Financial Markets and Products

FRM一级培训讲义-基础班

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Topic Weightings in FRM Part Ⅰ

Session NO.	Content	Weightings
Study Session 1	Foundations of Risk Management	20
Study Session 2	Quantitative Analysis	20
Study Session 3	Financial Markets and Products	30
Study Session 4	Valuation and Risk Models	30

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Framework

- Financial Products
  - Introduction of Bond Markets
  - Introduction of Derivatives Markets
  - Forward and Futures
  - Swaps
  - Options
  - MBS
- Financial Institutions
  - Central Counterparties
  - Banks
  - Insurance Companies
  - Mutual Funds and Hedge Funds

Financial Products

Topic 1: Introduction of Bond Markets

1. Interest Rates
2. Bond Valuation
3. Risk Metrics
4. Treasury Market
5. Corporate Bond

Interest Rates

- **Risk-Free Rate**
  - **Treasury Rates**
    - ✓ The rates an investor earns on Treasury bills and Treasury bonds.
    - ✓ Treasury rates are risk-free rates in the sense that an investor who buys a Treasury bill or Treasury bond is certain that interest and principal payments will be made as promised.
  - **LIBOR**
    - ✓ A LIBOR quote by a particular bank is the rate of interest at which the bank is prepared to make a large wholesale deposit with other banks.
  - **Repo Rates**
    - ✓ In a repurchase agreement, the difference between selling price (today) and the repurchased price (tomorrow or later) is called the repo rate.

Interest Rates

- **Compounding Frequencies**
  - **Simple Interest**
  - **Compounding Interest**
    - ✓ Suppose we have an account where the simple interest is added in each year and then that money also earns interest.
    - ✓ Assuming

      R_c is the rate of interest with continuous compounding.

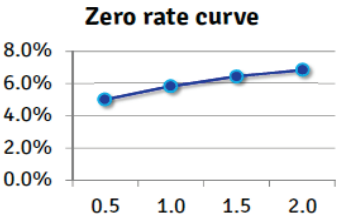
      R_m is the rate of interest with discrete compounding (m per annum)

      n is the number of years.

$$FV = PV\left(1+\frac{R_m}{m}\right)^{mn} \quad FV = PV \times e^{R_c \times n} \quad PV \times e^{R_c n} = PV\left(1+\frac{R_m}{m}\right)^{mn}$$

Interest Rates

- **Spot and Forward Rate**
  - **Spot Rate**
  - ✓ A t-period spot rate, or **zero rate**, denoted as z(t), is the yield to maturity on a zero-coupon bond that matures in t-years.



  - **Forward rates**
  - ✓ Interest rates corresponding to a future period implied by the spot curve.

$$\left(1+Z_1\right)^{T_1}\left(1+F_{1,2}\right)^{\left(T_2-T_1\right)}=\left(1+Z_2\right)^{T_2}$$

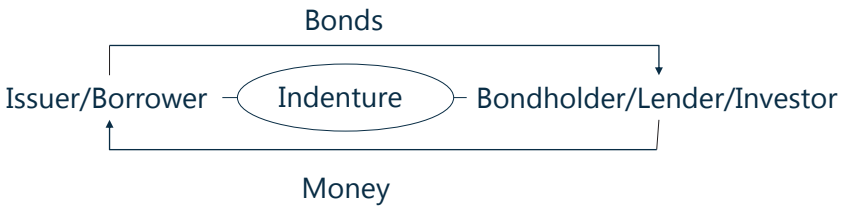
$$e^{Z_1T_1}\times e^{F_{1,2}\left(T_2-T_1\right)}=e^{Z_2T_2}\Rightarrow F_{1,2}=\frac{Z_2T_2-Z_1T_1}{T_2-T_1}$$

Interest Rates

- **Major Theories of the Term Structure of Interest Rates**
  - **Expectations Theory**
  - ✓ Forward interest rate corresponding to a certain future period is equal to the expected future spot rates. In reality, the expectations theory fails to explain why the interest rate curve is usually upward sloping.
  - **Market Segmentation Theory**
  - ✓ The bond market is segmented into different maturity sectors; supply and demand determine the bond prices or interest rates.
  - **Liquidity Preference Theory**
  - ✓ Liquidity preference theory argues that most entities like to borrow long and lend short. This theory is consistent with the empirical result that yield curves tend to be upward sloping more often than downward sloping.

Bond Valuation

- **What is a bond?**



- **Characteristics of Bonds**
  - Coupon Rate
  - Face Value
  - Maturity
  - Yield to Maturity (YTM)

Bond Valuation

- **How to determine the price of a bond?**
  - **Principle**

$$P = \frac{C_1}{1+y} + \frac{C_2}{(1+y)^2} + \cdots + \frac{C_T}{(1+y)^T} = \sum_{t=1}^{T} \frac{C_t}{(1+y)^t}$$

  - ✓ Where C_t = the cash flow (coupon or principal) in period t
  - ✓ t = number of periods to each payment (e.g., half years; a quarter years)
  - ✓ T = the number of periods to maturity
  - ✓ y = the discounting rate per period
  - **Perpetual Bond**

$$P = \frac{cF}{1+y} + \frac{cF}{(1+y)^2} + \cdots = \sum_{t=1}^{+\infty} \frac{cF}{(1+y)^t} = \frac{cF}{y}$$

Bond Valuation

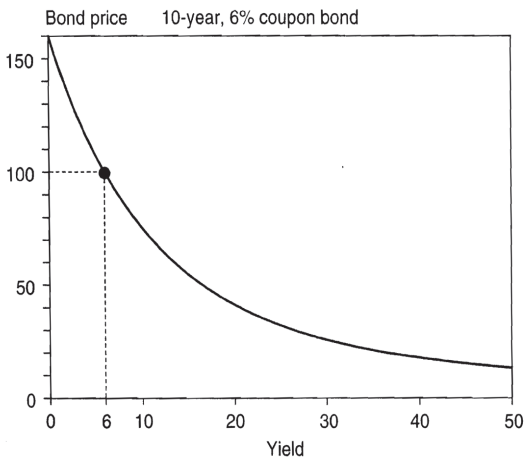
- **How to determine the price of a bond? (cont'd)**
  - **Example:** Suppose that a 2-year Treasury bond with a principal of $100 provides coupons at the rate of 6% per annum semiannually. The Treasury zero rates are below, compute the bond price:

Treasury Zero Rates Maturity (Years)	Zero Rate (%) (continuously Compounded)
0.5	5.0
1	5.8
1.5	6.4
2.0	6.8

$$P = 3e^{-0.05\times0.5} + 3e^{-0.058\times1.0} + 3e^{-0.064\times1.5} + 103e^{-0.068\times2.0} = 98.39$$

Bond Valuation

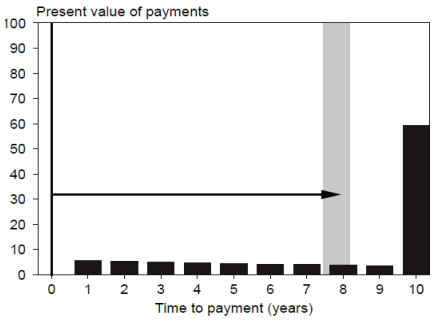
- **Price-Yield relationship**



Risk Metrics

- **Interest Rate Risk**
  - **Macaulay Duration**
    - ✓ Average period of cash flow returning weighted by discounted cash flow.

$$D = \frac{\sum_{t=1}^{T}\left[\frac{C_t}{(1+y)^t}\times t\right]}{\sum_{t=1}^{T}\frac{C_t}{(1+y)^t}} = \frac{\sum_{t=1}^{T}\left[PV(C_t)\times t\right]}{P}$$
$$= \sum_{t=1}^{T}\left[\frac{PV(C_t)}{P}\times t\right] = \sum_{t=1}^{T}(\omega_t \times t)$$



    - ✓ For a zero coupon bond, the Macaulay duration equals to its maturity.
    - ✓ For a plain bond, Macaulay duration is less than or equal to its maturity.

Risk Metrics

- **Interest Rate Risk (cont'd)**
  - **Modified Duration**

$$MD = -\frac{\Delta P}{\Delta y}\times\frac{1}{P} \qquad DD = -\frac{\Delta P}{\Delta y}$$
$$= \frac{D_{Macaulay}}{1+y} \qquad = MD \times P$$

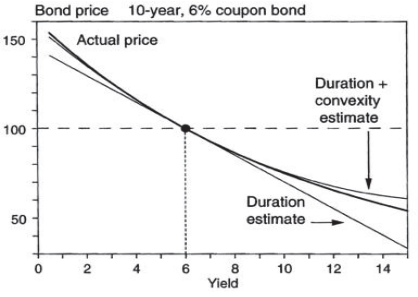
    - ✓ All else being equal, duration increase for longer maturities, lower coupons, and lower yields.
  - **DV01**

DV01 = Modified Duration × Bond Value ×0.0001

Risk Metrics

- **Interest Rate Risk (cont'd)**
  - **Convexity**
    - ✓ A measure of the non-linear relationship between price and yield. Changes in duration of a bond to changes in interest rates, the second derivative of the price of the bond with respect to interest rates.
    - ✓ All else being equal, convexity increase for longer maturities, lower coupons, and lower yields.

$$P = P_0 - DP_0\Delta y + \frac{1}{2}CP_0(\Delta y)^2$$



Risk Metrics

- **Interest Rate Risk (cont'd)**
  - **Portfolio Duration and Convexity**: In regard to both modified duration and convexity, portfolio duration and convexity equal the weighted sum of individual, respectively, durations and convexities where each component's weight is its value as a percentage of portfolio value.
  - **Example**

Coupon	Maturity	YTM	Price (% or par)	Par (millions)	Weights	D	C
5.00%	5	4.00%	104.4912925	3	22.97%	4.41	22.92
6.00%	15	5.00%	110.4651463	4	32.37%	10.11	132.54
7.00%	30	5.50%	121.9169965	5	44.66%	14.00	299.36

$D = (0.2297 \times 4.41) + (0.3237 \times 10.11) + (0.4466 \times 14) = 10.54$

$C = (0.2297 \times 22.92) + (0.3237 \times 132.54) + (0.4466 \times 299.36) = 181.86$

Risk Metrics

- **Reinvestment Risk**
  - Reinvestment risk is the risk that future coupons from a bond will not be reinvested at the prevailing interest rate from when the bond was initially purchased.
  - Reinvestment risk is more likely when interest rates are declining and affects the yield to maturity of a bond, which is calculated on the premise that all future coupon payments will be reinvested at the interest rate in effect when the bond was first purchased.
  - Zero-coupon bonds are the only fixed-income instruments to have no reinvestment risk since they have no interim coupon payments.

Treasury Market

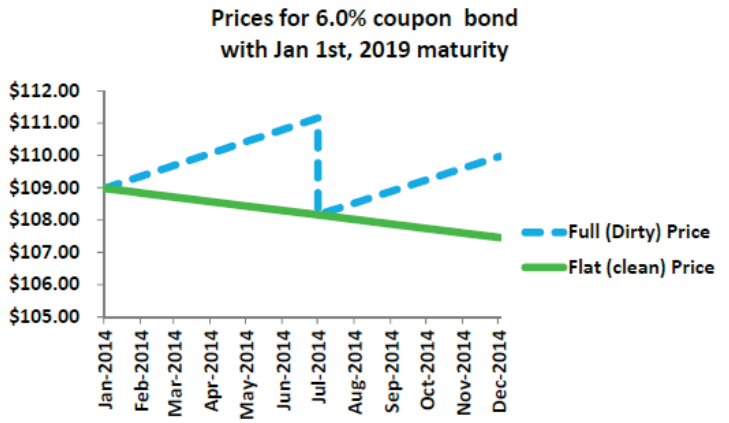
- **Treasury Bills**
  - A short-term debt obligation backed by the U.S. government with a maturity of one year or less.

$$\text{cash price} = 100\left(1 - \text{discount-rate} \times \frac{n}{360}\right)$$

  - **Example:** Suppose you have a 180-day T-bill with a discount rate, or quoted price, of five (i.e., the annualized rate of interest earned is 5% of face value). If face value is $100, the cash price is 97.5
- **Treasury Notes and Treasury Bonds**
  - T-Notes mature in 2 to 10 years. T-Bonds mature in more than 10 years.
  - Both make interest payments semi-annually.
  - **Quoted Price**
    - ✓ Dollars and thirty-seconds of a dollar with face value of $100

Treasury Market

➢ **Clean Price and Dirty Price**



Treasury Market

➢ **Clean Price and Dirty Price (cont'd)**

- **Clean Price:** The price of a coupon bond not including any accrued interest. Immediately following each coupon payment, the clean price will equal the dirty price.
- **Dirty Price:** A bond pricing quote referring to the price of a coupon bond that includes the present value of all future cash flows, including interest accruing on the next coupon payment.

dirty price = clean price + accrued interest

- **Accrued Interest and Day Count Conventions**

✓ Treasury bonds: actual/ actual
✓ Corporate and municipal bonds: 30/360
✓ Money market instruments (Treasury bills): actual/360

Treasury Market

➢ **Clean Price and Dirty Price (cont'd)**

- **Example:** Suppose a 1000 par value US corporate bond pays a semi-annual 10 percent coupon on January 1 and July 1. Assume that it is now April 1, 2005, and the bond matures on July 1, 2015. Compute the invoice (full) price of this bond if the required annual yield is 8 percent. Compute the flat (clean) price of the above bond.

Time	Feb 1st	Mar 1st	Apr 1st	May 1st	June 1st	July 1st
dirty price	1147.77	1155.30	1162.87	1170.50	1178.18	1185.90
clean price	1139.44	1138.63	1137.87	1137.17	1136.51	1135.90

Corporate Bond

- **Bond Indenture**
  - Contract contains corporate bond issuer promises and investors' rights.
  - Made out to corporate trustee, who represents bondholders' interests.
- **Corporate Trustee**
  - The corporate trustee is a third party to the contract. The trustee acts in a fiduciary (legal) capacity on behalf of the investors. Acting on behalf of the bondholders, the trustee must ensure that the bond issuer is in compliance with the covenants of the indenture at all times.
- **Main Types of Interest Payment Classifications**
  - Straight-coupon
  - Zero-coupon bonds
  - Floating-rate bonds

Corporate Bond

- **Zero-Coupon Corporate Bonds**
  - In bankruptcy, zero-coupon bond creditor claim original offering price plus accrued and unpaid interest, but not the principal amount of $1,000.
  - A zero-coupon bond's interest rate is determined by the **original issue discount (OID)**. The difference between the face amount and the offering price when first issued is called the original-issue discount.
  - **Example**

✓ Face value $1,000
✓ 20-year zero-coupon bond
✓ Yield 5%
✓ Compounded annually

N = 20; I/Y = 5;
PMT = 0; FV = 1,000,
CPT PV = -377
→ OID = 1,000 – 377 = 623

Corporate Bond

- **Different Types of Corporate Bonds**
  - Mortgage Bonds
  - Collateral Trust Bonds
  - Equipment Trust Certificates
  - Debenture Bonds (including Subordinated and Convertible Debentures)
  - Guaranteed Bonds
- **Corporate Bond Retirements**
  - Frequently, bonds are retired early, before maturity. There are several mechanisms by which a corporation may go about retiring their debt:
    - ✓ Call provision
    - ✓ Sinking-fund provisions
    - ✓ Maintenance and replacement funds
    - ✓ Tender offers

Corporate Bond

- **Credit Risk**
  - **Credit Default Risk**
    - ✓ Risk that a bond issuer will be unable to meet its financial obligations.
  - **Credit Spread Risk**
    - ✓ Risk of financial loss resulting from changes in the level of credit spreads.
    - ✓ The credit spread is the difference between a corporate bond's yield and the yield on a comparable-maturity benchmark Treasury security. The difference in yields is due primarily to the corporate bond's exposure to credit risk.
  - **Issuer Default Rate vs. Dollar Default Rate**
  - **Recovery Rate**

Corporate Bond

- **High-Yield Bond**
  - High-yield bonds are those rated below investment grade by the ratings agencies, these issues are also known as junk bonds.
  - **Types of High-Yield Bond Issuers**
    - ✓ Original Issuers
    - ✓ Fallen Angels
    - ✓ Restructurings and Leverage Buyouts
  - **Payment Features**
    - ✓ Deferred-Interest Bonds
    - ✓ Step-Up Bonds
    - ✓ Payment-in-Kind (PIK) Bonds

Exercise 1

- A bank uses a continuously-compounded annual interest rate of 5% in one of its risk models. What is the equivalent interest rate the bank should use if it converts to semi-annual compounding in the model?
  - A. 4.94%
  - B. 5%
  - C. 5.06%
  - D. 5.12%

- Correct Answer: C

Exercise 2

- An annuity pays $10 every year for 100 years and currently costs $100. The YTM is closest to:
  A. 5%
  B. 7%
  C. 9%
  D. 10%

- Correct Answer: D

Exercise 3

- A $1,000 par bond carries a coupon rate of 10%, pays coupons semiannually, and has 13 years remaining to maturity. Market rates are currently 9.25%. The price of the bond is closest to:
  A. $586.60
  B. $1,036.03
  C. $1,055.41
  D. $1,056.05

- Correct Answer: D

Exercise 4

- A Treasury bond has a coupon rate of 6% per annum (the coupons are paid semiannually) and a semiannually compounded yield of 4% per annum. The bond matures in 18 months and the next coupon will be paid 6 months from now. Which number below is closest to the bond's Macaulay duration?
  A. 1.023 years
  B. 1.457 years
  C. 1.500 years
  D. 2.915 years

- Correct Answer: B

Exercise 5

- An increase in which of the following factors will increase the duration of a fixed-rate coupon bond?
  A. Yield-to-maturity
  B. Maturity
  C. Coupon value
  D. Coupon frequency

- Correct Answer: B

Exercise 6

- Consider the following bonds:

Bond Number	Maturity (yrs)	Coupon Rate	Frequency	Yield
1	10	6%	1	6%
2	10	6%	2	6%
3	10	0%	1	6%
4	10	6%	1	5%
5	9	6%	1	6%

How would you rank the bonds from the shortest to longest duration?
A. 5-2-1-4-3
B. 1-2-3-4-5
C. 5-4-3-1-2
D. 2-4-5-1-3

- Correct Answer: A

Exercise 7

- Calculate the impact of a 10 basis point increase in yield on the following bond portfolio:

Bond	Value (USD)	Modified Duration
1	4,000,000	7.5
2	2,000,000	1.6
3	3,000,000	6.0
4	1,000,000	1.3

A. USD -41,000
B. USD -52,500
C. USD -410,000
D. USD -525,000

- Correct Answer: B

Exercise 8

- A bond portfolio has the following compositions:
  - Portfolio A: price $90,000, modified duration 2.5, long position in 8 bonds;
  - Portfolio B: price $110,000, modified duration 3, short position in 6 bonds;
  - Portfolio C: price $120,000, modified duration 3.3, long position in 12 bonds;

  All interest rates are 10%. If the rates rise by 25 bps, then the bond portfolio value will
  A. Decrease by $11,430
  B. Decrease by $21,330
  C. Decrease by $12,573
  D. Decrease by $23,463

- Correct Answer: A

Exercise 9

- A portfolio manager has a bond position worth USD 100 million. The position has a modified duration of eight and a convexity of 150. Assume that the term structure is flat. By how much does the value of the position change if interest rates increase by 25 basis points?
  A. USD −2,046,875
  B. USD −2,187,500
  C. USD −1,953,125
  D. USD −1,906,250

- Correct Answer: C

Exercise 10

- Assume a corporate bond with a face value of $1,000 that pays a semi-annual coupon (coupons pay January and July 1st) with a 12.0% coupon rate. The bond settles on June 13th, 2014 and matures, more than six years later, on July 1st, 2020. At the current traded price, the bond's yield (YTM) is 10.0%. Which is nearest to the bond's quoted (aka, clean) price?
  A. $975
  B. $1,089
  C. $1,107
  D. $1,143

- Correct Answer: B

Exercise 11

- A portfolio manager has recently purchased a 10-year investment-grade corporate bond. Which of the following tasks must typically be performed by the corporate trustee listed in the bond's indenture?
  A. Act in a fiduciary capacity for the bond issuer.
  B. Ensure that the bond issuer's reported financial ratios meet the requirements in the indenture.
  C. Change the terms of the indenture to provide protection for the bond purchaser.
  D. Monitor the bond issuer's balance sheet to ensure covenant compliance.

