2025 CAIA®
Exam Prep

SchweserNotes™
Introduction to Alternative Investments (Part 2), Real Assets, and Private Equity

Level I Book 2

KAPLAN SCHWESER

Book 2: Introduction to Alternative Investments (Part 2), Real Assets, and Private Equity

SchweserNotes™ 2025

CAIA Level I

SCHWESERNOTES™ 2025 CAIA® LEVEL I BOOK 2: INTRODUCTION TO ALTERNATIVE INVESTMENTS (PART 2), REAL ASSETS, AND PRIVATE EQUITY

Published in 2024 by Kaplan, Inc.

ISBN: 978-1-0788-4836-7

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Readings and Learning Objectives

TOPIC 2

CAIA Association. *CAIA Curriculum Level I Volume I*. Self-published, CAIA Association, 2024.

Reading 2.7: Derivatives and Risk-Neutral Valuation

2.7.1: Demonstrate knowledge of forward and futures contracts.
Including:

- Describe the trading differences between forward and futures contracts.
- Apply the marking-to-market process for futures positions.
- Discuss the effect of marking-to-market on counterparty risk.
- Evaluate the effect of marking-to-market and the time value of money on risk and on prices.
- Analyze initial margin for futures positions.
- Analyze maintenance margin for futures positions.

2.7.2: Demonstrate knowledge of foundations of forward contracts.
Including:

- Describe the settlement and delivery processes of forward contracts.
- Understand the no-arbitrage approach to determining forward prices.
- Determine the forward contract price of a zero-coupon default-free bond.
- Analyze forward prices and expected spot prices under risk neutrality.
- Understand the relationship between forward prices and expected bond rates.

2.7.3: Demonstrate knowledge of the impacts of forward contracts on rates.
Including:

- Describe the forward rate agreement (FRA) process.
- Understand and apply the relationship between FRAs and implied forward interest rates.
- Explain forward rates and their extensions.

2.7.4: Demonstrate knowledge of the impact of forward contracts on assets with benefits and costs of carry.
Including:

- Discuss the benefits and costs of carrying (i.e., holding) a cash position and the incorporation of convenience yields and storage costs in cost-of-carry models.
- Calculate the forward price of a commodity.
- Discuss four factors that differentiate forward pricing on financial assets with those of physical assets.
- Understand challenges involving measuring storage costs and convenience yields.
- Discuss the difficulties of short-selling physical assets and the resulting implication to the formula for forward prices.
- Calculate forward contracts with non-zero market value.

2.7.5: Demonstrate knowledge of managing long-term futures exposures.
Including:

- Discuss futures contracts with different settlement dates.
- Understand how rollover decisions alter long-run returns.

2.7.6: Demonstrate knowledge of option exposures.
Including:

- Understand option risk exposure diagrams.
- Explain the key characteristics of long and short positions in an underlying asset.
- Understand the key characteristics of call and put exposures.
- State the key characteristics of protective put exposures.
- Discuss characteristics of option spreads (e.g., bull spreads, bear spreads, and ratio spreads).
- Understand the key characteristics of option combinations (e.g., straddles, strangles, and the concept of risk reversals).
- Apply the concepts of option collars and put-call parity.

2.7.7: Demonstrate knowledge of interest rate options.
Including:

- Describe an interest rate cap and calculate cap payments.
- Describe interest rate floors and calculate floor payments.
- Discuss interest rate options and counterparty risk.

2.7.8: Demonstrate knowledge of interest rate swaps.
Including:

- Understand simple interest rate swaps.
- Identify payers and receivers of interest rate swaps.
- Explain how pensions use interest rate swaps.
- Understand the mechanics of interest rate swaps.
- Describe the initial valuation of an interest rate swap and calculate the expected payments of the swap.
- Understand how an existing swap is valued.
- Discuss risks in interest rate swaps.
- Discuss the global financial crisis of 2007-2009 in the context of swap risk.

2.7.9: Demonstrate knowledge of option pricing models and option sensitivities.
Including:

- Understand the concept of an option on a portfolio.
- Understand the Black-Scholes call-option formula.
- Understand the Black forward option pricing model.
- Understand the currency option pricing model.
- Explain the five most popular option sensitivities (i.e., delta, vega, theta, rho, and gamma).
- Describe option sensitivities such as omicron, lambda, and omega.
- Discuss the uses of option sensitivities in risk management.

Reading 2.8: Measures of Risk and Performance

2.8.1: Demonstrate knowledge of measures of risk.
Including:

- Define semivariance, semistandard deviation, downside deviation, semivolatility, and tracking error.
- Describe drawdown, shortfall risk, target semivariance, and target semistandard deviation.
- Calculate drawdown.
- Interpret value at risk (VaR) and conditional value at risk (CVaR).
- Discuss the strengths and weaknesses of VaR.

2.8.2: Demonstrate knowledge of methods for estimating value at risk (VaR).
Including:

- Apply a parametric approach to estimate VaR with normally distributed returns or with normally distributed underlying factors.
- Describe methods for estimating volatility as an input for VaR calculations.
- Describe methods for estimating VaR for leptokurtic positions.
- Describe methods for estimating VaR directly from historical data.
- Describe how the Monte Carlo analysis can be used to estimate VaR.
- Discuss and apply the aggregation of portfolio-component VaRs to determine the VaR for a portfolio under various assumptions (i.e., perfect correlation, zero correlation, and perfect negative correlation).

2.8.3: Demonstrate knowledge of benchmarking and performance attribution.
Including:

- Define benchmarking.
- Identify types of benchmarks.
- Discuss performance attribution.

2.8.4: Demonstrate knowledge of ratio-based performance measures used in alternative investment analysis.

Including:

- Describe the two major types of performance measures.
- Define Sharpe ratio, Treynor ratio, Sortino ratio, information ratio, and return on VaR.
- Discuss the properties in using the Sharpe ratio.
- Calculate Sharpe ratio, Treynor ratio, Sortino ratio, information ratio, and return on VaR.
- Discuss the properties in using the Treynor ratio.

2.8.5: Demonstrate knowledge of risk-adjusted performance measures used in alternative investment analysis.

Including:

- Define Jensen's Alpha and the M^2 (M-Squared) approach.
- Calculate Jensen's Alpha and the M^2 (M-Squared) approach.

2.8.6: Demonstrate knowledge of pricing and historic data analysis.

Including:

- Interpret models of stale prices.
- Describe the effect of stale pricing on historic mean returns and volatility.
- Calculate the effect of stale pricing on historic mean returns and volatility.

2.8.7: Demonstrate knowledge of valuation and volatility of private assets.

Including:

- Discuss the smoothing of prices and returns.
- Determine the effect of smoothing on observed volatility.
- Identify the primary ways that returns can be managed.
- Discuss how appraisals contribute to smoothing of private asset prices.
- Compare smoothed returns with market returns.

Reading 2.9: Alpha, Beta, and Hypothesis Testing

2.9.1: Demonstrate knowledge of beta and alpha.

Including:

- Understand the role of beta in the analysis of traditional and alternative investments.
- Understand the role of alpha in the analysis of traditional and alternative investments.

2.9.2: Demonstrate knowledge of return drivers.

Including:

- Discuss the classification of assets into beta drivers and alpha drivers.
- Discuss the characteristics of beta drivers and their behavior over time.
- Discuss passive beta drivers as pure plays on beta.
- Discuss the characteristics of alpha drivers.
- Discuss product innovators and process drivers.

2.9.3: Demonstrate knowledge of empirical approaches in estimating alpha and return persistence.

Including:

- Identify the steps involved in estimating alpha from historical performance.
- Discuss how an experiment of a fair casino game can illustrate the challenges to empirical analysis of manager skill.
- Define abnormal return persistence.
- Discuss attribution of idiosyncratic returns to luck or skill.
- Interpret estimated return persistence.

2.9.4: Demonstrate knowledge of return attribution.

Including:

- Calculate beta, forecasted alpha, and realized alpha.
- Discuss the three primary types of model misspecification (i.e., omitted systematic return factors, misestimated betas, and nonlinear risk-return relationships) and their effects on

return attribution.
- Describe various types of beta nonstationarity (i.e., beta creep, beta expansion, and market timing) and their effects on return attribution.
- Discuss how alpha and beta can become commingled.

2.9.5: Demonstrate knowledge of statistical issues in analyzing alpha and beta.
Including:
- Understand the effect of non-normality on the cross-sectional search for alpha.
- Identify the potential effects of outliers on reported results.
- Describe issues involving biased testing in the search for alpha.
- Discuss the challenges of spurious correlation and causality in beta estimation.
- Explain three major fallacies of alpha estimation and two major fallacies of beta estimation and the lessons that arise from them.

TOPIC 3

CAIA Association. *CAIA Curriculum Level I Volume II*. Self-published, CAIA Association, 2024.

Reading 3.1: Natural Resources and Land

3.1.1: Demonstrate knowledge of natural resources other than land.
Including:
- Discuss natural resources as an exchange option.
- Discuss the concept of moneyness as it pertains to the development of natural resources.
- Discuss why some in-the-money development options should not be immediately exercised.
- Describe the relationship between the moneyness of natural resource options and short-term financial risks.

3.1.2: Demonstrate knowledge of land as an alternative asset.
Including:
- Describe the three types of land lots (i.e., paper lots, blue top lots, and finished lots).
- Discuss investment in undeveloped land as a call option.
- Apply the binomial option pricing technique for valuing land as a call option.
- Describe the risks and returns of investing in land.
- Calculate the expected return of land investments.

3.1.3: Demonstrate knowledge of timber and timberland as alternative assets.
Including:
- Discuss the characteristics of timber and timberland.
- Discuss the role of timberland investment management organizations (TIMOs).
- Describe the risks and returns of timberland investments.
- Identify methods of gaining exposure to timberland.
- Explain benefits and disadvantages of timber investment.

