# 2023 CFA®
## Exam Prep

# SchweserNotes™
## Portfolio Management and Ethical and Professional Standards

LEVEL I **BOOK 5**

KAPLAN SCHWESER

# Book 5: Portfolio Management and Ethical and Professional Standards

SchweserNotes™ 2023

Level I CFA®

SCHWESERNOTES™ 2023 LEVEL I CFA® BOOK 5: PORTFOLIO MANAGEMENT AND ETHICAL AND PROFESSIONAL STANDARDS



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# CONTENTS

# LEARNING OUTCOME STATEMENTS (LOS)

## 61. Portfolio Management: An Overview

The candidate should be able to:

a. describe the portfolio approach to investing.
b. describe the steps in the portfolio management process.
c. describe types of investors and distinctive characteristics and needs of each.
d. describe defined contribution and defined benefit pension plans.
e. describe aspects of the asset management industry.
f. describe mutual funds and compare them with other pooled investment products.

## 62. Portfolio Risk and Return: Part I

The candidate should be able to:

a. calculate and interpret major return measures and describe their appropriate uses.
b. compare the money-weighted and time-weighted rates of return and evaluate the performance of portfolios based on these measures.
c. describe characteristics of the major asset classes that investors consider in forming portfolios.
d. explain risk aversion and its implications for portfolio selection.
e. explain the selection of an optimal portfolio, given an investor's utility (or risk aversion) and the capital allocation line.
f. calculate and interpret the mean, variance, and covariance (or correlation) of asset returns based on historical data.
g. calculate and interpret portfolio standard deviation.
h. describe the effect on a portfolio's risk of investing in assets that are less than perfectly correlated.
i. describe and interpret the minimum-variance and efficient frontiers of risky assets and the global minimum-variance portfolio.

## 63. Portfolio Risk and Return: Part II

The candidate should be able to:

a. describe the implications of combining a risk-free asset with a portfolio of risky assets.
b. explain the capital allocation line (CAL) and the capital market line (CML).
c. explain systematic and nonsystematic risk, including why an investor should not expect to receive additional return for bearing nonsystematic risk.
d. explain return generating models (including the market model) and their uses.
e. calculate and interpret beta.
f. explain the capital asset pricing model (CAPM), including its assumptions, and the security market line (SML).
g. calculate and interpret the expected return of an asset using the CAPM.
h. describe and demonstrate applications of the CAPM and the SML.
i. calculate and interpret the Sharpe ratio, Treynor ratio, $M^2$, and Jensen's alpha.

## 64. Basics of Portfolio Planning and Construction

The candidate should be able to:

a. describe the reasons for a written investment policy statement (IPS).
b. describe the major components of an IPS.
c. describe risk and return objectives and how they may be developed for a client.
d. explain the difference between the willingness and the ability (capacity) to take risk in analyzing an investor's financial risk tolerance.
e. describe the investment constraints of liquidity, time horizon, tax concerns, legal and regulatory factors, and unique circumstances and their implications for the choice of portfolio assets.
f. explain the specification of asset classes in relation to asset allocation.
g. describe the principles of portfolio construction and the role of asset allocation in relation to the IPS.
h. describe how environmental, social, and governance (ESG) considerations may be integrated into portfolio planning and construction.

## 65. The Behavioral Biases of Individuals

The candidate should be able to:

a. compare and contrast cognitive errors and emotional biases.
b. discuss commonly recognized behavioral biases and their implications for financial decision making.

c. describe how behavioral biases of investors can lead to market characteristics that may not be explained by traditional finance.

### 66. Introduction to Risk Management

The candidate should be able to:

a. define risk management.
b. describe features of a risk management framework.
c. define risk governance and describe elements of effective risk governance.
d. explain how risk tolerance affects risk management.
e. describe risk budgeting and its role in risk governance.
f. identify financial and non-financial sources of risk and describe how they may interact.
g. describe methods for measuring and modifying risk exposures and factors to consider in choosing among the methods.

### 67. Technical Analysis

The candidate should be able to:

a. explain principles and assumptions of technical analysis.
b. describe potential links between technical analysis and behavioral finance.
c. compare principles of technical analysis and fundamental analysis.
d. describe and interpret different types of technical analysis charts.
e. explain uses of trend, support, and resistance lines.
f. explain common chart patterns.
g. explain common technical indicators.
h. describe principles of intermarket analysis.
i. explain technical analysis applications to portfolio management.

### 68. Fintech in Investment Management

The candidate should be able to:

a. describe “fintech”.
b. describe Big Data, artificial intelligence, and machine learning.
c. describe fintech applications to investment management.
d. describe financial applications of distributed ledger technology.

### 69. Ethics and Trust in the Investment Profession

The candidate should be able to:

a. explain ethics.
b. describe the role of a code of ethics in defining a profession.
c. describe professions and how they establish trust.
d. describe the need for high ethical standards in investment management.
e. explain professionalism in investment management.
f. identify challenges to ethical behavior.
g. compare and contrast ethical standards with legal standards.
h. describe a framework for ethical decision making.

### 70. Code of Ethics and Standards of Professional Conduct

The candidate should be able to:

a. describe the structure of the CFA Institute Professional Conduct Program and the process for the enforcement of the Code and Standards.
b. identify the six components of the Code of Ethics and the seven Standards of Professional Conduct.
c. explain the ethical responsibilities required by the Code and Standards, including the sub-sections of each Standard.

### 71. Guidance for Standards I–VII

The candidate should be able to:

a. demonstrate the application of the Code of Ethics and Standards of Professional Conduct to situations involving issues of professional integrity.
b. recommend practices and procedures designed to prevent violations of the Code of Ethics and Standards of Professional Conduct.
c. identify conduct that conforms to the Code and Standards and conduct that violates the Code and Standards.

### 72. Introduction to the Global Investment Performance Standards (GIPS)

The candidate should be able to:

a. explain why the GIPS standards were created, who can claim compliance, and who benefits from compliance.
b. describe the key concepts of the GIPS Standards for Firms.
c. explain the purpose of composites in performance reporting.
d. describe the fundamentals of compliance, including the recommendations of the GIPS standards with respect to the definition of the firm and the firm's definition of discretion.
e. describe the concept of independent verification.

73. Ethics Application

The candidate should be able to:
a. evaluate practices, policies, and conduct relative to the CFA Institute Code of Ethics and Standards of Professional Conduct.
b. explain how the practices, policies, and conduct do or do not violate the CFA Institute Code of Ethics and Standards of Professional Conduct.

# READING 61

# PORTFOLIO MANAGEMENT: AN OVERVIEW

## EXAM FOCUS

Here, we introduce the portfolio management process and the investment policy statement. In this reading, you will learn the investment needs of different types of investors, as well as the different kinds of pooled investments. Later, our reading on Basics of Portfolio Planning and Construction will provide more detail on investment policy statements and investor objectives and constraints.

## MODULE 61.1: PORTFOLIO MANAGEMENT PROCESS

Video covering this content is available online.

**LOS 61.a: Describe the portfolio approach to investing.**

The **portfolio perspective** refers to evaluating individual investments by their contribution to the risk and return of an investor's portfolio. The alternative to taking a portfolio perspective is to examine the risk and return of individual investments in isolation. An investor who holds all his wealth in a single stock because he believes it to be the best stock available is not taking the portfolio perspective—his portfolio is very risky compared to holding a diversified portfolio of stocks. Modern portfolio theory concludes that the extra risk from holding only a single security is not rewarded with higher expected investment returns. Conversely, diversification allows an investor to reduce portfolio risk without necessarily reducing the portfolio's expected return.

In the early 1950s, the research of Professor Harry Markowitz provided a framework for measuring the risk-reduction benefits of diversification. Using the standard deviation of returns as the measure of investment risk, he investigated how combining risky securities into a portfolio affected the portfolio's risk and expected return. One important conclusion of his model is that unless the returns of the risky assets are perfectly positively correlated, risk is reduced by diversifying across assets.

In the 1960s, professors Treynor, Sharpe, Mossin, and Lintner independently extended this work into what has become known as modern portfolio theory (MPT). MPT results in equilibrium expected returns for securities and portfolios that are a linear function of each security's or portfolio's market risk (the risk that cannot be reduced by diversification).

One measure of the benefits of diversification is the **diversification ratio**. It is calculated as the ratio of the risk of an equally weighted portfolio of $n$ securities (measured by its standard

deviation of returns) to the risk of a single security selected at random from the *n* securities. If the average standard deviation of returns for the *n* stocks is 25%, and the standard deviation of returns for an equally weighted portfolio of the *n* stocks is 18%, the diversification ratio is 18 / 25 = 0.72. If the standard deviation of returns for an equally weighted portfolio is 25%, there are no diversification benefits and the diversification ratio equals one. A *lower* diversification ratio indicates a *greater* risk-reduction benefit from diversification.

While the diversification ratio provides a quick measure of the potential benefits of diversification, an equal-weighted portfolio is not necessarily the portfolio that provides the greatest reduction in risk. Computer optimization can calculate the portfolio weights that will produce the lowest portfolio risk (standard deviation of returns) for a given group of securities.

Portfolio diversification works best when financial markets are operating normally; diversification provides less reduction of risk during market turmoil, such as the credit contagion of 2008. During periods of financial crisis, correlations tend to increase, which reduces the benefits of diversification.

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## LOS 61.b: Describe the steps in the portfolio management process.

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There are three major steps in the portfolio management process:

*Step 1:* The **planning step** begins with an analysis of the investor's risk tolerance, return objectives, time horizon, tax exposure, liquidity needs, income needs, and any unique circumstances or investor preferences.

This analysis results in an **investment policy statement (IPS)** that details the investor's investment objectives and constraints. It should also specify an objective benchmark (such as an index return) against which the success of the portfolio management process will be measured. The IPS should be updated at least every few years and any time the investor's objectives or constraints change significantly.

*Step 2:* The **execution step** involves an analysis of the risk and return characteristics of various asset classes to determine how funds will be allocated to the various asset types. Often, in what is referred to as a *top-down* analysis, a portfolio manager will examine current economic conditions and forecasts of such macroeconomic variables as GDP growth, inflation, and interest rates, in order to identify the asset classes that are most attractive. The resulting portfolio is typically diversified across such asset classes as cash, fixed-income securities, publicly traded equities, hedge funds, private equity, and real estate, as well as commodities and other real assets.

Once the asset class allocations are determined, portfolio managers may attempt to identify the most attractive securities within the asset class. Security analysts use model valuations for securities to identify those that appear undervalued in what is termed *bottom-up* security analysis.

*Step 3:* The **feedback step** is the final step. Over time, investor circumstances will change, risk and return characteristics of asset classes will change, and the actual weights of the assets in the portfolio will change with asset prices. The portfolio manager must monitor these changes and **rebalance** the portfolio periodically in response, adjusting the

allocations to the various asset classes back to their desired percentages. The manager must also measure portfolio performance and evaluate it relative to the return on the benchmark portfolio identified in the IPS.

## LOS 61.c: Describe types of investors and distinctive characteristics and needs of each.

**Individual investors** save and invest for a variety of reasons, including purchasing a house or educating their children. In many countries, special accounts allow citizens to invest for retirement and to defer any taxes on investment income and gains until the funds are withdrawn. Defined contribution pension plans are popular vehicles for these investments. Pension plans are described later in this reading.

Many types of **institutions** have large investment portfolios. An **endowment** is a fund that is dedicated to providing financial support on an ongoing basis for a specific purpose. For example, in the United States, many universities have large endowment funds to support their programs. A **foundation** is a fund established for charitable purposes to support specific types of activities or to fund research related to a particular disease. A typical foundation's investment objective is to fund the activity or research on a continuing basis without decreasing the real (inflation adjusted) value of the portfolio assets. Foundations and endowments typically have long investment horizons, high risk tolerance, and, aside from their planned spending needs, little need for additional liquidity.

The investment objective of a **bank**, simply put, is to earn more on the bank's loans and investments than the bank pays for deposits of various types. Banks seek to keep risk low and need adequate liquidity to meet investor withdrawals as they occur.

**Insurance companies** invest customer premiums with the objective of funding customer claims as they occur. Life insurance companies have a relatively long-term investment horizon, while property and casualty (P&C) insurers have a shorter investment horizon because claims are expected to arise sooner than for life insurers.

**Investment companies** manage the pooled funds of many investors. **Mutual funds** manage these pooled funds in particular styles (e.g., index investing, growth investing, bond investing) and restrict their investments to particular subcategories of investments (e.g., large-firm stocks, energy stocks, speculative bonds) or particular regions (emerging market stocks, international bonds, Asian-firm stocks).

**Sovereign wealth funds** refer to pools of assets owned by a government. For example, the Abu Dhabi Investment Authority, a sovereign wealth fund in the United Arab Emirates funded by Abu Dhabi government surpluses, has approximately USD 700 billion in assets.[1]

Figure 61.1 provides a summary of the risk tolerance, investment horizon, liquidity needs, and income objectives for different types of investors.

Figure 61.1: Characteristics of Different Types of Investors

| Investor | Risk Tolerance | Investment Horizon | Liquidity Needs | Income Needs |
|---|---|---|---|---|
| Individuals | Depends on individual | Depends on individual | Depends on individual | Depends on individual |
| Banks | Low | Short | High | Pay interest |
| Endowments | High | Long | Low | Spending level |
| Insurance | Low | Long—life<br>Short—P&C | High | Low |
| Mutual funds | Depends on fund | Depends on fund | High | Depends on fund |
| Defined benefit pensions | High | Long | Low | Depends on age |

## LOS 61.d: Describe defined contribution and defined benefit pension plans.

A **defined contribution pension plan** is a retirement plan in which the firm contributes a sum each period to the employee's retirement account. The firm's contribution can be based on any number of factors, including years of service, the employee's age, compensation, profitability, or even a percentage of the employee's contribution. In any event, the firm makes no promise to the employee regarding the future value of the plan assets. The investment decisions are left to the employee, who assumes all of the investment risk.

In a **defined benefit pension plan**, the firm promises to make periodic payments to employees after retirement. The benefit is usually based on the employee's years of service and the employee's compensation at, or near, retirement. For example, an employee might earn a retirement benefit of 2% of her final salary for each year of service. Consequently, an employee with 20 years of service and a final salary of $100,000, would receive $40,000 ($100,000 final salary × 2% × 20 years of service) each year upon retirement until death. Because the employee's future benefit is defined, the employer assumes the investment risk. The employer makes contributions to a fund established to provide the promised future benefits. Poor investment performance will increase the amount of required employer contributions to the fund.

MODULE QUIZ 61.1

1. Compared to investing in a single security, diversification provides investors a way to:
   A. increase the expected rate of return.
   B. decrease the volatility of returns.
   C. increase the probability of high returns.
2. Which of the following is *least likely* to be considered an appropriate schedule for reviewing and updating an investment policy statement?
   A. At regular intervals (e.g., every year).
   B. When there is a major change in the client's constraints.
   C. Frequently, based on the recent performance of the portfolio.
3. A top-down security analysis begins by:
   A. analyzing a firm's business prospects and quality of management.
   B. identifying the most attractive companies within each industry.

C. examining economic conditions.

4. Portfolio diversification is *least likely* to protect against losses:
   A. during severe market turmoil.
   B. when markets are operating normally.
   C. when the portfolio securities have low return correlation.
5. Low risk tolerance and high liquidity requirements *best* describe the typical investment needs of:
   A. a defined-benefit pension plan.
   B. a foundation.
   C. an insurance company.
6. A long time horizon and low liquidity requirements *best* describe the investment needs of:
   A. an endowment.
   B. an insurance company.
   C. a bank.
7. In a defined contribution pension plan:
   A. the employee accepts the investment risk.
   B. the plan sponsor promises a predetermined retirement income to participants.
   C. the plan manager attempts to match the fund's assets to its liabilities.
8. In a defined benefit pension plan:
   A. the employee assumes the investment risk.
   B. the employer contributes to the employee's retirement account each period.
   C. the plan sponsor promises a predetermined retirement income to participants.

# MODULE 61.2: ASSET MANAGEMENT AND POOLED INVESTMENTS

Video covering this content is available online.

## LOS 61.e: Describe aspects of the asset management industry.

The asset management industry comprises firms that manage investments for clients. Asset management firms include both independent managers and divisions of larger financial services companies. They are referred to as **buy-side firms**, in contrast with **sell-side firms** such as broker-dealers and investment banks.

**Full-service asset managers** are those that offer a variety of investment styles and asset classes. **Specialist asset managers** may focus on a particular investment style or a particular asset class. A **multi-boutique firm** is a holding company that includes a number of different specialist asset managers.

A key distinction is between firms that use active management and those that use passive management. **Active management** attempts to outperform a chosen benchmark through manager skill, for example by using fundamental or technical analysis. **Passive management** attempts to replicate the performance of a chosen benchmark index. This may include traditional broad market index tracking or a **smart beta** approach that focuses on exposure to a particular market risk factor.

Passive management represents about one-fifth of assets under management. Its share of industry revenue is even smaller because fees for passive management are lower than fees for active management.

Asset management firms may also be classified as traditional or alternative, based on the asset classes they manage. Traditional asset managers focus on equities and fixed-income securities. Alternative asset managers focus on asset classes such as private equity, hedge funds, real estate, or commodities. Profit margins tend to be higher for the alternative asset classes. As a result, many traditional asset managers have been moving into this area, somewhat blurring the distinction between these types of firms.

Some trends in the asset management industry are worth noting:

- The market share for passive management has been growing over time. This is due in part to the lower fees passive managers charge investors, and in part to questions about whether active managers are actually able to add value over time on a risk-adjusted basis, especially in developed markets that are believed to be relatively efficient.
- The amount of data available to asset managers has grown exponentially in recent years. This has encouraged them to invest in information technology and third-party services to process these data, attempting to capitalize on information quickly to make investment decisions.
- **Robo-advisors** are a technology that can offer investors advice and recommendations based on their investment requirements and constraints, using a computer algorithm. These advisors increasingly appeal to younger investors and those with smaller portfolios than have typically been served by asset management firms. They have also lowered the barriers to entry into the asset management industry for firms such as insurance companies.

PROFESSOR'S NOTE

Robo-advisors and issues related to Big Data are discussed further in our reading on Fintech in Investment Management.

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## LOS 61.f: Describe mutual funds and compare them with other pooled investment products.

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**Mutual funds** are one form of **pooled investments** (i.e., a single portfolio that contains investment funds from multiple investors). Each investor owns shares representing ownership of a portion of the overall portfolio. The total net value of the assets in the fund (pool) divided by the number of such shares issued is referred to as the **net asset value (NAV)** of each share.

With an **open-end fund**, investors can buy newly issued shares at the NAV. Newly invested cash is invested by the mutual fund managers in additional portfolio securities. Investors can **redeem** their shares (sell them back to the fund) at NAV as well. All mutual funds charge a fee for the ongoing management of the portfolio assets, which is expressed as a percentage of the net asset value of the fund. **No-load funds** do not charge additional fees for purchasing shares (up-front fees) or for redeeming shares (redemption fees). **Load funds** charge either up-front fees, redemption fees, or both.

**Closed-end funds** are professionally managed pools of investor money that do not take new investments into the fund or redeem investor shares. The shares of a closed-end fund trade like equity shares (on exchanges or over-the-counter). As with open-end funds, the portfolio management firm charges ongoing management fees.

## Types of Mutual Funds

**Money market funds** invest in short-term debt securities and provide interest income with very low risk of changes in share value. Fund NAVs are typically set to one currency unit, but there have been instances over recent years in which the NAV of some funds declined when the securities they held dropped dramatically in value. Funds are differentiated by the types of money market securities they purchase and their average maturities.

**Bond mutual funds** invest in fixed-income securities. They are differentiated by bond maturities, credit ratings, issuers, and types. Examples include government bond funds, tax-exempt bond funds, high-yield (lower rated corporate) bond funds, and global bond funds.

A great variety of **stock mutual funds** are available to investors. **Index funds** are **passively managed**; that is, the portfolio is constructed to match the performance of a particular index, such as the Standard & Poor's 500 Index. **Actively managed** funds refer to funds where the management selects individual securities with the goal of producing returns greater than those of their benchmark indexes. Annual management fees are higher for actively managed funds, and actively managed funds have higher turnover of portfolio securities (the percentage of investments that are changed during the year). This leads to greater tax liabilities compared to passively managed index funds.

## Other Forms of Pooled Investments

**Exchange-traded funds (ETFs)** are similar to closed-end funds in that purchases and sales are made in the market rather than with the fund itself. There are important differences, however. While closed-end funds are often actively managed, ETFs are most often invested to match a particular index (passively managed). With closed-end funds, the market price of shares can differ significantly from their NAV due to imbalances between investor supply and demand for shares at any point in time. Special redemption provisions for ETFs are designed to keep their market prices very close to their NAVs.

ETFs can be sold short, purchased on margin, and traded at intraday prices, whereas open-end funds are typically sold and redeemed only daily, based on the share NAV calculated with closing asset prices. Investors in ETFs must pay brokerage commissions when they trade, and there is a spread between the bid price at which market makers will buy shares and the ask price at which market makers will sell shares. With most ETFs, investors receive any dividend income on portfolio stocks in cash, while open-end funds offer the alternative of reinvesting dividends in additional fund shares. One final difference is that ETFs may produce less capital gains liability compared to open-end index funds. This is because investor sales of ETF shares do not require the fund to sell any securities. If an open-end fund has significant redemptions that cause it to sell appreciated portfolio shares, shareholders incur a capital gains tax liability.

A **separately managed account** is a portfolio that is owned by a single investor and managed according to that investor's needs and preferences. No shares are issued, as the single investor owns the entire account.

**Hedge funds** are pools of investor funds that are not regulated to the extent that mutual funds are. Hedge funds are limited in the number of investors who can invest in the fund and are often sold only to qualified investors who have a minimum amount of overall portfolio wealth. Minimum investments can be quite high, often between $250,000 and $1 million.

**Private equity** and **venture capital** funds invest in portfolios of companies, often with the intention to sell them later in public offerings. Managers of funds may take active roles in managing the companies in which they invest.

PROFESSOR'S NOTE

Hedge funds, private equity, and venture capital are addressed in the Alternative Investments topic area.

MODULE QUIZ 61.2

1. Compared to exchange-traded funds (ETFs), open-end mutual funds are typically associated with lower:
   A. brokerage costs.
   B. minimum investment amounts.
   C. management fees.
2. Private equity and venture capital funds:
   A. expect that only a small percentage of investments will pay off.
   B. play an active role in the management of companies.
   C. restructure companies to increase cash flow.
3. Hedge funds *most likely*:
   A. have stricter reporting requirements than a typical investment firm because of their use of leverage and derivatives.
   B. hold equal values of long and short securities.
   C. are not offered for sale to the general public.

## KEY CONCEPTS

LOS 61.a

A diversified portfolio produces reduced risk for a given level of expected return, compared to investing in an individual security. Modern portfolio theory concludes that investors that do not take a portfolio perspective bear risk that is not rewarded with greater expected return.

LOS 61.b

The three steps in the portfolio management process are:

1. **Planning:** Determine client needs and circumstances, including the client's return objectives, risk tolerance, constraints, and preferences. Create, and then periodically review and update, an investment policy statement (IPS) that spells out these needs and circumstances.
2. **Execution:** Construct the client portfolio by determining suitable allocations to various asset classes based on the IPS and on expectations about macroeconomic variables such as inflation, interest rates, and GDP growth (top-down analysis). Identify attractively priced securities within an asset class for client portfolios based on valuation estimates from security analysts (bottom-up analysis).
3. **Feedback:** Monitor and rebalance the portfolio to adjust asset class allocations and securities holdings in response to market performance. Measure and report performance relative to the performance benchmark specified in the IPS.

