Financial Markets & Products

Exam Weight: 30%

Contents

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Study Guide Change

与2016年相比，2017年的考纲变化如下：

1、增加了financial institution的部分，Banks/Insurance Company/Funds为完全新加入的知识章节。

2、commodity forward部分加入新的要求，学会计算commodity spread。

3、rating agency的部分不再做要求，相关知识点被剔除出2017年考试范围。

Contents

Chapter 1

Banks

Learning Objectives

- Identify the major risks faced by a bank.
- Distinguish between economic capital and regulatory capital.
- Explain how deposit insurance gives rise to a moral hazard problem.
- Describe investment banking financing arrangements including private placement, public offering, best efforts, firm commitment, and Dutch auction approaches.

Learning Objectives

- Describe the potential conflicts of interest among commercial banking, securities services, and investment banking divisions of a bank and recommend solutions to the conflict of interest problems.
- Describe the distinctions between the “banking book” and the “trading book” of a bank.
- Explain the originate-to-distribute model of a bank and discuss its benefits and drawbacks.

Banks

Commercial Banking

- Commercial banking, including retail banks and wholesale banks in virtually all countries has been subject to a great deal of regulation.
- This is because almost all governments consider it important that individuals and companies have confidence in the banking system.

Banks

Risks Facing by Banks

- **Market Risk**: risk relating to possibility that instruments in trading book will decline in value.
- **Credit Risk:** risk that counterparties in loan transactions and derivative transactions will default.
- **Operational Risk:** risk that losses are made because internal systems fail to work as they supposed to or because of external events, which is also the biggest risk facing banks.

Banks

Capital requirements of commercial banks

- **Economic Capital**: Economic capital is the amount of capital estimated using a bank's own model, which is often less than regulatory capital.
- **Regulatory Capital**: The capital which financial regulators require banks to hold for supervision and systemic safety.
  - ✓ Two tiers in Basel III. Equity capital is categorized as "Tier 1 capital", subordinated long-term debt is categorized as " Tier 2 capital".

Banks

Deposit Insurance

- A tool which governments regulators introduced to maintain individuals' confidence in banks.
- Typically insure depositors of banks against losses up to a certain level. e.g. 500 thousand Yuan in China.
- Although these tools give some protections to depositors , also give rise to more moral hazards from banks.
  - ✓ Depositors pay less attention to banks' financial condition under the deposit insurance system.

Banks

Deposit Insurance(cont.)

- The existence of deposit insurance allow banks to follow risky strategies that would not otherwise feasible.
- For example: Bank can increase deposit base by offering high rates to depositors and use the funds to make risky loans. This behavior is a typical example of **moral hazard.**
  - ✓ Risk-based deposit insurance premiums is used to reduce moral hazard to some extent.

Banks

Investment Banking

- Raising debt and equity financing for corporations or governments. Form and price is negotiated between bank and entities.
- Investment bank's role in this funding activity involves: originating the securities, underwriting them and then placing them with investors, where a " road show" introduced.

Banks

Investment Banking(cont.)

- Private Placement: securities are sold to a small number large institutional investors, e.g. life insurance company, pension funds and mutual funds.
- Public offering: securities are offered to the general public, specific arrangements include **best effort** and **firm commitment**.

Banks

Investment Banking(cont.)

- Best effort: investment bank does well to sell the securities and receive a fee depends on its success. **Work as a broker.**
- Firm commitment: investment bank agrees to buy the securities at a particular price and attempt sell to the market to make a profit bearing the risk of inventory. **Work as a dealer.**

Banks

Best Effort & Firm Commitment

- A bank has agreed to underwrite an issue of 50 million shares by ABC corp. In negotiation, the target price to be received by ABC is set at $30 per share. In best effort arrangement bank receive $0.3 per share sold. Alternatively, bank can also buy the shares at $30 per share from ABC. If the price scenario for selling the securities include $29 or $32. What is the profit bank can make from this deal.

Banks

Initial Public Offering (IPO)

- Dutch Auction sometimes is used in offering the securities to publics in IPO.
- **Dutch Auction:** 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 through bidding process.

Banks

Dutch Auction

- A company wants to sell one million shares in an IPO through Dutch Auction. The price paid by all investors allocated with shares is $29.00.

Bidder	Number of shares	Price
A	100,000.00	US$30.00
B	200,000.00	US$28.00
C	50,000.00	US$33.00
D	300,000.00	US$29.00
E	150,000.00	US$30.50
F	300,000.00	US$31.50
G	400,000.00	US$25.00
H	200,000.00	US$30.25

Banks

Dutch Auction

Bidder	Number of Shares	Cumulative Number of Shares	Price
C	50,000	50,000	33.00
F	300,000	350,000	31.50
E	150,000	500,000	30.50
H	200,000	700,000	30.25
A	100,000	800,000	30.00
D	300,000	**1,100,000**	**29.00**

Banks

Potential conflicts

- Many conflicts may arise between commercial banking, securities services and investment banking when they are under the same umbrella.
  - ✓ The “advisor” is also the “seller” problem.
  - ✓ Pass inside information from lending arm to M&A arm.
  - ✓ Research independence is in question for companies investment bank want to have business with.
  - ✓ Dump the “garbage” on the banking book through investment bank.

Banks

Accounting

- **Banking Book:** include loans made to corporations and individuals. These value are not mark to market. Loan loss and reserve is introduced.
  - ✓ Smoothing rule is used in income statement management.
  - ✓ Rescheduling the debt.
- **Trading Book:** include all the assets and liabilities formed in the trading operations. The value of these assets and liabilities are marked to market daily or marked to model when there's no liquid market.

Banks

Originate-to-distribute Model

- It's also called **securitization.**
- Securitized assets include: mortgage loans, student loans, commercial mortgages, residential mortgages and credit card receivables.
- SPE plays a key role this securitization process.
  - ✓ During last financial crisis, GNMA, FNMA, FHLMC buy pools of mortgages from banks and other mortgage originators, repackage the cash flow streams and sell them to investors worldwide.

Summary

- Banks

  Major risks

  Economic capital and regulatory capital

  Deposit insurance

  Dutch auction

  Potential conflicts

- Exam Tips

  本章知识点以定性判别为主，理解的难度不大，从考试角度讲需要明确各个名词概念指的是什么。

  Dutch Auction的部分会涉及到一些计算，但是难度较小，需要搞清楚判别的规则。

Practice 1

- Based on a bank's own estimates, models and risk assessments, the minimum level of capital it needs to maintain is usually described as:

  A. economic capital.

  B. financial capital.

  C. fixed capital.

  D. regulatory capital.

- Answer: A
- Economic capital is from bank's own assessment and is often less than regulatory capital, which is the minimum level a bank must hold to comply with capital adequacy regulations.

Practice 2

- If an investment bank wants to earn a trading profit from buying at a lower price and selling at a higher price for some securities, this investment bank needs to arrange which kind of business?

  A. best efforts offering.

  B. firm commitment offering.

  C. Dutch auction.

  D. private placement.

Practice 2

- Answer: B
- With a firm commitment offering, an investment bank buys an entire issue of securities from the issuer and attempts to sell them to the public at a higher price. In a private placement or a best efforts offering, an investment bank earns fee income rather than trading income. A Dutch auction is a method of price discovery for an initial public offering that does not involve buying and reselling shares.

Practice 3

- Which actions have the most probability on moral hazard?

  A. Banks increase loans to higher-risk borrowers.

  B. Deposit insurers charge risk-based premiums.

  C. Governments implement deposit insurance programs.

  D. Banks increase the interest rates they offer to depositors.

- Answer: A

- Due to the deposit insurance program, banks tend to supply more loans to risker borrowers to earn higher return.

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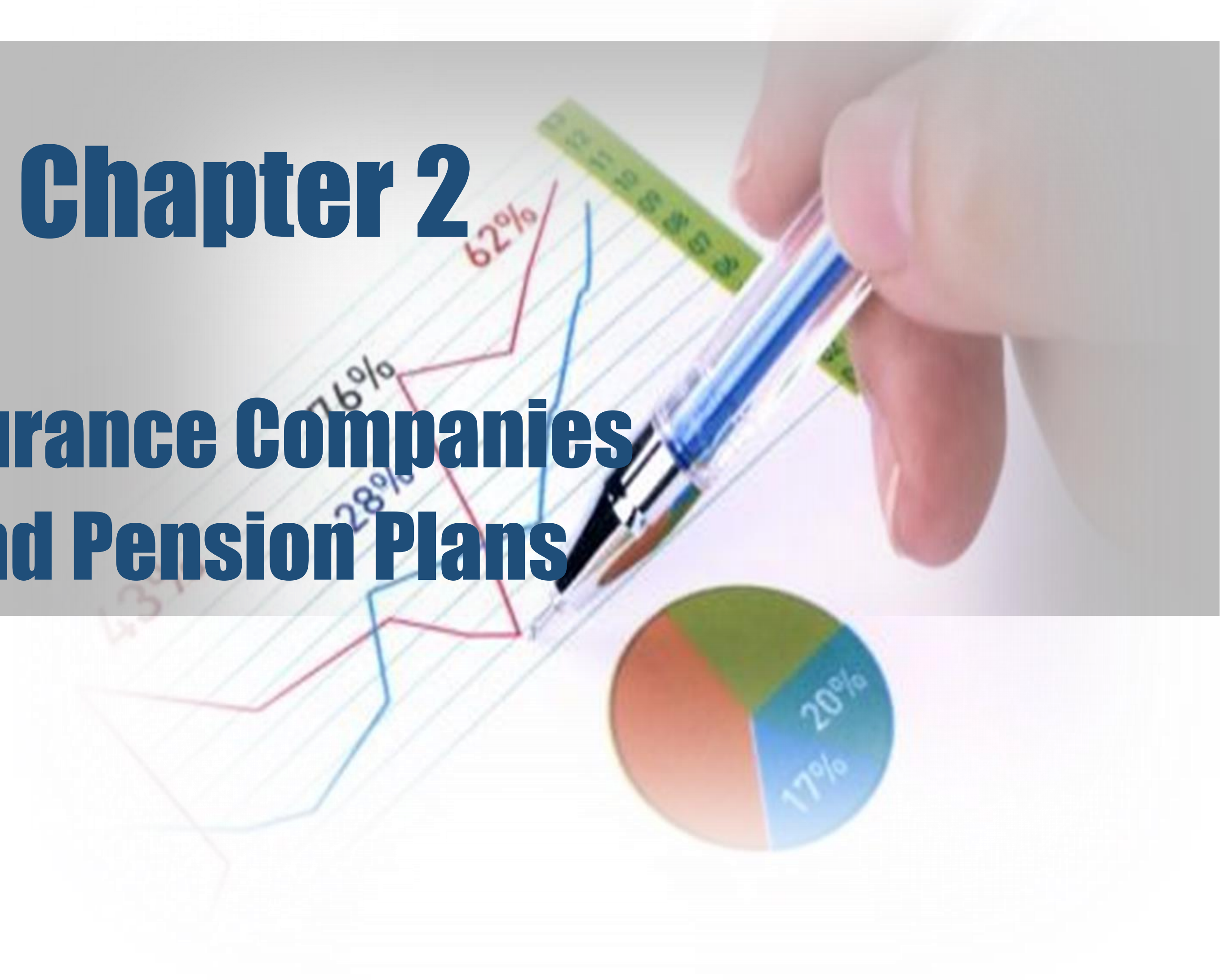
2. Insurance Companies and Pension Plans

3. Mutual Funds and Hedge Funds

Chapter 2

Insurance Companies and Pension Plans



Learning Objectives

- Describe the key features of the various categories of insurance companies and identify the risks facing insurance companies.
- Describe the use of mortality tables and calculate the premium payment for a policy holder.
- Calculate and interpret loss ratio, expense ratio, combined ratio, and operating ratio for a property-casualty insurance company.
- Describe moral hazard and adverse selection risks facing insurance companies, provide examples of each, and describe how to overcome the problems.