3.1.4: Demonstrate knowledge of farmland as an alternative asset.
Including:
- Discuss the characteristics of farmland investments.
- Calculate the value of farmland based on annual operating income and the cap rate.
- Understand the structure of farmland ownership and management.
- Discuss supply and demand factors of agricultural products.
- Identify three key benefits and three key disadvantages of farmland investment.
- Identify methods of obtaining exposure to farmland.
- Discuss the value and importance of assets with multiple purposes.

3.1.5: Demonstrate knowledge of contagion, price indices, and biases in real estate values.
Including:
- Discuss the reliability of market prices versus appraisal-based data.
- Define contagion.

3.1.6: Demonstrate knowledge of observations regarding historical returns of timberland and farmland.
Including:

- Summarize the key observations on historical timber and farmland returns that are consistent with economic reasoning.

Reading 3.2: Commodities

3.2.1: Demonstrate knowledge of investing in commodities without futures.
Including:
- Discuss disadvantages of direct investment in physical commodities.
- Interpret Hotelling's theory.
- Explain Julian Simon's argument related to direct commodity returns.
- Understand the idiosyncratic risks and two-betas of commodity-related equity returns.
- Describe investments in commodities through exchange-traded funds (ETFs).
- Discuss advantages and disadvantages of commodity-linked notes (CLNs).
- Apply option valuation methods to price commodity-linked notes.

3.2.2: Demonstrate knowledge of the term structure of forward prices on commodities.
Including:
- Understand the costs of carry for commodities.
- Calculate the costs of carry for commodities.
- Define supply elasticity and how it relates to harvests and shifts in demand.
- Define backwardation and contango with respect to the term structure of forward prices.
- Explain backwardation and contango in relation to cost of carry in a perfect market.
- Explain backwardation and contango in relation to cost of carry in an imperfect market.
- Discuss the basis of forward and futures contracts.
- Interpret calendar spreads on forward contracts.
- Calculate the return on calendar spreads.
- Discuss the risks of a calendar spread.

3.2.3: Demonstrate knowledge of rolling of forward and futures contracts.
Including:
- Discuss why returns on a futures contract can differ from the spot return.
- Understand the components of future returns and how they are calculated.
- Understand differing interpretations of rolling contracts.
- Explain roll yield and how it relates to the slope of a forward curve.
- Explain roll yield, carrying costs, and the basis in the context of alpha.
- Discuss how the strategy of rolling contracts affects return expectations.
- Interpret the impact of rolling contracts on alpha.
- Discuss three propositions regarding roll return.

3.2.4: Demonstrate knowledge of normal backwardation and normal contango.
Including:
- Explain normal backwardation.
- Explain normal contango.
- Interpret normal backwardation and normal contango with respect to the risks and returns of commodities and forward contracts on commodities.
- Discuss John Maynard Keynes' argument of normal backwardation.
- Discuss commodity forward curves and how they relate to storage costs and inventory variation.
- Define the market segmentation hypothesis and how it applies to commodity forward prices.
- Interpret option-based models of the forward curve for commodities.

3.2.5: Demonstrate knowledge of commodity exposure and diversification.
Including:
- Summarize why commodity returns may have low correlation with stock and bond prices.
- Discuss commodities as diversifiers in a perfect market equilibrium.
- Discuss commodities as diversifiers in the presence of market imperfections.
- Discuss commodities as diversifiers against unexpected inflation.

3.2.6: Demonstrate knowledge of expected returns and risk attributes on commodities.
Including:

- Interpret empirical evidence on long-run commodity price changes.
- Interpret theoretical evidence on expected commodity returns.
- Discuss irrelevancy of commodity price expectations to returns on futures contracts.
- Identify four favorable characteristics of commodities with respect to event risks.
- Describe commodities as a defensive investment.
- Discuss institutional investing demand and its effect on commodity prices.

3.2.7: Demonstrate knowledge of commodity indices.
Including:

- Discuss the process of construction of commodity futures indices.
- Discuss the characteristics of commodity indices given by S&P GSCI, BCOM, and CRB.
- Discuss production-weighted long only commodity indices.
- Discuss market liquidity-weighted long only commodity indices.
- Discuss tier-weighted long only commodity indices.

3.2.8: Demonstrate knowledge of observations regarding historical returns of commodities.
Including:

- Summarize the key observations on historical commodity returns that are consistent with economic reasoning.

Reading 3.3: Other Real Assets

3.3.1: Demonstrate knowledge of commodity producers.
Including:

- Describe how commodity prices drive the performance of an operating company.
- Describe the empirical evidence between commodity prices and operating firms.
- Discuss the empirical evidence on the correlation between commodity prices and equity prices of commodity-producing firms.

3.3.2: Demonstrate knowledge of liquid alternative real assets.
Including:

- Describe the structure of master limited partnerships (MLPs) within the MLP sector.
- Identify tax characteristics of MLPs.
- Discuss valuations and distribution rates of MLPs.

3.3.3: Demonstrate knowledge of infrastructure in the alternative investment space.
Including:

- Understand the history of infrastructure investing.
- Identify the common attributes of investable infrastructure.

3.3.4: Demonstrate knowledge of infrastructure classifications.
Including:

- Identify the five infrastructure sectors.
- Contrast economic infrastructure and social infrastructure.
- Understand the role of public-private partnerships in infrastructure investing.
- Identify the stages of infrastructure investing.

3.3.5: Demonstrate knowledge of infrastructure investing.
Including:

- Explain infrastructure investment vehicles.
- Contrast the four common types of infrastructure investment styles.
- Evaluate the performance of infrastructure relative to inflation.

3.3.6: Demonstrate knowledge of risk and opportunities in infrastructure.
Including:

- Identify twelve determinants of infrastructure.
- Discuss the risks and government regulation of infrastructure investing.
- Discuss opportunities and allocations of infrastructure investments.

3.3.7: Demonstrate knowledge of intellectual property.
Including:

- Identify and discuss characteristics of intellectual property.
- Identify six characteristics of real assets and how those relate to intellectual properties.
- Understand and apply a simplified model of intellectual property.

3.3.8: Demonstrate knowledge of cash flows of intellectual property.
Including:

- Discuss film production and its distribution revenues as an alternative investment.
- Discuss film production and its distribution expenses as an alternative investment.
- Discuss film financing in the context of investment.
- Explain the profitability of film investment.

3.3.9: Demonstrate knowledge of historical performance data on visual works of art.
Including:
- Discuss the historical performance data of visual works of art.

3.3.10: Demonstrate knowledge of research and development and patents as unbundled intellectual property.
Including:
- Explain the process of accessing research and development via patents.
- Discuss the process of patent acquisition and licensing strategies of patents.
- Discuss the enforcement of patent law and various litigation strategies.
- Identify patent sale license-back strategies.
- Identify patent lending strategies.
- Analyze patent sales and pooling.
- Discuss risks relevant to investing in patents.

Reading 3.4: Overview of Real Estate

3.4.1: Demonstrate knowledge of categories of real estate.
Including:
- Contrast the private and public ownership of real estate.
- Discuss the investment continuum of real estate equity and debt investing.
- Understand how allocators access residential real estate investments.
- Detail the major property types and subcategories of commercial real estate.
- Discuss real estate categorization based on market size.
- Understand the challenges of international real estate investments.

3.4.2: Demonstrate knowledge of advantages, disadvantages, and styles of commercial real estate investments.
Including:
- Discuss seven potential advantages of investing in commercial real estate.
- Discuss four potential disadvantages of investing in commercial real estate.
- Describe styles of real estate investing.
- Understand the core real estate style of investment.
- Understand the value-add real estate style of investment.
- Understand the opportunistic real estate style of investment.
- Describe the attributes of differentiating real estate styles.
- Discuss the purposes of real estate style analysis.

3.4.3: Demonstrate knowledge of the three real estate investment styles.
Including:
- Construct a portfolio that would meet real estate policy objectives by utilizing the three investment styles to add portfolio tilts.

3.4.4: Demonstrate knowledge of the office real estate sector.
Including:
- Identify the various types of office properties.
- Understand the classification of office properties.
- Discuss the factors impacting cap rates of office properties.
- Understand the supply and demand dynamics related to office properties.

3.4.5: Demonstrate knowledge of the industrial and retail real estate sectors.
Including:
- Identify the various types of industrial properties.
- Identify the various types of retail properties.
- Discuss the factors impacting cap rates of industrial properties.
- Discuss the factors impacting cap rates of retail properties.
- Understand the supply and demand dynamics related to industrial properties.
- Understand the supply and demand dynamics related to retail properties.

3.4.6: Demonstrate knowledge of the multifamily and other real estate sectors.
Including:

- Identify the various types of multifamily properties.
- Identify the various types of other real estate properties.
- Understand the supply and demand dynamics related to multifamily properties.

Reading 3.5: Real Estate Assets

3.5.1: Demonstrate knowledge of the debt securities in the private market real estate capital stack.
Including:

- Compare the characteristics of first mortgages, A/B structures, second mortgages, and mezzanine debt.
- Describe a fulcrum security.

3.5.2: Demonstrate knowledge of the equity portion of the private market real estate capital stack.
Including:

- Compare the characteristics of preferred equity and common equity.
- Describe the purpose of the intercreditor agreement.
- Compare the capital stack of a mortgaged fee simple deal to a leveraged asset on a ground lease.
- Calculate the total leverage and equity needed for a project on a ground lease.

3.5.3: Demonstrate knowledge of commercial mortgages in the context of alternative investments.
Including:

- Describe the analysis of default risk of commercial mortgages.
- Identify and apply financial ratios employed in the analysis of commercial mortgage default.
- Estimate the effects of leverage on cash-on-cash returns.

