2025 CFA®
Exam Prep

SchweserNotes™

Alternative Investments, Portfolio Management, and Ethical and Professional Standards

Level I Book 4

KAPLAN SCHWESER

Book 4: Alternative Investments, Portfolio Management, and Ethical and Professional Standards

SchweserNotes™ 2025

Level I CFA®

SCHWESERNOTES™ 2025 LEVEL I CFA® BOOK 4: ALTERNATIVE INVESTMENTS, PORTFOLIO MANAGEMENT, AND ETHICAL AND PROFESSIONAL STANDARDS

Published in 2024 by Kaplan, Inc.

ISBN: 978-1-0788-4566-3

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Learning Outcome Statements (LOS)

76. Alternative Investment Features, Methods, and Structures

The candidate should be able to:

a. describe features and categories of alternative investments.
b. compare direct investment, co-investment, and fund investment methods for alternative investments.
c. describe investment ownership and compensation structures commonly used in alternative investments.

77. Alternative Investment Performance and Returns

The candidate should be able to:

a. describe the performance appraisal of alternative investments.
b. calculate and interpret alternative investment returns both before and after fees.

78. Investments in Private Capital: Equity and Debt

The candidate should be able to:

a. explain features of private equity and its investment characteristics.
b. explain features of private debt and its investment characteristics.
c. describe the diversification benefits that private capital can provide.

79. Real Estate and Infrastructure

The candidate should be able to:

a. explain features and characteristics of real estate.
b. explain the investment characteristics of real estate investments.
c. explain features and characteristics of infrastructure.
d. explain the investment characteristics of infrastructure investments.

80. Natural Resources

The candidate should be able to:

a. explain features of raw land, timberland, and farmland and their investment characteristics.
b. describe features of commodities and their investment characteristics.
c. analyze sources of risk, return, and diversification among natural resource investments.

81. Hedge Funds

The candidate should be able to:

a. explain investment features of hedge funds and contrast them with other asset classes.
b. describe investment forms and vehicles used in hedge fund investments.
c. analyze sources of risk, return, and diversification among hedge fund investments.

82. Introduction to Digital Assets

The candidate should be able to:

a. describe financial applications of distributed ledger technology.
b. explain investment features of digital assets and contrast them with other asset classes.
c. describe investment forms and vehicles used in digital asset investments.
d. analyze sources of risk, return, and diversification among digital asset investments.

83. Portfolio Risk and Return: Part I

The candidate should be able to:

a. describe characteristics of the major asset classes that investors consider in forming portfolios.
b. explain risk aversion and its implications for portfolio selection.
c. explain the selection of an optimal portfolio, given an investor's utility (or risk aversion) and the capital allocation line.
d. calculate and interpret the mean, variance, and covariance (or correlation) of asset returns based on historical data.

e. calculate and interpret portfolio standard deviation.
f. describe the effect on a portfolio's risk of investing in assets that are less than perfectly correlated.
g. describe and interpret the minimum-variance and efficient frontiers of risky assets and the global minimum-variance portfolio.

84. 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.

85. 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.

86. 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.

87. 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.

88. 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.

89. 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.

90. 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.

91. 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.

92. 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.

93. 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 76

ALTERNATIVE INVESTMENT FEATURES, METHODS, AND STRUCTURES

MODULE 76.1: ALTERNATIVE INVESTMENT STRUCTURES

Video covering this content is available online.

LOS 76.a: Describe features and categories of alternative investments.

Alternative investments comprise various types of investments that do not fall under the heading of **traditional investments**, which refers to long-only investments in cash or publicly traded stocks and bonds.

Types of alternative investment structures include hedge funds, private equity funds, and various types of real estate investments. Alternative investments typically are actively managed and may include investments in commodities, infrastructure, and illiquid securities.

The perceived benefits of including alternative investments in portfolios are risk reduction from diversification (due to low correlations of alternative investments with traditional investments) and possible higher returns from holding illiquid securities, and from markets for some alternative investments possibly being less efficient than those for traditional investments.

Compared with traditional investments, alternative investments typically exhibit the following features:

- More specialized knowledge required of investment managers
- Relatively low correlations with returns of traditional investments
- Less liquidity of assets held
- Longer time horizons for investors
- Larger size of investment commitments

As a result of these unique features, alternative investments exhibit the following characteristics:

- Investment structures that facilitate direct investment by managers

- Information asymmetry between fund managers and investors, which funds typically address by means of incentive-based fee structures
- Difficulty in appraising performance, such as more problematic and less available historical returns and volatility data

Although correlations of returns on alternative investments with returns on traditional investments may be low on average, these correlations may increase significantly during periods of economic stress.

We will examine several types of alternative investments in detail in separate readings in this topic area. We may classify alternative investments into three broad categories of private capital, real assets, and hedge funds.

1. **Private capital** includes private equity and private debt:
   - As the name suggests, **private equity** funds invest in the equity of companies that are not publicly traded, or in the equity of publicly traded firms that the funds intend to take private. These firms are often in the mature or decline stages of their industry life cycle. **Leveraged buyout (LBO)** funds use borrowed money to purchase equity in established companies and comprise most private equity investment funds. **Venture capital** funds invest in young, unproven companies at the start-up or early stages in their life cycles.
   - **Private debt** funds may make loans directly to companies, lend to early-stage firms (**venture debt**), or invest in the debt of firms that are struggling to make their debt payments or have entered bankruptcy (**distressed debt**).
2. **Real assets** include real estate, infrastructure, natural resources, and other assets such as digital assets:
   - **Real estate** investments include residential or commercial properties, as well as real estate–backed debt. These investments are held in various structures, including full or leveraged ownership of individual properties, individual real estate–backed loans, private and publicly traded securities backed by pools of properties or mortgages, and limited partnerships.
   - **Natural resources** include commodities, farmland, and timberland. To gain exposure to **commodities**, investors can own physical commodities, commodity derivatives, or the equity of commodity-producing firms. Some funds seek exposure to the returns on various commodity indices, often by holding derivatives contracts (futures) that are expected to track a specific commodity index. **Farmland** can produce income from leasing the land out for farming or from raising crops or livestock for harvest and sale. **Timberland** investment involves purchasing forested land and harvesting trees to generate cash flows.
   - **Infrastructure** refers to long-lived assets that provide public services. These include economic infrastructure assets (e.g., roads, airports, and utility grids) and social infrastructure assets (e.g., schools and hospitals). While often financed and constructed by government entities, infrastructure investments have more recently been undertaken by **public-private partnerships**, with each holding a significant stake in the infrastructure assets. Various deal structures are employed, and the asset may revert to public ownership at some future date.
   - Other types of real assets include collectibles such as art, intangible assets such as patents, and **digital assets** such as cryptocurrencies.
3. **Hedge funds** are investment companies typically open only to qualified investors. These funds may use leverage, hold long and short positions, use derivatives, and invest in illiquid assets. Managers of hedge funds use many different strategies in attempting to generate investment gains. They do not necessarily hedge risk, as the name might imply.

LOS 76.b: Compare direct investment, co-investment, and fund investment methods for alternative investments.

Fund investing refers to investing in a pool of assets alongside other investors, using a fund manager who selects and manages a pool of investments using an agreed-upon strategy. In this case, the individual investors do not control the selection of assets for investment or their subsequent management and sale. The manager typically receives a percentage of the investable funds (management fee) as well as a percentage of the investment gains (incentive fee).

Compared to funds that invest in traditional asset classes, alternative investment funds typically require investors to commit larger amounts of capital for longer periods, provide less information on positions held and returns earned, and charge higher management fees. A fund's **term sheet** describes its investment policy, fee structure, and requirements for investors to participate.

With **co-investing**, an investor contributes to a pool of investment funds (as with fund investing) but also has the right to invest, directly alongside the fund manager, in some of the assets in which the manager invests. Compared to fund investing, co-investing can reduce overall fees while benefiting from the manager's expertise. Co-investing also can provide an investor with an opportunity to gain the skills and experience to pursue direct investing. For a fund manager, permitting co-investment may increase the availability of investment funds and expand the scope and diversification of the fund's investments.

Direct investing refers to an investor that purchases assets itself, rather than pooling its funds with others or using a specialized outside manager. Larger, more knowledgeable investors may purchase private companies or real estate directly. For example, a sovereign wealth fund may have its own specialized managers to invest in real estate, agricultural land, or companies in the venture stage.

Direct investing has advantages in that there are no fees to outside managers, and the investor has more control over investment choices. Disadvantages include the possibility of less diversification across investments, higher minimum investment amounts, and greater investor expertise required to evaluate deals and perform their own due diligence.

LOS 76.c: Describe investment ownership and compensation structures commonly used in alternative investments.

Alternative investments are often structured as **limited partnerships**. In a limited partnership, the **general partner (GP)** is the fund manager and makes all the investment decisions. The **limited partners (LPs)** are the investors, who own a partnership share proportional to their investment amounts. The LPs typically have no say in how the fund is managed and no liability beyond their investment in the partnership. The GP takes on the liabilities of the partnership, including the repayment of any partnership debt. Partnerships typically set a maximum number of LPs that may participate.

LPs commit to an investment amount, and in some cases, they only contribute a portion of that initially, providing the remaining funds over time as required by the GP (as fund investments are made). General partnerships are less regulated than publicly traded companies, and limited partnership shares are typically only available to **accredited investors**—those with sufficient wealth to bear significant risk and enough investment sophistication to understand the risks.

The rules and operational details that govern a partnership are contained in the **limited partnership agreement**. Special terms that apply to one limited partner but not to others can be stated in **side letters**. For example, an LP might negotiate an **excusal right** to withhold a capital contribution that the GP would otherwise require. Some limited partners may require that special terms offered to other LPs also be offered to them. This is known as a **most-favored-nation clause** in a side letter.

While most alternative investment limited partnership holdings are illiquid, a fund may be structured as a **master limited partnership (MLP)** that can be publicly traded. Master limited partnerships are most common in funds that specialize in natural resources or real estate.

Fee Structures

The total fees paid by investors in alternative investment funds often consist of a **management fee**, typically between 1% and 2% of the fund's assets, and a **performance fee** or **incentive fee** (sometimes referred to as **carried interest**).

The fund manager earns the management fee, regardless of investment performance. For hedge funds, the management fees are calculated as a percentage of assets under management (AUM), typically the net asset value of the fund's investments. For private equity funds, the management fee is calculated as a percentage of **committed capital**, not invested capital. Committed capital is typically not all invested immediately; rather, it is "drawn down" (invested) as securities are identified and added to the portfolio. Committed capital is usually drawn down over three to five years, but the drawdown period is at the discretion of the fund manager. Committed capital that has not yet been drawn down is referred to as **dry powder**. The reason for basing management fees on committed capital is that otherwise, the fund manager would have an incentive to invest capital quickly instead of selectively.

Performance fees (also referred to as incentive fees) are a portion of profits on fund investments. Most often, the partnership agreement will specify a **hurdle rate** (or **preferred return**) that must be met or exceeded before any performance fees are paid. Hurdle rates can be defined in two ways: either "hard" or "soft." If a **soft hurdle rate** is met, performance fees are a percentage of the total increase in the value of each partner's investment. With a **hard hurdle rate**, performance fees are based only on gains above the hurdle rate.

For example, consider a fund with a hurdle rate of 8% that has produced a return of 12% for the year. We will use a performance fee structure of 20% of gains. If the 8% is a soft hurdle rate, the performance fee will be 20% of the entire 12%, or 2.4%. If the 8% is a hard hurdle rate, the performance fee will be 20% of the gains above the hurdle rate (12% – 8% = 4%), which would be 0.8%.

Typically, performance fees are paid at the end of each year based on the increase in the value of fund investments, after management fees and other charges, which may include consulting and monitoring fees that are charged to individual portfolio companies.

A **catch-up clause** in a partnership agreement is based on a hurdle rate and is similar in its effect to a soft hurdle rate. Consider a fund with returns of 14%, a hurdle rate of 8%, and a 20% performance fee. A catch-up clause would result in the first 8% of gains going to the LPs and the next 2% going to the GP, allowing the GP to "catch up" to receiving 20% of the first 10% of gains. After the catchup, further gains are split 80/20 between the LPs and the GP.

Another feature that is often included is a **high-water mark**, which means no performance fee is paid on gains that only offset prior losses. Thus, performance fees are only paid to the extent that the current value of an investor's account is above the highest net-of-fees value previously recorded (at the end of a payment period). This feature ensures that investors will not be charged performance fees twice on the same gains in their portfolio values. Because investors invest in a fund at different times, they each may have a different high-water mark value.

A partnership's **waterfall** refers to the way in which payments are allocated to the GP and the LPs as profits and losses are realized on deals. With a **deal-by-deal waterfall** (or **American waterfall**), profits are distributed as each fund investment is sold and shared according to the partnership agreement. This favors the GP because performance fees are paid before 100% of the LPs' original investment plus the hurdle rate is returned to them. With a **whole-of-fund waterfall** (or **European waterfall**), the LPs receive all distributions until they have received 100% of their initial investment plus the hurdle rate (typically after all fund investments have been sold).

A **clawback provision** stipulates that if the GP accrues or receives incentive payments on gains that are subsequently reversed as the partnership exits deals, the LPs can recover previous (excess) incentive payments. With a deal-by-deal waterfall, successful deals might be exited initially, while losses are realized later. A clawback provision would allow the LPs to recover these performance fees to the extent that the subsequent losses negate prior gains on which performance fees had been paid.

MODULE QUIZ 76.1

1. Compared with alternative investments, traditional investments tend to:
   A. be less liquid.
   B. have lower fees.
   C. require more specialized knowledge.
2. An investor who wants to gain exposure to alternative investments but does not have the in-house expertise to perform due diligence on individual deals is *most likely* to engage in:
   A. co-investing.
   B. fund investing.
   C. direct investing.
3. Management fees for a private capital fund are determined as a percentage of:
   A. invested capital.
   B. committed capital.

C. assets under management.

4. For an investor in a private equity fund, the *least* advantageous of the following limited partnership terms is a(n):

   A. clawback provision.
   B. European-style waterfall provision.
   C. American-style waterfall provision.

KEY CONCEPTS

LOS 76.a

Alternative investments comprise various types of investments that do not fall under the heading of traditional investments. Categories of alternative investments include the following:

- Hedge funds
- Private capital (private equity and private debt)
- Real assets (real estate, natural resources, and infrastructure)

Alternative investments have relatively low correlations with returns of traditional investments. Compared with traditional investments, alternative investments typically require more specialized knowledge of investment managers. Assets held tend to be less liquid, making alternative investments appropriate for investors who have long time horizons and can commit large amounts of capital.

LOS 76.b

Fund investing refers to pooling assets along with other investors, using a fund manager that selects and manages investments according to an agreed-upon strategy.

Co-investing refers to fund investing that includes the right to invest additional capital directly alongside the fund manager.

Direct investing refers to purchasing assets independently, rather than pooling funds with others or using a specialized outside manager.

LOS 76.c

Many alternative investments are structured as limited partnerships, in which the GP is the fund manager and the LPs are the investors. They are less regulated than publicly traded companies and are typically only available to accredited investors. LPs may commit to an investment amount and, in some cases, contribute only a portion of that initially, providing the remaining funds over time as required by the GP.

Fees in alternative investment funds often consist of a management fee and a performance fee. For hedge funds, management fees are a percentage of assets under management. For private capital, management fees are a percentage of committed capital rather than capital invested.

Performance fees are a portion of profits on fund investments. Typically, a hurdle rate must be exceeded before performance fees are paid. With a soft hurdle rate, performance fees are based on the total increase in the value of each partner's

investment. With a hard hurdle rate, performance fees are based only on gains above the hurdle rate. A high-water mark is a provision that no performance fees are paid on gains that only offset prior losses.

A waterfall refers to the way payments are allocated to the GP and the LPs. With a deal-by-deal or American waterfall, profits are distributed as each fund investment is sold. With a whole-of-fund or European waterfall, the LPs receive all distributions until they have received 100% of their initial investment plus the hurdle rate.

With a clawback provision, if the GP receives incentive payments on gains that are subsequently reversed, the LPs can recover excess incentive payments.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 76.1

1. **B** Traditional investments typically have lower fees, require less specialized knowledge by investment managers, and are more liquid than alternative investments. (LOS 76.a)

2. **B** With fund investing, due diligence on the fund's portfolio investments is a responsibility of the fund manager rather than the fund investors. Direct investing and co-investing require greater due diligence of individual deals on the part of the investor. (LOS 76.b)

3. **B** For a private capital fund, management fees are a percentage of committed capital rather than invested capital. For a hedge fund, management fees are a percentage of assets under management. (LOS 76.c)

4. **C** An American-style waterfall structure has a deal-by-deal calculation of incentive fees to the GP. In this case, a successful deal where incentive fees are paid, followed by the sale of a holding that has losses in the same year, can result in incentive fees greater than those calculated using a European-style (whole-of-fund) waterfall. A clawback provision benefits the limited partners by allowing them to recover performance fees paid earlier if the fund realizes losses later. A clawback provision, coupled with an American-style waterfall, will result in the same overall performance fees as a European-style waterfall if the transactions occur in subsequent years. (LOS 76.c)

READING 77

ALTERNATIVE INVESTMENT PERFORMANCE AND RETURNS

MODULE 77.1: PERFORMANCE APPRAISAL AND RETURN CALCULATIONS

Video covering this content is available online.

LOS 77.a: Describe the performance appraisal of alternative investments.

Alternative investments are typically exposed to greater risks than unleveraged long-only traditional investments. These additional risks arise from the following:

- Timing of cash flows over an investment's life cycle
- Use of leverage by fund managers
- Valuation of investments that may or may not have observable market prices
- Complexity of fees, taxes, and accounting

Ideally, returns on alternative investments should be adjusted for these risks, although that may be difficult in practice. It is clear, however, that evaluating alternative investment returns (or expected returns) without considering these additional risks would be naïve and possibly misleading.