Learning Objectives

- Distinguish between mortality risk and longevity risk and describe how to hedge these risks.
- Evaluate the capital requirements for life insurance and property-casualty insurance companies.
- Compare the guaranty system and the regulatory requirements for insurance companies with those for banks.
- Describe a defined benefit plan and a defined contribution plan for a pension fund and explain the differences between them.

Insurance Company

Category of Insurance Company

- **Life Insurance:** Provide payments to policyholder's beneficiaries that depend on when policyholder dies. Typically last a long time.
- **Nonlife Insurance:** property-casualty insurance, it provides compensation for losses from accidents, fire, theft and so on.
- **Health Insurance:** Have some of the attributes of other two categories, but considered as a different group.

Insurance Company

Life Insurance Contracts

- Term Life Insurance
- Whole Life Insurance
- Variable Life Insurance
- Universal Life Insurance
- Variable-Universal Life Insurance
- Endowment Life Insurance
- Group Life Insurance

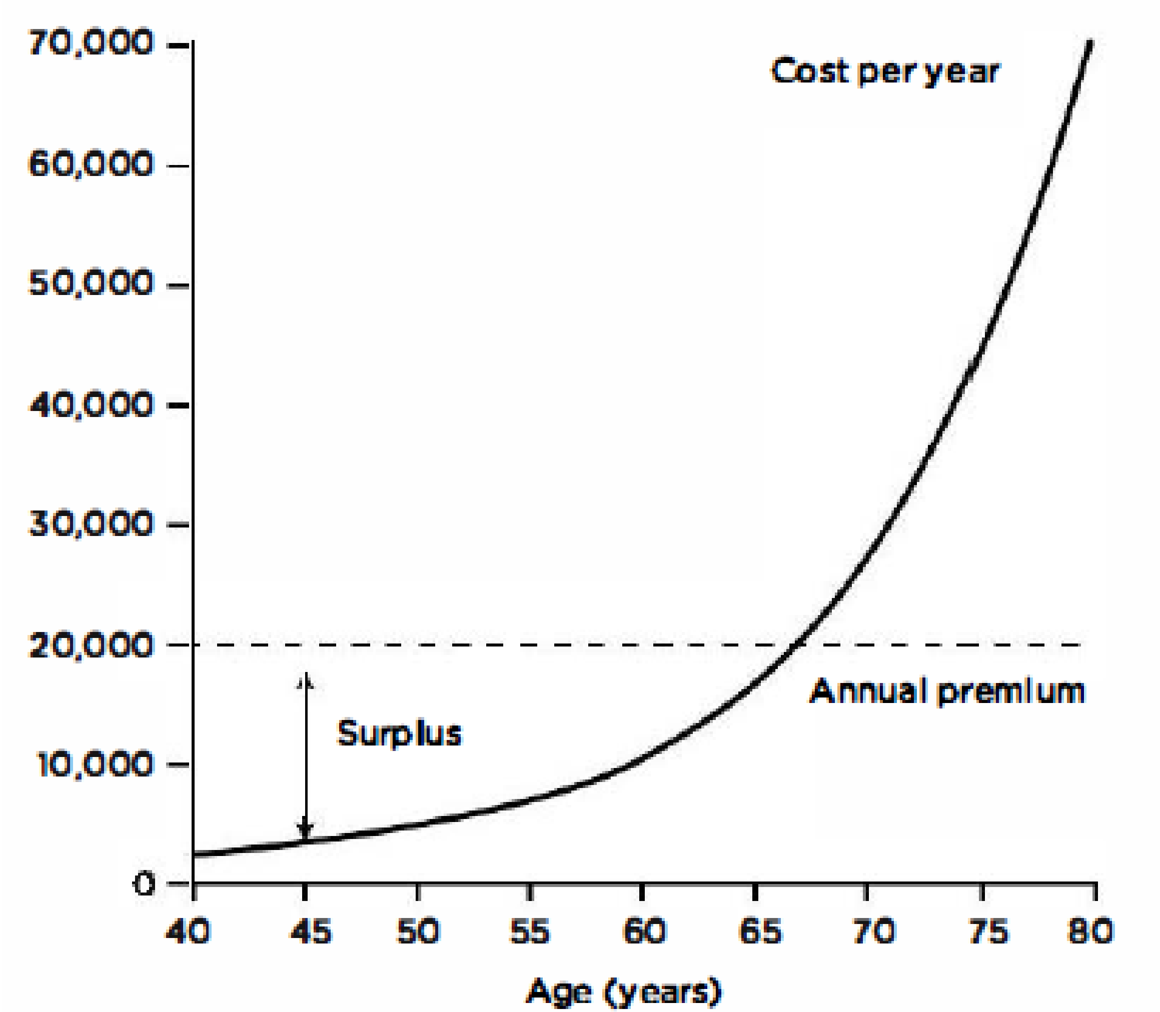
Insurance Company

Life Insurance Contracts(cont.)

- **Term Life Insurance:** Last a predetermined number of years. Make **face value amount** if policyholder dies within term. No payment made in the opposite occasion**. Mortgage funding.**
- **Whole Life Insurance:** Provides protection **for the life of** policyholder. Policyholder makes regular considerably higher premiums until death. **Payout is certain. May redeem early and use it as collateral. Surplus premiums** in early years are invested to fund later deficit. Tax advantage.

Insurance Company

Surplus premium & deficit



Insurance Company

Whole Life Insurance(cont.)

- **Variable Life Insurance:** Surplus premiums are invested in a fund chosen by policyholder. Minimum payout on death guaranteed, receive more if fund perform well.
- **Universal Life Insurance:** Minimum payout guaranteed. It can reduce the premium down to a specified minimum without policy lapsing. Surplus premium invested in fixed income products. Two payment options.
- **Variable-Universal Life Insurance:** A number of alternative investments available. It also can reduce the premium down to a specified minimum without policy lapsing.

Insurance Company

Life Insurance Contracts(cont.)

- **Endowment Life Insurance**: It lasts for a specified period and pays a lump sum when the policyholder dies or at the end of period. Payout can be with-profit. **Pure endowment** pays only if policyholder survive to the end of the life of policy.
- **Group Life Insurance:** It covers many people under a single policy. Premium payment can be contributory and noncontributory. Medical test is not necessary.

Insurance Company

Annuity Contracts

- Life insurance contract has the effect of converting regular payments into a lump sum, annuity contract has the opposite effect.
- It starts at a particular date and last for the rest of policyholder's life.
- Tax deferral advantages.
- Option might be embedded.

Insurance Company

Mortality Table

	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	0.9939	79.31
3	0.000233	0.99227	73.48	0.000186	0.99366	78.32
…	…	…	…	…	…	…
…	…	…	…	…	…	…
80	0.061620	0.49421	8.10	0.043899	0.62957	9.65
81	0.068153	0.46376	7.60	0.048807	0.60194	9.07
82	0.075349	0.43215	7.12	0.054374	0.57256	8.51
83	0.083230	0.39959	6.66	0.060661	0.54142	7.97
…	…	…	…	…	…	…
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

Insurance Company

- **Calculation on mortality table**
- The third column of the table shows that the probability of a man surviving to 90 is 0.16969. The probability of the man surviving to 91 is 0.14112.
- It follows that the probability of a man dying between his 90th and 91st birthday is 0.16969 - 0.14112 = 0.02857.
- Conditional on a man reaching the age of 90, the probability that he will die in the course of the following year is 0.02857/0.16969 = 0.1684, which is consistent with the number in the second column.

Insurance Company

- **Example of Breakeven premium payment**
- Based on the mortality table, with the interest rate is 4% and semiannual compounding, a 80-year-old woman has a \$1 million term insurance breakeven premium with the payouts halfway in the year.
- Calculate the insurance breakeven premium for a one-year.
- Answer
- Expected payout is $0.043899 \times \$1{,}000{,}000 = \$43{,}899$
- Breakeven premium is $\frac{43{,}899}{1.02} = 43{,}038.24$

Insurance Company

- **Example of Breakeven premium payment**
- With the information above, caculate the insurance breakeven premium for this woman for 2-year term.
- Answer:
- step 1: caculate the probability of death in the second year.

$$(1-0.043899)\times 0.048807=0.046665$$

- step2: calculate the expected payout and expected premium.
- Expected payout is $0.046665\times \$1{,}000{,}000=\$46{,}665$
- Breakeven premium is $\frac{46{,}665}{1.02^3}=\$43{,}973.47$

Insurance Company

- **Example of Breakeven premium payment**
- Step 3: Calculate total present value of payouts.
- 43,038.24 + 43,973.47=87,011.71
- Step 4: Analyze the payment occurrence.
- First premium payment is certain to be received, but only if this woman survived in the second year, the second premium payment could be received, which is $1 - 0.043899 = 0.956101$
- Using Y as the breakeven premium, the present value of premium payments is $Y + \frac{0.956101Y}{1.02^2} = 1.918974Y$

Insurance Company

- **Example of Breakeven premium payment**
- step 5: let the breakeven annual premium equate the present value of the payouts.
- 87,011.71=1.918974Y
- Solve the equation, Y=$45,342.83

Insurance Company

Longevity and Mortality Risk

- **Longevity Risk:** People live longer due to medical science and lifestyle changes, adversely affect the profitability of most annuity contracts, but increase the profitability of most life insurance contracts.
- **Mortality Risk:** A risk that epidemics, wars will lead to people living not as long as expected, effects on annuity contracts and life insurance are just the opposite.
  - ✓ Derivatives(survivor bond) and reinsurance can be used to manage those two risks.

Insurance Company

Property-Casualty Insurance

- **Property Insurance:** provide protection against loss or damage to property. E.g. fire, water.
- **Casualty Insurance:** provide protection against legal liability exposures. E.g. injuries caused to third parties.
  - ✓ Derivatives , like CAT bonds are used to hedge catastrophic risk.

Insurance Company

Ratios Calculated by Property-Casualty Insurers

- **Loss Ratio**=payouts/premiums earned, typically 60%-80%.
- **Expense Ratio**=expenses/premiums earned, selling expenses and loss adjustment expense are two major expenses.
- **Combined Ratio**= Expense Ratio + Loss Ratio
- **Combied Ratio after dividend**=Combined Ratio+ Dividend
- **Operating Ratio**=Combined Ratio after dividends-Investment Income(%)=Combined Ratio+dividend-Investment Icome

Insurance Company

Health Insurance

- Like other forms of insurance, policyholder makes regular premium payments and payouts are triggered by events. E.g. body examinations, treatment or prescription medication.
- It is like life insurance that reassessment of risk does not lead premium increase, but overall costs of meeting claims do lead to premium increases.