3.5.4: Demonstrate knowledge of commercial mortgages in the context of alternative investments.
Including:

- Describe characteristics of the different types of commercial real estate mortgages: construction mortgages, mini-perm construction mortgages, transitional mortgages, and permanent mortgages.
- Describe characteristics of commercial real estate first mortgages, first mortgage A/B note structures, second mortgages, and stretched first mortgages.
- Understand the advantages and disadvantages to both borrower and lender of each type of mortgage.

3.5.5: Demonstrate knowledge of the investment continuum in private market real estate.
Including:

- Contrast the characteristics of mezzanine debt, preferred equity, common equity, and ground leases as alternatives for financing real estate projects.
- Describe a fulcrum security.

3.5.6: Demonstrate knowledge of alternative real estate investment vehicles.
Including:

- Identify and describe private market real estate investment structures and the subcategories of each structure.
- Identify and describe the advantages and disadvantages of each investment structure's subcategories.
- Identify and describe private equity real estate funds.
- Identify and describe commingled real estate funds.
- Identify and describe syndications.
- Identify and describe joint ventures.
- Describe limited partnerships, and apply the concepts of gearing and loan-to-value (LTV) ratios.

3.5.7: Demonstrate knowledge of liquid alternatives: REITs, REOCs, and ETFs.
Including:

- Define types of real estate investment trusts (REITs).
- List advantages and disadvantages of REITs as an investment.
- Contrast private and public REITs.
- Define the FTSE NAREIT US Real Estate Index Series.
- Contrast the structures of REITs and real estate operating companies (REOCs).

Reading 3.6: Real Estate Methods

3.6.1: Demonstrate knowledge of real estate development in the context of alternative investments.
Including:

- Calculate a development yield.
- Understand the importance of due diligence in formulating assumptions.
- Describe the difference between hard and soft costs.
- Understand the relationship between the development yield and the market cap rate and how it can affect the development decision.

3.6.2: Demonstrate knowledge of commercial real estate valuation.
Including:

- Discuss the importance of commercial real estate equity exposures.
- Identify the four appraisal assumptions.
- Identify the six items that are included in an appraisal report.
- Identify and discuss the three common methodologies used in commercial real estate valuations.
- Explain the sales comparison approach and when it is most useful.
- Explain the cost approach and when it is most useful.
- Explain the income approach and the three subcategories of cap rate, discounted cash flow, and gross income multiplier.
- Calculate cap rates.
- Calculate a gross income multiplier.
- Explain the two ways to calculate a reversion cap rate for a discount cash flow valuation.
- Describe the NCREIF property index as an appraisal-based index.

3.6.3: Demonstrate knowledge of valuation and risks of real estate equity as well as the income method of real estate valuation.
Including:

- Apply the discounted cash flow approach (i.e., income approach) to the calculation of net operating income.
- Calculate a real estate project's discount rate using the risk premium approach, and use that rate to value the project.
- Understand the role of taxes in estimating both the discount rate and the cash flows of a real estate project.
- Calculate the appraised value of an office building using the income approach.

3.6.4: Demonstrate knowledge of alternative real estate investment vehicles and equity REIT returns.
Including:

- Identify and describe open-end real estate mutual funds.
- Discuss options and futures on real estate indices.
- Identify and describe exchange-traded funds based on real estate indices.
- Identify and describe closed-end real estate mutual funds.
- Discuss equity real estate investment trusts.
- Contrast private and public REITs.
- Discuss possible illiquidity premiums in public REITs.
- Define the FTSE NAREIT US Real Estate Index Series.

3.6.5: Demonstrate knowledge of historical risks and returns of equity real estate investment trusts (REITs).
Including:

- Summarize the key observations on historical equity REIT returns that are consistent with economic reasoning.

TOPIC 4

CAIA Association. *CAIA Curriculum Level I Volume II*. Self-published, CAIA Association, 2024.

Reading 4.1: Private Equity Investing

4.1.1: Demonstrate knowledge of the three main private equity strategies.
Including:
- Discuss private equity as an asset class and the three primary private equity strategies.
- Understand the relationship between the business life cycle and stages of private equity investing.
- Distinguish between venture capital, growth equity, and buyouts.

4.1.2: Demonstrate knowledge of private equity (PE) firms and funds.
Including:
- Define PE funds.
- Discuss the organization structure of PE funds.
- Understand PE investment by institutional investors.
- Discuss PE fund intermediation around efficient inefficiencies.
- Identify the five primary functions of PE funds.

4.1.3: Demonstrate knowledge of institutional investor PE fund programs.
Including:
- Describe forms of PE fund intermediation.
- Discuss the life cycle and stages of development of a fund investment program.
- Interpret the fund J-curve.
- Understand undrawn capital commitments.

4.1.4: Demonstrate knowledge of subscription lines in private equity.
Including:
- Identify the benefits and risks to general partners and limited partners when subscription lines are used.
- Apply IRR methodology to determine the change in reported return when subscription lines are used.

4.1.5: Demonstrate knowledge of the limited partner (LP) and general partner (GP) relationship life cycle in private equity.
Including:
- Understand the relationship between LPs and GPs in PE.
- Discuss the three phases in LP and GP relationships.

4.1.6: Demonstrate knowledge of publicly traded PE firms.
Including:
- Understand governance issues within publicly traded PE firms.
- Contrast PE governance structures.

4.1.7: Demonstrate knowledge of exit strategies for private equity and venture capital portfolio company investments.
Including:
- Identify the various types of exits available to private equity managers.
- Compare strategic mergers to financial mergers or secondary buyouts.
- Understand the IPO process.
- Discuss direct listings.

4.1.8: Demonstrate knowledge of SPACs.
Including:

- Understand SPACs.
- Compare direct listings, special purpose acquisition corporations (SPACs), and initial public offerings (IPOs), including their advantages and disadvantages.
- Explain how and when the shares of a SPAC can be described as a default-free convertible bond.

Reading 4.2: Venture Capital

4.2.1: Demonstrate knowledge of venture capital and its role financing startups.
Including:
- Define venture capital opportunities and venture capitalists.
- Discuss the history of venture capital.
- Understand the cash needs for startups and the VC financing model.

4.2.2: Demonstrate knowledge of the stages of venture capital.
Including:
- Distinguish between the earlier stages and later stages of venture capital investing.
- Contrast pre-seed, seed, and Series A stages.
- Identify investment and company characteristics by stage.

4.2.3: Demonstrate knowledge of venture capital risk and returns.
Including:
- Understand the historical returns of venture capital fund investors.
- Explain the risk profile of venture capital investments.
- Interpret the J-curve for private equity projects.
- Discuss return expectations for venture capital investors.

4.2.4: Demonstrate knowledge of academic research on venture returns.
Including:
- Understand performance persistence in venture capital returns.
- Identify return drivers of venture capital funds.
- Apply the conclusions from academic research on VC investing.
- Discuss the three primary risk premium associated with venture capital investing.

4.2.5: Demonstrate knowledge of venture capital valuation methods.
Including:
- Apply the valuation of VC companies based on Total Addressable Market.
- Apply the valuation of VC companies based on operating income.
- Understand the economic rationale for the high discount rates used by venture capitalists.
- Distinguish between pre-money valuation and post-money valuation.

4.2.6: Demonstrate knowledge of venture capital follow-on financing decisions.
Including:
- Discuss the factors in the decision process for follow-on investments.
- Discuss venture capital business plans.
- Analyze equity dilution in follow-on financings.
- Recommend a fund reserve strategy.

4.2.7: Demonstrate knowledge of venture capital securities.
Including:
- Identify the types of securities used by venture capitalists.
- Contrast Simple Agreement for Future Equity (SAFE) with warrants.
- Explain the advantages of using convertible preferred stock.

4.2.8: Demonstrate knowledge of the dynamics of venture opportunities.
Including:
- Identify implications of winner-take-all markets.
- Identify implications of longer time horizons to exits.
- Identify three potential reasons for the declining number of public firms in the US.
- Discuss competition between private and public ownership structures.

4.2.9: Demonstrate knowledge of growth equity.
Including:

- Define growth equity investments and describe growth equity investments.
- Discuss protective provisions as a key deal characteristic in growth equity investment.
- Discuss redemption rights as a key deal characteristic in growth equity investment.
- Explain the valuation of growth equity based on revenue.
- Calculate the valuation of growth equity based on revenue.

Reading 4.3: Buyout

4.3.1: Demonstrate knowledge of buyouts and leveraged buyouts, and merchant banking.
Including:

- Explain the buyout strategy.
- Discuss the history of leveraged buyouts.
- Discuss three key economic and agency issues of buyouts.
- Describe the evolution of the buyout market.
- Understand buyout objectives.
- Discuss capital structure optimization in buyouts.
- Discuss operation efficiency in buyouts.
- Discuss merchant banking practices.

4.3.2: Demonstrate knowledge of the various buyout strategies.
Including:

- Identify the categories of LBOs.
- Contrast the different types of private equity buyouts.

4.3.3: Demonstrate knowledge of the characteristics of buyout funds.
Including:

- Contrast LBO funds by target cap size.
- Analyze total number, size, and implications of buyout fund fees.
- Discuss agency relationships and their role in LBO firms.
- Understand LBO auction markets.
- Understand benefits and concerns of club deals in LBOs.
- Discuss factors driving buyout risks relative to VC risks.

4.3.4: Demonstrate knowledge of leveraged buyouts (LBOs).
Including:

- Calculate projected valuations of an LBO.
- Identify LBO exit strategies.
- Identify benefits of strong corporate governance principles to the public market.

4.3.5: Demonstrate knowledge of private investments in public equity (PIPEs).
Including:

- Identify characteristics and types of securities issued through PIPEs.
- Understand motivations of buyers and sellers in PIPEs.
- Contrast traditional and structured PIPEs.
- Explain toxic PIPEs.