Timing of Cash Flows

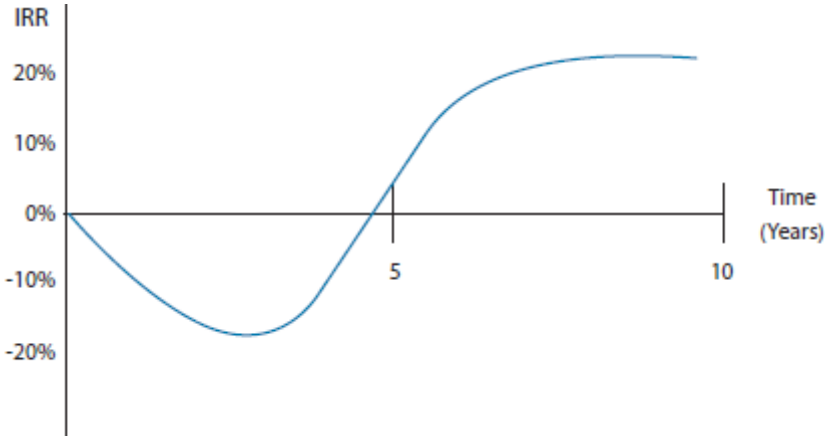
Alternative investments often have a life cycle that exhibits three phases:

1. In the **capital commitment phase**, a fund's managers are identifying investments and making **capital calls** from the partners. Recall that limited partners commit a stated amount of capital that they will invest, but they do not necessarily deliver the entire amount immediately in cash. Managers make capital calls as they identify investments for which they require cash. Because of these cash outflows and the long-term nature of the typical investments, returns tend to be negative during the capital commitment phase.
2. During the **capital deployment phase**, the managers fund, and often involve themselves directly in, the firms or projects in which they invest. Returns typically remain negative in this phase, especially if the investments are in start-up companies or troubled firms that the managers are attempting to turn around.

3. If the fund's investments succeed and begin to generate income and cash flows, the fund enters a **capital distribution phase** during which its returns turn positive and accelerate.

A **J-curve effect** (illustrated in Figure 77.1) reflects the norm of negative returns in the capital commitment phase, followed by increasing returns in the capital deployment phase and maximum returns in the capital distribution phase. Returns may reach a plateau toward the end of a fund's life as the managers exit any remaining investments.

Figure 77.1: J-Curve Example



Given the variability of cash flows over a fund's life and the importance of management decisions in the timing and magnitude of after-tax cash flows, an IRR over the life of a fund is the most appropriate measure of after-tax investment performance. (Recall from Quantitative Methods that a money-weighted rate of return, which is an IRR, is appropriate when a manager controls the timing of cash inflows and outflows.) A drawback to using IRRs is that they rest on assumptions about the cost of capital for cash outflows and the reinvestment rate for cash inflows.

A simpler measure of investment success is the **multiple of invested capital** (or **money multiple**)—the ratio of total capital returned plus the value of any remaining assets, to the total capital paid in over the life of the investment. Because this measure does not consider the timing of cash inflows and outflows, which can affect annual returns on invested capital significantly, it can be considered somewhat naïve.

Use of Leverage

Some alternative investments, particularly hedge funds, use borrowing to magnify their gains (at the risk of magnifying losses). Hedge funds may arrange margin financing with **prime brokers** or employ leverage by means of derivatives.

To state the effect of leverage on returns, consider a fund that can invest the amount V_0 without leverage, and earn the rate of return r. The fund's unleveraged portfolio return (as a money amount) is simply this: r × V_0. Now, let's say this fund can borrow the amount V_B at an interest rate of r_B, and earn r by investing the proceeds. The fund's leveraged portfolio return (again, as a money amount), after subtracting the interest cost, then becomes:

$$r \times (V_0 + V_B) - (r_B \times V_B)$$

Thus, stated as a rate of return on the initial portfolio value of V_0, the leveraged rate of return is as follows:

$$\text{leveraged return} = \frac{r(V_0 + V_B) - r_B V_B}{V_0}$$

One of the reasons that funds use leverage is that some strategies attempt to exploit relatively small pricing anomalies that might not produce meaningful results without leverage. A risk from using leverage is that a lender may issue margin calls if a fund's equity position decreases below a certain level. These can result in a fund having to realize losses by closing positions or liquidating investments at unfavorable prices. If the fund must sell a large position in a security, doing so may depress its price further. Another important risk of funds that depends on leverage is that lenders may limit their access to additional borrowing.

Valuation of Investments

As we have discussed, many alternative investments involve illiquid assets that do not trade frequently in transparent markets. While funds must recognize investments at fair value to comply with accounting standards, fair value might rest on assumptions of which an investor in a fund should be aware. A **fair value hierarchy** groups these assumptions into the following three levels:

- *Level 1.* The assets trade in active markets and have quoted prices readily available, such as exchange-traded securities.
- *Level 2*. The assets do not have readily available quoted prices, but they can be valued based on directly or indirectly observable inputs, such as many derivatives that can be priced using models.
- *Level 3.* The assets require unobservable inputs to establish a fair value, such as real estate or private equity investments, for which there have been few or no market transactions.

Particularly for Level 3 investments, the absence of market activity can result in valuations that remain near their initial cost for long periods. As a result, these values might not reflect the actual exit costs of the investments. Importantly, this relative lack of change in fair values can make reported returns for alternative investments appear higher, less risky, and less correlated with traditional investments than they really are.

Fee Structures

In the next LOS, we will examine some of the effects on investors' returns of different fee specifications, such as high-water marks, hard or soft hurdle rates, and waterfall structures. Keep in mind that fee structures are subject to negotiation (e.g., a limited partner might agree to a higher management fee in exchange for fewer restrictions on redemptions) and may differ depending on how early in a fund's life cycle an investor commits capital. Thus, different investors in the same fund might realize significantly different returns.

LOS 77.b: Calculate and interpret alternative investment returns both before and after fees.

We have seen how margin calls may require a leveraged fund to exit investments at unfavorable prices and unintended times. A similar risk arises from investor **redemptions**. The more negative a fund's returns, the more likely investors are to ask the manager to redeem their positions. For this reason, and because of the J-curve effect of negative returns in the early years, alternative investment funds (particularly hedge funds) typically take measures to restrict early redemptions.

A **lockup period** is the time after initial investment over which limited partners either cannot request redemptions or incur significant fees for redemptions. A **notice period** (typically between 30 and 90 days) is the amount of time a fund has to fulfill a redemption request. Notice periods allow time for managers to reduce positions in an orderly manner. Fund managers often incur significant transactions costs when they redeem shares. **Redemption fees** can offset these costs. Managers may also have the discretion to implement a **gate** that restricts redemptions for a temporary period.

Investors should be aware that other investors may receive terms that differ from those stated in the partnership agreement. Customized fee structures are contained in **side letters** with individual investors detailing how their terms differ from those in the standard offering documents.

Although "2 and 20" and "1 and 10" were, at one time, fairly standard fee structures for fund and fund-of-funds investments, these fee structures continue to be under competitive pressure. Investors making larger commitments can negotiate lower fees. There can also be a tradeoff between liquidity provisions and fees. Investors can negotiate for lower fees or better liquidity (shorter lockups and notice periods). Hurdle rates, hard versus soft hurdles, and catch-up provisions may also be subject to negotiation.

Early investors in a fund may also receive lower fees or better liquidity terms as an incentive to invest at the fund's inception. The investment interests of early investors who receive such relatively better terms are called **founders class shares**.

Annual investor fees can also be **either-or fees**, the maximum of the management fee or the incentive fee. Under such a structure, with a 1% management fee and a 30% incentive fee, investor fees each year would simply be the management fee unless the calculated incentive fee is higher. Such a structure may also stipulate that the 1% management fee be subtracted from the incentive fee in a subsequent year.

Biases in Alternative Investment Returns

Numerous alternative investment indexes exist to measure historical performance. However, they may not provide much meaningful information on the asset class because each fund's structure is unique, and the funds that exist at any given time can be in widely different phases of their life cycles. One way around this latter issue is to compare funds that originated in the same **vintage year**.

The effect of **survivorship bias** is greater for a hedge fund database than for other asset classes because by some estimates, more than 25% of hedge funds fail in the first three years of their existence. An index that does not include failed funds will overstate the returns and understate the risk of hedge funds as an asset class. These effects may be magnified by **backfill bias**, which occurs when managers only select their successful funds for inclusion in indexes.

Return Calculations for Alternative Investments

Before-fee returns on alternative investments are calculated the same way we calculate returns on any investment. The calculation of holding period returns and periodic rates of return, both with and without interim cash distributions, is described in Quantitative Methods and expanded on by application in other topic areas.

Calculating after-fee returns simply requires adjustment of the cash flows or values for the various fees involved, typically management and performance fees. For a simple case in which management fees are a fixed percentage of end-of-period assets and performance fees are a fixed percentage of total return with no hurdle rate, we can state the general partner's total fees in money terms as follows:

$$\text{total fees} = mV_1 + \max\left[0, p(V_1 - V_0)\right]$$

where:
m = management fee
p = performance fee
V_0 = beginning-of-period assets
V_1 = end-of-period assets

This is the rate of return for an investor after fees:

$$r = \frac{V_1 - V_0 - \text{total fees}}{V_0}$$

Fee structure provisions, such as hurdle rates and high-water marks, make calculating total fees more complex than this simple formula. Other provisions may state whether the performance fee is net of the management fee or independent of it, or whether the management fee is based on beginning-of-period assets or end-of-period assets.

PROFESSOR'S NOTE
Because none of these provisions are standard across alternative investment funds, exam questions that require calculations will have to specify all of those that apply. Do not assume any provision applies unless it is stated in the question.

Some examples will illustrate the application of various fees and the relevant terminology.

EXAMPLE: Hedge fund fees

BJI Funds is a hedge fund with a value of $110 million at initiation. BJI Funds charges a 2% management fee based on assets under management at the beginning of the year and a 20% performance fee with a 5% soft hurdle rate, and uses a high-water

mark. Performance fees are calculated on gains net of management fees. The year-end values before fees are as follows:

- Year 1: $100.2 million
- Year 2: $119.0 million

Calculate the total fees and the investor's after-fee return for both years.

Answer:

Year 1:

Management fee:

110.0 million × 2% = $2.2 million

Return net of management fees:

$$\frac{100.2 - 2.2}{110.0} - 1 = -10.9\%$$

There is no performance fee because the return after the management fee is less than the 5% hurdle rate.

Total fees:

$2.2 million

Ending value net of fees:

100.2 million – $2.2 million = $98.0 million

Year 1 after-fees return:

$$\frac{98.0}{110.0} - 1 = -10.9\%$$

Year 2:

Management fee:

98.0 million × 2% = $1.96 million

Year-end value net of management fee:

$119.0 – $1.96 = $117.04 million

The high-water mark is $110 million.

Year 2 value net of management fee, above high-water mark:

117.04 million – 110.0 million = $7.04 million

Year 2 return net of management fee, above high-water mark:

$$\frac{7.04}{110.0} = 6.4\%$$

Due to the high-water mark, the performance fee is calculated based on gains in value above $110 million.

The performance fee is calculated on the entire gain above the high-water mark because 6.4% is greater than the soft hurdle rate. If the 5% was a hard hurdle rate,

the performance fee would be calculated only on the gains more than 5% above the high-water mark.

Performance fee:

7.04 × 0.20 = $1.41 million

Total fees:

$1.96 million + $1.41 million = $3.37 million

Year 2 year-end value after fees:

119.0 – 3.37 = $115.63 million

Year 2 after-fee return:

$$\frac{115.63}{98.0} - 1 = 18.0\%$$

EXAMPLE: Fund-of-funds

An investor makes a total investment of $60 million in a fund-of-funds that has a "1 and 10" fee structure, with management and performance fees calculated independently based on year-end values. Of the $60 million investment, $40 million is allocated to the Alpha fund and $20 million is allocated to the Beta fund. One year later, the value of the Alpha fund investment is $45 million, and the value of the Beta fund investment is $28 million, both net of fund fees. Calculate the investor's return for the year net of fees.

Answer:

At year-end, the gross value of the investor's investment is $45 + $28 = $73 million.

The fund-of-funds management fee is 1% of $73 million, which is $0.73 million.

The investor's gain for the year before fund-of-funds fees is $73 – $60 = $13 million.

The fund-of-funds manager's performance fee is 10% of $13 million, which is $1.3 million.

The year-end value of the investor's fund-of-funds investment is $73 – $0.73 – $1.3 = $70.97 million.

The investor's one-year return after fees is: $\frac{70.97}{60} - 1 = 18.3\%$

Note that the same investments made directly with the Alpha and Beta funds would have returned $\frac{73}{60} - 1 = 21.7\%$.

EXAMPLE: Waterfall structure and clawback provision

A private equity fund invests $100 million in a venture company that is sold for $130 million. The fund also invests $100 million in an LBO that goes poorly and is liquidated for $80 million.

1. If the carried interest performance fee for the GP is 20% and there is no clawback provision, calculate the investor's return after performance fees, assuming the investment outcomes are realized in the same year under the following:
   a. An American-style (deal-by-deal) waterfall structure
   b. A European-style (whole-of-fund) waterfall structure
2. How would the answers be affected if the venture investment was sold in Year 1 and the LBO investment was sold in Year 2?
3. How would including a clawback provision affect investor returns calculated in Question 1?

Answer:

1. Under an American-style (deal-by-deal) waterfall structure, a performance fee of 20% × ($130 – $100) = $6 million would be paid on the venture investment. Because there is a loss on the LBO investment, no performance fee is paid.

   investor's return on investment: $\frac{130 + 80 - 6}{200} - 1 = 2\%$

   Under a European-style (whole-of-fund) waterfall structure, the gain for the period is 130 + 80 – 200 = $10 million, and the performance fee is 20% × 10 = $2 million.

   investor's return on investment: $\frac{130 + 80 - 2}{200} - 1 = 4\%$

2. The European-style waterfall structure would have the same overall return as the American-style structure, as the performance fee for the venture investment of $6 million would be paid in Year 1 and no performance fee would be received on the LBO investment.
3. With a clawback provision, after the LBO investment is sold, the performance fee of $6 million paid on the venture investment is more than 20% of the return on the total investment. The fee is 60% of the total (net) gain of $10 million. The investor could "claw back" $4 million of the $6 million paid as a performance fee on the venture investment, which would reduce the total performance fee to 20% of the $10 million gain.

MODULE QUIZ 77.1

1. Returns to investors in an alternative investment fund are *most likely* to be positive during its phase of capital:
   A. distribution.
   B. deployment.
   C. commitment.
2. A hedge fund has a return of 30% before fees in its first year. The fund has a management fee of 1.5% on end-of-year fund value and a 15% incentive fee, with an 8% hard hurdle rate on gains net of the management fee. The return after fees for an investor in this fund is *closest* to:
   A. 20.5%.
   B. 21.5%.

C. 25.0%.

3. A private equity fund has a "2 and 20" fee structure with the performance fee independent of management fees. The fund will sell a holding for a profit of 9%. The hurdle rate is specified as 8%. The provision that would result in an incentive fee of 1% is a:

   A. hard hurdle rate.
   B. soft hurdle rate.
   C. catch-up provision.

KEY CONCEPTS

LOS 77.a

Alternative investments are typically exposed to risks that traditional investments are not, including timing of cash flows, use of leverage, valuation assumptions for illiquid investments, and complex fee structures and taxation.

Alternative investment returns typically exhibit a J-curve effect: negative during the capital commitment phase, less negative during the capital deployment phase, and positive during the capital distribution phase.

Because managers control cash inflows and outflows, an IRR is appropriate for measuring returns. The multiple of invested capital is a simpler measure that does not depend on the timing of cash flows:

$$\text{leveraged return} = \frac{r(V_0 + V_B) - r_B V_B}{V_0}$$

where:
V_0 = initial assets
V_B = borrowed funds
r = rate of return on investments
r_B = borrowing interest rate

Assumptions underlying the fair value of assets can be described by a three-level hierarchy:

- *Level 1*. Quoted prices readily available.
- *Level 2*. Can be valued based on observable inputs.
- *Level 3*. Require unobservable inputs to establish a fair value.

Fair values of Level 3 assets might be updated infrequently due to a lack of market activity. This can bias return measures upward and risk measures downward.

LOS 77.b

Before-fee returns on alternative investments are calculated the same way we calculate fees on any investment. Calculating after-fee returns requires us to adjust the cash flows or values for the various fees involved (typically management and performance fees), and for specifications such as hurdle rates and high-water marks.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 77.1

1. **A** A successful fund is most likely to generate positive returns in its capital distribution phase. (LOS 77.a)

2. **C** This is easiest to see using an initial investment amount of 100.

   Year-end gross value = 100 × 1.30 = 130

   Management fee = 1.5% × 130 = 1.95

   Gains net of management fee = 30 – 1.95 = 28.05

   Hurdle gains = 8% × 100 = 8

   Incentive fee = 15% × (30 – 1.95 – 8) = 3.0075

   Total fees = 1.95 + 3.0075 = 4.9575

   Ending value after fees = 130 – 4.9575 = 125.0425

   Return after fees = 125.0425 / 100 – 1 = 25.0425%

   (LOS 77.b)

3. **C** With a catch-up provision, the limited partners receive the first 8% of gross return, and the general partner gets all returns above that to a maximum of 2%. Gains above that are shared 80% to the limited partners and 20% to the general partner.

   With a soft hurdle rate of 8%, the performance fee would be 20% of 9%, or 1.8%.

   With a hard hurdle rate of 8%, the performance fee would be 20% of (9% – 8%), or 0.2%.

   (LOS 77.b)

READING 78

INVESTMENTS IN PRIVATE CAPITAL: EQUITY AND DEBT

MODULE 78.1: PRIVATE CAPITAL

Video covering this content is available online.

LOS 78.a: Explain features of private equity and its investment characteristics.

Private capital is the funding provided to companies that is not raised from the public markets. Private capital includes private equity and private debt.

Private equity is equity capital raised from sources other than the public markets. Private equity funds usually invest in private companies or public companies that they plan to take private (leveraged buyout funds) or in early in companies' lives (venture capital funds). The companies in which a private equity fund invests are called its **portfolio companies**.