LOS 61.c

Types of investment management clients and their characteristics:

| Investor Type | Risk Tolerance | Investment Horizon | Liquidity Needs | Income Needs |
|---|---|---|---|---|
| Individuals | Depends on individual | Depends on individual | Depends on individual | Depends on individual |
| Banks | Low | Short | High | Pay interest |
| Endowments | High | Long | Low | Spending level |
| Insurance | Low | Long—life<br>Short—P&C | High | Low |
| Mutual funds | Depends on fund | Depends on fund | High | Depends on fund |
| Defined benefit pension | High | Long | Low | Depends on age |

LOS 61.d

In a defined contribution plan, the employer contributes a certain sum each period to the employee's retirement account. The employer makes no promise regarding the future value of the plan assets; thus, the employee assumes all of the investment risk.

In a defined benefit plan, the employer promises to make periodic payments to the employee after retirement. Because the employee's future benefit is defined, the employer assumes the investment risk.

LOS 61.e

The asset management industry comprises buy-side firms that manage investments for clients. Asset management firms include both independent managers and divisions of larger financial services companies and may be full-service or specialist firms offering investments in traditional or alternative asset classes.

Active management attempts to outperform a chosen benchmark through manager skill. Passive management attempts to replicate the performance of a chosen benchmark index. Most assets under management are actively managed, but the market share for passive management has been increasing.

LOS 61.f

**Mutual funds** combine funds from many investors into a single portfolio that is invested in a specified class of securities or to match a specific index. Many varieties exist, including money market funds, bond funds, stock funds, and balanced (hybrid) funds. Open-ended shares can be bought or sold at the net asset value. Closed-ended funds have a fixed number of shares that trade at a price determined by the market.

**Exchange-traded funds** are similar to mutual funds, but investors can buy and sell ETF shares in the same way as shares of stock. Management fees are generally low, though trading ETFs results in brokerage costs.

**Separately managed accounts** are portfolios managed for individual investors who have substantial assets. In return for an annual fee based on assets, the investor receives personalized investment advice.

**Hedge funds** are available only to accredited investors and are exempt from most reporting requirements. Many different hedge fund strategies exist. A typical annual fee structure is 20% of excess performance plus 2% of assets under management.

**Buyout funds** involve taking a company private by buying all available shares, usually funded by issuing debt. The company is then restructured to increase cash flow. Investors typically exit the investment within three to five years.

**Venture capital funds** are similar to buyout funds, except that the companies purchased are in the start-up phase. Venture capital funds, like buyout funds, also provide advice and expertise to the start-ups.

## ANSWER KEY FOR MODULE QUIZZES

### Module Quiz 61.1

1. **B** Diversification provides an investor reduced risk. However, the expected return is generally similar or less than that expected from investing in a single risky security. Very high or very low returns become less likely. (LOS 61.a)
2. **C** An IPS should be updated at regular intervals and whenever there is a major change in the client's objectives or constraints. Updating an IPS based on portfolio performance is not recommended. (LOS 61.b)
3. **C** A top-down analysis begins with an analysis of broad economic trends. After an industry that is expected to perform well is chosen, the most attractive companies within that industry are identified. A bottom-up analysis begins with criteria such as firms' business prospects and quality of management. (LOS 61.b)
4. **A** Portfolio diversification has been shown to be relatively ineffective during severe market turmoil. Portfolio diversification is most effective when the securities have low correlation and the markets are operating normally. (LOS 61.a)
5. **C** Insurance companies need to be able to pay claims as they arise, which leads to insurance firms having low risk tolerance and high liquidity needs. Defined benefit pension plans and foundations both typically have high risk tolerance and low liquidity needs. (LOS 61.c)
6. **A** An endowment has a long time horizon and low liquidity needs, as an endowment generally intends to fund its causes perpetually. Both insurance companies and banks require high liquidity. (LOS 61.c)
7. **A** In a defined contribution pension plan, the employee accepts the investment risk. The plan sponsor and manager neither promise a specific level of retirement income to participants nor make investment decisions. These are features of a defined benefit plan. (LOS 61.d)
8. **C** In a defined benefit plan, the employer promises a specific level of benefits to employees when they retire. Thus, the employer bears the investment risk. (LOS 61.d)

### Module Quiz 61.2

1. **A** Open-end mutual funds do not have brokerage costs, as the shares are purchased from and redeemed with the fund company. Minimum investment amounts and management fees are typically higher for mutual funds. (LOS 61.f)
2. **B** Private equity and venture capital funds play an active role in the management of companies. Private equity funds other than venture capital expect that the majority of investments will pay off. Venture capital funds do not typically restructure companies. (LOS 61.f)

3. **C** Hedge funds may not be offered for sale to the general public; they can be sold only to qualified investors who meet certain criteria. Hedge funds that hold equal values of long and short securities today make up only a small percentage of funds; many other kinds of hedge funds exist that make no attempt to be market neutral. Hedge funds have reporting requirements that are less strict than those of a typical investment firm. (LOS 61.f)

[1] Source: SWF Institute (https://www.swfinstitute.org/.

# READING 62

# PORTFOLIO RISK AND RETURN: PART I

## EXAM FOCUS

This reading makes use of many of the statistical and returns measures we covered in Quantitative Methods. You should understand the historical return and risk rankings of the major asset classes and how the correlation (covariance) of returns between assets and between various asset classes affects the risk of portfolios. An investor's degree of risk aversion describes an investor's preferences regarding the tradeoff between risk and return. These preferences, along with the risk and return characteristics of available portfolios, can be used to identify an optimal portfolio for an investor, that is, the portfolio that maximizes the investor's expected utility.

## MODULE 62.1: RETURNS MEASURES

Video covering this content is available online.

**LOS 62.a: Calculate and interpret major return measures and describe their appropriate uses.**

**Holding period return (HPR)** is simply the percentage increase in the value of an investment over a given time period:

$$\text{holding period return} = \frac{\text{end-of-period value}}{\text{beginning-of-period value}} - 1 = \frac{P_t + \text{Div}_t}{P_0} - 1$$

$$= \frac{P_t - P_0 + \text{Div}_t}{P_0}$$

If a stock is valued at €20 at the beginning of the period, pays €1 in dividends over the period, and at the end of the period is valued at €22, the HPR is:

$$\text{HPR} = (22 + 1) / 20 - 1 = 0.15 = 15\%$$

### Average Returns

The **arithmetic mean return** is the simple average of a series of periodic returns. It has the statistical property of being an unbiased estimator of the true mean of the underlying distribution of returns:

$$\text{arithmetic mean return} = \frac{(R_1 + R_2 + R_3 + \ldots + R_n)}{n}$$

The **geometric mean return** is a compound annual rate. When periodic rates of return vary from period to period, the geometric mean return will have a value less than the arithmetic mean return:

$$\text{geometric mean return} = \sqrt[n]{(1 + R_1) \times (1 + R_2) \times (1 + R_3) \times \ldots \times (1 + R_n)} - 1$$

For example, for returns $R_t$ over three annual periods, the geometric mean return is calculated as the following example shows.

EXAMPLE: **Return measures**

An investor purchased $1,000 of a mutual fund's shares. The fund had the following total returns over a 3-year period: +5%, –8%, +12%. Calculate the value at the end of the 3-year period, the holding period return, the mean annual return, and the geometric mean annual return.

**Answer:**

ending value = (1,000)(1.05)(0.92)(1.12) = $1,081.92

holding period return = (1.05)(0.92)(1.12) − 1 = 0.08192 = 8.192%, which can also be calculated as 1,081.92 / 1,000 − 1 = 8.192%

arithmetic mean return = (5% − 8% + 12%) / 3 = 3%

$$\text{geometric mean return} = \sqrt[3]{(1.05)(0.92)(1.12)} - 1 = 0.02659 = 2.66\%,$$
$$\text{which can also be calculated as geometric mean return} = \sqrt[3]{1 + \text{HPR}} - 1 = \sqrt[3]{1.08192} - 1 = 2.66\%.$$

## Other Return Measures

**Gross return** refers to the total return on a security portfolio before deducting fees for the management and administration of the investment account. **Net return** refers to the return after these fees have been deducted. Note that commissions on trades and other costs that are necessary to generate the investment returns are deducted in both gross and net return measures.

**Pretax nominal return** refers to the return prior to paying taxes. Dividend income, interest income, short-term capital gains, and long-term capital gains may all be taxed at different rates.

**After-tax nominal return** refers to the return after the tax liability is deducted.

**Real return** is nominal return adjusted for inflation. Consider an investor who earns a nominal return of 7% over a year when inflation is 2%. The investor's approximate real return is simply 7 − 2 = 5%. The investor's exact real return is slightly lower, 1.07 / 1.02 − 1 = 0.049 = 4.9%.

Real return measures the increase in an investor's purchasing power: how much more goods she can purchase at the end of one year due to the increase in the value of her investments. If she invests $1,000 and earns a nominal return of 7%, she will have $1,070 at the end of the year. If the price of the goods she consumes has gone up 2%, from $1.00 to $1.02, she will be able to consume 1,070 / 1.02 = 1,049 units. She has given up consuming 1,000 units today but instead is able to purchase 1,049 units at the end of one year. Her purchasing power has gone up 4.9%; this is her real return.

A **leveraged return** refers to a return to an investor that is a multiple of the return on the underlying asset. The leveraged return is calculated as the gain or loss on the investment as a percentage of an investor's cash investment. An investment in a derivative security, such as a futures contract, produces a leveraged return because the cash deposited is only a fraction of the

value of the assets underlying the futures contract. Leveraged investments in real estate are very common: investors pay only a portion of a property's cost in cash and borrow the rest.

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## LOS 62.b: Compare the money-weighted and time-weighted rates of return and evaluate the performance of portfolios based on these measures.

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The **money-weighted return** applies the concept of IRR to investment portfolios. The money-weighted rate of return is defined as the internal rate of return on a portfolio, taking into account all cash inflows and outflows. The beginning value of the account is an inflow, as are all deposits into the account. All withdrawals from the account are outflows, as is the ending value.

EXAMPLE: **Money-weighted rate of return**

Assume an investor buys a share of stock for $100 at t = 0 and at the end of the year (t = 1), she buys an additional share for $120. At the end of Year 2, the investor sells both shares for $130 each. At the end of each year in the holding period, the stock paid a $2.00 per share dividend. What is the money-weighted rate of return?

*Step 1:* Determine the timing of each cash flow and whether the cash flow is an inflow (+), into the account, or an outflow (–), available from the account.

| | | | | |
|---|---|---|---|---|
| t = 0: | purchase of first share | = | +$100.00 | inflow to account |
| t = 1: | purchase of second share | = | +$120.00 | |
| | dividend from first share | = | –$2.00 | |
| | Subtotal, t = 1 | | +$118.00 | inflow to account |
| t = 2: | dividend from two shares | = | –$4.00 | |
| | proceeds from selling shares | = | –$260.00 | |
| | Subtotal, t = 2 | | –$264.00 | outflow from account |

*Step 2:* Net the cash flows for each time period and set the PV of cash inflows equal to the present value of cash outflows.

$$PV_{inflows} = PV_{outflows}$$

$$\$100 + \frac{\$118}{(1+r)} = \frac{\$264}{(1+r)^2}$$

*Step 3:* Solve for *r* to find the money-weighted rate of return. This can be done using trial and error or by using the IRR function on a financial calculator or spreadsheet.

The intuition here is that we deposited $100 into the account at t = 0, then added $118 to the account at t = 1 (which, with the $2 dividend, funded the purchase of one more share at $120), and ended with a total value of $264.

To compute this value with a financial calculator, use these net cash flows and follow the procedure(s) described to calculate the IRR.

Net cash flows: $CF_0 = +100$; $CF_1 = +120 - 2 = +118$;
$CF_2 = -260 + -4 = -264$

**Calculating money-weighted return with the TI Business Analyst II Plus®**

Note that the values for F01, F02, etc., are all equal to one.

| Key Strokes | Explanation | Display |
|---|---|---|
| [CF] [2nd][CLR WORK] | Clear Cash Flow Registers | CF0 = 0.00000 |
| 100 [ENTER] | Initial Cash Outlay | CF0 = +100.00000 |
| [↓] 118 [ENTER] | Period 1 Cash Flow | C01 = +118.00000 |
| [↓] [↓] 264 [+/–] [ENTER] | Period 2 Cash Flow | C02 = –264.00000 |
| [IRR] [CPT] | Calculate IRR | IRR = 13.86122 |

The money-weighted rate of return for this problem is 13.86%.

PROFESSOR'S NOTE

In the preceding example, we entered the flows into the account as positive and the ending value as a negative (the investor could withdraw this amount from the account). Note that there is no difference in the solution if we enter the cash flows into the account as negative values (out of the investor's pocket) and the ending value as a positive value (into the investor's pocket). As long as payments into the account and payments out of the account (including the ending value) are entered with opposite signs, the computed IRR will be correct.

**Time-weighted rate of return** measures compound growth. It is the rate at which $1 compounds over a specified performance horizon. Time-weighting is the process of averaging a set of values over time. The *annual* time-weighted return for an investment may be computed by performing the following steps:

*Step 1:* Value the portfolio immediately preceding significant additions or withdrawals. Form subperiods over the evaluation period that correspond to the dates of deposits and withdrawals.

*Step 2:* Compute the holding period return (HPR) of the portfolio for each subperiod.

*Step 3:* Compute the product of (1 + HPR) for each subperiod to obtain a total return for the entire measurement period [i.e., $(1 + HPR_1) \times (1 + HPR_2) \ldots (1 + HPR_n)] - 1$. If the total investment period is greater than one year, you must take the geometric mean of the measurement period return to find the annual time-weighted rate of return.

EXAMPLE: **Time-weighted rate of return**

An investor purchases a share of stock at t = 0 for $100. At the end of the year, t = 1, the investor buys another share of the same stock for $120. At the end of Year 2, the investor sells both shares for $130 each. At the end of both years 1 and 2, the stock paid a $2 per share dividend. What is the annual time-weighted rate of return for this investment? (This is the same investment as the preceding example.)

**Answer:**

*Step 1:* Break the evaluation period into two subperiods based on timing of cash flows.

| | | |
|---|---|---|
| Holding period 1: | Beginning value | = $100 |
| | Dividends paid | = $2 |
| | Ending value | = $120 |
| Holding period 2: | Beginning value | = $240 (2 shares) |
| | Dividends paid | = $4 ($2 per share) |
| | Ending value | = $260 (2 shares) |

*Step 2:* Calculate the HPR for each holding period.

$$HPR_1 = [(\$120 + 2) / \$100] - 1 = 22\%$$

$$HPR_2 = [(\$260 + 4) / \$240] - 1 = 10\%$$

*Step 3:* Find the compound annual rate that would have produced a total return equal to the return on the account over the 2-year period.

$$(1 + \text{time-weighted rate of return})^2 = (1.22)(1.10)$$

$$\text{time-weighted rate of return} = [(1.22)(1.10)]^{0.5} - 1 = 15.84\%$$

In the investment management industry, *the time-weighted rate of return is the preferred method of performance measurement, because it is not affected by the timing of cash inflows and outflows*.

In the preceding examples, the time-weighted rate of return for the portfolio was 15.84%, while the money-weighted rate of return for the same portfolio was 13.86%. The results are different because the money-weighted rate of return gave a larger weight to the Year 2 HPR, which was 10%, versus the 22% HPR for Year 1. This is because there was more money in the account at the beginning of the second period.

If funds are contributed to an investment portfolio just before a period of relatively poor portfolio performance, the money-weighted rate of return will tend to be lower than the time-weighted rate of return. On the other hand, if funds are contributed to a portfolio at a favorable time (just prior to a period of relatively high returns), the money-weighted rate of return will be higher than the time-weighted rate of return. The use of the time-weighted return removes these distortions and thus provides a better measure of a manager's ability to select investments over the period. If the manager has complete control over money flows into and out of an account, the money-weighted rate of return would be the more appropriate performance measure.

## LOS 62.c: Describe characteristics of the major asset classes that investors consider in forming portfolios.

An examination of the returns and standard deviation of returns for the major investable asset classes supports the idea of a tradeoff between risk and return. Using U.S. data over the period 1926–2017 as an example, shown in Figure 62.1, small-capitalization stocks have had the greatest average returns and greatest risk over the period. T-bills had the lowest average returns and the lowest standard deviation of returns.

Figure 62.1: Risk and Return of Major Asset Classes in the United States (1926–2017)[1]

| Assets Class | Average Annual Return (Geometric Mean) | Standard Deviation (Annualized Monthly) |
|---|---|---|
| Small-cap stocks | 12.1% | 31.7% |
| Large-cap stocks | 10.2% | 19.8% |
| Long-term corporate bonds | 6.1% | 8.3% |
| Long-term government bonds | 5.5% | 9.9% |
| Treasury bills | 3.4% | 3.1% |
| Inflation | 2.9% | 4.0% |

Results for other markets around the world are similar: asset classes with the greatest average returns also have the highest standard deviations of returns.

The annual nominal return on U.S. equities has varied greatly from year to year, ranging from losses greater than 40% to gains of more than 50%. We can approximate the real returns over the period by subtracting inflation. The asset class with the least risk, T-bills, had a real return of only approximately 0.5% over the period, while the approximate real return on U.S. large-cap stocks was 7.3%. Because annual inflation fluctuated greatly over the period, real returns have been much more stable than nominal returns.

Evaluating investments using expected return and variance of returns is a simplification because returns do not follow a normal distribution; distributions are negatively skewed, with greater kurtosis (fatter tails) than a normal distribution. The negative skew reflects a tendency towards large downside deviations, while the positive excess kurtosis reflects frequent extreme deviations on both the upside and downside. These non-normal characteristics of skewness ($\neq 0$) and kurtosis ($\neq 3$) should be taken into account when analyzing investments.

Liquidity is an additional characteristic to consider when choosing investments because liquidity can affect the price and, therefore, the expected return of a security. Liquidity can be a major concern in emerging markets and for securities that trade infrequently, such as low-quality corporate bonds.

MODULE QUIZ 62.1

1. An investor buys a share of stock for \$40 at time $t = 0$, buys another share of the same stock for \$50 at $t = 1$, and sells both shares for \$60 each at $t = 2$. The stock paid a dividend of \$1 per share at $t = 1$ and at $t = 2$. The periodic money-weighted rate of return on the investment is *closest* to:
   A. 22.2%.
   B. 23.0%.
   C. 23.8%.
2. Which of the following asset classes has historically had the highest returns and standard deviation of returns?
   A. Small-cap stocks.
   B. Large-cap stocks.
   C. Long-term corporate bonds.

# MODULE 62.2: RISK AVERSION

**LOS 62.d: Explain risk aversion and its implications for portfolio selection.**

Video covering this content is

A **risk-averse** investor is simply one that dislikes risk (i.e., prefers less risk to more risk). Given two investments that have equal expected returns, a risk-averse investor will choose the one with less risk (standard deviation, σ). Financial models assume all investors are risk averse.

available online.

A **risk-seeking** (risk-loving) investor would actually prefer more risk to less and, given equal expected returns, would prefer the more risky investment. A **risk-neutral** investor would have no preference regarding risk and would therefore be indifferent between any two investments with equal expected returns.

Consider this gamble: A coin will be flipped; if it comes up heads, you receive $100; if it comes up tails, you receive nothing. The expected payoff is 0.5($100) + 0.5($0) = $50. A risk-averse investor would choose a payment of $50 (a certain outcome) over the gamble. A risk-seeking investor would prefer the gamble to a certain payment of $50. A risk-neutral investor would be indifferent between the gamble and a certain payment of $50.

When the expected returns on two portfolios are equal, a risk-averse investor will always prefer the less risky portfolio. Those who choose high-risk portfolios feel that the increase in expected portfolio returns is adequate compensation for their portfolio's higher risk.

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## LOS 62.e: Explain the selection of an optimal portfolio, given an investor's utility (or risk aversion) and the capital allocation line.

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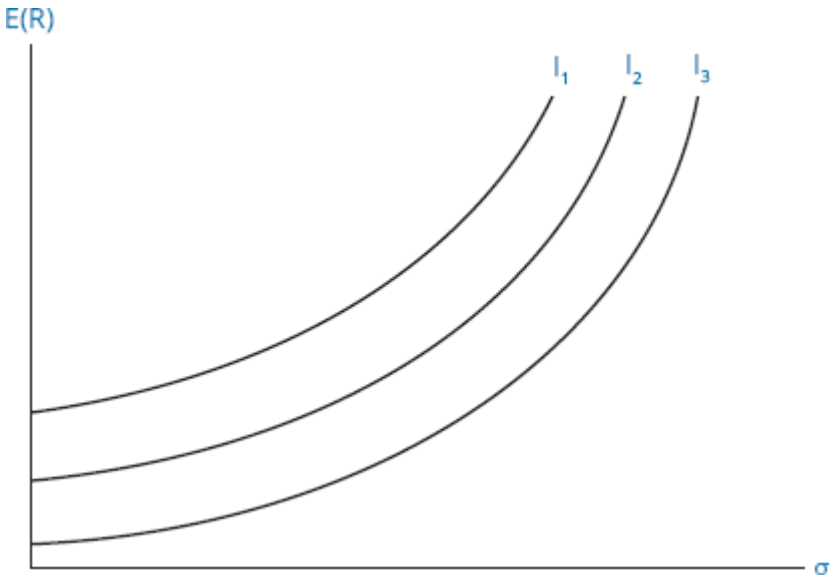
Investors' **utility functions** represent their preferences regarding the tradeoff between risk and return (i.e., their degrees of risk aversion). An **indifference curve** is a tool from economics that, in this application, plots combinations of risk (standard deviation) and expected returns among which an investor is indifferent. In constructing indifference curves for portfolios based on only their expected return and standard deviation of returns, we are assuming that these are the only portfolio characteristics that investors care about. In Figure 62.2, we show three indifference curves for an investor. The investor's expected utility is the same for all points (portfolios) along any single indifference curve. Portfolios along indifference curve $I_1$ in Figure 62.2 are preferred to all portfolios along $I_2$, which are preferred to all portfolios along $I_3$.

Figure 62.2: Risk-Averse Investor's Indifference Curves




Indifference curves slope upward for risk-averse investors because they will only take on more risk (standard deviation of returns) if they are compensated with greater expected returns. An investor who is more risk averse requires a greater increase in expected return to compensate for a given increase in risk than a less risk-averse investor. In other words, the indifference curves of a more risk-averse investor will be steeper than those of a less risk-averse investor, reflecting a higher **risk aversion coefficient**.

In our previous illustration of efficient portfolios available in the market, we included only risky assets. Now we will introduce a risk-free asset into our universe of available assets, and we will examine the risk and return characteristics of a portfolio that combines a portfolio of risky assets and a risk-free asset. As we have seen, we can calculate the expected return and standard deviation of a portfolio with weight $W_A$ allocated to risky Asset A and weight $W_B$ allocated to risky Asset B using the following formulas:

$$E(R_{portfolio}) = W_A E(R_A) + W_B E(R_B)$$

$$\sigma_{portfolio} = \sqrt{W_A^2 \sigma_A^2 + W_B^2 \sigma_B^2 + 2 W_A W_B \rho_{AB} \sigma_A \sigma_B}$$

Allow Asset B to be the risk-free asset and Asset A to be the risky asset portfolio. Because a risk-free asset has zero standard deviation and zero correlation of returns with those of a risky portfolio, this results in the reduced equation:

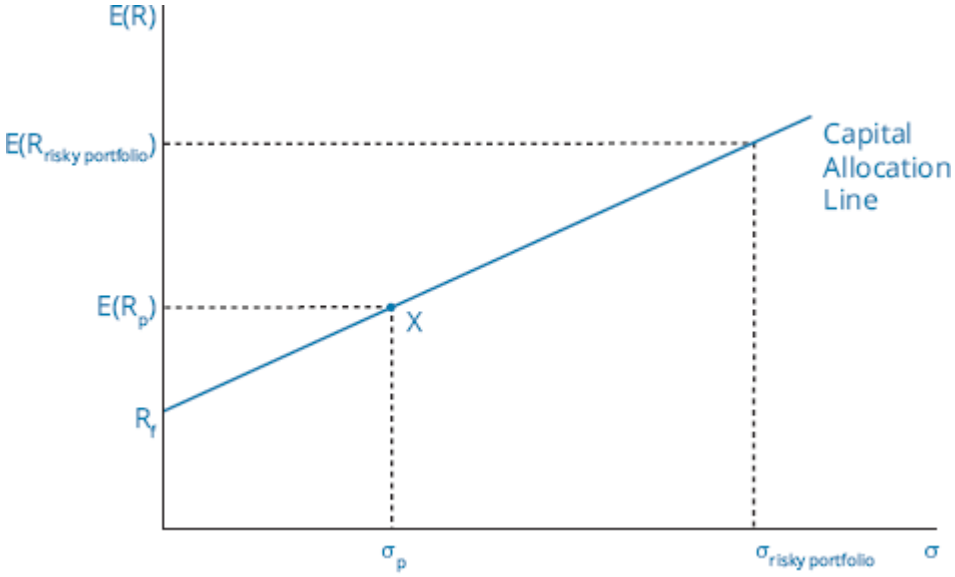
$$\sigma_{portfolio} = \sqrt{W_A^2 \sigma_A^2} = W_A \sigma_A$$

The intuition of this result is straightforward: If we put X% of our portfolio into the risky asset, and the rest into the risk-free asset, our portfolio will have X% of the risk of the risky asset. The relationship between portfolio risk and return for various portfolio allocations is linear, as illustrated in Figure 62.3.