4.3.6: Demonstrate knowledge of liquid alternatives in the private equity sector.
Including:

- Describe business development companies (BDCs).
- Calculate the premium (or discount) of closed-end fund prices.
- Understand the effect of illiquidity on closed-end fund pricing.
- Discuss the diversification and return-enhancement potential of liquid private equity pools.
- Discuss other liquid investments in private equity.

4.3.7: Demonstrate knowledge of long-hold buyout funds.
Including:

- Identify the types of funds and assets likely to be held for 15 to 20 years.
- List the benefits and drawbacks of long-hold buyout funds.

The following is a review of the Introduction to Alternative Investments principles designed to address the learning objectives set forth by CAIA Association®. Cross-reference to CAIA Association Reading 2.7.

READING 2.7

DERIVATIVES AND RISK-NEUTRAL VALUATION

Topic 2

EXAM FOCUS

This reading covers four types of derivatives: forwards, futures, options, and swaps. For the exam, understand how forward contracts are priced and how they are extended to forward rate agreements. Also, be able to explain how carrying costs and convenience yields impact the decision to invest in forwards versus long positions in the underlying assets. Forwards and futures differ in several key ways, including how they are traded, marked-to-market, and margin requirements. Understand the different types of option strategies and how pricing models are used to value option positions. In addition, know the mechanics of interest rate swaps and how to compute expected swap payments. Finally, be able to differentiate between the option sensitivities and describe how they can be used to manage risk.

FORWARD AND FUTURES CONTRACTS

LO 2.7.1: Demonstrate knowledge of forward and futures contracts.

Including:

- **Describe the trading differences between forward and futures contracts.**
- **Apply the marking-to-market process for futures positions.**
- **Discuss the effect of marking-to-market on counterparty risk.**
- **Evaluate the effect of marking-to-market and the time value of money on risk and on prices.**
- **Analyze initial margin for futures positions.**
- **Analyze maintenance margin for futures positions.**

Forward Contracts vs. Futures Contracts

A **forward contract** is a bilateral contract that obligates one party to buy and one party to sell a specific quantity of an asset, at a set price, on a specific date in the future. A **futures contract** is a forward contract that is standardized and exchange traded. The main differences between futures and forwards are that futures are regulated, traded in an active secondary market, backed by a clearinghouse, and require daily settlement of gains and losses. All trading in financial, currency, and commodity futures is regulated by the Commodity Futures Trading Commission (CFTC).

Futures contracts are similar to forward contracts in the following ways:

- *Settlement*. Futures and forwards can be either deliverable (i.e., the underlying asset must be delivered) or cash settlement contracts.
- *Initial pricing*. Futures and forwards are priced to have zero value at the time an investor enters into the contract.

Futures contracts differ from forward contracts in the following ways:

- *Exchange trading*. Futures contracts trade on organized exchanges and provide daily liquidity and transparent pricing. Forwards are private over-the-counter (OTC) contracts, generally do not trade, and do not have observable prices.
- *Standardization*. Futures contracts have standardized contract sizes and terms. Forward terms (e.g., collateral size, contract size, delivery terms, etc.) are customized to the needs of the parties involved, which is a significant advantage to using forwards.
- *Clearinghouse*. A single clearinghouse is the counterparty to all futures contracts. The clearinghouse comprises exchange members who pool capital and guarantee contract performance even if a single member were to default. Forwards are contracts with the originating counterparty and contain significant counterparty risk.
- *Mark-to-market*. Futures contracts are marked-to-market. Forward contracts are generally not marked-to-market. This process will be detailed in the next section.
- *Regulation*. The government regulates futures markets. Forward contracts are usually not regulated.

The party to the futures contract that agrees to buy or receive the financial or physical asset has a long futures position, and is called the long. The party to the futures contract that agrees to sell or deliver the asset has a short futures position, and is called the short. A trader may make a reverse (i.e., offsetting or opposite) trade in the futures market to close out the position of the initial futures contract. Forward contracts are more difficult to close out, as they require agreement by the counterparty to exit the contract. One party can always take an opposite position in another contract to eliminate market exposure, but counterparty risk will still exist. **Counterparty risk** is the risk that a party to a contract fails to perform the duties associated with that contract.

Open interest in the futures market is the number of outstanding contracts. A long position and short position on the same futures contract are counted as one contract toward open interest.

Marking-to-Market Process

In the futures markets, margin is a performance guarantee. It is money deposited with a broker by both the long and the short. To safeguard the clearinghouse, the exchange requires traders to post margin and settle their accounts on a daily basis.

Over the course of each daily trading session, futures contracts change in value, representing a loss to one counterparty and a gain to the other. At the end of the day,

futures contracts are **marked-to-market**, a process in which the change in contract value is transferred in cash from the margin account of the counterparty with a loss in value to the margin account of the counterparty with a gain in value. This adjusts the futures contract price to the spot price (i.e., current price of the underlying asset), resulting in a contract value of zero. For example, consider a long futures contract at a price of $10. If the underlying asset experiences a $1 decrease in value, the long position experiences a $1 per contract loss and will lose this amount from the margin account. Because of the $1 cash transfer out of the margin account, the new long contract price is effectively $9 per contract (i.e., $10 minus $1).

Marking-to-Market and Counterparty Risk

As a result of the mark-to-market process, large gains or losses are not allowed to accumulate over the life of the contract, and because the clearinghouse is the counterparty to all contracts, counterparty risk is minimal. Any counterparty that is unable to meet the financial obligation required in the mark-to-market process forfeits its position and a new counterparty takes over. In the absence of daily marking-to-market, a **crisis at maturity** will exist. This form of counterparty risk occurs when a party fails to deliver either the payment required or the asset itself at the end of the contract. Note that some firms prefer to use forward contracts to avoid the daily cash flow volatility that can occur from the mark-to-market process in futures markets. Forward contracts are not typically marked-to-market, and as such, will be exposed to higher counterparty risk.

Marking-to-Market and Time Value of Money

Because the marking-to-market concept requires that parties to futures contracts pay or receive cash on a daily basis, cash flows are accelerated versus identical forward contracts, which only require payment at maturity or settlement. As a result of the earlier payment and receipt of cash, futures contracts have higher price volatility (risk) and higher present values than forward contracts, which are otherwise identical.

Marking-to-market and the concept of time value of money also impacts prices on futures contracts. In a hypothetical situation where an identical forward and futures contract has an underlying asset with no systematic risk, the present value of the expected cash flows from marking-to-market is zero if interest rates are uncorrelated with the spot price.

The present value of the expected cash flows from marking-to-market will be positive to the long side of the futures contract when the spot price increases and interest rates are positively correlated to the spot price. In other words, when the spot price on the asset increases, interest rates are also increasing, and the long party to the futures contract will receive cash in a higher rate environment. This will drive the price of the futures contract above the forward contract.

When interest rates are negatively correlated to the spot price, the long party will deliver cash flows when rates are higher and receive cash flows when rates are lower; this will drive the price of the futures contract below an identical forward contract.

Initial Margin

Initial margin is the collateral (i.e., cash) that must be deposited in a futures account before any trading takes place. Initial margin requirements are unique to each type of underlying asset. Initial margin, which is expressed in currency per contract (e.g., $1,000 per contract), is relatively low and equals about one day's maximum price fluctuation on the total value of the contract's underlying asset. Generally, this is less than 10% of the full contract price.

> **EXAMPLE: Calculating initial margin**
>
> An investor wishes to take a short position in 10 gold futures contracts with a contract price of $30,000 each. The initial margin for each contract is $2,500. **Calculate** the total initial margin.
>
> **Answer:**
>
> The initial margin is equal to $2,500 per contract × 10 contracts = $25,000. The total contract price is $300,000, and the margin in this case represents 8.33% of the total.

Maintenance Margin

The **maintenance margin requirement** is the amount of margin, expressed as currency per contract that must be maintained in a futures account for open positions. If the margin balance in the account falls below the maintenance margin due to a change in the contract price for the underlying asset, additional funds must be deposited to bring the margin balance back up to the initial margin requirement. Maintenance margin is the amount of margin that must be maintained in a futures account and is usually set at 75%–80% of the initial margin.

As the price of the futures contract fluctuates, the value of a trader's margin account is adjusted to account for any gains and losses that have occurred as of the end of the trading day. These increases or decreases in the trader's margin account are called the **variation margin**. Positive variation margin adds to the equity in the margin account and can be withdrawn at any time. Negative variation margin reduces the equity in the margin account.

If negative variation margins reduce the trader's margin below the maintenance margin, the trader will receive a margin call. A **margin call** is a notification by the exchange to the trader that additional funds must be deposited to bring the equity in the account back to the initial margin level. The futures commission merchant may liquidate the position if the trader cannot post additional margin. Note that margin requirements may change with significant volatility or price changes.

> **EXAMPLE: Calculating maintenance margin**
>
> A trader has a long position in five contracts of corn bushels with an initial price of $3.80 per bushel, with each contract controlling 5,000 bushels. At an initial margin of 10%, the trader is required to post $9,500 (5,000 × 5 × $3.80 × 10%). The maintenance margin is set to $7,000 (or $1,400 per contract). Assuming corn drops

by $0.20 per bushel, **calculate** the margin balance and the required margin call needed.

Answer:

A decline of $0.20 per bushel × 5,000 bushels × 5 contracts results in a loss on the long position of $5,000. This results in a margin balance of $4,500 ($9,500 – $5,000) and, because the margin balance has fallen below the maintenance margin level of $7,000, will require a margin call of $5,000 to bring the balance back up to the original amount of $9,500.

FORWARD CONTRACT FOUNDATIONS

LO 2.7.2: Demonstrate knowledge of foundations of forward contracts.