- Correct Answer: B

Exercise 12

- Which bond instruments would have the lowest risk, as other things being equal?
  A. Junior tranches.
  B. Equity tranches.
  C. ETCs.
  D. Debentures.

- Correct Answer: C

Financial Products

Topic 2: Introduction of Derivatives Markets

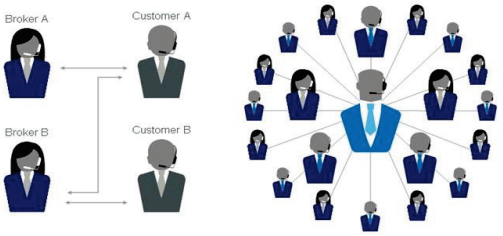
1. Financial Derivatives
2. Trading Characteristics
3. Market Participants

Financial Derivatives

- **Financial Derivatives:** an instrument whose value depends on the values of other more basic underlying assets.
- **Classification of Financial Derivatives**
  - **Forward and Futures**
    - ✓ Agreement to buy/sell asset at future time for certain price.
    - ✓ **Forward**: traded in the over-the-counter (OTC) market.
    - ✓ **Futures**: Standardized and trades on an exchange.
  - **Swap**
    - ✓ A series of forward contracts.
    - ✓ Exchange cash flows on period settlement dates.
  - **Option**
    - ✓ Gives holder the right (but not obligation) to buy/sell at a certain price.

Trading Characteristics

- **Over-the-Counter and Exchange Traded**



Over-the-Counter	Exchange-Traded
Customized	Standardized
Trade with counterparty (Default Risk)	Backed by a clearing house
Not trade in a central location	Trade in a physical exchange
Unregulated	Regulated
Trading volume: large	Trading volume: small

Market Participants

- **Hedgers**
  - Use derivatives markets to offset the risk of prices moving unfavorably for their ongoing business activities.
- **Speculators**
  - Use derivatives to seek profits by betting on the future direction of market prices of the underlying asset.
- **Arbitrageurs**
  - Use derivatives to take offsetting positions in two or more instruments to lock in a profit.
- **Market maker**
  - A market maker is a firm facilitate the trading of a particular security to keep the financial market liquid by providing buy and sell quotations simultaneously.

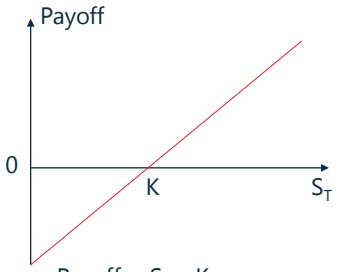
Financial Products

Topic 3: Forward and Futures

1. Forward vs. Futures Contracts
2. Commodity Forward Contract
3. Financial Forward Contract
4. Futures Contract
5. Forward and Futures Prices
6. Interest Rate Futures
7. Hedging Strategies using Futures

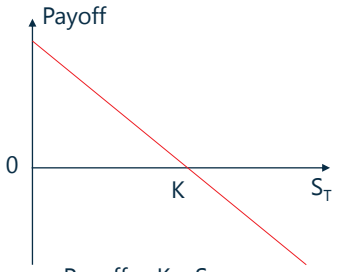
Forward vs. Futures Contracts

- **Payoffs**
  - (a) long position, (b) short position.
  - Delivery price = K
  - Price of asset at contract maturity = S_T



Payoff = $S_T - K$

(a)



Payoff = $K - S_T$

(b)

Forward vs. Futures Contracts

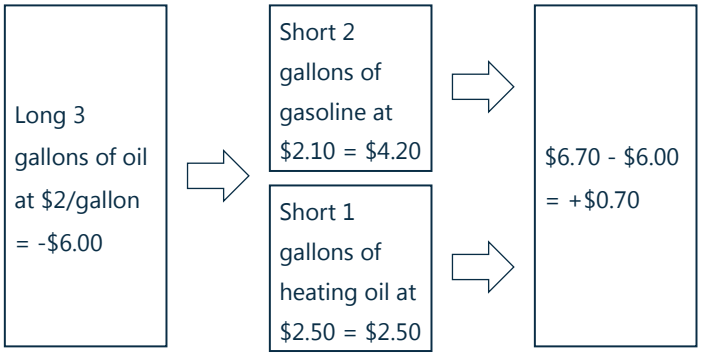
Forward	Futures
Trade over-the-counter (OTC)	Trade on an exchange
Not standardized	Standardized contracts
One specified delivery date	Range of delivery dates
Settled at contract's end	Settled daily
Delivery or final cash settlement usually occurs	Contract usually closed out prior to maturity
Reduces basis risk due to tailored specifications but less liquid	High liquidity due to standardized specifications but more basis risk
Default risk is present	Guaranteed by clearinghouse
No margin deposit required	Margin required and adjusted

Commodity Forward Contract

- **Commodity Forward Contract:** underlying commodities mainly include: base metals - copper, aluminum, lead; precious metals - gold, silver, platinum; energy - WTI crude oil, Brent crude oil and so on.
  - **Commodity Terminology**
  - ✓ Storage Costs
  - ✓ Lease Rate
  - ✓ Convenience Yields
  - **Crack Spread**
  - ✓ Crack Spread is a specific spread trade involving simultaneously buying and selling contracts in crude oil and one or more derivative products, typically gasoline and heating oil.
  - ✓ Oil refineries may trade it to hedge the price risk of their operations, while speculators attempt to profit from changes in the price differential.

Commodity Forward Contract

- **Commodity Forward Contract (cont'd)**
  - **Crack Spread (cont'd)**
  - ✓ **Example:** "3 – 2 – 1" = 3 gallons of oil (input), 2 gallons of gasoline (output) and 1 gallon of heating oil (output)



Financial Forward Contract

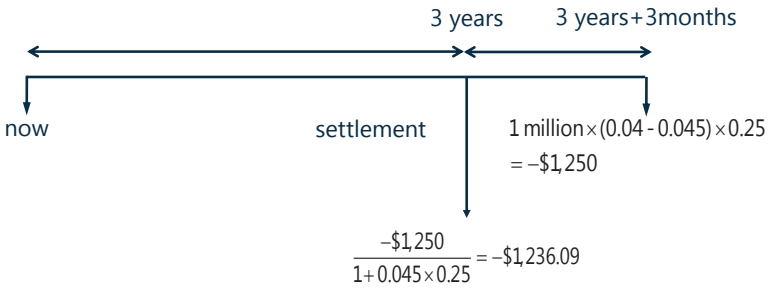
- **Financial Forward Contract:** Similar to commodity forward contract, but the underlying asset is financial asset. For example, a foreign exchange contract.
  - **Forward Rate Agreement**
  - ✓ A forward rate agreement (FRA) is an agreement that a certain rate will apply to a certain principal during a certain future time period.
  - ✓ The buyer of an FRA locks in a borrowing rate, and the seller locks in a lending rate. The long benefits from an increase in rates, and the short benefits from a fall in rates.
  - ✓ An FRA settles in one month on three-month LIBOR is called 1×4.
  - ✓ Valuation:

$$V_{FRA,\text{receive fixed } R_K} = L\left(R_K - R_F\right)\left(T_2 - T_1\right)e^{-R_2T_2}$$

$$V_{FRA,\text{pay fixed } R_K} = L\left(R_F - R_K\right)\left(T_2 - T_1\right)e^{-R_2T_2}$$

Financial Forward Contract

- **Financial Forward Contract (cont'd)**
  - **Forward Rate Agreement (cont'd)**
    - ✓ **Example:** A company enters into a FRA that specifies it will receive a fixed rate of 4% on a principal of $1 million for a 3-month period starting in 3 years. If 3-month LIBOR proves to be 4.5% for the 3-month period, then compute the payoff.



Futures Contract

- **Specifications of Futures Contract**
  - **Asset:** When the asset is a commodity (e.g., cotton, orange juice), the exchange specifies a grade (quality).
  - **Contract Size**
    - ✓ Treasury bond Futures has a face value of $100,000;
    - ✓ S&P 500 Futures contract is index×$250 (multiplier of 250)
    - ✓ Eurodollar futures contract has a face value of $1 million
  - **Delivery Arrangement**
  - **Delivery Month**
  - **Price Quotes**
  - **Price limits and position limits**

Futures Contract

Asset	Corn (No. 2 Yellow..)
Contract Size	5000 bushels
Delivery Arrangement	Toledo, St. Louis
Delivery Months	Dec, Mar, May, Jul, Sep
Price Quotes	1/4 cent/bushel ($12.50/contract)
Price limits and position limits	Daily Price Limit: Thirty cent ($0.30) per bushel ($1,500/contract) above or below the previous day's settlement price. No limit in the spot month

Asset	S&P 500 Index
Contract Size	$250 x S&P 500 Futures Price
Delivery Arrangement	Cash settlement
Delivery Months	Mar, Jun, Sep, Dec
Price Quotes	0.05 index points = $12.50
Price limits and position limits	20,000 net long or short in all contract months combined

Futures Contract

- **Mechanics of the Delivery Process**
  - **Close Out**
  - ✓ Most Futures contracts do not lead to delivery, because most trades "close out" their positions before delivery. Closing out a position means entering into the opposite type of trade from the original.
  - **Physical Delivery**
  - ✓ When there are alternatives about what is delivered, where it is delivered, and when it is delivered, the party with the short position chooses.
  - **Cash Settlement**
  - ✓ A few contracts (for example, those on stock indices and Eurodollars) are settled in cash.
  - **Exchange for Physicals**

Futures Contract

- **Role of Clearinghouse**
  - Acts as an intermediary in futures transactions
  - Guarantees performance of parties
  - Members must post funds with exchange
  - Main task to keep track of transactions, calculate net position of each member daily
- **Comparing: Collateralization in the Over-the-Counter Market**
  - Over-the-counter (OTC) markets traditionally imply significant credit (counterparty) risk; Collateralization is similar to the practice of posting margin in futures markets.

Futures Contract

- **Margin Requirement**
  - **Initial Margin**
  - ✓ Must be deposited when contract is initiated.
  - **Maintenance Margin**
  - ✓ Investor can withdraw funds in the margin account in excess of the initial margin. When the balance in the margin account falls below the maintenance margin, broker executes a margin call. The next day, the investor needs to "top up" the margin account back to the initial margin level.
  - **Variation Margin**
  - ✓ Extra funds deposited by the investor after receiving a margin call.
  - ✓ Variation margin = initial margin – margin account balance

Futures Contract

- **Margin Requirement (cont'd)**
  - **Example**

Contract Specifications		
Contract Size (ounces)		100
Number of Contracts		2
Initial Futures		$600
Margin	**Per**	**Total**
Initial margin	$2,000	$4,000
Maintenance margin	$1,500	$3,000

Futures Contract

Date	Futures Price	Daily gain/loss	Cumulative gain/loss	Margin Account	Margin call
	600.00			4000	
June 5	597.00	(600)	(600)	3400	
June 6	596.10	(180)	(780)	3220	
June 9	598.20	420	(360)	3640	
June 10	597.10	(220)	(580)	3420	
June 11	596.70	(80)	(660)	3340	
June 12	595.40	(260)	(920)	3080	
June 13	593.30	(420)	(1340)	2660	1340
June 16	593.60	60	(1280)	4060	
June 17	591.80	(360)	(1640)	3700	
June 18	592.70	180	(1460)	3880	
June 19	587.00	(1140)	(2600)	2740	1260
June 20	587.00	0	(2600)	4000	

Futures Contract

- **Trading Order Types**
  - **Market Order**
  - ✓ A request that a trade be carried out immediately at the best price available in the market.
  - **Limit Order**
  - ✓ This order specifies a particular price, the order can be executed only at this price or at one more favorable to the investor.
  - **Stop Order/Stop-Loss Order**
  - ✓ Also specifies a particular price. The order is executed at the best available price once a bid or offer is made at that particular price or a less-favorable price.

Futures Contract

- **Trading Order Types (cont'd)**
  - **Stop-Limit Order**
  - ✓ Combination of stop & limit order. Order becomes limit order as soon as a bid/offer is made at a price equal to/less favorable than the stop price.
  - **Market-if-Touch Order**
  - ✓ Executed at the best available price after a trade occurs at a specified price/at a price more favorable than the specified price. It is designed to ensure profits are taken if sufficiently favorable price movements occur.
  - **Discretionary Order/Market-not-Held Order**
  - ✓ Is traded as a market order except that execution may be delayed at the broker's discretion in an attempt to get a better price.
  - **Fill-or-Kill Order**
  - ✓ Must be executed immediately on receipt or not at all.

Forward and Futures Prices

- **Background Knowledge - Short Selling**
  - Orders to sell securities that the seller does not own.
  - **Example**

Purchase of Shares	
April: Purchase 500 shares at $120	-$60,000
June: Receive dividends $1 per share	$500
July: Sell 500 shares at $100	$50,000
Net Profit	-$9,500

Short Sale of Shares	
April: Borrow 500 shares and sell at $120	$60,000
June: Pay dividends $1 per share	-$500
July: buy 500 shares at $100, replace and close	-$50,000
Net Profit	$9,500

Forward and Futures Prices

- **Assumptions of Pricing: No Arbitrage Principle** $F_0 = S_0 e^{rT}$

$F_0 > S_0 e^{rT}$	$F_0 < S_0 e^{rT}$
Now: Borrow S_0 to buy a unit of asset, enter into a forward contract to short the asset for F_0 in time T;	*Now:* Short sale S_0 and invest in a bank, enter into a forward contract to buy the asset for F_0 in time T;
T later: ■ Sell asset at F_0 and repay the loan for $S_0 e^{rT}$ ■ Gain a profit of $F_0 - S_0 e^{rT}$	*T later:* ■ Get $S_0 e^{rT}$ from the bank and buy the asset at F_0 to close short position. ■ Gain a profit of $S_0 e^{rT} - F_0$

Forward and Futures Prices

- **Principle of Pricing – Cost of Carry**
  - Cost-of-carry model sets a futures price as a function of the spot price: the futures price equals the spot price compounded at the interest rate plus the storage cost of the asset less any income earned on the asset.
  - **Financial Forward/Futures:** No-arbitrage implies that the forward price is a function of the spot price and any dividends paid.
  - **Commodity Forward/Futures:** Because of convenience yield, storage cost and the lease rate, the forward price is not a simple function of spot.

$$F_0 = S_0 e^{(r-q)T} \qquad F_0 = S_0 e^{(r+u-q-y)T}$$

$$F_0 = (S_0 - I)e^{rT} \qquad F_0 = (S_0 + U - I)e^{(r-y)T}$$

Forward and Futures Prices

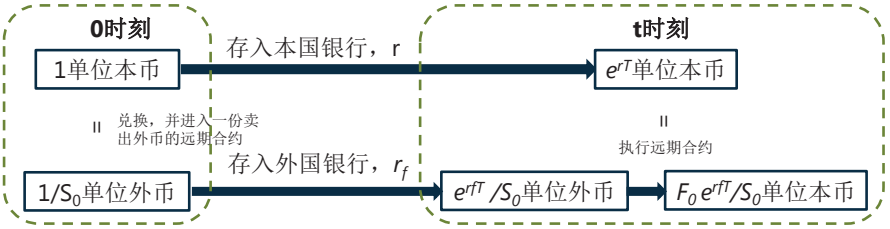
- **Principle of Pricing – Cost of Carry (cont'd)**
  - **Example**

1. Suppose we have an asset currently worth $1,000. The current continuously compounded rate is 4% for all maturities. Compute the price of a 6-month forward contract on this asset.
2. Compute the price of a 6-month forward contract for which the underlying asset is a stock index with a value of $1,000 and a continuously dividend yield of 1%. Assume the risk-free rate is 4%.
3. A stock's price today is $50. The stock will pay a $1 (2%) dividend in six months. The risk-free rate is 5% for all maturities. What is the price of a long forward contract to purchase the stock in one year?

Forward and Futures Prices

- **Foreign Exchange Forward/Futures**
  - **Interest Rate Parity**
    - ✓ A no-arbitrage condition representing an equilibrium state under which investors will be indifferent to interest rates available on bank deposits in two countries.

$$\text{Forward} = \text{Spot}\left(\frac{1+r_A}{1+r_B}\right)^T \qquad \text{Forward} = \text{Spot} \times e^{(r_A - r_B)T}$$



Forward and Futures Prices

- **Foreign Exchange Forward/Futures (cont'd)**
  - **Interest Rate Parity (cont'd)**
    - ✓ **Example:** 2-year interest rates in Australia and the US are 5% and 7% respectively (continuously compounding). The spot rate is 0.6200 USD per AUD. Calculate 2-year forward rate. If it is 0.6300, how to arbitrage?

$$0.6200e^{(0.07-0.05)\times 2} = 0.6453 > 0.6300$$

Arbitrage： buy spot USD and sell USD forward

Borrow 1000 AUD at 5% and convert to 620 USD. Invest in US at 7%;

Enter a forward contract to buy 1105.17 AUD at 0.6300 using 696.26 USD

2 years

Get 713.17 USD, use 696.26 USD to buy 1105.17 AUD, repay the loan.
Get 713.17 – 696.26 = 16.91 USD riskless profit.