Combining a risky portfolio with a risk-free asset is the process that supports the **two-fund separation theorem**, which states that all investors' optimal portfolios will be made up of some combination of the optimal portfolio of risky assets and the risk-free asset. The line representing these possible combinations of risk-free assets and the optimal risky asset portfolio is referred to as the **capital allocation line**.

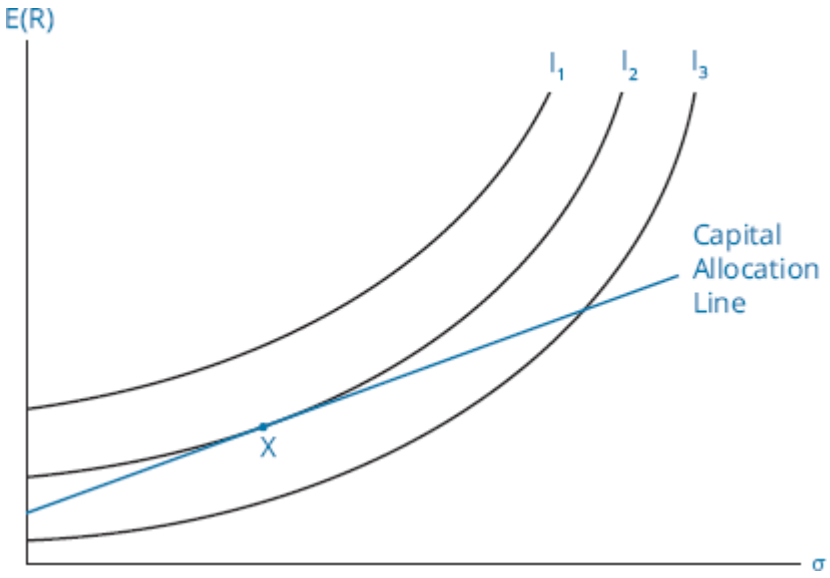
Point X on the capital allocation line in Figure 62.3 represents a portfolio that is 40% invested in the risky asset portfolio and 60% invested in the risk-free asset. Its expected return will be $0.40[E(R_{\text{risky asset portfolio}})] + 0.60(R_f)$, and its standard deviation will be $0.40(\sigma_{\text{risky asset portfolio}})$.

Figure 62.3: Capital Allocation Line and Risky Asset Weights



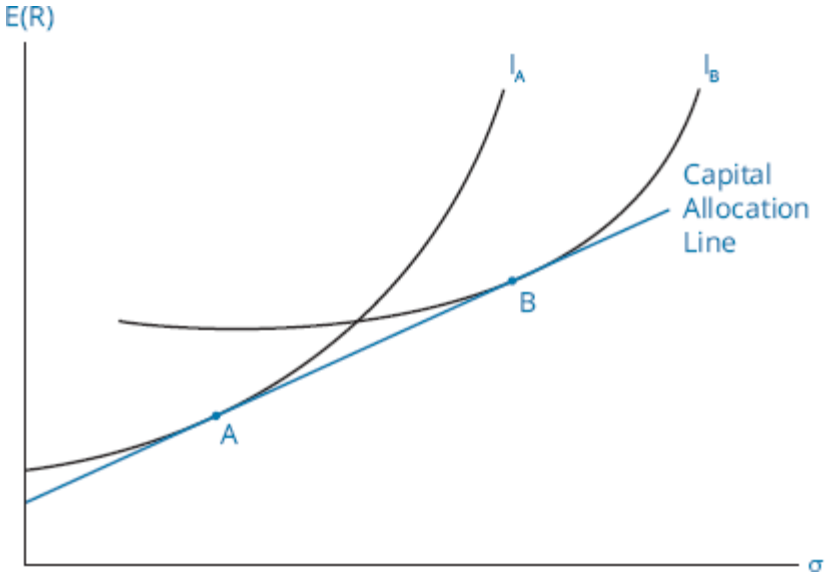

Now that we have constructed a set of the possible efficient portfolios (the capital allocation line), we can combine this with indifference curves representing an individual's preferences for risk and return to illustrate the logic of selecting an optimal portfolio (i.e., one that maximizes the investor's expected utility). In Figure 62.4, we can see that Investor A, with preferences represented by indifference curves $I_1$, $I_2$, and $I_3$, can reach the level of expected utility on $I_2$ by selecting Portfolio X. This is the optimal portfolio for this investor, as any portfolio that lies on $I_2$ is preferred to all portfolios that lie on $I_3$ (and in fact to any portfolios that lie between $I_2$ and $I_3$). Portfolios on $I_1$ are preferred to those on $I_2$, but none of the portfolios that lie on $I_1$ are available in the market.

Figure 62.4: Risk-Averse Investor's Indifference Curves




The final result of our analysis here is not surprising; investors who are less risk averse will select portfolios with more risk. Recall that the lower an investor's risk aversion, the flatter his indifference curves. As illustrated in Figure 62.5, the flatter indifference curve for Investor B ($I_B$) results in an optimal (tangency) portfolio that lies to the right of the one that results from a steeper indifference curve, such as that for Investor A ($I_A$). An investor who is less risk averse should optimally choose a portfolio with more invested in the risky asset portfolio and less invested in the risk-free asset.

Figure 62.5: Portfolio Choices Based on Two Investors' Indifference Curves




MODULE QUIZ 62.2

1. Which of the following statements about risk-averse investors is *most accurate*? A risk-averse investor:
   A. seeks out the investment with minimum risk, while return is not a major consideration.
   B. will take additional investment risk if sufficiently compensated for this risk.
   C. avoids participating in global equity markets.

2. The capital allocation line is a line from the risk-free return through:
   A. the global maximum-return portfolio.
   B. the optimal risky portfolio.
   C. the global minimum-variance portfolio.

# MODULE 62.3: PORTFOLIO STANDARD DEVIATION

Video covering this content is available online.

**LOS 62.f: Calculate and interpret the mean, variance, and covariance (or correlation) of asset returns based on historical data.**

## Variance (Standard Deviation) of Returns for an Individual Security

In finance, the variance and standard deviation of returns are common measures of investment risk. Both of these are measures of the variability of a distribution of returns about its mean or expected value.

We can calculate the population variance, $\sigma^2$, when we know the return $R_t$ for each period, the total number periods ($T$), and the mean or expected value of the population's distribution ($\mu$), as follows:

$$\sigma^2 = \frac{\sum_{t=1}^{T}(R_t - \mu)^2}{T}$$

In the world of finance, we are typically analyzing only a sample of returns data, rather than the entire population. To calculate sample variance, $s^2$, using a sample of $T$ historical returns and the mean, $\bar{R}$, of the observations, we use the following formula:

$$s^2 = \frac{\sum_{t=1}^{T}(R_t - \bar{R})^2}{T - 1}$$

## Covariance and Correlation of Returns for Two Securities

**Covariance** measures the extent to which two variables move together over time. A positive covariance means that the variables (e.g., rates of return on two stocks) tend to move together. Negative covariance means that the two variables tend to move in opposite directions. A covariance of zero means there is no linear relationship between the two variables. To put it another way, if the covariance of returns between two assets is zero, knowing the return for the next period on one of the assets tells you nothing about the return of the other asset for the period.

Here we will focus on the calculation of the covariance between two assets' returns using **historical data**. The calculation of the sample covariance is based on the following formula:

$$\text{Cov}_{1,2} = \frac{\sum_{t=1}^{n}\left\{\left[R_{t,1} - \overline{R}_1\right]\left[R_{t,2} - \overline{R}_2\right]\right\}}{n-1}$$

where:

$R_{t,1}$ = return on Asset 1 in period $t$

$R_{t,2}$ = return on Asset 2 in period $t$

$\overline{R}_1$ = mean return on Asset 1

$\overline{R}_2$ = mean return on Asset 2

$n$ = number of periods

The magnitude of the covariance depends on the magnitude of the individual stocks' standard deviations and the relationship between their co-movements. Covariance is an absolute measure and is measured in return units squared.

The covariance of the returns of two securities can be standardized by dividing by the product of the standard deviations of the two securities. This standardized measure of co-movement is called **correlation** and is computed as:

$$\rho_{1,2} = \frac{\text{Cov}_{1,2}}{\sigma_1 \sigma_2}$$

The relation can also be written as:

$$\text{Cov}_{1,2} = \rho_{1,2}\sigma_1\sigma_2$$

The term $\rho_{1,2}$ is called the *correlation coefficient* between the returns of securities 1 and 2. The correlation coefficient has no units. It is a pure measure of the co-movement of the two stocks' returns and is bounded by −1 and +1.

How should you interpret the correlation coefficient?

- A correlation coefficient of +1 means that deviations from the mean or expected return are always proportional in the same direction. That is, they are perfectly positively correlated.
- A correlation coefficient of −1 means that deviations from the mean or expected return are always proportional in opposite directions. That is, they are perfectly negatively correlated.
- A correlation coefficient of zero means that there is no linear relationship between the two stocks' returns. They are uncorrelated. One way to interpret a correlation (or covariance) of zero is that, in any period, knowing the actual value of one variable tells you nothing about the value of the other.

EXAMPLE: **Calculating mean return, returns variance, returns covariance, and correlation**

Given three years of percentage returns for Assets A and B in the following table, calculate the mean return and sample standard deviation for each asset, the sample covariance, and the correlation of returns.

| Year | Asset A | Asset B |
|---|---|---|
| 1 | 5% | 7% |
| 2 | –2% | –4% |
| 3 | 12% | 18% |

**Answer:**

mean return for Asset A = (5% – 2% + 12%) / 3 = 5%

mean return for Asset B = (7% – 4% + 18%) / 3 = 7%

$$\text{sample variance of returns for Asset A} = \frac{(5-5)^2 + (-2-5)^2 + (12-5)^2}{3-1} = 49$$

$$\text{sample standard deviation for Asset A} = \sqrt{49} = 7\%$$

$$\text{sample variance of returns for Asset B} = \frac{(7-7)^2 + (-4-7)^2 + (18-7)^2}{3-1} = 121$$

$$\text{sample standard deviation for Asset B} = \sqrt{121} = 11\%$$

sample covariance of returns for Assets A and B

$$= \frac{(5-5)(7-7) + (-2-5)(-4-7) + (12-5)(18-7)}{3-1} = 77$$

$$\text{correlation of returns for Assets A and B} = \frac{77}{7 \times 11} = 1$$

In this example, the returns on Assets A and B are perfectly positively correlated.

## LOS 62.g: Calculate and interpret portfolio standard deviation.

Video covering this content is available online.

The variance of returns for a portfolio of two risky assets is calculated as follows:

$$\text{Var}_{\text{portfolio}} = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\text{Cov}_{12}$$

where $w_1$ is the proportion of the portfolio invested in Asset 1, and $w_2$ is the proportion of the portfolio invested in Asset 2. $w_2$ must equal $(1 - w_1)$.

Previously, we established that the correlation of returns for two assets is calculated as:

$$\rho_{12} = \frac{\text{Cov}_{12}}{\sigma_1\sigma_2}, \text{ so that we can also write } \text{Cov}_{12} = \rho_{12}\sigma_1\sigma_2.$$

Substituting this term for $\text{Cov}_{12}$ in the formula for the variance of returns for a portfolio of two risky assets, we have the following:

$$\text{Var}_{\text{portfolio}} = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{12}\sigma_1\sigma_2$$

Writing the formula in this form allows us to easily see the effect of the correlation of returns between the two assets on portfolio risk.

EXAMPLE: **Calculating portfolio standard deviation**

A portfolio is 30% invested in stocks that have a standard deviation of returns of 20% and is 70% invested in bonds that have a standard deviation of returns of 12%. The correlation of bond returns with stock returns is 0.60. What is the standard deviation of portfolio returns? What would it be if stock and bond returns were perfectly positively correlated?

**Answer:**

portfolio standard deviation

$$= \sqrt{(0.3^2)(0.2^2) + (0.7^2)(0.12^2) + 2(0.3)(0.7)(0.6)(0.2)(0.12)}$$

$$= 12.9\%$$

If stock and bond returns were perfectly positively correlated, portfolio standard deviation would simply be the weighted average of the assets' standard deviations: 0.3(20%) + 0.7(12%) = 14.4%.

MODULE QUIZ 62.3

1. In a 5-year period, the annual returns on an investment are 5%, -3%, -4%, 2%, and 6%. The standard deviation of annual returns on this investment is *closest* to:
   A. 4.0%.
   B. 4.5%.
   C. 20.7%.
2. A measure of how the returns of two risky assets move in relation to each other is:
   A. the range.
   B. the covariance.
   C. the standard deviation.
3. Which of the following statements about correlation is *least accurate*?
   A. Diversification reduces risk when correlation is less than +1.
   B. If the correlation coefficient is 0, a zero-variance portfolio can be constructed.
   C. The lower the correlation coefficient, the greater the potential benefits from diversification.
4. The variance of returns is 0.09 for Stock A and 0.04 for Stock B. The covariance between the returns of A and B is 0.006. The correlation of returns between A and B is:
   A. 0.10.
   B. 0.20.
   C. 0.30.

Use the following data to answer Questions 5 and 6.

A portfolio was created by investing 25% of the funds in Asset A (standard deviation = 15%) and the balance of the funds in Asset B (standard deviation = 10%).

5. If the correlation coefficient is 0.75, what is the portfolio's standard deviation?
   A. 10.6%.
   B. 12.4%.
   C. 15.0%.
6. If the correlation coefficient is -0.75, what is the portfolio's standard deviation?
   A. 2.8%.
   B. 4.2%.
   C. 5.3%.

# MODULE 62.4: THE EFFICIENT FRONTIER

## LOS 62.h: Describe the effect on a portfolio's risk of investing in assets that are less than perfectly correlated.

Video covering this content is available online.

If two risky asset returns are perfectly positively correlated, $\rho_{12} = +1$, then the square root of portfolio variance (the portfolio standard deviation of returns) is equal to:

$$\sigma_{portfolio} = \sqrt{Var_{portfolio}} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2(1)} = w_1\sigma_1 + w_2\sigma_2$$

PROFESSOR'S NOTE

This might be easier to see by examining the algebra in reverse. If $w_1\sigma_1 + w_2\sigma_2$ equals the square root of the term under the radical in this special case, then $(w_1\sigma_1 + w_2\sigma_2)^2$ should equal the term under the radical. If we expand $(w_1\sigma_1 + w_2\sigma_2)^2$, we get:

$$\begin{aligned}(w_1\sigma_1 + w_2\sigma_2)^2 &= (w_1\sigma_1)^2 + (w_1\sigma_1)(w_2\sigma_2) + (w_2\sigma_2)(w_1\sigma_1) + (w_2\sigma_2)^2 \\ &= (w_1\sigma_1)^2 + (w_2\sigma_2)^2 + 2(w_1\sigma_1)(w_2\sigma_2) \\ &= w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1\sigma_1w_2\sigma_2\end{aligned}$$

In this unique case, with $\rho_{12} = 1$, the portfolio standard deviation is simply a weighted average of the standard deviations of the individual asset returns. A portfolio 25% invested in Asset 1 and 75% invested in Asset 2 will have a standard deviation of returns equal to 25% of the standard deviation ($\sigma_1$) of Asset 1's return, plus 75% of the standard deviation ($\sigma_2$) of Asset 2's return.

Focusing on returns correlation, we can see that the greatest portfolio risk results when the correlation between asset returns is +1. For any value of correlation less than +1, portfolio variance is reduced. Note that for a correlation of zero, the entire third term in the portfolio variance equation is zero. For negative values of correlation $\rho_{12}$, the third term becomes negative and further reduces portfolio variance and standard deviation.

We will illustrate this property with an example.

EXAMPLE: **Portfolio risk as correlation varies**

Consider two risky assets that have returns variances of 0.0625 and 0.0324, respectively. The assets' standard deviations of returns are then 25% and 18%, respectively. Calculate the variances and standard deviations of portfolio returns for an equal-weighted portfolio of the two assets when their correlation of returns is 1, 0.5, 0, and –0.5.

The calculations are as follows:

$$\text{variance}_{\text{portfolio}} = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_1\sigma_1\sigma_2$$

$$\sigma_{\text{portfolio}} = \sqrt{\text{variance}_{\text{portfolio}}}$$

$$\sigma_{\text{portfolio}} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{12}\sigma_1\sigma_2}$$

**ρ = correlation = +1:**

$\sigma$ = portfolio standard deviation = $0.5(25\%) + 0.5(18\%) = \mathbf{21.5\%}$

$\sigma^2$ = portfolio variance = $0.215^2 = 0.046225$

**ρ = correlation = 0.5:**

$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 + 2(0.5)(0.5)(\mathbf{0.5})(0.25)(0.18) = 0.034975$

$\sigma = \mathbf{18.70\%}$

**ρ = correlation = 0:**

$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 = 0.023725$

$\sigma = \mathbf{15.40\%}$

**ρ = correlation = –0.5:**

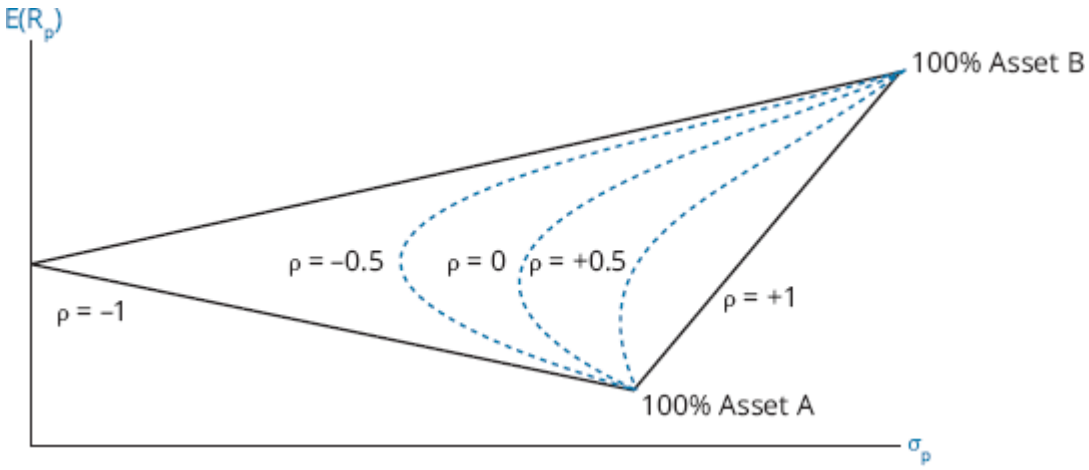
$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 + 2(0.5)(0.5)(\mathbf{-0.5})(0.25)(0.18) = 0.012475$

$\sigma = \mathbf{11.17\%}$

Note that portfolio risk decreases as the correlation between the assets' returns decreases. This is an important result of the analysis of portfolio risk: The lower the correlation of asset returns, the greater the risk reduction (diversification) benefit of combining assets in a portfolio. If asset returns were perfectly negatively correlated, portfolio risk could be eliminated altogether for a specific set of asset weights.

We show these relations graphically in Figure 62.6 by plotting the portfolio risk and return for all portfolios of two risky assets, for specific values of the assets' returns correlation.

Figure 62.6: Risk and Return for Different Values of ρ




From these analyses, the risk reduction benefits of investing in assets with low return correlations should be clear. The desire to reduce risk is what drives investors to invest in not just domestic stocks, but also bonds, foreign stocks, real estate, and other asset classes.

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## LOS 62.i: Describe and interpret the minimum-variance and efficient frontiers of risky assets and the global minimum-variance portfolio.

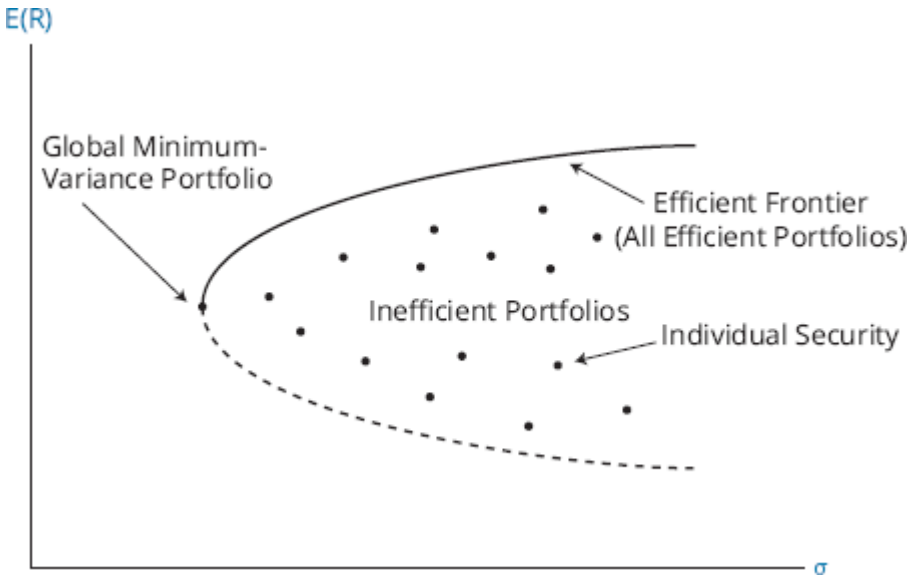
---

For each level of expected portfolio return, we can vary the portfolio weights on the individual assets to determine the portfolio that has the least risk. These portfolios that have the lowest standard deviation of all portfolios with a given expected return are known as **minimum-variance portfolios**. Together they make up the **minimum-variance frontier**.

Assuming that investors are risk averse, investors prefer the portfolio that has the greatest expected return when choosing among portfolios that have the same standard deviation of returns. Those portfolios that have the greatest expected return for each level of risk (standard deviation) make up the **efficient frontier**. The efficient frontier coincides with the top portion of the minimum-variance frontier. A risk-averse investor would only choose portfolios that are on the efficient frontier because all available portfolios that are not on the efficient frontier have lower expected returns than an efficient portfolio with the same risk. The portfolio on the efficient frontier that has the least risk is the **global minimum-variance portfolio**.

These concepts are illustrated in Figure 62.7.

Figure 62.7: Minimum-Variance and Efficient Frontiers




MODULE QUIZ 62.4

1. Which of the following statements about covariance and correlation is *least accurate*?
   A. A zero covariance implies there is no linear relationship between the returns on two assets.
   B. If two assets have perfect negative correlation, the variance of returns for a portfolio that consists of these two assets will equal zero.
   C. The covariance of a 2-stock portfolio is equal to the correlation coefficient times the standard deviation of one stock's returns times the standard deviation of the other stock's returns.
2. Which of the following available portfolios *most likely* falls below the efficient frontier?

| | Portfolio | Expected return | Expected standard deviation |
|---|---|---|---|
| A. | A | 7% | 14% |
| B. | B | 9% | 26% |
| C. | C | 12% | 22% |

## KEY CONCEPTS

LOS 62.a

Holding period return is used to measure an investment's return over a specific period. Arithmetic mean return is the simple average of a series of periodic returns. Geometric mean return is a compound annual rate.