Insurance Company

Moral Hazard and Adverse Selection

- **Moral Hazard:** Risk that the existence of insurance will cause the policyholder to behave differently than he would without the insurance. E.g. car theft, health care demanding, deposit insurance.
  - ✓ Deductible, co-insurance provision, and policy limit
- **Adverse Selection:** It's a phrase to describe the problems an insurance company has when it cannot distinguish between good and bad risks.
  - ✓ More information before setting the contracts

Insurance Company

Capital Requirements

Life Insurance Company Balance Sheet:

Assets		Liabilities and Net Worth	
Investments	90	Policy reserves	80
Other assets	10	Subordinated long-term debt	10
		Equity capital	10
Total	100	Total	100

Property-Casualty Insurance Company Balance Sheet:

Assets		Liabilities and Net Worth	
Investments	90	Policy reserves	45
Other assets	10	Unearned premiums	15
		Subordinated long-term debt	10
		Equity capital	30
Total	100	Total	100

Insurance Company

Pension Plans

- **Defined Benefit Plan:** Employee will receive on retirement is defined by the plan. There's no independent account for each individual, contributions and funds are managed in a pool.
- **Defined Contribution Plan:** Employee and employer contributions are invested on behalf of the employee. An account is set up for each employee, investment alternative are available to be chosen by employee. E.g. 401K

Insurance Company

Risks Facing Insurance Companies

- Policy reserve shortfall risk
- Investment performance risk
- Liquidity risk
- Credit risk
- Operational risk
- Business risk

Insurance Company

Regulations

- **Europe:**

✓ Central regulation.

- **US:**

✓ State regulation.

✓ Contributions have to be made after insolvency occurred in guaranty system, unlike banks.

Summary

✓ Insurance

Life insurance
Property-casualty insurance
Health insurance
Mortality table
Break-even premiums
Property-casualty ratios
Moral Hazard and adverse selection

✓ Exam Tips

1. 首要是分清每个险种之间的区别，切勿搞混淆
2. Insurance Premium 计算会是本章计算考察的一个难点，尤其是基于mortality table试算break-even premium。
3. 其余知识点以定性介绍为主，只需明确概念的内涵即可

Practice 1

- Compared with other kinds of insurance companies, life insurance companies have their specific considerations. What is the problem for life insurance companies leading to differentiating between good risks and bad risks?
- A. Longevity risk.
- B. Catastrophic risk.
- C. Adverse selection.
- D. Moral hazard.

Practice 1

- ✓ Answer: C.
- ✓ Adverse selection happens before action making. In other word, a lack of clear differentiation determines adverse selection. Those who fall sick easily tend to buy insurance is an example of adverse selection. Moral hazard happens after action making. In other word, one with insurance contract is becoming indifferent to the risks insured.

Practice 2

- ✓ A property and casualty (P&C) insurance company has following information:

  Investment income 5%

  Dividends 2%

  Loss ratio 71%

  Expense ratio 25%

Based on the information provided, what is this company's operating ratio?

- ✓ A. 89%. B. 93%. C. 96%. D. 98%.

Practice 2

- Answer: B
- The operating ratio is computed as follows: loss ratio (71%) + expense ratio (25%) + dividends (2%) - investment income (5%) = 93%
- The combined ratio is computed as follows: loss ratio (71%) + expense ratio (25%) = 96%
- The combined ratio after dividends is computed as follows: loss ratio (71%) + expense ratio (25%) + dividends (2%) = 98%

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3. Mutual Funds and Hedge Funds

Chapter 3

Mutual Funds and Hedge Funds

Learning Objectives

- Differentiate among open-end mutual funds, closed-end mutual funds, and exchange-traded funds (ETFs).
- Calculate the net asset value (NAV) of an open-end mutual fund.
- Explain the key differences between hedge funds and mutual funds.
- Calculate the return on a hedge fund investment and explain the incentive fee structure of a hedge fund including the terms hurdle rate, high-water mark, and clawback.

Learning Objectives

- Describe various hedge fund strategies, including long/short equity, dedicated short, distressed securities, merger arbitrage, convertible arbitrage, fixed income arbitrage, emerging markets, global macro, and managed futures, and identify the risks faced by hedge funds.
- Describe hedge fund performance and explain the effect of measurement biases on performance measurement.

Mutual Funds and Hedge Funds

Mutual Funds

✓ Growth of Assets of Mutual Funds in US

Year	Asset($ billions)
1940	0.5
1960	17
1980	134.8
2000	6964.6
2014	15196.2

✓ Three main type of long-term funds

- Bond funds
- Equity funds
- Hybrid funds

Mutual Funds and Hedge Funds

Mutual Funds(cont.)

- **Open-end fund:** Total number of shares outstanding goes up as investors buy more shares and down as shares redeemed **at next-calculated NAV.**
- **Close-end fund:** Like regular corporations and have fixed number of shares outstanding. Two NAV calculated(trading share price and fair portfolio market value).
- **ETF:** traded like close-end fund. Institutional investors can exchange shares with underlying assets. Small difference between share price and fair market value.

Mutual Funds and Hedge Funds

NAV

$$\text{NAV} = \frac{\text{funds assets} - \text{fund liabilities}}{\text{total shares outstanding}}$$

- For open-end funds, NAV could be only calculated after the close of trading days.
- For closed-end funds and ETFs, NAV would be calculated continuously during the time of trading.

Mutual Funds and Hedge Funds

	Mutual Fund	Hedge Fund
NAV calculation	Daily	Longer period
Investment policy	Full disclosure	Not full disclosure
Leverage	Limited use	High leverage
Redeemability	Redeemable at any time	Usually lock-up period exists

Mutual Funds and Hedge Funds

Hedge Funds

- Huge differences with mutual funds lie on
- ✓ **Regulation**
  - ✓ Share be redeemable at any time
  - ✓ NAV be calculated daily
  - ✓ Investment policies be disclosed
  - ✓ The use of leverage be limited
- ✓ **Fees structure**
  - ✓ Higher management fee
  - ✓ Incentive fee

Mutual Funds and Hedge Funds

Hedge Fund Fees

- Management Fees(1%-3%,typically 2%)
- Incentive Fees(typically 15%-30% plus of max(RNP,0))
- ✓ 2 plus 20%
- Hurdle Rate
- High-water mark clause
- Clawback clause

Mutual Funds and Hedge Funds

- **Example**
- A hedge fund takes “2 plus 20%” fees structure, with hurdle rate 6% and management fees on the beginning gross asset. The beginning gross asset is 100 million in the first year. If the ending gross asset for 3 consecutive years is 130 million, 135 million and 140 million.
- Calculate the management fees, incentive fees and end value after all fees for investors for the three years.

Mutual Funds and Hedge Funds

Hedge Fund Fees Calculation

Years	Beginning Gross NAV (million)	Ending Gross NAV (million)	Management Fee (million)	Incentive Fee (million)	End value net-of fee (million)
1	$100	$130	= 2%*100 = $2	= 20% of (130-100-2-6%*100)=$4.4	= 130-2-4.4 = $123.6 Net of fee returns = 23.6%
2	$130	$135	= 2%*123.6 = $2.472	= 20% of (135-123.6-2.472-6%*123.6) = 0.3024	= 135-2.472-0.3024 = 132.225
3	$135	$140	=2%*132.225 = $2.644	= 20% of (140-132.225-2.644-6%*132.225) = -0.56	= $140-2.644 = $137.356

Mutual Funds and Hedge Funds

Hedge Fund Strategies

- Long/Short Equity
- Dedicated Short
- Distressed Securities
- Merger/Fixed Income/Convertible Arbitrage
- Emerging Markets
- Global Macro
- Managed Futures

Mutual Funds and Hedge Funds

Hedge Fund Performance

Year	Hedge Fund Index	S&P 500 Including Dividends
2008	-15.66%	-37%
2009	18.57%	26.46%
2010	10.95%	15.06%
2011	-2.52%	2.11%
2012	7.67%	16%
2013	9.73%	32.39%

- Measurement Bias
- ✓ Survivorship bias: overestimate return of industry
- ✓ Backfill bias: backfill only good strategies
- ✓ Stale price bias: underestimate volatility
- ✓ Self-selection bias: only good players choose to report

Summary

- Mutual fund and Hedge fund
  - Mutual fund
  - Hedge fund fee
  - Hedge fund strategy

- Exam Tips
  1. 本章的重要计算难点在于hedge fund的after-fee return的计算，需要明确NAV、management fee、hurdle rate和incentive fee之间的关系
  2. 够辨析Hedge Fund的策略

Practice 1

Which of following comments is incorrect on mutual funds?

- A. Open-end mutual funds always transact at the next available net asset value.
- B. Stop orders can be used on closed-end funds.
- C. Short selling is available for some exchange-traded funds.
- D. Open-end mutual funds can be purchased with a limit order.

Practice 1

Answer: D.

- Open-end mutual funds could be applied for purchase or redeem at the next NAV. While closed-end mutual funds have the similar transaction method as stocks, which have stop orders, limit order and short selling.

Practice 2

- What is the expected return to a hedge fund if the fund uses a standard 2 and 20 incentive fee structure with an investment that has a 30% probability of making 62% and a 70% probability of losing 15%?
- A. 5.71%.
- B. 6.12%.
- C. 3.78%.
- D. 5.60%.

Practice 2

- Answer: D.
- Based on 2 and 20, the hedge fund could earn 14% [2% (flat fee) + 0.20 x 60% (incentive fee)], and the incentive fees should the number above 2% (flat fee). After that, we can get the expected payoff is that 30% x 14% + 70% x 2% = 5.60%.

Practice 3

- Which type of hedge fund focuses on mispricings in foreign interest rates?
- A. Convertible arbitrage hedge funds.
- B. Managed futures hedge funds.
- C. Global macro hedge funds.
- D. Fixed income arbitrage hedge funds.

Practice 3

- Answer: C
- Fixed income arbitrage funds make money by the mispricing of fixed income securities. Global macro funds make profit to utilize the mispricings involved in interest rates, exchange rates, stock indexes, housing price, commodity price and other macro variables. Managed futures trade futures contract, while convertible arbitrage focus on the price difference between convertible bonds the corresponding stocks price.