Forward and Futures Prices

- **Foreign Exchange Forward/Futures (cont'd)**
  - **Foreign Exchange Risk**
    - ✓ Financial Institution's Overall Foreign Exchange Exposure

$$\text{Net Exposure}_i = (\text{FX assets}_i - \text{FX Liabiities}_i) + (\text{FX bought}_i - \text{FX sold}_i)$$

$$= \text{net foreign assets}_i + \text{net FX bought}_i$$

$i = \text{ith currency}$

- ✓ A **positive net exposure** position is net long in a currency; A **negative net exposure position** is net short in a currency.
- ✓ Bank can match its foreign currency assets to its liabilities;
- ✓ Bank can match buys and sells in trading book.

Forward and Futures Prices

- **Foreign Exchange Forward/Futures (cont'd)**
  - **Foreign Exchange Risk (cont'd)**
    - ✓ **On-Balance-Sheet Hedging** involves making changes in the on-balance-sheet assets and liabilities.
    - ✓ One may choose to remain un-hedged on the balance sheet, and **Hedge Off-Balance-Sheet** involves no on-balance-sheet changes, but rather involves taking a position in forward or other derivative securities.

Example: On-Balance-Sheet Hedging

Assets	*Liabilities*
USD50 million U.S. loans, 1-year maturity, in USD, yielding 8%	USD50 million U.S. CDs, 1-year maturity, in USD, yielding 6%
USD50 million equivalent Swiss loans, 1-year maturity, made in CHF, yielding 13%	USD50 million Swiss CDs, 1-year maturity, raised in CHF, yielding 10%

What is the Net return if the exchange rate is 1.70 USD /CHF at the beginning while 1.55USD/CHF at the end of the year?

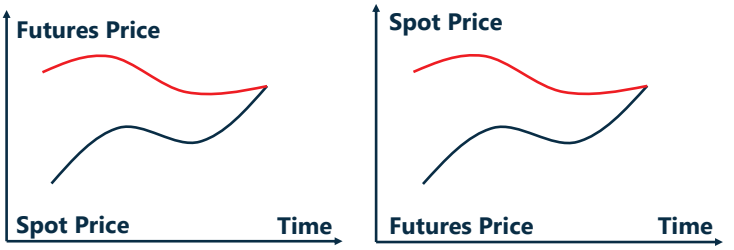
Forward and Futures Prices

- **Foreign Exchange Forward/Futures (cont'd)**
  - **Foreign Exchange Risk (cont'd)**
  - ✓ **Example: Off-Balance-Sheet Hedging**

    ABC Bank issues GBP10 million in U.K. CDs to fund its loan portfolio. Given the asset-liability position as follow:
    - A promised 1-year rate on the CDs of 7%.
    - It invests 50% of its GBP10 million in 1-year U.S. loans at 12% (loans made in USD).
    - The bank invests the other 50% in 1-year U.K. loans at 8% .
    - At the beginning of the year, the bank sells GBP 5 million for USD in the spot currency markets at an exchange rate of USD1.42/GBP.
    - The 1-year forward exchange rate is USD1.40/GBP.

Forward and Futures Prices

- **Normal and Inverted Futures Market**



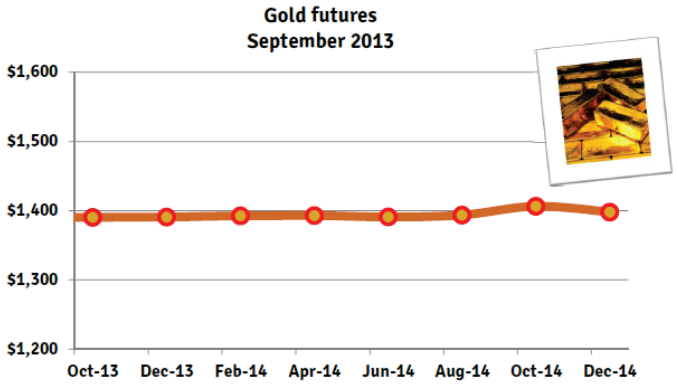
  - If the forward price is higher than the spot price (or the distant forward price is higher than the near forward price) the Futures curve is said to be normal, or in **Contango**.
  - If the forward price is less than the spot price (or the distant forward price is less than the near forward price), the Futures curve is said to be inverted, or in **Backwardation**.

Forward and Futures Prices

- **Forward Price vs. Forward Value**
  - Value of forward $f = (F_0 - K)e^{-rT}$ $\Longrightarrow$ $f = \begin{cases} S_0 - Ke^{-rT} \\ S_0 - I - Ke^{-rT} \\ S_0 e^{-qT} - Ke^{-rT} \end{cases}$
- **Forward Price vs. Futures Prices**
  - If risk-free rate is constant and same for all maturities, then forward price should equal futures price.
  - Correlation of underlying asset with interest rates
  - ✓ Strongly positive: futures > forward
  - ✓ Strongly negative: futures < forward
  - Contract Life
  - ✓ Short: negligible
  - ✓ Long: can be significant.

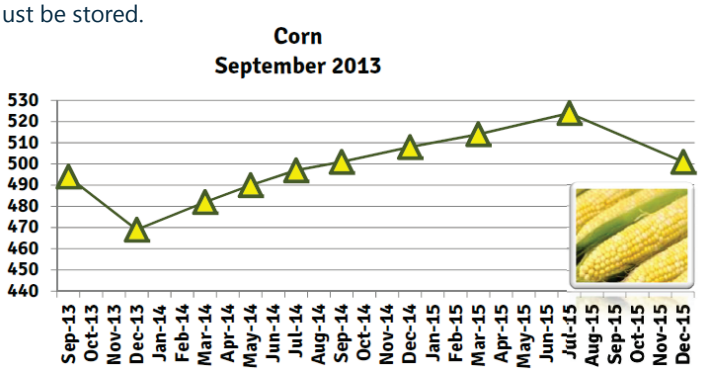
Forward and Futures Prices

- **Factors Impact Commodity Forward Prices**
  - **Gold**
    - ✓ Durable, (relatively) cheap to store. Forward curve is "uninteresting".



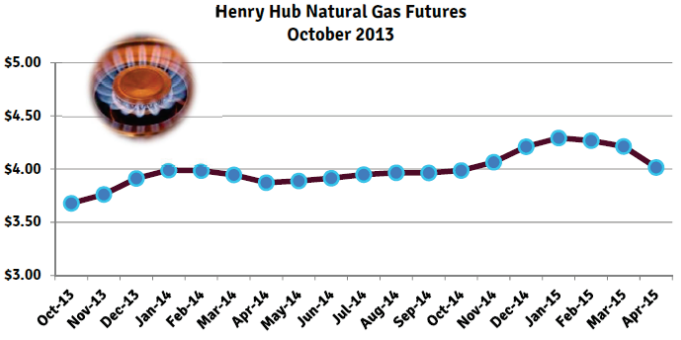
Forward and Futures Prices

- **Factors Impact Commodity Forward Prices (cont'd)**
  - **Corn**
    - ✓ Season production/supply (harvested in fall) but consumed year-round. Must be stored.



Forward and Futures Prices

- **Factors Impact Commodity Forward Prices (cont'd)**
  - **Natural gas**
    - ✓ Costly to transport. Costly to store. Highly seasonal demand.



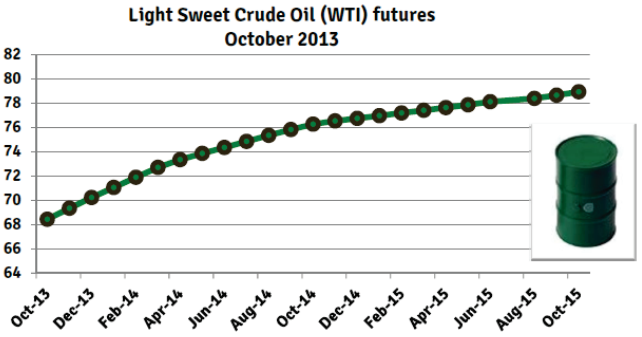
Forward and Futures Prices

➢ **Factors Impact Commodity Forward Prices (cont'd)**

- **Oil**

✓ Compared to natural gas, easier to store and transport.

✓ Long-run forward price less volatile than short-run forward.



Interest Rate Futures

➢ **T-Bond Futures**

- The Treasury bond futures contract allows the party with the short position to choose which particular bond with a maturity more than 15 years on the first day of the delivery month and is not callable within 15 years from that day to deliver.
- When a particular bond is delivered, a parameter known as conversion factor defines the price received for the bond by the party with the short position.
- Specially, the cash received by the short position is:

$$\text{Cash received} = (\text{QFP} \times \text{CF}) + \text{AI}$$

- **Cheapest-to-Deliver Bond**

$$\text{Cost} = \text{quoted bond price} - (\text{QFP} \times \text{CF})$$

Interest Rate Futures

➢ **T-Bond Futures (cont'd)**

- **Impact of the level and shape of the yield curve on the CTD decision**

✓ **Bond yield >6%**

- Favors delivery of low-coupon, long-maturity bonds (long duration).

✓ **Bond yield <6%**

- Favors delivery of high-coupon, short-maturity bonds (short duration).

✓ **Upward-sloping yield curve**

- Favors long time-to-maturity bonds (long duration)

✓ **Downward-sloping yield curve**

- Favors short time-to-maturity bonds (short duration)

Interest Rate Futures

➢ **T-Bond Futures (cont'd)**

- **Example:** Assume an investor with a short position is about to deliver a bond and has four bonds to choose from which are listed in the following table. The last settlement price is $95.75 (this is the quoted futures price). Determine which bond is the cheapest-to-deliver.

Bond	Quoted Bond Price	Conversion Factor	Cost
1	99	1.01	2.29
2	125	1.24	6.27
3	103	1.06	1.51
4	115	1.14	5.85

Interest Rate Futures

➢ **Eurodollar Futures**

- One of the most popular interest rate futures in the United States is the three-month Eurodollar futures contract traded by the CME Group.
- Eurodollar is a dollar deposited in a US or foreign bank outside US.
- A three-month Eurodollar futures contract is a futures contract on the interest that will be paid (by someone who borrows at the Eurodollar interest rate) on $1 million for a future three-month period.
- The value of one Eurodollar Futures contract

$$P_t = 10{,}000 \times \left[100 - 0.25\left(100 - FQ_t\right)\right] = 10{,}000 \times \left[100 - 0.25F_t\right]$$

- 1 basis point up move in the futures quote corresponds to a gain of $25 per contract for long position.

Interest Rate Futures

➢ **Eurodollar Futures (cont'd)**

- **Eurodollar Futures vs. FRA**
  - ✓ With the same underlying and the same maturity, They should be the same if interest rates are perfectly predictable.
  - ✓ $\rho(S, r) < 0$, Futures price is lower than forward price.
  - ✓ For short maturities, the differences are small enough to be ignored.
- **Convexity Adjustment**

$$\text{Forward Rate} = \text{Futures rate} - \frac{1}{2}\sigma^2 T_1 T_2$$

  - ✓ σ is the standard deviation of the change in the short-term interest rate in one year.
  - ✓ T_1 is time to maturity of futures contract.
  - ✓ T_2 is time to maturity of the rate underlying the futures contract.

Interest Rate Futures

- **Eurodollar Futures (cont'd)**
  - **Convexity Adjustment (cont'd)**
    - ✓ **Example:** Consider a situation where σ = 0.012 and calculate the forward rate when the 8-year Eurodollar futures price quote is 94.

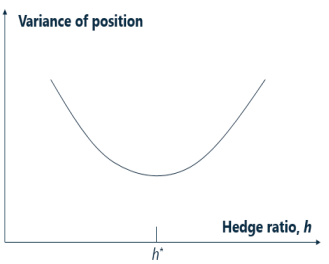
Maturity of Futures (years)	Convexity adjustments (bps)
2	3.2
4	12.2
6	27.0
8	47.5
10	73.8

Hedging Strategies using Futures

- **Classification of Hedging Strategies**
  - **Short Hedge and Long Hedge**
    - ✓ A **short hedge** involves a short position in futures contracts. A short hedge is appropriate when the hedger already owns an asset and expects to sell it at some time in the future.
    - ✓ A **long hedge** involves a long position in a futures contract. A long hedge is appropriate when a company knows it will have to purchase a certain asset in the future and wants to lock in a price now.
  - **Strip Hedge and Stack Hedge**
    - ✓ **Strip Hedge:** Hedge a stream of obligations by offsetting each individual obligation with a futures contract matching the maturity and quantity of the obligation.
    - ✓ **Stack Hedge:** Hedge using futures with single maturity to offset changes in the present value of the future obligations.

Hedging Strategies using Futures

- **Hedging with Futures Contract**
  - **Minimum Variance Hedge Ratio**
    - ✓ The minimum variance hedge ratio depends on the relationship between changes in the spot price and changes in the futures price. By using it, we can form a hedged position with minimum variance.



Dependent of variance of hedger's position on the hedge ratio

$$h^* = \rho_{S,F}\frac{\sigma_S}{\sigma_F}$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Optimal Number of Futures Contracts**
  - ✓ Define variables as follows:
  - Q_A: Size of position being hedged (units)
  - Q_F: Size of one futures contract (units)
  - N*: Optimal number of futures contracts for hedging

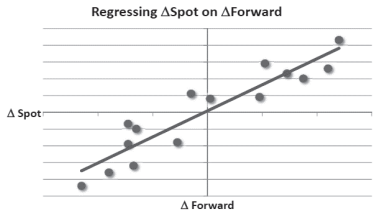
$$N^* = \frac{h^* Q_A}{Q_F}$$

  - **Tailing the Hedge**
  - ✓ When futures contracts are used for hedging, there is daily settlement and series of one-day hedges. Tailing the hedge can deal with this case when making hedging decision.

$$N^* = \frac{h \times V_A}{V_F}$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Effectiveness of Hedge**
  - ✓ Measures how much variance can be reduced by implementing the optimal hedge. We can use coefficient of determination (R^2) term to evaluate the effectiveness.
  - ✓ Note that for this simple linear regression, the R^2 measure is also the square of the correlation coefficient (ρ^2) between spot and futures prices.



Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Example:** An airline expects to purchase 2 million gallons of jet fuel in 1 month and decides to use heating oil futures for hedging. Each heating oil contract traded by the CME Group is on 42,000 gallons of heating oil.

Month i	*Change in heating oil futures price per gallon (= ΔF)*	*Change in jet fuel price per gallon (= ΔS)*
1	0.021	0.029
2	0.035	0.020
3	−0.046	−0.044
4	0.001	0.008
5	0.044	0.026
6	−0.029	−0.019
7	−0.026	−0.010
8	−0.029	−0.007
9	0.048	0.043
10	−0.006	0.011
11	−0.036	−0.036
12	−0.011	−0.018
13	0.019	0.009
14	−0.027	−0.032
15	0.029	0.023

	ΔF	ΔS
Std.	0.031	0.026
Correlation		0.928

$$HR = \rho_{S,F} \frac{\sigma_S}{\sigma_F}$$

$$= 0.928 \times \frac{0.026}{0.031} = 0.778$$

$$N = 0.778 \times \frac{2000000}{42000} = 37.03$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Hedging with Stock Index Futures**

$$\text{number of contracts} = \beta_{\text{portfolio}} \times \frac{\text{portfolio value}}{\text{value of futures contract}} = \beta_{\text{portfolio}} \times \frac{\text{portfolio value}}{\text{futures price} \times \text{contract multiplier}}$$

$$\text{number of contracts} = \left(\beta^* - \beta\right) \times \frac{\text{portfolio value}}{\text{value of futures contract}}$$

  - **Hedging with Interest Rate Futures**
  - ✓ The number of contracts required to hedge against an uncertain change in the yield given by Δy, is given by:

$$N^* = \frac{PD_P}{F_C D_F}$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Example 1**
  - ✓ You are a portfolio manager with a $20 million growth portfolio that has a beta of 1.4, relative to the S&P 500. The S&P 500 futures are trading at 1,150, and the multiplier is 250. You would like to hedge your exposure to market risk over the next few months. Identify whether a long or short hedge is appropriate, and determine the number of S&P 500 contracts you need to implement the hedge.

$$\text{Short } 1.4 \times \frac{\$20{,}000{,}000}{1{,}150 \times 250} \approx 97 \text{ contracts}$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Example 2**
  - ✓ Suppose that you would like to make a tailing the hedge adjustment to the number of contracts needed in the previous example. Assume that when evaluating the next daily settlement period you find that the S&P 500 spot price is 1,095 and the futures price is now 1,160. Determine the number of S&P 500 contracts needed after making a tailing the hedge adjustment.

$$1.4 \times \left[\left(\$20{,}000{,}000\right)/\left(1{,}150 \times 250\right)\right] \times \left(1{,}095/1{,}160\right) = 92 \text{ contracts}$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Example 3**
  - ✓ Suppose we have a well-diversified $100 million equity portfolio. The portfolio beta relative to the S&P 500 is 1.2. The current value of the 3-month S&P 500 Index is 1,080. The portfolio manager wants to completely hedge the systematic risk of the portfolio over the next three months using S&P 500 Index futures. Demonstrate how to adjust the portfolio's beta:

$$\text{number of contracts} = (0 - 1.2)\frac{100,000,000}{1,080 \times 250} = -444.44$$

Hedging Strategies using Futures

- **Hedging with Futures Contract (cont'd)**
  - **Example 4**
  - ✓ There is a portfolio of $100 million with a 6-month hedging horizon. And the 6-month T-bond contract is quoted at 105-09, and the contract size is $100,000. The duration of the portfolio is 15, and the duration of the futures contract is 17. Outline the appropriate hedge for small changes in yield.

$$N = -\frac{P \times D_P}{F \times D_F} = -\frac{100,000,000 \times 15}{105,218.25 \times 17} \approx -839$$

Hedging Strategies using Futures

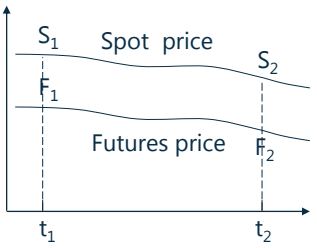
- **Basis Risk**
  - The **basis** is the difference between the price of the futures contract and the spot price of the underlying asset.

    Basis = spot price – futures price
  - **Long the basis** refers to a set of positions that consists of a short futures position and a long cash position. Position that are long the basis benefit when the basis is strengthening.
  - **Short the basis** refers to a set of positions that consists of a long futures position and a short cash position. Positions that are short the basis benefit when the basis is weakening.

Hedging Strategies using Futures

➢ **Basis Risk (cont'd)**

- Futures contract often does not track exactly with the underlying commodity. **Basis risk** is the risk (to the hedger) created by the uncertainty in the basis.
- The hedging risk is the uncertainty associated with b_2:
  - ✓ Different asset
  - ✓ Different maturity
- **Cross hedging** occurs when the assets underlying the futures contract and the asset whose price is being hedged are different.



