economic gain or loss and the CFA text does not discuss hedging such a risk.)

3. **Economic exposure:** This is less directly observable and occurs when currency volatility or changes in value affect the competitive standing of a business. For example, if Disney World in the U.S. incurs all revenue and expenses in the USD, a decline in the USD may be beneficial if it induces more foreign travelers to visit the U.S and Disney World. If this is the only effect on the company, profits and the stock price may increases. (Note that this issue may be discussed elsewhere under the concept of a minimum variance hedge ratio.)

Figure 32.1: Strategies for Hedging Expected Currency Positions

Contractual Agreement	Position	Action
Receiving foreign currency	Long	Sell forward contract
Paying foreign currency	Short	Buy forward contract

EXAMPLE: Managing exchange rate risk

Mach, Inc., is a U.S.-based maker of large industrial machines and has just received an order for some of its products. The agreed-upon price is £5 million (British pounds), and the delivery date is 60 days. The current exchange rate is $1.42 per pound, and the 60-day forward rate is $1.43 per pound. **Explain** the best way for Mach, Inc., to hedge the corresponding exchange rate risk.

Answer:

On the day the order comes in, Mach, Inc., effectively has a long position in pounds; therefore, it should take a short position in a forward contract. This contract would obligate Mach, Inc., to deliver the pounds that it will receive for dollars. Ideally, the contract would be to exchange the £5,000,000 for:

$7,150,000 = (5,000,000)($1.43)

According to the contract, in 60 days, Mach will exchange the £5,000,000 for $7,150,000. If it does not hedge and the realized spot rate in 60 days is $1.429, Mach will receive only $7,145,000 = 5,000,000($1.429), or $5,000 less than with the hedged position.

EXAMPLE: Exchange rate risk

U.S.-based Goblet, Inc., imports wine from France. It has just contracted to pay €8 million for a shipment of wine in 30 days. The current spot rate is €0.8/$, and the 30-day forward rate is €0.799/$. **Explain** the strategy Goblet, Inc., could employ to eliminate the exchange rate risk.

Answer:

Because Goblet, Inc., will have to pay euros, it is short the currency and should go long (buy) the forward contract. Goblet, Inc., should enter a forward contract that will allow it to buy the €8,000,000 it will need for the contract for $10,012,516 = €8,000,000 ($/€0.799).

What if Goblet, Inc., had not hedged, and the exchange rate is €0.7995/$ in 30 days? If this is the case, Goblet, Inc., would get the necessary €8 million from converting $10 million at that spot rate. The dollar cost would be $10,006,254 = €8,000,000($/€0.7995). Thus, without the contract, Goblet, Inc., would have been $6,262 dollars better off in the spot market.

HEDGING LIMITATIONS

LOS 32.g: Explain the limitations to hedging the exchange rate risk of a foreign market portfolio and discuss feasible strategies for managing such risk.

CFA® Program Curriculum, Volume 5, page 254

PROFESSOR'S NOTE

You are responsible for any of the calculations in this section, but they are covered elsewhere. It is important you focus on the implications of the math discussed here, not just the plug and do. We are returning to the issue of investing in foreign assets carrying two sources of return and risk. Remember that perfect hedging of the currency risk is unlikely, as that would require knowing the ending value of the asset at the start of the hedging period.

An equity investment in a foreign market has both equity risk and foreign exchange risk. That is, the foreign position will increase or decrease in value according to the activity in the foreign market, and then the domestic investor will face additional return volatility because of the uncertainty caused by fluctuations of the exchange rate. A foreign equity position may increase by 10%, but if the foreign currency depreciates by that much, the net change to the domestic investor is approximately zero.

The two hedging strategies utilized by global portfolio managers to manage the risk of a foreign-denominated portfolio involve selling forward contracts on the foreign market index (to manage market risk) and selling forward contracts on the foreign currency (to manage the currency risk). They can choose to hedge one or the other, both, or neither. Their four choices can be summed up as follows:

1. Hedge the foreign market risk and accept the foreign currency risk.
2. Hedge the foreign currency risk and accept the foreign market risk.
3. Hedge both risks.
4. Hedge neither risk.

Hedging Market Risk

To hedge the market value (i.e., market risk) of a foreign investment, the manager can short (i.e., sell forward) the foreign market index. The degree to which the portfolio is correlated with the market index will determine the effectiveness of the hedge. If the manager shorts the appropriate amount of the index and it is *perfectly correlated* with the portfolio of investments, the return from the hedging strategy must be the **foreign risk-free rate**.

If the same manager then chooses to hedge the currency risk, she knows the exact value of the foreign currency to hedge, and the return to the (double) hedging strategy must be the manager's **domestic risk-free rate**.

Hedging Currency Risk

An obvious problem faced when trying to hedge the foreign currency risk of a foreign investment is its uncertain future value. Managers use various strategies for managing the currency risk of a foreign portfolio, including:

- Hedging a minimum future value below which they feel the portfolio will not fall.
- Hedging the estimated future value of the portfolio.
- Hedging the initial value (i.e., the principal).

None of these strategies can eliminate all the currency risk. For example, even if management has determined a minimum future value below which the portfolio will not fall, they are still exposed to values above that. If they hedge the principal, portfolio gains are unhedged. A loss in portfolio value would represent an over-hedge (i.e., management has agreed to deliver too much of the foreign currency).

Another proposed strategy is doing nothing (i.e., hedging choice #4 noted previously). As long as the market and currency risks are not highly correlated, changes in the two values will tend to offset one another.

Hedging With Futures or Forwards?

Calculating and constructing the hedge treats futures and forwards interchangeably. There could be occasions when one or the other is favored for practical reasons. Some differences to know are:

- Futures are standardized contracts while forwards can be customized as to amount and expiration date.
- Futures are obligations of the exchange clearinghouse while forwards have counterparty risk.
- Futures are more regulated and transparent, and they require margin.

Empirically:

- Most bond and equity hedging is done with futures even though this usually creates some cross-hedge or basis risk because the futures provide ongoing liquidity and are continually priced.
- Hedging of interest payments or receipts is usually done with forwards (FRAs), so exact amounts and dates can be hedged.
- Likewise, currency hedging generally uses forwards to tailor amounts and dates.
- Eurodollar futures are a very large market but are mostly used by dealers and market makers to hedge their own business needs and positions and not used directly by final customers.

MODULE QUIZ 32.4

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

1. A domestic firm experiences a loss of revenue from the loss in sales caused by changes in value of the domestic currency. This type of loss is referred to as:
   A. translation risk.
   B. transaction risk.
   C. economic risk.
2. Sweat Pants, Inc., a U.S.-based firm, has entered into a contract to import £2,000,000 worth of wool from a firm in Scotland, and the spot exchange rate is $1.50/£. Management of Sweat Pants wants to alleviate the risk associated with the foreign currency. The forward exchange rate corresponding with the delivery

of the wool is $1.455/£. Which of the following would probably be the *best* tactic to use to alleviate the foreign exchange risk for Sweat Pants?

A. Sell £2,000,000 forward and agree to receive $2,910,000.
B. Buy £2,000,000 forward and agree to deliver $2,910,000.
C. Sell £2,000,000 forward and agree to receive $1,374,570.

3. A French investor has invested in a large, diversified portfolio of Japanese stocks. Which of the following tactics could be used to hedge the investment and target a return equal to the French risk-free rate?

A. Buy euros forward and sell the foreign equity index.
B. Sell euros forward and sell the foreign equity index.
C. Buy euros forward and buy the foreign equity index.

KEY CONCEPTS

LOS 32.a

Buy contracts to increase beta or duration. Sell contracts to decrease beta or duration.

$$\text{number of contracts} = \left(\frac{\beta_T - \beta_P}{\beta_f}\right)\left(\frac{V_p}{P_f(\text{multiplier})}\right)$$

where:

β_T = desired portfolio beta

β_P = portfolio beta

β_F = equity futures contract beta

V_p = current value of the portfolio

P_f = futures price

The same formula is used to calculate the number of bond contracts by replacing beta with duration. Yield beta is included as a multiplier if it is given, otherwise it is assumed to be 1.0.

LOS 32.b, 32.c

The same formulas used to adjust beta and duration can also be used to create synthetic positions. V_p must be replaced with a future value amount $V_p \times (1 + r_f)^T$.

Often the desired change in beta or duration is equal to the beta or duration of the contract being used (e.g., –1.1/1.1 or 0.97/0.97). This produces an absolute ratio of 1.00 and, as a result, the betas and durations do not affect the number of contracts calculation.

A synthetic equity position requires buying contracts and holding sufficient cash earning r_f to pay for the contracts at contract expiration.

The initial required cash position is:

$$\frac{(\text{number of contracts}_{\text{rounded}})(P_f)(\text{multiplier})}{(1+R_F)^T}$$

A synthetic cash position requires selling contracts and holding sufficient shares (with dividends reinvested in more shares) to provide the shares to deliver and close the short position.

The initial number of shares required is:

$$\frac{(\text{number of contracts}_{\text{rounded}})(\text{multiplier})}{(1+\text{dividend yield})^T}$$

LOS 32.d, 32.e

Adjusting asset allocation uses the same number of contracts formulas but requires multiple steps:

- Adjustments are often stated as percent allocations; however, the calculations require dollar or other nominal amounts (e.g., a 10% shift of a EUR 50M portfolio

is a EUR 5M V_p).

- Changing an allocation requires selling contracts to remove one exposure and buying contracts to create a different exposure.

LOS 32.f

1. Transaction exposure is the risk that changes in exchange rates will directly affect the value of a contracted payment in or receipt of a foreign currency.

   Derivatives are often used to hedge transaction exposure:

   Strategies for Hedging Expected Currency Positions

Contractual Agreement	Position	Action
Receiving foreign currency	Long	Sell forward contract
Paying foreign currency	Short	Buy forward contract

2. Translation exposure is the risk of converting financial statements in one currency to another currency.
3. Economic exposure is the risk that changes in currency value may affect competitive position, sales, and profits.

LOS 32.g

An equity investment in a foreign market has both equity risk and foreign exchange risk. The investment is exposed to both the change in value of the foreign investment measured in the foreign currency and the change in value of the foreign currency. This leads to four possible hedging strategies: hedge neither risk, hedge one but not the other risk, or hedge both risks. If both risks are perfectly hedged, all risk is removed and the hedged results should equal the investor's (not the foreign asset's) risk-free rate.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 32.1

1. **C** $\text{number of contracts} = (\text{yield beta})\left(\frac{-MD_P}{MD_f}\right)\left(\frac{V_P}{P_f(\text{multiplier})}\right)$

   $= (1)\left(\frac{-6}{4}\right)(24) = -36$

   Short 36 contracts to hedge the portfolio. (LOS 32.a)

2. $\text{number of contracts} = \frac{(1.2-1.6)(\$10{,}000{,}000)}{(1.25)(\$250{,}000)} = -12.8$, sell 13 contracts at 250,000

   (LOS 32.a)

Module Quiz 32.2

1. **B** The number of equity index futures is determined by dividing the expected cash position by the total price of the equity index. (LOS 32.e)

2. Because the portfolio is currently 40/40/20 large cap, small cap, and bonds, management should assume long positions in futures contracts in those proportions:

   40% small cap and large cap = $4,000,000 each; 20% bonds = $2,000,000

   Management should buy large-cap equity futures, small-cap equity futures, and Treasury futures:

$$\#\text{ equity futures} = \left(\frac{\beta_T - \beta_P}{\beta_f}\right)\left(\frac{V_P}{(P_f)(\text{multiplier})}\right)$$

$$\#\text{ large-cap contracts} = \left(\frac{0.9-0}{1.0}\right)\left(\frac{\$4{,}000{,}000}{\$350{,}000}\right) = 10.29, \text{ buy 10 at 350,000}$$

$$\#\text{ small-cap contracts} = \left(\frac{1.35-0}{1.3}\right)\left(\frac{\$4{,}000{,}000}{\$275{,}000}\right) = 15.10, \text{ buy 15 at 275,000}$$

$$\#\text{ Treasury futures} = \beta_{\text{Yield}}\left(\frac{D_T - D_P}{D_f}\right)\left(\frac{V_P}{P_f}\right)$$

$$\#\text{ contracts} = (1)\left(\frac{6.3-0}{5.8}\right)\left(\frac{\$2{,}000{,}000}{\$100{,}000}\right) = 21.72, \text{ buy 22 at 100,000}$$

   (LOS 32.e)

3. The desired shift in allocation is 20% of $100M = $20M. Sell stock contracts and buy bond contracts to achieve the desired 0 beta and 4.0 duration.

$$\text{number of stock futures} = \frac{(0-1.2)(\$20{,}000{,}000)}{(1.0)(\$225{,}000)}$$
$$= -106.67, \text{ sell 107 at 225,000}$$

$$\text{number of bond futures} = (1)\frac{(4-0.0)(\$20{,}000{,}000)}{(5)(\$100{,}500)}$$
$$= +159.20, \text{ buy 159 at 100,500}$$

(LOS 32.d)

4. The desired allocation shift is 25% of $10M = $2.5M. Sell large-cap and buy mid-cap equity contracts to achieve a large-cap beta of 0 and mid-cap beta of 1.2.

$$\text{number of contracts} = \frac{(0-0.8)(\$2{,}500{,}000)}{(0.75)(\$9{,}800)} = -272.11, \text{ sell 272 at 9,800}$$

$$\text{number of contracts} = \frac{(1.2-0)(\$2{,}500{,}000)}{(1.25)(\$240{,}000)}$$
$$= 10.0, \text{ buy 10 mid-cap at 240,000}$$

(LOS 32.e)

Module Quiz 32.3

1. $$\text{number of contracts} = \frac{(\$100{,}000{,}000)(1.02)^{0.25}}{(1{,}050)(\$250)} = 382.84, \text{ buy 383 at 1,050}$$

   This is equivalent to an initial investment of [(383)(1,050)(250)] / $(1.02)^{0.25}$ = $100,041,003. (LOS 32.b, 32.c)

Module Quiz 32.4

1. **C** This is economic exchange rate risk. (LOS 32.f)
2. **B** To alleviate the risk associated with moving foreign exchange values, Sweat Pants will enter a forward contract in which they agree to deliver $2,910,000 = ($1.455/£) (£2,000,000) and receive the £2,000,000 needed to pay for the wool. (LOS 32.f)
3. **A** The French investor is exposed to two sources of risk: change in value of the foreign stock market and change in value of the foreign currency. If both risks are eliminated, the position is risk-free and the investor earns his own domestic (French) risk-free rate.

   To hedge the foreign market, sell Japanese stock index futures forward. To hedge the foreign currency, sell the JPY forward (which is buy the investor's domestic currency, EUR) forward. (LOS 32.g)

The following is a review of the Risk Management Applications of Derivatives principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #33.

READING 33: RISK MANAGEMENT APPLICATIONS OF OPTION STRATEGIES

Study Session 17

EXAM FOCUS

As you read through this topic review, you will notice that almost all the LOS are quantitative, but do not just focus on the calculations. Instead, learn the underlying concepts. For example, you might memorize the equations associated with a bull spread as presented in the CFA text and not realize end of chapter questions presume you would have noticed the same result can be achieved in other ways. Interest rate collars have are an appealing choices for exam questions because many candidates are more familiar with options based on price, rather than options based directly on interest rates. Be prepared to work with either. For the exam, be sure you know the construction and payoffs for the strategies as well as their similarities. Be prepared for both item set and constructed response questions and for questions that integrate this material into determining the best solution for a given investor for a given set of facts.

MODULE 33.1: OPTION BASICS

Video covering this content is available online.

PROFESSOR'S NOTE

The next several pages up to Covered Calls and Protective Puts are review and have only one purpose: you must know the four basic payoff patterns of long or short a call or put and how to compute intrinsic value. These items are the starting point of the material assigned at Level III. Be sure you know it or nothing that follows makes much sense.

Option contracts have asymmetric payoffs. The buyer of an option has the right to exercise the option but is not obligated to exercise. Therefore, the maximum loss for the buyer of an option contract is the loss of the price (premium) paid to acquire the position, while the potential gains in some cases are theoretically infinite. Because option contracts are a zero-sum game, the seller of the option contract could incur substantial losses, but the maximum potential gain is the amount of the premium received for writing the option.

To understand the potential returns, we need to introduce the standard symbols used to represent the relevant factors:

X = strike price or exercise price specified in the option contract (a fixed value)
S_t = price of the underlying asset at time *t*
C_t = market value of a call option at time *t*

P_t = market value of a put option at time *t*

t = time subscript, which can take any value between 0 and *T*, where *T* is the maturity or expiration date of the option

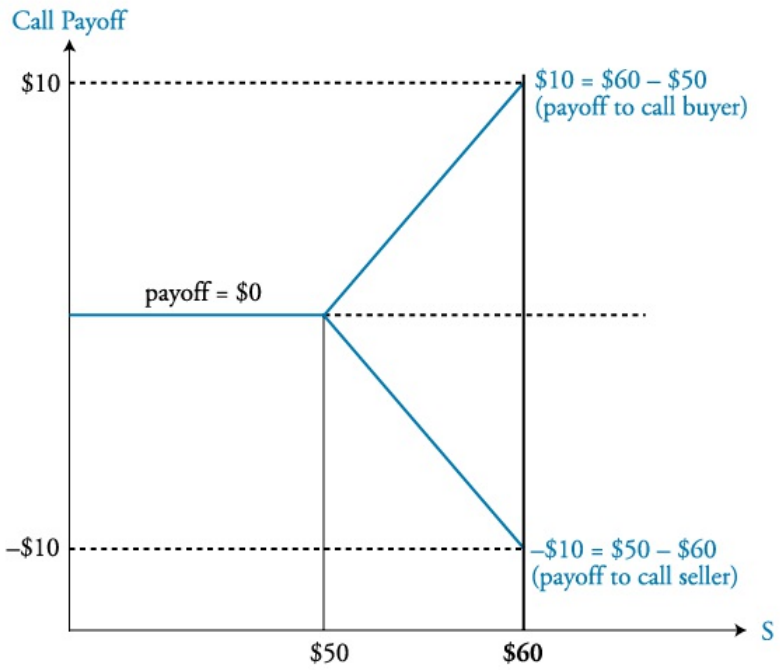
Call Options

A *call option* gives the *owner* the right, but not the obligation, to buy the stock from the seller of the option. The owner is also called the *buyer* or the holder of the *long position*. The buyer benefits, at the expense of the option *seller*, if the underlying stock price is greater than the exercise price. The option *seller* is also called the *writer* or holder of the *short position*.

At maturity, time *T*, if the price of the underlying stock is less than or equal to the strike price of a call option (i.e., $S_T \leq X$), the payoff is zero, so the option owner would not exercise the option. On the other hand, if the stock price is higher than the exercise price (i.e., $S_T > X$) at maturity, then the payoff of the call option is equal to the difference between the market price and the strike price ($S_T - X$). The "payoff" (at the option's maturity) to the call option seller, which will be at most zero, is the mirror image (opposite sign) of the payoff to the buyer.

Because of the linear relationships between the value of the option and the price of the underlying asset, simple graphs can clearly illustrate the possible value of option contracts at the expiration date. Figure 33.1 illustrates the payoff of a call with an exercise price equal to 50.

Figure 33.1: Payoff of Call With Exercise Price Equal to 50



PROFESSOR'S NOTE

A *payoff graph* ignores the initial cost of the option.

EXAMPLE: Payoff to the writer of a call option

An investor writes an at-the-money call option on a stock with an exercise price of $50 (X = $50). If the stock price rises to $60, what will be the *payoff* to the owner and seller of the call option?

Answer:

The call option may be exercised with the holder of the long position buying the stock from the writer at $50 for a $10 gain. The payoff to the option buyer is $10, and the payoff to the option writer is *negative* $10. This is illustrated in Figure 33.1, and as mentioned, does not include the premium paid for the option.

This example shows just how easy it is to determine option payoffs. At expiration time *T* (the option's maturity), the payoff to the option owner, represented by C_T, is:

$C_T = S_T - X$ if $S_T > X$

$C_T = 0$ if $S_T \leq X$

Discussion

Another popular way of writing this is with the "max(0, variable)" notation. If the variable in this expression is greater than zero, then max(0, variable) = variable; if the variable's value is less than zero, then max(0, variable) = 0. Thus, letting the variable be the quantity $S_0 - X$, we can write:

$$C_T = \max(0, S_T - X)$$

The payoff to the option seller is the negative value of these numbers. In what follows, we will always talk about payoff in terms of the option owner unless otherwise stated. We should note that $\max(0, S_t - X)$, where $0 < t < T$, is also the payoff if the owner decides to exercise the call option early. In this topic review, we will only consider time *T* in our analysis. Determining how to compute C_t when $0 < t < T$ is a complex task to be addressed later in this topic review.

Although our focus here is not to calculate C_t , we should clearly define it as the initial cost of the call when the investor purchases at time 0, which is *T* units of time *before T*. C_0 is the *call premium*. Thus, we can write that the profit to the owner at t = T is:

$$\text{profit} = C_T - C_0$$

This says that at time *T*, the owner's profit is the option payoff minus the premium paid at time 0. Incorporating C_0 into Figure 33.1 gives us the profit diagram for a call at expiration, and this is Figure 33.2.

Figure 33.2 illustrates an important point, which is that the profit to the owner is negative when the stock price is less than the exercise price plus the premium. At expiration, we can say that:

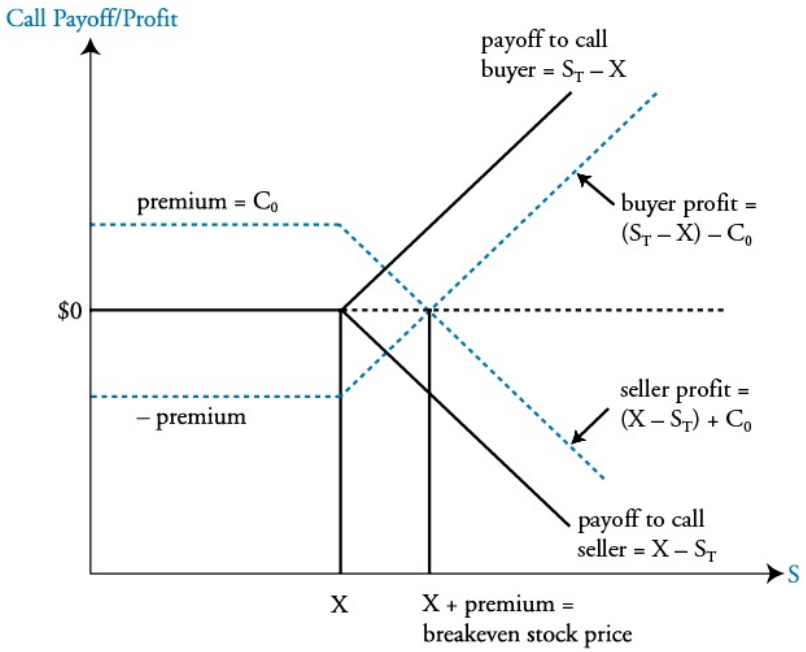
if $S_T < X + C_0$ then: call buyer profit < 0 < call seller profit

if $S_T = X + C_0$ then: call buyer profit = 0 = call seller profit

if $S_T > X + C_0$ then: call buyer profit > 0 > call seller profit

The ***breakeven*** *price* is a very descriptive term that we use for $X + C_0$, or X + premium.