Private Equity Investment Categories

A popular type of private equity fund is the **leveraged buyout (LBO)** fund, which acquires public companies with a large percentage of the purchase price financed by debt. LBOs are a way for a company to "go private" because after the transaction, the target company's stock is no longer publicly traded.

In an LBO, the private equity firm seeks to add value by improving or restructuring the portfolio company's operations to increase its sales, profits, and cash flows. The cash flows can then be used to service and pay down the debt taken to fund the acquisition.

Two of the various types of LBOs are **management buyouts (MBOs)**, in which the portfolio company's existing management team participates in the purchase, and **management buy-ins (MBIs)**, in which the private equity manager replaces the portfolio company's current management team with a new team.

Venture capital (VC) funds provide financing to companies in the early stages of their development. VC funds typically receive common equity interest in the portfolio companies, but they may also get convertible debt or convertible preferred stock. Convertible securities help to align the interests of the VC investors and the start-up firm, in that both want to increase the value of the firm, but give the VC investors a higher priority of claims in the event of liquidation.

VC investment involves a high level of risk, but the returns can be substantial. VC investors are actively involved in developing their portfolio companies, often sitting on the boards or filling key management roles.

We can classify VC investments by the portfolio company's stage of development:

1. The **formative stage** refers to investments made during a firm's earliest period and comprises three different phases:
   - **Pre-seed capital** or **angel investing** is the capital provided at the idea stage. The investment funds are used for business plans and assessing market potential. The amount of financing is usually small, coming from individuals ("angels") rather than VC funds.
   - **Seed-stage financing** or **seed capital** generally supports product development, marketing, and market research. This is the first stage at which VC funds usually invest.
   - **Early-stage financing** or **start-up stage financing** refers to investments made to fund operations in the lead-up to production and sales.
2. **Later-stage financing** or **expansion venture capital** comes after production and sales have begun. Investment funds provided at this stage are used to support initial growth, expansion, product improvement, or marketing. In this stage, the owners (typically the founders and managers of the company) often sell control of the company to VC investors.
3. **Mezzanine-stage financing** refers to capital provided to prepare the firm for an initial public offering (IPO). The term *mezzanine stage* is used to indicate the timing of the financing rather than the method. A similar term, *mezzanine financing*, refers to hybrids of equity and debt, such as convertible securities. Mezzanine-stage financing can use these, but more often, it consists of equity or short-term debt.

A private equity firm that engages in **minority equity investing** buys a less-than-controlling interest in public companies that are looking for capital with which to expand. One way it can make such investments is through a **private investment in public equity (PIPE)**, a private offering to institutional investors that allows a publicly traded firm to raise capital more quickly and cost effectively than a public offering, with fewer disclosures and lower transaction costs.

Private Equity Exit Strategies

Private equity firms typically add value to young companies, then sell them, with an average holding period of five years. Funds have several methods of exiting an investment in a portfolio company:

1. **Trade sale.** Sell a portion of the private company to a strategic buyer via direct sale or auction. An advantage of a trade sale is that the strategic investor typically pays a premium to realize synergies with an existing business. Advantages compared with an IPO include faster execution and lower transaction costs. Disadvantages of a trade sale include potential resistance from the portfolio company's management and employees, as well as a limited universe of potential buyers.
2. **Public listing.** Listing on a stock exchange can take place through an IPO, a direct listing, or a special purpose acquisition company:

- IPOs are the most common method of public listing, using investment banks to underwrite the offering. Compared to other methods, IPOs typically realize a higher price for the portfolio company. They may also improve its visibility to investors and the public, which can be positive for the value of shares that the private equity fund retains. However, IPOs involve high transaction and compliance costs and might not always be received favorably by the investing public. Portfolio companies best suited for exit via IPO are large firms in growing industries that have stable finances and clear strategies.
- A less frequently used alternative to an IPO is a **direct listing**, in which the stock of the company is floated on the public market directly without underwriters. This decreases the cost of the transaction, but does not raise new capital for the portfolio company.
- A **special purpose acquisition company (SPAC)** is an entity (sometimes referred to as a blank check company) set up solely to raise capital that it will use to acquire an unspecified private company within a stated time period; otherwise, it must return the capital to investors. This method can be more flexible than an IPO and reduce the uncertainty about the valuation of the portfolio company, as well as provide access to investors who transact regularly with the sponsors. However, SPACs have numerous disadvantages, including dilutive effects from SPAC shares and warrants, a spread between the value of the SPAC and the value of the acquired company, deal risk in the acquisition, and **stockholder overhang** from SPAC shareholders selling shares after the acquisition is announced. Scrutiny from securities regulators is also increasing.

3. **Recapitalization.** The company issues debt to fund a dividend distribution to equity holders. This is not an exit, in that the fund still controls the company, but a recapitalization allows the private equity fund to extract money from the company to pay its investors.
4. **Secondary sale.** Sell a portfolio company to another private equity firm or a group of investors.
5. **Write-off/liquidation.** Reassess and take losses from an unsuccessful investment in a portfolio company.

Risk and Return From Private Equity Investments

Empirical evidence shows that returns on private equity funds have been higher on average than overall stock returns. However, the standard deviation of private equity returns has been higher than the standard deviation of equity index returns, suggesting higher risk, including illiquidity and leverage risks. Furthermore, private equity indexes typically rely on self-reporting and are subject to survivorship and backfill biases, both of which lead to overstated returns. Because portfolio companies are revalued infrequently, measures of volatility and correlation with other investments may be biased downward.

LOS 78.b: Explain features of private debt and its investment characteristics.

Private debt refers to various forms of debt provided by investors directly to private entities. Categories of private debt include the following:

1. **Direct lending** refers to loans made directly to a private company without an intermediary. The debt is typically senior and secured, with covenants to protect the lender. A **leveraged loan** is a loan made by a private debt fund using money borrowed from other sources. That is, the fund's portfolio of loans is leveraged to magnify returns.

2. **Venture debt** is funding that provides VC backing to start-up or early-stage firms that are not yet profitable. Venture debt is often convertible to stock or combined with warrants. Managers of young companies may favor venture debt because it allows them to maintain ownership and control.
3. **Mezzanine debt** is private debt that is subordinated to senior secured debt. Mezzanine debt may have special features, such as conversion rights or warrants, to compensate investors for additional risk.
4. **Distressed debt** is the debt of mature companies in financial trouble, such as bankruptcy or default. In many cases, the fund becomes active in restructuring the existing debt or making other changes that increase the value of the acquired debt. Some distressed debt investors specialize in identifying otherwise good companies with temporary cash flow problems, anticipating that the value of the company and its debt will recover. Others focus on turnaround situations, acquiring a company's debt with an intent to be active in managing and restructuring the company.
5. **Unitranche debt** combines different classes of debt (secured and unsecured) into a single loan with an interest rate that reflects the blend of debt classes. The resulting debt typically ranks between senior and subordinated debt.

Private debt investments typically provide a higher rate of return relative to traditional bonds to compensate investors for higher risk and a lack of liquidity. Investors may also benefit from increased portfolio diversification because private debt returns have relatively low correlations with other traditional investments.

The interest rate of private debt is usually set relative to a reference rate, such as the Secured Overnight Financing Rate (SOFR). Therefore, the rate changes when the reference rate fluctuates due to changes to the interest rate environment.

The potential for higher returns of private debt is associated with higher risk, including illiquidity and default risk. Private debt investing requires specialized knowledge about the structure of the debt, the borrower's life cycle phase, and the features of the underlying assets for secured lending. Senior private debt has less risk and steadier yields than private mezzanine debt, but mezzanine debt offers greater upside potential.

LOS 78.c: Describe the diversification benefits that private capital can provide.

Private capital investments can provide some diversification benefit to a portfolio of traditional investments. Empirical evidence indicates that correlations of private capital fund index returns with public market index returns range from 0.63 to 0.83.[1]

Each private equity fund has a **vintage year**, which is the year the fund made its first investment. The performance of a fund is greatly influenced by its vintage year and the phase of the business cycle in that year. Funds that begin investing during a business cycle expansion are likely to earn higher rates of return if they specialize in early-stage companies. Funds that begin investing during business cycle contractions are likely to earn higher rates of return if they specialize in distressed companies. Investors in private capital should diversify across vintage years.

Risk and return profiles vary among categories of private capital. Private equity has the highest risk and return, followed by mezzanine debt, unitranche debt, senior direct lending, senior real estate debt, and infrastructure debt.

MODULE QUIZ 78.1

1. In which stage of a firm's development is a venture capital fund *most likely* to make its initial investment?
   A. Start-up.
   B. Seed capital.
   C. Angel investing.
2. In a secondary sale, a private capital firm sells one of its portfolio companies to:
   A. the public.
   B. a competitor in its industry.
   C. another private capital fund.
3. Unitranche debt is *best* described as:
   A. combining different classes of debt into a single loan.
   B. having special features, such as conversion rights or warrants.
   C. a loan made by a private debt fund using money borrowed from other sources.
4. Which type of private capital fund is *most likely* to earn excess returns over its life if its vintage year took place during an economic contraction?
   A. Venture capital fund.
   B. Distressed debt fund.
   C. Leveraged buyout fund.

KEY CONCEPTS

LOS 78.a

Private equity funds usually invest in the equity of private companies or companies wanting to become private, often financing their assets with high levels of debt:

- Venture capital funds provide capital to companies early in their development. Stages of venture capital investing include the formative stage (composed of the angel investing, seed, and early stages), the later stage (expansion), and the mezzanine stage (prepare for IPO).
- Leveraged buyouts include management buyouts, in which the existing management team is involved in the purchase, and management buy-ins, in which an external management team replaces the existing management.
- Developmental capital or minority equity investing refers to providing capital for business growth or restructuring. The firms financed may be public or private. In the case of public companies, such financing is referred to as a private investment in public equity.

Methods for exiting investments in portfolio companies include trade sale (sell to a competitor or another strategic buyer), IPO (sell some or all shares to investors), recapitalization (issue portfolio company debt), secondary sale (sell to another private equity firm or other investors), or write-off/liquidation.

LOS 78.b

Private debt refers to lending to private entities. Private debt investments include direct lending, venture debt, mezzanine loans, distressed debt, and unitranche debt. Private debt investing requires specialized knowledge about the structure of the debt, the borrower's life cycle phase, and the features of the underlying assets.

LOS 78.c

Private capital investments can provide some diversification benefit to a portfolio of traditional investments because their correlations of returns with traditional investments are relatively low.

Investors in private capital should diversify across vintage years. Funds that begin investing during a business cycle expansion are likely to earn higher rates of return if they specialize in early-stage companies. Funds that begin investing during business cycle contractions are likely to earn higher rates of return if they specialize in distressed companies.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 78.1

1. **B** VC funds typically make their initial investments during a firm's seed stage for product development, marketing, and market research. At the angel investing stage, the funding source is usually individuals rather than VC funds. The start-up stage or early stage follows the seed stage and refers to investments made to fund initial commercial production and sales. (LOS 78.a)

2. **C** In a secondary sale, a private capital firm sells one of its portfolio companies to another private capital fund or group of private investors. Selling a portfolio company to a competitor in its industry is known as a trade sale. Selling a portfolio company to the public requires an IPO. (LOS 78.a)

3. **A** Unitranche debt refers to combining different classes of debt into a single loan with an interest rate that reflects the blend of debt classes. (LOS 78.b)

4. **B** Funds with vintage years during contractions are likely to earn higher rates of return if they specialize in distressed companies. Funds with vintage years during expansions are likely to earn higher rates of return if they specialize in early-stage companies. (LOS 78.c)

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[1] Preqin, annualized quarterly return of Private Capital Quarterly Index rebased to December 31, 2007.

READING 79

REAL ESTATE AND INFRASTRUCTURE

MODULE 79.1: REAL ESTATE

Video covering this content is available online.

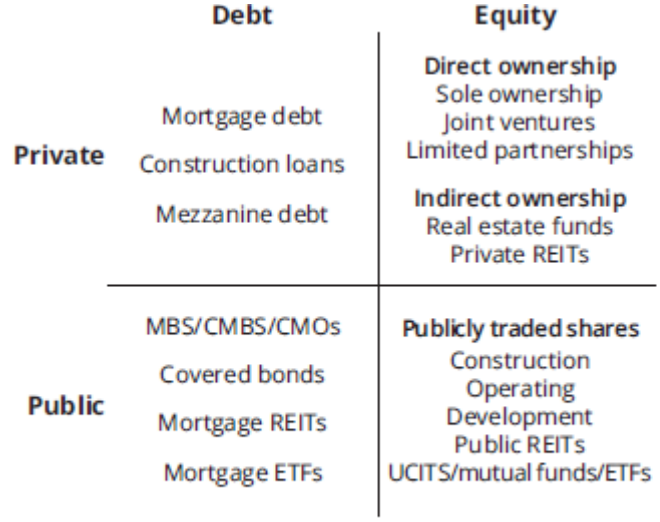
LOS 79.a: Explain features and characteristics of real estate.

Real estate can provide income in the form of rent, as well as the potential for price appreciation. Investment in real estate can be made directly in properties or indirectly through limited partnerships and publicly traded securities. The types of real estate we will discuss here include single-family residential and commercial. The four largest subcategories of commercial real estate are office buildings, shopping, industrial/warehouse/distribution, and rental residential (single-family detached and multifamily apartment).

As shown in Figure 79.1, real estate investment can be described in terms of a quadrant. In the first (vertical) dimension, investment is differentiated between public and private real estate.

- In the private market, ownership usually involves direct investment, such as purchasing property or lending money to a purchaser. Direct investments can be solely owned or indirectly owned through partnerships, where the general partner (GP) provides property management services and limited partners (LPs) are investors (e.g., pension plans).
- The public market does not involve direct investment. Rather, ownership involves securities that serve as claims on the underlying assets. Public real estate investment includes ownership of real estate investment trust (REIT) shares, equity in a real estate company, exchange-traded funds (ETFs), residential mortgage-backed securities (MBSs), commercial mortgage-backed securities (CMBSs), mortgage REITs, and mortgage ETFs.

Figure 79.1: Basic Forms of Real Estate Investments[1]



1 Reproduced from Level I CFA Curriculum learning module, "Real Estate and Infrastructure," Exhibit 2, with permission from CFA Institute.

The second (horizontal) dimension describes whether a real estate investment is in debt or equity.

- An equity investor has an ownership interest in real estate or securities of an entity that owns real estate. Equity investors control decisions such as borrowing money, property management, and the exit strategy.
- A debt investor is a lender that owns a mortgage or mortgage-backed securities. A mortgage is collateralized (secured) by the underlying real estate. The lender has a higher priority claim than an equity investor in the event of default. Because the lender must be repaid first, the value of an equity investor's interest is equal to the value of the property less the value of outstanding debt.

Each of the basic forms has its own risk, expected returns, regulations, legal issues, and market structure. Private real estate investments are usually larger than public investments because real estate is indivisible and illiquid. With public real estate investments, the investors can divide ownership without having to divide the property. As a result, public real estate investments are liquid and enable investors to diversify by participating in more properties.

Private real estate investment requires property management expertise on the part of the owner. In the case of publicly traded securities or private limited partnerships, the real estate is professionally managed.

Direct Real Estate Investment

Direct investment involves purchasing and financing a real estate investment. Benefits of direct investment include the following:

- *Control*. The owner can decide on what to purchase, how to finance it, what improvements to make, to which segment of tenants to market the property, and when to sell.
- *Diversification*. Real estate returns are less than perfectly correlated with the returns of stocks and bonds. Thus, adding private real estate investment to a portfolio can

reduce risk relative to the expected portfolio return.

- *Tax benefits*. Real estate can provide deductions for noncash depreciation (even as properties typically appreciate) as well as interest expense.

Drawbacks of direct real estate investment include the following:

- Illiquidity and price opacity
- Complexity of managing property
- Need for specialized knowledge about current market conditions
- High initial investment/capital needed
- Concentration risk if a portfolio has one or few properties

Indirect Real Estate Investment

Indirect investments in real estate can be through limited partnerships, joint ventures, or publicly traded securities. REITs are a popular form of investment for income-producing real estate as they are exempt from double taxation. REITs are exchange traded, and therefore (unlike mutual funds) they do not face redemption/liquidation risk. REITs have managers with the specialized knowledge necessary to invest in properties successfully. REITs report GAAP metrics such as earnings per share (EPS). Some REITs also provide non-GAAP metrics such as net asset value.

Types of REITs include equity REITs, which invest in real estate directly or via partnerships; mortgage REITs, which lend money for real estate or invest in MBSs/CMBSs; or hybrid REITS that invest in both real estate and mortgages.

REITs that pursue **core real estate strategies** invest in high-quality commercial and residential properties that deliver stable returns. These REITs typically have open-end structures with indefinite lives. Like open-end mutual funds, this structure gives investors the opportunity to invest or redeem at any time.

REITs with riskier investment strategies are most often structured as closed-end funds with finite lives. These strategies include:

- **Core-plus real estate strategies**, which accept a bit more risk than core strategies by undertaking modest development and redevelopment.
- **Value-add real estate strategies**, which undertake development and redevelopment on a somewhat larger scale than core-plus strategies.
- **Opportunistic real estate strategies**, which pursue large-scale redevelopment and repurposing of assets, invest in distressed properties, or speculate on upturns in real estate markets.

LOS 79.b: Explain the investment characteristics of real estate investments.

Among real estate investments, first mortgages or investment-grade CMBSs are the least risky and are similar to investing in bonds. Core strategies are the next-least risky and also have bond-like characteristics, in that they receive stable rental income from

many lessors (i.e., a diversified income pool). Value-add and opportunistic strategies are the most risky and are more equity-like in their risk-and-return characteristics.

Because REITs invest in many properties, they provide diversification benefits in addition to liquidity of a publicly traded security. However, the correlation of REIT returns with equity returns is higher than that for direct investment, and correlations increase during steep market downturns. Even so, real estate investments do improve the risk-return profile of a portfolio relative to one comprising only traditional asset classes.

MODULE QUIZ 79.1

1. Which of the following is *most likely* an advantage of direct real estate investment as compared to investing in a REIT?
   A. Diversification within the asset class.
   B. Higher liquidity.
   C. Greater control.
2. Which of the following real estate investment strategies is less risky than a core real estate strategy?
   A. First mortgage debt.
   B. Core-plus strategies.
   C. Opportunistic strategies.