Including:

- **Describe the settlement and delivery processes of forward contracts.**
- **Understand the no-arbitrage approach to determining forward prices.**
- **Determine the forward contract price of a zero-coupon default-free bond.**
- **Analyze forward prices and expected spot prices under risk neutrality.**
- **Understand the relationship between forward prices and expected bond rates.**

Forward Contract Settlement and Delivery

A **forward contract** is an agreement which results in either a deferred delivery of an asset or a cash settlement at a specific price or rate on the delivery/settlement date. If the asset itself is to be delivered, the short side of the contract (the seller) is obligated to deliver the assets to the long side of the contract (the buyer) at the prespecified, forward contract price. For cash settlements, the difference between the market price and the forward price on the settlement date is the amount which changes hands.

Forward contracts are obligations for both the buyer and the seller. The long side is obligated to buy the specific asset at the forward price on the delivery/settlement date. The short side is obligated to deliver the specific asset at a sale price equal to the forward price. The **forward price** is typically set to a value that makes the contract equal to zero, such that there is no immediate payment need for either party.

Forward Pricing—No-Arbitrage Approach

No-arbitrage, or **arbitrage-free modeling**, implies that two identical assets or investment strategies must offer the same exact returns. With identical returns and payoffs, the market prices must be identical or arbitrage opportunities would be available. Applying this theory to zero-coupon bonds, a long-term bond should provide an investor with the same return as a combination of a short-term bond and a forward contract covering the gap in maturities between the short-term and long-term bond. The following equation is used to apply the model:

$$(1 + R_{0,T}) = (1 + R_{0,t}) \times (1 + R_{t,T})$$

where:
$R_{0,T}$ = return on the long-term bond $(1 + R_{0,t})$
$R_{0,t}$ = return on the short-term bond
$R_{t,T}$ = return on the long forward contract position

Forward Contract Pricing for Zero-Coupon Default-Free Bonds

To see the formula applied, assume a forward contract to deliver a nine-month Treasury bill (T-bill) in exchange for *F* dollars with a principal or face value of $1,000, with delivery taking place in three months. The market price of a three-month T-bill with a $1,000 face value is $995, and the market price of a one-year T-bill, also with a $1,000 face value, is $950. Both strategies, noted here, should produce equivalent results:

- Strategy 1 is *T* = 12 months. Invest in the one-year T-bill.
- Strategy 2 is *T* = 12 months. Invest in the three-month T-bill (*T* = three months), take the proceeds at maturity and roll them into a nine-month T-bill at the forward contract price.

The **wealth ratio** is equal to the non-annualized return plus one. So, for Strategy 1, the wealth ratio is equal to $1,000 / $950, or 105.26%. The wealth ratio of Strategy 2 must be equal to the wealth ratio for Strategy 1 and, as such, the wealth ratios can be set to equal each other with the missing component representing the forward price, *F*, at which a nine-month T-bill is exchanged at delivery of the forward contract in three months' time:

$$\$1{,}000 / \$950 = (\$1{,}000 / \$995)(\$1{,}000 / F_{t,T})$$

The forward price (*F*) must therefore be equal to $954.77.

For any default-free zero-coupon bond, the forward price is a function of the spot price for the zero-coupon bond at the inception of the forward contract and the spot price for the zero-coupon bond at the termination of the forward contract. As an example, assume the following prices for bonds with a par value of $100:

- The spot price on a three-month zero-coupon bond is $98.
- The spot price on a six-month zero-coupon bond is $97.

The forward price of a three-month bond in three months must be equal to $98.98 [= ($97 / $98) × 100]. Alternatively, the spot price on a six-month zero-coupon bond in an arbitrage-free model must be equal to the three-month zero-coupon bond price of $98 times the forward price of the three-month bond in three months of $98.98. ($98 × $98.98) / 100 = $97.

Risk Neutrality

From a risk perspective, the long position on the forward contract is risking that the value of the bond ends up lower than the locked-in forward price, while the short position risks that the value of the bond is higher than the forward price. A declining rate environment will benefit the long position as the holder of classic interest rate risk. The short side is seen as laying off of this interest rate risk.

Applications to Term Structure Theories

Assuming expectations are unbiased, forward bond prices should reflect unbiased estimates of future cash market or spot prices. Under liquidity premium theories, investors should be compensated with higher expected returns for bearing interest rate risks. Forward bond prices should understate expected spot prices (by the amount of the expected risk premium) to compensate the long side for bearing interest rate risk; forward yields will overstate expected spot yields for this same reason.

FORWARD RATE AGREEMENTS

LO 2.7.3: Demonstrate knowledge of the impacts of forward contracts on rates.

Including:

- **Describe the forward rate agreement (FRA) process.**
- **Understand and apply the relationship between FRAs and implied forward interest rates.**
- **Explain forward rates and their extensions.**

FRA Process

A **forward rate agreement (FRA)** is a contract settled in cash where the contract buyer pays a specific fixed rate (the FRA rate) over a specified period in the future and receives in return a floating reference rate payment. The rate is applied to the **notional principal** (which serves as the base for the rate payments and is not actually exchanged). The secured overnight financing rate (SOFR) (for U.S. dollars) and Euribor (for euros) are common, short-term reference rates used in FRAs. The **reference rate** refers to a specific market rate in contracts that drives the direction and magnitude of cash settlements. Contract settlement involves a payment from the losing side to the winning side equal to the notional principal multiplied by the difference between the FRA rate and the actual market rate. For the buyer, the FRA is protection against rising interest rates. As long as the actual market rate for the reference rate is higher than the FRA rate, the buyer "wins" from having locked in the lower FRA rate. If the actual market rate is below the FRA rate at settlement, the FRA buyer "loses" and will make a payment to the FRA seller.

EXAMPLE: Determining the FRA payout

An FRA on an underlying rate of six-month SOFR with settlement date in 12 months' time has an FRA rate of 4.25% and a notional value of $5 million. On the settlement date, SOFR has fallen to 3.75%. **Determine** the amount of payment and which party is the payer on the settlement date.

Answer:

The amount of the payment owed is equal to the following: $5,000,000 × (6 months / 12 months) × (4.25% − 3.75%) = $12,500. The payment is made from the FRA buyer to the FRA seller because the reference rate has decreased below the FRA rate.

FRAs and Implied Forward Interest Rates

Assuming perfect markets, continuous compounding, and default-free instruments, the FRA rate should be equal to the following:

$$F_{T-t} = \frac{\left[\left(T \times r_T\right) - \left(t \times r_t\right)\right]}{\left(T - t\right)}$$

T and *t* represents longer and shorter time periods, and *r* represents the rates applicable to those periods. If a three-year rate is 3.00% and a two-year rate is 2.25%, the forward rate for a one-year period starting in two years' time per the formula just listed is equal to $[(3 \times 3.00\%) - (2 \times 2.25\%)] / (3 - 2) = 4.50\%$.

> **EXAMPLE: Determining FRA rate using forward rates**
>
> A four-year security has a yield of 2.75%. A forward contract on a one-year security settling in four years trades at a forward rate of 2.50%. Both securities are riskless, and compounding is continuous. **Calculate** the no-arbitrage yield for a five-year riskless security.
>
> **Answer:**
>
> Values are plugged into the FRA rate equation as follows:
>
> $$2.5\% = [(5 \times \text{five-year yield}) - (4 \times 2.75\%)] / (5 - 4)$$
>
> The five-year yield is therefore equal to 2.70%. An investor can earn the same 2.70% return from investing for four years at 2.75% and one additional year at 2.50%.

Because there is no such thing as a perfectly efficient market, the arbitrage-free relationships described in this topic are not valid in the real world. Actual market prices will differ from arbitrage-free prices, and it is here where investors have opportunities to earn profits.

Forward Rate Extensions

Swaps are a series of forward contracts lumped together with varying (but equally spaced) settlement times. The primary types of swaps are interest rate swaps, currency swaps, and commodities swaps. Investors and entities often use swaps as a means of protecting (hedging) themselves from adverse movements in the underlying asset. Risks are transferred using forward contracts, and because swaps are combinations of forward contracts, the overall risk of a swap comes from the risk of its underlying forward contracts.

FORWARD CONTRACT COSTS OF CARRY

LO 2.7.4: Demonstrate knowledge of the impact of forward contracts on assets with benefits and costs of carry.

Including:
- **Discuss the benefits and costs of carrying (i.e., holding) a cash position and the incorporation of convenience yields and storage costs in cost-of-carry models.**
- **Calculate the forward price of a commodity.**
- **Discuss four factors that differentiate forward pricing on financial assets with those of physical assets.**
- **Understand challenges involving measuring storage costs and convenience yields.**
- **Discuss the difficulties of short-selling physical assets and the resulting implication to the formula for forward prices.**
- **Calculate forward contracts with non-zero market value.**

Carrying Costs and Convenience Yields

Carrying costs (costs of carry) represent the financial difference between a forward market position and a cash market position. Maintaining inventory of a commodity results in storage costs that are not incurred with forward positions. **Storage costs** are positive carrying costs which include insurance, transportation, warehouse fees, and spoilage. A **cost-of-carry model** is used to project benefits and carrying costs in order to value derivative contracts. Assuming markets are efficient, as cash and forward positions converge in value, any current value differences should be tied to carrying benefits and costs.

In contrast to carrying costs, **convenience yield** is the economic benefit that the holder of a physical commodity receives from holding it inventory rather than in a forward contract. If a company uses a specific commodity in its production process, having an inventory on hand can reduce the risk of any supply disruptions. Figure 1 shows the costs and benefits for holders of both financial and real assets. It is worth noting that in pricing models, convenience yields for real assets and dividends/coupons for financial assets represent negative costs and are entered as negative numbers. Convenience yields will differ depending on the circumstances of each investor, whereas financial asset benefits like dividends and coupons are the same for all.