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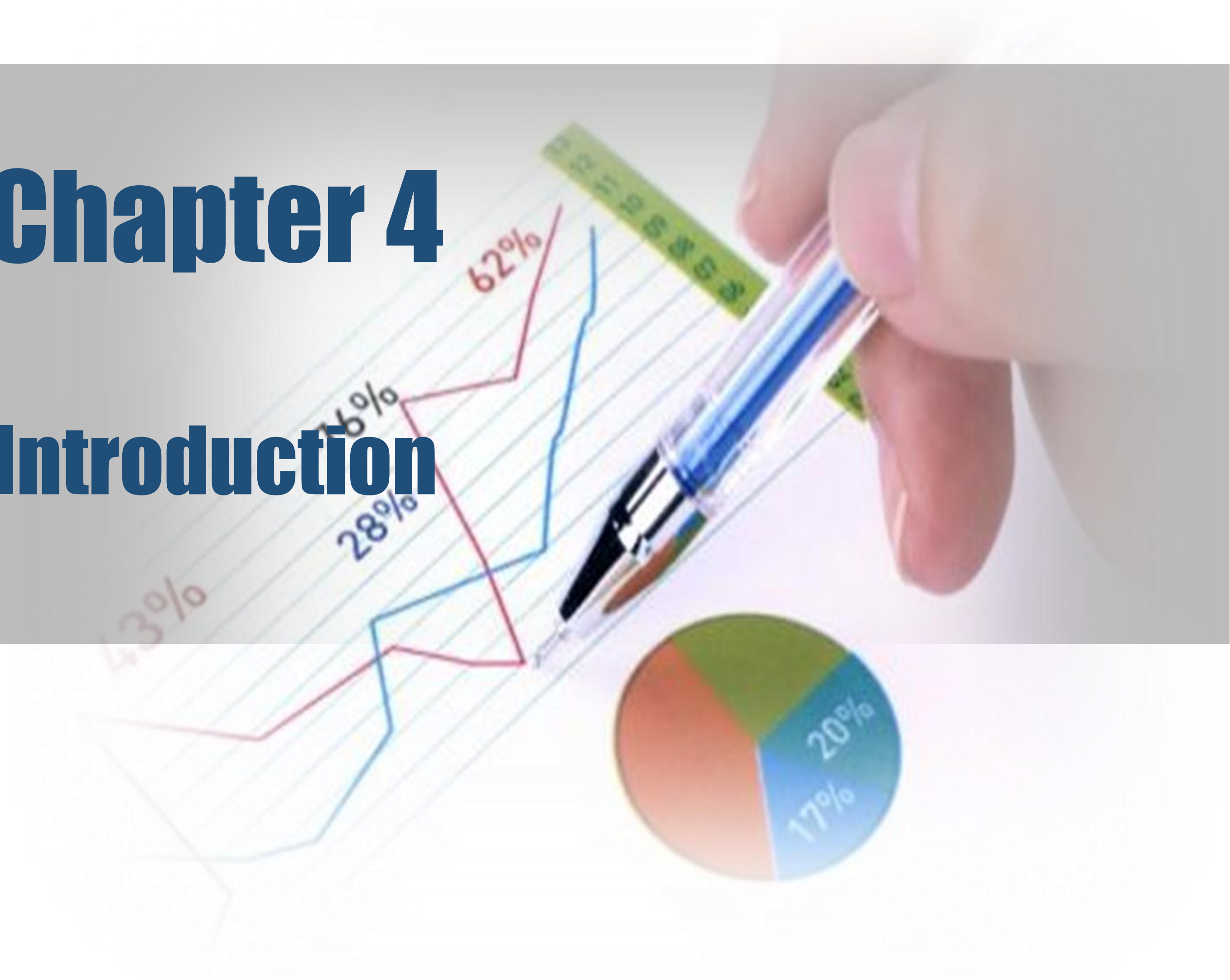
Chapter 4

Introduction



Learning Objectives

- Describe the over-the-counter market, distinguish it from trading on an exchange, and evaluate its advantages and disadvantages.
- Differentiate between options, forwards, and futures contracts.
- Identify and calculate option and forward contract payoffs.
- Calculate and compare the payoffs from hedging strategies involving forward contracts and options.
- Calculate and compare the payoffs from speculative strategies involving futures and options.
- Calculate an arbitrage payoff and describe how arbitrage opportunities are temporary.
- Describe some of the risks that can arise from the use of derivatives.

Derivatives

- A **derivative** is a security that its value based on the value or return of another asset or security.

Derivatives	Forward	Future	Option	Swap
Underlying Assets	stock	bonds	stock index	gold
	currency	commodity	metals	......

Derivatives

Forward commitment

- Contracts entered into at one point in time that require both parties to engage in a transaction at a later point in time (the expiration) on terms agreed upon at the start.
  - ✓ Forward, future, and swap

Contingent claim

- Derivatives in which the outcome or payoff is dependent on the outcome or payoff of an underlying asset.
  - ✓ Option

Derivatives

Forward

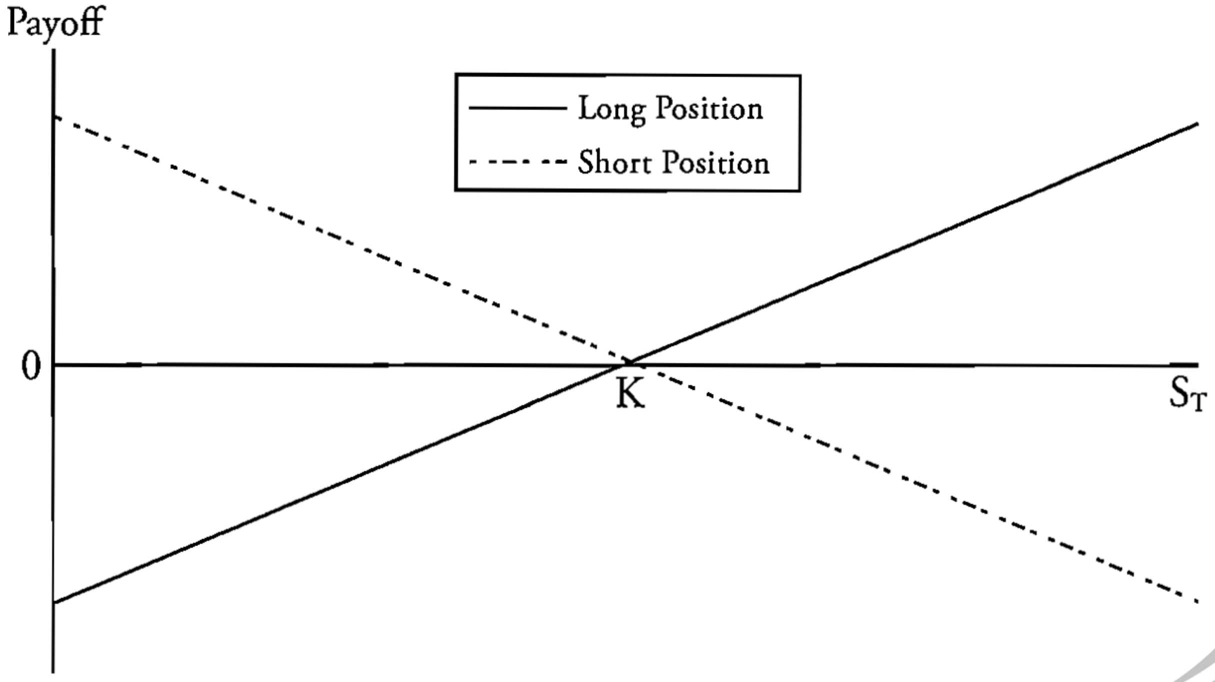
- An **over-the-counter** derivative contract in which two parties agree that one party, the buyer, will purchase an underlying asset from the other party, the seller, at a later date at a fixed price (forward price) they agree on when the contract is signed.
  - ✓ In addition to the (forward) price, the two parties also agree on several other matters, such as the identity and the quantity of the underlying.

Derivatives

- Forward payoff

  - K: delivery price

  - S_T: spot price



Derivatives

Price of forward commitment

- The fixed price or rate at which the underlying will be purchased at a later date.
  - ✓ Generally may not change as the (expected) price of the underlying asset changes.

Value of forward commitment

- The difference of "with the position" from "without the position".
  - ✓ May increase or decrease as the (expected) price of the underlying asset changes.

Derivatives

Futures

- Futures contracts are specialized forward contracts that have been **standardized** and **trade on a futures exchange**.
  - ✓ Futures contracts have specific underlying assets, times to expiration, delivery and settlement conditions, and quantities.
  - ✓ The exchange offers a facility in the form of a physical location and/or an electronic system as well as liquidity provided by authorized market makers.

Forward Vs. Futures

Forwards	Futures
Private contracts	Exchange-traded
Unique customized contracts	Standardized contracts
Default risk is present	Guaranteed by clearinghouse
Little or no regulation	Regulated
No margin deposit required	Margin required and adjusted
Settlement at maturity	Daily settlement (mark to market)
Delivery usually happens	Closed out before maturity

Derivatives

Swap

- An **over-the-counter** derivative contract in which two parties agree to exchange **a series of cash flows** whereby one party pays a variable series that will be determined by an underlying asset or rate and the other party pays either (1) a variable series determined by a different underlying asset or rate or (2) a fixed series.
  - ✓ A swap is a series of (off-market) forwards.

Derivatives

Option

- A derivative contract in which one party, the buyer, **pays a sum of money** to the other party, the seller or writer, and receives the right to either **buy or sell** an underlying asset at **a fixed price** either **on a specific expiration date or at any time prior to the expiration date**.
  - ✓ An option is a right, but not an obligation.
  - ✓ Default in options is possible only from the short to the long.

Derivatives

Option (Cont.)

- **Option premium (c_0, p_0):** payment to seller from buyer.
- **Call option:** right to buy;
- **Put option:** right to sell.
- **Exercise price/strike price (X):** the fixed price at which the underlying asset can be purchased or sell.
- **American option:** exercisable at or prior to expiration;
- **European option:** exercisable only at expiration.

Derivatives

Option (Cont.)

- 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

Derivatives

Arbitrage

- **Arbitrage:** a type of transaction undertaken when two assets or portfolios produce identical results but sell for different prices.
- **Law of one price:**
  - ✓ Assets that produce identical future cash flows regardless of future events should have the same price;
  - ✓ Trader will exploit the arbitrage opportunity quickly (**buy low and sell high**), then make the prices converge.

Derivatives

- **Three important types of traders:**
  - **Hedgers**: reduce risk, transfer risk
  - **Speculators:** actively take risk to make profit
  - **Arbitrageurs:** make risk-less profit (arbitrage opportunity: mispricing)
- **The functions of derivatives market:**
  - Price discovery
  - Transfer price risk

Derivatives

Replication

- Creation of an asset or portfolio from another asset, portfolio, and/or derivative.
- An asset and a **hedging position of derivative** on the asset can be combined to produce a position equivalent to a risk-free asset.
  - ✓ Asset + Derivative = Risk-free asset
  - ✓ Asset - Risk-free asset = -Derivative
  - ✓ Derivative - Risk-free asset = - Asset
  - ✓ A "-" sign indicates a short position, or borrowing at R_f.

Derivatives

No arbitrage pricing

- Determine the price of a derivative by assuming that there are no arbitrage opportunities (no arbitrage pricing).

✓ The derivative price can then be inferred from the characteristics of the underlying and the derivative, and the risk-free rate.

Trading Market

OTC (over-the-counter)

- Customized
- Trade with counterparty (default risk)
- Not trade in a central location
- Unregulated
- Large trading volume

Exchange Traded

- Standardized
- Backed by a clearing house
- Trade in a physical exchange
- Regulated
- Small trading volume

Trading Market

Open outcry system

- - more traditional system, which involves traders actually indicating their trades through hand signals and shouting.