Hedging Strategies using Futures

➢ **Basis Risk (cont'd)**

- **Risk in Rolling the Hedge Forward**
  - ✓ When the hedging horizon is longer than the maturity of the futures used in the hedging strategy, hedges have to be rolled forward. Specifically, as a maturity date approaches, the hedger must close out the existing position and replace it with another on-the-run contract. We call this kind of operation **rolling the hedge forward**.
  - ✓ When rolling the hedge forward, we should pay attention to basis risk. Hedgers are not only exposed to the basis risk of the original hedge, they are also exposed to the basis risk of a new rolling. This is referred to as rollover basis risk.

Hedging Strategies using Futures

➢ **Basis Risk (cont'd)**

- **Risk in Rolling the Hedge Forward (cont'd)**
  - ✓ **Example:** Apr. 07 a company will have 100,000 barrels of oil to sell in Jun. 08 and decides to hedge its risk with a hedge ratio of 1.0. The current spot price is $69. Only the first six delivery months have sufficient liquidity to meet the company's needs. The company shorts 100 Oct. 07 contracts. In Sept. 07 it rolls the hedge forward into the Mar. 08 contract. In Feb. 2008 it rolls the hedge forward again into the Jul. 2008 contract.

Data for the example of rolling oil hedge forward				
Date	**Apr. 2007**	**Sept. 2007**	**Feb. 2008**	**June 2008**
Oct. 2007 futures price	68.20	67.40		
Mar. 2007 futures price		67.00	66.50	
July. 2007 futures price			66.30	65.90
Spot price	69.00			66.00

Exercise 1

- Consider the following 6×9 FRA, Assume the buyer of the FRA agrees to a contract rate of 6.35% on a notional amount of 10 million USD, calculate the settlement amount of the seller if the settlement rate is 6.85%. Assume a 30/360 day count basis.
  - A. –12,500
  - B. –12,290
  - C. +12,500
  - D. +12,290

- Correct Answer: B

Exercise 2

- Assume the one-year zero rates is 3% and the fifteen month zero rate is 4% with continuous compounding. What is the value of a forward rate agreement that enables the holder to earn 7% expressed with quarterly compounding, for a 3-month period starting in one year on a notional of $1,000,000?
  - A. -$2,701
  - B. -$2,570
  - C. +$2,570
  - D. +$2,701

- Correct Answer: B

Exercise 3

- Which one of the following statements is incorrect regarding the margining of exchange-traded futures contracts?
  - A. Day trades and spread transactions require lower margin levels.
  - B. If an investor fails to deposit variation margin in a timely manner the positions may be liquidated by the carrying broker.
  - C. Initial margin is the amount of money that must be deposited when a futures contract is opened.
  - D. A margin call will be issued only if the investor's margin account balance becomes negative.

- Correct Answer: D

Exercise 4

- A trader buys one wheat contract (underlying = 5,000 bushels) at a price of $3.05 per bushel. The initial margin on the contract is $4,500 and the maintenance margin is $3,750. At what price will the trader receive a maintenance margin call?
  A. $2.30
  B. $2.90
  C. $3.20
  D. $3.80

- Correct Answer: B

Exercise 5

- To utilize the cash position of assets under management, a portfolio manager enters into a long futures position on the S&P 500 index with a multiplier of 250. The cash position is $15 million which at the current futures value of 1,000, requires the manager to be long 60 contracts. If the current initial margin is $12,500 per contract, and the current maintenance margin is $10,000 per contract, what variation margin does the portfolio manager have to advance if the futures contract value falls to 995 at the end of the first day of the position being placed?
  A. $30,000
  B. $0
  C. $300,000
  D. $75,000

- Correct Answer: B

Exercise 6

- On September 10, a trader opens a long position in 100 December S&P 500 futures contracts. The initial margin requirement is USD 2 million, and CME requires a maintenance margin of USD 1.5 million. Assume that the position is kept open until September 14 and no withdrawals take place. The following table summarizes the daily change in value of the position for that period:

Date	December S&P 500 Futures price	Daily Gain/Loss (USD)
9/10	1,734	-
9/11	1,756	550,000
9/12	1,712	-1,100,000
9/13	1,698	-350,000

On what dates will additional margin be required?
A. September 12, but not September 13
B. September 13, but not September 12
C. September 12 and September 13
D. Neither September 12 nor September 13

- Correct Answer: A

Exercise 7

- An investor with a long position in a futures contract wants to issue instructions to close out the position. A market-if-touched order would be used if the investor wants to:
  A. Execute at the best available price once a trade occurs at the specified or better price.
  B. Execute at the best available price once a bid/offer occurs at the specified or worse price.
  C. Allow a broker to delay execution of the order to get a better price.
  D. Execute the order immediately or not at all.

- Correct Answer: A

Exercise 8

- A natural gas producer wants to hedge the risk of a decline in the price of natural gas over the next three months. The trader representing the producer wants a short position in the 3-month natural gas futures contract to mitigate this risk and puts in an order to short the contract at a price of USD 5 per MMBTU or above. Which of the following describes this type of order?
  A. Market-not-held order
  B. Stop-loss order
  C. Discretionary order
  D. Limit order

- Correct Answer: D

Exercise 9

- A risk analyst observes that an emerging market stock index has hit a new all-time high with a value of 10,000, measured in the emerging market's currency. The analyst suggests buying futures on the index as a hedge on the firm's short exposure to this market. If the interest rate is 4% annually in this market and the average annualized dividend yield on the index for the next six months is 1%, what is the approximate price of a 6-month futures contract on the index in the emerging market's currency?
  A. 9,700
  B. 9,850
  C. 10,150
  D. 10,300

- Correct Answer: C

Exercise 10

- The current price of Commodity X in the spot market is $42.47. Forward contracts in one year are trading at a price of $43.11. If the current continuously compounded annual risk-free interest rate is 7.0%, calculate the implicit lease rate for Commodity X. Holding the calculated implicit lease rate constant, would the forward market for Commodity X be in backwardation or contango if the continuously compounded annual risk-free rate immediately fell to 5.0%?
  A. The implicit lease rate is 1.49%. Holding this rate constant, the forward market would be in contango if the continuously compounded annual risk-free rate immediately fell to 5.0%.
  B. The implicit lease rate is 5.50%. Holding this rate constant, the forward market would be in backwardation if the continuously compounded annual risk-free rate immediately fell to 5.0%.
  C. The implicit lease rate is 1.49%. Holding this rate constant, the forward market would be in backwardation if the continuously compounded annual risk-free rate immediately fell to 5.0%.
  D. The implicit lease rate is 5.50%. Holding this rate constant, the forward market would be in contango if the continuously compounded annual risk-free rate immediately fell to 5.0%.

- Correct Answer: B

Exercise 11

- A stock index is valued at USD 750 and pays a continuous dividend at the rate of 2% per annum. The 6-month futures contract on that index is trading at USD 757. The risk-free rate is 3.5% continuously compounded. There are no transaction costs or taxes. Is the futures contract priced so that there is an arbitrage opportunity? If yes, which of the following numbers comes closest to the arbitrage profit you could realize by taking a position in one futures contract?
  A. 4.18
  B. 1.35
  C. 12.60
  D. There is no arbitrage opportunity.

- Correct Answer: B

Exercise 12

- The spot price of silver is $20.00 per ounce. The storage cost is $3.00 per ounce per year payable quarterly in arrears. The risk-free interest rate is flat at 3.0% per annum with continuous compounding. Further, you have determined that the owning silver confers a convenience yield of 0.20% (20 basis points) per month with continuous compounding. Which is nearest to the theoretical futures price of silver for delivery in six months?
  A. $19.83
  B. $20.79
  C. $21.55
  D. $23.09

- Correct Answer: C

Exercise 13

- The spot price of the Euro is USD $1.280 per 1.0 EUR; i.e., EUR/USD = $1.280 where EUR is the base currency and USD is the quote currency. Risk-free interest rates are flat for all maturities, with continuous compounding: 1.00% for USD and 3.00% for EUR. Which is nearest to the theoretical four-year EUR/USD forward exchange rate?
  A. $0.983 per one EUR
  B. $1.182 per one EUR
  C. $1.307 per one EUR
  D. $1.559 per one EUR

- Correct Answer: B

Exercise 14

- Given the following:
  - Current spot CHF/USD rate: 1.3680 (1.3680CHF = 1USD)
  - 3-month USD interest rates: 1.05%
  - 3-month Swiss interest rates: 0.35%

  (Assume continuous compounding)
  A currency trader notices that the 3-month future price is USD 0.7350. In order to arbitrage, the trader should investment.
  A. Borrow CHF, buy USD spot, go long CHF futures
  B. Borrow CHF, sell CHF spot, go short CHF futures
  C. Borrow USD, buy CHF spot, go short CHF futures
  D. Borrow USD, sell USD spot, go long CHF futures

- Correct Answer: C

Exercise 15

- Three months ago a company entered in a one-year forward contract to buy 100 ounces of gold. At the time, the one-year forward price was USD 1,000 per ounce. The nine-month forward price of gold is now USD 1,050 per ounce. The continuously-compounded risk-free rate is 4% per year for all maturities, and there are no storage costs. Which of the following is closest to the value of the contract?
  A. USD 5,000
  B. USD 4,852
  C. USD 7,955
  D. USD 1,897

- Correct Answer: B

Exercise 16

- You are asked to evaluate the price relationship between the cash and futures markets on the S&P 500 index, based on the following information.

Futures Expiry	Futures Price
03/2015	1,845
06/2015	1,867
09/2015	1,897

How would you describe the structure of this market?

A. The market is normal
B. The market shows backwardation
C. The market is mixed
D. The market is inverted

- Correct Answer: A

Exercise 17

- Suppose the Treasury bond futures settlement price is $98.250 and there are four bonds eligible for delivery, as listed below:

T-Bond Settlement Price: $98.250		
Bond	Quoted Bond Price	Conversion
1	$84.19	0.82
2	$94.47	0.94
3	$124.28	1.22
4	$129.09	1.26

Which bond is the cheapest to deliver (CTD)?

A. Bond 1
B. Bond 2
C. Bond 3
D. Bond 4

- Correct Answer: B

Exercise 18

- A Eurodollar futures price changes from 98.00 to 97.20. What is the gain/loss to an investor who is long one contract?

A. LIBOR decreased by 80 basis point for a loss (to the long position) of $2,000
B. LIBOR increased by 80 basis point for a loss (to the long position) of $2,000
C. LIBOR decreased by 80 basis point for a gain (to the long position) of $2,000
D. LIBOR increased by 80 basis point for a gain (to the long position) of $2,000

- Correct Answer: B

Exercise 19

- If the volatility of the short interest rate (LIBOR) is 4.0%, what is the convexity adjustment for a five (5)-year Eurodollar futures contract?
  A. 0.75%
  B. 1.1%
  C. 2.1%
  D. 4.2%

- Correct Answer: C

Exercise 20

- A company plans to borrow $3.0 million for three months starting in one year. The Eurodollar futures contract that matures in one year has a quoted price of 98.00 and the company wants to (net) effectively lock-in this 2.0% LIBOR interest rate. At the end of one year, LIBOR increases to 3.0%. The company's borrowing (at the higher 3.0% LIBOR) will increase but will be hedged by the gain on the Eurodollar futures contract. What is the futures trade and what is the gain on the futures contract only?
  A. Long one contract for a gain of $2,500
  B. Long three contracts for a gain of $7,500
  C. Short one contract for a gain of $2,500
  D. Short three contracts for a gain of $7,500

- Correct Answer: D

Exercise 21

- It's June 2nd and a fund manager with USD 10 million invested in government bonds is concerned that interest rates will be highly volatile over the next three months. The manager decides to use the September treasury bond futures contract to hedge the value of the portfolio. The current futures price is USD 95.0625, each contract is for the delivery of USD 100,000 face value of the bonds. The duration of the manager's bond portfolio in three months will be 7.8 years, the cheapest to deliver bonds in the treasury bond futures contract is expected to have a duration of 8.4 years at maturity of the contract. At the maturity of the treasury bond futures contract, the duration of the underlying benchmark treasury bond is 9 years. What position should fund manager undertake to mitigate his interest rate risk exposure?
  A. short 94 contracts
  B. short 98 contracts
  C. short 105 contracts
  D. short 113 contracts

- Correct Answer: B

Exercise 22

- The current value of the S&P 500 index is 1,457, and each S&P futures contract is for delivery of 250 times the index. A long-only equity portfolio with market value of USD 300,000,000 has beta of 1.1. To reduce the portfolio beta to 0.75, how many S&P futures contract should you sell?
  A. 288 contracts
  B. 618 contracts
  C. 906 contracts
  D. 574 contracts

- Correct Answer: A

Exercise 23

- On Nov. 1, Jimmy Walton, a fund manager of a USD 60 million U.S. medium-to-large cap equity portfolio, considers locking up the profit from the recent rally. The S&P 500 index and its futures with the multiplier of 250 are trading at 900 and 910, respectively. Instead of selling off his holdings, he would rather hedge two-thirds of his market exposure over the remaining two months. Given that the correlation between Jimmy's portfolio and the S&P 500 index futures is 0.89 and the volatilities of the equity fund and the futures are 0.51 and 0.48 per year respectively, what position should he take to achieve his objective?
  A. Sell 250 futures contracts
  B. Sell 169 futures contracts
  C. Sell 167 futures contracts
  D. Sell 148 futures contracts

- Correct Answer: C

Exercise 24

- An oil producer has an obligation under an agreement to supply one million barrels of oil at a fixed price. The producer wishes to hedge this liability using futures in order to address the possibility of an upward movement in oil prices. In comparing a strip hedge to a stack and roll hedge, which of the following statements is correct?
  A. A stack and roll hedge tends to involve fewer transactions.
  B. A strip hedge tends to have smaller bid-ask spreads.
  C. A stack and roll hedge tends to have greater liquidity.
  D. A strip hedge tends to realize gains and losses more frequently.

- Correct Answer: C

Exercise 25

- Which of the following trade(s) contain mainly basis risk?
  - I. Long 1,000 lots Nov 07 ICE Brent Oil contracts and short 1,000 lots Nov 07 NYMEX WTI Crude Oil contracts
  - II. Long 1,000 lots Nov 07 ICE Brent Oil contracts and long 2,000 lots Nov 07 ICE Brent Oil at-the-money put
  - III. Long 1,000 lots Nov 07 ICE Brent Oil contracts and short 1,000 lots Dec 07 ICE Brent Oil contracts
  - IV. Long 1,000 lots Nov 07 ICE Brent Oil contracts and short 1,000 lots Dec 07 NYMEX WTI Crude Oil contracts
  - A. II and IV only
  - B. I and III only
  - C. I, III, and IV only
  - D. III and IV only

- Correct Answer: C

Financial Products

Topic 4: Swaps

1. Types of Swaps
2. Interest Rate Swap
3. Currency Swap
4. Other Types of Swaps

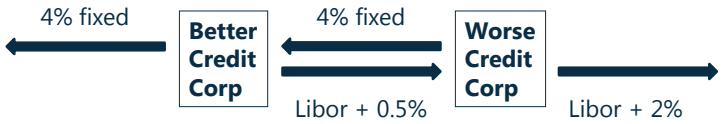
Main Types of Swaps

- **Interest Rate Swap**
  - An interest rate swap (IRS) is a popular and highly liquid financial derivative instrument in which two parties agree to exchange interest rate cash flows, based on a specified notional amount from a fixed rate to a floating rate (or vice versa).
  - Notional not exchanged.
- **Currency Swap**
  - A currency swap entails the exchange of principal and interest in one currency for the principal and interest in another currency.
  - Principal is exchanged at beginning/inception and end/maturity.

Interest Rate Swap

Comparative Advantage Argument

	Fixed	Floating	Comparative Advantage
BetterCreditCorp	4%	Libor +1%	Fixed Market
WorseCreditCorp	6%	Libor + 2%	Floating Market



Net Borrowing Rates (i.e., including swap)		
	Fixed	**Floating**
BetterCreditCorp		Libor + 0.5%
WorseCreditCorp	5.5%	

Interest Rate Swap

Valuation

- If two companies enter into an interest rate swap arrangement, then one of the companies has a swap position that is equivalent to a long position in floating-rate bond and a short position in a fixed-rate bond.

$$V_{swap} = B_{Float} - B_{Fixed}$$

- The counterparty to the same swap has the equivalent of a long position in a fixed-rate bond and a short position in a floating-rate bond.

$$V_{swap} = B_{Fixed} - B_{Float}$$

- **Notes:** The **value of a floating rate bond** will be equal to the notional amount at any of its periodic settlement dates when the next payment is set to the market rate (floating) or the bond can be treated as a single cash flow: the sum of the next coupon plus a bond that must trade at par immediately after paying the coupon.

Interest Rate Swap

Valuation (cont'd)

- **Example:** Consider a $1 million notional swap that pays a floating rate based on 6-month LIBOR and receives a 6% fixed rate semiannually. The swap has a remaining life of 15 months with pay dates at 3, 9 and 15 months. Spot LIBOR rates are as following: 3 months at 5.4%; 9 months at 5.6%; and 15 months at 5.8%. The LIBOR at the last payment date was 5.0%. Calculate the value of the swap to the fixed-rate receiver using the bond methodology.

$$Bond_{Fixed} = 30{,}000 \times e^{-5.4\% \times 0.25} + 30{,}000 \times e^{-5.6\% \times 0.75} + 1{,}030{,}000 \times e^{-5.8\% \times 1.25} = 1{,}016{,}332$$

$$Bond_{Float} = (1{,}000{,}000 + 25{,}000) \times e^{-5.4\% \times 0.25} = 1{,}011{,}255$$

$$V_{swap} = Bond_{Fixed} - Bond_{Float} = 1{,}016{,}332 - 1{,}011{,}255 = 5{,}077$$

Currency Swap

- **Comparative Advantage Argument**

	USD	AUD	Comparative Advantage
General Electric	5%	7.6%	USD Market
Qantas Airways	7%	8%	AUD Market

Net Borrowing Rates (i.e., including swap)		
	USD	**AUD**
General Electric		6.9%
Qantas Airways	6.3%	

Currency Swap

- **Valuation**
  - The valuation of currency swap is given by:

$$V_{Swap} = B_D - S_0 B_F$$
$$V_{swap} = S_0 B_F - B_D$$

  - **Example:** At the outset of the swap, company A pays a principal amount to B of USD 175 million, and B pays GBP 100 million to A. Both parties pay the interest rate of the borrowed currency (USD 5%, GBP 6%). At the end of the swap, the principal amounts are re-exchanged. Suppose the yield curves in the United States and Great Britain are flat at 2% and 4%, respectively, and the current spot exchange rate is USD1.50 = GBP1. Value the currency swap just discussed assuming the swap will last for three more years.

$$Bond_{USD} = 8.75 \times e^{-2\%\times 1} + 8.75 \times e^{-2\%\times 2} + 183.75 \times e^{-2\%\times 3} = 190.0329 \text{ million}$$

$$Bond_{GBP} = 6 \times e^{-4\%\times 1} + 6 \times e^{-4\%\times 2} + 106 \times e^{-4\%\times 3} = 105.3170 \text{ million}$$

$$V_{swap(\text{received USD})} = 190.0329 - 1.5 \times 105.3170 = 32.06 \text{ million}$$

Other Types of Swaps

- **Equity Swap**
  - An agreement to exchange the total return realized on an equity, a portfolio, or a stock index for either a fixed or a floating rate of interest.
- **Commodity swap**
  - Firms may enter into commodity swap agreements where they agree to pay a fixed rate for the multi-period delivery of a commodity and receive a corresponding floating rate based on the average commodity spot rates at the time of delivery.
- **Volatility swap**
  - An agreement to exchange the realized volatility of an asset for a prespecifed fixed volatility.
- **Swaption**
  - A swaption is an option granting its owner the right to enter into an underlying swap.