Gross return is total return after deducting commissions on trades and other costs necessary to generate the returns, but before deducting fees for the management and administration of the investment account. Net return is the return after management and administration fees have been deducted.

Pretax nominal return is the numerical percentage return of an investment, without considering the effects of taxes and inflation. After-tax nominal return is the numerical return after the tax liability is deducted, without adjusting for inflation. Real return is the increase in an investor's purchasing power, roughly equal to nominal return minus inflation. Leveraged return is the gain or loss on an investment as a percentage of an investor's cash investment.

LOS 62.b

The money-weighted rate of return is the IRR calculated using periodic cash flows into and out of an account and is the discount rate that makes the PV of cash inflows equal to the PV of cash outflows.

The time-weighted rate of return measures compound growth. It is the rate at which $1 compounds over a specified performance horizon.

If funds are added to a portfolio just before a period of poor performance, the money-weighted return will be lower than the time-weighted return. If funds are added just prior to a period of high returns, the money-weighted return will be higher than the time-weighted return.

The time-weighted return is the preferred measure of a manager's ability to select investments. If the manager controls the money flows into and out of an account, the money-weighted return is the more appropriate performance measure.

### LOS 62.c

As predicted by theory, asset classes with the greatest average returns have also had the highest risk.

Some of the major asset classes that investors consider when building a diversified portfolio include small-capitalization stocks, large-capitalization stocks, long-term corporate bonds, long-term Treasury bonds, and Treasury bills.

In addition to risk and return, when analyzing investments, investors also take into consideration an investment's liquidity, as well as non-normal characteristics such as skewness and kurtosis.

### LOS 62.d

A risk-averse investor is one that dislikes risk. Given two investments that have equal expected returns, a risk-averse investor will choose the one with less risk. However, a risk-averse investor will hold risky assets if he feels that the extra return he expects to earn is adequate compensation for the additional risk. Assets in the financial markets are priced according to the preferences of risk-averse investors.

A risk-seeking (risk-loving) investor prefers more risk to less and, given investments with equal expected returns, will choose the more risky investment.

A risk-neutral investor would be indifferent to risk and would be indifferent between two investments with the same expected return regardless of the investments' standard deviation of returns.

### LOS 62.e

An indifference curve plots combinations of risk and expected return that provide the same expected utility. Indifference curves for risk and return slope upward because risk-averse investors will only take on more risk if they are compensated with greater expected returns. A more risk-averse investor will have steeper indifference curves.

Flatter indifference curves (less risk aversion) result in an optimal portfolio with higher risk and higher expected return. An investor who is less risk averse will optimally choose a portfolio with more invested in the risky asset portfolio and less invested in the risk-free asset, compared to a more risk-averse investor.

LOS 62.f

We can calculate the population variance, $\sigma^2$, when we know the return $R_t$ for period $t$, the total number $T$ of periods, and the mean $\mu$ of the population's distribution:

$$\text{population variance} = \sigma^2 = \frac{\sum_{t=1}^{T}(R_t - \mu)^2}{T}$$

In finance, we typically analyze only a sample of returns, so the sample variance applies instead:

$$\text{sample variance} = S^2 = \frac{\sum_{t=1}^{T}(R_t - \bar{R})^2}{T - 1}$$

Covariance measures the extent to which two variables move together over time. Positive covariance means the variables (e.g., rates of return on two stocks) tend to move together. Negative covariance means that the two variables tend to move in opposite directions. Covariance of zero means there is no linear relationship between the two variables.

Correlation is a standardized measure of co-movement that is bounded by –1 and +1:

$$\rho_{1,2} = \frac{\text{Cov}_{1,2}}{\sigma_1 \sigma_2}$$

LOS 62.g

The standard deviation of returns for a portfolio of two risky assets is calculated as follows:

$$\sigma_{\text{portfolio}} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1 w_2 \rho_{1,2}\sigma_1\sigma_2}$$

LOS 62.h

The greatest portfolio risk will result when the asset returns are perfectly positively correlated. As the correlation decreases from +1 to –1, portfolio risk decreases. The lower the correlation of asset returns, the greater the risk reduction (diversification) benefit of combining assets in a portfolio.

LOS 62.i

For each level of expected portfolio return, the portfolio that has the least risk is known as a minimum-variance portfolio. Taken together, these portfolios form a line called the minimum-variance frontier.

On a risk versus return graph, the one risky portfolio that is farthest to the left (has the least risk) is known as the global minimum-variance portfolio.

Those portfolios that have the greatest expected return for each level of risk make up the efficient frontier. The efficient frontier coincides with the top portion of the minimum variance frontier. Risk-averse investors would only choose a portfolio that lies on the efficient frontier.

## ANSWER KEY FOR MODULE QUIZZES

### Module Quiz 62.1

1. **C** Using the cash flow functions on your financial calculator, enter $CF_0 = -40$; $CF_1 = -50 + 1 = -49$; $CF_2 = 60 \times 2 + 2 = 122$; CPT IRR = 23.82%. (LOS 62.a)

2. **A** Small-cap stocks have had the highest annual return and standard deviation of return over time. Large-cap stocks and bonds have historically had lower risk and return than small-cap stocks. (LOS 62.c)

## Module Quiz 62.2

1. **B** Risk-averse investors are generally willing to invest in risky investments, if the expected return of the investment is sufficient to reward the investor for taking on this risk. Participants in securities markets are generally assumed to be risk-averse investors. (LOS 62.d)

2. **B** An investor's optimal portfolio will lie somewhere on the capital allocation line, which begins at the risk-free asset and runs through the optimal risky portfolio. (LOS 62.e)

## Module Quiz 62.3

1. **B** mean annual return = (5% – 3% – 4% + 2% + 6%) / 5 = 1.2%

   Squared deviations from the mean:

   $5\% - 1.2\% = 3.8\%$ $\quad 3.8^2 = 14.44$

   $-3\% - 1.2\% = -4.2\%$ $\quad -4.2^2 = 17.64$

   $-4\% - 1.2\% = -5.2\%$ $\quad -5.2^2 = 27.04$

   $2\% - 1.2\% = 0.8\%$ $\quad 0.8^2 = 0.64$

   $6\% - 1.2\% = 4.8\%$ $\quad 4.8^2 = 23.04$

   sum of squared deviations = 14.44 + 17.64 + 27.04 + 0.64 + 23.04 = 82.8

   sample variance = 82.8 / (5 – 1) = 20.7

   sample standard deviation = $20.7^{1/2} = 4.55\%$

   (LOS 62.f)

2. **B** The covariance is defined as the co-movement of the returns of two assets or how well the returns of two risky assets move together. Range and standard deviation are measures of dispersion and measure risk, not how assets move together. (LOS 62.f)

3. **B** A zero-variance portfolio can only be constructed if the correlation coefficient between assets is –1. Diversification benefits can be had when correlation is less than +1, and the lower the correlation, the greater the expected benefit. (LOS 62.f)

4. **A** $\sqrt{A} = \sqrt{0.09} = 0.30$

   $\sqrt{B} = \sqrt{0.04} = 0.20$

   $\text{correlation} = 0.006 \,/\, [(0.30)(0.20)] = 0.10$

   (LOS 62.f)

5. **A** $\sqrt{(0.25)^2(0.15)^2 + (0.75)^2(0.10)^2 + 2(0.25)(0.75)(0.15)(0.10)(0.75)} =$

   $\sqrt{0.001406 + 0.005625 + 0.004219} = \sqrt{0.01125} = 0.106 = 10.6\%$

   (LOS 62.g)

6. **C** $\sqrt{(0.25)^2(0.15)^2 + (0.75)^2(0.10)^2 + 2(0.25)(0.75)(0.15)(0.10)(-0.75)} =$
$\sqrt{0.001406 + 0.005625 - 0.004219} = \sqrt{0.002812} = 0.053 = 5.3\%$
(LOS 62.g)

## Module Quiz 62.4

1. **B** If the correlation of returns between the two assets is –1, the set of possible portfolio risk/return combinations becomes two straight lines (see Figure 62.2). A portfolio of these two assets will have a positive returns variance unless the portfolio weights are those that minimize the portfolio variance. Covariance is equal to the correlation coefficient multiplied by the product of the standard deviations of the returns of the two stocks in a 2-stock portfolio. If covariance is zero, then correlation is also zero, which implies that there is no linear relationship between the two stocks' returns. (LOS 62.h)
2. **B** Portfolio B must be the portfolio that falls below the Markowitz efficient frontier because there is a portfolio (Portfolio C) that offers a higher return and lower risk. (LOS 62.i)

[1] 2018 SBBI Yearbook.

# READING 63

# PORTFOLIO RISK AND RETURN: PART II

## EXAM FOCUS

The concepts developed here are very important to finance theory and are also used extensively in practice. You must know this material completely—not only the formulas and definitions, but the ideas that underlie their use. A model assumption that diversification is costless leads to the conclusion that only systematic risk (which cannot be reduced by further diversification) is priced in equilibrium, so that bearing nonsystematic risk does not increase expected returns.

## MODULE 63.1: SYSTEMATIC RISK AND BETA

Video covering this content is available online.

**LOS 63.a: Describe the implications of combining a risk-free asset with a portfolio of risky assets.**

In the previous reading, we covered the mathematics of calculating the risk and return of a portfolio with a percentage weight of $W_A$ invested in a risky portfolio (P) and a weight of $W_B = 1 - W_A$ invested in a risk-free asset.

$$E(R_P) = W_A\,E(R_A) + W_B\,E(R_B)$$

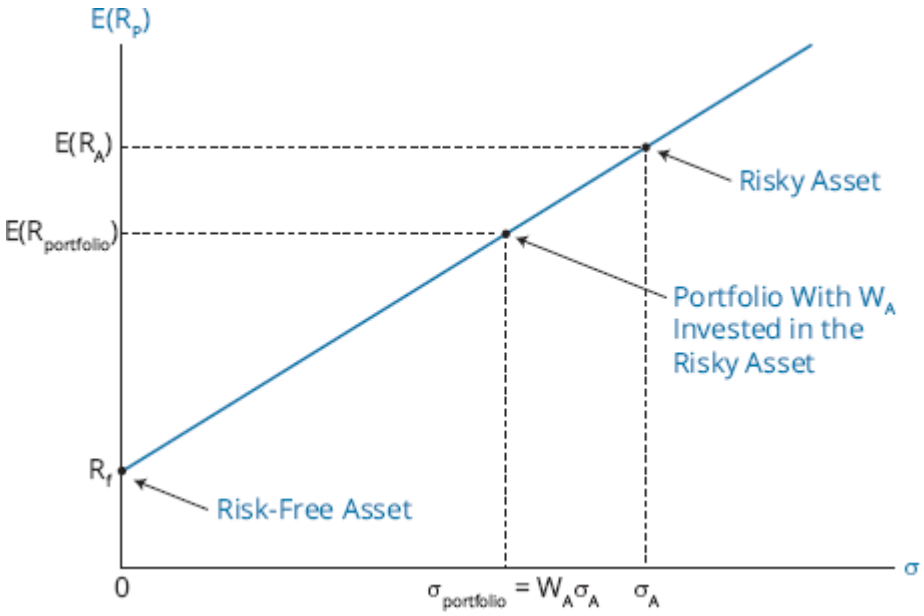
$$\sigma_P = \sqrt{W_A^2\sigma_A^2 + W_B^2\sigma_B^2 + 2\,W_A\,W_B\,\rho_{AB}\sigma_A\sigma_B}$$

Because a risk-free asset has zero standard deviation and zero correlation of returns with a risky portfolio, allowing Asset B to be the risk-free asset and Asset A to be the risky asset portfolio results in the following reduced equation:

$$\sigma_P = \sqrt{W_A^2\sigma_A^2} = W_A\sigma_A$$

Our result is that the risk (standard deviation of returns) and expected return of portfolios with varying weights in the risk-free asset and a risky portfolio can be plotted as a line that begins at the risk-free rate of return and extends through the risky portfolio. This result is illustrated in Figure 63.1.

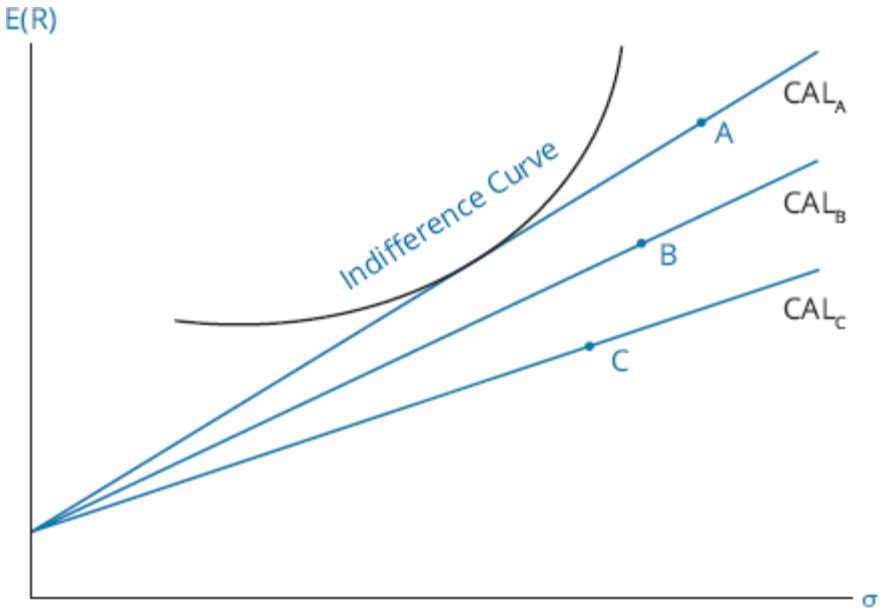
Figure 63.1: Combining a Risk-Free Asset With a Risky Asset




## LOS 63.b: Explain the capital allocation line (CAL) and the capital market line (CML).

The line of possible portfolio risk and return combinations given the risk-free rate and the risk and return of a portfolio of risky assets is referred to as the **capital allocation line (CAL)**. For an individual investor, the best CAL is the one that offers the most-preferred set of possible portfolios in terms of their risk and return. Figure 63.2 illustrates three possible investor CALs for three different risky portfolios A, B, and C. The optimal risky portfolio for this investor is Portfolio A because it results in the most preferred set of possible portfolios constructed by combining the risk-free asset with the risky portfolio. Of all the portfolios available to the investor, a combination of the risk-free asset with risky Portfolio A offers the investor the greatest expected utility.

Figure 63.2: Risky Portfolios and Their Associated Capital Allocation Lines

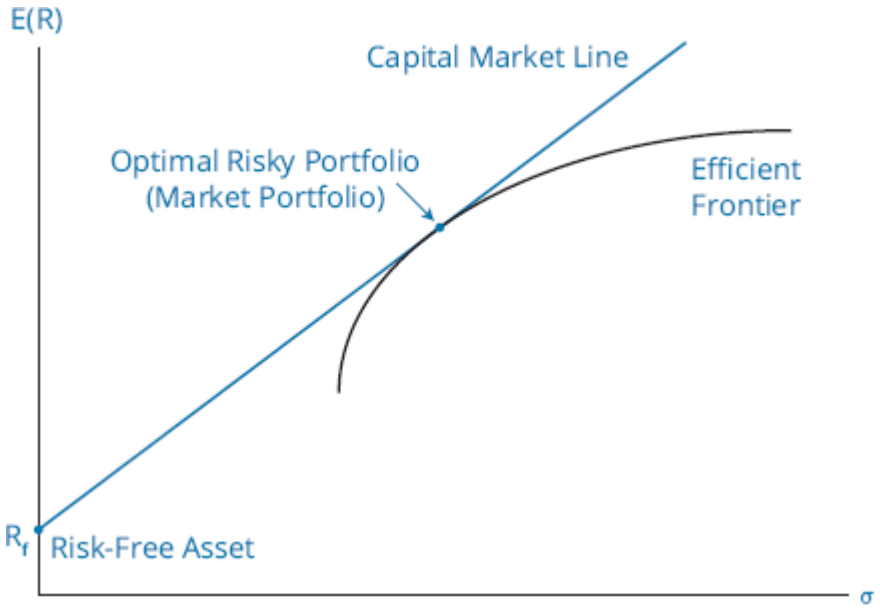


If each investor has different expectations about the expected returns of, standard deviations of, or correlations between risky asset returns, each investor will have a different optimal risky asset portfolio and a different CAL.

A simplifying assumption underlying modern portfolio theory (and the capital asset pricing model, which is introduced later in this reading) is that investors have homogeneous expectations (i.e., they all have the same estimates of risk, return, and correlations with other risky assets for all risky assets). Under this assumption, all investors face the same efficient frontier of risky portfolios and will all have the same optimal risky portfolio and CAL.

Figure 63.3 illustrates the determination of the optimal risky portfolio and optimal CAL for all investors under the assumption of homogeneous expectations. Note that, under this assumption, the optimal CAL for any investor is the one that is just tangent to the efficient frontier. Depending on their preferences for risk and return (their indifference curves), investors may choose different portfolio weights for the risk-free asset and the risky (tangency) portfolio. Every investor, however, will use the same risky portfolio. When this is the case, that portfolio must be the **market portfolio** of all risky assets because all investors that hold any risky assets hold the same portfolio of risky assets.

Figure 63.3: Determining the Optimal Risky Portfolio and Optimal CAL Assuming Homogeneous Expectations




Under the assumption of homogeneous expectations, this optimal CAL for all investors is termed the **capital market line (CML)**. Along this line, expected portfolio return, $E(R_P)$, is a linear function of portfolio risk, $\sigma_P$ . The equation of this line is as follows:

$$E(R_P) = R_f + \left(\frac{E(R_M) - R_f}{\sigma_M}\right)\sigma_P$$

The *y*-intercept of this line is $R_f$ and the slope (rise over run) of this line is as follows:

$$\left(\frac{E(R_M) - R_f}{\sigma_M}\right)$$

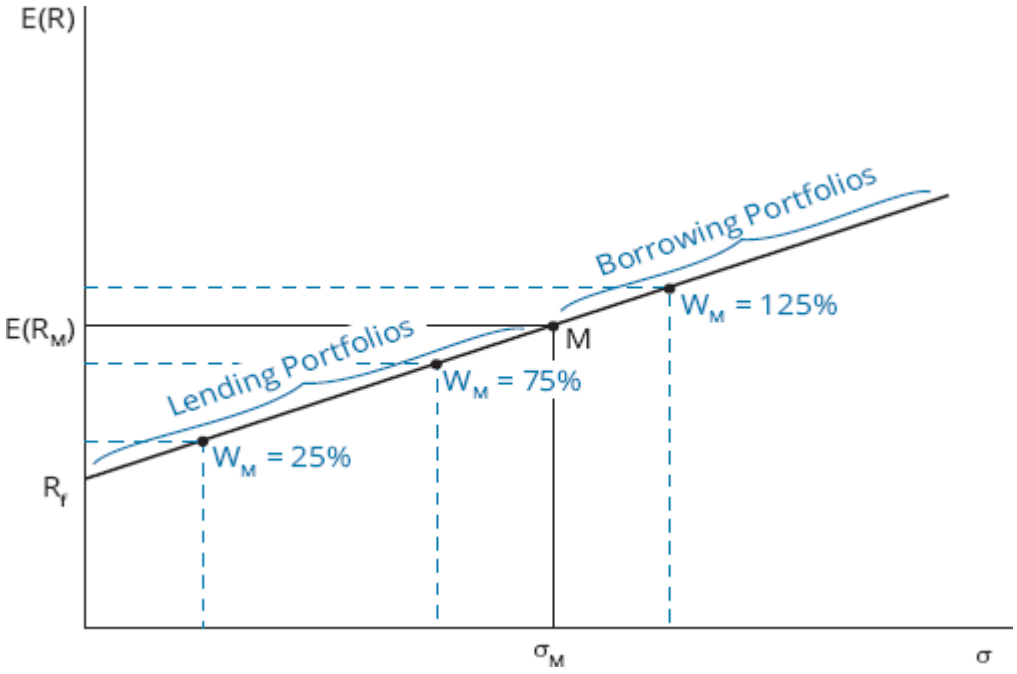
The intuition of this relation is straightforward. An investor who chooses to take on no risk ($\sigma_P = 0$) will earn the risk-free rate, $R_f$. The difference between the expected return on the market and the risk-free rate is termed the **market risk premium**. If we rewrite the CML equation as

$$E(R_P) = R_f + \left(E(R_M) - R_f\right)\left(\frac{\sigma_P}{\sigma_M}\right)$$

we can see that an investor can expect to get one unit of market risk premium in additional return (above the risk-free rate) for every unit of market risk, $\sigma_M$, that the investor is willing to accept.

If we assume that investors can both lend (invest in the risk-free asset) at the risk-free rate and borrow (as with a margin account) at the risk-free rate, they can select portfolios to the right of the market portfolio, as illustrated in Figure 63.4.

Figure 63.4: Borrowing and Lending Portfolios




Investors who believe market prices are informationally efficient often follow a **passive investment strategy** (i.e., invest in an index of risky assets that serves as a proxy for the market portfolio and allocate a portion of their investable assets to a risk-free asset, such as short-term government securities). In practice, many investors and portfolio managers believe their estimates of security values are correct and market prices are incorrect. Such investors will not use the weights of the market portfolio but will invest more than the market weights in securities that they believe are undervalued and less than the market weights in securities which they believe are overvalued. This is referred to as **active portfolio management** to differentiate it from a passive investment strategy that utilizes a market index for the optimal risky asset portfolio.

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**LOS 63.c: Explain systematic and nonsystematic risk, including why an investor should not expect to receive additional return for bearing nonsystematic risk.**

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When an investor diversifies across assets that are not perfectly correlated, the portfolio's risk is less than the weighted average of the risks of the individual securities in the portfolio. The risk that is eliminated by diversification is called **unsystematic risk** (also called *unique, diversifiable,* or *firm-specific risk*). Because the market portfolio contains *all* risky assets, it must be a well-diversified portfolio. All the risk that can be diversified away has been. The risk that remains cannot be diversified away and is called the **systematic risk** (also called *nondiversifiable risk* or *market risk*).

The concept of systematic risk applies to individual securities as well as to portfolios. Some securities' returns are highly correlated with overall market returns. Examples of firms that are highly correlated with market returns are luxury goods manufacturers such as Ferrari automobiles and Harley Davidson motorcycles. These firms have high systematic risk (i.e., they are very responsive to market, or systematic, changes). Other firms, such as utility companies, respond very little to changes in the systematic risk factors. These firms have very little systematic risk. Hence, total risk (as measured by standard deviation) can be broken down into its component parts: unsystematic risk and systematic risk. Mathematically:

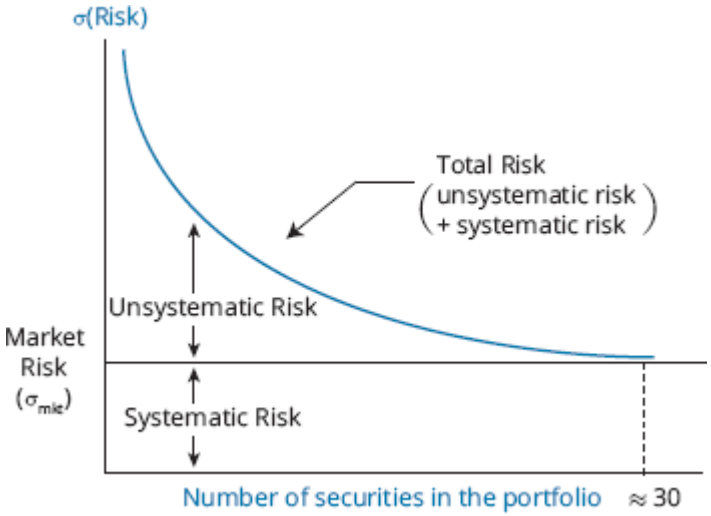
total risk = systematic risk + unsystematic risk

PROFESSOR'S NOTE

Know this concept!