Electronic trading system

- - not involve an actual "physical" exchange location, but rather involves matching buyers and sellers electronically via computers (e.g., NASDAQ)

Summary

Derivative

- Forward
- Futures
- Option
- Swap

Trading system

- OTC and Exchange
- Open outcry and Electronic trading system
- Three types of trader
- Derivative functions

Exam Tips

- Forward contract和 Futures 的对比
- 本章知识仅以介绍为主，更深入的各个衍生品的知识会在后续介绍

Practice 1

- Which of the following statements is an advantage of an exchange trading system? On an exchange system:
  A. Terms are not specified
  B. Trades are made in such a way as to reduce credit risk
  C. Participants have flexibility to negotiate
  D. In the event of a misunderstanding, calls are recorded between parties.

- Answer 1: B

Practice 2

- Which of the following statements regarding futures contracts is *most likely* correct? A business with a long exposure to an asset would hedge this exposure by either entering into a:

  A. Long futures contract or by buying a call option.

  B. Long futures contract or by buying a put option.

  C. short futures contract or by buying a call option.

  D. short futures contract or by buying a put option.

- Answer 2: D

Practice 3

- An investor enters into a long position in a gold-futures contract with the following characteristics:
  - The initial margin is $3,000
  - The futures price is $993.60
  - The maintenance margin is $2,250
  - Each contract controls 100 troy ounces.
- If the price drops to $991.00 at the end of the first day and $985.00 at the end of the second day, which of the following is closest to the variation margin required at the end of the second day?

  A. $0 B.$260 C.$600 D.$860

Practice 3

- Answer : D

✓ 991-993.6=-2.6 so after the first day -2.6*100=-260 loss would incur, and the balance is 3000-260=2740, which is larger than 2250.

✓ 985-991=-6 so after the second day -6*100=-600 loss would incur, and the balance is 2740-600=2140, which is smaller than 2250.

✓ However, the most crucial point is that it would increase its balance to its initial margin account, so it would be 860.

Practice 4

- **FRM EXAM 2004—QUESTION 66**

  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.

- Answer: D

Contents

Chapter 5

Interest Rates

Learning Objectives

- ✓ Describe Treasury rates, LIBOR, and repo rates, and explain what is meant by the "risk-free" rate.
- ✓ Calculate the value of an investment using different compounding frequencies.
- ✓ Convert interest rates based on different compounding frequencies.
- ✓ Calculate the theoretical price of a bond using spot rates.
- ✓ Derive forward interest rates from a set of spot rates.
- ✓ Derive the value of the cash flows from a forward rate agreement (FRA).
- ✓ Compare and contrast the major theories of the term structure of interest rates.

Interest Rate

- **Treasury Rates**

  Treasury rates are the rates an investor earns on Treasury bills and Treasury bonds.

- **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.

Interest Rate

- Repo Rates

  In a repo or repurchase agreement, the difference between the price at which the securities are sold and the price at which they are repurchased is the interest it earns. The interest rate is referred to as the repo rate.

Interest Rate

- **Three theories of term structure**
  - Pure Expectations Theory

Long-term interest rates should reflect expected future short-term interest rates.

Liquidity Preference (Premium) Theory

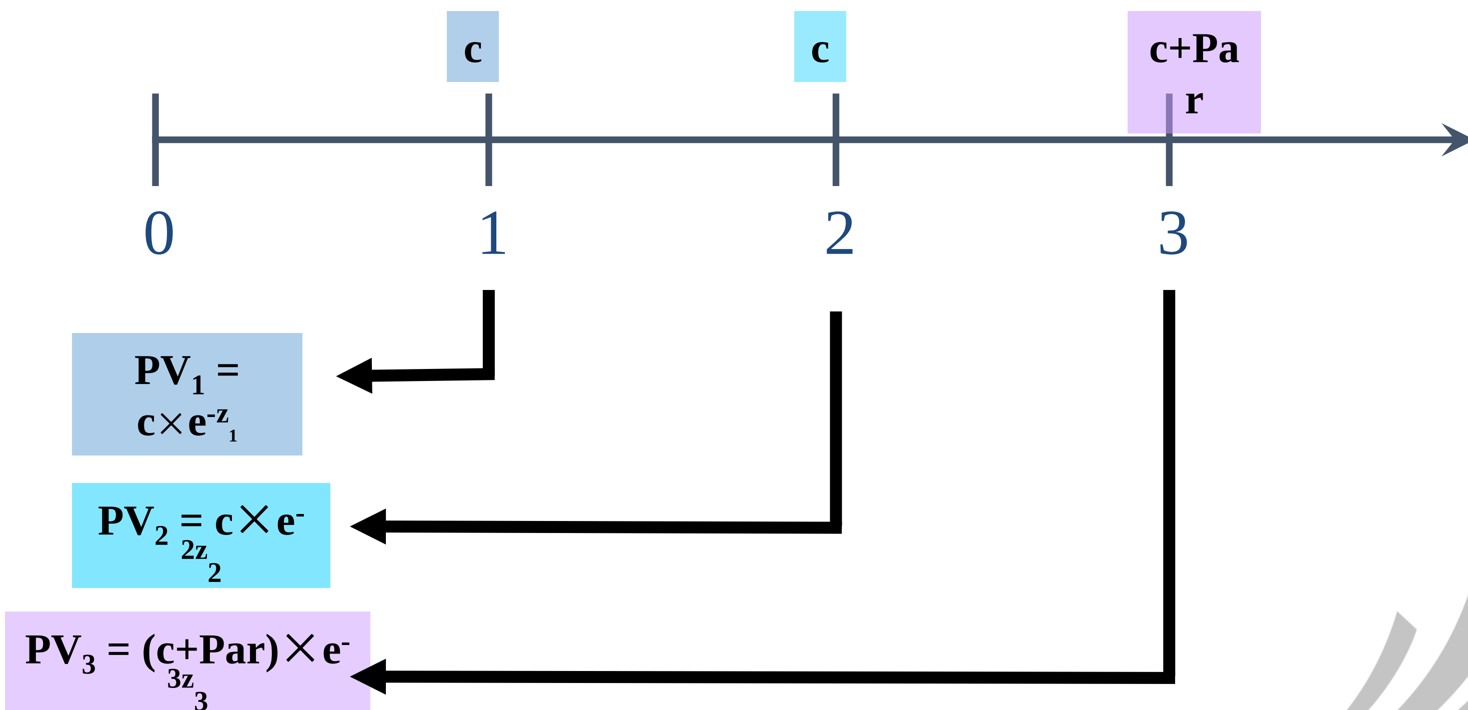
Investors prefer to preserve their liquidity and invest funds for short periods, while borrowers prefer to borrow for long periods.

Segmentation Theory

Supply and demand for specific maturity ranges determines interest rates, and segmentation of term exists.

Interest Rate

- Spot rates are the rates that correspond to zero-coupon bond yields.
- Bond Pricing



Interest Rate

- A coupon bond has a series of cash flows. Each cash flow could be analyzed separately, and each one could be regarded as a zero-coupon bond. Using continuous compounding and semiannual assumption, the value of a coupon bond equals:

$$B = \left(\frac{C}{2} \times \sum_{i=1}^{N} e^{-\frac{z_i}{2}}\right) + \left(\frac{Face\,Value}{e^{\frac{z_N}{2}}}\right)$$

- C= the annual coupon
- N= the number of semiannual payment periods
- Z_i =the bond equivalent spot rate that corresponds to i periods (i/2 years)on a continuously compounded basis
- FV= the face value of the bond

Interest Rate

- **Conclusion of spot rate valuation method**
- Value of a bond is the present value of its all cash flows, and each cash flow could be discounted using the appropriate spot rate on its maturity.
- Negative sign on the rate shows "discounted" process.

Interest Rate

Bootstrapping spot rates

- The theoretical spot curve is derived by interpreting each Treasury bond as a package of zero-coupon bonds. Using the prices for each bond, the spot curve is computed using the bootstrapping methodology.

Interest Rate

- **Determining Treasury spot rates with bootstrap method**

Data for bootstrap method

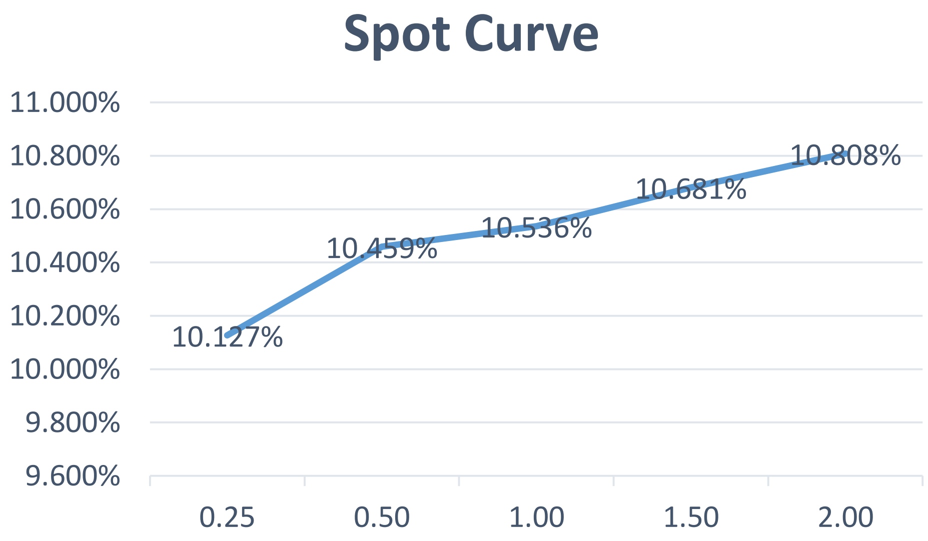
Bond principal ($)	Time to maturity (years)	Annual coupon* (years)	Bond price ($)
100	0.25	0	97.5
100	0.50	0	94.9
100	1.00	0	90.0
100	1.50	8	96.0
100	2.00	12	101.6

Except the first one, all other bonds are assumed as semiannual payment.

Interest Rate

➢ **Continuously compounded spot rates determined from above data**

Maturity (years)	Zero rate (%) (continuously compounded)
0.25	10.127
0.50	10.459
1.00	10.536
1.50	10.681
2.00	10.808



Interest Rate

- **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, yield to maturity (YTM), and par yield.