Exercise 1

- XYZ Corporation plans to issue a 10-year bond 6 months from now. XYZ would like to hedge the risk that interest rates might rise significantly over the next 6 months. In order to effect this, the treasurer is contemplating entering into a swap transaction. Under the swap, she should:
  A. Pay fixed and receive LIBOR
  B. Pay LIBOR and receive fixed
  C. Either swap (a or b above) will work
  D. Neither swap (a or b above) will work

- Correct Answer: A

Exercise 2

- Firm X wants to borrow GBP at a floating interest rate, and Firm Y wants to borrow GBP at a fixed annual interest rate. The interest rates that they face are shown in the table below. What is the maximum spread a financial intermediary could get if it designs a swap making firms X and Y each better off by 20 basis points?

Firm	Fixed	Floating
X	4.50%	6-month LIBOR + 1.5%
Y	5.50%	6-month LIBOR + 2.0%

  A. 5 basis points
  B. 10 basis points
  C. 15 basis points
  D. 20 basis mints

- Correct Answer: B

Exercise 3

- A trader executes a $420 million 5-year pay fixed swap (duration 4.433) with one client and a $385 million 10-year receive fixed swap (duration 7.581) with another client shortly afterwards. Assuming that the 5-year rate is 4.15 % and 10-year rate is 5.38 % and that all contracts are transacted at par, how can the trader hedge his net delta position?
  A. Buy 4,227 Eurodollar contracts
  B. Sell 4,227 Eurodollar contracts
  C. Buy 7,185 Eurodollar contracts
  D. Sell 7,185 Eurodollar contracts

- Correct Answer: B

Exercise 4

- In an interest rate swap with semiannual payments, StreetBase Bank has agreed to pay a fixed rate of 4.0% per annum with semiannual compounding and receive six-month LIBOR on a notional of USD 100 million. The swap has remaining maturity of 15 months. The LIBOR curve is flat at 2.0% per annum with continuous compounding for all maturities (out to 15 months), including the six-month LIBOR at the last payment date was also 2.0% (but with semiannual compounding). Which is nearest to the value of the swap to StreetBase Bank?
  A. -$4.88 million
  B. -$2.95 million
  C. Zero
  D. +$3.40 million

- Correct Answer: B

Exercise 5

- Consider the following 3-year currency swap, which involves exchanging annual interest of 2.75% on 10 million US dollars for 3.75% on 15 million Canadian dollars. The CAD/USD spot rate is 1.52. The term structure is flat in both countries. Calculate the value of the swap in USD if interest rates in Canada are 5% and in the United States are 4%. Assume continuous compounding. Round to the nearest dollar.
  A. $152,000
  B. $145,693
  C. $131,967
  D. $127,818

- Correct Answer: C

Financial Products

Topic 5: Options

1. Properties of Stock Options
2. Trading Strategies involving Options
3. Exotic Options

Properties of Stock Options

- **Option Contract**
  - The owner has the right, but not the obligation to conduct the transaction.
- **Long/Short; Call/Put**
  - An option to buy an asset at a particular price is termed a call option.

Long call	Right to buy	
Short call		Obligation to sell

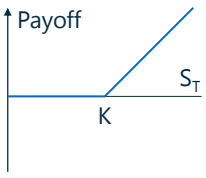
  - An option to sell an asset at a particular price is termed a put option.

Long put	Right to sell	
Short put		Obligation to buy

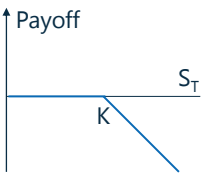
  - The seller or short position in an options contract is sometimes referred to as the writer of the option.
  - The price specified in the contract is known as strike price/exercise price.

Properties of Stock Options

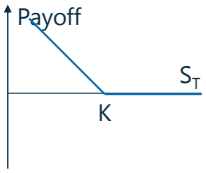
- **Payoffs of Options**



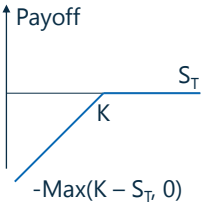
$Max(S_T - K, 0)$



$-Max(S_T - K, 0)$



$Max(K - S_T, 0)$



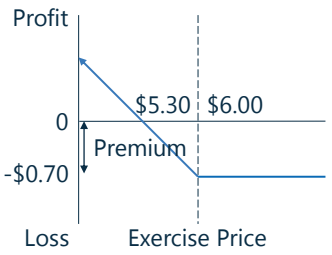
$-Max(K - S_T, 0)$

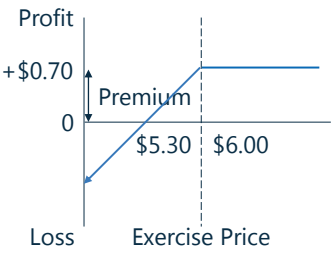
Properties of Stock Options

- **Profit of Call Option**

Properties of Stock Options

➢ **Profit of Put Option**





Properties of Stock Options

➢ **European Options and American Options**

- **European options**
  - ✓ Can only be exercised at expiration.
- **American Options**
  - ✓ Allow the owner to exercise the option at any time before or at expiration.
- **Early Exercise Features of American Call and Put Options**
  - ✓ All other things being equal, the value of an American style option must be at least as great as a European option with the same features.
  - ✓ From a mathematical standpoint, it's never optimal to execute an early exercise on an American call option on a non-dividend paying stock. However, it can be optimal to execute an early exercise on American put.

Properties of Stock Options

➢ **Properties of Option Value**

- **Moneyness**
  - ✓ **In the money:** Immediate exercise would generate a positive payoff.
  - ✓ **At the money:** Immediate exercise would generate no payoff.
  - ✓ **Out of the money:** Immediate exercise would result in a loss.

Moneyness	Call option	Put Option
In-the-money	S>K	S<K
At-the-money	S = K	S = K
Out-the-money	S<K	S>K

- **Intrinsic Value and Time Value**
  - ✓ **Intrinsic Value:** The amount that it is in the money, and zero otherwise.
    Intrinsic value of call option: $C = \max [S - K, 0]$
    Intrinsic value of put option: $P = \max [K - S, 0]$
  - ✓ **Time Value:** The difference between the price of an option (called its premium) and its intrinsic value is due to its time value.

Properties of Stock Options

- **Properties of Option Value (cont'd)**
  - **Six Factors that Affect Option's Price**

Factor	European call	European put	American call	American put
S	+	—	+	—
K	—	+	—	+
T	?	?	+	+
σ	+	+	+	+
r	+	—	+	—
D	—	+	—	+

Properties of Stock Options

- **Properties of Option Value (cont'd)**
  - **Upper and Lower Bounds for Option Prices**

Option	Proxy	Min Value	Max Value
European call	c	max (0, S_0 — Ke^{-rT})	S_0
American call	C	max (0, S_0 — Ke^{-rT})	S_0
European put	p	max (0, Ke^{-rT} — S_0)	Ke^{-rT}
American put	P	max (0 , K — S_0)	K

  - **Put-Call Parity**

$$C + Ke^{-rT} = p + S_0 \qquad p + S_0 = c + D + Ke^{-rT}$$

$$S - K \le C - P \le S - Ke^{-rT} \qquad S_0 - K - D \le C - P \le S_0 - Ke^{-rT}$$

Properties of Stock Options

- **Properties of Option Value (cont'd)**
  - **Example:**

✓ Compute the lowest possible price for 4-month American and European 65 puts on a stock that is trading at 63 when the risk-free rate is 5%.

$P > \max(0, K - S_0) = \max(0, 65\text{-}63) = \$2$

$p > \max(0, Ke^{-rT} - S_0) = \max(0, 65\, e^{-5\%/3} - 63) = \$0.92$

✓ Compute the lowest possible price for 3-month American and European 65 calls on a stock that is trading at 68 when the risk-free rate is 5%.

$C > \max(0, S_0 - Ke^{-rT}) = \max(0, 68\text{-}\ 65e^{-5\%/4}) = \$3.81$

$c > \max(0, S_0 - Ke^{-rT}) = \max(0, 68\text{-}\ 65e^{-5\%/4}) = \$3.81$

Properties of Stock Options

- **Option Contract with Stock Splits**
  - A **stock split** occurs when the existing shares are "split" into more shares. For example, in a 3-for-1 stock split, three new shares are issued to replace each existing share.
  - In general, an n-for-m stock split should cause the stock price to go down to m/n of its previous value.
  - Exchange-traded options are adjusted for stock splits. After an n-for-m stock split, the strike price is reduced to m/n of its previous value, and the number of shares covered by one contract is increased to n/m of its previous value. If the stock price declines in the way expected, the positions of both the writer and the purchaser of a contract remain unchanged.

Properties of Stock Options

- **Trading of Exchange-Traded Options**
  - **Market Makers**
    - ✓ Most options exchanges use market makers to facilitate trading.
    - ✓ A market maker for a certain option is an individual who, when asked to do so, will quote both a bid and an offer price on the option. The bid is the price at which the market maker is prepared to buy, and the offer or ask is the price at which the market maker is prepared to sell.
    - ✓ The existence of the market maker ensures that buy and sell orders can always be executed at some price without any delays. Market makers therefore add liquidity to the market.
  - **Offsetting Orders**
    - ✓ An investor who has purchased options can close out the position by issuing an offsetting order to sell the same number of options. Similarly, an investor who has written options can close out the position by issuing an offsetting order to buy the same number of options.

Properties of Stock Options

- **Commissions of Exchange-Traded Options**
  - **Discount brokers** generally charge lower commissions than full-service brokers. The actual amount charge is often calculated as a fixed cost plus a proportion of the dollar amount of the trade.

Sample Commission Schedule for a Discount Broker	
Dollar Amount of Trade	**Commission**
<$2,500	$20 + 2% of dollar amount
$2,500 to $10,000	$45 + 1% of dollar amount
>$10,000	$120 + 0.25% of dollar amount

  - If an option position is closed out by entering into an offsetting trade, the commission must be paid again. If the option is exercised, the commission is the same as it would be if the investor placed an order to buy or sell the underlying stock.

Properties of Stock Options

- **Margin Requirements of Exchange-Traded Options**
  - When call and put options with maturities less than 9 months are purchased, the option price must be paid in full. Investors are not allowed to buy these options on margin because options already contain substantial leverage and buying on margin would raise this leverage to an unacceptable level. For options with maturities greater than 9 months investors can buy on margin, borrowing up to 25% of the option value.
  - A trader who writes option is required to maintain funds in a margin account.
  - Calculation of margin requirements is repeated every day. Funds can be withdrawn from the margin account when the calculation indicates that the margin required is less than the current balance in the margin account. When the calculation indicates that a greater margin is required, a margin call will be made.

Properties of Stock Options

- **Margin Requirements of Exchange-Traded Options (cont'd)**
  - **Writing Naked Options**
  - ✓ A **naked option** is an option that is not combined with an offsetting position in the underlying stock.
  - ✓ The initial and maintenance margin required by the CBOE for a **written naked call option** is the greater of the following two calculations:
  1. A total of 100% of the proceeds of the sale plus 20% of the underlying share price less the amount by which the option is out of the money.
  2. A total of 100% of the option proceeds plus 10% of the underlying share price.
  - ✓ For a **written naked put option**, it is the greater of
  1. A total of 100% of the proceeds of the sale plus 20% of the underlying share price less the amount by which the option is out of the money.
  2. A total of 100% of the option proceeds plus 10% of the exercise price.

Properties of Stock Options

- **Margin Requirements of Exchange-Traded Options (cont'd)**
  - **Writing Naked Options (cont'd)**
  - ✓ **Example:**

    An investor writes four naked call option contracts on a stock. The option price is \$5, the strike price is \$40, and the stock price is \$38. Because the option is \$2 out of the money, the first calculation gives:

$$400\times\left(5+20\%\times38-2\right)=\$4,240$$

    The second calculation gives

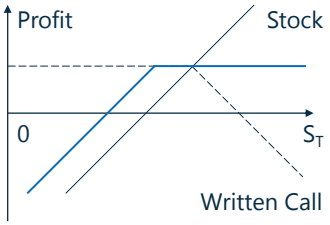
$$400\times\left(5+10\%\times38\right)=\$3,520$$

    The initial margin requirement is therefore \$4,240. Note that, if the option had been a put, it would be \$2 in the money and the margin requirement would be

$$400\times\left(5+20\%\times38\right)=\$5,040$$

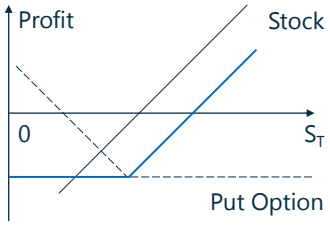
Trading Strategies involving Options

➢ **Simple Strategies**



Covered Call = -C + S

- Income Strategy
- Outlook is neutral to bullish



Protective Put = S + P

- Insurance Strategy

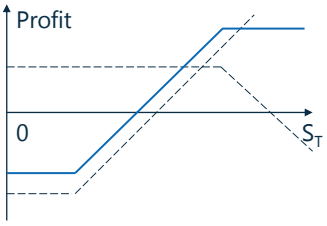
Trading Strategies involving Options

➢ **Spread Strategies**

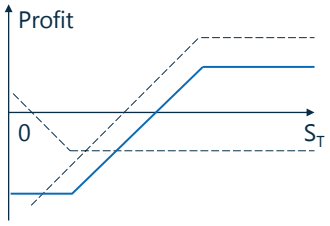
- A spread trading strategy involves taking a position in two or more options of the same type (i.e, two or more calls or two or more puts).
- Spread strategies combine options positions to get a desired payoff. The differences between the options are the strike prices and/or the expiration. The strategies we will discuss here are bull and bear spreads, butterfly spreads, calendar spreads, and diagonal spreads.

Trading Strategies involving Options

➢ **Spread Strategies (cont'd)**



Bull Call Spread

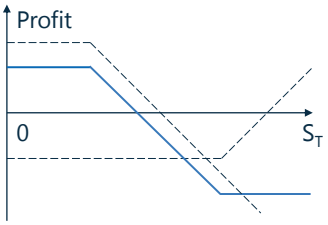


Bull Put Spread

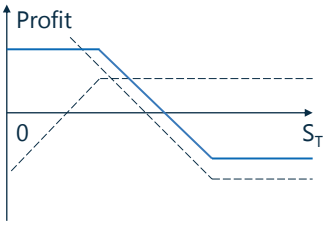
- Vertical spread
- Outlook is bullish

Trading Strategies involving Options

➢ **Spread Strategies (cont'd)**



Bear Call Spread

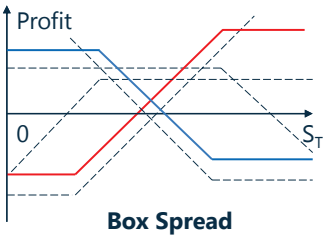


Bear Put Spread

- Vertical spread
- Outlook is bearish

Trading Strategies involving Options

➢ **Spread Strategies (cont'd)**

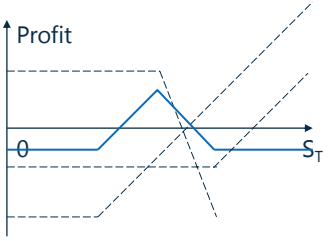


Box Spread

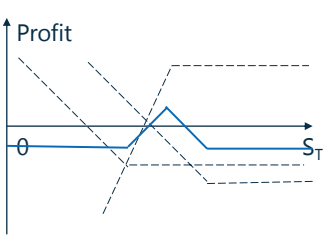
- A box spread is a combination of a bull call spread with strike prices K_1 and K_2 and a bear put spread with the same two strike prices.
- The payoff from a box spread is always $K_2 - K_1$. The value of a box spread is therefore always the present value of this payoff or $(K_2 - K_1)e^{-rT}$.
- If the market price of the box spread is too low, it is profitable to buy the box. If the market price of the box spread is too high, it is profitable to sell the box.

Trading Strategies involving Options

➢ **Spread Strategies (cont'd)**



Butterfly Spread

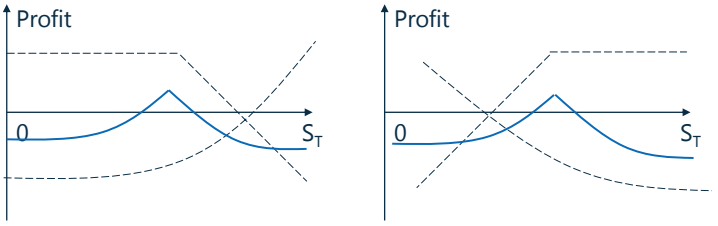


Butterfly Spread

- Expects low volatility
- Capped risk

Trading Strategies involving Options

➢ **Spread Strategies (cont'd)**



Calendar Spread

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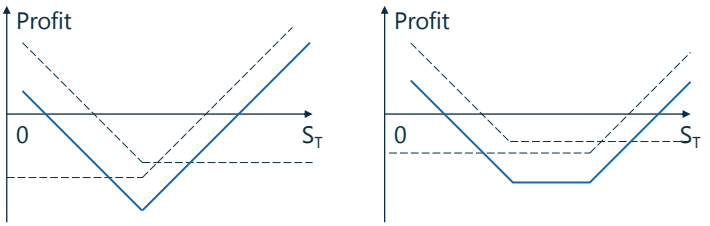
Trading Strategies involving Options

➢ **Combination Strategies**

- A Combination is an option trading strategy that involves taking a position in both calls and puts on the same stock.



Straddle

- A call and a put
- Same strike price
- Direction neutral
- Wants volatility

Strangle

- A call and a put
- Different strike price
- Like straddle, but cheaper

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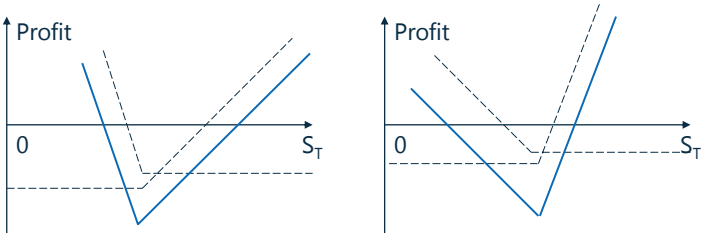
Trading Strategies involving Options

➢ **Combination Strategies (cont'd)**



Strip

- Two puts and one call
- Bet on volatility
- More bearish

Strap

- Two calls and one put
- Bet on volatility
- More bullish

Trading Strategies involving Options

- **Conclusion**

Simple Strategy	**A share and an option**
Spread Strategy	**Both are call, or both are put**
Bull	2 different K
Bear	2 different K
butterfly	3 different K
Calendar	2 different T
Combination Strategy	**Call and put**
Straddle & Strangle	Symmetric
Strip & Strap	Asymmetric

Exotic Options

- **Standard and Nonstandard American Options**
  - In a standard American option, exercise can take place at any time during the life of the option and the exercise price is always the same.
  - The American options that are traded in the over-the-counter market sometimes have nonstandard features.
    - ✓ Early exercise may be restricted to certain dates – **Bermudan Option**.
    - ✓ Early exercise may be allowed during only part of the life of the option.
    - ✓ The strike price may change during the life of the option.