Figure 33.2: Profit Diagram for a Call at Expiration



Put Options

If you understand the properties of a call, the properties of a put should come to you fairly easily. A ***put*** *option* gives the owner the right to sell a stock to the seller of the put at a specific price. At expiration, the buyer benefits if the price of the underlying is less than the exercise price X:

$P_T = X - S_T$ if $S_T < X$

$P_T = 0$ if $X < S_T$

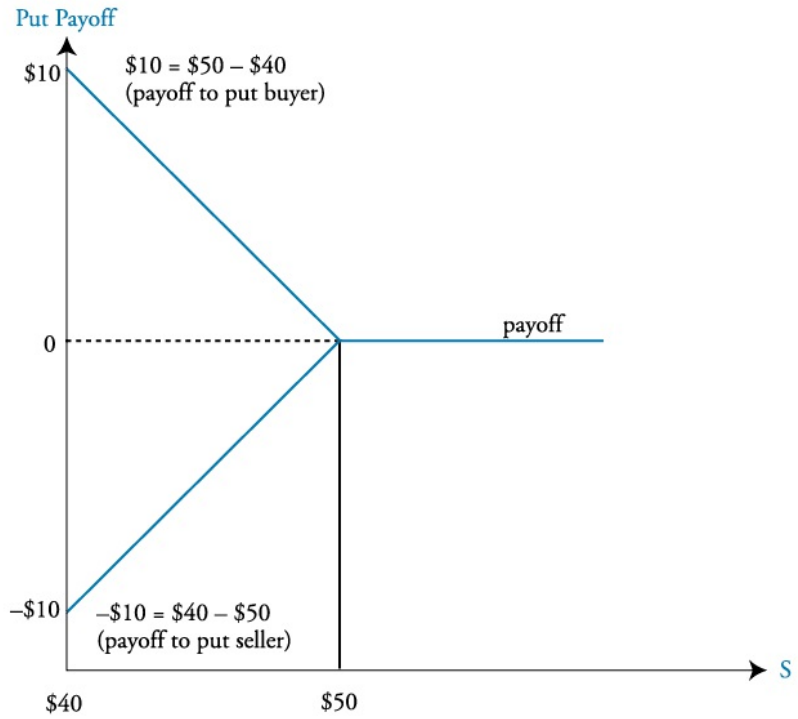
or

$P_T = \max(0, X - S_T)$

For example, an investor writes a put option on a stock with a strike price of X = 50. If the stock stays at $50 or above, the payoff of the put option is zero (because the holder may receive the same or better price by selling the underlying asset on the market rather than exercising the option). But if the stock price falls below $50, say to $40, the put option may be exercised with the option holder buying the stock from the market at $40 and selling it to the put writer at $50, for a $10 gain. The writer of the put option must pay the put price of $50, when it can be sold in the market at only $40, resulting in a $10 loss. The gain to the option holder is the same magnitude as the loss to the option writer. Figure 33.3 illustrates this example, excluding the initial cost of the put and

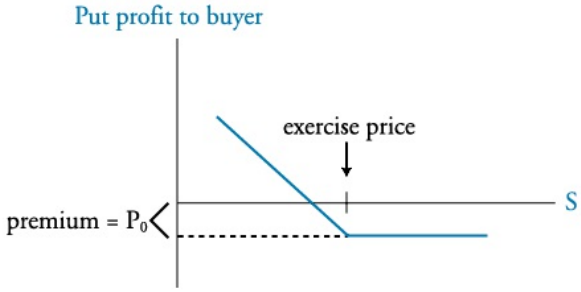
transaction costs. Figure 33.4 includes the cost of the put (but not transaction costs) and illustrates the profit to the put owner.

Figure 33.3: Put Payoff to Buyer and Seller



Given the "mirror-image quality" that results from the "zero-sum game" nature of options, we often just draw the profit to the buyer as shown in Figure 33.4. Then, we can simply remember that each positive (negative) value is a negative (positive) value for the seller.

Figure 33.4: Put Profit to Buyer



The breakeven price for a put position upon expiration is the exercise price minus the premium paid, $X - P_0$.

EXAMPLE: Call option

An investor purchases a call option on a stock with an exercise price of $35. The premium is $3.20. **Calculate** the payoffs and profits for the option owner at expiration for each of the following prices of the underlying stock S_T: $25, $30, $35, $40, $45, and $50. **Calculate** the breakeven price (assuming no transaction costs).

PROFESSOR'S NOTE

All examples ignore transactions costs. If by chance you see them on the exam, you can easily include them by just adding any costs onto the option premium in calculating breakeven or profits.

Answer:

The following table contains the payoffs and profits from a long call with an exercise price of $35.

Payoff and Profit on a Long Call Option

Stock Price	payoff = max(0, $S_T - X$)	profit = payoff − C_0
$25	max($25 − $35, 0) = $0	$0 − $3.20 = –$3.20
$30	max($30 − $35, 0) = $0	$0 − $3.20 = –$3.20
$35	max($35 − $35, 0) = $0	$0 − $3.20 = –$3.20
$40	max($40 − $35, 0) = $5	$5 − $3.20 = $1.80
$45	max($45 − $35, 0) = $10	$10 − $3.20 = $6.80
$50	max($50 − $35, 0) = $15	$15 − $3.20 = $11.80

As for the breakeven price, we clearly see that it is between $35 and $40 because the profit turns positive between these two strike prices. The calculation is simple:

breakeven price = $35.00 + $3.20 = $38.20

EXAMPLE: Put option

An investor purchases a put option on a stock with an exercise price of $15. The premium is $1.60. **Calculate** the payoffs and profits for the option owner at expiration for each of the following prices of the underlying stock S_T: $0, $5, $10, $15, $20, and $25. What is the breakeven price?

Answer:

The following table contains the payoffs and profits from a long put with an exercise price of $15.

Payoff and Profit on a Long Put Option

Stock Price	payoff = max(0, $X - S_T$)	profit = payoff − P_0
$0	max(0, $15 − $0) = $15	$15.00 − $1.60 = $13.40
$5	max(0, $15 − $5) = $10	$10.00 − $1.60 = $8.40
$10	max(0, $15 − $10) = $5	$5.00 − $1.60 = $3.40
$15	max(0, $15 − $15) = $0	$0 − $1.60 = –$1.60
$20	max(0, $15 − $20) = $0	$0 − $1.60 = –$1.60

$25	max(0, $15 − $25) = $0	$0 − $1.60 = –$1.60

We see that the breakeven price is between $15 and $10 because the profit turns positive between these two strike prices. The formula is simple:

breakeven price = $15.00 − $1.60 = $13.40

These examples illustrate the properties that we have mentioned so far.

- In both cases, the payoffs and profits are linear functions of S_T for the regions above and below X.
- The call option has the potential for an infinite payoff and profit because there is no upper limit to $S_T - X$, nor to $S_T - X - C_0$.
- The put has an upper payoff, which is X, and the upper limit to the profit is $X - P_0$.

COVERED CALLS AND PROTECTIVE PUTS

LOS 33.a: Compare the use of covered calls and protective puts to manage risk exposure to individual securities.

CFA® Program Curriculum, Volume 5, page 286

PROFESSOR'S NOTE

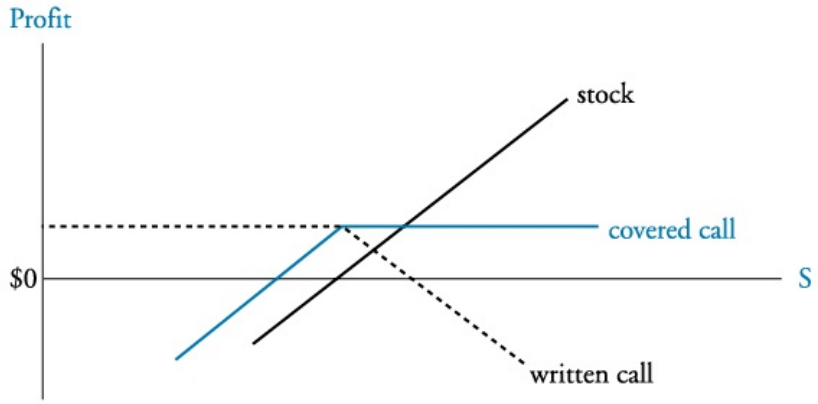
Covered calls and protective puts are the first of the combined positions. They were taught at Level I and Level II and have been tested at Level III. Know them well.

Covered Call

S-C

An investor creates a *covered call* position by buying the underlying security and selling a call option. Covered call writing strategies are used to generate additional portfolio income when the investor believes that the underlying stock price will remain unchanged over the short term. The profit profile for a covered call is given in Figure 33.5.

Figure 33.5: Profit Profile for a Covered Call



At expiration, the following relationships hold for the investor that both buys the stock and sells the call:

profit	$= -\max(0, S_T - X) + S_T - S_0 + C_0$
maximum profit	$= X + C_0 - S_0$
maximum loss	$= S_0 - C_0$
breakeven price	$= S_0 - C_0$
S_0	= initial stock price paid

IMPORTANT PROFESSOR'S NOTE

The CFA text has more than 65 formulas relating to value at expiration, profit, max profit, max loss, and breakeven(s) in this and the subsequent option positions material. Candidates who try to memorize these equations report being very frustrated and find the formulas are not sufficient to solve all of the end-of-chapter questions. The CFA material does not number the equations or in any way denote that memorization is expected.

We use a different approach in our videos and classes. It is mathematically identical to the formulas and consists of a few steps that work for all combined positions:

Calculate the initial investment in the strategy. Sales are a receipt of funds and purchases an expenditure. Therefore, the initial investment can be a net receipt or expenditure. If the underlying is part of the combination, its initial value at the start of the combination must also be included.

Max profit and loss are all found by examining the payoff pattern to determine the underlying price where max gain or loss occurs. At that underlying price, compute the intrinsic value of all positions in the combination, compare this to the initial investment, and the difference is the max profit or loss.

To compute profit or loss for any stated price of the underlying, the same process applies, just use the specified price of the underlying.

For breakeven start from the max gain or loss and from the payoff pattern, determine if the underlying must increase or decrease and by how much.

EXAMPLE: Covered call

An investor purchases a stock for S_0 = \$43 and sells a call for C_0 = \$2.10 with a strike price, X = \$45.

(1) **Compute** the maximum profit and loss and the breakeven price.

(2) **Compute** the profits when the stock price is \$0, \$35, \$40, \$45, \$50, and \$55.

Answer (1):

maximum profit $= X + C_0 - S_0$

$= \$45.00 + \$2.10 - \$43.00 = \$4.10$

maximum loss $= S_0 - C_0$

$= \$43.00 - \$2.10 = \$40.90$

breakeven price $= S_0 - C_0$

$= \$43.00 - \$2.10 = \$40.90$

Answer (2):

The following table shows profit calculations at the various stock prices.

Covered Call Profits

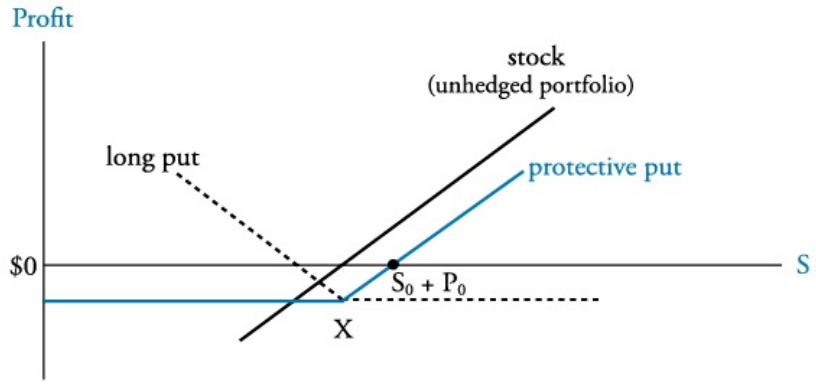
S_T	Covered Call Profits profit = –max(0, S_T − X) + S_T − S_0 + C_0
$0	–max(0, $0 − $45) + $0 − $43.00 + $2.10 = –$40.90
$35	–max(0, $35 − $45) + $35.00 − $43.00 + $2.10 = –$5.90
$40	–max(0, $40 − $45) + $40.00 − $43.00 + $2.10 = –$0.90
$45	–max(0, $45 − $45) + $45.00 − $43.00 + $2.10 = $4.10
$50	–max(0, $50 − $45) + $50.00 − $43.00 + $2.10 = $4.10
$55	–max(0, $55 − $45) + $55.00 − $43.00 + $2.10 = $4.10

Protective Put

S+P

A *protective put* (also called *portfolio insurance* or a *hedged portfolio*) is constructed by holding a long position in the underlying security and buying a put option. You can use a protective put to limit the downside risk at the cost of the put premium, P_0. You will see by the diagram in Figure 33.6 that the investor will still be able to benefit from increases in the stock's price, but it will be lower by the amount paid for the put, P_0. The profit profile for a protective put is shown in Figure 33.6.

Figure 33.6: Protective Put



PROFESSOR'S NOTE

Economists love these types of graphs because they were forced to spend long hours learning to understand them. Now they like to share that pain. If you like the graphs, use them. **The bottom line is you need to know the net payoff graph shape, the blue line for each combination.** All the other lines are interim steps used for constructing the graph. You can skip the other lines since they are not covered in the CFA text. Some candidates like seeing the extra lines.

At expiration, the following relationships hold:

profit = $\max(0, X - S_T) + S_T - S_0 - P_0$

maximum profit = $S_T - S_0 - P_0$ (no upside limit)

maximum loss = $S_0 - X + P_0$

breakeven price = $S_0 + P_0$

EXAMPLE: Protective put

An investor purchases a stock for S_0 = \$37.50 and buys a put for P_0 = \$1.40 with a strike price, X = \$35.
(1) **Compute** the max profit, max loss, and breakeven price.
(2) **Compute** the profits for when the price is \$0, \$30, \$35, \$40, \$45, and \$50.
Answer (1):

maximum profit = infinite

maximum loss = $S_0 - X + P_0$

= \$37.50 − \$35.00 + \$1.40 = \$3.90

breakeven price = $S_0 + P_0$ = \$37.50 + \$1.40 = \$38.90

Answer (2):
The figure below shows profit calculations for the protective put.
Protective Put Profits

S_T	**Protective Put Profits** **profit = max(0, X − S_T) + S_T − S_0 − P_0**
\$0	max(0, \$35 − \$0) + \$0 − \$37.5 − \$1.40 = –\$3.90
\$30	max(0, \$35 − \$30) + \$30.00 − \$37.5 − \$1.40 = –\$3.90
\$35	max(0, \$35 − \$35) + \$35.00 − \$37.5 − \$1.40 = –\$3.90
\$40	max(0, \$35 − \$40) + \$40.00 − \$37.5 − \$1.40 = \$1.10
\$45	max(0, \$35 − \$45) + \$45.00 − \$37.5 − \$1.40 = \$6.10
\$50	max(0, \$35 − \$50) + \$50.00 − \$37.5 − \$1.40 = \$11.10

Discussion

The answers here are per one unit of each asset (e.g., one share of stock and one option). The final results can just be multiplied by the number of units involved. For example, in

the preceding protective put example, if an investor had 200 shares of the stock and 200 puts, a value of $S_T = 50$ would give a total profit of 200 × \$11.10 or \$2,220.

MODULE 33.2: SPREAD STRATEGIES

Video covering this content is available online.

LOS 33.b: Calculate and interpret the value at expiration, profit, maximum profit, maximum loss, breakeven underlying price at expiration, and general shape of the graph for the following option strategies: bull spread, bear spread, butterfly spread, collar, straddle, box spread.

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Bull Spread

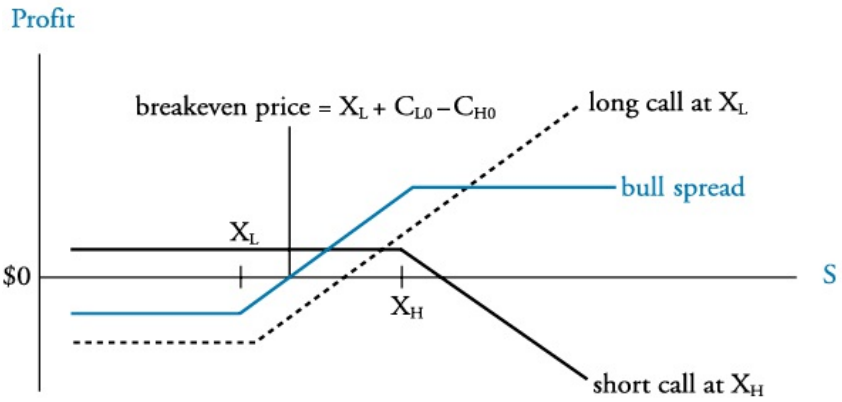
A bull spread provides limited upside if the underlying rises (hence the name bull) with limited downside. It can be constructed when the buyer of the spread purchases a call option with a low exercise price, X_L, and subsidizes the purchase price of that call by selling a call with a higher exercise price, X_H. The prices are C_{L0} and C_{H0}, respectively. At inception, the following relationships hold:

$$X_L < X_H$$

$$C_{L0} > C_{H0}$$

It is usually the case that $S_0 < X_L$ and almost always that $S_0 < X_H$. The investor who buys a bull spread expects the stock price to rise and the purchased call to finish in-the-money such that $X_L < S_T$. However, the investor does not believe that the price of the stock will rise above the exercise price for the out-of-the-money written call. The profit/loss diagram of a bull spread is shown in Figure 33.7.

Figure 33.7: Bull Spread Using Calls



profit	$= \max(0, S_T - X_L) - \max(0, S_T - X_H) - C_{L0} + C_{H0}$
maximum profit	$= X_H - X_L - C_{L0} + C_{H0}$
maximum loss	$= C_{L0} - C_{H0}$

breakeven price $= X_L + C_{L0} - C_{H0}$

EXAMPLE: Bull spread

An investor purchases a call for C_{L0} = \$2.10 with a strike price of X = \$45 and sells a call for C_{H0} = \$0.50 with a strike price of X = \$50.

(1) Compute the maximum profit and loss and the breakeven price.

(2) Compute the profits for when the price is \$0, \$35, \$45, \$48, \$50, and \$55.

Answer (1):

maximum profit $= X_H - X_L - C_{L0} + C_{H0}$

$= \$50.00 - \$45.00 - \$2.10 + \$0.50$

$= \$3.40$

maximum loss $= C_{L0} - C_{H0}$

$= \$2.10 - \$0.50$

$= \$1.60$

breakeven price $= X_L + C_{L0} - C_{H0}$

$= \$45.00 + \$2.10 - \$0.50$

$= \$46.60$

Answer (2):

The following figure shows the calculations of the profit on the bull spread.

Bull Spread Profits

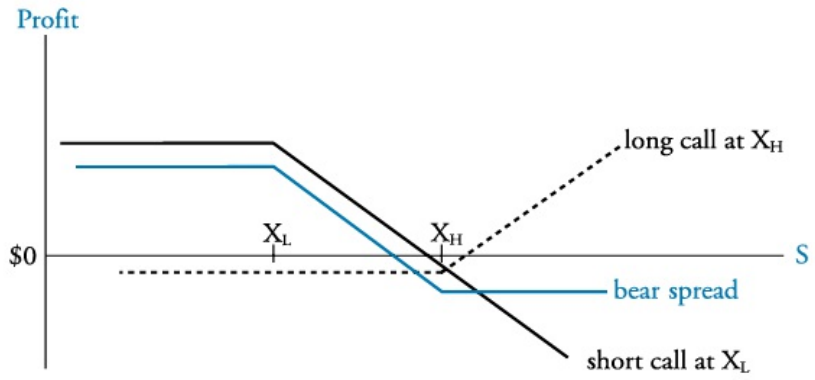
S_T	**Bull Spread Strategy** **profit = max(0, $S_T - X_L$) − max(0, $S_T - X_H$) − C_{L0} + C_{H0}**	
\$0	max(0, \$0 − \$45) − max(0, \$0 − \$50) − \$2.10 + \$0.50	= –\$1.60
\$35	max(0, \$35 − \$45) − max(0, \$35 − \$50) − \$2.10 + \$0.50	= –\$1.60
\$45	max(0, \$45 − \$45) − max(0, \$45 − \$50) − \$2.10 + \$0.50	= –\$1.60
\$48	max(0, \$48 − \$45) − max(0, \$48 − \$50) − \$2.10 + \$0.50	= \$1.40
\$50	max(0, \$50 − \$45) − max(0, \$50 − \$50) − \$2.10 + \$0.50	= \$3.40
\$55	max(0, \$55 − \$45) − max(0, \$55 − \$50) − \$2.10 + \$0.50	= \$3.40

Bear Spread

CH-CL

A bear spread provides limited upside if the underlying declines (hence the name bear) with limited downside. It is most commonly constructed by selling a call with a low strike price and purchasing a call with a high strike price. As stock prices fall, you keep the premium from the written call, net of the long call premium. The purpose of the long call is to protect you from sharp increases in stock prices. The payoff/profits, shown in Figure 33.8, are the opposite (inverted image) of the bull spread.

Figure 33.8: Bear Spread Using Calls



Bear Spread Using Puts

Virtually any payoff pattern can be constructed in more than one way. For example, the bear spread can also be constructed using puts. The investor buys a put with the higher exercise price and sells a put with a lower exercise price. The important relationships are:

profit	$= \max(0, X_H - S_T) - \max(0, X_L - S_T) - P_{H0} + P_{L0}$
maximum profit	$= X_H - X_L - P_{H0} + P_{L0}$
maximum loss	$= P_{H0} - P_{L0}$
breakeven price	$= X_H + P_{L0} - P_{H0}$

EXAMPLE: Bear spread using puts

An investor purchases a put for P_{H0} = \$4.00 with a strike price of X_H = \$25.00 and sells a put for P_{L0} = \$1.80 with a strike price of X_L = \$20.00.

(1) Compute the maximum profit and loss and the breakeven price.

(2) Calculate the profits when the price is \$0, \$15, \$20, \$22, \$25, and \$30.

Answer (1):

maximum profit $= X_H - X_L - P_{H0} + P_{L0}$

$= \$25.00 - \$20.00 - \$4.00 + \$1.80$

$= \$2.80$

maximum loss $= P_{H0} - P_{L0}$

= $4.00 − $1.80 = $2.20

breakeven price = $X_H + P_{L0} − P_{H0}$

= $25.00 + $1.80 − $4.00

= $22.80

Answer (2):

The following figure shows the calculations of the profits on the bear spread.