Storage costs are typically expressed as a continuous rate (c) and are shown in pricing models with the same sign as the opportunity cost of capital (interest, r). Storage and opportunity (financing) costs can be reflected together, although storage costs differ by market participants whereas opportunity costs for financial assets are relatively consistent across participants.

Figure 1: Direct Ownership: Costs and Benefits

	Financial Assets	Real Assets
Costs	Interest (r), custody (should be 0)	Interest (r) and storage (c)
Benefits	Dividends and coupons (d)	Convenience (y)

Commodity Forward Prices

The formula for a forward contract with an underlying commodity is shown in the following. The rationale for the inequality results directly from physical assets, which cannot be shorted:

$$F_T \leq P_0 e^{(r+c-y)T}$$

where:
F = forward price on the underlying
P = price of a long position in the underlying
r = spot interest rate
T = time to maturity in years
c = storage cost
y = continuously compounded convenience yield

EXAMPLE: Calculating a forward contract price

A commodity has a spot price of $25. The commodity has storage costs of 1.75%, financing costs of 5.75%, and a convenience yield of 2.50%. **Calculate** the cost of a three-month forward contract on this commodity.

Answer:

The forward price is equal to $F_T \leq 25e^{(0.0575+0.0175-0.0250)0.25} = \$25.31$.

In this example, the implied growth rate of the forward over the spot is equal to 5% (= 5.75% + 1.75% − 2.50%).

Forward Pricing: Financial Assets vs. Physical Assets

Financial security forward pricing is a by-product of spot rates, which include interest rate term structure attributes and potential dividend yields. Forward rate interest curves only reveal information about the term structure of spot rates, and expected spot rates do not create the spread between financial asset spot and forward rates.

For commodity forward prices, the cost-of-carry relationship described previously does not always apply due to storage cost differentials, short selling difficulties, convenience yield differentials, and forecasts of supply and demand changes.

Measuring Convenience Yields and Storage Costs

As noted earlier, storage costs and convenience yields will differ depending on supply and demand as well as market participants and their locations. Seasonal effects will impact supply and demand, which in turn will impact the term structure of forward prices. In the forward contract price equation presented previously, the spread between the storage costs and the convenience yield reflects that of the marginal market participant. The **marginal market participant** is an entity with benefits and costs that make them indifferent between synthetic and physical positions.

Because storage costs and convenience yields do vary over time and by participants, the term structure of forward prices tends to vary in shape and slope. Market participants who can more accurately predict supply and demand changes can earn superior returns on forward contract transactions.

Physical Asset Short Selling and Impact on Forward Prices

When an organized market exists for borrowing and lending stocks and bonds, short selling of financial assets is a very feasible investment strategy. For physical assets like commodities, developed markets for lending do not exist. Arbitrageurs will then struggle to short sell commodities as a hedge on long forward positions, which will reduce demand for such positions. The rationale for the inequality in the commodity forward pricing equation results directly from physical assets, which cannot be shorted.

Nonzero Market Value Forward Contracts

A nonzero initial value for a forward contract is possible in situations where one party provides an initial payment to the other. As the underlying asset price changes, even a contract with an initial value of zero will change in value over time. At a given point in time, assuming the underlying asset can be sold short, the value of a long forward contract position is shown in the following equation:

$$\text{value of long position in forward contract at time } t = P_t e^{(r+c-y)(T-t)} - F_0$$

where:
P_t = price of the underlying asset at time t
F_0 = forward price of the contract

EXAMPLE: Calculating forward contract value

A commodity has a spot price of $60. The commodity has storage costs of 3%, financing costs of 6%, and a convenience yield of 2%. Assuming a six-month forward contract price of $64 and a market where the asset can be sold short, what is the value of the contract to the short side?

Answer:

The value to the short side is calculated by first determining the value to the long side. The long-side value is equal to the following: value of long position in forward contract at time $t = 60e^{(0.06 + 0.03 - 0.02)0.50} - 64 = -\$1.86$, which for the short side means the value is equal to $1.86.

LONG-TERM FUTURES EXPOSURES

LO 2.7.5: Demonstrate knowledge of managing long-term futures exposures.

Including:
- **Discuss futures contracts with different settlement dates.**
- **Understand how rollover decisions alter long-run returns.**

Futures Contracts With Different Dates

Unlike long positions in investments such as equity and real estate, forwards and futures have set expiration dates. To maintain long-term exposure, these contracts must be rolled over before or on their settlement dates. **Rolling contracts** involves closing one contract as it nears or is at settlement and opening another position on the same underlying asset with a longer settlement time. Settlement dates for futures contracts are at regular intervals such as quarterly, monthly, or even weekly. The **front month contract** (also referred to as the front contract, spot contract, or nearby contract) is the futures contract on the exchange with the shortest time until settlement. **Distant contracts** (also referred to as back contracts or deferred contracts) have longer settlement times. The order of the deferred contracts, with shortest time to settlement and extending outward, may be referred to as first deferred, second deferred, and so on.

Rides and *rolls* are expressions that represent the regular extensions of settlement dates by closing nearby forwards/futures positions and opening deferred positions to keep a continuous exposure to a commodity or other underlying asset. The investor will *ride* the position as settlement nears and then *roll* over to the new position with the longer settlement time as the old positions are closed. Note that a roll also describes holding commodity forward positions over time.

Long-Run Returns and Rollover Decisions

The decision as to when to close out the old position and enter the new one is up to each investor, as some may choose to roll to a new contract with considerable time left on the old contract, while others may wait up until the settlement date. An investor's long-term return is heavily impacted by timing decisions on when to roll over forwards and futures contracts, with each investor experiencing a different return depending on when and how they roll their contracts over.

OPTION EXPOSURES

LO 2.7.6: Demonstrate knowledge of option exposures.

Including:
- **Understand option risk exposure diagrams.**
- **Explain the key characteristics of long and short positions in an underlying asset.**
- **Understand the key characteristics of call and put exposures.**
- **State the key characteristics of protective put exposures.**
- **Discuss characteristics of option spreads (e.g., bull spreads, bear spreads, and ratio spreads).**
- **Understand the key characteristics of option combinations (e.g., straddles, strangles, and the concept of risk reversals).**
- **Apply the concepts of option collars and put-call parity.**

Long and Short Option Positions on Calls and Puts

Options are contracts that give the option holder (the buyer or long position) the right, but not the obligation, to enter into a specific transaction in the future. The other side of a contract is the option seller (short position) who has an obligation to sell (call option) or buy (put option).

A **call option** gives the option holder the right to buy a security or a particular asset in the future at a specified price. A **put option** gives the holder the right to sell a particular security or asset in the future at a specified price. The option holder pays a fee for the option (the premium), and risk is limited to the amount of the premium. As the security price changes over time, options can be in the money (immediate exercise would result in a positive payoff), at the money (zero payoff), and out of the money (immediate exercise would result in a negative payoff). These three money terms describe the option's **moneyness**. Note that an option price can never be negative, even for out-of-the-money options.

The **strike price** (or *exercise price*) refers to the price at which the option contract can be exercised. **Option maturity** is the time when the option expires. **European options** can only be exercised at maturity, while **American options** can be exercised at any time up to and including maturity.

Options allow investors to make or change their decisions as new information about a security or asset arrives into the market. Alternative investment strategies often rely on the use of options, or securities with options.

This section examines risk exposures, also called option payoffs, using payoff diagrams, where in-the-money options are shown at maturity. Price is shown on the horizontal axis, and profits are shown on the vertical axis.

A long position in a security has unlimited upside profit potential but limited downside loss potential, because the security value cannot fall below zero value. A short position is the mirror exposure and has unlimited loss potential, but limited profit potential. Short positions can be particularly important in alternative investment strategies.

Option positions behave differently than the underlying security, given that the right (but not the obligation) to buy or sell the security limits the downside for the call and

put option holder to the premium paid. A **long call** option has unlimited upside profit potential but limited downside, while a **short call** has unlimited downside potential but limited upside. A **long put** option has limited upside profit potential because the security price cannot fall below zero and has limited downside, while a **short put** has limited downside loss potential and limited upside. The following figures illustrate the payoff diagrams of a basic call and put option.