Exotic Options

- **Compound Options**
  - Compound options are options on options. There are four main types of compound options: a call on a call, a put on a call, a call on a put, and a put on a put.
  - The advantages of compound options are that they allow for large leverage and they advantages of compound options . However, if both options are exercised, the total premium will be more than the premium on a single option.
  - The payoff structure of the four main types is as follow:

$$\max\left[C(T_1)-K_1,0\right] \qquad \max\left[P(T_1)-K_1,0\right]$$
$$\max\left[K_1-C(T_1),0\right] \qquad \max\left[K_1-P(T_1),0\right]$$

Exotic Options

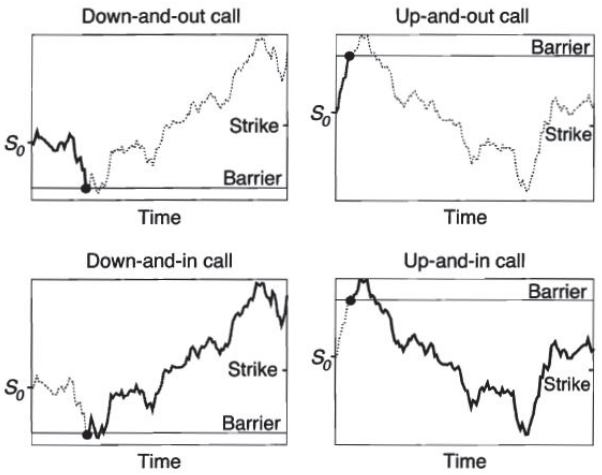
- **Forward Start Options**
  - A forward start option is an advance purchase of a put or call option that will become active at some specified future time. It is essentially a forward on an option.
  - The value of a forward start option will be identical to that of a similar European option with same maturity when the underlying asset is a no-dividend-paying stock.
- **Chooser Option**
  - A chooser option has the feature that after a specified period of time, the holder can choose whether the option is a call or a put.
  - Suppose that the time when the choice is made is T_1. The value of the chooser option at this time is:

$$\max(c,p)$$

Exotic Options

- **Barrier Options**
  - Payoffs and existence depend on whether the underlying's asset price reaches a certain barrier level over the life of the option.
  - Barrier options are attractive to market participants because they are less expensive than the corresponding regular options. A knock-out option ceases to exist when the underlying asset price reaches a certain barrier while a knock-in option comes into existence only when the underlying asset price reaches a barrier.
  - **In-out parity** is the barrier option's answer to put-call parity. If we combine one "in" option and one "out" barrier option with the same strikes and expirations, we get the price of a vanilla option. Note that this argument only works for European options.
  - Unlike other simpler options, barrier options are path-dependent. That is, the value of the option at any time depends not just on the underlying at that point, but also on the path taken by the underlying.

Exotic Options



Exotic Options

- **Binary Options/Digital Option**
  - Binary option is a type of option where the payoff is either some fixed amount of some asset or nothing at all. Two main types of binary option are cash-or-nothing options and asset-or-nothing option.
  - The **cash-or-nothing binary option** pays some fixed amount of cash if the option expires in-the-money while the **asset-or-nothing** pays the value of the underlying security.
  - A regular European call option is equivalent to a long position in an asset-or-nothing call and a short position in a cash-or-nothing call where the cash payoff in the cash-or-nothing call equals the strike price.
  - Similarly, a regular European put option is equivalent to a long position in a cash-or-nothing put and a short position in an asset-or-nothing put where the cash payoff on the cash-or-nothing put equals the strike price.

Exotic Options

- **Lookback Options**
  - The payoff from lookback options depend on the maximum or minimum asset price reached during the life of the option. There exist two kinds of lookback options: with floating strike and with fixed strike.

Floating lookback call payoff = Final Asset Price – Minimum Price

Fixed lookback call payoff = Maximum Price – Strike

Floating lookback put payoff = Maximum Price – Final Asset Price

Fixed lookback put payoff = Strike – Minimum Asset Price

Exotic Options

- **Shout Options**
  - A shout option is a European option where the holder can "shout" to the writer at one time during its life. At the end of the life of the option, the option holder receives either the usual payoff from a European option or the intrinsic value at the time of the shout, whichever is greater.
- **Asian Options**
  - Options where the payoff depends on the arithmetic average of the price of the underlying asset during the life of the option. There are two types of Asian Options: average price option and average strike option.
  - The payoff from an **average price call** is $\text{Max}(S_{ave} - K, 0)$ and that from an **average price put** is $\text{Max}(K - S_{ave}, 0)$
  - An **average strike call** pays off $\text{Max}(S_T - S_{ave}, 0)$ and an **average strike put pays** off $\text{Max}(S_{ave} - S_T, 0)$

Exotic Options

- **Volatility and Variance Swaps**
  - A volatility/variance swap is an agreement to exchange the realized volatility/variance of an asset for a prespecifed fixed volatility. The variance rate is the square of the volatility.
  - Variance swaps are easier to value than volatility swaps since the variance rate can be replicated using a portfolio of put and call options.
- **Static Options Replication**
  - This technique involves searching for a portfolio of actively traded options (regular options) that approximately replicates the exotic option. Shorting this position provides the hedge.

Exotic Options

- **Other Nonstandard Products**
  - **Options on exchange-trade funds**. ETFs have become a popular alternative to mutual funds for investors. They are traded like stocks and designed so that their prices reflect the value of the assets of the fund closely.
  - **Weeklys**. These are options that are created on a Thursday and expire on Friday of the following week.
  - **Credit event binary options (CEBOs)**. These are options that provide a fixed payoff if a particular company (known as the reference entity) suffers a "credit event" by the maturity date.
  - **DOOM options.** These are **deep-out-of-the-money put options**. Because they have a low strike price, they cost very little. They provide a payoff only if the price of the underlying asset plunges.

Exercise 1

- The current stock price of a share is USD 100, and the continuously compounding risk-free rate is 12% per year. The maximum possible prices for a 3-month European call option, American call option, European put option, and American put option, all with strike price of USD 90, are:
  A. 100, 100, 87.34, 90
  B. 100, 100, 90, 90
  C. 97.04, 100, 90, 90
  D. 97.04, 97.04, 87.34, 87.34

- Correct Answer: A

Exercise 2

- Stock UGT is trading at USD 100. A 1-year European call option on UGT with a strike price of USD 80 is trading at USD 30. No dividends are being paid in the following year. What should be the lower bound of an American put option on UGT with a strike price of USD 80 in order to not have arbitrage opportunities? Assume a continuously-compounded risk-free rate of 4% per year.
  A. 6.1
  B. 7.7
  C. 5.7
  D. 6.9

- Correct Answer: D

Exercise 3

- A risk manager is analyzing the option prices for a non-dividend-paying stock. How would the risk manager create a synthetic long European call option position on this stock using an appropriate zero-coupon risk-free bond and options having the same exercise price and exercise date?
  A. Buy a European put on the stock, buy the stock, and sell a zero-coupon risk-free bond.
  B. Buy a European put on the stock, sell the stock, and buy a zero-coupon risk-free bond.
  C. Sell a European put on the stock, buy the stock, and sell a zero-coupon risk-free bond.
  D. Sell a European put on the stock, sell the stock, and buy a zero-coupon risk-free bond.

- Correct Answer: A

Exercise 4

- The risk-free rate is 3.0% per annum while the current price of a non-dividend-paying stock is $56.00. An underwater (OTM) European put option on the stock has a strike price of $42.00 and maturity of one year; the value of this European put is $1.06. Which is nearest to the value of a European call option with the same strike price ($42.00; i.e., an in-the money call option) and one-year maturity?
  A. $7.49
  B. $14.00
  C. $16.30
  D. $28.28

- Correct Answer: C

Exercise 5

- An investor sells a June 2008 call of ABC Limited with a strike price of USD 45 for USD 3 and buys a June 2008 call of ABC Limited with a strike price of USD 40 for USD 5. What is the name of this strategy and the maximum profit and loss the investor could incur?
  A. Bear spread, maximum loss USD 2, maximum profit USD 3
  B. Bull spread, maximum loss Unlimited, maximum profit USD 3
  C. Bear spread, maximum loss USD 2, maximum profit unlimited
  D. Bull spread, maximum loss USD 2, maximum profit USD 3

- Correct Answer: D

Exercise 6

- Which portfolio will create a bull spread?
  A. Buy a put with a strike price of 32 and buy a call with a strike price of 25.
  B. Buy a put with a strike price of 25 and sell a call with a strike price of 32.
  C. Buy a call with a strike price of 32 and sell a call with a strike price of 25.
  D. Buy a call with a strike price of 25 and sell a call with a strike price of 32.

- Correct Answer: D

Exercise 7

- An investor constructs a long straddle by buying an April $30 call for $4 and buying an April $30 put for $3. If the price of the underlying shares is $27 at expiration, what is the profit on the position?
  A. -$4
  B. -$2
  C. $2
  D. $3

- Correct Answer: A

Exercise 8

- An investor is decided to buy a call option with a strike price of $45 for $5 and buy a call option with a strike price of $55 for $1, simultaneously sells two call options with a strike price of $50 for $3, when the stock price turn to be $30, what is the profit or loss on the option strategy?
  A. -$1
  B. $0
  C. $1
  D. $2

- Correct Answer: B

Exercise 9

- You are an institutional portfolio manager. One of your clients is very interested in the flexibility of options but expresses great concern about the high cost of some of them. In general, which of the following options would be the least costly to purchase?
  A. Shout options
  B. American options
  C. Lookback options
  D. Bermudan options

- Correct Answer: D

Exercise 10

- You want to choose at a particular date whether the option is a call or a put. What type of option should you buy?
  A. Chooser option
  B. Barrier option
  C. Binary option
  D. Asian option

- Correct Answer: A

Exercise 11

- All else being equal, which of the following options would cost more than plain-vanilla options that are currently at-the-money?

  I. Lookback options
  II. Barrier options
  III. Asian options
  IV. Chooser option

  A. I only
  B. I and IV
  C. II and III
  D. I, III, and IV

- Correct Answer: B

Exercise 12

- A 1-year forward contract on a stock with a forward price of USD 100 is available for USD 1.50. The table below lists the prices of some barrier option on the same stock with a maturity of 1 year and strike of USD 100. Assuming a continuously compounded risk-free rate of 5% per year. What is the price of a European put option on the stock with a strike of USD 100.

Option	Price
Up-and-in barrier call, barrier USD 95	USD 5.21
Up-and-out barrier call, barrier USD 95	USD 1.40
Down-and-in barrier put, barrier USD 80	USD 3.5

A. USD 2.00
B. USD 4.90
C. USD 5.11
D. USD 6.61

- Correct Answer: C

Financial Products

Topic 6: MBS

1. Introduction of Mortgage Loans
2. Cash Flow of Mortgage Loans
3. Prepayment of Mortgage Loans
4. Mortgage-Backed Securities Market

Introduction of Mortgage Loans

➢ **Types of Mortgage Loans**

- Almost exclusively on fixed rate residential mortgages.
- **Agency or conforming loans** are eligible to be securitized by such entities as Federal National Mortgage Association (FNMA), Federal Home Loan Mortgage Corporation (FHLMS), or Government National Mortgage Association (GNMA). These Loans are relatively creditworthy.
- **Non-agency or non-conforming loans** have to be part of private-label securitizations.
  - ✓ The relevant loan types include **jumbos**, which are larger in notional than conforming loans but otherwise similar;
  - ✓ **Alt-A**, which deviate from conforming loans in one requirement.
  - ✓ **Subprime**, which deviate from conforming loans in several dimensions. About 80% of subprime loans are adjustable-rate mortgages (ARMS)

Cash Flow of Mortgage Loans

➢ **Fixed Rate Mortgage Payments**

- The mortgage loan is fair in the sense that the present value of the monthly mortgage payments, discounted at the monthly compounded mortgage rate, equals the original amount borrowed. In general, for a monthly payment X on a T-year mortgage with a mortgage rate y and an original principal amount or loan balance of B(0):

$$X\sum_{n=1}^{12T}\frac{1}{\left(1+\frac{y}{12}\right)^{n}}=B(0);\ X\frac{12}{y}\left[1-\frac{1}{\left(1+\frac{y}{12}\right)^{12T}}\right]=B(0)$$

Cash Flow of Mortgage Loans

➢ **Fixed Rate Mortgage Payments (cont'd)**

- The fixed monthly payment is often divided into its interest and principal components. Letting B(n) be the principal amount outstanding after the mortgage payment due on date n, the interest component on the payment on date n + 1 is:

$$B(n)\times\frac{y}{12}$$

- In words, the monthly interest payment over a particular period equals the mortgage rate times the principal outstanding at the beginning of that period. The principal component of the monthly payment is the remainder, that is:

$$X-B(n)\times\frac{y}{12}$$

Cash Flow of Mortgage Loans

- **Fixed Rate Mortgage Payments (cont'd)**
  - **Example:** A homeowner might borrow $100,000 from a bank at 4% and agree to make payments of $477.42 every month for 30 years. The mortgage rate and the monthly payment are related by the following equation:

$$\$477.42\sum_{n=1}^{360}\frac{1}{\left(1+\frac{0.04}{12}\right)^{n}}=\$100,000$$

In the example, the original balance is $100,000. At the end of the first month, interest at 4% is due on this balance, which comes to $100,000×0.04/12 or $333.33. The rest of the monthly payment, $477.42 - $333.33 or $144.08, is payment of principal. This $144.08 principal payment reduces the outstanding balance from the original $100,000 to $100,000 - $144.08 or $99,855.92 at the end of the first month.

Cash Flow of Mortgage Loans

- **Fixed Rate Mortgage Payments (cont'd)**
  - Discounting using the mortgage rate at origination, the present value of the remaining payments equals the principal outstanding. This is a fair pricing condition under the assumptions that term structure is flat and interest rates have not changed since the origination of the mortgage.
  - ✓ **Example:** To illustrate this shortcut in this example, after 5 years or 60 monthly payments there remain 300 payments. The present value of these payments at the mortgage rate of 4% is

$$\$477.42\sum_{n=1}^{300}\frac{1}{\left(1+\frac{0.04}{12}\right)^{n}}=\$477.42\frac{12}{0.04}\left[1-\frac{1}{\left(1+\frac{0.04}{12}\right)^{300}}\right]$$

$$=\$90,448$$

Prepayment of Mortgage Loans

- **Prepayment Option**
  - Mortgage borrowers have a prepayment option, that is, the option to pay the lender the outstanding principal at any time and be freed of the obligation to make further payments.
  - **Example:** In the example of the previous subsection, the mortgage balance at the end of five years is $ 90,448. At that time, therefore, the borrower can pay the lender this balance and no longer have to make monthly payments.
  - The prepayment option is valuable when mortgage rates have fallen. In that case, the present value of the remaining monthly payments exceeds the principal outstanding. Therefore, the borrower gains in present value from paying the principal outstanding in exchange for not having to make further payments.

Prepayment of Mortgage Loans

- **Prepayment Option**
  - **SMM and CPR**
    - ✓ The **single monthly mortality rate** at month n, denoted SMM_n, is the percentage of principal outstanding at the beginning of month n that is prepaid during month n. The SMM is often annualized to a **constant prepayment rate or conditional prepayment rate (CPR)**. A pool that prepays at a constant rate equal to SMM_n has $1 - SMM_n$ of the principal remaining at the end of one month, $(1 - SMM_n)^{12}$ remaining at the end of 12 months, and therefore $1 - (1 - SMM_n)^{12}$ principal prepaying over those 12 months. Hence, the annualized CPR is related to SMM as follows:

$$CPR_n = 1 - \left(1 - SMM_n\right)^{12}$$

Mortgage-Backed Securities Market

- **Mortgage Pass-Through**
  - A simplest structure that the cash flows from the underlying mortgages, that is, interest, scheduled principal, and prepayments, are passed from the borrowers to the investors with some short processing delay.
- **Participant**
  - **Mortgage servicers** manage the flow of cash from borrowers to investors in exchange for a fee taken from those cash flows.
  - **Mortgage guarantors** guarantee investors the payment of interest and principal against borrower defaults, also in exchange for a fee.
- **Indicators**
  - The **weighted-average coupon or WAC** is the weighted average of the mortgage rates of the loans.
  - **Weighted-average maturity (WAM)**

Mortgage-Backed Securities Market

- **Trading of Agency Mortgage Pools**
  - Agency mortgage pools trade in two forms: specified pools and TBAs (To Be Announced)
    - ✓ In the **specified pools market**, buyer and sellers agree to trade a particular pool of loans. Consequently, the price of a trade reflects the characteristics of the particular pool.
    - ✓ Much more liquid, however, is the **TBA market**, which is a forward market with a delivery option. The TBA seller will pick the cheapest-to-deliver pool, that is, the pool that is worth the least subject to the issuer, maturity, and coupon requirements.

Mortgage-Backed Securities Market

- **Dollar Rolls**
  - Consider an investor who has just purchased a mortgage pool but wants to finance that purchase over the next month. An alternative for financing mortgages is the **dollar roll**. The buyer of the roll sells a TBA for one settlement month and buys the same TBA for the following settlement month.
  - **Value of the Dollar Roll**
  - ✓ Difference in proceeds between: a. Starting with a given pool and buying the roll and; b. Holding that pool over the month.
  - ✓ If the value of the roll is zero, the roll is said to trade at **breakeven**.
  - ✓ If the forward drop is larger so that the value of the roll is positive, the roll is said to trade **above carry**.

Mortgage-Backed Securities Market

- **Dollar Rolls (cont'd)**
  - **Example**
  - ✓ Suppose TBA prices of the Fannie Mae 5% for July 12 and August 12 settlements are $102.50 and $102.15.
  - ✓ The accrued interest to be added to each of these prices is 12 actual/360 days of a month's worth of a 5% coupon, i.e., 0.167.
  - ✓ Let the expected total principal pay down comprising of scheduled principal plus prepayments is 2% of outstanding balance and the prevailing short-term rate is 1%.
  - ✓ A balance of $10 million.