MODULE 79.2: INFRASTRUCTURE

Video covering this content is available online.

LOS 79.c: Explain features and characteristics of infrastructure.

Infrastructure investments include transportation assets (e.g., roads, airports, ports, railways), utility assets (e.g., gas distribution facilities, electric generation and distribution facilities, and waste disposal and treatment facilities), information and communication technology (e.g., telecom towers and cable systems), and social infrastructure (e.g., prisons, schools, and health care facilities).

One way to invest in infrastructure is to construct the assets and either sell or lease them to the government or operate them directly. Alternatively, an investor might buy existing assets from a government to lease back or operate. Infrastructure investments can also be made by a **public-private partnership**.

Cash flows generated from infrastructure investments include **availability payments** for making the infrastructure available, **usage-based payments** such as highway tolls, and **take-or-pay arrangements** that require the buyer to pay minimum purchase price for an agreed-upon volume.

Investments in infrastructure assets that are to be constructed are referred to as **greenfield investments**. Greenfield investments typically follow a life cycle known as **build-operate-transfer (BOT)**, with cash outflows during the building phase, increasing cash inflows as the private investor begins operating the facility, and finally a transfer of the facility to a government entity or a third party.

Investments to expand or privatize an existing infrastructure asset are known as **brownfield investments**. An example of a brownfield investment is a sale-leaseback arrangement whereby the asset is purchased from and leased back to the government. Investments in fully operational facilities that do not need any further development are called **secondary-stage investments**.

Infrastructure assets typically have a long life and are quite large in cost and scale, so direct investment in them has low liquidity. However, more liquid investments backed by infrastructure assets are available through ETFs, mutual funds, private equity funds, or master limited partnerships (MLPs). Publicly traded vehicles for investing in infrastructure are a small part of the overall universe of infrastructure investments and are relatively concentrated in a few categories of assets. Debt issued to fund infrastructure can be privately placed or publicly traded.

LOS 79.d: Explain the investment characteristics of infrastructure investments.

In general, investing in brownfield investments provides stable cash flows and relatively high current yields, but offers little potential for growth. Secondary-stage brownfield investments (e.g., existing toll roads and hospitals) are the least risky and offer the lowest return. Greenfield investments (e.g., new toll roads, renewable energy facilities) are subject to more uncertainty and may provide relatively lower yields in the near term, but offer greater growth potential. Infrastructure projects that rely on revenues from uncertain future demand tend to be the riskiest.

Because of long-term contracts and barriers to entry, cash flows from equity investment in infrastructure are stable and have low correlation with public equities. Infrastructure debt also tends to be safer and less affected by economic cycles. Greenfield investments in developing economies, while risky, have generated attractive returns over the long term as they benefit from increasing per-capita incomes and wealth.

Investing in infrastructure assets can provide diversification benefits, but investors should be aware that these investments are often subject to regulatory risk, risk from financial leverage, and the possibility that cash flows will be less than expected. Projects that involve building infrastructure assets have construction risk. When the assets are operated by a private owner, operational risk must also be considered.

Infrastructure investments tend to be most suitable for long-term institutional investors such as pension plans, life insurance companies, and sovereign wealth funds.

MODULE QUIZ 79.2

1. Which of the following infrastructure investments provides the greatest degree of certainty about cash flows?
   A. Secondary-stage investments.
   B. Sale and leaseback arrangements.
   C. Greenfield investments.
2. Which of the following is *best* characterized as a direct investment in infrastructure?
   A. Infrastructure exchange-traded fund.

B. Master limited partnership.
C. First mortgage on a toll road.

3. Which of the following infrastructure projects is *most likely* to offer the highest expected return?
   A. First-lien mortgage on an existing toll road.
   B. Equity investment in a new airport in a developed country.
   C. Equity investment in a new passenger rail line in a developing country.

KEY CONCEPTS

LOS 79.a

Equity or debt investments in real estate can be direct or indirect. Advantages of direct (equity) investment include more operational control, higher tax savings, and diversification to reduce portfolio risk. Drawbacks of direct real estate investment include illiquidity, operational complexity, a need for specialized knowledge, high initial investment, and concentration risk.

Publicly traded securities such as REITs offer liquidity, professional management, exposure to a diversified pool of real estate, and exemption from double taxation. REITs following core strategies invest in high-quality commercial property. Core-plus strategies involve higher risk as they entail some redevelopment of the properties acquired. Value-add strategies take even more risk as they seek to undertake major redevelopment. Opportunistic strategies have the highest risk.

LOS 79.b

Real estate investments with bond-like risk-and-return characteristics include senior debt (the least risky) and core strategies. Real estate investments with equity-like characteristics include core-plus, value-add, and opportunistic strategies.

LOS 79.c

Infrastructure investments include transportation assets, utility assets, information and communication technology, and social infrastructure.

Brownfield investments are already constructed infrastructure facilities, while greenfield investments are yet to be constructed. Fully operational facilities that generate stable cash flows are called secondary-stage brownfield investments.

LOS 79.d

Brownfield investments are less risky than greenfield investments. Demand-based infrastructure projects tend to be the riskiest. Equity investment in infrastructure has a low correlation with public equities, while debt tends to be safer and less affected by economic cycles.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 79.1

1. **C** Direct investments tend to have lower diversification within the asset class (concentration risk), lower liquidity, but greater control (deciding on which property to invest/develop/sell) relative to investment in REITs. (LOS 79.a)

2. **A** The risk levels (lowest to highest) are senior debt, core strategies, core-plus strategies, value-add strategies, and opportunistic strategies. (LOS 79.b)

Module Quiz 79.2

1. **A** Secondary-stage investments are brownfield investments that are fully operational, do not require further investment, and generate predictable periodic cash flows. Other brownfield investments, such as the privatization of public assets or sale and leaseback arrangements, may have a short operating history and uncertainty of cash flows. Greenfield investments tend to be the most risky, requiring development of new assets with uncertain cash flows. (LOS 79.c)

2. **C** A first mortgage on a toll road is a direct debt investment in infrastructure. The other choices are indirect investments. (LOS 79.c)

3. **C** Projects that are most risky would generally have the highest expected returns. A new rail line in a developing country is a greenfield investment. Greenfield investments in developing economies, while risky, have generated attractive returns over the long term as per-capita incomes and wealth increase. An existing toll road is a brownfield investment, the debt of which is likely to be less risky and therefore offer a lower expected return. A greenfield investment in a developed country would most likely be in the middle of risk and return profile of the other two choices. (LOS 79.d)

READING 80

NATURAL RESOURCES

MODULE 80.1: FARMLAND, TIMBERLAND, AND COMMODITIES

Video covering this content is available online.

LOS 80.a: Explain features of raw land, timberland, and farmland and their investment characteristics.

Natural resources comprise raw land, land used for growing crops or timber, and commodities. Investment in natural resources can be a direct investment or via commingled funds such as exchange-traded funds, real estate investment trusts (REITs), limited partnerships, and limited liability companies (LLCs). Derivatives such as commodity futures and swaps are also commonly used for exposure to this asset class.

Raw land, farmland, and timberland are all illiquid investments, and their value is primarily driven by location. For timberland and farmland, proximity to transportation and markets increases value, as does access to water and quality of soil. While all three kinds of land can generate lease income and price appreciation, farmland and timberland also generate income from their output.

Farmland is primarily held by individuals, while institutions are most likely investors in raw land and timberland. Timberland lot sizes tend to be much larger than farmland. Timberland also requires specialized expertise. Investors who lack the expertise can invest through **timberland investment management organizations (TIMOs)**.

Farmland and timberland have fewer financing alternatives than residential and commercial real estate. Financing is often in the form of bank loans or direct private debt. Newer REITs in farmland allow retail investors to get a foothold in this category.

While most agricultural crops must be harvested within a short period, the choice of when to harvest timber is based on current prices and expected growth rates. Because commodity prices fluctuate, farmers often use short positions in commodity futures to hedge their expected harvest. Agricultural crops (including trees) consume carbon, and therefore, they are attractive to investors with an environmental, social, and governance (ESG) focus on climate change.

LOS 80.b: Describe features of commodities and their investment characteristics.

We can divide commodities into three major sectors: metals (including base or industrial metals and precious metals), agricultural products, and energy products. Commodity contracts are also classified based on grade (quality) and delivery location.

Governments may provide subsidies for some food crops for consumers or price support to farmers. They may also control access to extractable natural resources or even be directly involved in production. Climate change–related regulation may decrease demand for fossil fuels while increasing demand for minerals such as lithium, cobalt, and nickel.

While it is possible to invest directly in commodities such as grain and gold, derivatives such as futures are more commonly used to gain exposure to commodities. Because commodities are physical goods, they have costs for storage and transportation.

Futures, forwards, and options on futures are all available forms of commodity derivatives. Futures trade on exchanges and therefore have no counterparty risk.

Other methods of exposure to commodities include the following:

- Exchange-traded products (ETPs) include **exchange-traded funds (ETFs)** or **exchange-traded notes (ETNs)**. ETPs are suitable for investors who are limited to buying equity shares. ETFs can invest in commodities or commodity futures and can track prices or indexes.
- **Managed futures funds**, such as **commodity trading advisers (CTAs)**, are actively managed. Some managers concentrate on specific sectors (e.g., agricultural commodities), while others are more diversified. Managed futures funds can be structured as limited partnerships with fees like those of hedge funds and restrictions on the number, net worth, and liquidity of the investors. They can also be structured like mutual funds with shares that are publicly traded so that retail investors can benefit from professional management. This structure allows a lower minimum investment and offers greater liquidity than a limited partnership structure. **Separately managed accounts (SMAs)** are appropriate for larger investors who may require custom portfolios based on their individual preferences and needs.
- Specialized funds in specific commodity sectors can be organized under any of the structures we have discussed and focus on commodities such as oil and gas, grains, precious metals, or industrial metals.

Commodity Valuation

Wheat today and wheat six months from today are different products. Purchasing the commodity today will give the buyer the use of it if needed, while contracting for wheat to be delivered six months from today avoids storage costs (warehouse cost, insurance, and spoilage) and having cash tied up. An equation that considers these aspects is:

$$\text{futures price} \approx \text{spot price} \times (1 + \text{risk-free rate}) + \text{storage costs} - \text{convenience yield}$$

Convenience yield is the nonmonetary value of having a physical commodity for use over the period of a futures contract. If there is little or no convenience yield, futures

prices will be higher than spot prices, a situation termed **contango**. When the convenience yield is high enough to more than offset storage costs, futures prices will be less than spot prices, a situation referred to as **backwardation**. Contango decreases the return of long-only investors, while backwardation increases it.

LOS 80.c: Analyze sources of risk, return, and diversification among natural resource investments.

Commodity Prices and Investments

Spot prices for commodities are a function of supply and demand. Demand is affected by the value of the commodity to end users and by global economic conditions. Supply is affected by production, storage costs, and existing inventories.

For many commodities, supply is inelastic in the short run because of long lead times to alter production levels (e.g., drill oil wells, plant crops, or decide to plant less of them). As a result, commodity prices can be volatile when demand changes significantly over the economic cycle, or when there are supply shocks such as natural disasters.

Production of some commodities, especially agricultural commodities, can be significantly affected by the weather and plant disease, leading to high prices when production is low and low prices when production is high. Costs of extracting oil and minerals increase as more expensive methods or more remote areas are used.

To estimate future needs, commodity producers analyze economic events, government policy, and forecasts of future supply. Investors analyze inventory levels, forecasts of production, changes in government policy, and expectations of economic growth to forecast commodity prices.

In recent decades, returns and the volatility of returns have been higher for commodities than for global stocks or bonds. Timberland and farmland also have higher average returns, but with lower volatility than global stocks (but similar volatility to global bonds). As with other investments, speculators can earn high returns over short periods when their expectations about short-term commodity price movements are correct.

Historically, correlations of commodity returns with the returns of global equities and global bonds have been low. As a result, adding commodities to a portfolio of traditional assets can provide diversification benefits. Because commodity prices tend to move with inflation rates, holding commodities can act as a hedge of inflation risk. During periods of high (low) inflation, commodities outperform (underperform) both stocks and bonds. Commodity prices are more sensitive to geopolitical and weather-related risk factors.

MODULE QUIZ 80.1

1. Which of the following is *most likely* an attribute of timberland and farmland?
   A. There is a flexibility option to increase output when market prices are high.
   B. They both cater to institutional investors.

C. The investment is relatively illiquid.

2. Which of the following is *least likely* when net cost of carry for a commodity is negative?
   A. Futures prices will be in backwardation.
   B. Futures prices will be in contango.
   C. Long-only investors will generally earn a higher return.
3. Which of the following is *least accurate* about commodity returns?
   A. Returns and volatility have been higher for commodities than for stocks or bonds.
   B. Timberland and farmland returns have lower volatility as compared to global stock returns.
   C. Because commodity prices tend to have negative correlation with inflation rates, holding commodities can act as a hedge of inflation risk.

KEY CONCEPTS

LOS 80.a

Returns on farmland and timberland are driven by changes in land prices and prices for the underlying output. Risks of investing in farmland and timberland include low liquidity, variable cash flows that depend on weather, and potential losses from natural disasters.

LOS 80.b

Natural resource investments include commodities, farmland, and timberland.

Exposure to commodity prices is most commonly achieved with derivatives. Other methods of exposure include commodity ETFs, managed futures funds, and specialized funds in specific commodity sectors.

futures price = spot price + net cost of carry

When the convenience yield is sufficiently high (low), net cost of carry is negative (positive), a situation known as backwardation (contango). Contango decreases the return of long-only investors, while backwardation increases it.

LOS 80.c

Returns on farmland and timberland include sales of the products raised on the land. Timberland returns also include price changes on the land, which depend on expected lumber prices and how much timber has been harvested. Farmland returns also depend on land price changes, changes in farm commodity prices, and the quality and quantity of the crops produced.

Commodity returns have low correlation with traditional asset classes and provide diversification benefits as well as a hedge against inflation.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 80.1

1. **C** Timberland and farmland are relatively illiquid. While timberland mostly caters to institutional investors due to the large investment required, most farms are family owned (individual investors). Only timberland enjoys the flexibility option, whereby the trees can be cut when the market price of timber is high. Farm products need to be harvested when ready. (LOS 80.a)

2. **B** When the cost of carry is negative, futures prices will be lower than the spot prices, which is called backwardation. Under backwardation, long-only investors will generally earn a higher return. (LOS 80.b)

3. **C** Because commodity prices tend to move with inflation rates (positive correlation), holding commodities can act as a hedge of inflation risk. (LOS 80.c)

READING 81

HEDGE FUNDS

MODULE 81.1: HEDGE FUNDS

Video covering this content is available online.

LOS 81.a: Explain investment features of hedge funds and contrast them with other asset classes.

Hedge funds are private pooled investment vehicles that are generally available only to qualified or accredited investors. While these funds were traditionally designed to use long and short exposures to generate positive returns in any market, they have evolved to pursue a wide variety of strategies. Unlike mutual funds, hedge funds tend to be lightly regulated, and their managers have great freedom in selecting investment strategies. The primary return drivers for hedge funds are market inefficiency and price volatility.

Hedge funds invest in traditional asset classes (debt and equity), use leverage, and use derivatives in pursuit of their strategies. Hedge funds are often evaluated on a total return or risk-adjusted return basis, rather than against a benchmark.

Hedge fund managers often invest their own money in their funds. Performance fees for hedge fund managers may be linked to a **high-water mark** requirement, whereby performance fees are payable only when the fund value exceeds its highest prior value.

Mutual funds, REITs, and ETFs are all publicly traded, while hedge funds are privately held. Unlike private equity funds, hedge funds tend to invest mostly in liquid asset classes and have a shorter time horizon. Private equity funds require a longer time horizon, while hedge funds have periodic redemptions.

Hedge Fund Categories

We can classify hedge funds by the strategies they pursue. Here we list some examples of each.

1. **Equity hedge fund strategies** seek to profit from long or short positions in publicly traded equities and derivatives with equities as their underlying assets. Short positions taken to reduce or remove overall market risk can be in a market index if a manager does not have a negative opinion on specific securities. Subcategories include the following:
   - **Fundamental long/short.** Use long positions in undervalued securities based on fundamental analysis while simultaneously having a short position in a portfolio of stocks or an index. This

strategy seeks to capture alpha when a market correction occurs. Most managers have net long exposure (i.e., a long bias).

- **Fundamental growth.** Use fundamental analysis to find high-growth companies. Identify and buy equities of companies that are expected to sustain relatively high rates of capital appreciation, and short equities of companies expected to have low or no revenue growth. Typically, these funds have a net long bias.
- **Fundamental value.** Buy equity shares that are believed to be undervalued, and short equities believed to be overvalued, based on fundamental analysis. The performance of value stocks relative to growth stocks drives performance.
- **Market neutral.** Use technical or fundamental analysis to select undervalued equities to be held long and to select overvalued equities to be sold short, in approximately equal amounts to profit from their relative price movements without exposure to market risk. Leverage may be used.
- **Short bias.** Employ technical, quantitative, and fundamental analysis and take predominantly short positions in overvalued equities, possibly with smaller long positions but with negative market exposure overall. This is a contrarian strategy that focuses on the manager's skills at discerning flawed business strategies or accounting.

2. **Event-driven strategies** are typically based on a corporate restructuring or acquisition that creates profit opportunities for long or short positions in common equity, preferred equity, or debt of a specific corporation. Event-driven funds are typically long biased. Subcategories are as follows:

- **Merger arbitrage.** Buy the shares of a firm being acquired and sell short the firm making the acquisition. Although the term *arbitrage* is used, such a strategy is not risk free because deal terms may change or an announced merger may not take place.
- **Distressed/restructuring.** Buy the securities of firms in financial distress when analysis indicates that value will be increased by a successful restructuring, and possibly short overvalued securities at the same time.
- **Activist shareholder.** Buy sufficient equity shares to influence a company's policies, with the goal of increasing company value (e.g., by restructuring, change in strategy or management, or return of capital to equity holders).
- **Special situations.** Invest in the securities of firms that are issuing or repurchasing securities, spinning off divisions, selling assets, or distributing capital.