Bear Spread Profits

S_T	Bear Spread profit = max(0, $X_H − S_T$) − max(0, $X_L − S_T$) − $P_{H0} + P_{L0}$	
$0	max(0, $25 − $0) − max(0, $20 − $0) − $4.00 + $1.80	= $2.80
$15	max(0, $25 − $15) − max(0, $20 − $15) − $4.00 + $1.80	= $2.80
$20	max(0, $25 − $20) − max(0, $20 − $20) − $4.00 + $1.80	= $2.80
$22	max(0, $25 − $22) − max(0, $20 − $22) − $4.00 + $1.80	= $0.80
$25	max(0, $25 − $25) − max(0, $20 − $25) − $4.00 + $1.80	= –$2.20
$30	max(0, $25 − $30) − max(0, $20 − $30) − $4.00 + $1.80	= –$2.20

Butterfly Spread With Calls

CL+CH-2CM

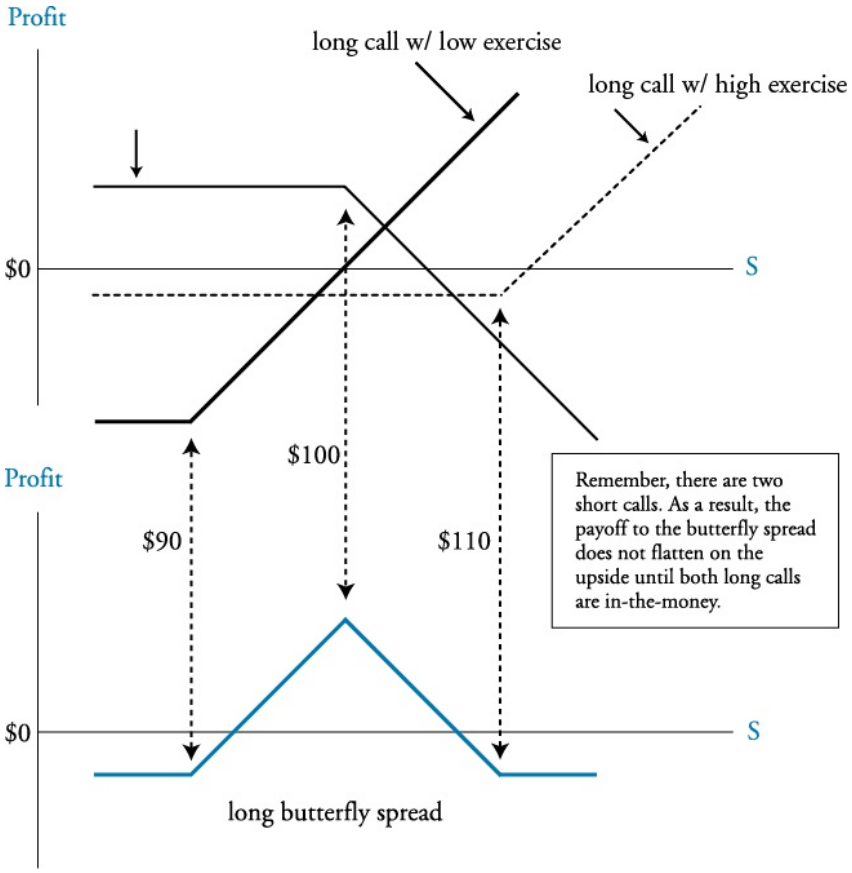
A butterfly spread with calls involves the purchase or sale of four call options of three different types:

- Buy one call with a low exercise price (X_L).
- Buy another call with a high exercise price (X_H).
- Write *two* calls with an exercise price in between (X_M).

Typically the strike prices are equidistant apart, for example 10, 15, and 20.

The buyer of a butterfly spread is essentially betting that the stock price will stay near the strike price of the written calls. However, the loss that the butterfly spread buyer sustains if the stock price strays from this level is not large. The two graphs in Figure 33.9 illustrate the construction and behavior of a butterfly spread. The top graph shows the profits of the components, and the bottom graph illustrates the spread itself.

Figure 33.9: Butterfly Spread Construction and Behavior



profit	$= \max(0, S_T - X_L) - 2\max(0, S_T - X_M) + \max(0, S_T - X_H) - C_{L0} + 2C_{M0} - C_{H0}$
maximum profit	$= X_M - X_L - C_{L0} + 2C_{M0} - C_{H0}$
maximum loss	$= C_{L0} - 2C_{M0} + C_{H0}$
breakeven prices	$= X_L + C_{L0} - 2C_{M0} + C_{H0}$ and $2X_M - X_L - C_{L0} + 2C_{M0} - C_{H0}$

EXAMPLE: Butterfly spread with calls

An investor makes the following transactions in calls on a stock:

- Buys one call defined by C_{L0} = \$7 and X_L = \$55.
- Buys one call defined by C_{H0} = \$2 and X_H = \$65.
- Sells two calls defined by C_{M0}= \$4 and X_M = \$60.

(1) Compute the max profit, max loss, and breakeven price.

(2) Calculate the profits for when the price is \$50, \$55, \$58, \$60, \$62, and \$65.

Answer (1):

maximum profit $= X_M - X_L - C_{L0} + 2C_{M0} - C_{H0}$

$= \$60 - \$55 - \$7 + 2(\$4) - \$2$

$= \$4$

maximum loss = $C_{L0} - 2C_{M0} + C_{H0}$

= $7 − 2($4) + $2 = $1

breakeven prices = $55 + $7 − 2($4) + $2 and 2(60) − $55 − $7 + 2($4) − $2

= $56 and $64

Answer (2):

The figure shows the calculations of the profits on the butterfly spread.

Butterfly Spread Profits

S_T	**Butterfly Spread profit = max(0, $S_T - X_L$) − 2max(0, $S_T - X_M$) + max(0, $S_T - X_H$) − $C_{L0} + 2C_{M0} - C_{H0}$**
$50	max(0, $50 − $55) − 2max(0, $50 − $60) + max(0, $50 − $65) − $1 = –$1
$55	max(0, $55 − $55) − 2max(0, $55 − $60) + max(0, $55 − $65) − $1 = –$1
$58	max(0, $58 − $55) − 2max(0, $58 − $60) + max(0, $58 − $65) − $1 = $2
$60	max(0, $60 − $55) − 2max(0, $60 − $60) + max(0, $60 − $65) − $1 = $4
$62	max(0, $62 − $55) − 2max(0, $62 − $60) + max(0, $62 − $65) − $1 = $2
$65	max(0, $65 − $55) − 2max(0, $65 − $60) + max(0, $65 − $65) − $1 = –$1

Butterfly Spread With Puts

A butterfly spread with puts is constructed by buying one put with a low exercise price, buying a second put with a higher exercise price, and selling two puts with an intermediate exercise price. The profit function is very similar to that of the butterfly spread with calls. You will notice that in each of the max( ) functions, the S_T and X_i have switched, but otherwise it is basically the same format:

$$\text{profit} = \max(0, X_L - S_T) - 2\max(0, X_M - S_T) + \max(0, X_H - S_T) - P_{L0} + 2P_{M0} - P_{H0}$$

As with the butterfly spread with calls, the long butterfly spread with puts will have its highest terminal value if the stock finishes at the exercise price for the written puts.

EXAMPLE: Butterfly spread with puts

An investor composes a butterfly spread by buying puts with premiums of $0.80 and $5.50 and exercise prices of $40 and $50, respectively. The investor sells two puts with a premium of $3 and an exercise price of $45. **Calculate** the profit if the value of the underlying stock at expiration is $46.30.

Answer:

profit

= max(0, $40.00 − $46.30) − 2max(0, $45.00 − $46.30) + max(0, $50.00 − $46.30) − $0.80 + 2($3.00) − $5.50

profit = 0 − 0 + $3.70 − $0.30 = $3.40

The obvious motivation for the butterfly spread is to earn a profit if the underlying asset does not move very much over the lives of the options used to create the spread. If there is a big movement, then the loss is limited to a lower bound (e.g., –$1 in the first example and –$0.30 in the butterfly put example—try it and see). Of course, an investor who thinks there will be a big move will take the other side or short the butterfly spread. The butterfly spread's appeal is that it limits the loss to the long side of the strategy.

MODULE QUIZ 33.1, 33.2

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

1. Which of the following option combinations cannot be used to construct a butterfly?
   A. Two put option contracts.
   B. Four call option contracts.
   C. Two call options and two put options.
2. A stock trades at 51. Calls with strike prices of 47 and 53 are priced at 5.25 and 0.75, respectively. **Compute** the initial investment for a bull spread and the breakeven price or prices of the spread.

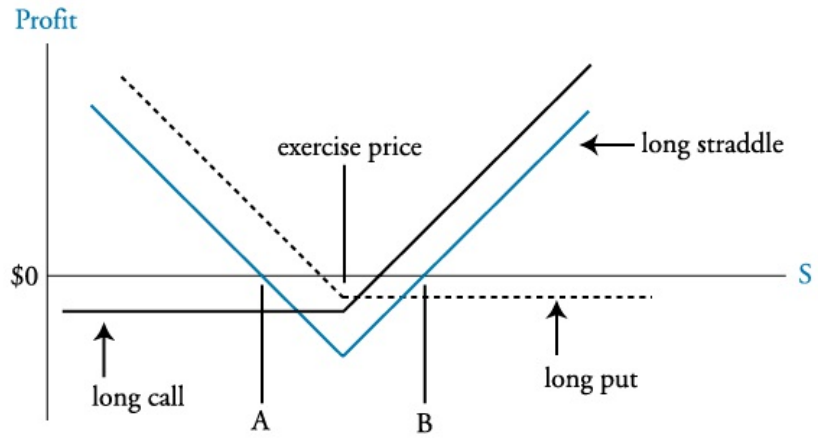
MODULE 33.3: MORE SPREAD STRATEGIES

Video covering this content is available online.

Straddle

A *straddle* consists of the purchase of both a put option and a call option on the same asset. The put and call are purchased with the same exercise price and expiration. In a straddle, you expect a large stock price move, but you are unsure of the direction. You lose if the stock price remains unchanged. The profit/loss diagram for a straddle is shown in Figure 33.10.

Figure 33.10: Straddle



Note that to break even on a straddle, the stock price must move enough to recoup the premiums paid for the options. The breakeven price is equal to the exercise price ± (put + call premium), denoted by points A and B in Figure 33.10.

For the *straddle*, the important relationships are:

profit	$= \max(0, S_T - X) + \max(0, X - S_T) - C_0 - P_0$
maximum profit	$= S_T - X - C_0 - P_0$ (unlimited upside as S_T increases)
maximum loss	$= C_0 + P_0$
breakeven price	$= X - C_0 - P_0$ and $X + C_0 + P_0$

EXAMPLE: Straddle

An investor purchases a call on a stock, with an exercise price of $45 and premium of $3, and a put option with the same maturity that has an exercise price of $45 and premium of $2.

(1) Compute the max profit, max loss, and breakeven price.

(2) Compute the profits when the price is $0, $35, $40, $45, $50, $55, and $100.

Answer (1):

maximum profit	= infinite, as the underlying increases
maximum loss	$= C_0 + P_0 = \$5$
breakeven price	$= X - C_0 - P_0$ and $X + C_0 + P_0$
	= $45 − $5 and $45 + $5
	= $40 and $50

Answer (2):

The figure below shows the calculation for the profit on a straddle.

Profits on a Long Straddle

S_T	**Straddle** **profit = max(0, S_T − X) + max(0, X − S_T) − C_0 − P_0**
$0	max(0, $0 − $45) + max(0, $45 − $0) − $3 − $2 = $40

$35	max(0, $35 − $45) + max(0, $45 − $35) − $5 = $5
$40	max(0, $40 − $45) + max(0, $45 − $40) − $5 = $0
$45	max(0, $45 − $45) + max(0, $45 − $45) − $5 = –$5
$50	max(0, $50 − $45) + max(0, $45 − $50) − $5 = $0
$55	max(0, $55 − $45) + max(0, $45 − $55) − $5 = $5
$100	max(0, $100 − $45) + max(0, $45 − $100) − $5 = $50

The values S_T = $0 and $100 were included in the previous example to illustrate the fact that the upside potential for a long straddle is unlimited, and the downside risk is only the sum of the premiums of the call and put.

PROFESSOR'S NOTE

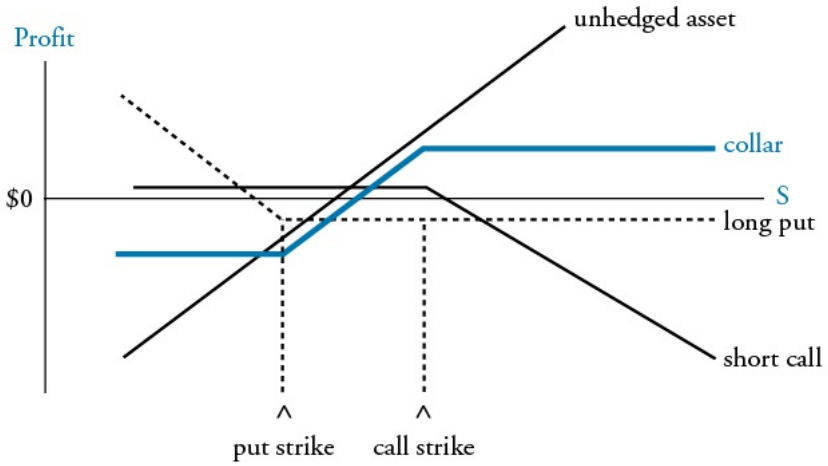
It is entirely possible you will get an exam question that "extends the basics." For example, if a straddle is long the call and put (with the same strike price), a reverse straddle is short the call and put. You initially receive the premiums and profit if the underlying does not move from the strike price. The graph flips on the horizontal axis and looks like a broad, flattened A, instead of a V.

Collar

A collar is the combination of a protective put and covered call. The usual goal is for the owner of the underlying asset to buy a protective put and then sell a call to pay for the put. If the premiums of the two are equal, it is called a *zero-cost collar*. The usual practice is to select strike prices such that put strike < call strike. Because this is the case, we can continue to use our X_L and X_H notation where X_L is the put strike price and X_H is the call strike price.

As Figure 33.11 illustrates, this effectively puts a band or *collar* around the possible returns. Both the upside and downside are limited, the downside by the long put and the upside by the short call. Many possibilities exist. By lowering X_L, for example, the put premium will fall, so the investor could sell a call with a higher X_H to offset the lower put premium. With a lower X_L and higher X_H, the upside and downside potential both increase.

Figure 33.11: Collar



profit = $\max(0, X_L - S_T) - \max(0, S_T - X_H) + S_T - S_0$

maximum profit = $X_H - S_0$

maximum loss = $S_0 - X_L$

breakeven price = S_0

PROFESSOR'S NOTE

The CFA text only covers zero cost collars where the initial net option premium is zero.

EXAMPLE: Zero-cost collar

An investor purchases a stock for \$29 and a put for P_0 = \$0.20 with a strike price of X_L = \$27.50. The investor sells a call for C_0 = \$0.20 with a strike price of X_H = \$30. The two option premiums are equal.

(1) Calculate the maximum profit and loss and the breakeven price.

(2) Calculate the profits when the price is \$0, \$20.00, \$25.00, \$28.50, \$30.00, and \$100.00.

Answer (1):

This is a zero-cost collar because the premiums on the call and put are equal.

maximum profit = $X_H - S_0$

= \$30 − \$29

= \$1

maximum loss = $S_0 - X_L$

= \$29.00 − \$27.50

= \$1.50

breakeven price = S_0 = \$29

Answer (2):

The table on the following page shows the calculations for profits on this zero-cost collar.

Profits on a Zero-Cost Collar

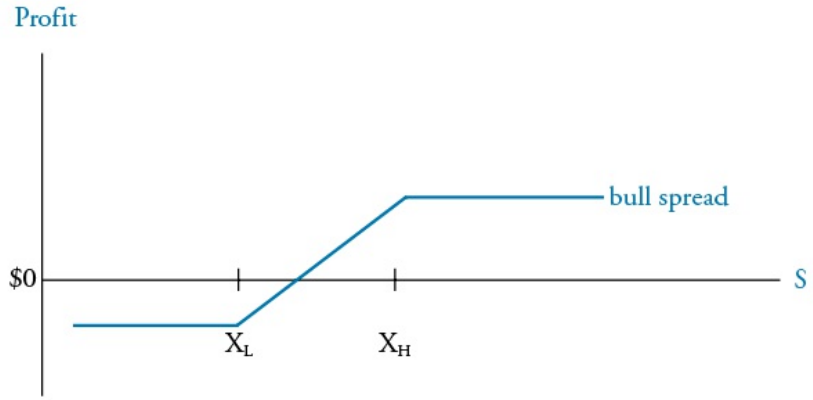
S_T	Zero-Cost Collar profit = max(0, $X_L - S_T$) − max(0, $S_T - X_H$) + $S_T - S_0$
$0.00	max(0, $27.50 − $0) − max(0, $0 − $30.00) + $0 − $29.00 = –$1.50
$20.00	max(0, $27.50 − $20.00) − max(0, $20.00 − $30.00) + $20.00 − $29.00 = –$1.50
$25.00	max(0, $27.50 − $25.00) − max(0, $25.00 − $30.00) + $25.00 − $29.00 = –$1.50
$28.50	max(0, $27.50 − $28.50) − max(0, $28.50 − $30.00) + $28.50 − $29.00 = –$0.50
$30.00	max(0, $27.50 − $30.00) − max(0, $30.00 − $30.00) + $30.00 − $29.00 = $1.00
$100.00	max(0, $27.50 − $100.00) − max(0, $100.00 − $30.00) + $100.00 − $29.00 = $1.00

We see how the lower limit of dollar return is –$1.50, even when the underlying asset's price is zero. The upper limit on return or profit is $1, even when the underlying asset's price is $100. For a price of the underlying asset between the strike prices, such as S_T = $28.50 in this example, the profit is between –$1.50 and $1.00. The collar is a good strategy for locking in the value of a portfolio at a minimal cost. The cost is zero if the appropriate put and call have the same premium.

Box Spread Strategy

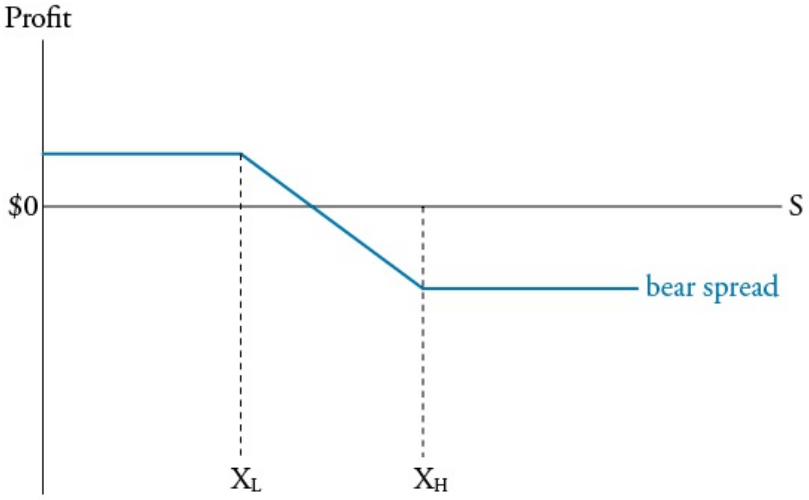
The *box spread* is a combination of a bull spread and a bear spread on the same asset, using only two strike prices. For example, a bull spread is the combination of two calls: a short call with a higher strike price (X_H) and a long call with a lower strike price (X_L).

Figure 33.12: Bull Spread



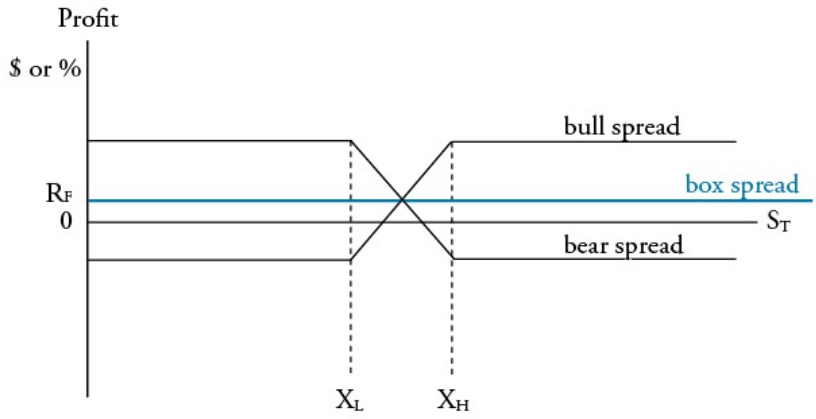
The bear spread is a short put with a lower strike price (X_L) and long put with a higher strike price (X_H).

Figure 33.13: Bear Spread



Combining the two produces the box spread with an interesting result. The ending value of the box spread is the same no matter what the ending value of the underlying. The initial investment (net option premium) is the same, so if the options are priced correctly, the difference in ending and beginning value of the box spread must reflect the risk-free rate. If the options are not priced correctly and the box spread return is not the risk-free rate, the box spread has identified an arbitrage opportunity.

Figure 33.14: Payoff to the Box Spread



EXAMPLE: Box spread

An investor buys a call and sells a put with a strike price of X_L = \$25. The call and put premiums are C_{L0} = \$1.75 and P_{L0} = \$0.50. The investor then sells a call and buys a put with a strike price of X_H = \$30. For the second pair of options, the call and put premiums are C_{H0} = \$0.20 and P_{H0} = \$3.90. The options all expire in two months.

Compute the profit and the annualized return on the investment and **determine** whether this a worthwhile investment, if the risk-free rate is 5%.

Answer:

profit = $X_H - X_L + PL0 - C_{L0} + C_{H0} - P_{H0}$

profit = \$30.00 − \$25.00 + \$0.50 − \$1.75 + \$0.20 − \$3.90

profit = \$0.05

The initial cost was $4.95 = + $0.50 − $1.75 + $0.20 − $3.90. This means the holding period return is 0.05 / 4.95 = 0.0101. This is a 2-month return, so the annualized return is 0.06216 (= $1.0101^{12/2} - 1$). Because this return is greater than the risk-free rate of 5%, this would be a worthwhile strategy. If the investor can borrow for less than 0.06216 (6.2%), an arbitrage profit is possible.

MODULE QUIZ 33.3

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

1. The holder of a long straddle *most likely* will have a net loss if the asset's price:
   A. stays the same.
   B. moves up.
   C. moves down.
2. The EUR is trading at USD 1.035. A trader expects the EUR to become much more volatile than reflected in current option prices. Puts and calls on the EUR are available. Puts with a strike of USD 0.98 are trading at USD 0.005 and with a strike of USD 1.04 are trading at USD 0.017. Calls with a strike of USD 0.98 are trading at USD 0.068 and with a strike of USD 1.04 are trading at USD 0.004. **Compute** the breakeven price or prices of the correct option strategy.