Do you actually have to buy all the securities in the market to diversify away unsystematic risk? No. Academic studies have shown that as you increase the number of stocks in a portfolio, the portfolio's risk falls toward the level of market risk. One study showed that it only took about 12 to 18 stocks in a portfolio to achieve 90% of the maximum diversification possible. Another study indicated it took 30 securities. Whatever the number, it is significantly less than *all* the securities. Figure 63.5 provides a general representation of this concept. Note, in the figure, that once you get to 30 or so securities in a portfolio, the standard deviation remains constant. The remaining risk is systematic, or nondiversifiable, risk. We will develop this concept later when we discuss beta, a measure of systematic risk.

Figure 63.5: Risk vs. Number of Portfolio Assets



## Systematic Risk Is Relevant in Portfolios

One important conclusion of capital market theory is that equilibrium security returns depend on a stock's or a portfolio's systematic risk, not its total risk as measured by standard deviation. One of the assumptions of the model is that diversification is free. The reasoning is that investors will not be compensated for bearing risk that can be eliminated at no cost. If you think about the costs of a no-load index fund compared to buying individual stocks, diversification is actually very low cost if not actually free.

The implications of this conclusion are very important to asset pricing (expected returns). The riskiest stock, with risk measured as standard deviation of returns, does not necessarily have the greatest expected return. Consider a biotech stock with one new drug product that is in clinical trials to determine its effectiveness. If it turns out that the drug is effective and safe, stock returns will be quite high. If, on the other hand, the subjects in the clinical trials are killed or otherwise harmed by the drug, the stock will fall to approximately zero and returns will be quite poor. This describes a stock with high standard deviation of returns (i.e., high total risk).

The high risk of our biotech stock, however, is primarily from firm-specific factors, so its unsystematic risk is high. Because market factors such as economic growth rates have little to do with the eventual outcome for this stock, systematic risk is a small proportion of the total risk of the stock. Capital market theory says that the equilibrium return on this stock may be less than that of a stock with much less firm-specific risk but more sensitivity to the factors that drive the return of the overall market. An established manufacturer of machine tools may not be a very risky investment in terms of total risk, but may have a greater sensitivity to market (systematic) risk factors (e.g., GDP growth rates) than our biotech stock. Given this scenario, the stock with more total risk (the biotech stock) has less systematic risk and will therefore have a lower equilibrium rate of return according to capital market theory.

Note that holding many biotech firms in a portfolio will diversify away the firm-specific risk. Some will have blockbuster products and some will fail, but you can imagine that when 50 or 100 such stocks are combined into a portfolio, the uncertainty about the portfolio return is much less than the uncertainty about the return of a single biotech firm stock.

To sum up, unsystematic risk is not compensated in equilibrium because it can be eliminated for free through diversification. Systematic risk is measured by the contribution of a security to the risk of a well-diversified portfolio, and the expected equilibrium return (required return) on an individual security will depend only on its systematic risk.

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**LOS 63.d: Explain return generating models (including the market model) and their uses.**

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**Return generating models** are used to estimate the expected returns on risky securities based on specific factors. For each security, we must estimate the sensitivity of its returns to each specific factor. Factors that explain security returns can be classified as macroeconomic, fundamental, and statistical factors. **Multifactor models** most commonly use macroeconomic factors such as GDP growth, inflation, or consumer confidence, along with fundamental factors such as earnings, earnings growth, firm size, and research expenditures. Statistical factors often have no basis in finance theory and are suspect in that they may represent only relations for a

specific time period which have been identified by data mining (repeated tests on a single dataset).

The general form of a multifactor model with *k* factors is as follows:

$$E(R_i) - R_f = \beta_{i1} \times E(\text{Factor 1}) + \beta_{i2} \times E(\text{Factor 2}) + \ldots + \beta_{ik} \times E(\text{Factor k})$$



This model states that the expected excess return (above the risk-free rate) for Asset *i* is the sum of each **factor sensitivity** or **factor loading** (the βs) for Asset *i* multiplied by the expected value of that factor for the period. The first factor is often the expected excess return on the market, $E(R_m - R_f)$.

One multifactor model that is often used is that of Fama and French. They estimated the sensitivity of security returns to three factors: firm size, firm book value to market value ratio, and the return on the market portfolio minus the risk-free rate (excess return on the market portfolio). Carhart suggests a fourth factor that measures price momentum using prior period returns. Together, these four factors do a relatively good job of explaining returns differences for U.S. equity securities over the period for which the model has been estimated.

The simplest factor model is a single-factor model. A single-factor model with the return on the market, $R_m$, as its only risk factor can be written (in excess returns form) as:

$$E(R_i) - R_f = \beta_i \times [E(R_m) - R_f]$$

Here, the expected excess return (return above the risk-free rate) is the product of the factor weight or factor sensitivity, Beta i, and the risk factor, which in this model is the excess return on the market portfolio or market index, so that this is also sometimes called a **single-index model**.

A simplified form of a single-index model is the **market model**, which is used to estimate a security's (or portfolio's) beta and to estimate a security's abnormal return (return above its expected return) based on the actual market return.

The form of the market model is as follows:

$$R_i = \alpha_i + \beta_i R_m + e_i$$

where:
$R_i$ = return on Asset *i*
$R_m$ = market return
$\beta_i$ = slope coefficient
$\alpha_i$ = intercept
$e_i$ = abnormal return on Asset *i*

The intercept $\alpha_i$ and slope coefficient $\beta_i$ are estimated from historical return data. We can require that $\alpha_i$ is the risk-free rate times $(1 - \beta_i)$ to be consistent with the general form of a single-index model in excess returns form.

The expected return on Asset *i* is $\alpha_i + \beta_i E(R_m)$. A deviation from the expected return in a given period is the abnormal return on Asset i, $e_i$, or $R_i - (\alpha_i + \beta_i R_m)$.

In the market model, the factor sensitivity or beta for Asset *i* is a measure of how sensitive the return on Asset *i* is to the return on the overall market portfolio (market index).

## LOS 63.e: Calculate and interpret beta.

The sensitivity of an asset's return to the return on the market index in the context of the market model is referred to as its **beta**. Beta is a standardized measure of the covariance of the asset's return with the market return. Beta can be calculated as follows:

$$\beta_i = \frac{\text{covariance of Asset } i\text{'s return with the market return}}{\text{variance of the market return}} = \frac{\text{Cov}_{im}}{\sigma_m^2}$$

We can use the definition of the correlation between the returns on Asset *i* with the returns on the market index:

$$\rho_{im} = \frac{\text{Cov}_{im}}{\sigma_i \sigma_m}$$

$$\text{to get } \text{Cov}_{im} = \rho_{im} \sigma_i \sigma_m$$

Substituting for $\text{Cov}_{im}$ in the equation for $B_i$, we can also calculate beta as:

$$\beta_i = \frac{\rho_{im} \sigma_i \sigma_m}{\sigma_m^2} = \rho_{im}\left(\frac{\sigma_i}{\sigma_m}\right)$$

EXAMPLE: **Calculating an asset's beta**

The standard deviation of the return on the market index is estimated as 20%.

1. If Asset A's standard deviation is 30% and its correlation of returns with the market index is 0.8, what is Asset A's beta?

   Using the formula $\beta_i = \rho_{im}\left(\frac{\sigma_i}{\sigma_m}\right)$, we have: $\beta_i = 0.80\left(\frac{0.30}{0.20}\right) = 1.2.$

2. If the covariance of Asset A's returns with the returns on the market index is 0.048, what is the beta of Asset A?

   Using the formula $\beta_i = \frac{\text{Cov}_{im}}{\sigma_m^2}$, we have $\beta_i = \frac{0.048}{0.2^2} = 1.2.$

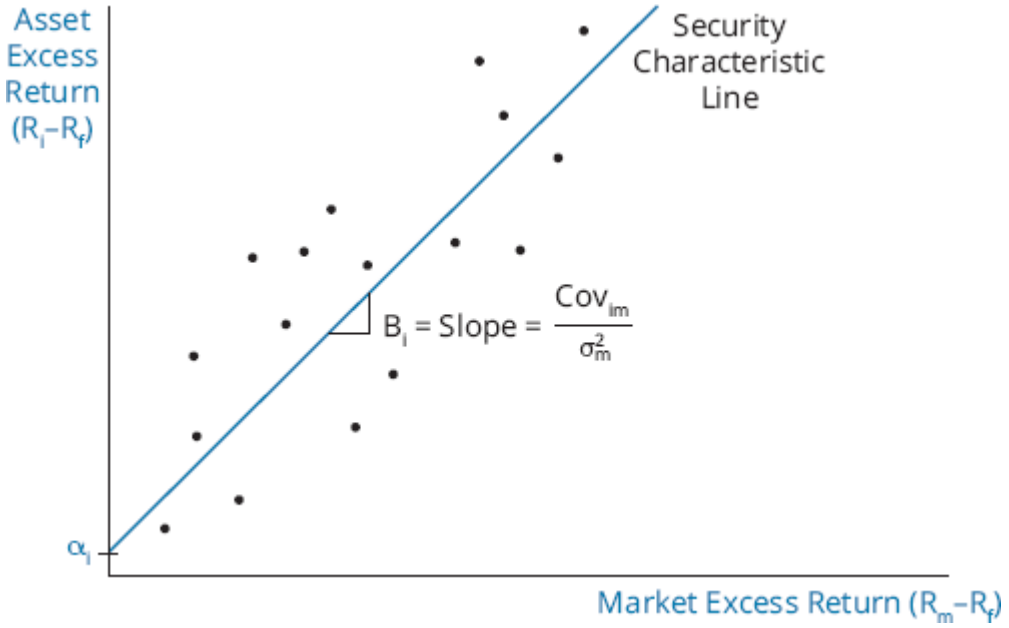
PROFESSOR'S NOTE

Candidates should be prepared to calculate beta in either of the two ways in the example.

In practice, we estimate asset betas by regressing returns on the asset on those of the market index. While regression is a Level II concept, for our purposes, you can think of it as a mathematical estimation procedure that fits a line to a data plot. In Figure 63.5, we represent the excess returns on Asset *i* as the dependent variable and the excess returns on the market index as the independent variable. The *least squares regression line* is the line that minimizes the

sum of the squared distances of the points plotted from the line (this is what is meant by the line of *best fit*). The slope of this line is our estimate of beta. In Figure 63.6, the line is steeper than 45 degrees, the slope is greater than one, and the asset's estimated beta is greater than one. Our interpretation is that the returns on Asset *i* are more variable in response to systematic risk factors than is the overall market, which has a beta of one.

Figure 63.6: Regression of Asset Excess Returns Against Market Asset Returns




This regression line is referred to as the asset's **security characteristic line**. Mathematically, the slope of the security characteristic line is $\frac{Cov_{im}}{\sigma_m^2}$, which is the same formula we used earlier to calculate beta.

MODULE QUIZ 63.1

1. An investor put 60% of his portfolio into a risky asset offering a 10% return with a standard deviation of returns of 8% and put the balance of his portfolio in a risk-free asset offering 5%. What is the expected return and standard deviation of his portfolio?

| | Expected return | Standard deviation |
|---|---|---|
| A. | 6.0% | 6.8% |
| B. | 8.0% | 4.8% |
| C. | 10.0% | 6.6% |

2. What is the risk measure associated with the capital market line (CML)?
   A. Beta risk.
   B. Unsystematic risk.
   C. Total risk.
3. A portfolio to the right of the market portfolio on the CML is:
   A. a lending portfolio.
   B. a borrowing portfolio.
   C. an inefficient portfolio.
4. As the number of stocks in a portfolio increases, the portfolio's systematic risk:
   A. can increase or decrease.

B. decreases at a decreasing rate.
C. decreases at an increasing rate.

5. Total risk equals:
   A. unique plus diversifiable risk.
   B. market plus nondiversifiable risk.
   C. systematic plus unsystematic risk.
6. A return generating model is *least likely* to be based on a security's exposure to:
   A. statistical factors.
   B. macroeconomic factors.
   C. fundamental factors.
7. The covariance of the market's returns with a stock's returns is 0.005 and the standard deviation of the market's returns is 0.05. What is the stock's beta?
   A. 1.0.
   B. 1.5.
   C. 2.0.

# MODULE 63.2: THE CAPM AND THE SML

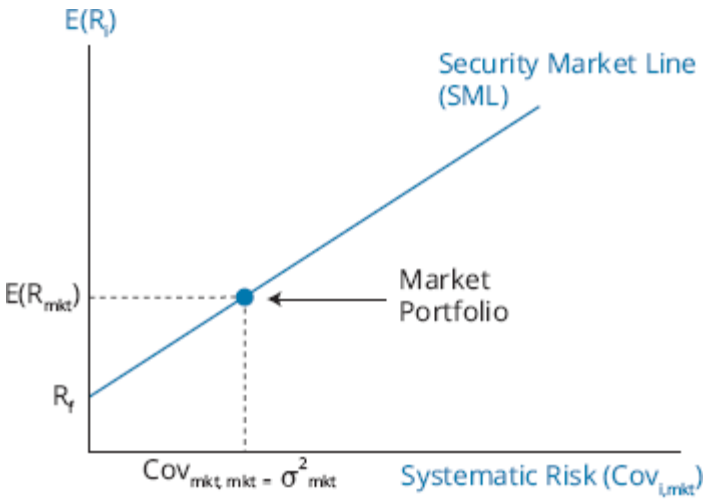
**LOS 63.f: Explain the capital asset pricing model (CAPM), including its assumptions, and the security market line (SML).**

**LOS 63.g: Calculate and interpret the expected return of an asset using the CAPM.**

Video covering this content is available online.

Given that the only relevant (priced) risk for an individual Asset *i* is measured by the covariance between the asset's returns and the returns on the market, $Cov_{i,mkt}$, we can plot the relationship between risk and return for individual assets using $Cov_{i,mkt}$ as our measure of systematic risk. The resulting line, plotted in Figure 63.7, is one version of what is referred to as the **security market line (SML).**

Figure 63.7: Security Market Line




The equation of the SML is:

$$E(R_i) = R_f + \frac{E(R_{mkt}) - R_f}{\sigma^2_{mkt}}(Cov_{i,mkt})$$

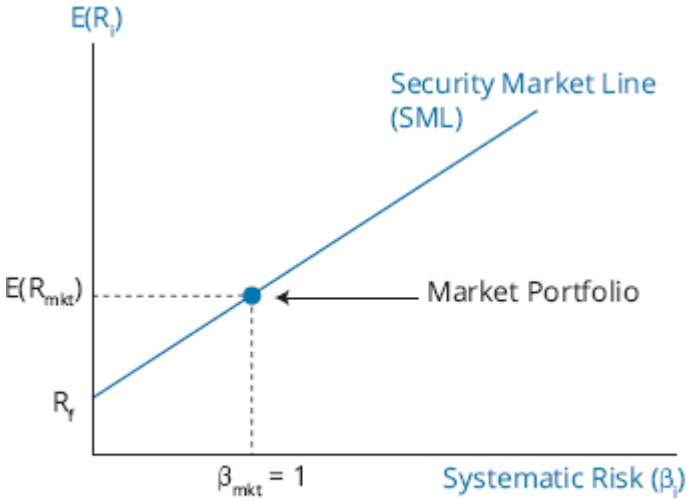
which can be rearranged and stated as:

$$E(R_i) = R_f + \frac{Cov_{i,mkt}}{\sigma^2_{mkt}}[E(R_{mkt}) - R_f]$$

The line described by this last equation is presented in Figure 63.8, where we let the standardized covariance term, $\frac{Cov_{i,mkt}}{\sigma^2_{mkt}}$, be defined as beta, $\beta_i$.

This is the most common means of describing the SML, and this relation between beta (systematic risk) and expected return is known as the **capital asset pricing model** (CAPM).

Figure 63.8: The Capital Asset Pricing Model






So, we can define beta, $\beta = \frac{Cov_{i,mkt}}{\sigma^2_{mkt}}$, as a standardized measure of systematic risk.

Beta measures the relation between a security's excess returns and the excess returns to the market portfolio.

Formally, the CAPM is stated as:

$$E(R_i) = R_f + \beta_i[E(R_{mkt}) - R_f]$$

The CAPM holds that, in equilibrium, the expected return on risky asset $E(R_i)$ is the risk-free rate ($R_f$) plus a beta-adjusted market risk premium, $\beta_i[E(R_{mkt}) - R_f]$. Beta measures systematic (market or covariance) risk.

EXAMPLE: **Capital asset pricing model**

The expected return on the market is 8%, the risk-free rate is 2%, and the beta for Stock A is 1.2. Compute the rate of return that would be expected (required) on this stock.

**Answer:**

$E(R_A) = 2\% + 1.2(8\% - 2\%) = 9.2\%$

Note: $\beta_A > 1$, so $E(R_A) > E(R_{mkt})$

The **assumptions of the CAPM** are:

- *Risk aversion*. To accept a greater degree of risk, investors require a higher expected return.
- *Utility maximizing investors*. Investors choose the portfolio, based on their individual preferences, with the risk and return combination that maximizes their (expected) utility.
- *Frictionless markets*. There are no taxes, transaction costs, or other impediments to trading.
- *One-period horizon*. All investors have the same one-period time horizon.
- *Homogeneous expectations*. All investors have the same expectations for assets' expected returns, standard deviation of returns, and returns correlations between assets.
- *Divisible assets*. All investments are infinitely divisible.
- *Competitive markets*. Investors take the market price as given and no investor can influence prices with their trades.

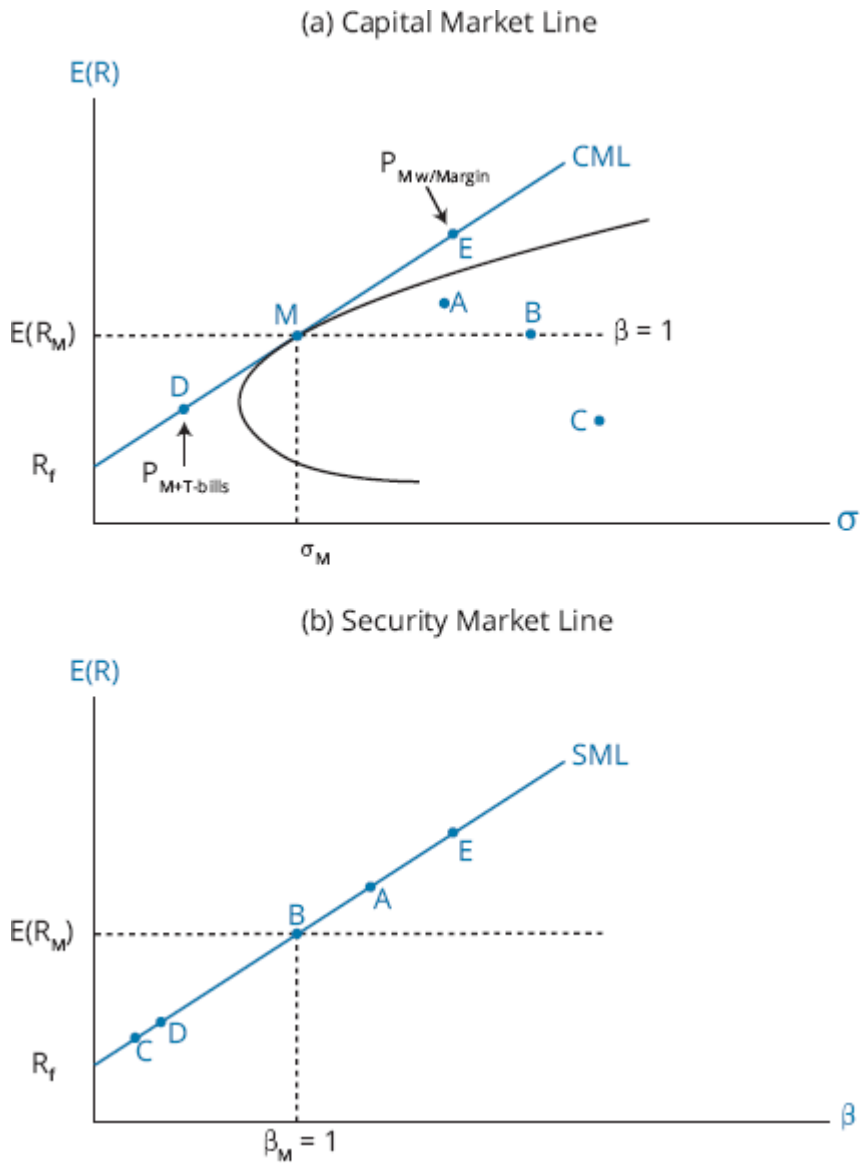
## Comparing the CML and the SML

It is important to recognize that the CML and SML are very different. Recall the equation of the CML:

$$E(R_p) = R_f + \sigma_p \left\{ \frac{[E(R_M) - R_f]}{\sigma_M} \right\}$$

The CML uses total risk = $\sigma_p$ on the x-axis. Hence, only efficient portfolios will plot on the CML. On the other hand, the SML uses beta (systematic risk) on the x-axis. So in a CAPM world, *all properly priced securities and portfolios of securities will plot on the SML*, as shown in Figure 63.9.

Figure 63.9: Comparing the CML and the SML




Portfolios that are not well diversified (efficient) plot inside the efficient frontier and are represented by risk-return combinations such as points A, B, and C in panel (a) of Figure 63.9. Individual securities are one example of such inefficient portfolios. According to the CAPM, the expected returns on all portfolios, well diversified or not, are determined by their systematic risk. Thus, according to the CAPM, Point A represents a high-beta stock or portfolio, Point B a stock or portfolio with a beta of one, and Point C a low-beta stock or portfolio. We know this because the expected return at Point B is equal to the expected return on the market, and the expected returns at Point A and C are greater and less than the expected return on the market (tangency) portfolio, respectively.

Note that a low-beta stock, such as represented by Point C, is not necessarily low-risk when total risk is considered. While its contribution to the risk of a well-diversified portfolio may be low, its risk when held by itself can be considered quite high. A firm whose only activity is developing a new, but as yet unproven, drug may be quite speculative with highly uncertain returns. It may also have quite low systematic risk if the uncertainty about its future returns depends primarily on firm-specific factors.

All stocks and portfolios that plot along the line labeled β = 1 in Figure 63.9 have the same expected return as the market portfolio and, thus, according to the CAPM, have the same systematic risk as the market portfolio (i.e., they all have betas of one).

All points on the CML (except the tangency point) represent the risk-return characteristics of portfolios formed by either combining the market portfolio with the risk-free asset or borrowing at the risk-free rate in order to invest more than 100% of the portfolio's net value in the risky market portfolio (investing on margin). Point D in Figure 63.9 represents a portfolio that combines the market portfolio with the risk-free asset, while points above the point of tangency, such as Point E, represent portfolios created by borrowing at the risk-free rate to invest in the market portfolio. Portfolios that do not lie on the CML are not efficient and therefore have risk that will not be rewarded with higher expected returns in equilibrium.

According to the CAPM, all securities and portfolios, diversified or not, will plot on the SML in equilibrium. In fact, all stocks and portfolios along the line labeled β = 1 in Figure 63.9, including the market portfolio, will plot at the same point on the SML. They will plot at the point on the SML with beta equal to one and expected return equal to the expected return on the market, regardless of their total risk.

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## LOS 63.h: Describe and demonstrate applications of the CAPM and the SML.

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We have used beta to estimate a security's expected return based on our estimate of the risk-free rate and the expected return on the market. In equilibrium, a security's expected return and its required return (by investors) are equal. Therefore, we can use the CAPM to estimate a security's required return.