3. **Relative value strategies** involve buying a security and selling short a related security, with the goal of profiting when a perceived pricing discrepancy between the two is resolved. Subcategories include the following:

- **Convertible arbitrage fixed income.** Exploit pricing discrepancies between convertible bonds and the common stock of the issuing companies and options on the common shares.
- **Specific fixed income (ABS/MBS/high yield).** Exploit pricing and quality discrepancies.
- **General fixed income.** Exploit pricing discrepancies among fixed-income securities of various issuers and types.
- **Multistrategy.** Exploit pricing discrepancies among securities within and across asset classes and markets.

4. **Opportunistic strategies** focus on macro events and commodity trading. Often, these strategies are implemented using ETFs or derivatives in addition to individual securities. Subcategories include the following:

- **Macro strategies** are based on global economic trends and events and may involve long or short positions in equities, fixed income, currencies, or commodities. These funds benefit from heightened volatility surrounding major events. Smoothing of economic shocks by central bank actions reduce the attractiveness of these strategies.

- **Managed futures** funds may focus on trading commodity futures (these funds are known as commodity trading advisers, or CTAs) or incorporate financial futures. Commodity prices tend to behave differently than financial assets, in that high prices tend to decrease demand (which in turn decreases prices), while low prices reduce supply (which in turn increases prices).

Unique Characteristics of Hedge Fund Investing

Hedge funds differ from other private investment vehicles, such as mutual funds and REITs:

- They tend to be less regulated and have flexible mandates, allowing them freedom to deploy a wide range of strategies, use leverage, and choose from a larger universe of securities and derivatives.
- Hedge funds are higher cost, as they charge higher fees in the form of an incentive fee on top of generally high management fees.
- They have lower liquidity, including lockup periods and liquidity gates. A **lockup period** is the time after initial investment over which limited partners either cannot request redemptions or incur significant fees for redemptions (a soft lockup). A **notice period** is the amount of time a fund has to fulfill a redemption request made after the lockup period has passed. A **liquidity gate** is a partial restriction on redemptions (i.e., less than a full suspension of them).

Hedge fund managers often incur significant transactions costs when they redeem shares. Redemption fees can offset these costs. Notice periods and liquidity gates allow time for managers to reduce positions in an orderly manner. Redemptions often increase when hedge fund performance is poor over a period, and the costs of honoring redemptions may further decrease the value of the remaining partnership interests.

- There is reduced transparency about strategies followed and investments made by the fund to protect proprietary trading methods. This makes it difficult for investors and analysts to assign accurate values to a hedge fund's holdings.

LOS 81.b: Describe investment forms and vehicles used in hedge fund investments.

Hedge funds can be structured as commingled funds, whereby capital from many investors is pooled together, or as a **separately managed account (SMA)** for a single large investor.

Commingled funds often have a **master-feeder structure** that is designed to be tax efficient, enjoys economies of scale, and allows for funding from global investors. Under such a structure, there are two feeder funds: offshore (in a tax haven) and onshore. Both funds flow into a master fund, which makes the investments. The master-feeder structure bypasses regional regulatory requirements.

SMAs allow for a customized portfolio to meet an investor's risk/return objectives. One concern is that the manager has no stake in the fund, so the manager's interests are not as well aligned with those of the investor as they would be in a typical commingled fund. SMAs also require more operational oversight and thus are appropriate for larger or institutional investors. The benefit of lower negotiated fees in SMA structure is offset

by the disadvantage of receiving allocations of only the fund manager's most liquid trades.

Hedge funds are typically structured as limited partnerships or limited liability corporations. The general partner is the fund manager and receives compensation based on the fund's performance. The contractual relationships between the GP and LPs are laid out in the fund documents: partnership agreement, **private placement memorandum**, or articles of incorporation. Typically, a fund is structured to have an indefinite life, though most funds do wind down as they are liquidated on a regular basis.

Recently, there has been market pressure to reduce hedge fund fees from the previous standard of 2% management fees and 20% performance fees. Some of the newer funds have 1% management fees plus 30% performance fees based on performance relative to a benchmark (as opposed to being based on total returns).

Indirect Investment Forms

A **fund-of-funds** is an investment company that invests in hedge funds. Fund-of-funds investing can give investors diversification among hedge fund strategies, offer a manager's expertise in selecting individual hedge funds, and provide smaller investors with access to hedge funds in which they may not be able to invest directly. These funds also have reduced lockup periods and greater exit liquidity.

Fund-of-funds managers charge an additional layer of fees beyond the fees charged by the individual hedge funds in the portfolio. Historically, these additional fees have been a 1% management fee and a 10% incentive fee. Because these fees to the fund-of-funds manager are on top of fees charged by the individual funds, they can significantly reduce investors' net returns.

LOS 81.c: Analyze sources of risk, return, and diversification among hedge fund investments.

Hedge fund returns come from three sources:

1. *Market beta*. This is the return attributable to the broad market index. Investors can get this from passive investments in index funds.
2. *Strategy beta*. This is the return attributable to specific sectors in which a fund has exposure.
3. *Alpha*. This is the additional return that is delivered by the manager through security selection.

Hedge fund managers use leverage to magnify the value added through strategy beta and alpha. High fees, however, act as a drag on performance.

Hedge fund performance as measured by indexes is often overstated. These indexes compile results based on voluntary reporting of performance data by participating fund managers. This likely biases returns and correlations with traditional investment

returns. Because index reporting is voluntary, poor-performing funds are less likely to report.

- Index returns may exhibit **survivorship bias** because hedge funds might not be included until they have existed for a minimum time or reached a minimum size. In this case an index will not reflect the poor performance of funds that fail before reaching these minimums.
- **Selection bias** may result from index providers assigning funds to categories inconsistently or having different requirements for including a fund.
- **Backfill bias** refers to the effect on historical index returns of adding fund returns for prior years to index returns when a fund is added to an index. Like selection bias, this tends to overstate performance because funds with better historical returns are more likely to be added.

Historical data show that while a hedge fund's performance is highly dependent on the time period over which the performance is measured, hedge funds as an asset class provide diversification benefits relative to portfolios that invest in traditional asset classes. Hedge funds tend to be more correlated with equities than with fixed income.

MODULE QUIZ 81.1

1. An institutional investor who wants to invest in a hedge fund that engages in convertible bond arbitrage would *most appropriately* select a:
   A. relative value strategy fund.
   B. special situation fund.
   C. separately managed account.
2. An investor who chooses a fund-of-funds as an alternative to a single hedge fund is *most likely* to benefit from:
   A. lower fees.
   B. higher returns.
   C. manager expertise.
3. Hedge funds use leverage to magnify which of the following?
   A. Alpha.
   B. Market beta.
   C. Currency risk.

KEY CONCEPTS

LOS 81.a

Hedge fund investments tend to have high fees, lower transparency, lower regulatory burden, and lower liquidity than mutual funds or ETFs.

Hedge funds generally use leverage, take both long and short positions, and use derivatives.

Equity hedge strategies take long and short positions in equities and equity derivatives. Strategies include market neutral, fundamental growth, fundamental value, fundamental long/short, and short bias.

Event-driven strategies include merger arbitrage, distressed/restructuring, activist, and special situations.

Relative value strategies seek profits from unusual pricing issues.

Opportunistic strategies include macro strategies and managed futures.

LOS 81.b

Hedge funds can be structured as commingled funds (master-feeder structure) or as a separately managed account.

A fund-of-funds invests in other hedge funds. Its advantages are that it can give investors diversification among hedge fund strategies, provides expertise in selecting hedge funds, and provides access to hedge funds that are otherwise unavailable. Its disadvantage is the additional layer of fees beyond the fees charged by the hedge funds in the portfolio.

LOS 81.c

Hedge fund returns comprise market beta, strategy beta, and alpha. Hedge funds often magnify strategy beta and alpha by using leverage.

Hedge fund performance is often overstated because of selection, backfill, and survivorship bias.

With proper due diligence, hedge funds can offer diversification benefits to a portfolio of traditional investments.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 81.1

1. **A** Convertible bond arbitrage is an example of a relative value strategy. Institutional investors may choose a separately managed account if their investment allocation is large and if they want custom funds to align with the institution's risk/return objectives. A special situation fund would be an equity investment strategy focusing on companies undertaking issuance/repurchase or other similar capital market transactions. (LOS 81.a, 81.b)

2. **C** A fund-of-funds manager is expected to provide expertise in selecting hedge funds. Funds-of-funds charge fees in addition to those charged by the funds in which they invest. Investing in funds-of-funds may provide more diversification, but it may not necessarily provide higher returns, due in part to the additional layer of fees. (LOS 81.b)

3. **A** Fund managers seek to magnify sector beta and alpha by using leverage. Hedge funds seek to reduce risks and often remove market beta exposure with short positions. (LOS 81.c)

READING 82

INTRODUCTION TO DIGITAL ASSETS

MODULE 82.1: DISTRIBUTED LEDGER TECHNOLOGY

Video covering this content is available online.

LOS 82.a: Describe financial applications of distributed ledger technology.

Digital assets are assets that can be electronically created, stored, and transferred. This relatively new alternative asset class includes cryptocurrencies, tokens, and digital collectibles. A digital asset is secured and validated using **distributed ledger technology (DLT)**, also known as blockchain technology. Cryptocurrencies have their own blockchains, while crypto tokens are built on blockchains that already exist.

A **distributed ledger** is a database shared among market participants. It maintains a record of all transactions, which allows each participant to have an identical copy of the database. DLT benefits include accuracy, transparency, and security; rapid ownership transfer; and peer-to-peer (P2P) interactions for creating, trading, and monitoring digital assets. DLT disadvantages include data protection concerns, potential privacy violations, and the large amount of computational power needed for verifying transactions.

A DLT network consists of a digital ledger, a consensus mechanism, and a network of participants. A consensus mechanism establishes a common state of the ledger, which involves validating transactions and updating the ledger. These two steps generate records that are immutable (i.e., unchangeable) while providing transparency for all network participants. DLT uses cryptography to encrypt data, which prevents unauthorized parties from accessing data.

DLT can also implement **smart contracts**, where a computer program self-executes based on predetermined terms and conditions. Automating contingent claims and collateral transfers during default events are examples of smart contract applications.

A **blockchain** is a digital ledger that records information sequentially within blocks. These blocks are linked together (i.e., chained), and information is secured using cryptographic techniques. Blocks within the chain contain a group of transactions as well as a secure link (known as a hash) to the previous block. A newly created

transaction is only added to a chain after it has been validated by authorized participants.

Consensus Protocols

Consensus protocols determine how blocks are chained together. They are structured to protect against market manipulation. The main types of consensus protocols are proof of work and proof of stake.

For the **proof of work (PoW) protocol**, when a transaction takes place, **miners** use computers to solve a cryptographic problem, which then verifies the transaction. Blocks are validated and locked into the blockchain thanks to powerful computers that use massive amounts of energy. This process rewards the miners with cryptocurrency. The resources required for mining impose substantial costs on any attempt to manipulate the blockchain's historical record. To do so would require one party to control most (i.e., 51%) of the network. For this reason, a blockchain is more likely to succeed when there is a large number of network participants. PoW is the most widely used consensus mechanism.

The **proof of stake (PoS) protocol** is an emerging consensus mechanism in which certain network participants pledge collateral (a process known as staking) to guarantee the validity of a block. These participants, who are known as **validators**, use their stake to signal to the network that a transaction is ready to be added to the blockchain. Additional validators will then verify that the transaction is, indeed, authentic. Validators also protect the network from potential malicious attacks by controlling most of the network's computational power. Validators are rewarded with a return on their staked collateral.

Permissionless and Permissioned Networks

The two forms of DLT networks are permissionless and permissioned.

In **permissionless networks**, transactions are visible to all users within the network, and any user can execute a transaction. In addition, all network functions can be performed by any network participant. Bitcoin is considered a permissionless network, as are many other types of cryptocurrency.

An advantage of a permissionless (i.e., open) network is that transactions are confirmed or denied through consensus mechanisms rather than by a centralized authority. Blockchain transactions cannot be manipulated once they have been added to the ledger, which creates an immutable record of all transactions. Transacting parties do not have to trust each other in permissionless networks.

In **permissioned networks**, users may be restricted from some network activities. Permissions (or controls) can modify the level of ledger accessibility. These levels range from adding transactions (for network participants) to viewing only the transaction history (for regulators). Because permissioned blockchains have stronger restrictions, they are more cost effective than open and decentralized permissionless networks.

Digital Asset Categories

DLT has many potential applications within the financial industry, including the creation of digital assets and the delivery of more efficient financial services. Figure 82.1 outlines the main types of digital assets currently available.

Figure 82.1: Types of Digital Assets

Cryptocurrencies	Tokens
■ Bitcoin ■ Altcoins – Other cryptocurrencies (e.g., Ether) – Stablecoins (e.g., Tether) – Meme coins (e.g., Dogecoin) ■ Central bank digital currencies (CBDCs)	■ Nonfungible tokens (NFTs) ■ Security tokens – Initial coin offerings (ICOs) ■ Utility tokens ■ Governance tokens

A **cryptocurrency** is a digital currency issued privately with no backing from a central bank. By using this digital medium of exchange, parties can execute near-real-time transactions without the need for an intermediary. Cryptocurrencies commonly limit how many currency units can be issued. The objective of this supply limit is to maintain the unit as a store of value; however, many cryptocurrencies still experience extreme price volatility.

Various cryptocurrencies exist because their blockchains are designed and optimized differently. As the most widely traded cryptocurrency, Bitcoin has influenced the development of many other types of digital assets. Alternate cryptocurrencies, known as **altcoins**, are based on the technology used by Bitcoin. The most well-known altcoin is Ether, which is built on the Ethereum network. The Ethereum blockchain allows users to develop applications (i.e., smart contracts) to secure and validate transactions. Therefore, the value of Ethereum and other programmable blockchains extends beyond being only a store of value. To date, Bitcoin and Ether are the two most popular cryptocurrencies; as of July 2022, they made up more than 80% of the total cryptocurrency market.

Stablecoins offer stable digital currency values. These coins are linked to the value of another asset, such as the U.S. dollar, and secured by a basket of assets. The value of stablecoins is protected from price volatility through this reserve basket, which minimizes risk from potential transaction failures. Smart stablecoins or algorithmic stablecoins control their supply by using algorithms to mint additional assets when demand increases. Stablecoins cannot be exchanged for fiat currency, and they have no legal or regulatory backing. One of the most popular stablecoins is Tether, which is pegged to the U.S. dollar. A special case of stablecoins is an asset-backed token, which maintains price parity with a target asset, such as gold. We will discuss these tokens in more detail later in this reading.

PROFESSOR'S NOTE

The TerraUSD stablecoin was pegged to the U.S. dollar "algorithmically" instead of being directly linked to the underlying collateral value. In May

2022, the 1:1 peg failed after significant investor withdrawals and its value collapsed, resulting in a run on several stablecoins.

In general, **meme coins** are launched for entertainment purposes. In some cases, their rapid rise in popularity has allowed early purchasers to sell these coins for a quick and significant profit. The most popular meme coin is Dogecoin, which is based on a popular internet meme. In May 2021, Dogecoin saw a dramatic increase in market value thanks to social media endorsements. However, a year later, its market value dropped sharply as its usefulness came into question.

As mentioned, governments do not currently back or regulate cryptocurrencies. Nevertheless, central banks are currently exploring the potential benefits of cryptocurrency equivalents as alternatives to physical currency. A **central bank digital currency (CBDC)** is essentially a digital version of a banknote or coin issued by a central bank.

When physical assets like real estate change hands, considerable work is required to verify ownership. **Tokenization** uses DLT to streamline this process by digitally tracking the historical record of ownership. A **nonfungible token (NFT)** is an example of tokenization in which a digital asset is linked to a certificate of authenticity. The key difference between NFTs and "fungible" tokens is that each NFT represents a distinct object. For example, digital artwork is a common application for NFTs.

A **security token** digitally tracks ownership rights in publicly traded securities. A blockchain can facilitate the custody, settlement, recordkeeping, and post-trade processing of security tokens. With this single ledger technology, participants can perform various transactions more easily and with more transparency. An example of a security token is an **initial coin offering (ICO)**, which is an unregulated process in which companies offer crypto tokens in exchange for money or other cryptocurrency. In an ICO, tokens are issued to investors for future purchases of products or services. An ICO is an alternative to regulated initial public offerings (IPOs). ICOs are potentially less expensive and take less time to raise capital compared to IPOs; however, most ICOs do not have attached voting rights. Many jurisdictions are considering regulating ICOs due to an increase in fraud connected to these offerings.

Utility tokens provide network services, such as service payments and network fees. In contrast to security tokens that may pay dividends, a utility token only compensates investors for network activities. **Governance tokens** are offered on permissionless networks and act as voting rights to determine how networks should operate. For example, a network can maintain stability and integrity by voting on solutions for a technical issue.

MODULE QUIZ 82.1

1. Which of the following statements about distributed ledger technology (DLT) is *most accurate*?
   A. A disadvantage of blockchain is that past records are vulnerable to manipulation.
   B. Tokenization can potentially streamline transactions involving high-value physical assets.

C. Only parties who trust each other should carry out transactions on a permissionless network.

2. The benefits of using distributed ledger technology (DLT) to validate transactions on a blockchain *least likely* include:
   A. improved accuracy and transparency.
   B. quicker transfer of ownership records.
   C. using high-performance computers for verifying transactions.
3. The proof of work (PoW) consensus protocol involves:
   A. miners using computers to solve cryptographic problems.
   B. network participants pledging collateral to guarantee the validity of transactions.
   C. validators controlling most of the network's computational power to prevent attacks.
4. Smart contracts are *most likely* to be used for:
   A. pegging cryptocurrency to the value of another asset.
   B. extending the value of a blockchain beyond a store of value.
   C. creating a digital version of a bank note issued by a central bank.
5. An initial coin offering (ICO) is *best* described as a:
   A. utility token.
   B. security token.
   C. nonfungible token.