Long straddle
Buy ATM call and put

MODULE 33.4: INTEREST RATE OPTIONS AND EAR

Video covering this content is available online.

LOS 33.c: Calculate the effective annual rate for a given interest rate outcome when a borrower (lender) manages the risk of an anticipated loan using an interest rate call (put) option.

CFA® Program Curriculum, Volume 5, page 312

PROFESSOR'S NOTE

The general rule for interest rate options (such as caps and floors) is the interest rate for the payout is set at the expiration of the option but paid at the end of the interest rate period, not when the option expires.

Hopefully, you are already familiar with the basic mechanics of an interest rate call option that makes a payment to the owner when the reference rate (a.k.a. the *underlying*) exceeds the strike rate (i.e., the exercise rate). Because LIBOR is the usual reference rate, we will put that in the formula. The formula for the payment is:

$$\text{payoff} = (NP)[\max(0, \text{LIBOR} - \text{strike rate})](D / 360)$$

where *NP* stands for notional principal and *D* stands for *days in underlying rate* (i.e., the number of days the notional principal would be theoretically borrowed). NOTE: Do not confuse this with the maturity of the call! *Maturity* is the time between today and when the payoff is determined.

As an example, we will say that the notional principal of the contract is $20 million, the option expires in 49 days, the strike rate is 6%, and D = 90 days. If at option maturity in 49 days LIBOR is 6.2%, the payoff would be:

$$\text{payoff} = (\$20{,}000{,}000)(0.002)(90 / 360) = \$10{,}000$$

The payoff will occur 139 days after the purchase of the option. If the underlying rate (LIBOR) had been less than 6%, then the payoff would have been zero. Because the call has a positive payoff when interest rates rise above a certain level, they can hedge a floating-rate loan.

EXAMPLE: Interest rate call option

On March 1, a firm plans to borrow $10 million for 90 days beginning on April 1 (31 days in the future, which is the maturity of the *call*). It can currently borrow at LIBOR plus 200 basis points, and LIBOR is currently 4.5%. The firm buys an interest rate call option where LIBOR is the underlying, and the strike rate is 4%. The notional principal is $10 million, and D = 90 days, which is also the length of the loan. The premium of the call is $5,000. **Calculate** the effective borrowing rates of the loan when LIBOR is 2.0%, 3.5%, 4.0%, 4.5%, and 6%.

Answer:

If the manager chooses to purchase the call, that is a cost today. To accurately measure its effect on the borrowing costs, we need to compute its (future) value at the date of the loan, using the firm's cost of borrowing (LIBOR + 0.02):

$$\text{FV(premium)} = \text{premium}[1 + (\text{current LIBOR} + \text{spread})(\text{maturity} / 360)]$$

$$\text{FV(premium)} = \$5{,}000[1 + (0.045 + 0.02)(31 / 360)]$$

$$\text{FV(premium)} = \$5{,}028$$

Hence, when the firm actually borrows on April 1 (31 days in the future), it is effectively receiving:

$$\text{net amount} = \text{loan} - \text{FV(premium)}$$

$$\text{net amount} = \$10{,}000{,}000 - \$5{,}028$$

$$\text{net amount} = \$9{,}994{,}972$$

With the call premium now reflected in the net proceeds of the loan, the interest cost will be LIBOR plus the 200 basis point spread at that time less any payoff from the call:

$$\text{effective dollar interest cost} = \$10{,}000{,}000(\text{LIBOR}_{\text{April 1}} + 0.02)(90 / 360) - (\text{call payoff})$$

The call payoff is:

$$\text{payoff} = (\text{NP})[\max(0, \text{LIBOR} - \text{strike rate})(D / 360)]$$

$$\text{payoff} = (\$10{,}000{,}000)[\max(0, \text{LIBOR}_{\text{April 1}} - 0.04)(90 / 360)]$$

The effective annual rate (EAR) of borrowing for the 90 days is:

$$\text{EAR} = [(\$10{,}000{,}000 + \text{effective dollar interest cost}) / (\$9{,}994{,}972)]^{(365/90)} - 1$$

Let's look at the two extremes first: 2% and 6%. If LIBOR is less than 4%, the call payoff is zero. If LIBOR is 2% on April 1, for example, the effective dollar interest cost is:

$$\$100{,}000 = \$10{,}000{,}000(0.02 + 0.02)(90 / 360)$$

If the firm did not hedge, the effective annual rate would be:

EAR without hedge = ($10,100,000 / $10,000,000)$^{(365/90)}$ – 1

EAR without hedge = 0.04118

Including the cost of the call will increase the rate to:

EAR with hedge = ($10,100,000 / $9,994,972)$^{(365/90)}$ – 1

EAR with hedge = 0.04331

Thus, the cost of the call is incorporated into the effective rate of the loan. Just like a purchased call on a stock, if the underlying is below the strike at expiration, the buyer loses (i.e., the option is worthless and the buyer has paid a premium for it).

Where the borrowing firm benefits is when LIBOR is higher than the strike rate. If $LIBOR_{April\ 1}$ = 6%, the option payoff is:

payoff = ($10,000,000)(0.06 − 0.04)(90 / 360)

payoff = $50,000

effective dollar interest cost = $10,000,000(0.06 + 0.02)(90 / 360) − $50,000

effective dollar interest cost = $150,000

Comparing the EAR with and without the hedge:

EAR without hedge = ($10,200,000 / $10,000,000)$^{(365/90)}$ – 1

EAR without hedge = 0.08362

Including the cost of the call will decrease the effective rate to:

EAR with hedge = ($10,150,000 / $9,994,972)$^{(365/90)}$ – 1

(call payoff = $50,000)

EAR with hedge = 0.06441

In fact, this effective rate of 0.06441 is the highest rate the firm can expect to pay with the call.

Let's look at what happens for the cases in between, where 0.02 < $LIBOR_{April\ 1}$ < 0.06. If $LIBOR_{April\ 1}$ = 0.035, the firm will incur dollar interest costs equal to:

effective dollar interest cost = $10,000,000(0.055)(90 / 360) = $137,500

because the call expires worthless. The effective rate on the net inflow from the borrowing is:

EAR with hedge = ($10,137,500 / $9,994,972)$^{(365/90)}$ – 1 = 0.05910

If $LIBOR_{April\ 1}$ = 0.04, the firm will incur dollar interest costs equal to:

effective dollar interest cost = $10,000,000 × 0.06 × (90 / 360) = $150,000

because the call expires worthless. The effective rate on the net inflow from the borrowing is:

EAR with hedge = ($10,150,000 / $9,994,972)$^{(365/90)}$ – 1 = 0.06441

If $LIBOR_{April\ 1}$ = 0.045, the firm will earn a payoff on the call:

payoff = ($10,000,000) × max(0, 0.045 – 0.04) × (90 / 360) = $12,500

The effective dollar interest cost will be:

effective dollar interest cost = $10,000,000(0.065)(90 / 360) − $12,500

effective dollar interest cost = $162,500 − $12,500 = $150,000

The effective rate on the net inflow from the borrowing is:

EAR with hedge = ($10,150,000 / $9,994,972)$^{(365/90)}$ − 1 = 0.06441

This is the same effective cost for when $LIBOR_{April\ 1} = 0.06$.

Let's try another example with less explanation in the answer.

EXAMPLE: Interest rate option

In 40 days, a firm wishes to borrow $5 million for 180 days. The borrowing rate is LIBOR plus 300 basis points. The current LIBOR is 5%. The firm buys a call that matures in 40 days with a notional principal of $5 million, 180 days in underlying (D = 180), and a strike rate of 4.5%. The call premium is $8,000.

Calculate the effective annual rate of the loan if at expiration LIBOR = 4%, and **calculate** if LIBOR = 5%.

Answer:

First we compute the implied net amount to be borrowed after the cost of the call:

$5,000,000 – $8,000[1 + (0.05 + 0.03)(40 / 360)] = $4,991,929

For LIBOR = 0.04 at expiration, the dollar cost is (the option is out-of-the-money):

$5,000,000(0.07)(180 / 360) = $175,000

The effective annual rate is:

($5,175,000 / $4,991,929)$^{(365/180)}$ − 1 = 0.0758

For LIBOR = 0.05, the call option is in-the-money:

payoff = ($5,000,000)[max(0, 0.05 − 0.045)(180 / 360)] = $12,500

The dollar interest cost is effectively:

$5,000,000(0.08)(180 / 360) − $12,500 = $187,500

The effective annual rate is:

($5,187,500 / $4,991,929)$^{(365/180)}$ − 1 = 0.0810

You should verify that the rate of 0.0810 is the highest possible rate by trying other values higher than LIBOR = 4.5%.

Interest Rate Put

An interest rate put has a payoff to the owner when the reference rate, usually LIBOR, is *below* a certain strike rate at the maturity of the option:

payoff = (NP)[max(0, strike rate − LIBOR)(D / 360)]

A lender can combine a long position in an interest rate put with a specific floating-rate loan to place a lower limit on the income to be earned on the position. The combination has many of the same basic mechanics as borrowing with an interest rate call. As in the case of the interest rate call, we compute the future value of the put premium, but we *add* it to the loan made by the lender because that represents the total outflow of cash from the lender at the time of the loan.

As in the case of the interest rate call, the payoff of the put places a limit on the effective dollar interest. In this case, the payoff is added to the interest received to ensure a *minimum* amount of revenue to the lender. To make our example easier to

follow, we will look at the same loan examined in our last example, which was the second example of an interest rate call. Now we will look at it from the lender's point of view.

EXAMPLE: Interest rate put

In 40 days, a bank plans to lend $5 million for 180 days. The lending rate is LIBOR plus 300 basis points. The current LIBOR is 5%. The bank buys a put that matures in 40 days with a notional principal of $5 million, 180 days in the underlying, and a strike rate of 4.5%. The put premium is $5,000. **Calculate** the effective annual rate of the loan if at expiration LIBOR = 4%, and then **calculate** the rate if LIBOR = 5%.

Answer:

First we compute the total amount the bank pays out (lends) at time of the loan. This means computing the future value of the premium and adding it to the loan amount.

Loan amount plus future value of premium paid:

$$\$5{,}000{,}000 + \$5{,}000[1 + (0.05 + 0.03)(40 / 360)] = \$5{,}005{,}044$$

This amount is used for computing the effective interest rate earned on the outflow of cash at the beginning of the loan. The dollar interest earned by the bank will be based upon the prevailing rate applied to the loan and the payoff of the put. In this case, the expression is:

$$\text{effective interest earned} = \$5{,}000{,}000(\text{LIBOR}_{\text{maturity}} + 0.03)(180 / 360) + (\text{put payoff})$$

The effective annualized rate on the loan is:

$$\text{EAR} = [(\$5{,}000{,}000 + \text{effective dollar interest earned}) / (\$5{,}005{,}044)]^{(365/180)} - 1$$

You can see where the lender gets hurt because both the principal returned and the interest earned are based upon the $5 million, but the effective loan is $5,005,044.

If $\text{LIBOR}_{\text{maturity}}$ equals 4%, the payoff of the put would be:

$$\text{payoff} = (\$5{,}000{,}000)[\max(0, 0.045 - 0.04)(180 / 360)] = \$12{,}500$$

The dollar interest earned is:

$$\$5{,}000{,}000(0.04 + 0.03)(180 / 360) = \$175{,}000$$

The effective interest rate is:

$$\text{EAR} = [(\$5{,}000{,}000 + \$175{,}000 + \$12{,}500) / (\$5{,}005{,}044)]^{(365/180)} - 1$$

$$\text{EAR} = [(\$5{,}187{,}500) / (\$5{,}005{,}044)]^{(365/180)} - 1$$

$$\text{EAR} = 0.07531 \text{ or } 7.531\%$$

While not asked, you might notice that in this case the put turned out to be desirable. Without the put the bank would have earned LIBOR + 300 bp or 7%.

If $\text{LIBOR}_{\text{maturity}} = 0.05$, the dollar interest earned is:

$$\$5{,}000{,}000[0.05 + 0.03](180 / 360) = \$200{,}000$$

$$\text{EAR} = [(\$5{,}200{,}000) / (\$5{,}005{,}044)]^{(365/180)} - 1$$

$$\text{EAR} = 0.08057 \text{ or } 8.057\%$$

Without the hedge, and LIBOR = 5% + 300 bp, the lender would have earned $200,000 on only $5 million for an effective rate of $0.08278 = [(\$5{,}200{,}000) / (\$5{,}000{,}000)]^{(365/180)} - 1$.

PROFESSOR'S NOTE

EAR

Borrowing at floating rates:

- The rate of borrowing is roughly calculated as outflows *divided* by inflows.
- Outflow is repayment of principal and interest *minus* any option payoffs
- Inflow is the loan proceeds *minus* the total option cost. The borrower often pays for a call option to protect against rising rates, and that reduces the net amount of borrowed funds in the denominator.

Lending at floating rates:

- The rate of return is roughly calculated as inflows *divided* by outflows.
- Inflow is receipt of principal and interest *plus* any option payoffs
- Outflow is the loan proceeds *plus* the total option cost. The lender often pays for a put option to protect against falling rates and that increases the net amount of lent funds in the denominator.

For both borrowing and lending:

- The adjustment for the option payoff is always in the numerator.
- The adjustment for the option cost is always in the denominator.

MODULE QUIZ 33.4

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

1. For hedging risk, owning an interest rate put would *most likely* be useful for:
   A. a variable-rate borrower.
   B. a fixed-rate lender.
   C. a variable-rate lender.
2. In 60 days, a bank plans to lend $10 million for 90 days. The lending rate is LIBOR plus 200 basis points. The current LIBOR is 4%. The bank buys a put that matures in 60 days with a notional principal of $10 million, 90 days in underlying, and a strike rate of 5%. The put premium is $2,000. **Calculate** the effective annual rate of the loan if at expiration the LIBOR = 4.5%, and if the LIBOR = 6.5%.

MODULE 33.5: INTEREST RATE CAPS, FLOORS, AND COLLARS

Video covering this content is available online.

LOS 33.d: Calculate the payoffs for a series of interest rate outcomes when a floating rate loan is combined with 1) an interest rate cap, 2) an interest rate floor, or 3) an interest rate collar.

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An interest rate cap is an agreement in which the cap seller agrees to make a payment to the cap buyer when the reference rate exceeds a predetermined level called the *cap strike* or *cap rate*. The cap is a series of interest rate call options. Each individual option

can be called a caplet. An interest rate floor is an agreement in which the seller agrees to pay the buyer when the reference rate falls below a predetermined interest rate called the *floor strike* or *floor rate*. The floor is a series of interest rate put options. Each individual option can be called a floorlet.

Caps and floors are over-the-counter contracts, so the two parties involved can tailor the agreement to suit their specific needs. Generally, the terms of a cap or floor agreement will include the:

- Reference rate (typically LIBOR).
- Cap or floor strike that sets the ceiling or floor.
- Length of the agreement.
- Reset frequency, which determines days in each settlement period, D_t.
- Notional principal (*NP*).

For the Exam:

- The CFA text follows the convention that the payoff on the individual caplets and floorlets in interest rate caps and floors based on LIBOR is for the actual number of days in the interest rate period divided by 360. For example, suppose the annual rate is 8% for a quarterly payment and the actual days in the quarter are 92 days; the periodic rate is 8% × (92 / 360) = 2.04444%. If the actual day count had not been given, this could be approximated as 8% / 4 = 2.00%.
- Like individual interest rate calls and puts, the payments are in arrears with the rate at the expiration of each caplet or floorlet determining the payoff at the end of the next interest rate period.
- Floating rate loan interest payments are also set in arrears. At the origination of the loan, the first interest payment is known and no caplet covers the first loan period. Instead, the first caplet expires at the end of the first loan interest period to be paid at the end of the second loan interest period. Think of the first "floating rate" as in fact a fixed rate known at initiation of the loan, only the subsequent payments are unknown and floating.

These conventions are illustrated in the following examples.

Interest Rate Caps

An interest rate cap is a series of call options on interest rates. The buyer receives the interest rate difference if rates are above the strike rate. Each potential payoff is called a caplet. The natural user of a cap is the payer on a floating rate loan.

EXAMPLE: Interest rate cap

On April 15, KS, Inc., takes out a 1-year floating rate loan for $10 million. Interest payments are quarterly at LIBOR plus 200 basis points based on actual days in the period over 360. The payments are due July 15, October 15, January 15, and April 15. KS purchases a nine-month, quarterly pay cap for $15,000 with a strike rate of 8.5%. The first caplet expires July 15.

Assuming LIBOR rates on April 15, July 15, October 15, and January 15 are 8.0%, 8.4%, 8.65%, and 8.4%, respectively, **determine** the four payoff dates on the loan, the loan interest paid, any option payment received, and the effective net interest paid.

Day counts:

April 15 to July 15: 91 days

July 15 to October 15: 92 days

October 15 to January 15: 92 days

January 15 to April 15: 90 days

Answer:

The payment dates on the loan as stated in the question are July 15, October 15, January 15, and April 15.

Loan interest due:

July 15: $10,000,000 × (0.08 + 0.02) × (91 / 360) = $252,778

October 15: $10,000,000 × (0.084 + 0.02) × (92 / 360) = $265,778

January 15: $10,000,000 × (0.0865 + 0.02) × (92 / 360) = $272,167

April 15: $10,000,000 × (0.084 + 0.02) × (90 / 360) = $260,000

Cap payoffs:

July 15: N/A. The loan originates April 15 with first loan payment due July 15 based on LIBOR as of April 15. Because the first loan interest payment is known at initiation of the analysis, the first caplet expires July 15 with payoff (if in the money) on October 15.

October 15: July 15 start of period LIBOR is 8.4%, below the strike rate of 8.5%, caplet is out of the money.

January 15: October 15 start of period LIBOR is 8.65%, above the strike rate of 8.5%, caplet is in the money: $10,000,000 × (0.0865 − 0.085) × (92 / 360) = $3,833.

April 15: January 15 start of period LIBOR is 8.4%, below the strike rate of 8.5%, caplet is out of the money.

Effective net interest due:

July 15: $252,778

October 15: $265,778 − 0 = $265,778

January 15: $272,167 − 3,833 = $268,334

April 15: $260,000 − 0 = $260,000

When a long position in a cap is combined with a floating-rate loan, the payoffs can offset interest costs when the floating rate increases. Because caps trade over the counter, the terms of the cap are very flexible, so the cap buyer/borrower can align the settlements of the cap with the interest rate payments.

Interest Rate Floors

An interest rate floor is in essence the opposite of a cap. The buyer receives the interest rate difference if rates are below the strike rate. Each potential payoff is called a floorlet. The natural user of a floor is the receiver on a floating rate loan.

EXAMPLE: Interest rate floor

The facts in the question are the same as in the previous example, except the example is a lender who purchases a floor.

On April 15, DHBank makes a 1-year floating rate loan for $10 million. Interest payments are quarterly at LIBOR plus 200 basis points based on actual days in the period over 360. The payments are due July 15, October 15, January 15, and April 15. DHBank purchases a nine-month, quarterly pay floor for $85,000 with a strike rate of 8.5%.

Assuming LIBOR rates on April 15, July 15, October 15, and January 15 are 8.0%, 8.4%, 8.65%, and 8.4%, respectively, **determine** the four payoff dates on the loan, the loan interest received, any option payment received, and the effective net interest earned by DHBank.

Day counts:

April 15 to July 15: 91 days

July 15 to October 15: 92 days

October 15 to January 15: 92 days

January 15 to April 15: 90 days

Answer:

The payment dates on the loan as stated in the question are July 15, October 15, January 15, and April 15.

Loan interest due:

July 15: $10,000,000 × (0.08 + 0.02) × (91 / 360) = $252,778

October 15: $10,000,000 × (0.084 + 0.02) × (92 / 360) = $265,778

January 15: $10,000,000 × (0.0865 + 0.02) × (92 / 360) = $272,167

April 15: $10,000,000 × (0.084 + 0.02) × (90 / 360) = $260,000

Floor payoffs:

July 15: N/A. The loan originates April 15 with first loan payment due July 15 based on LIBOR as of April 15. Because the first loan interest payment is known at initiation of the analysis, the first floorlet expires July 15 with payoff (if in the money) on October 15.

October 15: July 15 start of period LIBOR is 8.4%, below the strike rate of 8.5%, floorlet is in the money: $10,000,000 × (0.085 – 0.084) × (92 / 360) = $2,556.

January 15: October 15 start of period LIBOR is 8.65%, above the strike rate of 8.5%, floorlet is out of the money.

April 15: January 15 start of period LIBOR is 8.4%, below the strike rate of 8.5%, floorlet is in the money: $10,000,000 × (0.085 – 0.084) × (90 / 360) = $2,500

Effective net interest due:

July 15: $252,778

October 15: $265,778 + 2,556 = $268,334

January 15: $272,167 + 0 = $272,167

April 15: $260,000 + 2,500 = $262,500

Interest Rate Collar

An interest rate collar is a combination of a cap and a floor where the agent is long in one position and short in the other. If the agent buys a 6% cap on LIBOR and sells a 3%

floor on LIBOR, the agent will receive cash payments when LIBOR exceeds 6%, and the agent will make payments when LIBOR is below 3%. If LIBOR is between 3% and 6%, the agent neither receives nor pays.

This would be attractive to a bank that has among its liabilities large deposits with floating interest rates. When the rates start to rise, the bank's increasing costs can be offset by the payments from the collar. By selling the floor, the bank may have to make payments if the interest rates on the deposits fall too much, but the bank earned a premium for exposing itself to this risk. That premium offsets the cost of the cap. The overall position provides some certainty to the bank, because it essentially provides a predetermined range for the cost of funds.

A special interest rate collar occurs when the initial premiums on the cap and the floor are equal and offset each other. Suppose that the premium on a 4-year, 3% floor is equal to the premium on the 6% cap. The combination of the two would be called a *zero-cost collar* (a.k.a. a *zero-premium collar*). The motivation for zero-cost collars is that they are a way of providing interest rate protection without the cost of the premiums. Calling the collar zero cost is misleading in some regards. There is no initial cost but there is a back end cost if rates move in such a way that payments must be made.

EXAMPLE: Interest rate collar

On December 15, the DHBank issues a $50 million "2-year" floating rate liability. The four interest payments are based on 180-day LIBOR plus 150 basis points. The first interest rate is set today with payment 180 days thereafter. Each loan payment is 180 days after the preceding payment. To hedge against rising interest rates, the bank buys an appropriate interest rate cap with a strike rate of 4.75%. To fully offset the initial cost of the cap, the bank sells a floor with a strike rate of 2.25%.