Treasury zero rates Maturity (years)	Zero rate (%) (continuously compounded)
0.5	5.0
1.0	5.8
1.5	6.4
2.0	6.8

Interest Rate

- **Example (Cont.)**
- Bond price: $P = 3e^{-0.05\times0.5} + 3e^{-0.058\times1.0} + 3e^{-0.064\times1.5} + 103e^{-0.068\times2.0} = 98.39$
- YTM: $3e^{-y\times0.5} + 3e^{-y\times1.0} + 3e^{-y\times1.5} + 103e^{-y\times2.0} = 98.39 \rightarrow y = 6.76\%$
- Par yield: $\frac{c}{2}e^{-0.05\times0.5} + \frac{c}{2}e^{-0.058\times1.0} + \frac{c}{2}e^{-0.064\times1.5} + (100 + \frac{c}{2})e^{-0.068\times2.0} = 100 \rightarrow c = 6.87$

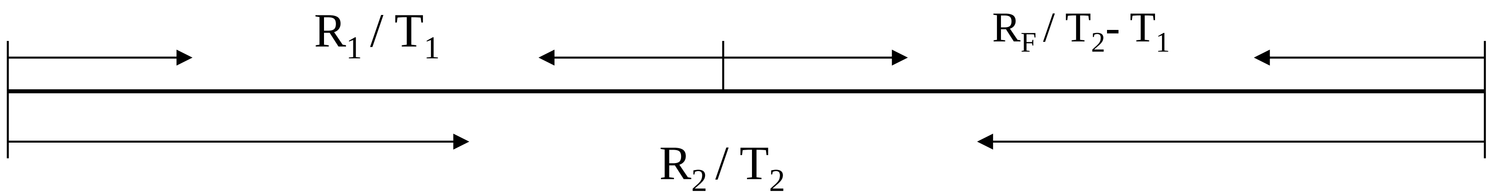
- **Par yield** for a certain bond maturity is the coupon rate that causes the bond price to equal its par value.

Interest Rate

Forward rates

- **Forward interest rates** are the future rates of interest implied by current zero rates for periods of time in the future.
  - **Notation is R_F.**

Interest Rate



$$A\cdot e^{R_1T_1}\cdot e^{R_F(T_2-T_1)}=A\cdot e^{R_2T_2}$$

$$\rightarrow \mathrm{R}_F=\frac{R_2T_2-R_1T_1}{T_2-T_1}$$

$$=\mathrm{R}_2+(\mathrm{R}_2-\mathrm{R}_1)\frac{T_1}{T_2-T_1}$$

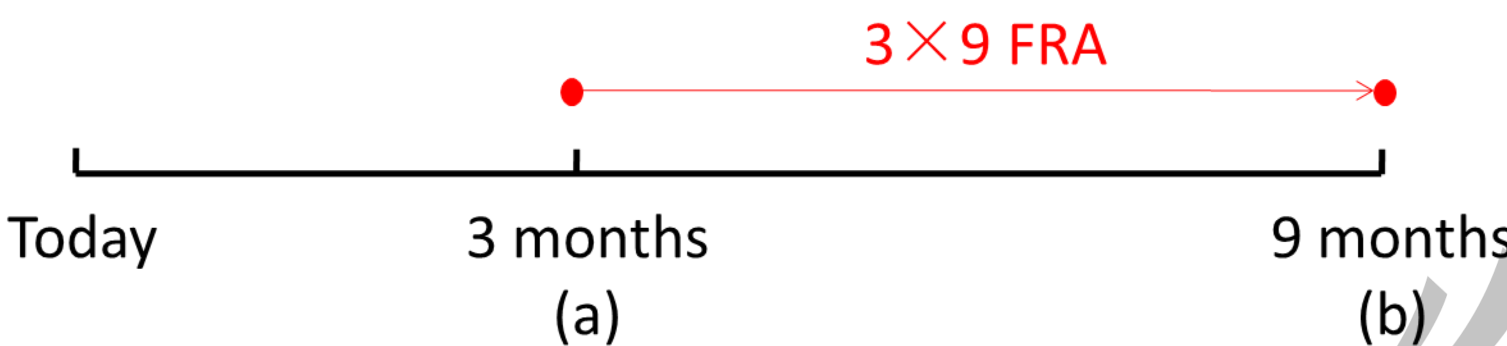
Interest Rate

Forward rate agreement (FRA)

- A FRA is an over-the-counter (OTC) forward contract in which the underlying is an interest rate (e.g. Libor).
  - Long position can be viewed as the obligation to take a loan at the contract rate (i.e., borrow at the fixed rate, floating receiver); gains when reference rate increase;
  - Short position can be viewed as the obligation to make a loan at the contract rate (i.e., lend at the fixed rate, fixed receiver); gains when reference rate decrease.

Interest Rate

- The notation of FRA
- The notation of FRA is typically “a×b FRA”:
  - a: the number of months until the contract expires;
  - b: the number of months until the underlying loan is settle.
  - Example: 3×9 FRA

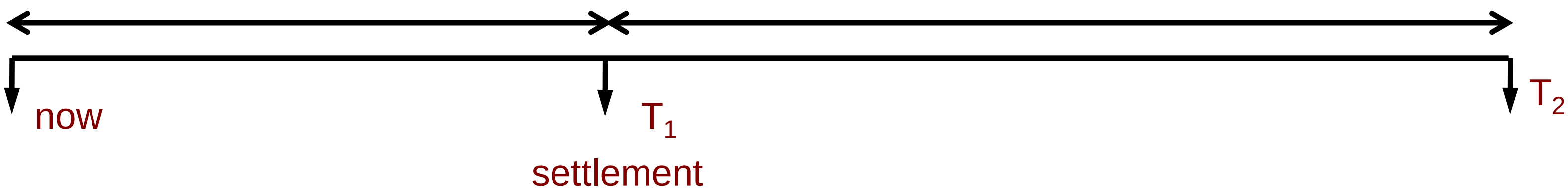


Interest Rate

- **The uses of FRA**
  - Lock the interest rate or hedge the risk of borrowing or lending at some future date.
  - One party will pay the other party the difference (based on notional value) between the interest rate specified in the FRA and the market interest rate at contract settlement.
  - If FRA rate < future spot rate, the long receives payment;
  - If FRA rate > future spot rate, the short receives payment.

Interest Rate

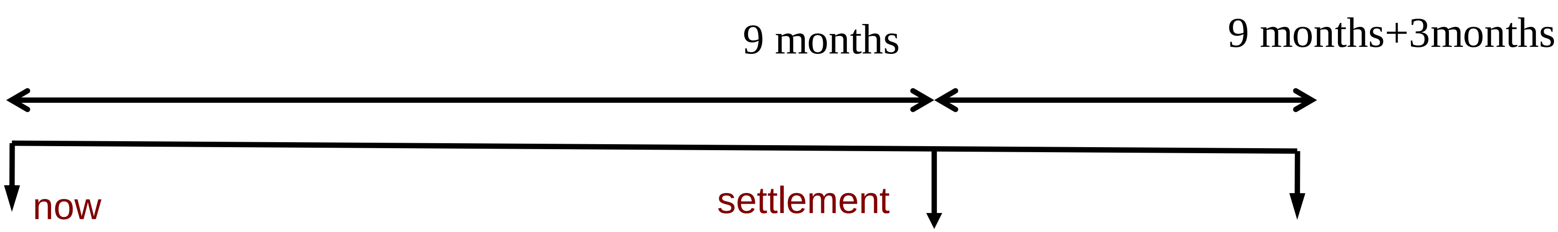
- **Valuation from an FRA**



- Value of Long Position $= Principal \times (R_{real} - R_{forward}) \times (T_2 - T_1) e^{-R2 \times T2}$

Interest Rate

- **Example**
- Suppose that 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 9 months. If 1-year risk-free rate is 5% with continuous compounding, then compute the payoff.



$1\ million \times (4\% - 5\%) \times (1 - 0.75)e^{-5\% \times 1}$

$1\ million \times (4\% - 5\%) \times (1 - 0.75)$

Summary

✓ **Interest Rate**

- Treasury rate
- Repo rate
- Libor
- Forward rate
- Spot rate
- Bootstrapping

✓ **Exam Tips**

- Bootstrapping求spot rate会是本章计算的重难点
- Forward rate和spot rate之间的模型关系
- FRA的理解以及现金流的计算

Practice 1

- **FRM EXAM 2002—QUESTION 27**
- ✓ A long position in a FRA 2 × 5 is equivalent to the following positions in the spot market:
  A. Borrowing in two months to finance a five-month investment
  B. Borrowing in five months to finance a two-month investment
  C. Borrowing half a loan amount at two months and the remainder at five months
  D. Borrowing in two months to finance a three-month investment
- Answer 1: B

Practice 2

- **FRM EXAM 2005—QUESTION 57**

✓ ABC, Inc., entered a forward rate agreement (FRA) to receive a rate of 3.75% with continuous compounding on a principal of USD 1 million between the end of year 1 and the end of year 2. The zero rates are 3.25% and 3.50% for one and two years. What is the value of the FRA when the deal is just entered?

A. USD 35,629

B. USD 34,965

C. USD 664

D. USD 0

Practice 2

- Answer 2: D

$$e^{3.25\%} \times e^{Rforward} = e^{3.5\% \times 2}$$

$$R_{forward} = 3.75\%$$

Practice 3

- Assume that the 3-month and 6-month LIBOR spot rates are 4% and 5% respectively (continuously compounded). An investor enters into an FRA in which she will receive 8% (quarterly compounding) on a principal of $5,000,000 between months 3 and 6. Calculate the value of an FRA.

  A. $23,773
  B. $24,773
  C. $25,773
  D. $26,773

Answer 3: A

$$R(forward) = 5\% + (5\% - 4\%) \times \left(\frac{0.25}{0.5 - 0.25} \right) = 6\%$$

$$R(quarterly) = 4(e^{\frac{6\%}{4}} - 1) = 6.05\%$$

$$Value = 5M \times (8\% - 6.05\%) \times (0.5 - 0.25)e^{-0.05 \times 0.5}$$

Practice 4

- A \$100 face value, 1-year, 4% semiannual bond is priced at 99.806128. If the annualized 6-month spot rate (z_1) is 4.1%, what is the 1-year spot rate (z_2) ? (Both spots are continuously compounded rates).

A. 4.07%

B. 4.16%

C. 4.20%

D. 4.26%

$$B = 2e^{\left(-\frac{z1}{2}\times 1\right)} + 102e^{\left(-\frac{z2}{2}\times 2\right)}$$

$$z_1 = 4.1\%$$

$$z_2 = 4.16\%$$

Answer 4: B

Contents

Chapter 6

Interest Rate Futures

Learning Objectives

- ✓ Identify the most commonly used day count conventions, describe the markets that each one is typically used in, and apply each to an interest calculation.
- ✓ Calculate the conversion of a discount rate to a price for a US Treasury bill.
- ✓ Differentiate between the clean and dirty price for a US Treasury bond; calculate the accrued interest and dirty price on a US Treasury bond.
- ✓ Explain and calculate a US Treasury bond futures contract conversion factor.

Learning Objectives

- ✓ Calculate the cost of delivering a bond into a Treasury bond futures contract.
- ✓ Describe the impact of the level and shape of the yield curve on the cheapest-to-deliver Treasury bond decision.
- ✓ Calculate the theoretical futures price for a Treasury bond futures contract.
- ✓ Calculate the final contract price on a Eurodollar futures contract.
- ✓ Describe and compute the Eurodollar futures contract convexity adjustment.
- ✓ Explain how Eurodollar futures can be used to extend the LIBOR zero curve.

Interest Rate Futures

- **Day count conventions**

Day count conventions play a role when computing the interest that accrues on a fixed income security.