MODULE 82.2: DIGITAL ASSET CHARACTERISTICS

Video covering this content is available online.

LOS 82.b: Explain investment features of digital assets and contrast them with other asset classes.

Investing in digital assets is becoming more commonplace in the financial industry. In 2013, approximately 70 cryptocurrencies were recorded, but by early 2022, over 10,000 cryptocurrencies had been issued. Due to the high expected returns and diversification benefits of investing in cryptocurrencies, institutional investors are taking more interest in this alternative asset class. To accommodate the growing number of investors, financial service providers—including digital exchanges and custodians—have strengthened their infrastructures to support future institutional investment.

The nature of digital assets differs from traditional financial assets. Key investment differences between digital assets and other asset classes are as follows:

- *Inherent value differences*. Most digital assets are not backed by underlying assets or the cash flows they generate, such as interest or dividends. Because digital assets lack expected earnings, they have no fundamental value. In general, digital asset prices are determined by projected asset growth, which is based on scarcity (due to the limited currency supply) and the ability to transfer value in the future.
- *Transaction validation differences*. Traditional financial instruments are typically recorded on private ledgers maintained by central intermediaries. In contrast, digital assets are typically recorded on decentralized digital ledgers.

- *Medium of exchange differences*. Traditional financial assets are traded and priced in globally accepted fiat currencies. Financial systems rely on these fiat currencies as a medium of exchange. In contrast, digital assets are used as an alternative to fiat currencies and are mainly used for online transactions. However, the mainstream financial system is hesitant to accept cryptocurrencies as a medium of exchange. This is due to high transaction costs, cryptocurrencies not being legal tender in many jurisdictions, and cryptocurrencies being heavily restricted in several countries. CBDCs are currently being evaluated as tokenized forms of fiat currencies.
- *Regulatory differences*. Most jurisdictions have clear and established rules governing financial instruments. However, unlike traditional financial assets, digital assets lack well-developed standards. Regulations specific to digital assets are currently under development. Regulators in the United States consider some digital currencies to be commodities, while other regulators consider them as nonfinancial assets. In addition, the cryptocurrency exchanges used to trade digital currencies are typically unregulated. As a result, participants in these exchanges are not specifically prohibited from engaging in behaviors like market manipulation.

LOS 82.c: Describe investment forms and vehicles used in digital asset investments.

Investing in digital assets can be done directly on the blockchain, or indirectly through exchange-traded products and hedge funds. Direct ownership of cryptocurrencies requires the use of a "cryptocurrency wallet," which contains digital encryption keys for accessing and trading assets. The two categories of exchanges for trading cryptocurrencies are centralized exchanges and decentralized exchanges.

Centralized exchanges are privately held and offer trading platforms for price transparency and volume information. Despite being at odds with Bitcoin's decentralized nature, centralized exchanges are the most popular type of cryptocurrency exchange. Traders on these exchanges trade directly and electronically on private servers, which may introduce security vulnerabilities. Compromised exchange servers can cause trading to halt and valuable user information to leak, such as keys to cryptocurrency wallets. Depending on the jurisdiction, some of these exchanges are regulated as financial exchanges.

Similar in concept to Bitcoin, **decentralized exchanges** implement decentralized blockchain principles. A decentralized exchange does not have a centralized authority and it operates on a distributed framework. Multiple computers are used to service this type of exchange, so if one computer is attacked, the exchange will remain in operation. Therefore, attacks on decentralized exchanges are substantially more difficult. In addition, because no one person, group, or organization controls a decentralized exchange, regulations are difficult to enforce.

On either type of exchange, a lack of regulatory oversight raises investor protection concerns. Fraud and market manipulation are more likely to occur, such as **pump-and-dump schemes** involving questionable promotion of cryptocurrencies on social media to deliberately increase prices.

PROFESSOR'S NOTE
The centralized exchange FTX became one of the largest crypto and stablecoin exchanges in 2021. However, falling cryptocurrency prices, increasing interest rates, and fraudulent management decisions led to extreme illiquidity issues for the exchange. In November 2022 these issues triggered substantial investor withdrawals, which ultimately led to the bankruptcy of FTX.

Direct Investment

Direct investment in cryptocurrencies occurs when a transaction is recorded on the blockchain. When a transaction takes place, it becomes validated and permanently stored on the blockchain. Examples of gaining direct exposure include purchasing tokens on a cryptocurrency exchange, trading an NFT, and investing in an ICO. Continuous trading is offered on most cryptocurrency exchanges.

Investing in cryptocurrencies directly has several risks. Fraud has become more prevalent with the rise in popularity of cryptocurrencies. This includes scam ICOs, pump-and-dump schemes, market manipulation, theft, and attempts to gain access to wallet credentials. Also, because cryptocurrencies are normally held in secure wallets that require unique passkeys to access, losing those passkeys makes the cryptocurrency in a wallet worthless. It is estimated that 20% of Bitcoin is in lost or abandoned wallets. In addition, many small cryptocurrencies are held primarily by a few large entities (known as whales) that may hold enough of a cryptocurrency to manipulate its price.

Indirect Investment

Indirect exposure to cryptocurrencies can be achieved through coin trusts, futures contracts, exchange-traded products, stocks, and hedge funds.

Cryptocurrency coin trusts offer shares in a trust that holds large amounts of cryptocurrency. This type of investment trades over the counter and is similar to a closed-end fund. Coin trusts increase transparency while eliminating the need for digital wallets and encryption keys. However, some trusts charge substantial fees and expenses.

Cryptocurrency futures contracts involve buying or selling a specific quantity of cryptocurrency at a predetermined future date. For example, the Chicago Mercantile Exchange trades Bitcoin futures based on spot Bitcoin prices from cryptocurrency exchanges. These contracts are typically cash settled and involve leverage. Because this market is newly developing, cryptocurrency futures are typically more volatile and less liquid than traditional futures markets.

Cryptocurrency exchange-traded products, such as exchange-traded funds, attempt to mimic the returns of digital assets. These products typically gain exposure to cryptocurrency price movements using cash or cryptocurrency derivatives.

Cryptocurrency stocks offer indirect exposure through their business connection to digital assets. Examples include public digital exchanges; payment providers that

support cryptocurrencies; corporations that accept cryptocurrencies as payments, invest in cryptocurrencies, or mine cryptocurrencies; and companies that provide products or services for operating blockchain networks.

Cryptocurrency hedge funds employ strategies such as discretionary long, long/short, quantitative, and multistrategy to invest indirectly in cryptocurrencies. Some hedge funds also conduct Bitcoin mining activities to generate additional returns.

Digital Investment in Nondigital Assets

Asset-backed tokens represent digital ownership of physical assets or financial assets (i.e., nondigital assets). These tokenized assets are collateralized by the underlying asset, such as oil, gold, or equities. Asset-backed tokens can potentially increase liquidity of high-priced assets, such as real estate, by allowing for fractional ownership. A digital representation also allows for an immutable record of ownership, which improves transparency and reduces transaction costs. Regulators generally classify asset-backed tokens as securities.

The Ethereum network is often used to issue asset-backed tokens by allowing P2P interactions via smart contracts. Decentralized applications, referred to as dApps, enable transactions to be recorded on the blockchain without the need for a centralized system.

Decentralized finance (DeFi) grew out of this movement toward financial decentralization. DeFi seeks to develop sophisticated financial products and services using open-source financial applications. Essentially, DeFi is a marketplace of dApps that can offer a medium for exchange, a store of value, tokenization of assets, and immutable records of ownership. Currently, most dApps focus on digital asset speculation.

LOS 82.d: Analyze sources of risk, return, and diversification among digital asset investments.

Cryptocurrency values depend largely on asset appreciation, and a significant driver of prices is their limited supply. For instance, Bitcoin is limited to 21 million units. As a result, some investors refer to Bitcoin as digital gold. To date, Bitcoin has generated high returns and high volatility compared to traditional asset classes. For example, Bitcoin's price has risen from $0.05 when it was first made publicly available in mid-2010 to over $65,000 in November 2021, before falling below $20,000 in June 2022. Figure 82.2 illustrates the risk and return of Bitcoin compared to other major asset class indexes.

Figure 82.2: Monthly Log Returns for Bitcoin and Asset Class Benchmarks

(January 2011–January 2022)[1]

	Bitcoin (In USD)	S&P 500 Index Total Return	MSCI World Index Return	Bloomberg Global Aggregate Index
Average	8.84%	1.13%	0.66%	0.16%
Standard deviation	0.32	0.04	0.04	0.01
Coefficient of variation	3.66	3.43	6.09	8.16

Other cryptocurrencies exhibit similar price volatility to Bitcoin. This volatility reflects the overall uncertainty associated with this asset class. Even though some of these assets are regulated as digital commodities in the United States and formal rules in the European Union are under development, investors remain wary due to recent fraud and crime. Consequently, cryptocurrencies have been severely restricted by several countries, including China, which banned them outright in 2021.

Historically, cryptocurrency returns have demonstrated low correlations with traditional asset class returns. Therefore, cryptocurrencies have the potential to provide portfolio diversification benefits. However, correlations may increase during periods of extreme market stress. In general, cryptocurrency prices are influenced by the unique aspects of this asset class, including market adoption, risk appetite, technological innovation, network impacts, speculation, and regulation. Figure 82.3 displays a correlation matrix for Bitcoin and other major asset class indexes.

Figure 82.3: Correlations Between Monthly Log Returns for Cryptocurrencies and Selected Asset Classes (January 2011–January 2022)[2]

	Bitcoin in U.S. Dollars	S&P 500 Index Total Return	MSCI World Index Return	Bloomberg Global Aggregate Index
Bitcoin in U.S. dollars	1	—	—	—
S&P 500 Index total return	0.21	1	—	—
MSCI World Index return	0.22	0.97	1	—
Bloomberg Global Aggregate Index	0.14	0.25	0.33	1

MODULE QUIZ 82.2

1. In contrast with traditional asset classes, digital assets *most likely*:
   A. are not typically backed by underlying asset cash flows.
   B. have established regulatory guidance in most jurisdictions.
   C. are recorded on private ledgers maintained by central intermediaries.
2. Mainstream financial systems are hesitant to accept cryptocurrencies as a medium of exchange due to which of the following factors?
   A. Low transaction costs.
   B. Lack of cryptocurrency roadblocks in several countries.
   C. Cryptocurrencies not being considered legal tender in many countries.
3. Which of the following statements is *most accurate* regarding centralized and decentralized cryptocurrency exchanges?

A. Decentralized exchanges are the prevalent type of cryptocurrency exchange.
B. Centralized exchanges are more highly regulated than decentralized exchanges.
C. Decentralized exchanges are less susceptible to network attacks and security vulnerabilities.

4. An example of a digital form of investment in a nondigital asset is:
A. an asset-backed token.
B. a cryptocurrency exchange-traded product.
C. purchasing tokens on a cryptocurrency exchange.

5. The main driver of cryptocurrency values is:
A. low price volatility.
B. asset appreciation.
C. unlimited supply of currency units.

KEY CONCEPTS

LOS 82.a

Digital assets are those that can be electronically created, stored, and transferred. This alternative asset class includes cryptocurrencies, tokens, and digital collectibles. A digital asset relies on distributed ledger technology (DLT).

A blockchain is a digital ledger that records information sequentially within blocks. Consensus protocols determine how blocks are chained together. The main types of consensus mechanisms are proof of work (miners use powerful computers to verify transactions) and proof of stake (validators pledge collateral to guarantee the validity of transactions).

In permissionless networks, transactions are visible to all users within the network, and any user can execute a transaction. In permissioned networks, some network activities may be modified or restricted for users.

A cryptocurrency is a digital currency issued privately with no backing from a central bank. Stablecoins offer stable digital currency values by linking to another asset (e.g., the U.S. dollar). Meme coins are launched for entertainment purposes. A central bank digital currency is a digital version of a bank note or coin issued by a central bank.

Tokenization uses blockchain technology to digitally track the historical record of asset ownership.

LOS 82.b

The key differences in investment features between digital assets and other asset classes are as follows:

- Most digital assets are not backed by underlying assets or cash flows, as traditional financial instruments are. Digital assets do not have expected earnings, so they have no fundamental value.
- Traditional financial assets are typically recorded on private ledgers maintained by central intermediaries. Digital assets are typically recorded on decentralized digital ledgers.

- Traditional financial assets are traded and priced in fiat currencies. Digital assets are an alternative to fiat currencies and are mainly used for online transactions.
- Most jurisdictions have clear and established rules that govern traditional financial instruments. Digital assets currently lack these well-developed standards.

LOS 82.c

Centralized exchanges allow participants to trade directly and electronically on private servers. Decentralized exchanges operate on a distributed framework where multiple computers service the network. For both exchanges, investor protection concerns arise due to a lack of regulatory oversight.

Direct investment in cryptocurrencies occurs when a transaction is recorded directly on the blockchain. Investing in cryptocurrencies directly has several risks, including scam ICOs, pump-and-dump schemes, market manipulation, theft, and attempts to gain access to cryptocurrency wallet credentials.

Indirect investment in cryptocurrencies can be achieved through coin trusts, futures contracts, exchange-traded products, stocks, and hedge funds.

Asset-backed tokens represent digital ownership of nondigital assets. The movement toward decentralization and using digital investment forms for nondigital assets has led to decentralized finance (DeFi) products and services.

LOS 82.d

Cryptocurrency values are driven by asset appreciation and the limited supply of currency units. To date, digital assets have generated high returns and high volatility compared to traditional asset classes. Because digital asset returns have demonstrated low correlations with traditional asset class returns, this alternative asset class has the potential to provide portfolio diversification benefits.

ANSWER KEY FOR MODULE QUIZZES

Module Quiz 82.1

1. **B** By enabling electronic proof of ownership, tokenization has the potential to streamline transfers of physical assets such as real estate. The high cost and difficulty of manipulating past records is a strength of blockchain technology. Permissionless networks do not require trust between the parties to a transaction because the record of a transaction is unchangeable and visible to all network participants. (LOS 82.a)

2. **C** The large amount of computational power needed for verifying transactions is considered a disadvantage of DLT. Benefits include accuracy, transparency, and security of transactions; rapid ownership transfer; and peer-to-peer interactions for creating, trading, and monitoring digital assets. (LOS 82.a)

3. **A** The PoW protocol involves miners using powerful computers to verify transactions by solving cryptographic problems. The proof of stake (PoS)

protocol involves network participants pledging collateral to guarantee the validity of a block. In both cases, a large number of network participants help to prevent malicious attacks; however, the term *validators* applies specifically to the PoS consensus mechanism. (LOS 82.a)

4. **B** Smart contracts are often associated with the Ethereum blockchain and can help programmable blockchains add value beyond being only a store of value. Stablecoins involve pegging values to another asset, and central bank digital currencies involve creating a digital version of a bank note or coin issued by a central bank. (LOS 82.a)

5. **B** An example of a security token is the ICO, an unregulated process in which companies offer crypto tokens for money or other cryptocurrency. (LOS 82.a)

Module Quiz 82.2

1. **A** Most digital assets are not backed by underlying assets or the cash flows that they generate. Also, digital assets lack well-developed regulatory standards, and they are typically recorded on decentralized digital ledgers. (LOS 82.b)

2. **C** Financial systems are hesitant to accept cryptocurrencies as a medium of exchange due to high transaction costs, cryptocurrencies not being legal tender in many jurisdictions, and cryptocurrencies being heavily restricted in several countries. (LOS 82.b)

3. **C** For decentralized exchanges, multiple computers service the exchange, so if one computer is attacked, the exchange will remain operational. Thus, attacks on decentralized exchanges are more difficult than on centralized exchanges. However, centralized exchanges are the prevalent type of cryptocurrency exchange. Both types of exchange currently lack significant regulatory oversight. (LOS 82.c)

4. **A** Asset-backed tokens represent digital ownership of physical assets or financial assets (i.e., nondigital assets). A cryptocurrency exchange-traded product is an example of an indirect exposure to digital assets. Purchasing tokens on a cryptocurrency exchange is an example of a direct investment in digital assets. (LOS 82.c)

5. **B** Cryptocurrency values are based largely on asset appreciation, given that these digital assets have no underlying cash flows. The supply of several cryptocurrencies is limited, which is a key driver of price increases. Cryptocurrencies exhibit extreme price volatility, which reflects investor uncertainty with this asset class. (LOS 82.d)

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TOPIC QUIZ: ALTERNATIVE INVESTMENTS

You have now finished the Alternative Investments topic section. Please log into your Schweser online dashboard and take the Topic Quiz on this section. The Topic Quiz provides immediate feedback on how effective your study has been for this material. Questions are more exam-like than typical Module Quiz or QBank questions; a score of less than 70% indicates that your study likely needs improvement. These tests are best taken timed; allow 1.5 minutes per question.

READING 83

PORTFOLIO RISK AND RETURN: PART I

MODULE 83.1: HISTORICAL RISK AND RETURN

Video covering this content is available online.

LOS 83.a: 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 83.1, 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 83.1: 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 (≠ 0) and kurtosis (≠ 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 83.1

1. Liquidity is *most likely* a concern for:
   A. emerging market stocks.
   B. high-quality corporate bonds.
   C. U.S. Treasuries.
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 83.2: RISK AVERSION

Video covering this content is available online.

LOS 83.b: Explain risk aversion and its implications for portfolio selection.

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.

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.