Initial LIBOR is 3.40%. Assuming that in 180, 360, 540, and 720 days LIBOR rates are 4.00%, 5.10%, 2.00%, and 1.75%, respectively, **calculate** the net interest paid by the bank on each payment date and **show** all the cash flows leading to that net payment. **Explain** the cost of the collar.

Answer:

Payment in 180 days:

Paid on floating rate liability: $50,000,000 × (0.034 + 0.015) × (180 / 360) = $1,225,000

No payments on the cap or floor. The first of three caplets and floorlets will expire and possible payments will be determined for the next loan payment date.

Net paid on loan: $1,225,000

Payment in 360 days:

Paid on floating rate liability: $50,000,000 × (0.040 + 0.015) × (180 / 360) = $1,375,000

The cap is out of the money with beginning of period LIBOR at 4.00% versus a cap strike rate of 4.75%.

The floor is out of the money with beginning of period LIBOR at 4.00% versus a floor strike rate of 2.25%.

Net paid on loan: $1,375,000 − 0 + 0 = $1,375,000

Payment in 540 days:

Paid on floating rate liability: $50,000,000 × (0.051 + 0.015) × (180 / 360) = $1,650,000

The cap is in the money with beginning of period LIBOR at 5.10% versus a cap strike rate of 4.75%: Receive $50,000,000 × (0.051 − 0.0475) × (180 / 360) = $87,500.

The floor is out of the money with beginning of period LIBOR at 5.10% versus a floor strike rate of 2.25%.

Net paid on loan: $1,650,000 − 87,500 + 0 = $1,562,500

Payment in 720 days:

Paid on floating rate liability: $50,000,000 × (0.020 + 0.015) × (180 / 360) = $875,000

The cap is out of the money with beginning of period LIBOR at 2.00% versus a cap strike rate of 4.75%.

The floor is in the money with beginning of period LIBOR at 2.00% versus a floor strike rate of 2.25%: Pay $50,000,000 × (0.0225 − 0.0200) × (180 / 360) = $62,500

Net paid on loan: $875,000 − 0 + 62,500 = $937,500

For a properly structured collar, there will be no additional caplet or floorlet expirations on or after the liability due date. The LIBOR rate at day 720 is irrelevant.

The true cost of the collar is not zero even though the net initial premium was zero. Any time the floor is in the money the bank incurs an obligation to pay on the floor that was sold. For example, on day 720, the bank must make a payment on the floor of $62,500. This increases the bank's cost of funds.

Discussion

Caps and floors are the most common way to modify interest payments or receipts because they can be tailored for exact dates, amounts, and day count conventions. All else the same, the selection of strike rates determines the degree of protection that can be obtained and also affects the premium paid. Like any option, the more in the money the option is at initial purchase, the higher the premium paid and the more likely there will be subsequent payoffs; the more out of the money the option is at initial purchase, the lower the premium paid and the less likely there will be subsequent payoffs. Interest payments can also be modified with FRAs, interest rate swaps, and interest rate futures. These have no initial premium but generally modify upside and downside symmetrically while caps and floors (options) allow for tailored, asymmetric payoff patterns.

MODULE QUIZ 33.5

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

1. A cap contract has a notional principle of $5 million, a strike rate of 5%, and an annual frequency of settlement. If the reference rate is 6% for a given settlement date, what is the payoff to the agent long the cap for that period?
   A. $25,000.
   B. $50,000.
   C. $100,000.
2. On August 1, a bank enters a 2-year, zero-cost collar for a $20 million portfolio of floating-rate loans by buying the floor and selling the cap. The floor strike is 2.5%, the cap strike is 4.7%, and the reference rate is LIBOR. The interest payments on the loan assets are LIBOR plus 240 basis points. The collar's semiannual settlement dates exactly match the dates when the floating-rate payments are made: August 1 and February 1 over the next two years. Payments made August 1 cover 181 days and payments made February 1 cover 184 days. Current LIBOR is 4.1%. The values of LIBOR on the next three settlement dates are 2.4%, 5%, and 5%. **Calculate** the actual interest rate payments (to the bank), settlements, and effective interest payments.

MODULE 33.6: DELTA HEDGING

LOS 33.e: Explain why and how a dealer delta hedges an option position, why delta changes, and how the dealer adjusts to maintain the delta hedge.

Video covering this content is available online.

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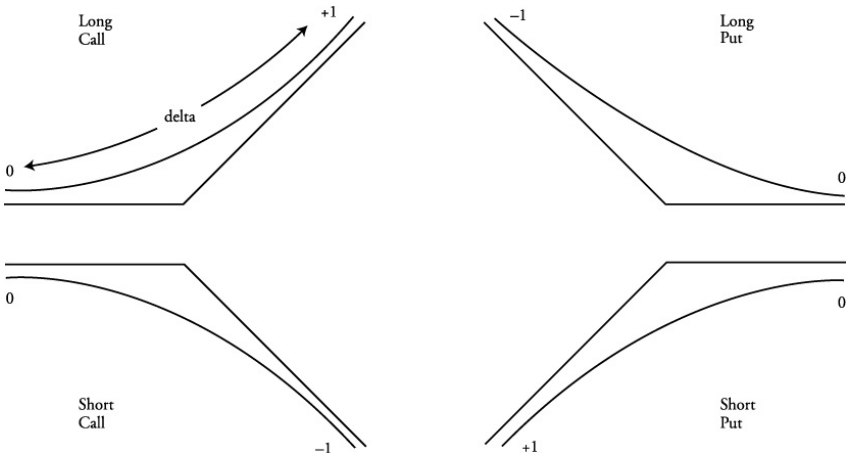
The purchase of options has inherent appeal. The option buyer has the potential for a payoff that may far exceed the initial cost of the options. This frequently leads to a natural imbalance, with more demand to buy options than there are sellers. This imbalance provides a business opportunity for dealers. Dealers provide liquidity by being willing to buy or sell options. As compensation they earn the bid/asked spread as the option buyer must buy at the higher or sell at the lower price. Dealers can also serve as a source of supply by being willing to risk capital with a net short position in options. But this exposes the dealer to the potential large downside of short option positions.

Delta hedging allows dealers to hedge the downside risk of short option positions. Recall that a short call decrease in value (has greater negative value) as the underlying increases. If the dealer has a long position in the underlying, that will produce an offsetting gain to hedge the short call position. A short put decrease in value (has greater negative value) as the underlying decreases. If the dealer has a short position in the underlying, that will produce an offsetting gain to hedge the short put position. However the price moves of the underlying and option are not one for one. Delta determines the ratio of movement.

Delta = change in price of the option / change in price of the underlying

Delta ranges between: 0 for options that are deep out-of-the-money (OTM) where the price of the option is largely unaffected by the underlying, to 1 for options that are deep in-the-money (ITM) where the price of the option moves nearly 1 for 1 with change in the underlying. An at-the-money (ATM) option with the price of the underlying equal to the option strike price has a delta of approximately 0.5. For ATM call options it is generally somewhat higher than 0.5. In realty deltas can be positive or negative and it is the absolute value of the delta that shifts between 0 and 1. It is normal to refer to dealt in positive terms and the user must interpret if it is + or −most in a given situation. A graphic depiction of the delta relationships are shown in Figure 33.15.

Figure 33.15: Delta for Long and Short Call and Put Options



Establishing the delta neutral hedge follows from an understanding of delta:

Suppose a dealer is short calls on 1,000 shares of XYZ and the call delta is 0.40. The dealer would lose approximately USD 400 if the stock price increases USD 1 (1,000 × 0.40). Therefore if the dealer owned 400 shares the dealer would be hedged as the long 400 shares produce a gain of USD 400 for a USD 1 increase in the stock price. The issue of approximately will be discussed shortly.

Suppose the dealer is also short puts on 10,000 shares of ZZY and the put delta is 0.67. The dealer would lose approximately GBP 6,700 if the stock price decreases GBP 1 (10,000 × 0.67). Therefore if the dealer shorted 6,700 shares the dealer would be hedged as the 6,700 short position produces a gain of GBP 6,700 for a GBP 1 decrease in the stock price.

Technically the hedge position in the stock will be:

–delta × number of options

For the 1,000 XYZ short calls: −(–0.40)(1,000) = +400 (i.e., buy 400 shares).

For the 10,000 ZZY short puts: −(0.67)(10,000) = –6,700 (i.e., short 6,700 shares).

Using the previous formula is tricky as you must use the correct + or − sign for the call or put delta, along with the − sign from the formula. Short calls have − delta so in the formula this becomes − −, to indicate buy shares.
Short puts have + delta so in the formula this becomes −, to indicate short shares. It is more straightforward to work in two steps:

Step 1: establish whether to buy or sell the underlying shares:

- Short calls decline as the underlying increases, buy shares to hedge.
- Short puts decline as the underlying decreases, short shares to hedge.

Step 2: Compute the number of shares needed as:

|delta × number of options|

The Reality of Delta Hedging: Rebalancing

Delta hedging is not perfect as delta changes over time and with changing market conditions. Delta is a straight line projection of option price change as the price of the underlying changes. This issue is addressed by continually rebalancing the hedge. Recompute the number of shares required for the hedge. If more shares are required,

buy them and borrow the needed funds for the purchase (which can be referred to as a short bond position). If fewer shares are required, sell them and invest the excess funds from the sale (which can be referred to as a long bond position or lending). The required borrowing or lending of funds is for the remaining term of the option and is typically assumed to be at r_f. Theoretically the expected return of the delta hedged position will be to earn the risk-free rate on the capital invested in the hedged position.

PROFESSOR'S NOTE

The ultimate actual return of the delta hedge cannot be known in advance because the hedge must be continually rebalanced and is subject to other risks. If you ran multiple simulations of the hedge and varied the underlying in a way consistent with the initial implied volatility in the option's price, then the risk-free rate would be the average result. Fortunately that demonstration is well beyond the scope of the CFA material. Just remember the intent of delta hedging is to lock in a fully hedged position (i.e., no upside or downside).

EXAMPLE: Initiating and maintaining a delta hedge on calls

A dealer is net short 6 month calls on 50,000 shares of ACC. The dealer plans to hedge the position and uses an option pricing model to generate the following information:

strike price	46		rf	1.30%
expiration	6 months		volatility	15%
stock price	45.9	46.0	46.1	46.2
option price	2.0469	2.1011	2.1560	2.2118
option delta	0.5376	0.5457	0.5538	0.5618
gamma	0.0812	0.0809	0.0805	0.0801

Answer the following question parts in order.

1. The stock is trading at 46. **Determine** the dealer's initial hedge position for the December calls.
2. **Determine** what to do if the stock then declines from $46 to 45.90. **Calculate** the net gain or loss on the hedged position.
3. **Determine** what to do if the stock then increases from $45.90 to $46.20. **Calculate** the net gain or loss on the hedged position.

Answer:

1. The short call position is at risk if the stock price increases, buy shares of the stock. Buy 50,000 × 0.5457 = 27,285 shares at $46.
2. The new required hedge is long: 50,000 × 0.5376 = 26,880; therefore sell 405 shares and invest the proceeds of 405 × $45.90 = $18,589.50. The dealer is now long 26,880 shares at $45.90.

   Gain on short call position as stock and option price declined (caution, be sure to use start of period shares, not end of period):

   50,000 (2.1011 − 2.0469) = 2,710.00

   Loss on long stock position as stock price declines:

   27,285 (46 − 45.90) = 2,728.50

Net loss: $18.50

3. The new required hedge is long: 50,000 × 0.5618 = 28,090; therefore buy 1,210 shares and borrow the needed funds of 1,210 × $46.20 = $55,902.00. The dealer is now long 28,090 shares at $46.20.

   Loss on short call position as stock and option price increased:

   50,000 (2.2118 − 2.0469) = 8,245.00

   Gain on long stock position as stock price increases:

   26,880 (46.20 − 45.90) = 8,064.00

   Net loss: $181.00

Further discussion: When you look at the graph of a short call, it is evident the hedge will not perform perfectly and should systematically underperform as the down side of the short call position exceeds the upside:

In bonds, more limited upside with greater downside would be called negative convexity. In options this convexity effect is called gamma and will be discussed further. In that discussion we will see that options that are relatively far form expiration have gradual changes in delta and as a result, delta hedging works rather well. The hedge also works better when the rebalancing is done frequently and after relatively small changes in the underlying.

EXAMPLE: Initiating and maintaining the delta hedge on puts

The same dealer who is short call positions is also net short puts on 25,000 shares of BBD. The options expire in 5 days. The dealer generates the follow information using the option pricing model:

strike price	32		rf	1.30%	
expiration	5 days		volatility	15%	
stock price	30	31	32	33	34
option price	1.9943	1.0022	0.2213	0.0089	0.0001
option delta	0.9999	0.9632	0.4925	0.0382	0.0003
gamma	0.0009	0.1478	0.7100	0.1433	0.0016

1. The stock is trading at 32. **Determine** the dealer's initial hedge position for the short put position.
2. **Determine** what to do if the stock then declines from $32 to 31. Calculate the net gain or loss on the hedged position.
3. **Determine** what to do if the stock then increases from $31 to 34. Calculate the net gain or loss on the hedged position.

Answer:

1. The short put position is at risk if the stock price decreases, short shares of the stock. Sell 25,000 × 0.4925 = 12,313 shares at $32.
2. The new required hedge is short: 25,000 × 0.9632 = 24,080, therefore sell 11,767 more shares and invest the proceeds of 11,767 × $31 = $364,777. The dealer is now short 24,080 shares at $31.

   Loss on short put position as stock and option price declined:

   25,000 (1.0022 − 0.2213) = $19,522.50

Gain on short stock position as stock price declined (caution, be sure to use start of period shares, not end of period):

12,313 (32 − 31) = $12,313

Net loss: $7,209.50

3. The new required hedge is short: 25,000 × 0.0003 = 8, therefore buy 24,072 shares and borrow the needed 24,072 × $34 = $818,448. The dealer is now short 8 shares at $34.

   Gain on short put position as stock and option price increased:

   25,000 (1.0022 − 0.0001) = $25,052.50

   Loss on short stock position as stock price increased:

   24,080 (34 − 31) = $72,240.00

   Net loss: $47,187.50

Further discussion: The options were very close to expiration and ATM. In addition the hedge was rebalanced after relatively large changes in the underlying. Both factors contributed to the poor performance of the hedge. These issues are discussed further under the Reality of Delta Hedging sections.

THE REALITY OF DELTA HEDGING: DELTA, GAMMA, AND TIME TO EXPIRATION

LOS 33.f: Interpret the gamma of a delta-hedged portfolio and explain how gamma changes as in-the-money and out-of-the-money options move toward expiration.

CFA® Program Curriculum, Volume 5, page 342

Figure 33.16: As Options Approach Expiration

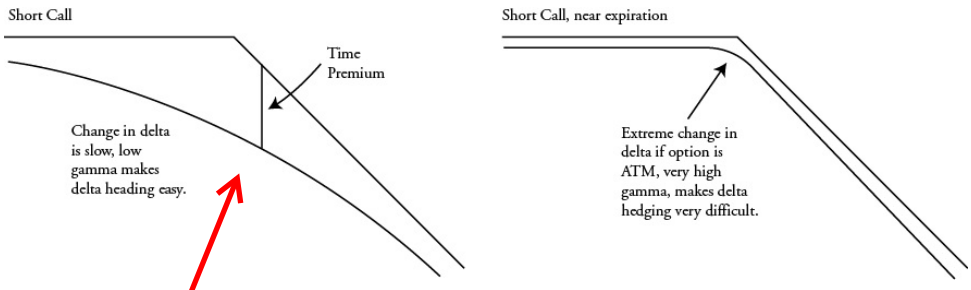


Figure 33.16 depicts what happens as a short call option approaches expiration. Prior to expiration, options generally trade with a significant time premium (option market value − intrinsic value). That time premium is largest for ATM options and it diminishes as the option moves OTM or ITM. As a result the option's price and delta change smoothly and gradually as the underlying changes. Gamma measures change in delta for change in the underlying (gamma = Δ delta / Δ in underlying), thus the gamma will be small. (In this discussion small means close to 0, no assignment of + or − is being made.) With low gamma and delta being relatively stable, there will be less need to rebalance the hedge. The straight line projection (using delta) of change in value of the option will be relatively accurate and change in value of the shares used for the hedge

will closely approximate the change in option value. The delta hedge will work well. The same effects will occur for delta hedging the puts when gamma is low.

However, as the time to expiration of the option approaches the time premium will shrink and the option will trade near intrinsic value. This has significant implications for the delta, gamma, and hedge results:

If the option is OTM the delta will be close to zero and stable (i.e. low gamma). The option will have little value, few shares will be needed for the hedge, the number needed will not change significantly, and the hedge will work well.

If the option is ITM the delta will be close to one and stable (i.e. low gamma). The option will have more value, approximately 1 share will be needed for each option, the number need will not change significantly, and the hedge will work well.

But if the option is close to ATM the delta can fluctuate quickly between zero and one, the gamma is very high, and delta hedging becomes very difficult, as occurred in the put hedging example.

How frequently the hedge is rebalanced also matters. In specific it matters how much the underlying is allowed to change before rebalancing. In general and all else the same, if the underlying changes more, the delta could have changed more, a larger rebalancing will be needed, and the hedge can suffer more significant losses. Rounding the number of shares used in the hedge to a whole number can also produce a small error.

PROFESSOR'S NOTE

A simple way to think about this is delta neutral hedging is always a bit behind. You do not know if the underlying will increase or decrease so you do not know if you need to buy or sell shares to rebalance the hedge until after the share price moves. Unfortunately for both short calls and short puts, after the share price moves the delta will have shifted in a way that you must buy shares at a higher price or sell shares at a lower price and the initial hedge position of shares will have undercompensated for how the option position has changed in value. If you rebalance more quickly (as price of the underlying moves) that will minimize the underperformance, though the trade-off is increased transaction costs. The reality is delta hedging basically does not work for ATM options approaching expiration. The dealer would likely think about closing out the positions prior to expiration or move on to more advance hedging strategies (not part of the CFA material).

Delta is generally obtained from option pricing models. For the exam:

- Delta will most likely be given as in the examples used here.
- Delta could be calculated as change in price of the option divided by change in price of the underlying if given ending and beginning prices of the option and underlying.
- Call delta is the Nd1 term in the Black-Scholes-Merton model.
- The absolute delta of a matched put and call (same expiration and underlying) sum to 1 (e.g., if call delta is 0.7, then put delta is 0.3).

The correct + or − sign for the delta of each option position are shown in Figure 33.15.

The Reality of Delta Hedging: Vega

The passage of time (approach of expiration) and the price of the underlying are not the only factors that affect the price of options. The most significant additional factor is

volatility of the underlying. High volatility makes both call and put options more valuable. (The call benefits from the increased potential upside of the underlying and the put from its potential downside.) Because volatility does not affect the immediate price of shares used in the hedge but does affect the price of the options, it introduces another element in the performance of the hedge:

An increase in volatility makes both calls and puts more valuable. That increase in value is a loss to the dealer's short option position and is not offset by immediate change in value of the shares used for the hedge. There is an immediate loss on the net hedged position.

A decrease in volatility makes both calls and puts less valuable. That decrease in value is a gain to the dealer's short option position and is not offset by immediate change in value of the shares used for the hedge. There is an immediate gain on the net hedged position.

There are some technical details that are not particularly relevant and are therefore not the focus here or in the CFA material:

- Delta is an approximation of option price move because delta is continually changing. Think of delta as the equivalent of duration; both are a good but not perfect projection of price change. (Delta and duration are the first derivative of the price function of the option and bond respectively.)
- Gamma can also be positive or negative. Both short calls and short puts have negative gamma as their potential loss in value (generally) exceeds their gain in value. (Gamma and convexity are the second derivative of the price function of options and bonds respectively.)
- The delta of an ATM call is normally somewhat higher than 0.5. This can be shown with an option pricing model. One way to conceptualize it is that the underlying more upside (unlimited) than downside (to zero), so the delta reflects more weight to the positive side of the intrinsic value graph (and delta of 1) than to the zero side of the intrinsic value graph (and delta of 0).

MODULE QUIZ 33.6

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

Use the following information to answer Questions 1 through 3. Answer the questions in order.

An option dealer sold call options on 1,667 shares of stock. The underlying stock is priced at $70 per share. The options have a delta of 0.60.

1. How many shares of stock must the dealer buy to hedge his price risk with a delta hedge?
   A. 669
   B. 1,000.
   C. 2,777.
2. If the delta associated with the call option changes from 0.60 to 0.70, what will the dealer do?
   A. Buy shares and borrow funds.
   B. Buy shares and lend funds.

C. Sell shares and lend funds.

3. If the dealer implemented the required hedge from the first question and rebalanced as required in the second question, the excess profit during the time period between initiation and rebalancing is *most likely*:
   A. zero.
   B. positive.
   C. negative.

KEY CONCEPTS

LOS 33.a

An investor creates a *covered call* position by buying the underlying security and selling a call option. Covered call writing strategies are used to generate additional portfolio income when the investor believes that the underlying stock price will remain unchanged over the short term.

A *protective put* (also called *portfolio insurance* or a *hedged portfolio*) is constructed by holding a long position in the underlying security and buying a put option. You can use a protective put to limit the downside risk at the cost of the put premium, P_0.

The purchase of the put provides a lower limit to the position at a cost of lowering the possible profit (i.e., the gain is reduced by the cost of the *insurance*). It is an ideal strategy for an investor who thinks the stock may go down in the near future, yet the investor wants to preserve upside potential.

LOS 33.b

There are many strategies that combine calls, puts, and the underlying asset.

- A bull spread strategy consists of a long call and a short call. The short call has a higher exercise price, and its premium subsidizes the long call. It offers gains if the underlying asset's price goes up, but the upside is limited.
- A bear spread strategy is the opposite side of a bull spread. It offers a limited upside gain if the underlying asset's price declines.
- A butterfly spread consists of two long and two short call positions. It offers a return, with a limited upside if the underlying asset price does not move very much.
- A collar strategy is simply a covered call and protective put combined to limit the down and upside value of the position.
- A long straddle is a long call and long put with the same exercise price. The greater the move in the stock price, the greater the payoff from a straddle.
- A box spread strategy combines a long put and a short put with a long call and a short call to produce a guaranteed return. That return should be the risk-free rate.

LOS 33.c

The basic approach is simple and consists of steps.

To hedge a future borrowing, purchase a call on interest rates for protecting from increasing rates.

To hedge a future lending, purchase a put on interest rates for protection from declining interest rates.

1. Assume that at time 0 the option to hedge the risk is purchased, and the purchase price is financed by borrowing at a rate reflecting the primary loan spread for a net CF of zero at time 0.

2. At time *t* when the primary loan occurs, net the cash flow of the primary loan with the option premium financing repayment to determine a net CF at time *t*.
3. At time *T* when the primary loan is repaid, net the repayment of primary loan cash flow and any payoff on the option for a net CF at time *T*.
4. Calculate the EAR between T_T and T_t net CFs.