Mortgage-Backed Securities Market

- **Dollar Rolls (cont'd)**
  - **Example (cont'd)**
  - ✓ Selling the July TBA and investing the proceeds:

$$\$10M \times (102.50 + 0.167)/100 = \$10,266,700$$

$$\$10,266,700 \times 1\% \times 31/360 = \$8,841$$

  - ✓ Purchasing the August TBA

$$\$10M \times (1 - 2\%) \times (102.15 + 0.167)/100 = \$10,027,066$$

  - ✓ Net proceeds from the roll are:

$$(\$10,266,700 + \$8,841) - \$10,027,066 = \$248,475$$

  - ✓ Had the investor not rolled, the net proceeds would have been the sum of Coupon and Principal Pay down, derived as:

$$\$10M \times (5\%/12 + 2\%) = \$241,667$$

  - ✓ The value of the roll: $248,475 - $241,667 = $6,808

Mortgage-Backed Securities Market

- **Valuing MBS**
  - Valuing MBSs can not use binomial model while the cash flows of MBSs are strongly linked to prepayment choose.
  - The most popular solution to pricing path-dependent claims is Monte Carlo simulation.
  - A mortgage security is valued using the Monte Carlo methodology by:
  - ✓ Modeling interest rate path and refinancing path.
  - ✓ Calculate the cash flows of the security along each path.
  - ✓ With forecast in each path, calculate the discounted value of the MBS's cash flows.
  - ✓ Compute the value of the MBS as the average of the discounted values across paths.

Mortgage-Backed Securities Market

- **Valuing MBS (cont'd)**
  - **Option-Adjusted Spread (OAS)**
  - ✓ When using simulation to derive the value of MBS, OAS is the yield spread which has to be added to a benchmark yield curve to discount MBS's payments to match its market price.
  - ✓ OAS is the most popular measure of relative value for MBS.
  - **OAS vs. Z-Spread**
  - ✓ **Zero-Volatility Spread (Z-Spread):** The spread is the parallel shift or spread over the zero-coupon Treasury yield curve required for discounting a pre-determined cash flow schedule to arrive at its present market price.
  - ✓ The implied cost of the embedded prepayment option is called option cost and it is equal to the difference between the OAS and z-spread.

Exercise 1

- A homeowner has a 30-year, 5% fixed rate mortgage with a current balance of USD 250,000. Mortgage rates have been decreasing. Which of the following is closest to the amount that the homeowner would save in monthly mortgage payments if the existing mortgage was refinanced into a new 30-year, 4% fixed rate mortgage?
  - A. USD 145
  - B. USD 150
  - C. USD 155
  - D. USD 160

- Correct Answer: B

Exercise 2

- A fixed-income portfolio manager purchases a seasoned 5.5% agency mortgage-backed security with a weighted average loan age of 60 months. The current balance on the loans is USD 20 million, and the conditional prepayment rate is assumed to be constant at 0.4% per year. Which of the following is closest to the expected principal prepayment this month?
  A. USD 1,000
  B. USD 7,000
  C. USD 10,000
  D. USD 70,000

- Correct Answer: B

Exercise 3

- An investor has financed a purchase of an MBS pool using a dollar roll valued at USD 10 million. The net proceeds of buying the January/February dollar roll are USD 133,000. The short-term (1-month) interest rate is 0.5%, and the expected total principal pay down is 1%. The current prices are in the table below:

FNMA 30-Year TBAs 4% Coupon	
Settlement	Price (USD)
15-Jan	102.00
15-Feb	101.73

If the February settlement price declined to USD 101.50, which of the following is true?
A. The dollar roll is trading below carry and the proceeds are higher.
B. The dollar roll is trading below carry and the proceeds are lower.
C. The dollar roll is trading above carry and the proceeds are higher.
D. The dollar roll is trading above carry and the proceeds are lower.

Financial Institutions

Topic 1: Central Counterparties

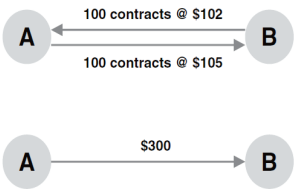
1. Exchanges and OTC Derivatives
2. Central Counterparty

Exchanges and OTC Derivatives

- **Exchange Market**
  - **Properties of Exchange Market**
  - ✓ An exchange is a central financial center where parties can trade standardized contracts such as futures and options at a specified price.
  - ✓ An exchange promotes market efficiency and enhances liquidity by centralizing trading in a single place.
  - **Clearing Function**
  - ✓ Clearing is the term that describes the reconciling and resolving of contracts between counterparties.
  - ✓ Exchanges have provided methods for improving 'clearing' and therefore mitigating counterparty risk.

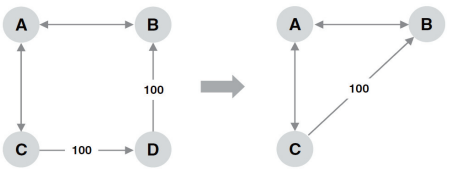
Exchanges and OTC Derivatives

- **Exchange Market (cont'd)**
  - **Three Forms of Clearing**
  - ✓ **Direct Clearing** refers to a bilateral reconciliation of commitments between the original two counterparties. In direct clearing original counterparties still have exposure to one another, albeit potentially reduced by methods such as payment of differences.



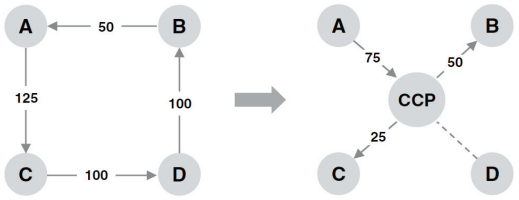
Exchanges and OTC Derivatives

- **Exchange Market (cont'd)**
  - **Three Forms of Clearing (cont'd)**
  - ✓ **Clearing Rings** were relatively informal means of reducing exposure via a ring of three or more members. In a clearing ring, groups of exchange members agree to accept each other's contracts and allow counterparties to be interchanged. Clearing rings clearly reduce counterparty risk. They also simplify the dependencies of a member's open positions and allow them to close out contracts more easily, increasing liquidity.



Exchanges and OTC Derivatives

- **Exchange Market (cont'd)**
  - **Three Forms of Clearing (cont'd)**
    - ✓ **Complete Clearing** the final stage in the development of clearing is complete clearing where a **CCP or 'clearinghouse'** becomes counterparty to all transactions. Complete clearing reduces counterparty risk further, as a member no longer needs to be concerned about the credit quality of its counterparty.



Exchanges and OTC Derivatives

- **OTC Markets**
  - **Properties of OTC Market**
    - ✓ The main **benefits** of OTC derivatives include customization of terms, settlement, and documentation, which are negotiated bilaterally between two parties.
    - ✓ A customized OTC derivative may be considered more useful for risk management than an exchange-traded derivative, which would give rise to additional 'basis risk'.
    - ✓ **Disadvantages** of OTC derivatives include bilateral credit risk, counterparty risk, difficulty in unwinding, assigning, or novating a transaction, and difficulty in clearing the generally longer maturity contracts.

Exchanges and OTC Derivatives

- **OTC Markets (cont'd)**
  - **5 Broad classes of OTC derivatives**
    - ✓ Interest rate, foreign exchange, equity, commodity, and credit derivatives.
    - ✓ Interest rate derivatives comprise the largest class, followed by foreign exchange derivatives and credit derivatives.
    - ✓ A key aspect of derivatives products is that their exposure is substantially smaller than that of an equivalent loan or bond.
    - ✓ Whilst most foreign exchange products are short-dated, the long-dated nature and exchange of notional in **cross-currency swaps** means they carry a lot of counterparty risk.
    - ✓ **Credit default swaps** not only have a large volatility component but also constitute significant 'wrong-way risk'.

Exchanges and OTC Derivatives

- **OTC Markets (cont'd)**
  - **Main Risk**
  - ✓ Counterparty Risk
  - ✓ Systemic Risk
  - **Risk Management of OTC Markets**
  - ✓ Netting agreements, margin requirements, periodic cash resettlement, and other forms of bilateral credit mitigation
  - SPVs, DPCs, monolines and CDPCs.
  - Ultimate solution to systemic risk: have the means in place to manage periodic failures in a controlled manner, which is one role of a CCP.

Central Counterparty

- **Central Counterparty**
  - **Clearing Members and Non-Members**
  - ✓ **General clearing member (GCM)**: able to clear for third parties, as well as their own trades.
  - ✓ **Individual clearing member (ICM)**: clear only their own trades.
  - ✓ **Non-clearing member (NCM)**: has no direct relationship with the CCP and therefore clears trades through a GCM.
  - ✓ Generally, only clearing members have a direct relationship with the CCP. Trades by NCMs ('clients') of GCMs must be guaranteed by a clearing member, and that clearing member is liable to the CCP for any outstanding payment obligations that its clients cannot satisfy.
  - ✓ If a CCP fails, a non-member may be able to avoid losses so long as its counterparty is solvent.

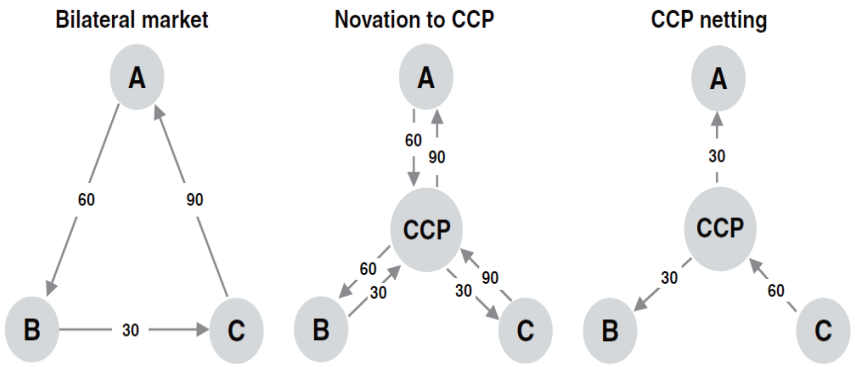
Central Counterparty

- **Central Counterparty (cont'd)**
  - **Mechanics of a CCP**
  - ✓ CCP can reduce the interconnectedness within financial markets, which may lessen the impact of an insolvency of a participant.
  - ✓ The CCP being at the heart of trading can provide more transparency on the positions of the members.
  - ✓ In the central clearing of **non-OTC trades**, the primary role of the CCP is to standardize and simplify operational processes. In contrast, **OTC CCPs** have a much more significant role to play in terms of counterparty risk mitigation.

Central Counterparty

- **Central Counterparty (cont'd)**
  - **Risk Management Function**
    - ✓ **Novation**
      - Replacement of one contract with one or more other contracts.
      - Novation means that the contract between the original parties ceases to exist and they therefore do not have counterparty risk to one another.
    - ✓ **Netting**
      - Involves offsetting of contracts, which is useful to reduce the exposure of counterparties and the underlying network to which they are exposed.
    - ✓ **Loss Sharing Model/Default Funds**
      - CCPs developed a loss sharing model. Losses above the resources contributed by the defaulter are shared between CCP members. Default fund is typically used after the defaulter's own resources to cover losses.

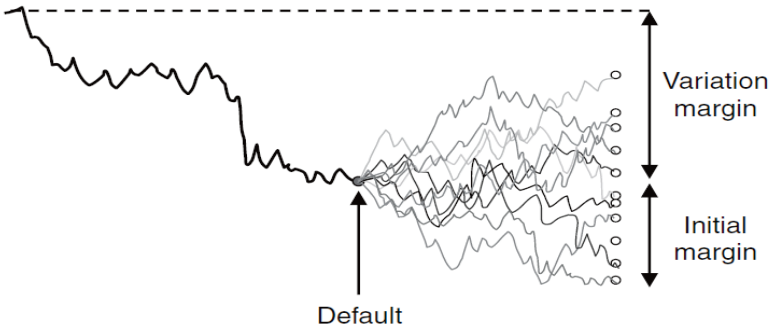
Central Counterparty



Central Counterparty

- **Central Counterparty (cont'd)**
  - **Risk Management Function**
    - ✓ **Margin Requirements**
      - Dynamic using daily mark-to-market valuation to define **variation margin** relating to daily payment of profits and losses, as well as **initial margin** to cover the potential close out cost of positions that a CCP could experience when a member defaulted.
      - Margin requirements by **CCPs** are in general much stricter than in bilateral **derivative markets**. Variation margin has to be transferred on a daily or even intra-daily basis, and must usually be in cash.
      - CCPs usually set margin levels solely on the risks of the transactions held in each member's portfolio.

Central Counterparty



Central Counterparty

- **Central Counterparty (cont'd)**
  - **Types of Risks Faced by CCPs**
  - ✓ **Default Risk**
  - Default of a clearing member and, more importantly, the possible associated or knock-on effects that this could cause.
  - Aftermath of a default event create further problems: Default or distress of other clearing members; Failed auctions; Resignations; Reputational.
  - ✓ **Liquidity Risk**
  - A CCP faces liquidity risk due to the large quantities of cash that flow through them due to variation margin payments and other cash flows.
  - In the event of a default, the CCP must continue to fulfil its obligations to surviving members in a timely manner.

Central Counterparty

- **Central Counterparty (cont'd)**
  - **Types of Risks Faced by CCPs (cont'd)**
  - ✓ **Model Risk**
  - Valuation models are required to mark-to-market products for **variation margin** purposes. The approaches for marking-to-market must be standard and robust across all possible market scenarios.
  - Most exposed to model risk via their **initial margin** approaches. Particular modelling problems could arise from misspecification with respect to volatility, tail risk, complex dependencies and wrong-way risk.
  - Another important feature of models is that they generally impose linearity. For example, model-based initial margins will increase in proportion to the size of a position. It is important in this situation to use additional components such as margin multipliers.

Central Counterparty

- **Central Counterparty (cont'd)**
  - **Types of Risks Faced by CCPs (cont'd)**
  - ✓ **Operational Risk**
  - CCPs are exposed to operational risks, such as systems failures and fraud.
  - ✓ **Legal Risk**
  - Aspects such as segregation and the movement of margin and positions can be subject to legal risk from laws in different jurisdictions.
  - ✓ **Investment Risk**
  - Losses from investments of cash and securities held as margin.
  - ✓ **Other risks**
  - Settlement and payment risk, foreign exchange risk, custody risk, concentration risk, sovereign risk, and wrong-way risk.

Central Counterparty

- **Central Counterparty (cont'd)**
  - **Lessons Learned from Prior CCP Failures**
  - ✓ Variation margins should be recalculated frequently and collected promptly (intradaily in volatile markets).
  - ✓ Initial margin and default funds should be resilient to large negative asset shocks or gaps in market variables and to extreme dependency.
  - ✓ A CCP should carefully monitor positions, penalize concentration and act quickly in the case of excessively large positions.
  - ✓ Operational risk must be controlled as much as possible.
  - ✓ A CCP should have availability to external liquidity sources since it could otherwise default due to being illiquid but not insolvent.

Central Counterparty

- **OTC Central Clearing**
  - **Advantages of OTC Central Clearing**
  - ✓ Transparency
  - ✓ Offsetting
  - ✓ Loss mutualisation
  - ✓ Legal and operational efficiency
  - ✓ Liquidity
  - ✓ Default management
  - **Disadvantages of OTC Central Clearing**
  - ✓ Moral hazard
  - ✓ Adverse selection
  - ✓ Bifurcations
  - ✓ Procyclicality

Central Counterparty

- **OTC Central Clearing (cont'd)**
  - **Impact of Central Clearing**
    - ✓ In accordance with a sort of conservation of risk principal, CCPs will not so much reduce counterparty risk but rather distribute it and convert it into different forms such as liquidity, operational and legal risks.
    - ✓ CCPs also concentrate these risks in a single place and therefore magnify the systemic risk linked to their own potential failure.
    - ✓ OTC markets have proved that they are a good source of financial innovation and can continue to offer cost-effective and well-tailored risk reduction products. There is a risk that mandatory central clearing has a negative impact on the positive role that OTC derivatives play.

Exercise 1

- There are four counterparties A, B, C and D, which are members of a derivatives exchange. C has a short derivative position with D, and D has a short derivative position with B. Which type of clearing will make the equivalent obligations between C and D and between D and B are replaced with a single obligation between C and B?
  - A. Direct Clearing
  - B. Complete Clearing
  - C. Clearing Ring
  - D. Bilateral Clearing

- Correct Answer: C

Financial Institutions

Topic 2: Banks

1. Financing Arrangements of Investment Banking
2. Originate-to-Distribute Model
3. Conflicts of Interest Problems
4. Banking Book vs. Trading Book
5. Capital Management
6. Deposit Insurance

Financing Arrangements of Investment Banking

- **Private Placement**
  - Securities are sold to small number of large institutional investors, such as life insurance companies/pension funds, and investment bank receives a fee.
- **Public Offering**
  - Securities are offered to the general public. A public offering may be on a **best efforts** or **firm commitment** basis.
  - ✓ **Best Efforts:** the investment bank does as well as it can to place the securities with investors and is paid a fee that depends, to some extent, on its success.
  - ✓ **Firm Commitment:** the investment bank agrees to buy the securities from the issuer at a particular price and then attempts to sell them in the market for a slightly higher price.

Financing Arrangements of Investment Banking

- **IPOs**
  - When the company wishing to issue shares is not publicly traded, the share issue is known as an initial public offering (IPO). These types of offering are typically made on a best efforts basis.
  - **Dutch Auction Approach**
  - ✓ A few companies have used a Dutch auction approach for their IPOs. As for a regular IPO, a prospectus is issued and usually there is a road show. Individuals and companies bid by indicating the number of shares they want and the price they are prepared to pay. Shares are first issued to the highest bidder, then to the next highest bidder, and so on, until all the shares have been sold. The price paid by all successful bidders is the lowest bid that leads to a share allocation.

Originate-to-Distribute Model

- **Characteristic**
  - Involves the bank originating but not keeping loans. Portfolios of loans are packaged into tranches which are then sold to investors.

  Also termed **securitization**.
- **Benefits**
  - By securitizing the loans it gets them off the balance sheet and frees up funds to enable it to make more loans.
  - It also frees up capital that can be used to cover risks being take elsewhere in the bank.
  - A bank can earn a further fee if it services the loan after it has been sold.
- **Drawbacks**
  - Banks may relax their mortgage lending standards and the credit quality of the instruments being originated may decline sharply.

Conflicts of Interest Problems

- **Potential Conflicts of Interest**
  - When asked for advice by an investor, a bank might be tempted to recommend securities that the investment banking part of its organization is trying to sell. When it has a fiduciary account (i.e., a customer account where the bank can choose trades for the customer), the bank can "stuff" difficult-to-sell securities into the account.
  - A bank, when it lends money to a company, often obtains confidential information. It might be tempted to pass that information to the mergers and acquisitions arm of the investment bank to help it provide advice to one of its clients on potential takeover opportunities.
  - The research end of the securities business might be tempted to recommend a company's share as a "buy" in order to please the company's management and obtain investment banking business.