-U.S Treasury bonds uses actual/actual.

-U.S corporate and municipal bonds use 30/360.

-U.S money market instruments (Treasury bills) use actual/360

Interest Rate Futures

- **Quotations for T-Bill**

- $Quoted\ Price = \frac{360}{n}(100 - Y)$

  - Y is cash price, n is the remaining life of the T-bill.
  - Quoted price is 100×discount rate

- Suppose there is a 180-day T-bill with cash price is 97.5, then its quoted price is 5.

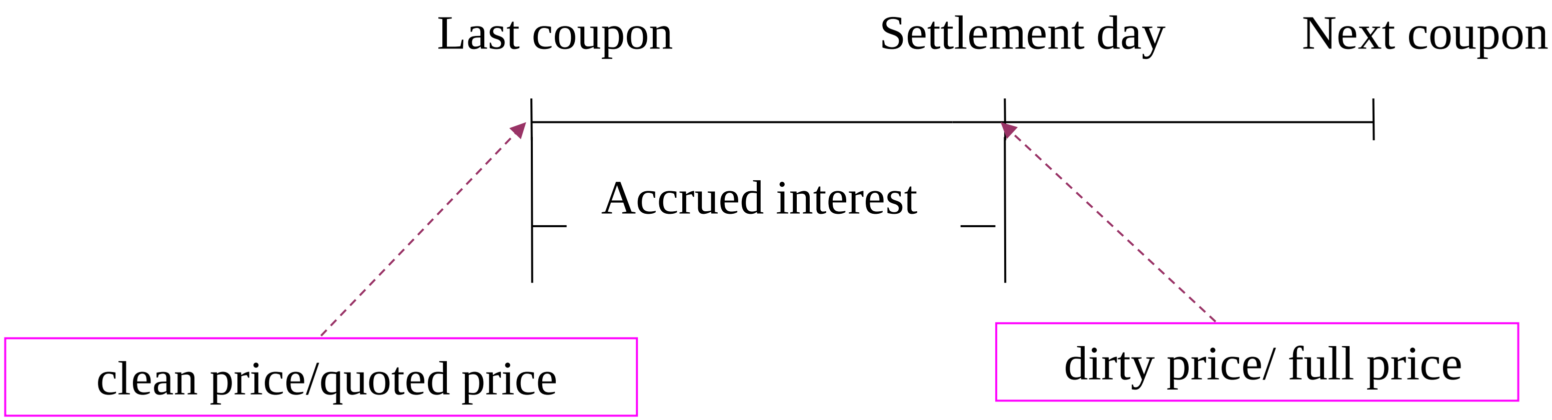
$$\text{cash price}=100\left(1-\text{discount-rate}\times\frac{n}{360}\right)$$

Interest Rate Futures

- **Quotations for T-Bond**
- Dollars and thirty-seconds(32) of a dollar for a bond with a face value of $100 .
- A quote of 90-05 indicates that the quoted price for a bond with a face value of $100,000 is $90,156.25.
  - $\frac{90+\frac{5}{32}}{100} \times 100{,}000 = 90{,}156.25$

Interest Rate Futures

Quotations for T-Bond



- Full price = clean price + accrued interest
  - **clean price = dirty price – accrued interest**

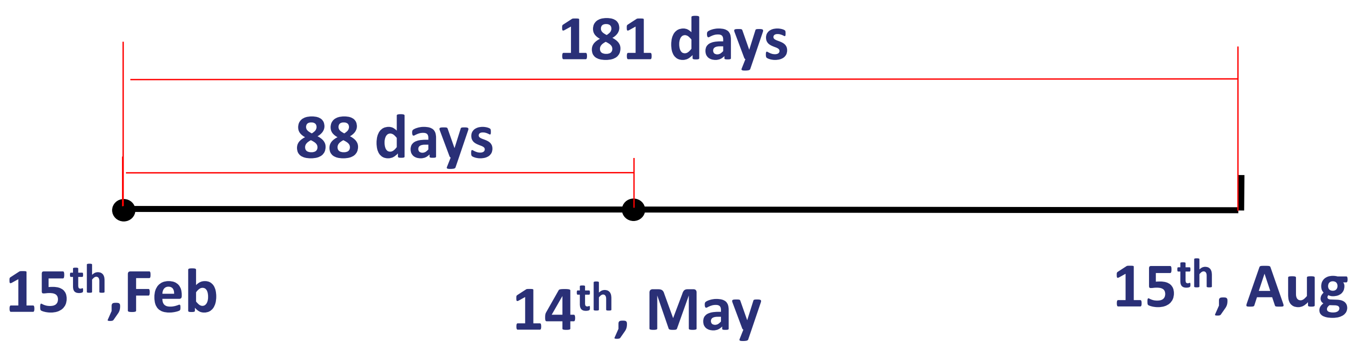
$$accured\ \text{interest} = \text{coupon} \times \frac{\#\ of\ days\ from\ last\ coupon\ to\ the\ settlement\ date}{\#\ of\ days\ in\ coupon\ period}$$

Interest Rate Futures

- **Example**
- Consider a 5% semiannual coupon bond with par value of 100 and required yield of 4.8%. The bond will matures on 15 February 2024 and coupon are made on 15 February and 15 August of each year. The bond is to be priced for settlement on 14 May 2015, and that date is 88 days into the 181-day period. What should be the price paid and what should be the price quoted?

Interest Rate Futures

- **Example (Cont.)**
- Answer:



- PMT=2.5, N=18, FV=100, I/Y=2.4, PV=(101.45)
- Full price (price paid) = 101.45*$(1+2.4\%)^{88/181}$ = 102.62
- AI = (88/181)*2.5=1.22
- Clean price (price quoted) = 102.62 - 1.22 = 101.41

Interest Rate Futures

Two most popular interest rate futures

- T-bond futures (CBOT) -physical delivery
  - day count conventions
  - quotations of contracts
  - cheapest to deliver
- Eurodollar futures (CME) -cash settled
  - quotation of contract
  - convexity adjustment
  - extend LIBOR zero curve

Interest Rate Futures

Conversion factor of T-bond futures contract

- In Treasury bonds futures contract, any government bond that has more than 15 years to maturity on the first day of the delivery month and is not callable within 15 years from that day can be delivered.
- Its face value is 100,000 USD.
- Since the deliverable bonds have very different market values, the Chicago Board of Trade (CBOT) has created conversion factors.

Interest Rate Futures

- The cash received by the short position is:

  Cash received = (QFP × CF) + AI

  Wherein:

  QFP: quoted futures price

  CF: conversion factor for the bond delivered

  AI: accrued interest since the last coupon date on the bond delivered

Interest Rate Futures

Cheapest-to-deliver bond

- The conversion factor system is not perfect and often results in one bond that is the cheapest (or more profitable) to deliver. The procedure to determine which bond is the cheapest-to-deliver (CTD) is as follows:
  - **cash received by the short = (QFP×CF)+AI**
  - **cost to purchase bond = (quoted bond price +AI)**
- The CTD is the bond that minimizes the following:
  - **cost=quoted bond price – (QFP×CF)**

Interest Rate Futures

- **Example**
- Michael Loose, an investor with a short position, is going to deliver a bond and has four bonds to choose from which are listed in the following table. The quoted futures price is $98.25, he wants to know which bond is the cheapest-to-deliver.

Bond	*Quoted Bond Price*	*Conversion Factor*
1	100	1.01
2	135	1.37
3	105	1.06
4	118	1.20

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Interest Rate Futures

- **Example (Cont.)**
- Cost of delivery:
- Bond 1: 100-(98.25 × 1.01) = $0.7675
- Bond 2: 135-(98.25 × 1.37) = $0.3975
- Bond 3: 105-(98.25 × 1.06) = $0.8550
- Bond 4: 118-(98.25 × 1.20) = $0.1000
- Bond 4 is the cheapest-to-deliver with a cost of delivery of $0.1.

Interest Rate Futures

Eurodollar futures price:

- A Eurodollar is a dollar deposited in a US or foreign bank outside US.
- The Eurodollar Interest Rate is the rate of interest earned on Eurodollars deposited by one bank with another.
- The value of one Eurodollar Futures contract
  - $$\mathbf{Pt = 10{,}000 \times [100 - 0.25(100 - Z)] = 10{,}000 \times [100 - 0.25F_t]}$$
- Z is the quoted Eurodollar futures price
- F_t is the forward rate expressed in percent
- 0.25 represents the 3-month maturity

Interest Rate Futures

- **Eurodollar futures price: (Cont.)**
- Forward rate increases then the short position makes a profit.
- 1 basis point up move in the futures quote corresponds to a change of $25 per contract.

Interest Rate Futures

Convexity Adjustment:

- The rates implied by futures and the forward rates is of difference due to convexity.
- Actual forward rate

  =forward rate implied by futures $-1/2 \times \sigma^2 \times T_1 \times T_2$

  - T_1: maturity on the futures contract
  - T_2: time to maturity of the rate underlying the contract
  - σ^2: the annual standard deviation of the change in the rate underlying the futures contract, or 90-day LIBOR

Interest Rate Futures

Extend LIBOR zero curve

- Forward rates implied by convexity-adjusted Eurodollar futures can be used to produce a LIBOR spot curve

  - $R_{forward} = \frac{R_2T_2 - R_1T_1}{T_2 - T_1}$

  - $R_2 = \frac{R_{forward}(T_2 - T_1) + R_1T_1}{T_2}$

Interest Rate Futures

- **Example**
- Assume that the continuously compounded 10-year spot rate is 5% and the 9-year spot rate is 4.9%. Which of the following is closer to the 1-year-forward rate nine years from now?
- A. 4.1%
- B. 5.1%
- C. 5.9%
- D. 6.0%

Interest Rate Futures

- **Answer: C**

$$R_{Forward} = R_2 + (R_2 - R_1) \times [T_1/(T_2 - T_1)]$$

$$= 0.05 + (0.05 - 0.049) \times [9/(10-9)]$$

$$= 5.9\%$$

Duration-based Hedging

- In order to eliminate or minimize the effect from interest rate change to the price of a bond portfolio or a money market security, duration hedge is a useful solution.

$$N = -\frac{P \times D_P}{F \times D_F}$$

- P is the price of a bond portfolio or a money market security
- F is the price of interest rate futures contract
- D_p is the duration of portfolio
- D_f is the duration of future
- N is the appropriate number of future contract

Duration-based Hedging

- **Example**
- There is a portfolio with value of \$10 million, and appropriate T-bond future contract is quoted at 108-24. The duration of the portfolio is 15 while that of the future is 12. How many futures contract is needed to minimize the interest rate change?
- **Answer**
- The face value of T-bond futures is \$100,000, with the quote 108-24, the value per T-bond futures is $\frac{108+\frac{24}{32}}{100} \times \$100{,}000 = \$108{,}750$
- $N = \frac{10{,}000{,}000 \times 15}{108{,}750 \times 12} = 114.9 \approx 115$

Summary

✓ **Interest rate futures**

- Day count conventions
- Quotations for T-Bill
- CTD Bond
- Eurodollar Future Price
- Convexity Adjustment
- Libor zero curve extension

✓ **Exam Tips**

- CTD bond的计算
- Conversion factor的理解以及计算
- 根据期权implied的forward rate做convexity调整，并且根据调整后的rate做spot rate延展
- Eurodollar futures的计算。

高顿财经 GOLDEN FINANCE

Practice 1

- FRM EXAM 2005—QUESTION 49

John H., a portfolio manager, is shorting a U.S. Treasury bond futures contract and has decided to deliver. The quoted futures price is USD 95.5. Among the four deliverable bonds, which is the cheapest-to-deliver?