Because the SML shows the equilibrium (required) return for any security or portfolio based on its beta (systematic risk), analysts often compare their forecast of a security's return to its required return based on its beta risk. The following example illustrates this technique.

EXAMPLE: **Identifying mispriced securities**

The following figure contains information based on analyst's forecasts for three stocks. Assume a risk-free rate of 7% and a market return of 15%. Compute the expected and required return on each stock, determine whether each stock is undervalued, overvalued, or properly valued, and outline an appropriate trading strategy.

**Forecast Data**

| Stock | Price Today | E(Price) in 1 Year | E(Dividend) in 1 Year | Beta |
|---|---|---|---|---|
| A | $25 | $27 | $1.00 | 1.0 |
| B | 40 | 45 | 2.00 | 0.8 |
| C | 15 | 17 | 0.50 | 1.2 |

**Answer:**

Expected and required returns computations are shown in the following figure.

**Forecasts vs. Required Returns**

| Stock | Forecast Return | Required Return |
|---|---|---|
| A | ($27 – $25 + $1) / $25 = 12.0% | 0.07 + (1.0)(0.15 – 0.07) = 15.0% |
| B | ($45 – $40 + $2) / $40 = 17.5% | 0.07 + (0.8)(0.15 – 0.07) = 13.4% |
| C | ($17 – $15 + $0.5) / $15 = 16.6% | 0.07 + (1.2)(0.15 – 0.07) = 16.6% |

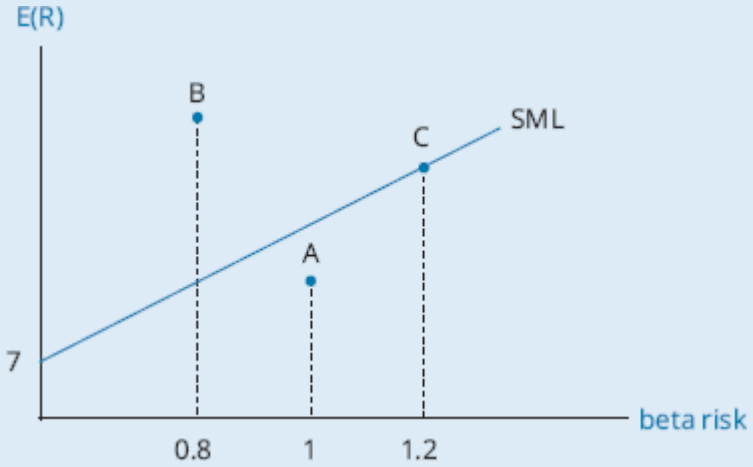
- Stock A is *overvalued*. It is expected to earn 12%, but based on its systematic risk, it should earn 15%. It plots *below* the SML.
- Stock B is *undervalued*. It is expected to earn 17.5%, but based on its systematic risk, it should earn 13.4%. It plots *above* the SML.
- Stock C is *properly valued*. It is expected to earn 16.6%, and based on its systematic risk, it should earn 16.6%. It plots *on* the SML.

The appropriate trading strategy is:

- Short sell Stock A.
- Buy Stock B.
- Buy, sell, or ignore Stock C.

We can do this same analysis graphically. The expected return/beta combinations of all three stocks are graphed in the following figure relative to the SML.

**Identifying Mispriced Securities**




PROFESSOR'S NOTE

If the estimated return plots "over" the SML, the security is "under" valued. If the estimated return plots "under" the SML, the security is "over" valued.

Remember, all stocks should plot on the SML; any stock not plotting on the SML is mispriced. Notice that Stock A falls below the SML, Stock B lies above the SML, and Stock C is on the SML. If you plot a stock's expected return and it falls below the SML, the stock is overpriced. That is, the stock's expected return is too low given its systematic risk. If a stock plots above the SML, it is underpriced and is offering an expected return greater than required for its systematic risk. If it plots on the SML, the stock is properly priced.

Because the equation of the SML is the capital asset pricing model, you can determine if a stock is over- or underpriced graphically or mathematically. Your answers will always be the same.

## LOS 63.i: Calculate and interpret the Sharpe ratio, Treynor ratio, $M^2$, and Jensen's alpha.

**Performance evaluation** of an active manager's portfolio choices refers to the analysis of the risk and return of the portfolio. **Attribution analysis**, an analysis of the sources of returns differences between active portfolio returns and those of a passive benchmark portfolio, is part of performance evaluation. Success in active portfolio management cannot be determined simply by comparing portfolio returns to benchmark portfolio returns; the risk taken to achieve returns must also be considered. A portfolio with greater risk than the benchmark portfolio (especially beta risk) is expected to produce higher returns over time than the benchmark portfolio.

When evaluating the performance of a portfolio with risk that differs from that of a benchmark portfolio, we need to adjust the active portfolio return's risk. Of the alternative ways to consider both risk and return in evaluating portfolio performance, the most commonly used is the **Sharpe ratio**. The Sharpe ratio of a portfolio is its excess returns per unit of total portfolio risk. Higher Sharpe ratios indicate better risk-adjusted portfolio performance.

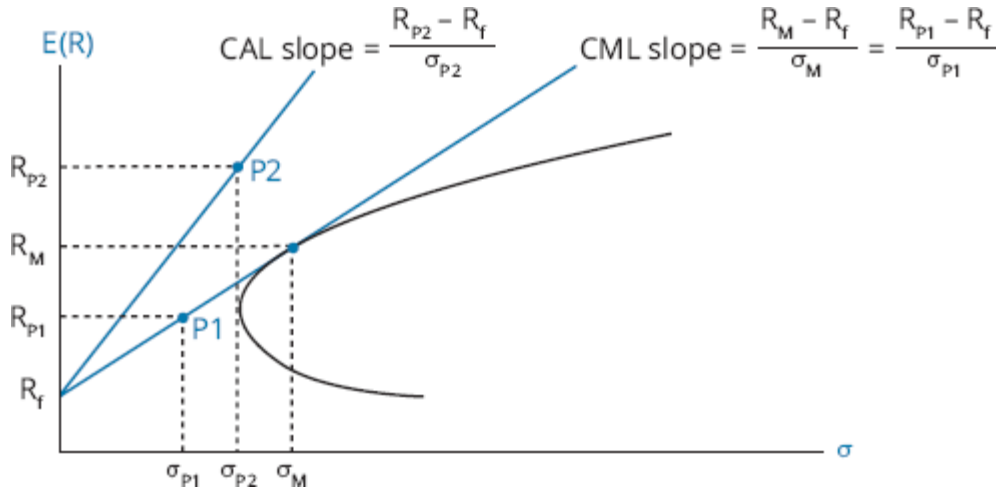
$$\text{Sharpe ratio} = \frac{E[R_{portfolio}] - R_f}{\sigma_{portfolio}}$$

We have shown the Sharpe ratio as an ex ante (before the fact) measure, using the expected values of portfolio returns and standard deviation. However, it can also be used as an ex post (after the fact) measure of portfolio performance, using mean returns and sample standard deviation over a period.

The Sharpe ratio is based on total risk (standard deviation of returns), rather than systematic risk (beta). For this reason, the Sharpe ratio can be used to evaluate the performance of concentrated portfolios (those affected by unsystematic risk) as well as well-diversified portfolios (those with only systematic, or beta, risk). Note that the value of the Sharpe ratio is only useful for comparison with the Sharpe ratio of another portfolio.

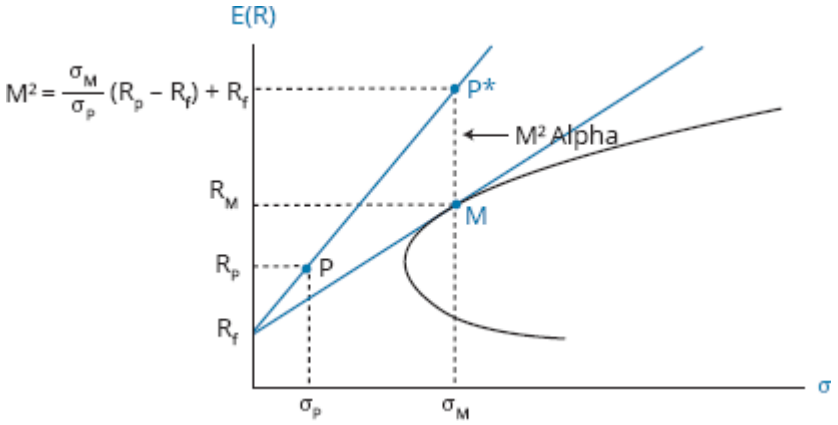
In Figure 63.10, we illustrate that the Sharpe ratio of a portfolio is the slope of the CAL for that portfolio and can be compared to the slope of the CML, which is the Sharpe ratio for portfolios that lie on the CML.

Figure 63.10: Sharpe Ratios as Slopes



For a portfolio of risky assets, **M-squared ($M^2$)**\index{M-squared (M2)} is an alternative to the Sharpe ratio as a risk-adjusted rate of return, expressed as a percentage rather than as a slope. Given a Portfolio P, we can calculate the return on a Portfolio P* that is leveraged (when $\sigma_M > \sigma_P$), or deleveraged (when $\sigma_M < \sigma_P$), so that P* has the same risk (standard deviation of returns) as the market portfolio. The return on P* is $R_f + \frac{\sigma_M}{\sigma_P}(R_P - R_f)$ and we refer to that as the M2 measure for Portfolio P. We illustrate the return on the leveraged Portfolio P*, given the standard deviation and return on Portfolio P, in Figure 63.11. The extra return on the Portfolio P* above the return on the market portfolio, ($P^* - R_M$), is referred to as **$M^2$ alpha**\index{M2 alpha}. Note that in Figure 63.11, P* is created by borrowing at $R_f$ and investing the proceeds in Portfolio P, in an amount so that the standard deviation of P* = $\sigma_M$.

Figure 63.11: M-Squared for a Portfolio




The M2 measure produces the same risk-adjusted portfolio rankings as the Sharpe ratio, but is stated in percentage terms. Note that M2 can be derived from the Sharpe ratio (SR) for Portfolio P, SR = $(R_P - R_f)/\sigma_P$, as SR ($\sigma_M$) + $R_f$, so that if the Sharpe ratio of Portfolio P is greater than the slope of the CML, M2 > $R_m$ and M2 alpha > 0.

As an example, consider a Portfolio P with return of 10% and standard deviation of returns of 20%, when $R_f$ = 5%, $R_M$ = 11% and $\sigma_M$ = 30%. The Sharpe ratio of Portfolio P = (10 – 5)/20 = 0.25, and M2 = 0.25(0.30) + 0.05 = 12.5%. Comparing that to $R_M$ = 11%, we can see that M2 alpha is 1.5%.

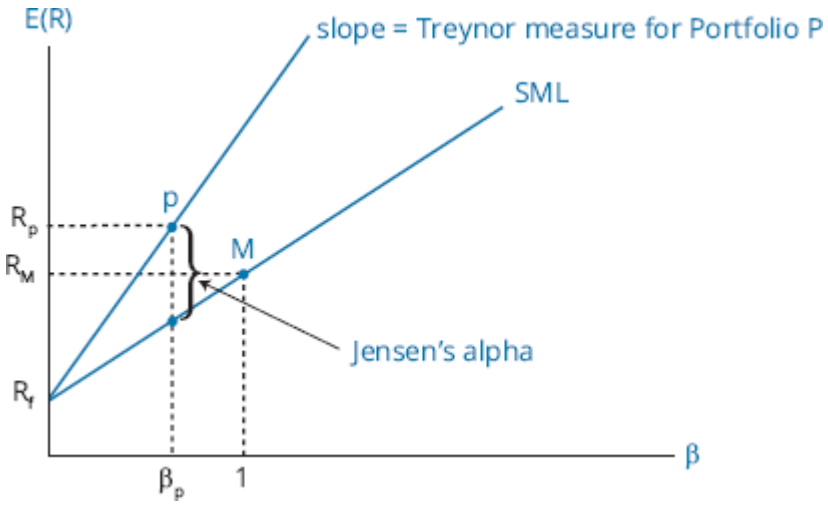
Two measures of portfolio performance based on systematic (beta) risk rather than total risk are the **Treynor measure** and **Jensen's alpha**. They are analogous to the Sharpe ratio and $M^2$ in that the Treynor measure is a measure of slope and Jensen's alpha is a measure of percentage returns in excess of those from a portfolio that has the same risk (beta) but lies on the SML.

The Treynor measure is calculated as $\frac{R_P - R_f}{\beta_P}$, interpreted as excess returns per unit of systematic risk, and represented by the slope of a line as illustrated in Figure 63.12. Jensen's alpha for Portfolio P is calculated as

$$\alpha_P = R_p - [R_f + \beta_P(R_M - R_f)]$$

and is the percentage portfolio return above that of a portfolio (or security) with the same beta as the portfolio that lies on the SML, as illustrated in Figure 63.12.

Figure 63.12: Treynor Measure and Jensen's Alpha




Whether risk adjustment should be based on standard deviation of returns or portfolio beta depends on whether a manager's portfolio bears unsystematic risk. If a single manager is used, then the total risk (including any nonsystematic risk) is the relevant measure and risk adjustment using total risk, as with the Sharpe and $M^2$ measures, is appropriate. If a fund uses multiple managers so that the overall fund portfolio is well diversified (has no unsystematic risk), then performance measures based on systematic (beta) risk, such as the Treynor measure and Jensen's alpha, are appropriate.

These measures of risk-adjusted returns are often used to compare the performance of actively managed funds to passively managed funds. Note in Figure 63.10 and Figure 63.11 that portfolios that lie above the CML have Sharpe ratios greater than those of any portfolios along the CML and have positive $M^2$ measures. Similarly, in Figure 63.12, we can see that portfolios that lie above the SML have Treynor measures greater than those of any security or portfolio that lies along the SML and also have positive values for Jensen's alpha.

One final note of caution is that estimating the values needed to apply these theoretical models and performance measures is often difficult and is done with error. The expected return on the market, and thus the market risk premium, may not be equal to its average historical value. Estimating security and portfolio betas is done with error as well.

MODULE QUIZ 63.2

1. Which of the following statements about the SML and the CML is *least accurate*?
   A. Securities that plot above the SML are undervalued.
   B. Investors expect to be compensated for systematic risk.
   C. Securities that plot on the SML have no value to investors.
2. According to the CAPM, what is the expected rate of return for a stock with a beta of 1.2, when the risk-free rate is 6% and the market rate of return is 12%?
   A. 7.2%.
   B. 12.0%.
   C. 13.2%.

3. According to the CAPM, what is the required rate of return for a stock with a beta of 0.7, when the risk-free rate is 7% and the expected market rate of return is 14%?
   A. 11.9%.
   B. 14.0%.
   C. 16.8%.
4. The risk-free rate is 6%, and the expected market return is 15%. A stock with a beta of 1.2 is selling for $25 and will pay a $1 dividend at the end of the year. If the stock is priced at $30 at year-end, it is:
   A. overpriced, so short it.
   B. underpriced, so buy it.
   C. underpriced, so short it.
5. A stock with a beta of 0.7 currently priced at $50 is expected to increase in price to $55 by year-end and pay a $1 dividend. The expected market return is 15%, and the risk-free rate is 8%. The stock is:
   A. overpriced, so do not buy it.
   B. underpriced, so buy it.
   C. properly priced, so buy it.
6. Which of these return metrics is defined as excess return per unit of systematic risk?
   A. Sharpe ratio.
   B. Jensen's alpha.
   C. Treynor measure.

## KEY CONCEPTS

### LOS 63.a

The availability of a risk-free asset allows investors to build portfolios with superior risk-return properties. By combining a risk-free asset with a portfolio of risky assets, the overall risk and return can be adjusted to appeal to investors with various degrees of risk aversion.

### LOS 63.b

On a graph of return versus risk, the various combinations of a risky asset and the risk-free asset form the capital allocation line (CAL). In the specific case where the risky asset is the market portfolio, the combinations of the risky asset and the risk-free asset form the capital market line (CML).

### LOS 63.c

Systematic (market) risk is due to factors, such as GDP growth and interest rate changes, that affect the values of all risky securities. Systematic risk cannot be reduced by diversification. Unsystematic (firm-specific) risk can be reduced by portfolio diversification.

Because one of the assumptions underlying the CAPM is that portfolio diversification to eliminate unsystematic risk is costless, investors cannot increase expected equilibrium portfolio returns by taking on unsystematic risk.

### LOS 63.d

A return generating model is an equation that estimates the expected return of an investment, based on a security's exposure to one or more macroeconomic, fundamental, or statistical factors.

The simplest return generating model is the market model, which assumes the return on an asset is related to the return on the market portfolio in the following manner:

$$R_i = \alpha_i + \beta_i R_m + e_i$$

LOS 63.e

Beta can be calculated using the following equation:

$$\beta_i = \frac{[\text{Cov}(R_i, R_m)]}{\sigma_m^2} = \rho_{im}\left(\frac{\sigma_i}{\sigma_m}\right)$$

where [Cov $(R_i,R_m)$] and $\rho_{i,m}$ are the covariance and correlation between the asset and the market, and $\sigma_i$ and $\sigma_m$ are the standard deviations of asset returns and market returns.

The theoretical average beta of stocks in the market is 1. A beta of zero indicates that a security's return is uncorrelated with the returns of the market.

LOS 63.f

The capital asset pricing model (CAPM) requires several assumptions:

- Investors are risk averse, utility maximizing, and rational.
- Markets are free of frictions like costs and taxes.
- All investors plan using the same time period.
- All investors have the same expectations of security returns.
- Investments are infinitely divisible.
- Prices are unaffected by an investor's trades.

The security market line (SML) is a graphical representation of the CAPM that plots expected return versus beta for any security.

LOS 63.g

The CAPM relates expected return to the market factor (beta) using the following formula:

$$E(R_i) - R_f = \beta_i[E(R_m) - R_f]$$

LOS 63.h

The CAPM and the SML indicate what a security's equilibrium required rate of return should be based on the security's exposure to market risk. An analyst can compare his expected rate of return on a security to the required rate of return indicated by the SML to determine whether the security is overvalued, undervalued, or properly valued.

LOS 63.i

The Sharpe ratio measures excess return per unit of total risk and is useful for comparing portfolios on a risk-adjusted basis.

$$\text{Sharpe ratio} = \left(\frac{R_P - R_f}{\sigma_P}\right)$$

Given a Portfolio P, we can calculate the return on a Portfolio P* that is leveraged or deleveraged, so that P* has the same risk as the market portfolio. The return on P* is the M-squared measure for portfolio P.

$$M^2 = R_f + \frac{\sigma_M}{\sigma_P}(R_P - R_f)$$

M-squared alpha is the extra return on Portfolio P* above the market portfolio.

The Treynor measure measures a portfolio's excess return per unit of systematic risk. Jensen's alpha is the difference between a portfolio's return and the return of a portfolio on the SML that has the same beta:

$$\text{Treynor measure} = \frac{R_p - R_f}{\beta_p}$$

$$\text{Jensen's alpha} = \alpha_p = R_p - [R_f + \beta_p(R_M - R_f)]$$

## ANSWER KEY FOR MODULE QUIZZES

### Module Quiz 63.1

1. **B** Expected return: (0.60 × 0.10) + (0.40 × 0.05) = 0.08, or 8.0%
   Standard deviation: 0.60 × 0.08 = 0.048, or 4.8%
   (LOS 63.a)
2. **C** The capital market line (CML) plots return against *total risk*, which is measured by standard deviation of returns. (LOS 63.b)
3. **B** A portfolio to the right of a portfolio on the CML has more risk than the market portfolio. Investors seeking to take on more risk will *borrow* at the risk-free rate to purchase more of the market portfolio. (LOS 63.b)
4. **A** When you increase the number of stocks in a portfolio, *unsystematic risk* will decrease at a decreasing rate. However, the portfolio's *systematic risk* can be increased by adding higher-beta stocks or decreased by adding lower-beta stocks. (LOS 63.c)
5. **C** Total risk equals systematic plus unsystematic risk. Unique risk is diversifiable and is unsystematic. Market (systematic) risk is nondiversifiable risk. (LOS 63.c)
6. **A** Macroeconomic, fundamental, and statistical factor exposures can be included in a return generating model to estimate the expected return of an investment. However, statistical factors may not have any theoretical basis, so analysts prefer macroeconomic and fundamental factor models. (LOS 63.d)
7. **C** beta = covariance / market variance
   market variance = $0.05^2 = 0.0025$
   beta = 0.005 / 0.0025 = 2.0
   (LOS 63.e)

### Module Quiz 63.2

1. **C** Securities that plot on the SML are expected to earn their equilibrium rate of return and, therefore, do have value to an investor and may have diversification benefits as well. The other statements are true. (LOS 63.f)
2. **C** 6 + 1.2(12 − 6) = 13.2% (LOS 63.g)
3. **A** 7 + 0.7(14 − 7) = 11.9% (LOS 63.g)
4. **B** required rate = 6 + 1.2(15 − 6) = 16.8%
   return on stock = (30 − 25 + 1) / 25 = 24%
   Based on risk, the stock plots above the SML and is underpriced, so buy it. (LOS 63.h)
5. **A** required rate = 8 + 0.7(15 − 8) = 12.9%

return on stock = (55 − 50 + 1) / 50 = 12%

The stock falls below the SML, so it is *overpriced*. (LOS 63.h)

6. **C** The Treynor measure is excess return (return in excess of the risk-free rate) per unit of systematic risk (beta). The Sharpe ratio is excess return per unit of total risk (portfolio standard deviation). Jensen's alpha is the difference between a portfolio's actual rate of return and the equilibrium rate of return for a portfolio with the same level of beta (systematic) risk. (LOS 63.i)

# READING 64

# BASICS OF PORTFOLIO PLANNING AND CONSTRUCTION

## EXAM FOCUS

There is nothing difficult here, but the material is important because it is the foundation for the portfolio construction material at Level II and especially Level III. You should be ready to explain why investment policy statements are created and what their major components are. You should be familiar with the objectives (risk and return) and the constraints: liquidity, legal, time horizon, tax treatment, and unique circumstances. Know the difference between ability and willingness to take risk, the factors that define an asset class, and how asset allocation is used in constructing portfolios.

## MODULE 64.1: PORTFOLIO PLANNING AND CONSTRUCTION

Video covering this content is available online.

### LOS 64.a: Describe the reasons for a written investment policy statement (IPS).

An investment manager is very unlikely to produce a good result for a client without understanding that client's needs, circumstances, and constraints.

A written **investment policy statement** will typically begin with the investor's goals in terms of risk and return. These should be determined jointly, as the goals of high returns and low risk (while quite popular) are likely to be mutually exclusive in practice. Investor expectations in terms of returns must be compatible with investor's tolerance for risk (uncertainty about portfolio performance).

### LOS 64.b: Describe the major components of an IPS.

The major components of an IPS typically address the following:

- *Description of Client* circumstances, situation, and investment objectives.
- *Statement of the Purpose* of the IPS.
- *Statement of Duties and Responsibilities* of investment manager, custodian of assets, and the client.

- *Procedures* to update IPS and to respond to various possible situations.
- *Investment Objectives* derived from communications with the client.
- *Investment Constraints* that must be considered in the plan.
- *Investment Guidelines* such as how the policy will be executed, asset types permitted, and leverage to be used.
- *Evaluation of Performance*, the benchmark portfolio for evaluating investment performance, and other information on evaluation of investment results.
- *Appendices* containing information on strategic (baseline) asset allocation and permitted deviations from policy portfolio allocations, as well as how and when the portfolio allocations should be rebalanced.

In any case, the IPS will, at a minimum, contain a clear statement of client circumstances and constraints, an investment strategy based on these, and some benchmark against which to evaluate the account performance.

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## LOS 64.c: Describe risk and return objectives and how they may be developed for a client.