Figure 2: Long Call and Short Call Payoff Diagram

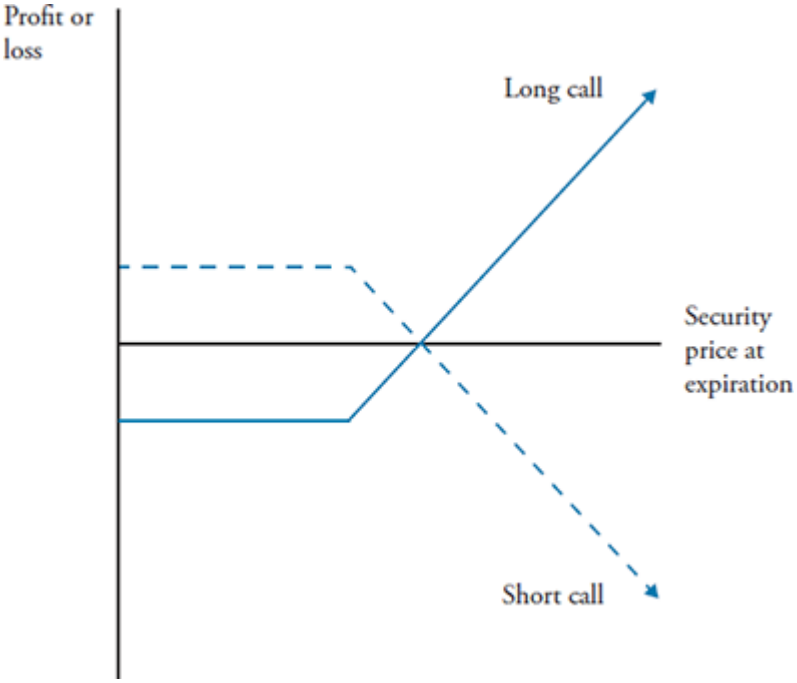
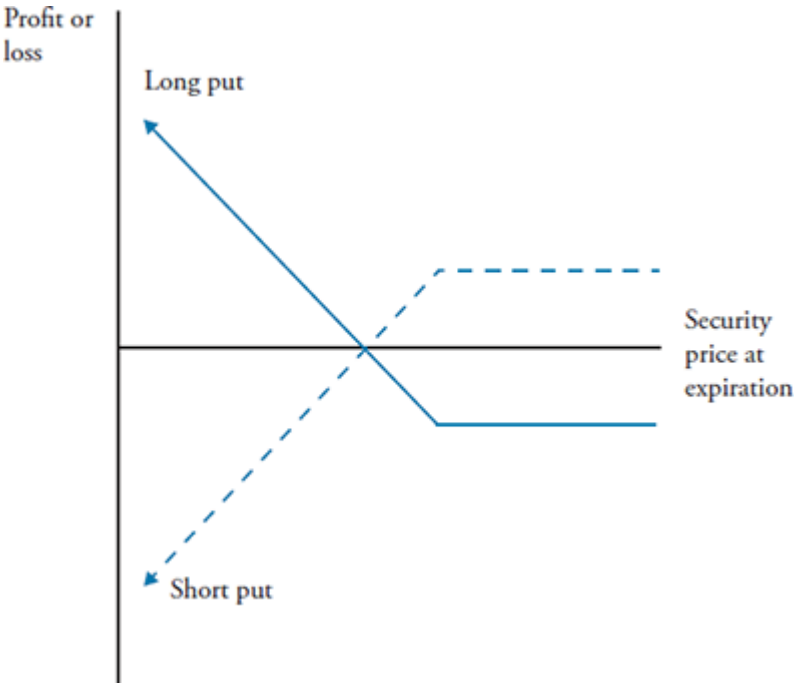


Figure 3: Long Put and Short Put Payoff Diagram



Covered Calls and Protective Puts

Naked options (or *uncovered options*) refer to short options in which the holder of the option does not also own a position in the underlying asset. A **covered call** strategy combines being long the underlying security and being short a call option on the security. The term *covered* means the long security position covers the investor's obligation to deliver the security. A covered call has limited upside, large but limited downside, and has the same payoff diagram as a short put. A protective put strategy combines being long the underlying security and being long a put option on the security. The term *protective* means the put option protects the investor against downside risk, while keeping unlimited upside potential. A **protective put** has the same payoff diagram as a long call. Figure 4 and Figure 5 illustrate the payoff diagrams of a covered call and a protective put.

Figure 4: Covered Call Payoff Diagram

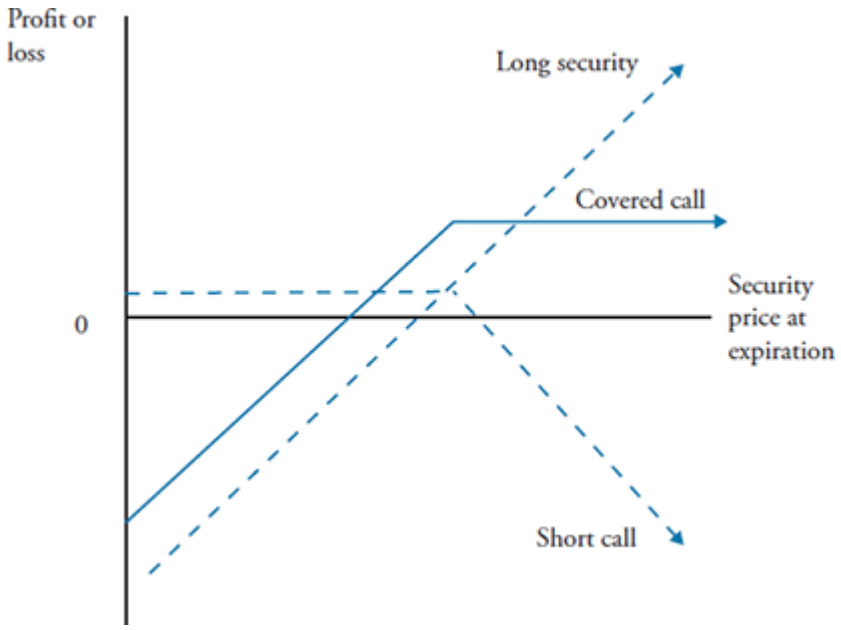
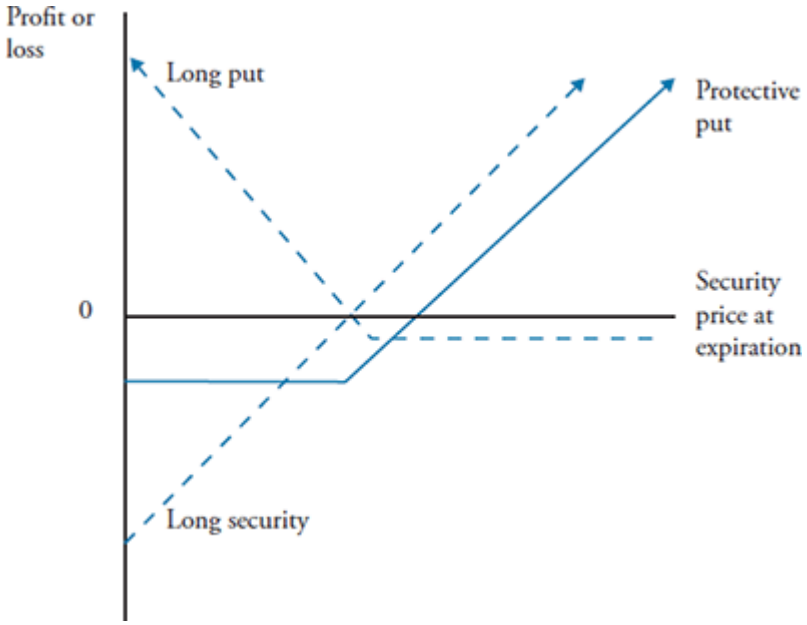


Figure 5: Protective Put Payoff Diagram



Option Spreads

An **option spread** involves (1) either calls or puts (but not both) and (2) both long and short positions on the underlying security. The options used in *horizontal spreads* (or *calendar spreads*) differ only by expiration date. The options used in *vertical spreads* differ only by strike price. Finally, the options used in *diagonal spreads* differ by both expiration date and strike price.

Figure 6 and Figure 7 show the payoff diagrams of a bull spread and a bear spread. A **bull spread** is an option strategy that combines a long position in a lower strike price option with a short position in a higher strike price option. The strategy results in a bullish exposure that starts at the lower strike price and is bound by the higher strike price. A **bear spread** combines a long position in a higher strike price option with a short position in a lower strike price option. The strategy results in a bearish exposure that starts at the higher strike price and is bound by the lower strike price.

Ratio spreads incorporate differing option numbers for each position (e.g., one long call and two short calls). The differing numbers provide a greater exposure to one side over another.

Figure 6: Bull Spread Payoff Diagram

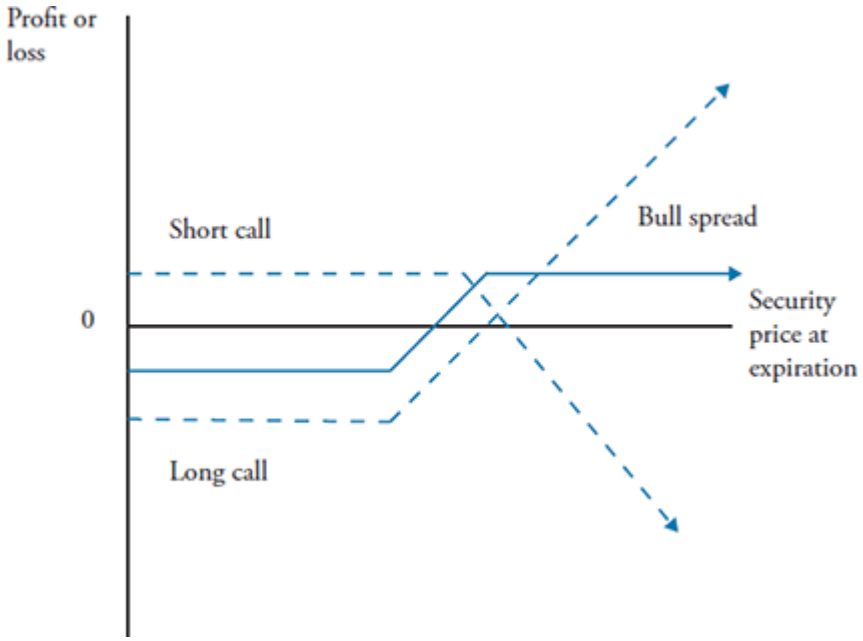
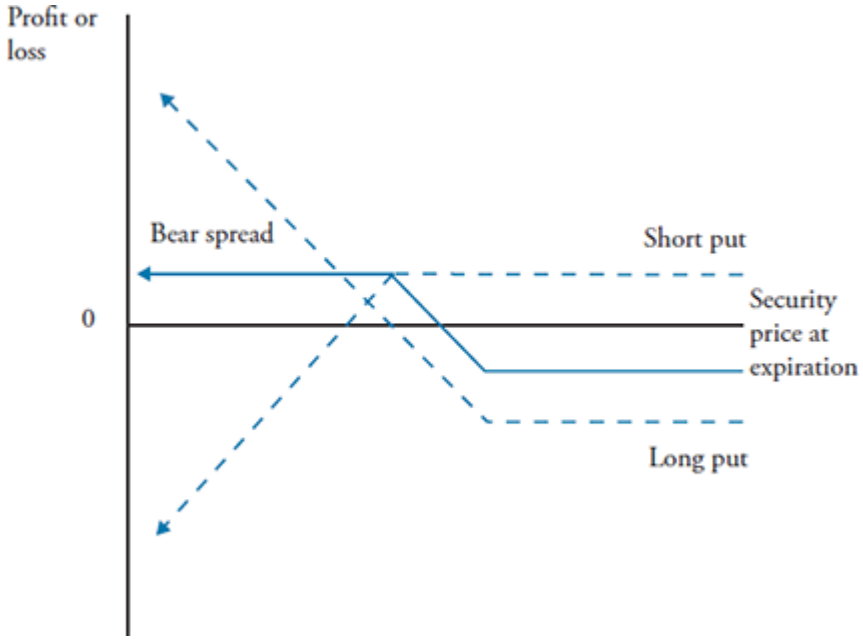