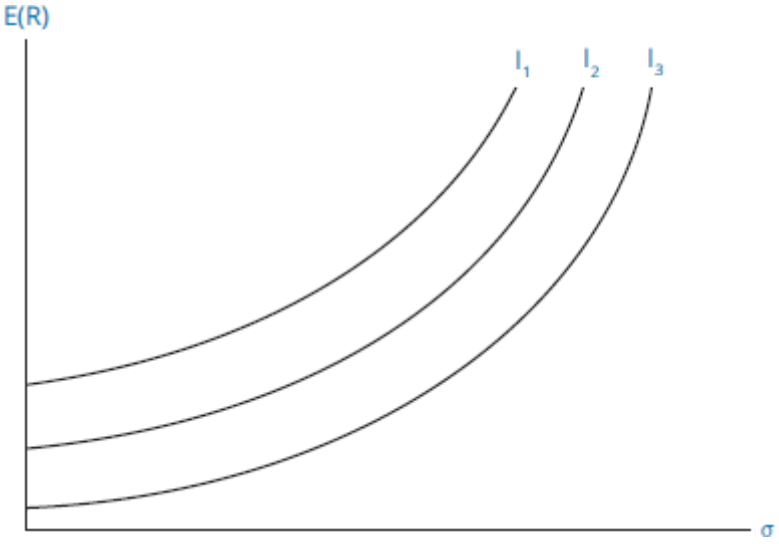
Consider this gamble: A coin will be flipped; if it comes up heads, you receive $100; if it comes up tails, you receive nothing. The expected payoff is 0.5($100) + 0.5($0) = $50. A risk-averse investor would choose a payment of $50 (a certain outcome) over the gamble. A risk-seeking investor would prefer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

LOS 83.c: Explain the selection of an optimal portfolio, given an investor's utility (or risk aversion) and the capital allocation line.

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 83.2, 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 83.2 are preferred to all portfolios along I_2, which are preferred to all portfolios along I_3.

Figure 83.2: 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:

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

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

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:

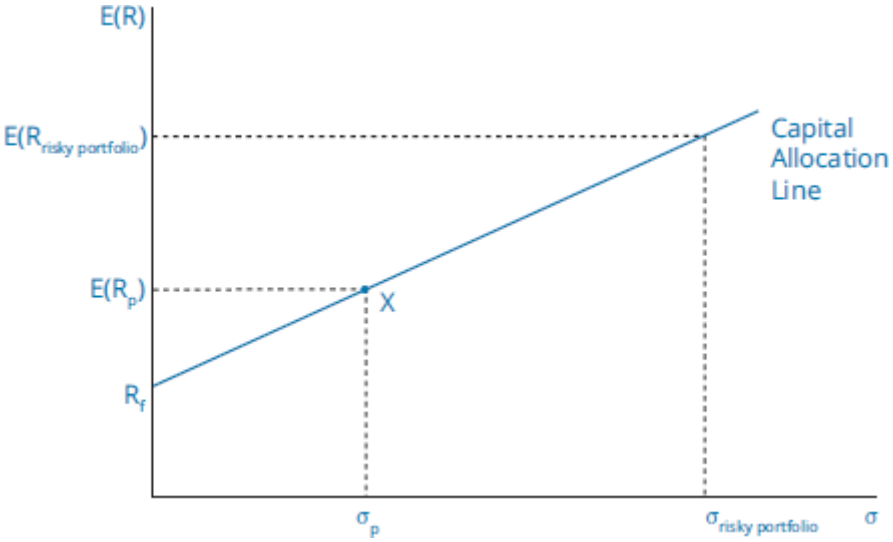
$$\sigma_{portfolio} = \sqrt{W_A^2\sigma_A^2} = W_A\sigma_A$$

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 83.3.

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 83.3 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 $0.40(\sigma_{\text{risky asset portfolio}})$.

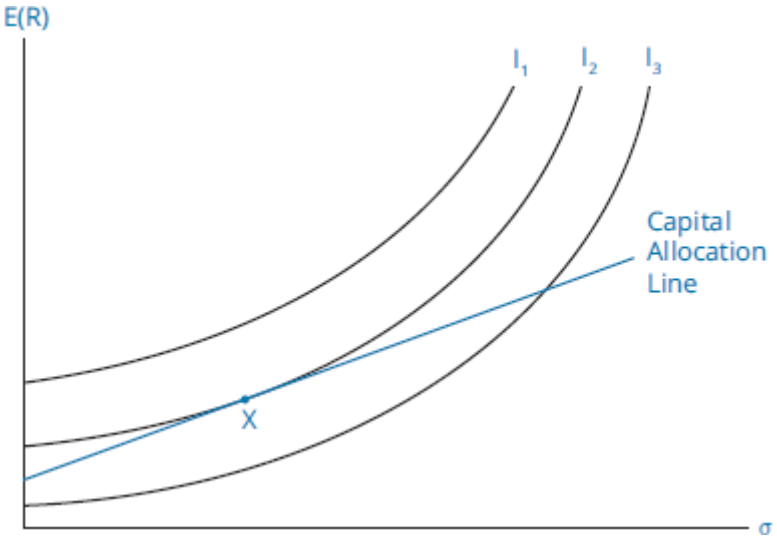
Figure 83.3: Capital Allocation Line and Risky Asset Weights



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 83.4, 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).

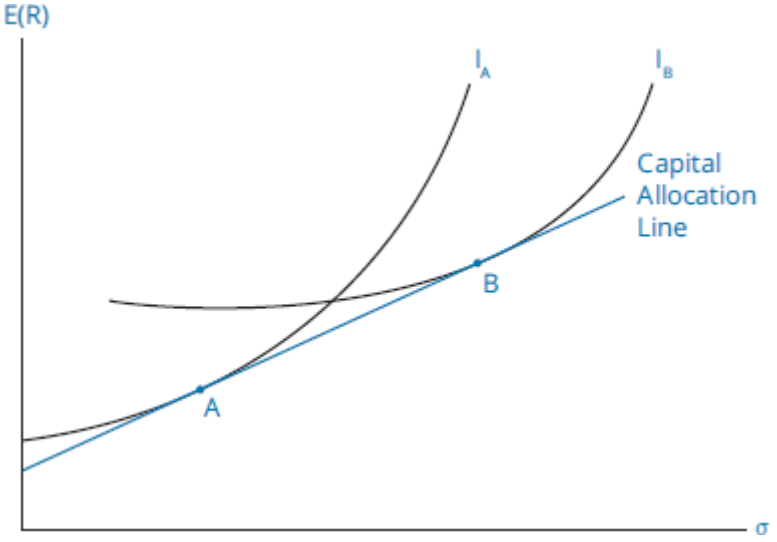
Portfolios on I_1 are preferred to those on I_2, but none of the portfolios that lie on I_1 are available in the market.

Figure 83.4: 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 83.5, 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 83.5: Portfolio Choices Based on Two Investors' Indifference Curves



MODULE QUIZ 83.2

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 the:
   A. global maximum-return portfolio.
   B. optimal risky portfolio.
   C. global minimum-variance portfolio.

MODULE 83.3: PORTFOLIO STANDARD DEVIATION

Video covering this content is available online.

LOS 83.d: 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, σ^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 (μ), 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:

$$\text{mean return for Asset A} = (5\% - 2\% + 12\%) / 3 = 5\%$$

$$\text{mean return for Asset B} = (7\% - 4\% + 18\%) / 3 = 7\%$$

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

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

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

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

$$\text{sample covariance of returns for Assets A and B} = \frac{(5-5)(7-7) + (-2-5)(-4-7) + (12-5)(18-7)}{3-1} = 77$$

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

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

LOS 83.e: 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 Cov_{12} in the formula for the variance of returns for a portfolio of two risky assets, we have the following:

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

Because $\text{Var}_{\text{portfolio}} = \sigma^2_{\text{portfolio}}$, this can also be written as:

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

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 83.3

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 the:
   A. range.
   B. covariance.
   C. 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.
5. 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%). If the correlation coefficient is –0.75, what is the portfolio's standard deviation?
   A. 2.8%.
   B. 4.2%.

C. 5.3%.

MODULE 83.4: THE EFFICIENT FRONTIER

Video covering this content is available online.

LOS 83.f: Describe the effect on a portfolio's risk of investing in assets that are less than perfectly correlated.

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 (σ_1) of Asset 1's return, plus 75% of the standard deviation (σ_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 ρ_{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:

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

σ^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:

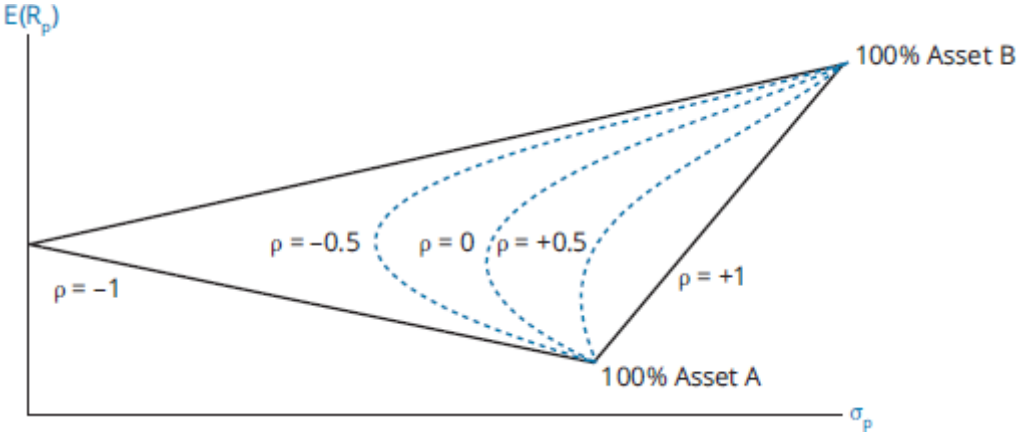
$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 + 2(0.5)(0.5)(\mathbf{-0.5})(0.25)(0.18) = 0.012475$

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

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 83.6 by plotting the portfolio risk and return for all portfolios of two risky assets, for specific values of the assets' returns correlation.

Figure 83.6: 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.

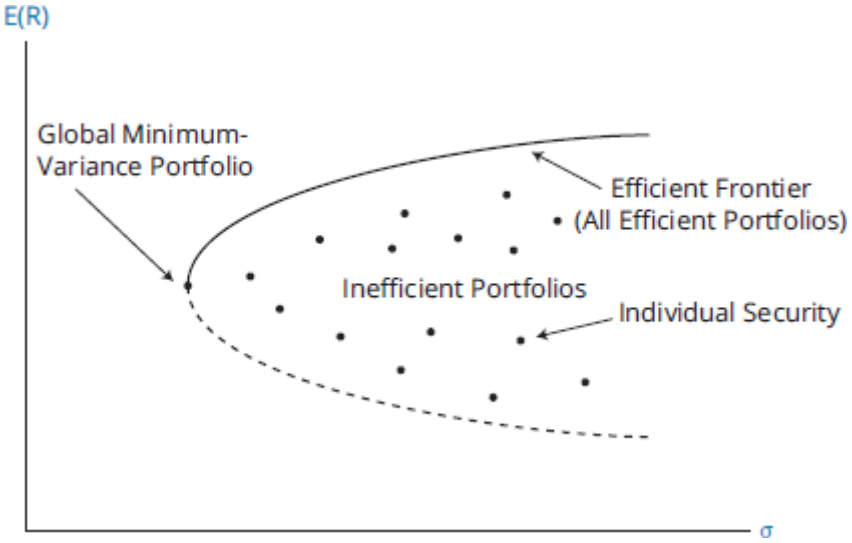
LOS 83.g: Describe and interpret the minimum-variance and efficient frontiers of risky assets and the global minimum-variance portfolio.

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 83.7.

Figure 83.7: Minimum-Variance and Efficient Frontiers



MODULE QUIZ 83.4

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 83.a

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 83.b

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 83.c

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 83.d

We can calculate the population variance, σ^2, when we know the return R_t for period t, the total number T of periods, and the mean μ 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 83.e

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

$$\sigma_{\text{portfolio}} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2}$$

LOS 83.f

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 83.g

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 83.1

1. **A** Liquidity can be a concern for emerging market stocks and for securities that trade infrequently, such as low-quality corporate bonds. U.S. Treasuries exhibit high degrees of liquidity. (LOS 83.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 83.a)

Module Quiz 83.2

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 83.b)

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 83.c)

Module Quiz 83.3

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 83.d)

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 83.d)

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 83.d)

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

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

   correlation = 0.006 / [(0.30)(0.20)] = 0.10

(LOS 83.d)

5. **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 83.e)

Module Quiz 83.4

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 83.6). 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 83.f)

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 83.g)

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[1] 2018 SBBI Yearbook.

READING 84

PORTFOLIO RISK AND RETURN: PART II

MODULE 84.1: SYSTEMATIC RISK AND BETA

Video covering this content is available online.

LOS 84.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.

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

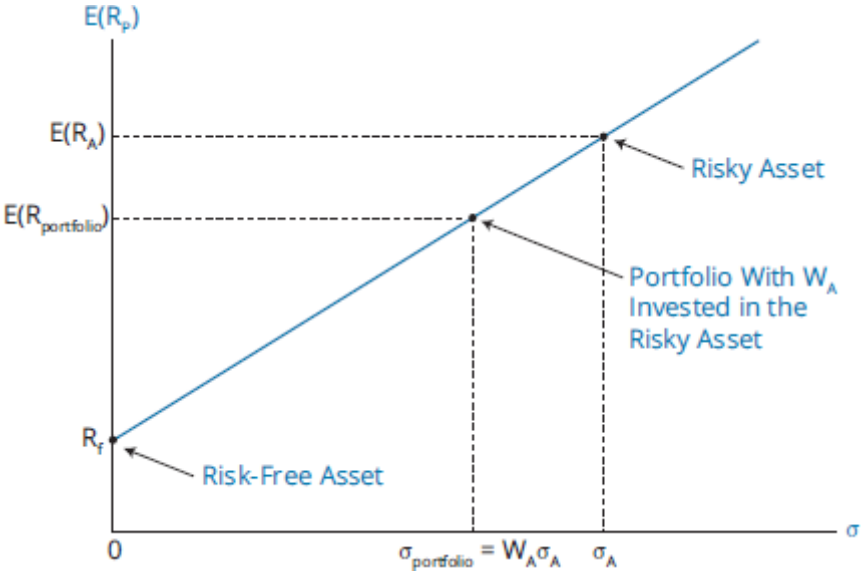
$$\sigma_P = \sqrt{W_A^2\sigma_A^2 + W_B^2\sigma_B^2 + 2\,W_A\,W_B\rho_{AB}\sigma_A\sigma_B}$$

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 84.1.

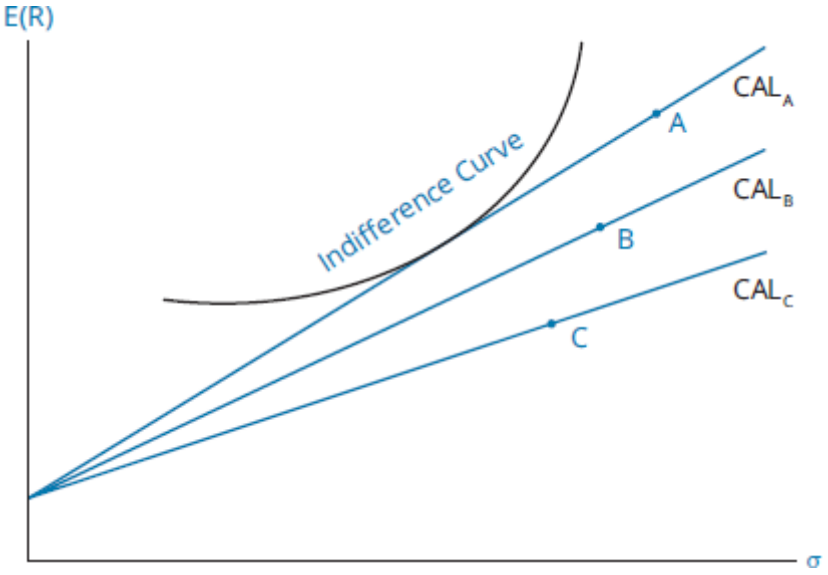
Figure 84.1: Combining a Risk-Free Asset With a Risky Asset



LOS 84.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 84.2 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 84.2: Risky Portfolios and Their Associated Capital Allocation Lines



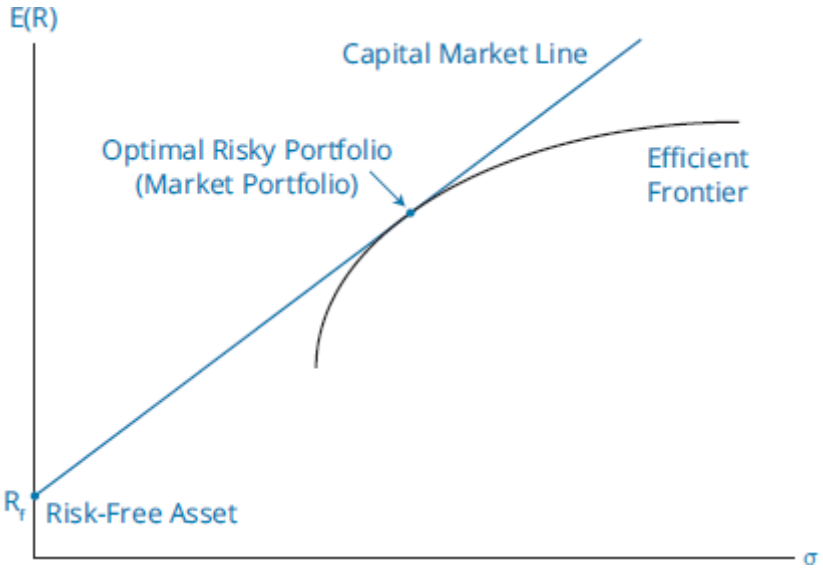
If each investor has different expectations about the expected returns of, standard deviations of, or correlations between risky asset returns, each investor will have a different optimal risky asset portfolio and a different CAL.