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The **risk objectives** in an IPS may take several forms. An **absolute risk objective** might be to "have no decrease in portfolio value during any 12-month period" or to "not decrease in value by more than 2% at any point over any 12-month period." Low absolute percentage risk objectives such as these may result in portfolios made up of securities that offer guaranteed returns (e.g., U.S. Treasury bills).

Absolute risk objectives can also be stated in terms of the probability of specific portfolio results, either percentage losses or dollar losses, rather than strict limits on portfolio results. Examples are as follows:

- "No greater than a 5% probability of returns below –5% in any 12-month period."
- "No greater than a 4% probability of a loss of more than $20,000 over any 12-month period."

An absolute return objective may be stated in nominal terms, such as "an overall return of at least 6% per annum," or in real returns, such as "a return of 3% more than the annual inflation rate each year."

**Relative risk objectives** relate to a specific benchmark and can also be strict, such as, "Returns will not be less than 12-month euro LIBOR over any 12-month period," or stated in terms of probability, such as, "No greater than a 5% probability of returns more than 4% below the return on the MSCI World Index over any 12-month period."

Return objectives can be relative to a benchmark portfolio return, such as, "Exceed the return on the S&P 500 Index by 2% per annum." For a bank, the return objective may be relative to the bank's cost of funds (deposit rate). While it is possible for an institution to use returns on peer portfolios, such as an endowment with a stated objective to be in the top quartile of endowment fund returns, peer performance benchmarks suffer from not being *investable* portfolios. There is no way to match this investment return by portfolio construction before the fact.

In any event, the account manager must make sure that the stated risk and return objectives are compatible, given the reality of expected investment results and uncertainty over time.

## LOS 64.d: Explain the difference between the willingness and the ability (capacity) to take risk in analyzing an investor's financial risk tolerance.

An investor's **ability to bear risk** depends on financial circumstances. Longer investment horizons (20 years rather than 2 years), greater assets versus liabilities (more wealth), more insurance against unexpected occurrences, and a secure job all suggest a greater ability to bear investment risk in terms of uncertainty about periodic investment performance.

An investor's **willingness to bear risk** is based primarily on the investor's attitudes and beliefs about investments (various asset types). The assessment of an investor's attitude about risk is quite subjective and is sometimes done with a short questionnaire that attempts to categorize the investor's risk aversion or risk tolerance.

When the adviser's assessments of an investor's ability and willingness to take investment risk are compatible, there is no real problem selecting an appropriate level of investment risk. If the investor's willingness to take on investment risk is high but the investor's ability to take on risk is low, the low ability to take on investment risk will prevail in the adviser's assessment.

In situations where ability is high but willingness is low, the adviser may attempt to educate the investor about investment risk and correct any misconceptions that may be contributing to the investor's low stated willingness to take on investment risk. However, the adviser's job is not to change the investor's personality characteristics that contribute to a low willingness to take on investment risk. The approach will most likely be to conform to the lower of the investor's ability or willingness to bear risk, as constructing a portfolio with a level of risk that the client is clearly uncomfortable with will not likely lead to a good outcome in the investor's view.

## LOS 64.e: Describe the investment constraints of liquidity, time horizon, tax concerns, legal and regulatory factors, and unique circumstances and their implications for the choice of portfolio assets.

PROFESSOR'S NOTE

When I was studying for the CFA exams over 20 years ago, we memorized R-R-T-T-L-L-U as a checklist for addressing the important points of portfolio construction, and it still works today. Then, as now, the important points to cover in an IPS were Risk, Return, Time horizon, Tax situation, Liquidity, Legal restrictions, and the Unique constraints of a specific investor.

**Investment constraints** include the investor's liquidity needs, time horizon, tax considerations, legal and regulatory constraints, and unique needs and preferences.

**Liquidity:** Liquidity refers to the ability to turn investment assets into spendable cash in a short period of time without having to make significant price concessions to do so. Investor needs for money to pay tuition, to pay for a parent's assisted living expenses, or to fund other possible

spending needs may all require that some liquid assets be held. As we noted in an earlier reading discussing property and casualty insurance companies, claims arrive unpredictably to some extent and therefore their portfolios must hold a significant proportion of liquid (or maturing) securities in order to be prepared to honor these claims. Illiquid investments in hedge funds and private equity funds, which typically are not traded and have restrictions on redemptions, are not suitable for an investor who may unexpectedly need access to the funds.

**Time horizon:** In general, the longer an investor's time horizon, the more risk and less liquidity the investor can accept in the portfolio. While the expected returns on a broad equities portfolio may not be too risky for an investor with a 20-year investment horizon, they likely are too risky for an investor who must fund a large purchase at the end of this year. For such an investor, government securities or a bank certificate of deposit may be the most appropriate investments because of their low risk and high liquidity at the time when the funds will be needed.

**Tax situation:** Besides an individual's overall tax rate, the tax treatment of various types of investment accounts is also a consideration in portfolio construction. For a fully taxable account, investors subject to higher tax rates may prefer tax-free bonds (U.S.) to taxable bonds or prefer equities that are expected to produce capital gains, which are often taxed at a lower rate than other types of income. A focus on expected after-tax returns over time in relation to risk should correctly account for differences in tax treatments as well as investors' overall tax rates.

Some types of investment accounts, such as retirement accounts, may be tax exempt or tax deferred. Investors with such accounts may choose to put securities that generate fully taxed income, such as corporate bond interest, in accounts that are tax deferred, while seeking long-term capital gains, tax-exempt interest income, and dividend income (in jurisdictions where dividends receive preferential tax treatment) in their personal accounts, which have no tax deferral benefit.

**Legal and regulatory:** In addition to financial market regulations that apply to all investors, more specific legal and regulatory constraints may apply to particular investors. Trust, corporate, and qualified investment accounts may all be restricted by law from investing in particular types of securities and assets. There may also be restrictions on percentage allocations to specific types of investments in such accounts. Corporate officers and directors face legal restrictions on trading in the securities of their firms that the account manager should be aware of.

**Unique circumstances:** Each investor, whether individual or institutional, may have specific preferences or restrictions on which securities and assets may be purchased for the account. Some of these may be nonfinancial considerations, which are commonly categorized as **responsible investing**. Ethical preferences, such as prohibiting investment in securities issued by tobacco or firearms producers, are not uncommon. Restrictions on investments in companies or countries where human rights abuses are suspected or documented would also fall into this category. Religious preferences may preclude investment in securities that make explicit interest payments.

Unique investor preferences may also be based on diversification needs when the investor's income depends heavily on the prospects for one company or industry. An investor who has

founded or runs a company may not want any investment in securities issued by a competitor to that company.

## LOS 64.f: Explain the specification of asset classes in relation to asset allocation.

After having determined the investor objectives and constraints through the exercise of creating an IPS, a **strategic asset allocation** is developed which specifies the percentage allocations to the included asset classes. In choosing which asset classes to consider when developing the strategic asset allocation for the account, the correlations of returns *within* an asset class should be relatively high, indicating that the assets within the class are similar in their investment performance. On the other hand, it is low correlations of returns *between* asset classes that leads to risk reduction through portfolio diversification.

Historically, only the broad categories of equities, bonds, cash, and real estate were considered. More recently, a group of several investable asset classes, referred to collectively as alternative investments, has gained more prominence. Alternative investment asset classes include hedge funds of various types, private equity funds, managed or passively constructed commodity funds, artwork, and intellectual property rights.

We can further divide equities by whether the issuing companies are domestic or foreign, large or small, or whether they are traded in emerging or developed markets. An example of specifying asset classes is world equities. A U.S. investor may want to divide world equities into different regions.

With bonds, we can divide the overall universe of bonds into asset classes based on maturities or on criteria such as whether they are foreign or domestic, government or corporate, or investment grade or speculative (high yield). Overall, the asset classes considered should approximate the universe of permissible investments specified in the IPS.

Once the universe of asset classes has been specified, the investment manager will collect data on the returns, standard deviation of returns, and correlations of returns with those of other asset classes for each asset class.

Figure 64.1 illustrates the strategic asset allocation for a pension fund.

Figure 64.1: Strategic Asset Allocation

The Vermont Pension Investment Committee manages more than $4 billion in retirement assets for various teachers and state and municipal employees in that state. VPIC's investment policy specifies the following strategic asset allocation:

| Asset Class | Target |
|---|---|
| **Growth assets** | |
| Passive global equities | 24% |
| Active global equities | 5% |
| Large cap U.S. equities | 4% |
| Small-/mid-cap U.S. equities | 3% |
| Non–U.S. developed market equities | 5% |
| International small-cap equities | 2% |
| Private equity | 10% |
| Core plus fixed income | 6% |
| Emerging market debt | 4% |
| Private debt | 5% |
| Non-core real estate | 3% |
| **Total growth assets** | **71%** |
| **Downturn hedging assets** | |
| Core fixed income | 14% |
| Short-term quality credit | 5% |
| **Total downturn hedging** | **19%** |
| **Inflation hedging assets** | |
| Core real estate | 5% |
| U.S. TIPS | 3% |
| Infrastructure/farmland | 2% |
| **Total inflation hedging** | **10%** |

Source: State of Vermont, Office of the State Treasurer. Target allocation as of March 25, 2019. www.vermonttreasurer.gov/content/pension.

## LOS 64.g: Describe the principles of portfolio construction and the role of asset allocation in relation to the IPS.

Once the portfolio manager has identified the investable asset classes for the portfolio and the risk, return, and correlation characteristics of each asset class, an *efficient frontier*, analogous to one constructed from individual securities, can be constructed using a computer program. By combining the return and risk objectives from the IPS with the actual risk and return properties of the many portfolios along the efficient frontier, the manager can identify that portfolio which best meets the risk and return requirements of the investor. The asset allocation for the efficient portfolio selected is then the strategic asset allocation for the portfolio.

So far, we have not concerned ourselves with deviations from strategic asset allocations or with selection of individual securities within individual asset classes. These activities are referred to as active (versus passive) portfolio management strategies. A manager who varies from strategic asset allocation weights in order to take advantage of perceived short-term opportunities is adding **tactical asset allocation** to the portfolio strategy. **Security selection** refers to

deviations from index weights on individual securities within an asset class. For example, a portfolio manager might overweight energy stocks and underweight financial stocks, relative to the index weights for U.S. large-cap equities as an asset class. For some asset classes, such as hedge funds, individual real estate properties, and artwork, investable indexes are not available. For these asset classes, selection of individual assets is required by the nature of the asset class.

While each of these active strategies may produce higher returns, they each also increase the risk of the portfolio compared to a passive portfolio of asset class indexes. A practice known as **risk budgeting** sets an overall risk limit for the portfolio and budgets (allocates) a portion of the permitted risk to the systematic risk of the strategic asset allocation, the risk from tactical asset allocation, and the risk from security selection.

Active portfolio management has two specific issues to consider.

1. An investor may have multiple managers actively managing to the same benchmark for the same asset class (or may have significant benchmark overlap). In this case, one manager may overweight an index stock while another may underweight the same stock. Taken together, there is no net active management risk, although each manager has reported active management risk. Overall, the risk budget is underutilized as there is less net active management than gross active management.
2. When all managers are actively managing portfolios relative to an index, trading may be excessive overall. This extra trading could have negative tax consequences, specifically potentially higher capital gains taxes, compared to an overall efficient tax strategy.

One way to address these issues is to use a **core-satellite approach**. The core-satellite approach invests the majority, or core, portion of the portfolio in passively managed indexes and invests a smaller, or satellite, portion in active strategies. This approach reduces the likelihood of excessive trading and offsetting active positions.

Clearly, the success of security selection will depend on the manager's skill and the opportunities (mispricings or inefficiencies) within a particular asset class. Similarly, the success of tactical asset allocation will depend both on the existence of short-term opportunities in specific asset classes and on the manager's ability to identify them.

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## LOS 64.h: Describe how environmental, social, and governance (ESG) considerations may be integrated into portfolio planning and construction.

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In our Corporate Issuers review of "Introduction to Corporate Governance and Other ESG Considerations," we described several approaches to ESG investing. Briefly, these approaches include:

- **Negative screening**, excluding specific companies or industries based on ESG factors.
- **Positive screening**, investing in companies that have positive ESG practices.
- **Thematic investing**, selecting sectors or companies to promote specific ESG-related goals.
- **Impact investing**, selecting investments both to provide a return and to promote positive ESG practices.

- **Engagement/active ownership**, using share ownership as a platform to promote improved ESG practices at a company.
- **ESG integration**, considering ESG factors throughout the asset allocation and security selection process.

Here, we look at some issues these approaches raise for portfolio management.

If a portfolio's investment universe is constrained by negative screening, measuring its performance against a broad market index is unlikely to be appropriate. Indexes excluding companies or industries that investors with ESG concerns commonly avoid are available.

While many investors use positive screening, thematic, or impact investing approaches, choices of which specific companies to invest in and which ESG factors to focus on differ among investors. Thus, portfolios and performance benchmarks must be customized under these approaches, and they may require investment managers who specialize in these styles of investing.

For investment managers with clients who wish to engage in active ownership, it is important to clarify whether the clients intend to vote their shares themselves or direct the managers to vote the shares according to specified ESG factors.

Regardless of the approach chosen, investors should be aware that imposing constraints based on ESG factors will likely affect portfolio performance. How these constraints will affect portfolio performance in practice is uncertain. Both limiting the universe of investment choices and incurring the costs involved in considering ESG factors may decrease returns. On the other hand, investing in companies with good corporate governance practices and avoiding those that face ESG-related risks may increase portfolio returns.

MODULE QUIZ 64.1

1. The investment policy statement is *most accurately* considered:
   A. the starting point of the portfolio management process.
   B. the key intermediate step in the portfolio management process.
   C. the end product of the portfolio management process.
2. The component of an investment policy statement that defines the investment objectives is *most likely* to include information about:
   A. the investor's risk tolerance.
   B. unique needs and preferences of the investor.
   C. permitted asset types and use of leverage in the investment account.
3. When an investment advisor is developing return and risk objectives for a client:
   A. return objectives should be absolute and risk objectives should be relative.
   B. risk objectives should be absolute and return objectives should be relative.
   C. both return and risk objectives may be stated in absolute or relative terms.
4. A client exhibits an above-average willingness to take risk but a below-average ability to take risk. When assigning an overall risk tolerance, the investment adviser is *most likely* to assess the client's overall risk tolerance as:
   A. above average.
   B. average.
   C. below average.
5. Which of the following is *least likely* an example of a portfolio constraint?
   A. Higher tax rate on dividend income than on capital gains.

B. Significant spending requirements in the near future.
C. Minimum total return requirement of 8%.

6. For asset allocation purposes, asset classes should be specified such that correlations of returns are relatively:
   A. low within each asset class and low among asset classes.
   B. high within each asset class and low among asset classes.
   C. low within each asset class and high among asset classes.
7. In determining the appropriate asset allocation for a client's investment account, the manager should:
   A. consider only the investor's risk tolerance.
   B. incorporate forecasts of future economic conditions.
   C. consider the investor's risk tolerance and future needs, but not forecasts of market conditions.

## KEY CONCEPTS

LOS 64.a

A written investment policy statement, the first step in the portfolio management process, is a plan for achieving investment success. An IPS forces investment discipline and ensures that goals are realistic by requiring investors to articulate their circumstances, objectives, and constraints.

LOS 64.b

Many IPS include the following sections:

- Introduction—Describes the client.
- Statement of Purpose—The intentions of the IPS.
- Statement of Duties and Responsibilities—Of the client, the asset custodian, and the investment managers.
- Procedures—Related to keeping the IPS updated and responding to unforeseen events.
- Investment Objectives—The client's investment needs, specified in terms of required return and risk tolerance.
- Investment Constraints—Factors that may hinder the ability to meet investment objectives; typically categorized as time horizon, taxes, liquidity, legal and regulatory, and unique needs.
- Investment Guidelines—For example, whether leverage, derivatives, or specific kinds of assets are allowed.
- Evaluation and Review—Related to feedback on investment results.
- Appendices—May specify the portfolio's strategic asset allocation (policy portfolio) or the portfolio's rebalancing policy.

LOS 64.c

Risk objectives are specifications for portfolio risk that are developed to embody a client's risk tolerance. Risk objectives can be either absolute (e.g., no losses greater than 10% in any year) or relative (e.g., annual return will be within 2% of FTSE return).

Return objectives are typically based on an investor's desire to meet a future financial goal, such as a particular level of income in retirement. Return objectives can be absolute (e.g., 9% annual return) or relative (e.g., outperform the S&P 500 by 2% per year).

The achievability of an investor's return expectations may be hindered by the investor's risk objectives.

LOS 64.d

Willingness to take financial risk is related to an investor's psychological factors, such as personality type and level of financial knowledge.

Ability or capacity to take risk depends on financial factors, such as wealth relative to liabilities, income stability, and time horizon.

A client's overall risk tolerance depends on both his ability to take risk and his willingness to take risk. A willingness greater than ability, or vice versa, is typically resolved by choosing the more conservative of the two and counseling the client.

LOS 64.e

Investment constraints include:

- Liquidity—The need to draw cash from the portfolio for anticipated or unexpected future spending needs. High liquidity needs often translate to a high portfolio allocation to bonds or cash.
- Time horizon—Often the period over which assets are accumulated and before withdrawals begin. Risky or illiquid investments may be inappropriate for an investor with a short time horizon.
- Tax considerations—Concerns the tax treatments of the investor's various accounts, the relative tax treatment of capital gains and income, and the investor's marginal tax bracket.
- Legal and regulatory—Constraints such as government restrictions on portfolio contents or laws against insider trading.
- Unique circumstances—Restrictions due to investor preferences (religious, ethical, etc.) or other factors not already considered.

LOS 64.f

An asset class is a group of securities with similar risk and performance characteristics. Examples of major asset classes include equity, fixed income, cash, and real estate. Portfolio managers also use more narrowly defined asset classes, such as large-cap U.S. equities or speculative international bonds, and alternative asset classes, such as commodities or investments in hedge funds.

LOS 64.g

Strategic asset allocation is a set of percentage allocations to various asset classes that is designed to meet the investor's objectives. The strategic asset allocation is developed by combining the objectives and constraints in the IPS with the performance expectations of the various asset classes. The strategic asset allocation provides the basic structure of a portfolio.

Tactical asset allocation refers to an allocation that deviates from the baseline (strategic) allocation in order to profit from a forecast of shorter-term opportunities in specific asset classes.

LOS 64.h

Imposing portfolio constraints based on ESG factors may affect performance. Limiting the universe of investment choices may decrease returns, but good corporate governance and low

ESG-related risks may increase returns.

If a portfolio's investment universe is constrained by negative screening, its performance should be measured against a benchmark that excludes companies with negative ESG factors.

Positive screening, best-in-class, or thematic investing approaches typically require portfolio construction to be customized for the investor's choices of which ESG factors to focus on.

For active ownership, it is important to clarify whether investors intend to vote their shares themselves or direct managers to vote the shares according to specified ESG factors.

## ANSWER KEY FOR MODULE QUIZZES

### Module Quiz 64.1

1. **A** An investment policy statement is considered to be the starting point of the portfolio management process. The IPS is a plan for achieving investment success. (LOS 64.a)
2. **A** Investment objectives are defined based on both the investor's return requirements and risk tolerance. Investment constraints include the investor's time horizon, liquidity needs, tax considerations, legal and regulatory requirements, and unique needs and preferences. Policies regarding permitted asset types and the amount of leverage to use are best characterized as investment guidelines. (LOS 64.b)
3. **C** Both risk and return objectives can be defined either in absolute terms or relative to some benchmark. (LOS 64.c)
4. **C** When assigning an overall risk tolerance, the prudent approach is to use the lower of ability to take risk and willingness to take risk. (LOS 64.d)
5. **C** Return objectives are part of a policy statement's objectives, not constraints. (LOS 64.e)
6. **B** Asset classes should be defined such that correlations of returns within the asset class are relatively high (because assets within a class should perform alike over time), while correlations of returns among asset classes are relatively low (to benefit from diversification). (LOS 64.f)
7. **B** An adviser's forecasts of the expected returns and expected volatilities (risk) of different asset classes are an important part of determining an appropriate asset allocation. (LOS 64.g)

# READING 65

# THE BEHAVIORAL BIASES OF INDIVIDUALS

## EXAM FOCUS

Behavioral finance investigates ways in which human behavior differs from the rationality assumed by traditional economic models. Some believe these irrational behaviors or biases lead to predictable deviations of financial markets from the implications of financial models of security price behavior. Here, candidates must learn some of the terminology of behavioral finance and examples that support a belief in irrational investor behavior. Additionally, we cover how investor biases and irrationality may explain certain anomalous results of tests of market efficiency.

## MODULE 65.1: COGNITIVE ERRORS VS. EMOTIONAL BIASES

Video covering this content is available online.

Traditional finance assumes that individuals act as perfectly rational economic beings who objectively consider all relevant information to make rational decisions, and that this process results in efficient markets. Research results have called these assumptions into question. Kahneman and Tversky pioneered this work in the early 1970s, initially setting logic tests where individuals' intuitive answers were predictably flawed. This supported the idea that human decision-making has systematic biases that lead to irrational decisions.

This work was extended by Kahneman, Tversky, and others, who have suggested that a better understanding of these biases by clients (and by the professionals who work with those clients) should produce securities prices and returns over time that better match the informationally efficient markets of traditional finance theory.

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**LOS 65.a: Compare and contrast cognitive errors and emotional biases.**

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Individuals, when facing complex decision-making, often lack the time or ability to derive the optimal course of action prescribed by traditional finance. Cognitive limitations and emotional responses introduce bias into the decision-making process, leading to decisions that are biased (not perfectly rational). Behavioral finance asserts that certain biases, which are not simply random errors, are widespread and therefore predictable.

**Cognitive errors** are due primarily to faulty reasoning or irrationality. They can arise from not understanding statistical analysis, information processing errors, illogical reasoning, or memory errors. Such errors can possibly be reduced by increased awareness, better training, or more information.

**Emotional biases** are not related to conscious thought. Rather, they stem from feelings, impulses, or intuition. As such, they are difficult to overcome and may have to be accommodated.

Despite the distinction in grouping biases as either cognitive or emotional, a bias may have elements of both cognition and emotion. When trying to overcome or mitigate biases that are both emotional and cognitive, success is more likely by focusing on the cognitive issues.

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**LOS 65.b: Discuss commonly recognized behavioral biases and their implications for financial decision making.**

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Cognitive errors can be divided into *belief perseverance* biases that reflect an irrational reluctance to change prior conclusions and decisions, and *processing errors* where the information analysis is flawed.

## Cognitive Errors: Belief Perseverance

Psychologists use the term **cognitive dissonance** to refer to a situation where an individual holds conflicting beliefs or receives information that causes a current belief to be questioned. Cognitive dissonance causes stress that individuals seek to reduce. They may do so by letting go of prior beliefs in favor of the conflicting belief. On the other hand, they might discount the conflicting information or viewpoints by questioning their truth, source, applicability, or significance. To the extent that it is easier to do the latter than the former, bias in favor of currently held beliefs is the result.

1. **Conservatism bias** occurs when market participants **rationally form an initial view but then fail to change that view as new information becomes available**. That is, they overweight their prior probabilities and do not adjust them appropriately as new information becomes available. Individuals displaying this bias tend to maintain prior forecasts and securities allocations, ignoring or failing to recognize the significance of new information. Individuals may react slowly to new data or ignore information that is complex to process.

> EXAMPLE: **Conservatism bias**
>
> John Molinari allocates assets based on his observation that over the last 80 years, recessions occurred in 20% of those years. When a coworker informs Molinari that the country's central bank has announced a policy change to a tightening of monetary conditions, Molinari does not adjust his recommended asset allocations. Does this reflect conservatism bias?
>
> **Answer:**
>
> Molinari should consider that the conditional probability of a recession, given that the central bank is tightening, may differ from the unconditional probability of a recession that

> he previously estimated. He is showing conservatism bias by not considering the impact of this new information.

Conservatism bias may result in market participants holding investments too long because they are unwilling or slow to update a view or forecast. They may be avoiding the mental effort or stress of updating prior beliefs by not considering the implications of new information.