Figure 7: Bear Spread Payoff Diagram



Option Combinations

Option combinations involve a combination of both calls and puts on the underlying security. Two of the better-known volatility strategies are the option straddle and the option strangle. An **option straddle** is a position in a call and a put (either both long or both short) on the same underlying security, same expiration date, and same strike price. An **option strangle** is a position in a call and a put (either both long or both short) on the same underlying security and expiration date, but with different strike prices. Figure 8 and Figure 9 illustrate the payoff diagrams of a long straddle and long strangle.

Figure 8: Straddle Payoff Diagram

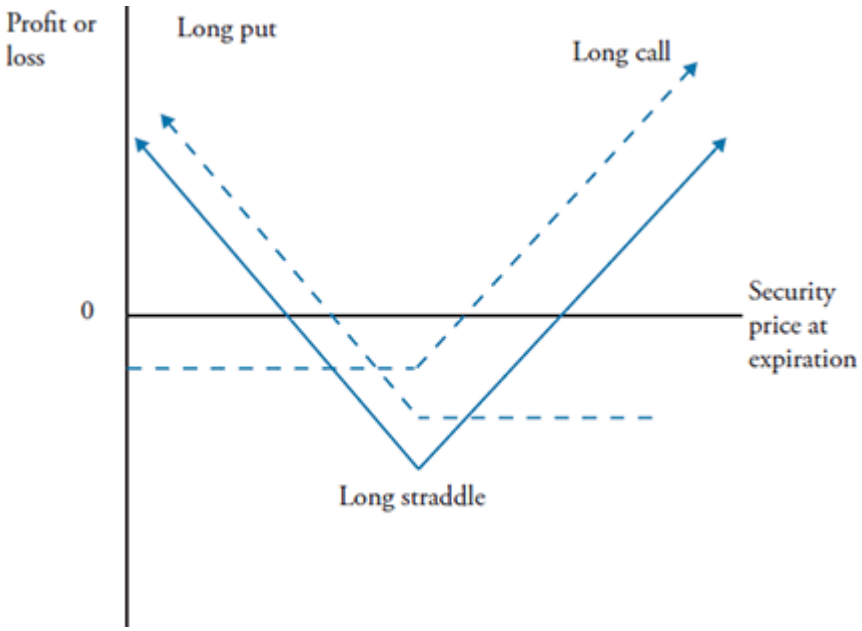
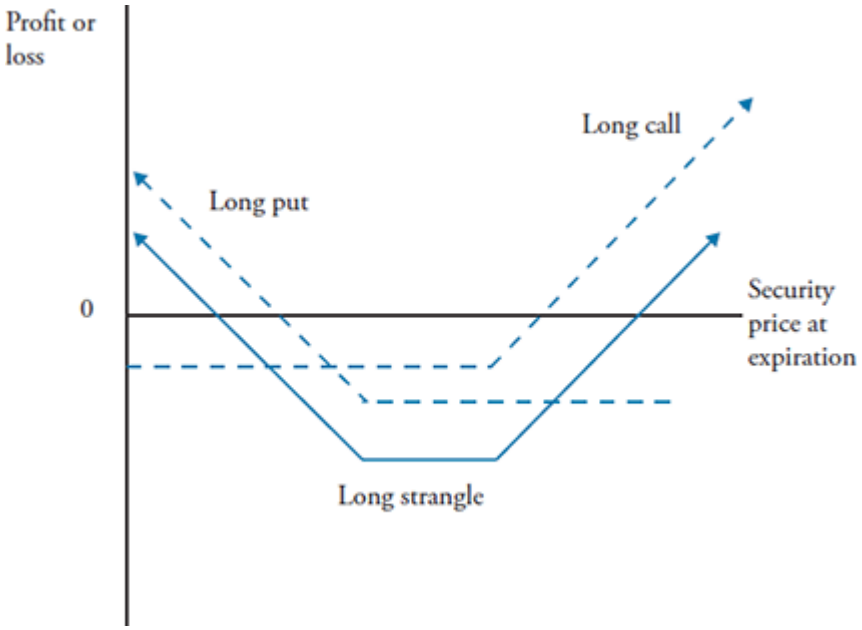


Figure 9: Strangle Payoff Diagram



PROFESSOR'S NOTE

Option straddles and strangles are called volatility strategies because they are used when large swings are expected in the security price, but the direction of the swings is not known. They are often used ahead of earnings announcements. Given the two option premiums, these are expensive strategies for the long investor who is expecting sufficient swings in security price to recover both premiums.

If an option straddle consists of options with different signs (e.g., long call and short put), the result would be a synthetic position in the underlying security with a straight-line payoff diagram. A long call and short put would result in a synthetic long position

in the security, while a long put short call would result in a synthetic short position in the security.

We can also extend the previous scenario to option strangles. For example, a long out-of-the-money call combined with a short out-of-the-money put on the same asset and with the same expiration is called a **risk reversal**. It is similar to a synthetic long position in the underlying security, but it has a break between the two option strike prices.

Option Collars

Another popular strategy is a collar. A **collar** includes a long position in the underlying security, which is combined with a long put option and a short call option. It is, in some regard, a hybrid of the protective put and covered call positions. The idea behind a collar is that the investor expects only modest volatility and is looking to protect against downside risk, but is willing to forgo upside potential beyond a certain point. An **option collar** is a long position in an out-of-the-money put and a short position in an out-of-the-money call. The option collar is therefore the same as the short position in a risk reversal, and has the same payoff diagram as a bull spread.

Put-Call Parity

Using the option positions we previously described, we can construct the put-call parity, a particularly important relationship for analyzing options. The **put-call parity** is a no-arbitrage relationship between two sets of positions with identical payoffs: (1) a long position in an underlying asset and (2) a long call, short put, and long risk-free bond positions:

$$\text{call} + \text{risk-free bond} - \text{put} = \text{underlying asset}$$

The call and the put both have identical strike prices and expiration dates. Upside exposure is provided by the long call and downside exposure by the short put. The risk-free bond indicates the amount of cash that must be invested today. This equation can be rearranged many ways, including to calculate the value of the call or the put. However, no matter how it is rearranged, the intuition will always be that the two sides require the same investment and provide the same exposure, and therefore their values must always be equal.

INTEREST RATE OPTIONS

LO 2.7.7: Demonstrate knowledge of interest rate options.

Including:
- **Describe an interest rate cap and calculate cap payments.**
- **Describe interest rate floors and calculate floor payments.**
- **Discuss interest rate options and counterparty risk.**

Interest Rate Caps

An **interest rate cap** is an agreement in which one party (i.e., the cap seller) agrees to pay the other party (i.e., the cap buyer) if an adjustable rate (i.e., the reference rate) rises above a **cap rate** (a predetermined threshold which functions as the strike rate). For very short time periods, a **caplet** is an interest rate cap that is valid for only a single period. A caplet can be priced using the Black-Scholes option pricing model. Relatedly, a **cap** is a series of caplets, and its price is the sum of the respective caplets that comprise the in-force period of the cap.

Interest rate caps (also known as *ceilings*) are used by issuers of floating-rate securities to hedge against rising short-term interest rates. The contracts function like insurance. The cap purchaser will pay a premium to the seller. If the adjustable rate remains below the cap rate, then no payments are made, and the seller keeps all premiums. However, if the adjustable rate rises above the cap rate, then the seller will make payments based upon a stated notional principal, based on *m* periods per year, according to the following formula:

$$\text{cap payment} = \max\left[\left(\text{reference rate} - \text{strike rate}\right), 0\right] \times \frac{\text{notional value}}{\text{m}}$$

Party A (the cap buyer) purchases an interest rate cap from Party B. The contract is in force for five years with settlement every three months (i.e., quarterly). The strike (cap) rate is 4%, the reference rate is assumed to be the SOFR, and the notional value is $25 million. For the next five years, Party B will pay Party A whenever SOFR settles above 4% on a quarterly basis. If SOFR remains below 4%, then Party B simply keeps all premiums received and pays nothing to Party A. For example, in Quarter 1 of the second year of the contract, SOFR is 3.5%. In this instance, Party B makes no payments to Party A. In Quarter 2 of the second year of the contract, SOFR is 5%. Now, Party B will pay Party A $62,500 calculated as [(5% – 4%) × $25,000,000 / 4].

Interest Rate Floors

An **interest rate floor** is an agreement in which one party (i.e., the floor seller) agrees to pay the other party (i.e., the floor buyer) if an adjustable rate (i.e., the reference rate) falls below a **floor rate** (a predetermined threshold that functions as the strike rate). Analogous to caps, a **floorlet** is an interest rate floor that is valid for only a single period. A floorlet can also be priced using the Black-Scholes model. In like manner, a **floor** is a series of floorlets, and its price is the sum of the respective floorlets that comprise the in-force period of the floor.