Conflicts of Interest Problems

- **Potential Conflicts of Interest (cont'd)**
  - Suppose a commercial bank no longer wants a loan it has made to a company on its books because the confidential information it has obtained from the company leads it to believe that there is an increased chance of bankruptcy. It might be tempted to ask the investment bank to arrange a bond issue for the company, with the proceeds being used to pay off the loan. This would have the effect of replacing its loan with a loan made by investors who were less well-informed.
- **Recommend Solutions to the Potential Conflicts of Interest**
  - **Internal barriers (Chinese walls)** prohibit the transfer of information from one part of the bank to another. Violations of conflict-of-interest rules will lead to hefty fines and lawsuits.

Banking Book vs. Trading Book

- **Banking Book**
  - Includes loans made to corporations and individuals.
  - These are not marked to market.
  - A bank creates a reserve for loan losses. This is a charge against the income statement for an estimate of the loan losses that will be incurred.
- **Trading Book**
  - Includes all the assets and liabilities the bank has as a result of its trading operations.
  - The values of these assets and liabilities are marked to market daily.

Capital Management

- **Regulatory Capital**
  - Central bank regulators require banks to hold capital for the risks they are bearing. In 1988, international standards were developed for the determination of this capital.
  - Capital is required for three types of risk: credit risk, market risk, and operational risk. The time horizon used by regulators for considering losses from credit risks and operational risks is 1 year, whereas the time horizon for considering losses from market risks is usually much shorter.
- **Economic Capital**
  - This is the capital that the bank, using its own models rather than those prescribed by regulators, thinks it needs. Economic capital is often less than regulatory capital. However, banks have no choice but to maintain their capital above the regulatory capital level.

Deposit Insurance

- **Deposit Insurance:** To maintain confidence in banks, government regulators in many countries have introduced guaranty programs. These typically insure depositors against losses up to a certain level.
  - **Moral Hazard:** the possibility that the existence of insurance changes the behavior of the insured party.
  - ✓ Deposit insurance allowed banks to follow risky strategies that would not otherwise be feasible. Without it, a bank could not follow the strategy because their depositors would see what they were doing, decide that the bank was too risky, and withdraw their funds. With it, bank can follow the strategy because depositors know that, if the worst happens, they are protected under the deposit insurance.
  - ✓ The introduction of risk-based deposit insurance premiums has reduced moral hazard to some extent.

Financial Institutions

Topic 3: Insurance Companies

1. Categories of Insurance Companies
2. Life Insurance
3. Property-Casualty Insurance
4. Pension Plans
5. Risks Facing Insurance Companies
6. Regulatory Requirements

Categories of Insurance Companies

➢ **Various Categories of Insurance Companies**

- Insurance is usually classified as life insurance and nonlife insurance, with health insurance often being considered to be a separate category. Nonlife insurance is also referred to as property-casualty insurance.
- A **life insurance** contract typically lasts a long time and provides payments to the policyholder's beneficiaries that depend on when the policyholder dies.
- A **property-casualty insurance** contract typically lasts one year (although it may be renewed) and provides compensation for losses from accidents, fire, theft, and so on.
- A **pension plan** is a form of insurance arranged by a company for its employees. It is designed to provide the employees with income for the rest of their lives once they have retired.

Life Insurance

➢ **Valuation of Life Insurance Contracts**

- Mortality tables are the key to valuing life insurance contracts.

	Male			Female		
Age (Years)	Probability of Death within 1 Year	Survival Probability	Life Expectancy	Probability of Death within 1 Year	Survival Probability	Life Expectancy
0	0.006990	1.00000	75.90	0.005728	1.00000	80.81
1	0.000447	0.99301	75.43	0.000373	0.99427	80.28
2	0.000301	0.99257	74.46	0.000241	0.99390	79.31
3	0.000233	0.99227	73.48	0.000186	0.99366	78.32
…	…	…	…	…	…	…
90	0.168352	0.16969	4.02	0.131146	0.28649	4.85
91	0.185486	0.14112	3.73	0.145585	0.24892	4.50
92	0.203817	0.11495	3.46	0.161175	0.21268	4.19
93	0.223298	0.09152	3.22	0.177910	0.17840	3.89

Life Insurance

➢ **Valuation of Life Insurance Contracts (cont'd)**

- **Example**

✓ Assume interest rates for all maturities are 4% per annum (with semiannual compounding). Premiums are paid once a year at the beginning of the year. Given the above mortality tables, what is an insurance company's break-even premium for $100,000 of life insurance for a man of average health aged 90?

✓ **Scenario 1: Lasts 1 year. Payout occurs halfway through the year.**
Expected payout: 0.168352 × 100,000 = $16,835
Premium: 16,835/1.02 = $16,505

✓ **Scenario 2: Lasts 2 years. Payout in 1st year occurs halfway through the year. Payout in the 2nd year occurs at time 18 months.**

Life Insurance

➢ **Valuation of Life Insurance Contracts (cont'd)**

- **Example (cont'd)**

Present value of expected payout in the first year: $16,505

Probability that the policyholder dies during the second year is:

$(1 - 0.168352) \times 0.185486 = 0.154259$

Present value of expected payout in the second year:

$0.154259 \times 100{,}000/(1.02^3) = \$14{,}536$

Total present value of payouts is: $16,505 + $14,536 = $31,041

Present value of the premium payments is:

$X + (1 - 0.168352)X/(1.02^2) = 1.799354X$

The break-even annual premium is the value of X that solves:

$1.799354X = 31{,}041 \rightarrow X = \$17{,}251$

Life Insurance

➢ **Risks in Life Insurance**

- **Mortality Risk**
  - ✓ The risk that wars, epidemics such as AIDS, or pandemics such as Spanish flu will lead to people living not as long as expected.
  - ✓ This adversely affects the payouts on most types of life insurance contracts since the insured amount has to be paid earlier than expected.
- **Longevity Risk**
  - ✓ The risk that advances in medical sciences and lifestyle changes will lead to people living longer.
  - ✓ Increases in longevity increases the profitability of most life insurance contracts since final payout is either delayed or less likely to happen.
- **Hedging:** If the exposure in the insurance company is unacceptable, they may decide to enter into reinsurance contracts for some of the risks.

Property-Casualty Insurance

➢ **Key Indicators**

- **Loss Ratio**
  - ✓ Ratio of payouts made to premiums earned in a year.
- **Expense Ratio**
  - ✓ Ratio of expenses to premiums earned in a year.
  - ✓ The two major sources of expenses are loss adjustment expenses and selling expenses.
- **Combined Ratio**
  - ✓ Sum of the loss ratio and the expense.
  - ✓ Sometimes a small dividend is paid to policyholders. Ratios taking it into account is referred to as the combined ratio after dividends.
- **Operating Ratio**
  - ✓ Take investment income into account.

Property-Casualty Insurance

- **Key Indicators**

TABLE 3.2 Example Showing Calculation of Operating Ratio for a Property-Casualty Insurance Company

Loss ratio	75%
Expense ratio	30%
Combined ratio	105%
Dividends	1%
Combined ratio after dividends	106%
Investment income	(9%)
Operating ratio	97%

Pension Plans

- **Main Types**
  - **Defined Benefit Plan**
    - ✓ The pension that the employee will receive on retirement is defined by the plan.
    - ✓ Typically it is calculated by a formula that is based on the number of years of employment and the employee's salary.
  - **Defined Contribution Plan**
    - ✓ The employer and employee contributions are invested on behalf of the employee. When employees retire, there are typically a number of options open to them.

Pension Plans

- **Main Types (cont'd)**
  - **Key Difference between Defined Benefit and Defined Contribution**
    - ✓ In a **defined benefit plan**, all contributions are pooled and payments to retirees are made out of the pool. In a **defined contribution plan**, the funds are identified with individual employees. An account is set up for each employee and the pension is calculated only from the funds contributed to that account.
    - ✓ **Defined contribution plans** involve very little risk for employers. If the performance of the plan's investments is less than anticipated, the employee bears the cost. By contrast, **defined benefit plans** impose significant risks on employers because they are ultimately responsible for paying the promised benefits.

Risks Facing Insurance Companies

- **Moral Hazard**
  - Is the risk that the existence of insurance will cause the policyholder to behave differently than he or she would without the insurance.
  - **Deductible:** the policyholder is responsible for bearing the first part of any loss. **Co-insurance provision:** the insurance company pays a predetermined percentage (less than 100%) of losses in excess of the deductible. **Policy limit:** an upper limit to the payout.
- **Adverse Selection**
  - The problems an insurance company has when it cannot distinguish between good and bad risks. It offers the same price to everyone and inadvertently attracts more of the bad risks.
  - To lessen impact of adverse selection, insurance company tries to find out as much as possible about the policyholder before committing itself.

Regulatory Requirements

- **Regulatory Requirements in United States**
  - Insurance companies are regulated at the state level rather than the federal level.
  - In the case of banks, there is a permanent fund created from premiums paid by banks to the FDIC to protect depositors. In the case of insurance companies, there is no permanent fund. Insurance companies have to make contributions after an insolvency has occurred.
  - Some insurance companies trade derivatives in the same way as banks, but are not subject to the same regulations as banks.
- **Regulatory Requirements in Europe**
  - Insurance companies are regulated centrally.
  - The regulatory framework is known as Solvency II.

Financial Institutions

Topic 4: Mutual Funds and Hedge Funds

1. Mutual Funds Market
2. Hedge Funds Market
3. Hedge Funds Strategies

Mutual Funds Market

- **Different Types of Mutual Funds**
  - **Open-End Funds**
  - ✓ Total number of shares outstanding goes up as investors buy more shares and down as shares are redeemed. Shares in the fund can be bought from the fund or sold back to the fund at any time.
  - ✓ Fund manager calculating the market value of each asset in the portfolio so that the total value of the fund is determined. This total value is divided by the number of shares outstanding to obtain the value of each share. The latter is referred to as the **net asset value (NAV)** of the fund.
  - **Closed-End Funds**
  - ✓ Like regular corporations and have a fixed number of shares outstanding.
  - ✓ For closed-end funds, two NAVs can be calculated. One is the price at which the shares of the fund are trading. The other is the market value of the fund's portfolio divided by the number of shares outstanding. The latter can be referred to as the fair market value.

Mutual Funds Market

- **Different Types of Mutual Funds (cont'd)**
  - **Exchange-Traded Funds (ETFs)**
  - ✓ They often track an index and so are an alternative to an index mutual fund for investors who are comfortable earning a return that is designed to mirror the index.
  - ✓ An institutional investor deposits a block of securities with the ETF and obtains shares in the ETF (known as creation units) in return. Some or all of the shares in the ETF are then traded on a stock exchange. This gives ETFs characteristics of a closed-end fund rather than an open-end fund.
  - ✓ Institutional investors can give up shares they hold in the ETF and receive the assets or they can deposit new assets and receive new shares. This ensures that there's never any appreciable difference between the price at which shares in the ETF are trading and their fair market value. This is a key difference between ETFs and closed-end funds and makes ETFs more attractive to investors than closed-end funds.

Mutual Funds Market

- **Mutual Funds vs Hedge Funds**
  - **Mutual funds**, which are called "unit trusts" in some countries, serve the needs of relatively small investors, while **hedge funds** seek to attract funds from wealthy individuals and large investors such as pension funds.
  - **Hedge funds** are subject to much less regulation than mutual funds because they accept funds only from financially sophisticated individuals and organizations. This gives them a great deal of freedom to develop sophisticated, unconventional, and proprietary investment strategies. Hedge funds are sometimes referred to as alternative investments.
  - **Hedge funds** are free to use a wider range of trading strategies than mutual funds and are usually more secretive about what they do. **Mutual funds** are required to explain their investment policies in a prospectus that is available to potential investors.

Hedge Funds Market

- **Fee Structure**
  - An **annual management fee** that is usually between 1% and 3% of assets under management is charged.
  - An **incentive fee** that is usually between 15% and 30% of realized net profits is charged if the net profits are positive.
  - Thus, a typical hedge fund fee schedule might be expressed as "2 plus 20%" indicating that the fund charges 2% per year of assets under management and 20% of net profit.
  - The agreements offered by hedge funds may include clauses that make the incentive fees more palatable. For example:
  - ✓ Hurdle Rate
  - ✓ High-Water Mark Clause
  - ✓ Clawback Clause

Hedge Funds Market

- **Fee Structure (cont'd)**
  - **Hurdle Rate**
  - ✓ Minimum return necessary for the incentive fee to be applicable.
  - **High-Water Mark Clause**
  - ✓ Any previous losses must be recouped by new profits before an incentive fee applies.
  - ✓ There may be a proportional adjustment clause stating that, if funds are withdrawn by investors, the amount of previous losses that has to be recouped is adjusted proportionally.
  - **Clawback Clause**
  - ✓ Allows investors to apply part or all of previous incentive fees to current losses. A portion of the incentive fees paid by the investor each year is then retained in a recovery account. This account is used to compensate investors for a percentage of any future losses

Hedge Funds Market

- **Fee Structure (cont'd)**
  - **Example: Calculate the Return on a Hedge Fund Investment**
    Suppose that an investment is divided equally between two funds, A and B. Both funds charge 2 plus 20%. In the first year, Fund A earns 20% while Fund B earns –10%.
  - ✓ Average return on investment before fees:
    $0.5 \times 20\% + 0.5 \times (-10\%) = 5\%$
  - ✓ Fees paid to fund A:
    $2\% + (20\% - 2\%) \times 20\% = 5.6\%$
  - ✓ Fees paid to fund B:
    2%
  - ✓ Average fee paid on the investment in the hedge funds:
    $0.5 \times 5.6\% + 0.5 \times 2\% = 3.8\%$
  - ✓ The investor is left with a 1.2% return.

Hedge Funds Market

- **Historical Hedge Fund Performance**
  - **Prior to 2008**, hedge funds performed quite well.
  - **In 2008**, hedge funds on average lost money but provided a better performance than the S&P 500.
  - **During the years 2009 to 2013**, the S&P 500 provided a much better return than the average hedge fund.
- **Measurement Biases on Performance Measurement**
  - When returns are reported by a hedge fund, the database is usually backfilled with the fund's previous returns. This creates a bias in the returns that are in the data set because the hedge funds that decide to start providing data are likely to be the ones doing well. Small hedge funds and those with poor track records often do not report their returns and are therefore not included in the data set.

Hedge Funds Strategies

- **Long/Short Equity**
  - The hedge fund manager identifies a set of stocks that are considered to be undervalued by the market and a set that are considered to be overvalued. The manager takes a long position in the first set and a short position in the second set.
  - **Equity-Market-Neutral Fund**
  - ✓ **Dollar-neutral fund**: the dollar amount of the long position equals the dollar amount of the short position.
  - ✓ **Beta-neutral fund**: the weighted average beta of the shares in the long portfolio equals the weighted average beta of the shares in the short portfolio so that the overall beta of the portfolio is zero.
- **Dedicated Short**
  - Look exclusively for overvalued companies and sell them short.
  - They are attempting to take advantage of the fact that brokers and analysts are reluctant to issue sell recommendations.

Hedge Funds Strategies

- **Distressed Securities**
  - Bonds with a credit rating of CCC are referred to as "distressed". Typically, distressed bonds sell at a big discount to their par value and provide a yield that is over 10% more than the yield on Treasury bonds.
  - Bankruptcy proceedings usually lead to a reorganization or liquidation of a company. Managers of funds are searching for debt that is undervalued by the market.
  - Some funds are passive investors. They buy distressed debt when the price is below its fair value and wait. Other hedge funds adopt an active approach. They might purchase a sufficiently large position in outstanding debt claims so that they have the right to influence a reorganization proposal.

Hedge Funds Strategies

- **Merger Arbitrage**
  - Merger arbitrage involves trading after a merger or acquisition is announced in the hope that the announced deal will take place.
  - **Cash Deals**
  - ✓ *Example:* Suppose the shares of Company B were trading at $20 prior to the announcement. Immediately after the announcement its share price might jump to $28. Merger-arbitrage hedge funds buy the shares in company B for $28 and wait. If the acquisition goes through at $30, the fund makes a profit of $2 per share. If it goes through at a higher price, the profit is higher. However, if for any reason the deal does not go through, the hedge fund will take a loss.

Hedge Funds Strategies

- **Merger Arbitrage (cont'd)**
  - **Share-for-Share Exchanges**
  - ✓ *Example:* Suppose that Company A announces that it is willing to exchange one of its shares for four of Company B's shares. Assume that Company B's shares were trading at 15% of the price of Company A's shares prior to the announcement. After the announcement, Company B's share price might rise to 22% of Company A's share price. A merger-arbitrage hedge fund would buy a certain amount of Company B's stock and at the same time short a quarter as much of Company A's stock. This strategy generates a profit if the deal goes ahead at the announced share-for-share exchange ratio or one that is more favorable to Company B.

Hedge Funds Strategies

- **Convertible Arbitrage**
  - **Convertible bonds** are bonds that can be converted into the equity of the bond issuer at certain specified future times with the number of shares received in exchange for a bond possibly depending on the time of the conversion.
  - The issuer usually has the right to call the bond in certain circumstances.
  - Many convertible bonds trade at prices below their fair value. Hedge fund managers buy the bond and then hedge their risks by shorting the stock (delta hedging). Interest rate risk and credit risk can be hedged by shorting nonconvertible bonds that are issued by the company that issued the convertible bond.

Hedge Funds Strategies

- **Fixed Income Arbitrage**
  - **Relative value strategy**: hedge fund managers buy bonds that the zero-coupon yield curve indicates are undervalued by the market and sell bonds that it indicates are overvalued.
  - **Market-neutral strategies** are similar to relative value strategies except that the hedge fund manager tries to ensure that the fund has no exposure to interest rate movements.
  - Some fixed-income hedge fund managers follow **directional strategies** where they take a position based on a belief that a certain spread between interest rates, or interest rates themselves, will move in a certain direction.

Hedge Funds Strategies

- **Emerging Markets**
  - Emerging market hedge funds specialize in investments associated with developing countries.
  - Some of these funds focus on equity investments. Usually they invest in securities trading on the local exchange, but sometimes they use American Depository Receipts (ADRs). ADRs are certificates issued in the United States and traded on a U.S. exchange. They are backed by shares of a foreign company.
  - Another type of investment is debt issued by an emerging market country. Eurobonds are bonds issued by the country and denominated in a hard currency such as the U.S. dollar or the euro. Local currency bonds are bonds denominated in the local currency.

Hedge Funds Strategies

- **Global Macro**
  - Global macro hedge fund managers carry out trades that reflect global macroeconomic trends.
  - They look for situations where markets have, for whatever reason, moved away from equilibrium and placed large bets that they will move back into equilibrium.
- **Managed Futures**
  - Hedge fund managers that use managed futures strategies attempt to predict future movements in commodity prices.
  - Some managers base their trading on technical analysis, which analyzes past price patterns to predict the future. Others use fundamental analysis, which involves calculating a fair value for the commodity from economic, political, and other relevant factors.