LOS 33.d

An interest rate cap is a series of interest rate calls with the same strike rate but different expiration dates. Settlements are at the end of each period but are based on rates at the beginning of each period.

An interest rate floor is a series of interest rate puts with the same strike rate but different expiration dates. As with the cap, settlements are at the end of each period based on rates at the beginning of each period.

An interest rate collar is a combination of cap and floor where the investor is long one and short the other. A short cap and long floor would be of use to a lender of floating-rate loans. The collar will guarantee a range of income for the total position to the lender. A long cap and short floor will guarantee a floating-rate borrower a range of interest costs on the loan.

LOS 33.e

Dealers use delta hedging to hedge the risk of short call or put positions. Short calls are hedged by buying the underlying and short puts by shorting the underlying. The option delta is the number of underlying needed for the hedge. As the underlying, time to expiration, and other conditions change; delta can change and the hedge must be rebalanced. If more (less) units of the underlying are needed, buy them (sell them) and borrow (lend) the needed funds.

LOS 33.f

Gamma measures change in delta as the underlying changes. It is typically a smaller second order effect. But gamma becomes very large, delta changes quickly, and the hedge becomes very difficult to maintain for ATM options approaching expiration.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 33.1, 33.2

1. **A** By examining the payoff pattern of a butterfly, it is clear that there must be three strike prices used. With only two option contracts, there can only be two strike prices. Either of the two other combinations are possible. Starting from the left side of the payoff pattern: a long call with a lower strike price, plus two short calls with a medium strike price, plus a long call with a higher strike price will work. Alternatively, beginning from the middle of the payoff pattern, and utilizing a reverse straddle (sell a medium strike price call and put) plus buy a put with a lower strike price and buy a call with a higher strike price will achieve the same payoff pattern. Be prepared to understand combinations such as this that were not specifically discussed in the reading. It is just combining the four intrinsic value patterns. (Module 33.2, LOS 33.b)

2. Buy the 47 call at 5.25 and sell the 53 call at 0.75 for an initial investment of 4.50.

   BE can be computed from either max loss or max gain. Looking at the graph for a bull spread the max loss is at S = 47. Both calls are worthless. The loss is the initial investment of 4.50. Again looking at the graph, the stock must increase 4.50 to 51.50 for BE. (Module 33.2, LOS 33.b)

Module Quiz 33.3

1. **A** If the asset's price is between the put and call breakeven points, the long straddle produces a net loss. (LOS 33.b)

2. Buy ATM puts and calls on the EUR. The 1.04 strike price is the closest to ATM. Buying the call and put will cost: 0.004 + 0.017 = 0.021. Looking at the graph for a straddle, this is the max loss and occurs if the EUR closes at 1.04. For breakeven prices, the EUR must decrease or increase 0.021 to USD 1.019 or 1.061. (LOS 33.b)

Module Quiz 33.4

1. **C** The put pays the floor holder when interest rates fall, so they would hedge the risk of a variable rate lender (i.e., the owner of a floating rate asset). (LOS 33.c)

2. First, we compute the effective amount the bank parts with or lends at time of the loan. This means computing the future value of the premium:

   future value of premium = $2,020 = $2,000[1 + (0.04 + 0.02)(60 / 360)]

   Thus, the cash outflow at the loan's inception is $10,002,020. At the given LIBOR rates of 4.5% and 6.5%, the put's payoffs are:

   LIBOR = 4.5%: payoff = $12,500 = $10,000,000[max(0, 0.050 − 0.045)(90 / 360)]

LIBOR = 6.5%: payoff = $0 = $10,000,000[max(0, 0.050 − 0.065)(90 / 360)]

The interest income earned is:

LIBOR = 4.5%: int. income = $162,500 = $10,000,000 × (0.045 + 0.020)(90 / 360)

LIBOR = 6.5%: int. income = $212,500 = $10,000,000 × (0.065 + 0.020)(90 / 360)

The effective rate earned is:

LIBOR = 4.5%:

$$EAR = [(\$10,000,000 + \$162,500 + \$12,500) / (\$10,002,020)]^{(365 / 90)} - 1$$

$$EAR = [(\$10,175,000) / (\$10,002,020)]^{(365 / 90)} - 1$$

$$EAR = 0.0720 = 7.2\%$$

LIBOR = 6.5%:

$$EAR = [(\$10,000,000 + \$212,500 + \$0) / (\$10,002,020)]^{(365 / 90)} - 1$$

$$EAR = [(\$10,212,500) / (\$10,002,020)]^{(365 / 90)} - 1$$

$$EAR = 0.0881 = 8.81\%$$

(LOS 33.c)

Module Quiz 33.5

1. **B** payoff = $50,000 = ($5,000,000)(0.06 – 0.05)(1) (LOS 33.d)
2. The first collar expiration will occur on February 1 for payment on August 1. There will be no collar payment on the first February 1. The payoffs on the derivatives are:
   Floorlets:

   Year 1

   payoff on Feb. 1 = N/A

   payoff on Aug. 1 = $10,056 = $20,000,000[max(0, 0.025 − 0.024)(181 / 360)]

   Year 2

   payoff on Feb. 1 = $0 = $20,000,000[max(0, 0.025 − 0.050)(184 / 360)]

payoff on Aug. 1 = $0 = $20,000,000[max(0, 0.025 − 0.050)(181 / 360)]

Caplets:

Year 1

payoff on Feb. 1 = N/A

payoff on Aug. 1 = $0 = $20,000,000[max(0, 0.024 − 0.047)(181 / 360)]

Year 2

payoff on Feb. 1 = $30,667 = $20,000,000[max(0, 0.050 − 0.047)(184 / 360)]

payoff on Aug. 1 = $30,167 = $20,000,000[max(0, 0.050 − 0.047)(181 / 360)]

The interest payments are:

pmt. on Feb. 1 = $664,444 = $20,000,000(0.041 + 0.024)(184 / 360)

pmt. on Aug. 1 = $482,667 = $20,000,000(0.024 + 0.024)(181 / 360)

pmt. on Feb. 1 = $756,444 = $20,000,000(0.050 + 0.024)(184 / 360)

pmt. on Aug. 1 = $744,111 = $20,000,000(0.050 + 0.024)(181 / 360)

The following table illustrates how the payments and payoffs combine to give an effective rate for each period.

Settlement	Year	Actual Interest	Floor Payoffs	Cap Payoffs	Effective Interest
Feb. 1	1	$664,444	N/A	N/A	$664,444
Aug. 1	1	$482,667	$10,056	0	$492,723
Feb. 1	2	$756,444	0	–$30,667	$725,777
Aug. 1	2	$744,111	0	–$30,167	$713,944

(LOS 33.d)

Module Quiz 33.6

1. **B** The short call position will lose value if the underlying increases. The loss is 0.6 for each $1 increase in the stock price. To hedge, the dealer will buy 1,667 × 0.6 = 1,000 shares. (LOS 33.e)
2. **A** The hedge is now 1,667 × 0.7 = 1,167 shares. The purchase of another 167 shares is financed by borrowing. (LOS 33.e)

3. **C** Examine the graph of a short call position. As the underlying increases, the loss on the short call accelerates (the delta increases). Any delay in rebalancing the hedge results in the loss on the short calls exceeding the gain on the long shares as the underlying increases. (LOS 33.e)

The following is a review of the Risk Management Applications of Derivatives principles designed to address the learning outcome statements set forth by CFA Institute. Cross-Reference to CFA Institute Assigned Reading #34.

READING 34: RISK MANAGEMENT APPLICATIONS OF SWAP STRATEGIES

Study Session 17

EXAM FOCUS

Swaps are commonly used to modify risk in portfolios and on balance sheets. Virtually any swap analysis starts with the swap diagram. The swap diagram begins with the initial situation of the principal involved. Then an appropriate swap can be designed to accomplish the desired objective. From the diagram, the duration of the swap can be inferred. Be prepared for both conceptual as well as calculation questions.

MODULE 34.1: USING INTEREST RATE SWAPS

Video covering this content is available online.

LOS 34.a: Demonstrate how an interest rate swap can be used to convert a floating-rate (fixed-rate) loan to a fixed-rate (floating-rate) loan.

CFA® Program Curriculum, Volume 5, page 359

The most common interest rate swap is the *plain vanilla* interest rate swap. In this swap, Company X agrees to pay Company Y a periodic fixed rate on a notional principal over the tenor of the swap. In return, Company Y agrees to pay Company X a periodic floating rate on the same notional principal. Payments are in the same currency, so only the net payment is exchanged.

Most interest rate swaps use the London Interbank Offered Rate (LIBOR) as the reference rate for the floating leg of the swap. Finally, because the payments are based in the same currency, there is no need for the exchange of principal at the inception of the swap. This is why it is called *notional* principal.名义本金

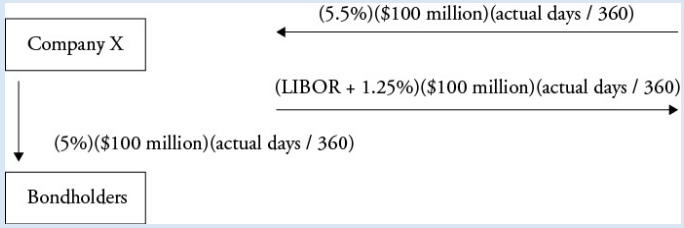
EXAMPLE: Converting fixed to floating and floating to fixed

Company X has a $100 million, 2 year, 5% fixed rate semi-annual pay debt. Payments are actual day count over a 360-day year. The company expects interest rates to fall and would prefer to have a floating rate debt.

Company Y has a $100 million, 2-year, floating rate semiannual pay debt at LIBOR plus 100 basis points. Payments are actual day count over a 360-day year. The company expects interest rates to rise and would like to use a swap to convert the debt to fixed rate.

A $100 million, 2-year, 5.5% semiannual pay swap versus LIBOR plus 125 basis points is available to both X and Y.

Converting Fixed-Rate Debt to Floating for Company X

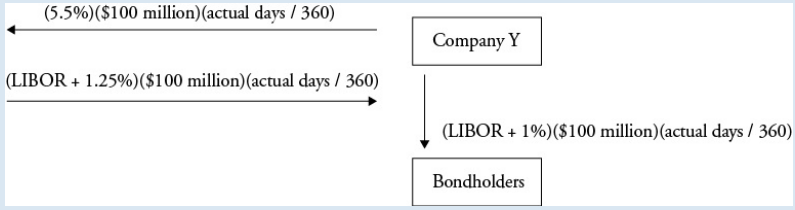


The net result is Company X is now paying a synthetic floating rate of LIBOR plus 75 basis points.

- Pay 5% on fixed rate debt.
- Pay LIBOR plus 1.25% on swap.
- Receive 5.5% on swap.

Company X has effectively removed its fixed-rate liability exposure and converted it to LIBOR exposure. Its fixed-rate debt would have had a higher duration and now its debt has the lower duration of a floating rate liability. Company X is effectively speculating LIBOR will fall.

Converting Floating-Rate Debt to Fixed-Rate Debt for Company Y



The net result is Company Y is now paying a synthetic fixed rate of 5.25%.

- Pay LIBOR plus 1% on floating rate debt.
- Receive LIBOR plus 1.25% on swap.
- Pay 5.5% on swap.

Company Y has effectively removed its floating rate liability exposure and converted it to fixed rate exposure. Its floating rate debt would have had a lower duration and now its debt has the higher duration of a fixed rate liability. Company Y is effectively speculating LIBOR will rise.

DURATION OF AN INTEREST RATE SWAP

LOS 34.b: Calculate and interpret the duration of an interest rate swap.

CFA® Program Curriculum, Volume 5, page 361

The duration properties of swaps are another reason for their popularity. Each counterparty in a swap is essentially either of the following:

- Long a fixed cash flow and short a floating cash flow.
- Short a fixed cash flow and long a floating cash flow.

You should recall that duration is the sensitivity of an asset's price to changes in a relevant interest rate. Here are two important points with respect to fixed and floating-rate instruments:

1. For fixed-rate instruments, duration will be higher because the change in interest rates will change the present value of the fixed cash flows.
2. For floating-rate instruments, duration is close to zero because the future cash flows vary with interest rates, and the present value is fairly stable with respect to changes in interest rates.

A *floating-rate* instrument can have a non-zero duration if its next cash flow has been set, which is the case with swaps. The convention is to treat the duration of the floating rate side of the swap as being half the reset period. For example, for a 6-month reset, the duration would be taken to be 0.25, for a quarterly reset it would be taken to be 0.125, et cetera.

Because we know that the duration of a zero-coupon bond is its maturity, the duration of the floating payments where the next payment is known will be the time to the next payment. At inception or just after a settlement for a *quarterly* reset swap, the duration of the floating payments is 0.25; for a *semiannual* reset swap, the duration is 0.5; et cetera. Just before the payment is due, however, the duration is 0.0. Hence, the *average* duration of a floating instrument over the reset period is one-half the length of its settlement periods.

For a pay-floating counterparty in a swap, the duration can be expressed as:

$$D_{\text{pay floating}} = D_{\text{fixed}} - D_{\text{floating}} > 0$$

Because the floating-rate payor receives fixed cash flows, taking the receive-fixed/pay-floating position in a swap increases the dollar duration of a fixed-income portfolio. The modified duration of the portfolio will move an amount determined by (1) the relative values of the notional principal of the swap and the portfolio's value and (2) relative values of the modified duration of the swap and that of the portfolio.

PROFESSOR'S NOTE

Calculating swap duration is simple; it is the difference in the durations of the two sides of the swap. The swap diagram is an easy way to remember how to calculate swap duration. The arrow coming in represents an asset; add the duration of what is received on the swap. The arrow going out represents a liability; subtract the duration of what is paid on the swap. The result is the swap duration.

EXAMPLE: Pay-floating swap duration

At the inception of a 2-year swap, the duration of the fixed payments is 1.1, and the duration of the floating payments is 0.25. What is the duration of the swap to the pay-floating party to the swap?

Answer:

The duration of the swap is 1.1 − 0.25 = 0.85.

This is +0.85 to the receive fixed and pay floating counterparty.

MARKET VALUE RISK AND CASH FLOW RISK

LOS 34.c: Explain the effect of an interest rate swap on an entity's cash flow risk.

CFA® Program Curriculum, Volume 5, page 362

It is common to refer to converting a floating-rate liability to fixed-rate as a hedge. In the sense that it reduces cash flow risk, it is a hedge. However, it is essentially converting highly visible cash flow risk into less visible market value risk.

Cash flow risk is reduced by entering the swap because the uncertain future floating-rate payments on the liability are essentially converted to fixed payments that can be

more easily planned for and budgeted, resulting in a reduction in cash flow risk. However, the low duration of the floating-rate liability is now converted to the higher duration of a fixed-rate liability. The liability market value will now fluctuate more as interest rates change. For example, if interest rates fall, the liability will rise in market value, creating a corresponding decline in the firm's theoretical market value of equity.

Some argue that these changes in market value are unrealized, which is true. They are nonetheless real, and financial theory would clearly suggest they should affect the market value of the firm and of the equity. The swap reduces cash flow risk but increases market value risk.

USING SWAPS TO CHANGE DURATION

LOS 34.d: Determine the notional principal value needed on an interest rate swap to achieve a desired level of duration in a fixed-income portfolio.

CFA® Program Curriculum, Volume 5, page 363

The duration of the portfolio plus a swap position (i.e., the target duration) is calculated as:

$$V_p(MD_T) = V_p(MD_p) + NP(MD_{swap})$$

where:

V_p = original value of the portfolio

MD_i = modified duration i (i = swap, target, portfolio without swap)

NP = notional principal of the swap

Usually, the portfolio manager selects a swap of a certain maturity which determines the modified duration of the swap, MD_{swap}. He then selects the *NP* that will achieve the desired MD_T . Rearranging, we can solve for the amount of notional principal necessary to achieve the target duration:

$$NP = (V_p)\left(\frac{MD_T - MD_p}{MD_{swap}}\right)$$

PROFESSOR'S NOTE

This is just a variation of the basic bond hedging formula but set up to calculate notional principal rather than the number of contracts.

EXAMPLE: Determining the notional principal

A manager of a $60 million fixed-income portfolio with a duration of 5.2 wants to lower the duration to 4.0. The manager chooses a swap with a net duration of 3.1. What NP should the manager choose for the swap to achieve the target duration?

Answer:

From the given information, we have:

$$\begin{aligned}
V_p &= \$60,000,000 \\
MD_p &= 5.2 \\
MD_{swap} &= 3.1 \\
MD_T &= 4.0 \\
NP &= (V_p)\left(\frac{MD_T - MD_p}{MD_{swap}}\right) \\
NP &= \$60,000,000\left(\frac{4.0-5.2}{-3.1}\right) = \$23,225,806
\end{aligned}$$

Because the manager wants to *reduce* the duration of his portfolio, he should take a receive-floating/pay-fixed position in the swap with that notional principal. Remember that a receive-floating swap has a negative duration, so we enter –3.1 in the equation.

For the Exam: Be sure to enter the net duration of the swap correctly in the denominator of the equation (i.e., negative if pay-fixed; positive if receive-fixed). You can tell if you have entered it correctly because the sign on the notional principal should always be positive.

MODULE QUIZ 34.1

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

1. Which of the following would *best* transform a floating-rate liability to a fixed-rate liability? Enter into a contract to:
   A. pay fixed on an interest rate swap.
   B. receive floating on a currency swap.
   C. pay floating on an equity swap.
2. A firm issues fixed-rate bonds and simultaneously becomes a fixed-rate receiver counterparty in a corresponding plain vanilla interest rate swap. Which of the following *best* describes the subsequent, effective periodic interest payments of the firm? (SFR = swap fixed rate)
   A. Pay fixed rate on debt and SFR, reduced by receiving LIBOR.
   B. Pay LIBOR and SFR, reduced by receiving fixed rate on debt.
   C. Pay LIBOR and fixed rate on debt, reduced by receiving SFR.
3. For a plain vanilla interest rate swap, a decrease in interest rates will *most likely*:
   A. increase the value of the pay-fixed side of the swap.
   B. decrease the value of the pay-fixed side of the swap.
   C. leave the value of the pay-floating side unchanged.
4. For a pay-floating counterparty, the duration of the swap will generally be:
   A. less than the duration of the fixed-rate payments.
   B. equal to the duration of the fixed-rate payments.
   C. greater than the duration of the fixed-rate payments.
5. A manager of a $40 million dollar fixed-income portfolio with a duration of 4.6 wants to lower the duration to 3. The manager chooses a swap with a net duration of 2. **Determine** the notional principal that the manager should choose for the swap to achieve the target duration.

6. You are the treasurer of a company with a 4-year, $20 million FRN outstanding at LIBOR. You are concerned about rising interest rates in the short term and would like to refinance at a fixed rate for the next two years. A swap dealer arranges a 2-year plain vanilla interest rate swap with annual payments in which you pay a fixed rate of 8.1% and receive LIBOR. The counterparty receives 7.9% and pays LIBOR. Assume that the counterparty has a $20 million fixed-rate debt outstanding at 8%. One-year LIBOR is currently 7%. **Diagram** and **compute** each party's net borrowing cost and first-year cash flows.

MODULE 34.2: USING CURRENCY SWAPS

Video covering this content is available online.

A *currency swap* is different from an interest rate swap in two very important ways:

1. There are two notional principals, one in each currency, and the counterparties generally exchange the principals on the effective date and return them at the maturity date.
2. Because the cash flows in a currency swap are denominated in different currencies, the periodic interest payments are not usually settled on a net basis, so each counterparty makes a payment to the other in the appropriate currency.

A *plain vanilla currency swap* is one in which the floating-rate cash flows (usually based on LIBOR) are in dollars, while the other cash flows (in another currency, like euros) are based on a fixed rate. However, because swaps are OTC instruments, the counterparties can design them any way they choose (e.g., floating for floating, dollar floating and foreign fixed, fixed for fixed).

One of the more common reasons for a firm to engage in a currency swap is to gain access to loanable funds in a foreign currency that might be too costly to obtain from a bank, the reason being that the firm does not have close relationships with banks in the country of the desired currency.

A firm may also have issued a foreign-currency bond earlier, and now the firm wishes to *convert* it into a domestic obligation. A swap can help with that, too. If a U.S. company has a fixed-rate note denominated in euros and wishes to make it a synthetic dollar loan, the U.S. firm can enter into a receive-euro/pay-dollar swap. Because the plain vanilla currency swap exchanges fixed foreign currency for floating dollars, the U.S. firm's synthetic position will now be a floating-rate dollar obligation.

The following demonstration illustrates the mechanics of the swap in combination with the loans on both sides of the swap. Also, for added measure, we put the dealer in the mix, too! Dealers are involved in most transactions, and you may see them as part of an exam question.

EXAMPLE: Currency swap

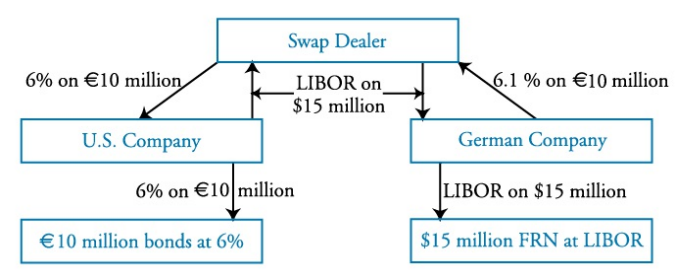
A U.S. company has a liability of €10 million in fixed-rate bonds outstanding at 6%. A German company has a $15 million FRN outstanding at LIBOR. The exchange rate is $1.5/€. The U.S. company enters into a plain vanilla currency swap with the swap dealer in which it pays LIBOR on $15 million and receives the swap rate of 6.0% on €10 million. The German company also enters into a plain vanilla currency swap with the same dealer, in which it pays a swap rate of 6.1% on €10 million and receives LIBOR on $15 million. One-year LIBOR is currently 5.2%.

Calculate each party's net borrowing cost, the principal cash flows at the initiation and maturity of the contract, and first-year cash flows (assume annual settlement).

Answer:

The cash flow for each settlement date for this plain vanilla currency swap is illustrated in the figure below.

Cash Flows for a Plain Vanilla Currency Swap



The U.S. company's net borrowing cost: LIBOR on $15 million

(6% on €10 million) + (LIBOR on $15 million − 6% on €10 million)

The German company's net borrowing cost: 6.1% on €10 million

(LIBOR on $15 million) + (6.1% on €10 million − LIBOR on $15 million)

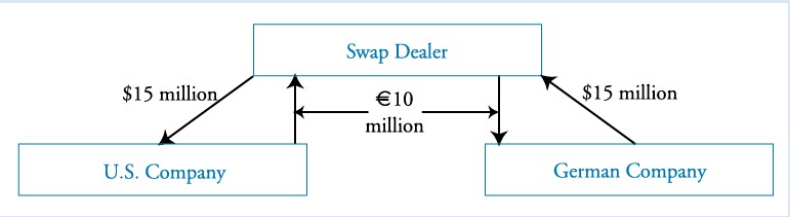
The swap dealer's spread: 0.1% on €10 million = €10,000

(LIBOR on $15 million − 6% on €10 million) + (6.1% on €10 million − LIBOR on $15 million)

Not only are the firms paying in different currencies, but they get access to the funds because they exchange notional principals at the beginning of the swap.