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 84.3 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 84.3: 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, σ_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:

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

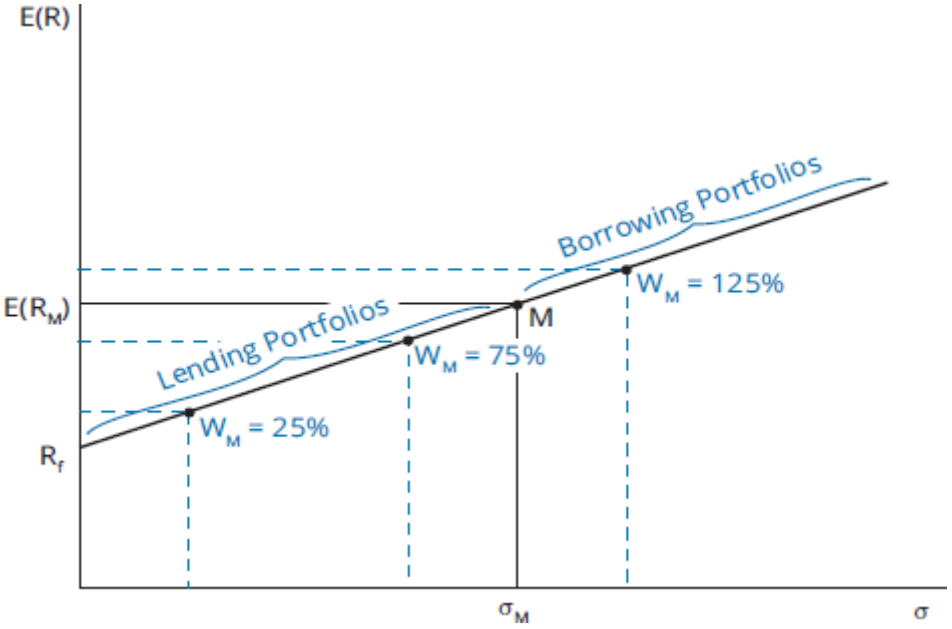
The intuition of this relation is straightforward. An investor who chooses to take on no risk ($\sigma_P = 0$) will earn the risk-free rate, R_f. The difference between the expected return on the market and the risk-free rate is termed the **market risk premium**. If we rewrite the CML equation as

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

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, σ_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 84.4.

Figure 84.4: 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.

LOS 84.c: Explain systematic and nonsystematic risk, including why an investor should not expect to receive additional return for bearing nonsystematic risk.

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*).

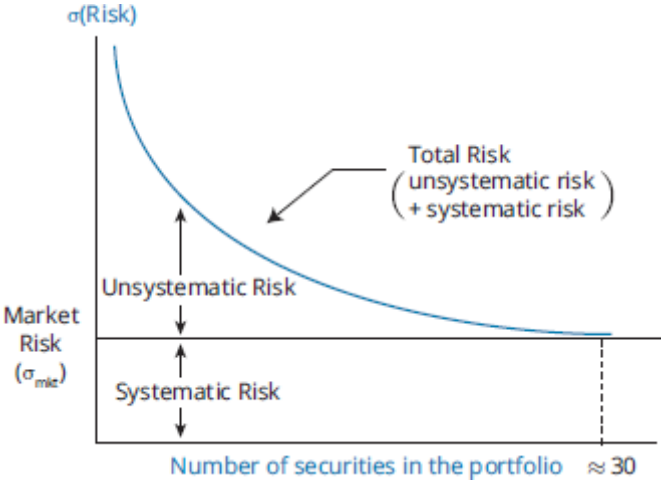
The concept of systematic risk applies to individual securities as well as to portfolios. Some securities' returns are highly correlated with overall market returns. Examples of firms that are highly correlated with market returns are luxury goods manufacturers such as Ferrari automobiles and Harley 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

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 84.5 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 84.5: 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.

LOS 84.d: Explain return generating models (including the market model) and their uses.

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
β_i = slope coefficient
α_i = intercept
e_i = abnormal return on Asset *i*

The intercept α_i and slope coefficient β_i are estimated from historical return data. We can require that α_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 84.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 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?

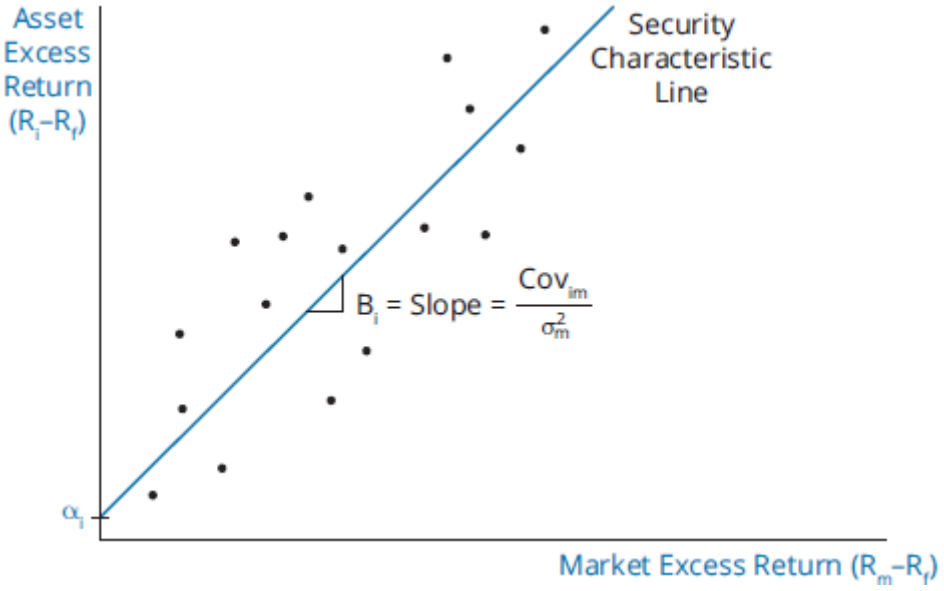
   Using the formula $\beta_i = \frac{\text{Cov}_{im}}{\sigma_m^2}$, we have $\beta_i = \frac{0.048}{0.2^2} = 1.2$.

PROFESSOR'S NOTE

You should be able to calculate beta using either of the approaches illustrated in this example.

In practice, we estimate asset betas by regressing returns on the asset on those of the market index. In Figure 84.5, 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 84.6, 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 84.6: 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 84.1

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(n):
   A. lending portfolio.
   B. borrowing portfolio.
   C. 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 84.2: THE CAPM AND THE SML

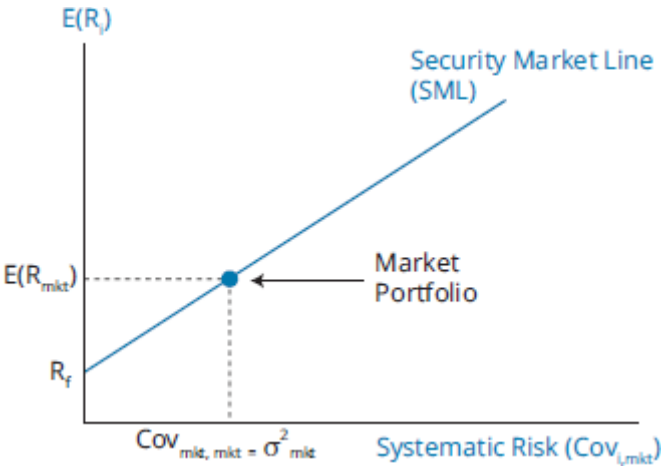
Video covering this content is available online.

LOS 84.f: Explain the capital asset pricing model (CAPM), including its assumptions, and the security market line (SML).

LOS 84.g: Calculate and interpret the expected return of an asset using the CAPM.

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 84.7, is one version of what is referred to as the **security market line (SML)**.

Figure 84.7: Security Market Line



The equation of the SML is:

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

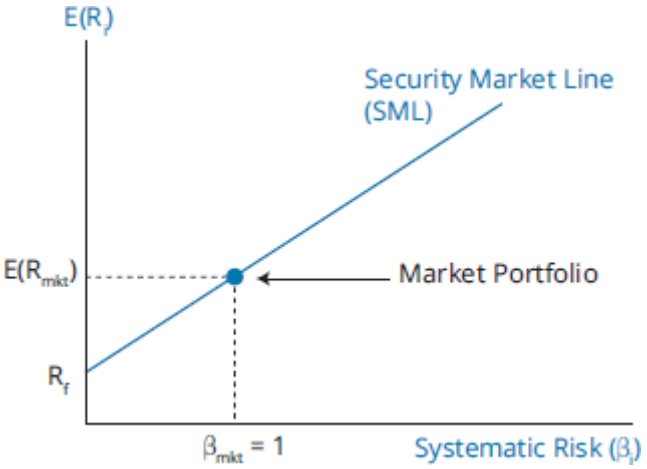
which can be rearranged and stated as:

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

The line described by this last equation is presented in Figure 84.8, where we let the standardized covariance term, $\frac{Cov_{i,mkt}}{\sigma^2_{mkt}}$, be defined as beta, β_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 84.8: 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. Calculate 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.

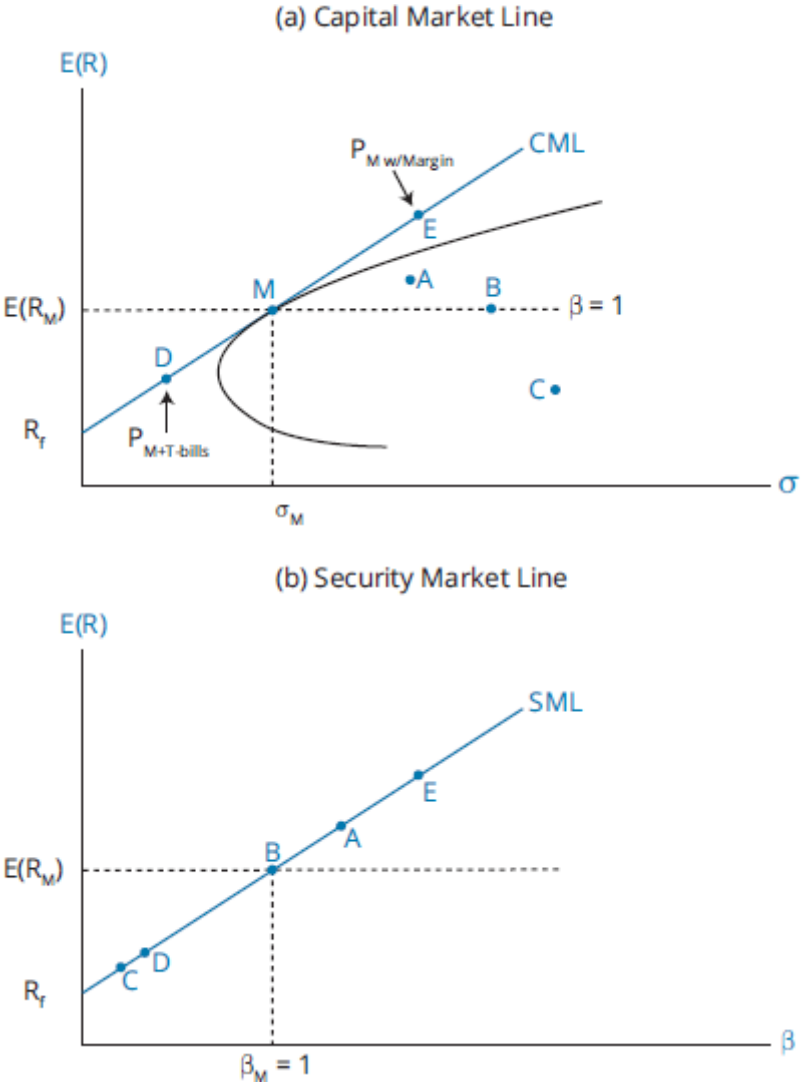
Comparing the CML and the SML

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 = σ_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 84.9.

Figure 84.9: 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 84.9. 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 84.9 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 84.9 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 84.9, 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.

LOS 84.h: Describe and demonstrate applications of the CAPM and the SML.

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%. Calculate 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%

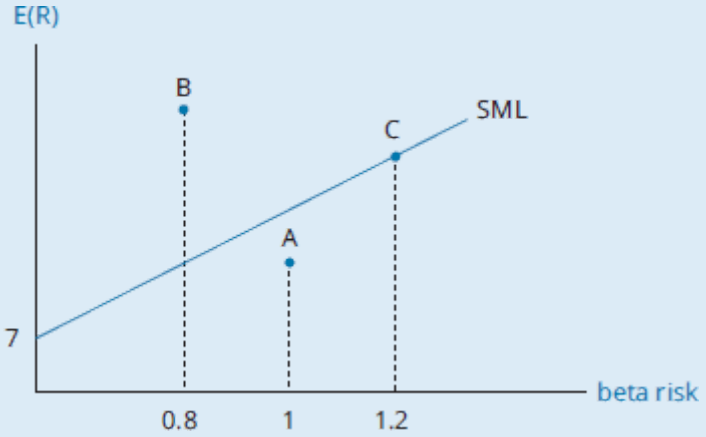
- Stock A is *overvalued*. It is expected to earn 12%, but based on its systematic risk, it should earn 15%. It plots *below* the SML.
- Stock B is *undervalued*. It is expected to earn 17.5%, but based on its systematic risk, it should earn 13.4%. It plots *above* the SML.
- Stock C is *properly valued*. 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 84.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.

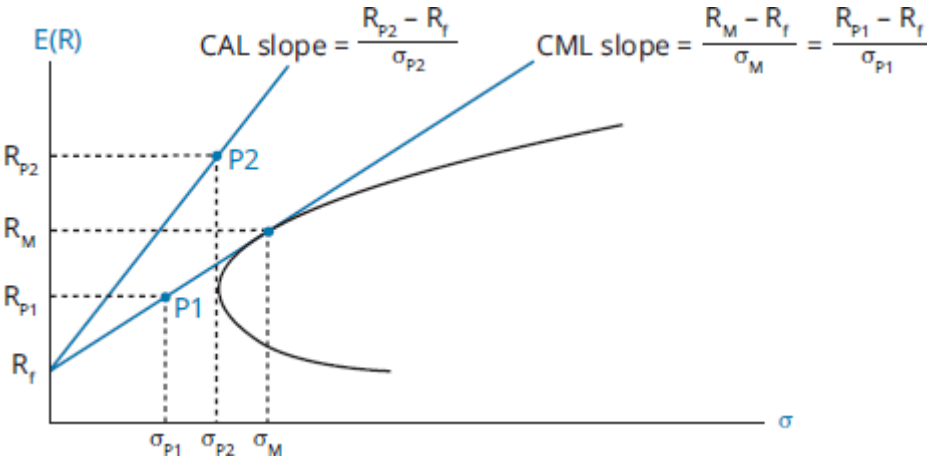
$$\text{Sharpe ratio} = \frac{E[R_{portfolio}] - R_f}{\sigma_{portfolio}}$$

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.

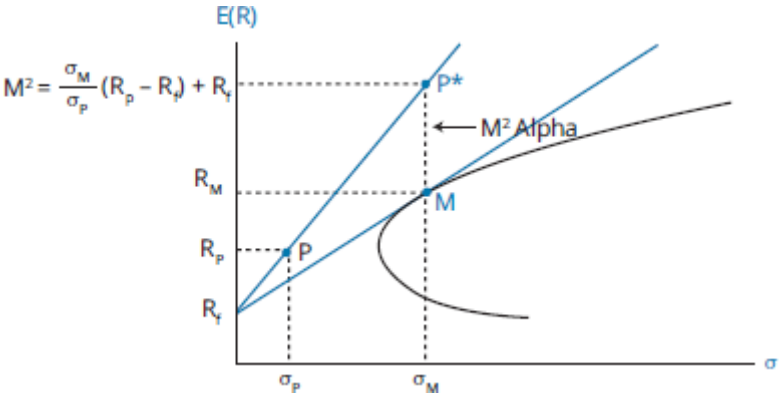
In Figure 84.10, we illustrate that the Sharpe ratio of a portfolio is the slope of the CAL for that portfolio and can be compared to the slope of the CML, which is the Sharpe ratio for portfolios that lie on the CML.

Figure 84.10: Sharpe Ratios as Slopes



For a portfolio of risky assets, **M-squared (M^2)** 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 M^2 measure for Portfolio P. We illustrate the return on the leveraged Portfolio P*, given the standard deviation and return on Portfolio P, in Figure 84.11. The extra return on the Portfolio P* above the return on the market portfolio, (P* - R_M), is referred to as **M^2 alpha**. Note that in Figure 84.11, 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* = σ_M.

Figure 84.11: M-Squared for a Portfolio



The M^2 measure produces the same risk-adjusted portfolio rankings as the Sharpe ratio, but is stated in percentage terms. Note that M^2 can be derived from the Sharpe ratio (SR) for Portfolio P, SR = $(R_P - R_f)/\sigma_P$, as SR (σ_M) + R_f, so that if the Sharpe ratio of Portfolio P is greater than the slope of the CML, $M^2 > R_m$ and M^2 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 σ_M = 30%. The Sharpe ratio of Portfolio P

= (10 - 5)/20 = 0.25, and M^2 = 0.25(0.30) + 0.05 = 12.5%. Comparing that to R_M = 11%, we can see that M^2 alpha is 1.5%.

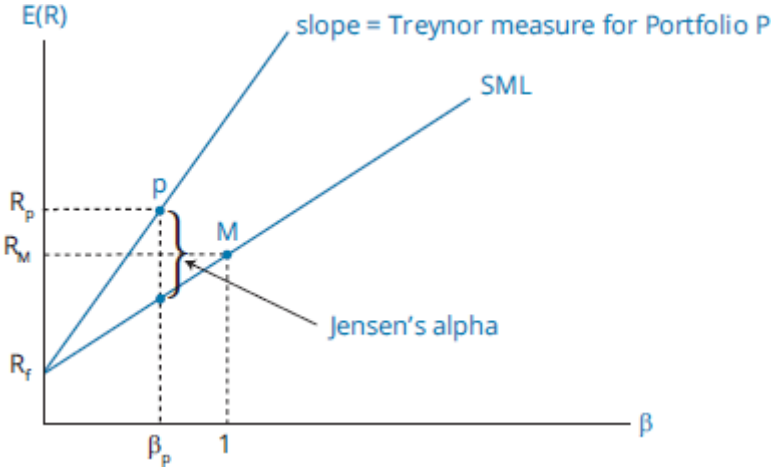
Two measures of portfolio performance based on systematic (beta) risk rather than total risk are the **Treynor measure** and **Jensen's alpha**. They are analogous to the Sharpe ratio and M^2 in that the Treynor measure is a measure of slope and Jensen's alpha is a measure of percentage returns in excess 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 84.12. 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 84.12.

Figure 84.12: 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 84.10 and Figure 84.11 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 84.12, 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.