2. **Confirmation bias** occurs when market participants focus on or seek information that supports prior beliefs, while avoiding or diminishing the importance of conflicting information or viewpoints. They may distort new information in a way that remains consistent with their prior beliefs.

   For example, after buying a car from a given manufacturer, the buyer would exhibit confirmation bias by reading articles about how great cars from that manufacturer are but avoiding news about problems with that particular brand. Because the buyer already purchased the car, information suggesting that it was a bad decision is unwelcome.

   Consequences and implications of confirmation bias may include market participants who:

   – Consider positive information but ignore negative information.

   – Set up a decision process or data screen incorrectly to support a preferred belief.

   – Become overconfident about the correctness of a presently held belief.

   Market participants can reduce confirmation bias by seeking out contrary views and information—for example, by reading analyses and viewpoints that disagree with a presently held belief, rather than only reading those that reinforce the belief.

3. **Representativeness bias** occurs when certain characteristics are used to put an investment in a category and the individual concludes that it will have the characteristics of investments in that category. Individuals systematically make the error of believing that two things that are similar in some respects are more similar in other respects than they actually are.

   Two forms of representativeness bias are base-rate neglect and sample-size neglect.

   **Base-rate neglect** refers to analyzing an individual member of a population without adequately considering the probability of a characteristic in that population (the base rate). Consider this example of base-rate neglect: a group was asked to identify the most likely occupation of a man who was characterized as somewhat shy as a salesperson or a librarian. Most participants chose librarian, thinking that most librarians would tend to be more shy on average than salespeople, who tend to be outgoing. Their mistake was in not considering that there are relatively few male librarians and a great number of male salespeople. Even though a greater percentage of librarians may be characterized as somewhat shy, the absolute number of salespeople who could be characterized as somewhat shy is significantly greater.

   **Sample-size neglect** refers to making a classification based on a small and potentially unrealistic data sample. The error is believing the population reflects the characteristics of the small sample.

For example, a fund manager may show strong performance over a three-year time horizon. This may lead investors to assume this is evidence of superior skill. However, examination of longer sample periods shows a lack of persistence; there will be some three-year "winners" even when annual returns results are actually random. The evidence of the lack of persistence of managers' relative performance over time does not support investors' conclusion that this manager will continue to outperform.

> EXAMPLE: **Representativeness bias**
>
> XYZ company has long been recognized as a growth stock, delivering superior earnings growth and stock price appreciation. While earnings have continued to grow, last year's revenue has not, and neither has the stock price. Under the following two conditions, would an analyst be more likely to buy or sell the stock?
>
> 1. The analyst suffers from base-rate and sample-size neglect.
> 2. The analyst treats the growth classification as representative.
>
> **Answer:**
>
> If the analyst exhibits sample-size neglect and base-rate neglect biases, the analyst will ignore XYZ's long record as a growth stock, focus on the short-term disappointing results, and may recommend selling the stock without considering the long-term possibility it will revert to growth behavior.
>
> However, if the analyst over-relies on the initial growth classification, the analyst may assume that the stock will return to growth and recommend buying it, without properly considering the reasons for its recent results or their longer-term implications.

Representativeness bias may lead market participants to attach too much importance to a few characteristics based on a small sample size or make decisions based on simple rules and classifications rather than conducting a more-thorough and complex analysis.

4. **Illusion of control bias** exists when **market participants believe they can control or affect outcomes when they cannot**. It is often associated with emotional biases: illusion of knowledge (belief you know things you do not know), self-attribution (belief you personally caused something to happen), and overconfidence (an unwarranted belief that your beliefs will prove to be correct).

   An example of control bias can be seen in humans' attempts to control the weather using ritual ceremonies. This allowed them to believe they had some control of the environment, when in fact it is highly unlikely that a ceremony can influence the weather.

   Illusion of control may cause market participants to overweight securities for which they believe they have control over outcomes, such as a company they work for or are otherwise associated with. This can result in their portfolios being inadequately diversified.

5. **Hindsight bias** is a **selective memory of past events, actions, or what was knowable in the past, resulting in an individual's tendency to see things as more predictable than they really are.** People tend to remember their correct predictions and forget their incorrect ones. They also overestimate what could have been known. This behavior results from

individuals being able to observe outcomes that did occur but not the outcomes that did not materialize. Hindsight bias is sometimes referred to as the *I-knew-it-all-along phenomenon*.

Hindsight bias is caused by three types of errors:

1. Individuals distort their earlier predictions when looking back. This is the tendency to believe that we knew the outcome of an uncertain event all along.
2. Individuals tend to view events that have occurred as inevitable.
3. Individuals assume they could have foreseen the outcomes of uncertain events.

Hindsight bias can lead to overconfidence in ability to predict outcomes. It may also cause investors to cast aside valid analysis techniques that did not turn out to be correct in favor of poor techniques that turned out well by chance.

## Cognitive Errors: Information-Processing Biases

These are related more to the processing of information and less to the decision-making process.

**Anchoring and adjustment bias** refers to basing expectations on a prior number and overweighting its importance, making adjustments in relation to that number as new information arrives. Examples would be estimating the value of a security relative to its current value or making estimates of earnings per share relative to a previously reported value or relative to a prior estimate. Anchoring leads to underestimating the implications of new information. New data should be considered objectively without regard to any initial anchor point.

**Mental accounting bias** refers to viewing money in different accounts or from different sources differently when making investment decisions. This conflicts with the idea that security decisions should be made in the context of the investor's overall portfolio of assets based on their financial goals and risk tolerance.

An example of mental accounting is an investor who receives an unexpected bonus at work and chooses to invest it in a very risky biotechnology stock, reasoning that the bonus is "found money" that can acceptably be risked on speculation. In fact, while such a stock may have a place in the investor's portfolio, decisions about whether and how much of it to include should be based on a total portfolio approach. Another example may be an investor who receives an inheritance from a parent and segregates those funds into low-risk bonds out of a desire to "not lose any of the money the parent worked so hard to save." This behavior also conflicts with the principle that investments should be considered in the context of the entire portfolio.

The result of such mental accounting may be that an investor's overall portfolio is not optimal given the investor's circumstances, investment goals, and risk tolerance. It can cause an investor to hold positions that offset each other, rather than considering investments in the context of their correlation of returns. One common form of mental accounting bias is a tendency to view income differently from capital appreciation. This may cause an investor to hold a mix of income-producing and non-income-producing securities that does not match the investor's circumstances.

A study by Camerer et al. (1997)[1] investigated behavior of New York taxi drivers. The study suggests that each new day was a separate account in the minds of the taxi drivers. It appears that New York taxi drivers have a reference rate for daily income and perceive a loss if they fail to meet it (which we may also view as an example of anchoring). On rainy days, demand for taxis is high, while on sunny days, the demand is low. Logically, you would expect taxi drivers to work more hours on rainy days to maximize their incomes. In reality, the opposite was true. Taxi drivers worked longer hours on sunny days as they strove to hit their target income. On rainy days, once the target was achieved, the taxi drivers stopped working.

**Framing bias** occurs **when decisions are affected by the way in which the question or data is "framed."** In other words, the way a question is phrased can influence the answer given. Tversky and Kahneman (1980)[2] illustrate framing bias with the following example.

EXAMPLE: **Framing bias (framing as a gain)**

The United States is preparing for the outbreak of an unusual disease, which is expected to kill 600 people. Two alternative programs have been proposed. If Program A is adopted, 200 people will be saved. If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no one will be saved. Which program will people choose?

**Answer:**

Program A is typically selected. Although the expected value of both Program A and Program B is 200 lives saved, the majority choice is risk averse. The prospect of saving 200 lives with certainty is more attractive than the risky option with the same expected value.

EXAMPLE: **Framing bias (framing as a loss)**

A different group of individuals is given the same issue, but the two programs are framed differently. If Program A is adopted, 400 people will die. If Program B is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 will die. Which program will people choose?

**Answer:**

In this situation, Program B is typically selected. The majority choice is now risk-taking, with the certain death of 400 people being less acceptable than a two-thirds chance that 600 people will die.

In these examples, the two programs presented (A and B) are identical for both groups, but the framing of the information results in different choices. For the first group, the information was presented in the context of a gain, while for the second group, it was in the context of a loss. Loss aversion—the idea that we fear losses more than we value gains—is then demonstrated by the choices made.

An example of framing bias in an investment context is overestimating the significance of short-term price volatility (risk) without weighing it against long-term considerations. This may result in overly conservative portfolios.

Investment managers must take care to avoid framing bias when creating questions to assess an investor's risk tolerance. Failing to properly assess risk tolerance may identify investors as more or less risk averse than they actually are, resulting in portfolios that are inconsistent with the investors' needs.

**Availability bias** refers to putting **undue emphasis on information that is readily available, easy to recall, or based narrowly on personal experience or knowledge.** Availability bias occurs when individuals judge the probability of an event occurring by the ease with which examples and instances come to mind. By the very nature of memory, more-recent events are typically easier to recall than events further in the past, which leads to the bias of attaching too much significance to events that have occurred recently and too little to events that occurred further in the past. People also tend to assume that if something is easily remembered, it must occur with a higher probability.

EXAMPLE: **Availability bias**

Imagine a word is picked at random from a dictionary. Is it more likely that the word has the letter *r* as the first letter in the word or the third letter?

**Answer:**

When faced with this problem, most individuals state that it is more likely the letter *r* will be the first letter. In fact, in the English language, there are approximately three times more words with *r* as the third letter than the first. Individuals find it easier to recall words that begin with *r* than words with *r* as the third letter, which distorts their estimation of probabilities.

Availability bias may lead market participants to choose a manager or investment based on advertising or recalling they have heard the name. They may limit their universe of potential investments to familiar firms, resulting in inappropriate asset allocations and lack of diversification. They may also overreact to recent market conditions while ignoring data on historical market performance, or they may place too much emphasis on events that receive a large amount of media attention.

# MODULE 65.2: EMOTIONAL BIASES

Video covering this content is available online.

PROFESSOR'S NOTE

Some of the terms we are about to discuss have already come up in the discussion of cognitive biases. In general, if an investor's view is based on unconscious emotion that the holder is unwilling or unable to change, we should regard it as an emotional bias. If a bias can be overcome with a relatively simple change in thought process or information, we should regard it as a cognitive bias.

While there is no formally accepted definition, these six biases generally arise from emotion and feelings rather than through conscious thought:

1. **Loss-aversion bias** arises from **feeling more pain from a loss than pleasure from an equal gain**. Kahneman and Tversky (1979)[3] investigated differences between how people feel

when they gain and when they lose and how that affects behavior when faced with risk. They found that individuals' willingness to take a gamble (risk) was very different when facing a loss or a gain.

Consider the following two scenarios:

*Scenario 1*: An individual is given $10. The individual is then given the following options:

– Take an additional $5 with certainty.

– Flip a coin and win an additional $10 if it lands heads up or nothing if it lands tails up.

Both options represent a gain relative to the original $10, and the expected value of the gain is $5 for either option. Option 1 creates a guaranteed outcome of $15. Option 2 introduces uncertainty, with equal probabilities of an outcome of $10 or $20. Most individuals chose the riskless Option 1 over the riskier Option 2.

*Scenario 2*: An individual is given $20. The individual is then given the following options:

– Take a $5 loss with certainty.

– Flip a coin and lose nothing if it lands heads up, but lose $10 if it lands tails up.

Both options represent a potential loss relative to the original $20, and the expected loss is $5 for either option. Most individuals chose risky Option 2 over the riskless certain loss of Option 1.

In both scenarios, the expected value of the individual's wealth is $15. The options given to the individuals are also identical, with Option 1 resulting in a guaranteed outcome of $15 and Option 2 providing equal probabilities of either $10 or $20. Yet, when faced with gains, people preferred certainty, and when faced with losses, they preferred risk.

The conclusion is that individuals display asymmetrical responses to gains and losses. Kahneman and Tversky suggested that people look at decisions relative to a reference rate. Anything below the reference rate is seen as a loss, and anything above the reference rate is seen as a gain. The reference rate in scenario 1 was the $10 initially given to the individual, and in scenario 2, it was $20. The conflicting responses to the scenarios are explained by attitudes toward gains and losses. Crucially, people fear losses far more than they value gains. Thus, in scenario 2, they were willing to take the risk in the hope of avoiding a loss.

PROFESSOR'S NOTE

Be sure to understand the difference between risk aversion and loss aversion. A risk-averse investor is simply an investor who, given two investments with the same expected returns, would select the investment with the lowest risk. A loss-averse investor is one who feels greater pain (decreases in utility) from losses than satisfaction (increase in utility) from gains. As a result, the individual is more likely to take a risk in the hope of avoiding losses than in the hope of achieving gains.

Consequences of loss-aversion bias may include trading too much by selling for small gains, which increases transaction costs and decreases returns, or incurring too much risk by continuing to hold assets that have deteriorated in quality and lost value. If an initial decline in value occurs, loss-averse investors may take excessive risk in the hope of recovering (investment managers may be particularly susceptible to this behavior). A loss-averse investor might view a position inappropriately as a gain or a loss based on the framing of the reference point.

2. **Overconfidence bias** occurs when **market participants overestimate their own intuitive ability or reasoning.** It can show up as illusion of knowledge when they think they do a better job of predicting than they actually do. Combined with self-attribution bias, individuals may give themselves personal credit when things go right (self-enhancing) but blame others or circumstances when things go wrong (self-protecting). Prediction overconfidence leads individuals to underestimate uncertainty and the standard deviation of their predictions, while certainty overconfidence occurs when they overstate the probability they will be right.

   While overconfidence is both cognitive and emotional, it is more emotional in nature because it is difficult for most individuals to correct and is rooted in the desire to feel good. Overconfidence bias may cause market participants to underestimate risk, overestimate return, and fail to diversify sufficiently.

3. **Self-control bias** occurs when **individuals lack self-discipline and favor** short-term satisfaction **over long-term goals**. Often, individuals are not prepared to make short-term sacrifices to meet their long-term goals. They may favor small payoffs now at the expense of larger payoffs in the future, which is known as hyperbolic discounting.

   Self-control bias may result in insufficient savings to fund retirement needs, which in turn may cause an investor to take excessive risk to try to compensate for insufficient savings accumulation. It may also result in overemphasis on income-producing assets to meet short-term needs.

   Self-control bias might be mitigated by establishing an appropriate investment plan (asset allocation) and a budget to achieve sufficient savings. Both should be reviewed on a regular basis.

4. **Status quo bias** occurs when comfort with an existing situation causes an individual to be resistant to change. If investment choices include the option to maintain existing investments or allocations, or if a choice will happen unless the participant opts out, status quo choices become more likely.

   Companies have found that automatically enrolling workers in retirement savings schemes, with the option to opt out, increases participation compared with making it necessary for employees to opt in. Thaler and Sunstein (2008)[4] argue for framing choices in this way to achieve better participation rates in retirement plans, as well as other choices, such as whether to register as an organ donor.

   Consequences of status quo bias may include holding portfolios with inappropriate risk and not considering other, better investment alternatives.

5. **Endowment bias** occurs when an asset is felt to be special and more valuable simply because it is already owned. For example, a spouse may hold on to securities the deceased spouse purchased, for reasons like sentiment that are unrelated to the current merits of the securities. Endowment bias is common with inherited assets and might be detected or mitigated by asking a question such as "Would you make this same investment with new money today?"

   In studies, individuals have been asked to state their minimum sales price for an asset they own (say $25) and the maximum price they would pay now to buy the same asset (say $23). The price at which they would be willing to sell tended to be higher than the price they would pay. This has been explained as an endowment effect. Once they own an asset, they act as if it is worth more than they would pay.

   Market participants who exhibit endowment bias may be failing to sell assets that are no longer appropriate for their investment needs, or they hold assets with which they are familiar because they provide some intangible sense of comfort.
6. **Regret-aversion bias** occurs when market participants **do nothing out of excessive fear that actions could be wrong**. They attach undue weight to errors of commission (doing something that turns out wrong) and not enough weight to errors of omission (not doing something that would have turned out right). Their sense of regret and pain is stronger for acts of commission. This is quite similar to status quo bias.

   Herding behavior is a form of regret aversion where participants go with the consensus or popular opinion. Essentially, participants tell themselves they are not to blame if others are wrong too.

   Consequences of regret-aversion bias may include excess conservatism in the portfolio because it is easy to see that riskier assets do at times underperform. Therefore, an investor might not buy riskier assets so as not to experience regret when they decline.

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## LOS 65.c: Describe how behavioral biases of investors can lead to market characteristics that may not be explained by traditional finance.

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In our Equity Investments reading on Market Efficiency, we developed the ideas of anomalies (results that do not fit the prevailing model of securities risks and returns) and market inefficiencies (anomalies that present opportunities to earn positive risk-adjusted returns). Many market anomalies have been explained by small sample size, time period bias, or inadequacies in the specification of prevailing models of returns. In the same way, some anomalies once considered evidence of market inefficiency have been explained by the possible misspecification of risk, leading to inaccurate risk adjustment of returns.

Bubbles and subsequent crashes have been with us as long as trading markets have existed. Some have offered explanations for these extremes of valuation based on rational behavior. Investors who leave markets that they determine are exhibiting characteristics of a bubble may miss out on high returns over extended periods. On the other hand, investors who stay invested based on a belief that they will be able to get out at or near the market top often find that that is

not realistic. Either type of mistake, leaving the market too early or staying fully invested too long, can be quite damaging to a fund manager's career. Exploiting the fact that a market is "in a bubble" for an arbitrage profit may not be possible due to the restrictions on and risk of short selling in a rapidly rising market.

While behavioral finance does not provide an overall explanation for bubbles and their aftermath, some have claimed that cognitive and emotional biases exhibited during such periods may have some causal effects. These claims include the following:

- *Overconfidence* may lead to overtrading, underestimation of risk, and lack of diversification.
- Persistently good results combined with *self-attribution* bias can fuel overconfidence, as can *hindsight* bias (as investors give themselves credit for choosing profitable stocks in a bull market).
- *Confirmation bias* may lead investors to ignore or misinterpret new information suggesting that valuations will not continue to rise, or to misinterpret initial decreases in asset values as simply another buying opportunity.
- *Anchoring* may cause investors to believe recent highs are rational prices even after prices begin their eventual decline.
- Fear of *regret* may keep even very skeptical investors in the market.

One anomaly that has been persistent over time is the value/growth anomaly. Value stocks (low market-book, low P/E, high dividend yield stocks) have outperformed growth stocks (high P/E, low dividend yield stocks) over long periods. Fama and French (1992) found that adding risk factors for firm size and book-to-market ratio to a model of stock returns eliminated the evidence of value stock outperformance. These results suggest that the extra returns to value stocks were compensation for additional risks captured by firm size and book-to-market ratios.

Others have suggested behavioral factors as the cause of the seeming outperformance of value stocks. The **halo effect** is a version of representativeness in which a company's good characteristics, such as fast growth and a rising stock price, are extended into a conclusion that it is a good stock to own, leading to overvaluation of growth stocks.

The fact that investors tend to invest heavily in firms in their domestic country in a global portfolio, or more heavily in firms operating in their region of a country, is considered anomalous in that rationality suggests greater diversification. Such **home bias**, it is claimed, may result from a belief that they have better access to information or simply an emotional desire to invest in companies "closer to home." Similarly, investors may underestimate the risk or overestimate the future returns of firms whose products they use or firms for which they are exposed to a great amount of positive marketing messages.

MODULE QUIZ 65.1, 65.2

1. Which of the following would *most likely* be classified as an emotional bias?
   A. The investor has difficulty interpreting complex new information.
   B. The investor only partially adjusts forecasts when he receives new information.
   C. The investor has a tendency to value the same assets higher if he owns them than if he does not own them.
2. Which of the following would *most likely* indicate that an investor is subject to an emotional bias?
   A. Regularly basing decisions on only a subset of available information.

B. Reacting spontaneously to a negative earnings announcement by quickly selling a stock.
C. Remaining invested in a profitable technology stock even though new information indicates its P/E ratio is too high.

3. A cognitive error is *most likely* indicated by which of the following?
   A. A client is the chief executive officer of a public company that she founded and insists she will not diversify her holding of the company stock.
   B. The spouse of a now-deceased company founder becomes upset when it is recommended the portfolio holdings in that company need to be diversified.
   C. A client who initially resists recommendations to diversify the portfolio later thanks the manager for explaining the benefits of diversification.
4. Abby Lane has investments scattered across many different accounts, from bank savings to before- and after-tax retirement accounts to taxable nonretirement accounts. She has multiple investing goals ranging from important short-term goals to longer-term "wish list" goals. She looks at her financial assets and views each holding as designed to meet specific goals. Lane has been very successful in her investment decisions for several decades and believes she can continue to achieve reasonable results. Lane *most likely* exhibits:
   A. framing bias.
   B. mental accounting.
   C. overconfidence bias.
5. Twenty years ago, Jane Ivy set up her initial asset allocation in her defined contribution plan by placing an equal amount in each asset class and never changed it. Over time, she increased her contribution by 1% per year until she reached the maximum amount allowed by law. Due to her steadfastness and good fortune, coupled with matching funds from her employer, she now finds herself in her early 40s with a million-dollar retirement account. Which of the following biases does Ivy *most likely* exhibit?
   A. Representativeness.
   B. Status quo bias.
   C. Availability bias.
6. The halo effect suggests that investors tend to overvalue stocks:
   A. from their own country or region.
   B. with which the investors are most familiar.
   C. that have experienced rapid growth and price appreciation.

## KEY CONCEPTS

LOS 65.a

Cognitive errors result from the inability to analyze information or from basing decisions on partial information. Individuals try to process information and make rational decisions, but they may lack the capacity or sufficient information to do so. Cognitive errors can be divided into belief perseverance errors and processing errors.

Emotional biases are caused by the way individuals frame information and decisions, rather than the process used to analyze and interpret information. Emotional bias is more of a spontaneous reaction.

LOS 65.b

Cognitive Errors: Belief Perseverance

- Conservatism bias.
- Confirmation bias.
- Representativeness bias.

- Control bias.
- Hindsight bias.

Cognitive Errors: Information Processing

- Anchoring and adjustment.
- Mental accounting bias.
- Framing bias.
- Availability bias.

Emotional Biases

- Loss-aversion bias.
- Overconfidence bias.
- Self-control bias.
- Status quo bias.
- Endowment bias.
- Regret-aversion bias.

LOS 65.c

Many reported anomalies have been explained by inadequate specification of security risk, but some have attempted to explain the existence of persistent anomalies as the results of cognitive errors and emotional biases.

Behavioral finance has not explained bubbles and crashes, but some cognitive errors and emotional biases may be exhibited during bubbles and crashes.

## ANSWER KEY FOR MODULE QUIZZES

### Module Quiz 65.1, 65.2

1. **C** This describes the *endowment bias*, where individuals place a higher value on assets they own than if they did not own those same assets. The other two answer choices describe cognitive errors that are due to the inability to analyze all the information. (Modules 65.1, 65.2, LOS 65.a, 65.b)

2. **B** Emotional biases tend to elicit more of a spontaneous reaction than cognitive errors. Making a decision based only on partial information is indicative of a cognitive error. Ignoring a high P/E ratio could be indicative of the conservatism bias, which is reacting slowly to new information or avoiding analyzing new information. It could also indicate confirmation bias, where the investor focuses on positive information and ignores negative information. Both conservatism and confirmation biases are cognitive errors. (Modules 65.1, 65.2, LOS 65.a, 65.b)

3. **C** Individuals making cognitive errors are more likely to respond rationally when new information is provided. The client initially resists a rational recommendation but then reverses their thoughts when given more information.

   There are rational reasons a CEO may want to hold a large block of her company's stock. Those include legal restrictions on sale or a desire to take concentrated risk in a situation where she has a lot of control. A rational decision is not an error. Alternatively, the "*insists*" could indicate an emotional bias. Neither interpretation suggests a cognitive error.