The cash flows of the notional principals at the initiation of the swap are shown in the following figure.

Exchange of Notional Principals



The U.S. Company

At the end of the first year, the U.S. company pays interest on its euro borrowing. It pays LIBOR and receives euros under the swap (the negative sign means outflow):

interest on euro borrowing	= –€600,000	= €10,000,000 × 0.060
euros received under swap	= €600,000	= €10,000,000 × 0.060
U.S. dollars paid under swap	= –$780,000	= $15,000,000 × 0.052
net cash flow	= –$780,000	

At the beginning of the period, the U.S. company gets a dollar principal and will pay dollars on the amount that was once a euro loan.

The German Company

The German company gets euros and will pay interest on its U.S. dollar borrowing. It receives LIBOR and pays euros under the swap:

interest on U.S. dollar borrowing	= –$780,000	= $15,000,000 × 0.052
euros paid under swap	= –€610,000	= €10,000,000 × 0.061
U.S. dollars received under swap	= $780,000	= $15,000,000 × 0.052
net cash flow	= –€610,000	

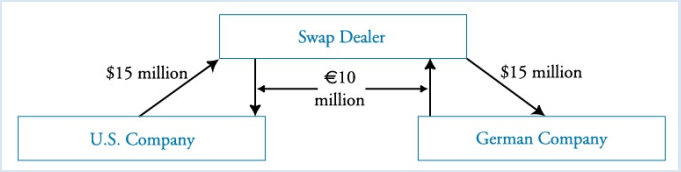
The Swap Dealer

The net cash flow to the swap dealer is:

euros received from German firm	= €610,000	= €10,000,000 × 0.061
euros paid to U.S. firm	= €600,000	= €10,000,000 × 0.060
net cash flow	= €10,000	= €10,000,000 × 0.001

The principal cash flows at maturity of the swap are shown next.

Cash Flows at the Maturity of the Swap



LOS 34.e: Explain how a company can generate savings by issuing a loan or bond in its own currency and using a currency swap to convert the obligation into another currency.

CFA® Program Curriculum, Volume 5, page 370

As mentioned earlier, a counterparty may use a currency swap to gain access to a foreign currency at a lower cost. Borrowing in a foreign country via a foreign bank may be difficult, and the interest rates may be high. A U.S. firm that wishes to initiate a project in a foreign country, say Korea, might not have the contacts necessary to borrow Korean currency (the won) cheaply. It may have to pay a high interest rate, such as 9%. A Korean counterparty may exist that would like to borrow dollars to invest in the United States but finds that banks in the United States charge 7.2% because they are unfamiliar with the Korean firm.

The U.S. firm can borrow at 6% in the United States because it has established relationships with those banks. It swaps the principal (borrowed dollars) with the Korean counterparty for the won, which the Korean firm borrowed at 7% in Korea. The U.S. firm uses its proceeds from its new business to pay the won interest to the Korean counterparty, who in turn pays won interest on its bank loan to the Korean bank. The

Korean firm pays the dollar interest to the U.S. firm, who in turn pays dollar interest on its loan to the U.S. bank.

Here are the important points to this exchange:

- The U.S. firm is now paying 7% on a won loan on which it would have had to pay 9% if it had borrowed from a Korean bank.
- The Korean firm is now paying 6% on a dollar loan on which it would have had to pay 7.2% if it had borrowed from a U.S. bank.

An easier way to understand the analysis is to draw the swap diagram:

Figure 34.1: Effect of Currency Swap Cash Flows on Interest Payments

A dealer might have increased the swap interest rates 10 basis points for each counterparty with the dealer earning the spread. But the resulting 7.1% for the U.S. firm is still less than 9%, and the resulting 6.1% is still less than 7.2% for the Korean firm.

CONVERTING FOREIGN CASH RECEIPTS

LOS 34.f: Demonstrate how a firm can use a currency swap to convert a series of foreign cash receipts into domestic cash receipts.

CFA® Program Curriculum, Volume 5, page 375

Dealers will contract with a firm in a currency swap that does not require an exchange of notional principals. This essentially becomes a series of exchange-rate purchases in the future at a fixed exchange rate. The amounts exchanged are a function of both the current exchange rate and interest rates (swap rates) in the countries involved.

As an example, let's consider a U.S. firm that wishes to convert its quarterly cash flows of €6 million each to dollars upon receipt. The exchange rate is currently €0.8/$, and the swap rates in the United States and Europe are 4.8% and 5%, respectively. To obtain the swapped dollar cash flow, we first back out the notional principal in euros, translate this to a dollar notional principal, and then calculate the interest in dollars:

$$\text{NP}\left({}^{0.05}/_{4}\right) = €6,000,000$$

$$\text{NP} = \frac{€6,000,000}{{}^{0.05}/_{4}} = €480,000,000$$

The corresponding dollar amount is €480,000,000 / (€0.8/$) = $600,000,000. The quarterly interest payments on this amount would be $600,000,000(0.048 / 4) = $7,200,000.

The swap would then allow the firm to exchange its €6,000,000 quarterly inflow for $7,200,000 per period. The maturity of the swap would be negotiated to meet the needs of the firm. You should note that no exchange of principals was required.

For the Exam: Follow these steps in determining the appropriate swap:

1. Divide the foreign cash flow received by the foreign interest rate to determine the corresponding foreign-denominated notional principal (NP).
    a. This is the foreign NP that would have produced the foreign cash flow at the given foreign interest rate.
2. Using the current exchange rate, convert the foreign NP into the corresponding domestic NP.
3. Enter a swap with this NP.
    a. Pay the foreign cash flows received on the assets and receive the equivalent domestic amount.
    b. The amount of each domestic cash flow is determined by multiplying the domestic interest rate by the domestic NP.

EXAMPLE: Currency swap without a notional principal exchange

A firm will be receiving a semiannual cash flow of €10 million. The swap rates in the United States and Europe are 6% and 5%, respectively. The current exchange rate is €0.9/$. **Identify** the appropriate swap needed to convert the periodic euro cash flows to dollars.

Answer:

For the euros, the NP = €10,000,000 / (0.05 / 2) = €400,000,000. The corresponding dollar amount is €400,000,000 / 0.9 = $444,444,444. Using these values for the swap, the firm will give the swap dealer €10,000,000 every six months over the maturity of the swap for:

$444,444,444(0.06 / 2) = $13,333,333

MODULE QUIZ 34.2

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

1. A common reason for two potential borrowers in different countries to enter into a currency swap is to:
    A. borrow cheap domestic and swap for foreign to reduce borrowing costs.
    B. borrow cheap foreign and swap for domestic to reduce borrowing costs.
    C. speculate on interest rate moves.
2. A firm will be receiving a semiannual cash flow of €20 million. The swap rates in the United States and Europe are 4.0% and 4.6%, respectively. The current exchange rate is €1.2/$. **Identify** the appropriate swap needed to convert the periodic euro cash flows to dollars.

MODULE 34.3: EQUITY SWAPS

Video covering this content is available online.

LOS 34.g: Explain how equity swaps can be used to diversify a concentrated equity portfolio, provide international diversification to a domestic portfolio, and alter portfolio allocations to stocks and bonds.

CFA® Program Curriculum, Volume 5, page 380

An equity swap is a contract where at least one counterparty makes payments based upon an equity position. The other counterparty may make payments based upon another equity position, a bond, or just fixed payments. We will begin with that example.

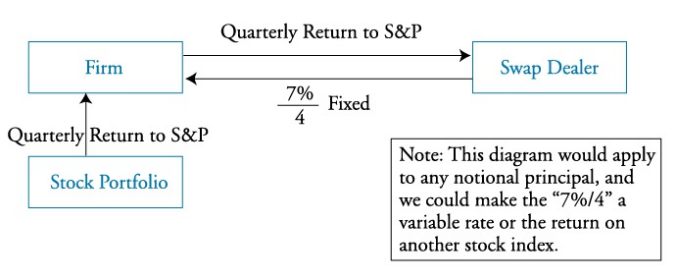
EXAMPLE: Equity swap with fixed payments

A firm owns a stock portfolio that is closely correlated with the S&P 500. The firm is concerned that the stock market will fall over the next year. A 1-year, quarterly equity swap is available with a notional principal equal to the value of the portfolio and a fixed rate of 7%. **Diagram** the net quarterly cash flows to a hedge.

Answer:

The net effect for the firm is a fixed-rate return of 7% / 4 = 1.75% per period as shown below.

Quarterly Cash Flows to an Equity Swap



The swap does create some secondary risks, including:

- Counterparty risk if the swap dealer experiences difficulty and is unable to make the swap payments as expected to the firm.
- Basis risk if the return on the stock portfolio does not exactly match the S&P return payments the firm must make on the swap.
- Some cash flow risk in that the S&P payments to the swap dealer are unlikely to match the fixed payments to the firm. If a net is paid, the firm must have the cash available. Note: if the firm had sold the stock and actually bought fixed rate bonds, there is no cash flow risk as the firm just collects coupons.

Swaps to Create International Diversification

As a variation on the previous example, suppose the firm had a $500 million equity portfolio and swapped $100 million to receive the 7% fixed rate. The firm effectively has 20% fixed rate bond exposure. Now the firm does a second swap for $50 million, paying the S&P return and receiving the return for the MSCI, an international stock index. This would further diversify the portfolio by creating a 10% allocation to international equity.

This second swap will have the same secondary risks as the first swap, but the cash flow risk is potentially even greater because the firm is receiving an index return rather than a known fixed rate. Consider the worst case scenario, where the S&P return paid is very large due to a high return on the S&P but the MSCI return is a large negative. The firm contracted to receive the MSCI return and when that return is negative, that means the firm must pay the MSCI return. The firm could end up making two payments with no receipt in a worst case scenario. Notice paying the MSCI return out when it is negative simply replicates the loss in value that would have occurred if the firm owned the MSCI and it declined. However, the swap requires cash to be paid, while owning the MSCI would only be a decline in market value. Economically they are the same result but the swap creates cash flow issues.

Benefits of using the swap are that transaction costs for the swap are generally lower than actually selling domestic stocks to buy international stocks. The swap can be for a defined period if this is a temporary exposure that is desired. Also the swap can be structured as payment in U.S. dollars to limit the foreign currency exposure from owning foreign denominated assets and any need to hedge the currency exposure. The dealer may consider these factors in pricing the swap, so the firm should consider whether the pricing is still attractive (to the firm).

> **EXAMPLE: Diversifying concentrated positions**
>
> An investor has an overweighed 30,000 share position in a stock with a current market value of $80 per share and a dividend yield of 2%. The investor wishes to reduce the position by half for a position in the S&P 500. **Demonstrate** how this can be accomplished with a swap.
>
> **Answer:**
>
> The owner of the stock would probably approach a dealer and swap the returns on $1.2 million = (30,000 × $80) / 2 worth of the stock for the returns on a $1.2 million investment in the S&P 500. Each settlement period (e.g., quarter) the total return on each position is calculated. The net amount is transferred between the parties.

Changing Allocations of Stock and Bonds

Another type of swapping of index returns can occur between, for example, large- and small-cap stocks. A firm with an equity portfolio that is 60% in large-cap stocks, 30% in mid-cap stocks, and 10% small-cap stocks can use a swap to synthetically adjust this position. If the value of the portfolio is $200 million and the firm decides to make the large- and mid-cap exposure equal without touching the small-cap position, then it can become a counterparty in a swap that receives the return of the S&P Mid-Cap 400 Index and pays the return on the Dow Jones Industrial Average Index on a notional principal of 15% of $200 million (i.e., $30 million). Ignoring tracking error, this will synthetically make the portfolio a 45% large-cap, 45% mid-cap, and 10% small-cap stock portfolio over the life of the swap. The small-cap position is unaffected.

This concept can also be applied to the synthetic adjustment of a *bond portfolio*. A firm with a given portfolio of high-grade and low-grade bonds can enter into a swap that pays the return on an index of one type (e.g., the high-grade) and receives the return on the index of another type (e.g., the low-grade). *Do not confuse this with an interest rate*

swap! In the swap based on bond returns, there is an interest component and a capital gain component just as there is in an equity swap.

EXAMPLE: Changing allocations of stocks and bonds

We will consider a manager of a $120 million bond portfolio that consists of $80 million in investment-grade corporate bonds and $40 million in U.S. Treasuries. The manager wants to switch the weights. **Demonstrate** how this can be accomplished with a swap.

Answer:

Once again, the manager approaches a dealer about swapping the returns on indices like the Barclays Capital Long-Term Treasury Bond Index and the Merrill Lynch Corporate Bond Index. The notional principal will be $40 million.

MODULE QUIZ 34.3

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

1. A firm has an $8 million portfolio of large-cap stocks. The firm enters into an equity swap to pay a return based on the DJIA and receive a return based on the Russell 2000. To achieve an effective 60/40 mix of large-cap to small-cap exposure, the notional principal of the swap should be:
   A. $6.0 million.
   B. $4.8 million.
   C. $3.2 million.

MODULE 34.4: USING SWAPTIONS

Video covering this content is available online.

LOS 34.h: Demonstrate the use of an interest rate swaption 1) to change the payment pattern of an anticipated future loan and 2) to terminate a swap.

CFA® Program Curriculum, Volume 5, page 389

For the Exam: Be able to explain why and how a manager would use a swaption as well as calculate the payoff or cash flows to the swaption if exercised.

An *interest rate swaption* is an option on a swap where one counterparty (buyer) has paid a premium to the other counterparty (seller) for an option to choose whether the swap will actually go into effect on some future date. The terms of the swap are usually determined at the time of the swaption's inception, prior to the effective date of the swap. Swaptions can be either American or European in the same way as options. European-style swaptions may only be exercised on the expiration date, whereas an American-style swaption may be exercised on any day up to and including the expiration date.

There are two types of swaptions:

1. *Payer swaption*: A payer swaption gives the buyer the right to be the fixed-rate payer (and floating-rate receiver) in a prespecified swap at a prespecified date. The payer swaption is almost like a protective put in that it allows the holder to pay a set fixed rate, even if rates have increased.

2. *Receiver swaption*: A receiver swaption gives the buyer the right to be the fixed-rate receiver (and floating-rate payer) at some future date. The receiver swaption is the reverse of the payer swaption. In this case, the holder must expect rates to fall, and the swap ensures receipt of a higher fixed rate while paying a lower floating rate.

The key point is that the terms of the underlying swap and the swap fixed rate (SFR) are negotiated and set at the purchase of the swaption. The purchaser of the swaption can wait and see if subsequent market moves make that SFR attractive or not and then decide whether to turn on the underlying swap.

Payer Swaption

- If market interest rates move high enough at the expiration of the swaption such that the new SFR is above the swaption SFR, the holder of the payer swaption will exercise the option. Paying the swaption SFR is better than the terms on a new swap. The swaption swap has positive value.
- If interest rates move low enough such that the new SFR is below the swaption SFR, the holder would let the swaption expire worthless and only lose the premium paid. The swaption swap has negative value.

Receiver Swaption

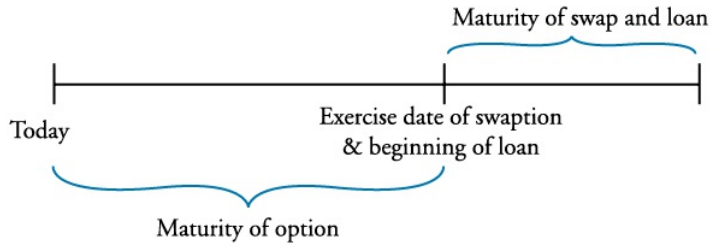
- If interest rates move high enough and the new SFR is above the swaption SFR, the holder of the swaption would let it expire worthless and only lose the premium paid. The SFR that would be received on the swaption SFR is unattractive and the swaption swap has negative value. A better SFR is available on a new swap.
- If market interest rates move low enough and the new SFR is below the swaption SFR, the swaption will be exercised. The swaption swap has positive value with an above market SFR to be received.

Using Swaptions to Hedge a Future Loan Transaction

A corporate manager may wish to purchase a fixed-rate payer swaption to synthetically *lock in* a maximum fixed rate to be paid on an FRN to be issued in the future. If interest rates decline, the manager can always let the option expire worthless and take advantage of lower rates. The time line is illustrated in Figure 34.2. Today the manager enters into a swaption by paying a premium. The option expires at the time the loan will be taken out. For generality, Figure 34.2 does not specify a floating- or fixed-rate loan.

- The payer swaption would convert a future floating-rate loan to a fixed-rate loan.
- The receiver swaption would convert a future fixed-rate loan to a floating-rate loan.

Figure 34.2: Swaption and Future Loan



As an example, if a manager is planning to take out a 3-year loan of $10 million at a floating rate, say LIBOR plus 250 basis points, then the manager could hedge the risk of rising interest rates by purchasing a payer swaption with a notional principal of $10 million. (The premium might be $200,000, but the amount is not important for our discussion here. You should just know that an up-front premium is usually required.) The swap would be to receive 90-day LIBOR each quarter, to hedge the loan payments, and pay a fixed rate. The fixed rate might be 3.6% or 0.9% each quarter. At the exercise date of the swaption and the beginning of the loan, one of the following two scenarios will result.

1. The fixed rate on 3-year swaps that pay LIBOR is *greater than* 3.6%. Then the manager will exercise the swaption to pay the contracted 3.6% and receive LIBOR. We will recall our formula for a floating-rate borrower who is a floating-rate receiver in a swap:

   net payment = NP[swap rate + (loan spread)](D_t / 360)

   In this case, the floating-rate loan plus swap will become a synthetic fixed-rate loan with the following quarterly payments (assuming 90-day settlement periods):

   net payment = $10,000,000(0.036 + 0.025)(90 / 360) = $152,500

2. The fixed rate on 3-year swaps that pay LIBOR is *less than* 3.6%, say 3.2%. Then the manager will let the swaption expire, which means there was no realized benefit for the $200,000 premium paid. The manager *may* contract, at a zero cost, to enter into a 3-year swap with a fixed rate of 3.2%. In this case, the floating-rate loan plus swap will become a synthetic fixed-rate loan with quarterly payments (assuming 90-day settlement periods):

   $142,500 = $10,000,000 × (0.032 + 0.025) × (90 / 360)

   Scenario 2, the no-swaption exercise, could have had the manager not engage in any swap, even at the lower strike rate of 3.2%. That would be up to the manager. The concept is fairly simple. If exercised, the swap does its job. If not exercised, the manager is free to hedge or not hedge.

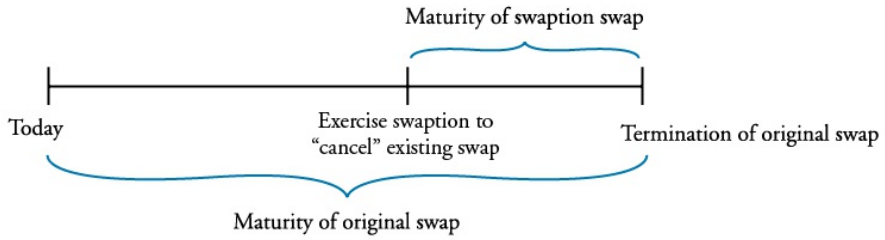
Using Swaptions to Potentially Terminate an Existing Swap Early

The actions outlined previously can easily be modified to apply to other situations. A manager who is under contract in an existing swap can enter into a swaption with the exact characteristics of the existing swap but take the other counterparty's position. It is

possible to match the payments and characteristics because the premium can be adjusted to make the contract worthwhile to the dealer.

Figure 34.3 has the same general form as Figure 34.2, but it has been relabeled to depict a *cancellation* of an existing swap with a swaption.

Figure 34.3: Swaption Cancels Swap



A manager in a pay-floating swap with a given NP and swap fixed rate (SFR) would simply contract to be the receive-floating counterparty in a swaption that has an exercise date in the future. If the NP and SFR are the same for both the swaption and the swap, then upon exercise the swaption's cash flows will effectively *cancel* the cash flows of the existing swap. If the manager buys the swaption from the same dealer with whom the original swap was contracted, the position would effectively be closed. The purchaser of the swaption can then wait until expiration of the swaption and decide if market conditions make it attractive to turn on the swaption swap and effectively cancel the existing swap.

Synthetically Adding or Removing a Call Feature on Existing Debt

PROFESSOR'S NOTE

There is no direct Learning Outcome Statement for the section on bond calls but it is in the assigned text. It would be an unlikely question.

A company has a 10-year, non-callable bond liability and wishes it were callable in three years. The company would buy a 3-year swaption on a 7-year swap to pay floating and receive fixed. Now assume three years have passed:

- If interest rates are low enough, the company can exercise the swaption and enter the 7-year swap (the remaining term of the bond issue) to receive fixed and pay floating. The fixed receipts on the swap cover the fixed coupon payments on the bond and effectively convert it to floating (at now-low rates). This replicates the economic benefit the company would have received if the bond could have been called. If desired the company could even enter a new additional swap to receive floating (covering the floating payments the company must make on the executed swaption) and pay fixed. Interest rates are down and this new swap SFR will be low. It is as if the company called its debt and refinanced at new lower interest rates.
- If interest rates are high enough that the company would not have wanted to call the bond, the company does nothing and lets the swaption expire worthless.

Another company has a 5-year bond issue outstanding that is callable in 1 year. Further suppose the company does not expect rates to be low enough to make calling the bond worthwhile, or alternatively, the company needs cash today. The company could sell a 1-year swaption on a 4-year swap to pay fixed. Now assume one year has passed:

- If rates are high enough to make the swaption worthless, the purchaser of the swaption (who would receive fixed) will let it expire worthless. With high rates, the company will not call the bond.
- Alternatively if rates fall low enough, the purchaser of the swaption will exercise and receive the swaption's SFR. In addition, the company will call the bonds in the low rate environment. The net is the company benefits from calling the bond but loses when the swaption is exercised and requires the company to pay fixed. The company gains and loses the benefit of calling the bond and economically is in a position as if the bond had not been callable.

MODULE QUIZ 34.4

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

1. Which of the following statements *most accurately* describes the rights of the counterparties in a swaption structure?
   A. The holder of a receiver swaption has the right to enter a swap agreement as the fixed-rate receiver.
   B. The holder of a payer swaption has the right to enter a swap agreement as the fixed-rate receiver.
   C. The seller of a payer swaption has the right to enter a swap agreement as the fixed-rate payer.
2. A firm has most of its liabilities in the form of floating-rate notes with a maturity of two years and quarterly reset. The firm is not concerned with interest rate movements over the next four quarters but is concerned with potential movements after that. Which of the following strategies will allow the firm to hedge the expected change in interest rates?
   A. Enter into a 2-year, quarterly pay-fixed, receive-floating swap.
   B. Buy a swaption that allows the firm to be the fixed-rate payer upon exercise. In other words, go long a payer swaption with a 1-year maturity.
   C. Buy a swaption that allows the firm to be the floating-rate payer upon exercise. In other words, go short a payer swaption with a 1-year maturity.

KEY CONCEPTS

LOS 34.a

Interest rate swaps are used to change the nature of the cash flows (either fixed or floating) on assets and liabilities. A floating-rate (fixed-rate) payment on a liability can be effectively converted to a fixed-rate (floating-rate) by entering a pay-fixed, receive-floating (pay-floating, receive-fixed) swap. The goal is for the cash flow received on the swap to offset the original payment on the liability, such that the nature of the net payment on the liability is opposite from the original. For a floating- (fixed-) rate asset, the manager will enter a pay-floating, receive-fixed (pay-fixed, receive-floating) swap. The goal is to have the payment on the swap offset the receipt on the asset, such that the net receipt is opposite in nature from the original.

LOS 34.b

$$D_{swap} = D_{asset} - D_{liability}$$

For a pay-floating counterparty in a swap, the duration can be expressed as follows:

$$D_{pay\ floating} = D_{fixed} - D_{floating} > 0$$

For a pay-fixed counterparty, the duration can be expressed as follows:

$$D_{pay\ fixed} = D_{floating} - D_{fixed} < 0$$

LOS 34.c

Cash flow risk, uncertainty regarding the *size* of cash flows, is a concern with floating-rate instruments. Because their cash flows are reset each period according to the prevailing rate at the beginning of the period, however, their market values are subject to only minor changes.

Market value risk is a concern with fixed-rate instruments. A decline in interest rates, for example, increases the value of the liability (or pay-fixed side of a swap), thus increasing the liability of the borrower.

For individual assets and liabilities, the tradeoff is between the market value risk associated with fixed rates and the cash flow risk associated with floating rates.

LOS 34.d

The duration of the portfolio plus a swap position (i.e., the target duration) is calculated as:

$$V_p(MD_T) = V_p(MD_p) + NP(MD_{swap})$$

where:

V_p = original value of the portfolio

MD_i = modified duration i (i = swap, target, portfolio without swap)

NP = notional principal of the swap

Usually, the manager selects a swap of a certain maturity which determines the modified duration of the swap, MD_{swap}. He then selects the *NP* that will achieve the

desired MD_T . Rearranging, we can solve for the amount of *NP* necessary to achieve the target duration as:

$$\text{NP} = (\text{V}_\text{p}) \left(\frac{\text{MD}_\text{T} - \text{MD}_\text{p}}{\text{MD}_\text{swap}} \right)$$

LOS 34.e

Borrowing in a foreign country via a foreign bank may be difficult, and the interest rates may be high. A U.S. firm that wishes to initiate a project in a foreign country, say Korea, might not have the contacts necessary to borrow Korean currency (the won) cheaply. A Korean counterparty may exist that would like to borrow dollars to invest in the United States.

The U.S. firm borrows in the United States because it has established relationships with banks in the United States. It swaps the principal (borrowed dollars) with the Korean counterparty for the won, which the Korean firm borrowed in Korea.

LOS 34.f

Follow these steps in determining the appropriate swap:

1. Divide the foreign cash flow received by the foreign interest rate to determine the corresponding foreign-denominated notional principal (NP).
    a. This is the foreign NP that would have produced the foreign cash flow at the given foreign interest rate.
2. Using the current exchange rate, convert the foreign NP into the corresponding domestic NP.
3. Enter a swap with this NP.
    a. Pay the foreign cash flows received on the assets and receive the equivalent domestic amount.
    b. The amount of each domestic cash flow is determined by multiplying the domestic interest rate by the domestic NP.

LOS 34.g

A manager can swap all or part of the return on a portfolio for the return on a domestic equity index, the return on a foreign index, or the return on a fixed-income index. A manager desiring an exposure to foreign equities equivalent to 15% of the existing portfolio, for example, could enter a swap with a foreign NP equivalent to that amount. The manager pays the swap dealer the return on that portion of the portfolio and receives the return on the foreign equity index equivalent to an investment in the amount of the notional principal.

LOS 34.h

An *interest rate swaption* is an option on a swap where one counterparty (buyer) has paid a premium to the other counterparty (seller) for an option to choose whether the swap will actually go into effect on some future date. Swaptions can be either American or European in the same way as options.

1. *Payer swaption*: A payer swaption gives the buyer the right to be the fixed-rate payer (and floating-rate receiver) in a prespecified swap at a prespecified date.

The payer swaption is almost like a protective put in that it allows the holder to pay a set fixed rate, even if rates have increased.

2. *Receiver swaption*: A receiver swaption gives the buyer the right to be the fixed-rate receiver (and floating-rate payer) at some future date. The receiver swaption is the reverse of the payer swaption. In this case, the holder must expect rates to fall, and the swap ensures receipt of a higher fixed rate while paying a lower floating rate.

The key point is that the terms of the underlying swap and the swap fixed rate (SFR) are negotiated and set at the purchase of the swaption. The purchaser of the swaption can wait and see if subsequent market moves make that SFR attractive or not and then decide whether to turn on the underlying swap.

ANSWER KEYS FOR MODULE QUIZZES

Module Quiz 34.1

1. **A** Pay fixed means receive floating. The floating receipt on the interest swap will cover the floating payments on the liability, leaving a net pay fixed position overall. Using a currency swap introduces another currency and is not appropriate, even though receive floating is part of a correct solution. Pay floating is wrong, as is introducing equity returns into the situation. (LOS 34.a)

2. **C** A swap diagram is a good way to solve this, as well as knowing swap terminology. The question asks for the net payment.

   On the debt the firm is paying:

   fixed rate on debt

   On the swap the firm is receiving the swap fixed rate,

   a reduction in payment: –SFR

   and paying floating: LIBOR

   This is a net payment of:

   fixed rate on debt − SFR + LIBOR

   Looking at the answer choices, this is equivalent to Pay LIBOR and fixed rate on debt, reduced by receiving SFR. (LOS 34.a)

3. **B** Choice C is not correct because changes in rates affect both sides of the swap, and choice B best describes the result from a decrease in rates. The pay-fixed side of the swap will be paying an amount greater than the SFRs of newly issued swaps. (LOS 34.a)

4. **A** Although most of the duration is associated with the fixed payments, the next *floating* payment is predetermined. Therefore, the duration of a quarterly-reset swap might be the duration of the fixed payments minus 0.125 (0.25 / 2 = 0.125). (LOS 34.b)

5. From the given information, we have:

   $V = \$40{,}000{,}000$

   $MD_V = 4.6$

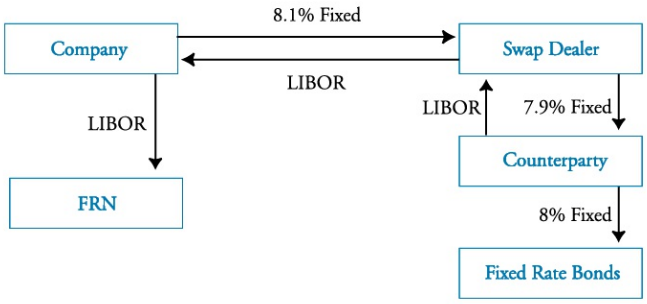
   $MD_{swap} = 2.0$

   $MD_T = 3.0$

NP = $40,000,000 × [(3.0 – 4.6) / –2] = $32,000,000

The manager should take a receive-floating/pay-fixed position in the swap with a $32,000,000 notional principal. (LOS 34.d)

6. The box and arrow diagram is shown below:



Your net borrowing cost is:

(LIBOR − LIBOR) + 0.081 = 0.081 = 8.1%

The counterparty's net borrowing cost is:

(0.080 − 0.079) + LIBOR = LIBOR + 0.001 = LIBOR + 0.1%

The swap dealer's spread is:

0.002 = 0.20% = 20 basis points = (0.081 − 0.079) + (LIBOR − LIBOR)

At the end of the first year, assuming LIBOR is 7%, your fixed-rate payment under the swap is:

fixed-rate payment = (0.081 – 0.07)($20,000,000) = $220,000

Your total interest costs equal the LIBOR-based interest payments plus the swap payment:

$20,000,000(0.07) + $220,000 = $1,620,000

At the end of the first year, the counterparty's fixed-rate receipt under the swap is:

(fixed-rate receipt) = (0.079 − 0.07)($20,000,000) = $180,000

The counterparty's total interest costs equal the 8% interest payment on their outstanding fixed-rate debt minus the swap payment:

$20,000,000(0.08) − $180,000 = $1,420,000

The cash flows to the swap dealer are:

$220,000 − $180,000 = ($20,000,000 × 0.002) = $40,000

Everybody is happy. You've converted floating-rate debt to fixed-rate debt, your counterparty has converted fixed-rate debt to floating-rate debt, and the swap dealer has made $40,000 without being exposed to interest rate risk. (LOS 34.a)

Module Quiz 34.2

1. **A** A domestic borrower may be able to borrow at, say, 6% and swap the principal for a foreign currency. The domestic borrower will pay the counterparty the interest on the foreign currency received. This will presumably be lower than the rate the domestic borrower would have to pay if he had borrowed directly from a foreign bank. The foreign counterparty pays the interest on the domestic loan, which is presumably lower than that it would pay if it borrowed directly from a domestic bank. (LOS 34.e)
2. For the euros, the NP = 20,000,000 / (0.046 / 2) = €869,565,217. The corresponding dollar amount is $724,637,681 = €869,565,217 / 1.2. Using these values for the swap, the firm will give the swap dealer €20,000,000 every six months over the maturity of the swap for $724,637,681(0.04 / 2) = $14,492,754. (LOS 34.f)

Module Quiz 34.3

1. **C** The notional principal should be 40% of the portfolio's value. (LOS 34.g)

Module Quiz 34.4

1. **A** The holder of a receiver swaption has the right to enter a swap agreement as the fixed-rate receiver. (LOS 34.h)
2. **B** The firm is paying floating now but may want to lock in a fixed rate of interest if interest rates rise one year from now. Hence, buy a swaption that allows the firm to be the fixed-rate payer upon exercise. In other words, go long a payer swaption with a 1-year maturity. (LOS 34.h)

TOPIC ASSESSMENT: RISK MANAGEMENT APPLICATIONS OF DERIVATIVES

Use the following information for Questions 1 through 6.

George Kaufman, portfolio manager and CEO of Kaufman Co., is extremely busy. He has a number of important issues that must be dealt with before the end of the week.

The portfolio Kaufman manages consists of $40 million in bonds and $60 million in equities. The modified duration of the bond portfolio is 6.3. The beta of the equity portfolio is 1.25. The holding period for each is one year. Kaufman also has the authority to borrow up to $25 million which may be invested on a short-term basis to earn the spread between the borrowing rate and the investing rate.

Kaufman is afraid that interest rates will raise 25 basis points in the near future and would like to decrease the duration of the bond portion of the portfolio to 5.0 for a short period. He prefers to use futures contracts to do this because it is a temporary change and he does not want to sell bonds in the portfolio. Kaufman is considering using a Treasury bond futures contract that has a modified duration of 4.2, a yield beta of 1.1, and a price (including the multiplier) of $245,000.

Kaufman would like to borrow money three months from today so he can invest at the expected higher interest rates. However, he would like to take advantage of today's lower interest rates for the loan. To do this he is considering using derivatives to hedge against the higher expected future interest rates. A cash settlement will be made based on the actual interest rate three months from now based on the terms of the derivative used. If Kaufman decides on this strategy, he would borrow $20 million at 5% for nine months. The loan date would start three months from today.

The equity portion of the portfolio has performed extremely well over the recent past and Kaufman must decide on one of the following two strategies:

Equity Strategy 1: Kaufman could hold on to his current profits for the next six months which should make the reported annual return rank in the top one percentile of similar portfolios. Again, Kaufman prefers to use futures contracts instead of selling stocks to lock in the profits. The portfolio is composed of the same stocks and sector weightings as the S&P 500. The contract on the index is at 2000 (with a multiplier of 250), and it expires in six months. The risk free rate is 2% and the dividend yield on the index is 3%.

Equity Strategy 2: Kaufman believes there is a chance the market may move significantly over the next six months. To benefit from the expected move in the market, Kaufman could increase the equity portion of the portfolio from its current beta of 1.25 to 1.4 by using equity index futures. The appropriate equity index futures contract that Kaufman is considering using has a beta of 0.90 and a price (including the multiplier) of $335,000.

Finally, Kaufman Co. is expecting a $6 million cash inflow in four months and would like to pre-invest the funds to create the same exposure to the bond and stock market that is found in the original portfolio. The most appropriate stock index futures contract

for accomplishing this has a total price (including the multiplier) of $315,650 and a beta of 1.10. The most appropriate bond index futures contract has a total price of $115,460, a yield beta of 1.05 and an effective duration of 6.2.

1. Assume Kaufman Co. uses derivatives to hedge the loan rate, which of the following options would be *least appropriate* to use?
   A. An interest rate collar.
   B. Buy an interest rate call.
   C. Buy an interest rate put on the price of Treasury futures.
2. If no futures are used to change portfolio duration, the value of the bond portfolio given a 25 basis point increase is *closest* to:
   A. $37,480,000.
   B. $39,370,000.
   C. $39,580,000.
3. The number of Treasury bond futures contracts that Kaufman would need to reduce the duration of the bonds in the portfolio is *closest* to:
   A. sell 51 contracts.
   B. sell 56 contracts.
   C. buy 269 contracts.
4. Kaufman is interested in increasing the beta of the equity portfolio to 1.4 for a brief period of time. Kaufman is expecting:
   A. an increase in the market; a long position in approximately 30 contracts will accomplish this target.
   B. an increase in the market; a long position in approximately 27 contracts will accomplish this target.
   C. a decrease in the market; a short position in approximately 72 contracts will accomplish this target.
5. How many S&P index futures contracts would Kaufman need to buy or sell to create a six-month synthetic cash position?
   A. Buy approximately 121 contracts.
   B. Sell approximately 121 contracts.
   C. Sell approximately 400 contracts.
6. The *most appropriate* strategy to pre-invest the anticipated $6 million inflow would be to buy:
   A. 22 bond futures contracts and buy 13 stock futures contracts.
   B. 21 bond futures contracts and buy 35 stock futures contracts.
   C. 22 bond futures contracts and sell 13 stock futures contracts.

TOPIC ASSESSMENT ANSWERS: RISK MANAGEMENT APPLICATIONS OF DERIVATIVES

1. **A** Kaufman wants to hedge against increasing interest rates in anticipation of taking out a loan. An interest rate collar can consist of either a long floor and short cap or a long cap and short floor. A long cap and short floor would protect against increasing interest rates but an interest collar consisting of a long floor and short cap would protect against decreasing interest rates, not increasing interest rates, making this an inappropriate option choice and the correct answer. Buying an interest call option would pay off interest rates rose above the strike rate. Likewise, an interest put on the price of Treasuries would also pay off if interest rates rose causing the price of Treasury futures to fall below the strike price of the option. (Study Session 17, Module 33.5, LOS 33.d)

2. **C** In this case, use the modified duration of the bond portfolio, 6.3, to find the value of the portfolio given a 25 basis point increase in rates:

   new value = \$40,000,000 × (1 − (6.3 × 0.0025)) = \$39,370,000

   (Study Session 11, Module 22.2, LOS 22.d)

3. **B** contracts = (yield beta) $[(MD_{Target} - MD_P) / MD_F][V_P / (P_f(\text{multiplier}))]$

   contracts = 1.1 × [(5 − 6.3) / 4.2] × (\$40,000,000 / \$245,000) = −55.59

   To reduce the duration of the portfolio, take a short position in the futures contract. Note that we must round the number of contracts up to 56 since partial contracts cannot be traded. (Study Session 17, Module 32.2, LOS 32.d)

4. **A** number of contracts = [(target beta – portfolio beta) / beta on futures] × value of the portfolio / (price of the futures × the multiplier)

   number of contracts = [(1.4 − 1.25) / 0.90] × (\$60,000,000 / \$335,000) = 29.85 contracts

   The positive sign indicates that we should take a long position in the futures to "leverage up" the position. If that is Kaufman's goal, he must be expecting an increase in the market. (Study Session 17, Module 32.1, LOS 32.d)

5. **B** $[\$60,000,000 \times (1.02)^{0.50}] / (2,000 \times \$250) = 121.19$ contracts

   Kaufman would need to sell the contracts to create the synthetic cash (zero equity) position. If he were converting cash to a synthetic equity position, he would of course buy contracts. (Study Session 17, Module 32.3, LOS 32.c)

6. **A** Take the existing portfolio weights, 40% debt and 60% equity and apply them to the new money that is coming in. Also, "mirror" the duration and beta of the original portfolios.

number of bond futures = 1.05 × [(6.3 − 0) / 6.2] × [(6,000,000 × 0.40) / 115,460] = 22.18 contracts

number of stock futures = [(1.25 − 0) / 1.10] × [(6,000,000 × 0.60) / 315,650] = 12.96

Kaufman Co. would take a long position in both the stock index and bond futures contracts because it is synthetically creating an existing portfolio until the actual $6 million is received and can be invested. (Study Session 17, Module 32.2, LOS 32.e)

FORMULAS

Herfindahl-Hirschman index (HHI)

$$HHI = \sum_{i=1}^{n} w_i^2$$

effective number of stocks$= \frac{1}{\mathrm{HHI}}$

fundamental law of active management: $\mathrm{E}\left(\mathrm{R_A}\right) = \mathrm{IC}\sqrt{\mathrm{BR}}\sigma_{\mathrm{R_A}}\,\mathrm{TC}$

$$\textbf{Active Share} = \frac{1}{2}\sum_{i=1}^{n} |W_{p,i} - W_{b,i}|$$

$$\textbf{active risk}\left(\sigma_{\mathrm{R_A}}\right) = \sqrt{\frac{\sum_{\mathrm{t=1}}^{\mathrm{T}} \left(\mathrm{R_{At}}\right)^2}{\mathrm{T-1}}}$$

$$= \sqrt{\sigma^2\left(\sum\left(\beta_{\mathrm{pk}} - \beta_{\mathrm{bk}}\right) \times \mathrm{F_k}\right) + \sigma_{\mathrm{e}}^2}$$

Contribution to portfolio variance calculated on an *absolute* or *relative* basis

- The contribution of asset i to absolute portfolio variance

$$\mathrm{CV_i} = \sum_{j=1}^{n} w_i w_j C_{ij} = w_i C_{ip}$$

- The contribution of factor i to absolute portfolio variance

$$= CV_i = \sum_{j=1}^{n} \beta_i \beta_j C_{ij} = \beta_i C_{ip}$$

- The contribution of asset i to relative portfolio variance

$$= CAV_i = \sum_{j=1}^{n} \left(w_{pi} - w_{bi}\right)\left(w_{pj} - w_{bj}\right) RC_{ij} = \left(w_{pi} - w_{bi}\right) RC_{ip}$$

$$\mathrm{VaR} = \left[\widehat{\mathrm{R}}_{\mathrm{p}} - \left(\mathrm{z}\right)\left(\sigma\right)\right] \mathrm{V_p}$$

$\sigma_{\mathrm{daily}} \cong \frac{\sigma_{\mathrm{annual}}}{\sqrt{250}}; \sigma_{\mathrm{monthly}} \cong \frac{\sigma_{\mathrm{annual}}}{\sqrt{12}};\ \sigma_{\mathrm{daily}} \cong \frac{\sigma_{\mathrm{monthly}}}{\sqrt{22}}$

forward contract credit risk exposure: $\mathrm{value_{manager}} = \mathrm{PV_{inflows}} - \mathrm{PV_{outflows}}$

Sharpe ratio: $\mathrm{S_P} = \frac{\overline{\mathrm{R}}_{\mathrm{P}} - \overline{\mathrm{R}}_{\mathrm{F}}}{\sigma_{\mathrm{P}}}$

Sortino ratio: Sortino$= \frac{\overline{\mathrm{R}}_{\mathrm{p}} - \mathrm{MAR}}{\textbf{downside deviation}}$

return over maximum drawdown: $\mathrm{RoMAD} = \frac{\overline{\mathrm{R}}_{\mathrm{p}}}{\textbf{maximum drawdown}}$

$R_{DC} = (1 + R_{FC})(1 + R_{FX}) - 1 = R_{FC} + R_{FX} + (R_{FC})(R_{FX})$

$$R_{DC} = \sum_{i=1}^{n} w_i \left(R_{DC,i}\right)$$

$\sigma^2(R_{DC}) \approx \sigma^2(R_{FC}) + \sigma^2(R_{FX}) + 2\sigma(R_{FC})\sigma(R_{FX})\rho(R_{FC},R_{FX})$

$\sigma(R_{DC}) = \sigma(R_{FX})(1 + R_{FC})$

where:

R_{FC} = the return on a foreign currency denominated risk-free asset

$$\beta_i = \frac{\mathrm{Cov(i,m)}}{\sigma_m^2}$$

$$\text{number of contracts} = \left(\frac{\beta_T - \beta_P}{\beta_f}\right)\left(\frac{V_p}{P_f(\text{multiplier})}\right)$$

$$\text{number of contracts} = (\text{yield beta})\left(\frac{MD_T - MD_P}{MD_F}\right)\left(\frac{V_p}{P_f(\text{multiplier})}\right)$$

Note that for synthetic positions, V_p must be a future value amount. If the desired change in beta or duration is the contract's beta or duration, they have no effect on the calculation of number of contracts.

interest rate call payoff = (NP)[max(0, LIBOR − strike rate)](D / 360)

interest rate put payoff = (NP)[max(0, strike rate − LIBOR)(D / 360)]

$$\Delta_{call} = \frac{C_1 - C_0}{S_1 - S_0} = \frac{\Delta C}{\Delta S}$$

gamma = (change in delta) / (change in S)

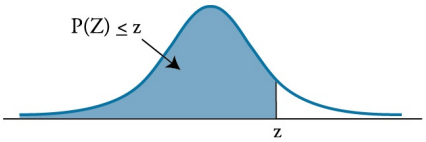
$D_{pay\ floating} = D_{fixed} - D_{floating} > 0$

$D_{pay\text{-}fixed} = D_{floating} - D_{fixed} < 0$

$$NP = (V_p)\left(\frac{MD_T - MD_p}{MD_{swap}}\right)$$

APPENDIX

Cumulative *Z*-Table



$P(Z \leq z) = N(z)$ for $z \geq 0$

$P(Z \leq -z) = 1 - N(z)$

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.937	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.983	0.9834	0.9838	0.9842	0.9846	0.985	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.989
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.994	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

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