Bond	A	B	C	D
Quote	125.69	90.31	87.6	128.56
Conversion Factor	1.1979	0.8109	0.8352	1.2249

A. Bond A B. Bond B

C. Bond C D. Bond D

Practice 1

- Answer : C
- ✓ Minimize the cost
- ✓ Cost=quoted bond price-(QFP*Conversion Factor)

#	Deliver Price	Conversion Factor	QFP	Cash Received	Cost
Bond A	125.69	1.1979	95.5	114.39945	11.29055
Bond B	90.31	0.8109	95.5	77.44095	12.86905
Bond C	87.6	0.8352	95.5	79.7616	7.8384
Bond D	128.56	1.2249	95.5	116.97795	11.58205

Practice 2

- Assume a 6-month hedging horizon and a portfolio value of $30 million. Further assume that the 6-month Treasury bond contract is quoted at 100-13, with a contract size of $100,000. The duration of the portfolio is 8, and the duration of the futures contract is 12. Which of the following is *closest* to the appropriate hedge?

  A. Long 298 contract

  B. Short 298 contract

  C. Long 199 contract

  D. Short 199 contract

Practice 2

- Answer 2: D

$$N = -\frac{P \times D_P}{F \times D_F} = -\frac{30M \times 8}{0.1M \times 12 \times \frac{100\frac{13}{32}}{100}} = -199.2$$

Practice 3

- Assume the cash price on a 90-T-Bill is quoted as 98.75. The discount rate is closest to:
  A. 4%
  B. 7%
  C. 6%
  D. 5%
- Answer 3: D

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

$$98.75=100\times(1-r\times\frac{90}{360})$$

$$r=5\%$$

Contents

Chapter 7

Swaps

Learning Objectives

- ✓ Explain the mechanics of a plain vanilla interest rate swap and compute its cash flows.
- ✓ Explain how a plain vanilla interest rate swap can be used to transform an asset or a liability and calculate the resulting cash flows.
- ✓ Explain the role of financial intermediaries in the swaps market.
- ✓ Describe the role of the confirmation in a swap transaction.
- ✓ Describe the comparative advantage argument for the existence of interest rate swaps and evaluate some of the criticisms of this argument.
- ✓ Explain how the discount rates in a plain vanilla interest rate swap are computed.
- ✓ Calculate the value of a plain vanilla interest rate swap based on two simultaneous bond positions.

Learning Objectives

- ✓ Calculate the value of a plain vanilla interest rate swap from a sequence of forward rate agreements (FRAs).
- ✓ Explain the mechanics of a currency swap and compute its cash flows.
- ✓ Explain how a currency swap can be used to transform an asset or liability and calculate the resulting cash flows.
- ✓ Calculate the value of a currency swap based on two simultaneous bond positions.
- ✓ Calculate the value of a currency swap based on a sequence of FRAs.
- ✓ Describe the credit risk exposure in a swap position.
- ✓ Identify and describe other types of swaps, including commodity, volatility, and exotic swaps.

Swap Overview

- If A loans money to B for a fixed rate of interest and B loans the same amount to A for floating rate of interest, it’s an interest rate swap.
- If one of the returns streams is based on a stock portfolio or index return, it’s an equity swap.
- If the loans are in two different currencies, it’s a currency swap.
- Comparative advantage is the basic reason behind swap transaction.

Swap Characteristics

- Custom instruments
- Not traded in any organized secondary market
- Largely unregulated
- Default risk is a concern
- Most participants are large institutions
- Private agreements
- Difficult to alter or terminate

Swap

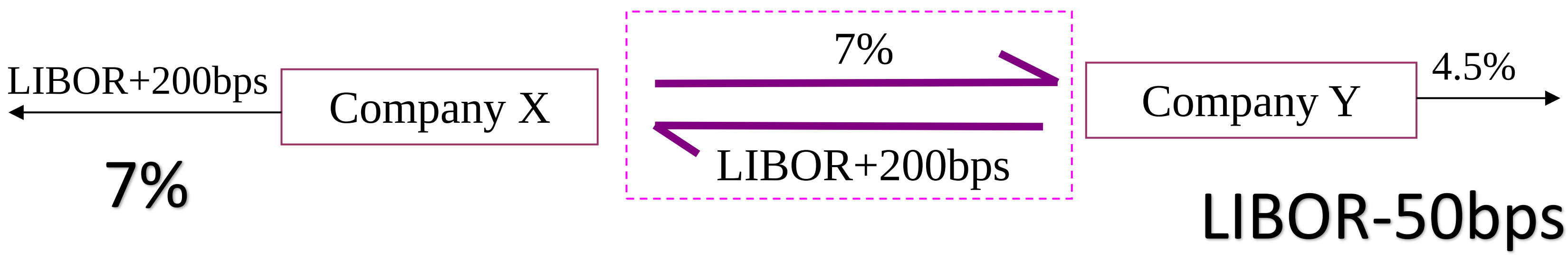
- **Example**
- Company X wants a fixed borrowing while company Y wants a floating borrowing. The two companies have borrowing rate as following:
- Company X and Y have access to borrowing for two years as follows:

Company	Fixed Borrowing	Floating Borrowing
X	7.5%	LIBOR+200 bps
Y	4.5%	LIBOR
Incremental	3.0%	2.0%

- Company Y has an absolute advantage in both market, but a comparative advantage in fixed market.

Swap

- **Example (Cont.)**
- If there is no swap, company X must pay 7.5% interest rate, while company Y must pay Libor. However, if swap exists, both parties would save 1% totally.
- If they share the saving equally, the arrangement would be following:



Swap Terminology

- Notional principal: Amount used to calculate periodic payments
- Floating rate: Usually US LIBOR
- Tenor: Time period covered by swap
- Settlement dates: Payment due dates

Plain Vanilla Interest Rate Swap

- Fixed interest rate payments are exchanged for floating-rate payments.
- Notional amount is not exchanged at the beginning or end of the swap (both loans are in same currency and amount).
- Interest payments are netted.
- On settlement dates, both interest payments are calculated and only the difference is paid by the party owing the greater amount.
- Floating rate payments are typically made in arrears, payment is made at end of period based on beginning-of-period LIBOR.

Plain Vanilla Interest Rate Swap

- **Fixed Rate Payment (at time t)**

$$= (Swap\ Rate - Libor_{t-1}) \times \left(\frac{T}{360}\right) \times (NP)$$

  - Swap rate: fixed rate in swap contract
  - T: #days in settlement period
  - NP: notional principle

Plain Vanilla Interest Rate Swap

- Here one party pays fixed, the other pays floating (usually LIBOR, or LIBOR plus a fixed spread), for example:

Party A (e.g. a company) the pay-fixed side of the swap	Fixed rate: 9% p.a. → ← Floating rate 3 month LIBOR	Party B (e.g. a bank) the pay-floating side of the swap

- There is no need for an exchange of the principal.
- The above cash flows are netted and paid at the end of each settlement period, usually based on the LIBOR at the start of the period (the arrears method)

Fixed-for-Floating Swap

Example:

- 2-year, semiannual-pay, LIBOR, plain vanilla interest rate swap for \$10 million with a fixed rate of 6%. Semiannual fixed payments are: (0.06 / 2) × \$10 million = \$300,000

LIBOR t_0 = 5%, t_1 = 5.8%, t_2 = 6.2%, t_3 = 6.6%

Fixed-for-Floating Swap

- 1st payment: Fixed-rate payer pays \$50,000 net

  (0.06 – 0.05)(180/360)(10 million) = \$50,000

  - First net payment is known at swap initiation!

- 2nd payment: Fixed rate payer pays \$10,000 net

  (0.06 – 0.058)(180/360)(10 million) = \$10,000

- 3rd payment: Floating rate payer pays \$10,000 net

  (0.06 – 0.062)(180/360)(10 million) = –\$10,000

- 4th payment: Floating rate payer pays \$30,000 net

  (0.06 – 0.066)(180/360)(10 million) = –\$30,000

Currency Swap

Example:

- Assume current exchange rate is $1.20/euro

  Company A lends $1.2 million to Company B at 5%/year (USD interest rate)

  Company B lends 1 million euros to Company A at 4%/year (euro interest rate)

  Loans are for two years and interest is paid semiannually

Currency Swap Example

- At time 0:
  - Company A lends $1.2 million to Company B
  - Company B lends €1 million to Company A
- At each semi-annual settlement date (t = 1,2,3,4):
  - A pays 0.04 / 2 × €1 million = €20,000 to B
  - B pays 0.05 / 2 × $1.2 million = $30,000 to A
- At t = 4 settlement date, in addition to the interest payments:
  - Company B repays $1.2 million to Company A
  - Company A repays €1 million to Company B
  - This is a fixed-for-fixed currency swap because both loans carried a fixed rate of interest
  - Could be fixed-for-floating or floating-for-floating

Swap Pricing

- **Swap Pricing**
  - "Pricing" swaps requires the determination of the swap fixed rate (or swap rate).
    - Swap rate is the rate paid by the pay-fixed side
  - Principle: $PV_{\text{fixed-payments}} = PV_{\text{floating-payments}}$
- Swap value: Difference in the value of the fixed payments and floating payments
    - Zero at initiation
    - Usually non-zero after initiation

Swap Pricing

- **Guiding principle**: Swap fixed rate must be set so swap value at initiation is zero.
- **Method**: Value the swap as a combination of **fixed-rate** bond and floating rate bond
- **Value of payer swap**

  = value of “replicating” floating rate bond

  – value of “replicating” fixed rate bond

Swap Pricing

- The net formula for the fixed-rate payer is:

$$(\text{net fixed rate payment})_t = (\text{swap fixed rate} - \text{LIBOR}_{t-1})\left(\frac{\text{number of days}}{360}\right)(\text{notional principal})$$

- Company X is equivalent to a long position in a floating rate bond and a short position in a fixed-rate bond.
- Bonds have principal payments, but swaps do not. However, we replicate swaps with bonds and therefore include the bond's principal payments in the valuation procedure.
- On each settlement date, the value of a floating rate note (FRN) will always reset to par (interest rates "adjust" to market rates).

Other Type of Swap

- Equity swap
- Swaption
- Commodity swap
- Volatility swap

Swap

Example

XYZ, Inc. has entered into a "plain-vanilla" interest rate swap on $5,000,000 notional principal. XYZ company pays a fixed rate of 8.5 percent on payments that occur at 180-day intervals. Platteville Investments, a swap broker, negotiates with another firm, SSP, to take the receive-fixed side of the swap. The floating rate payment is based on LIBOR (currently at 7.2 percent). At the time of the next payment (due in exactly 180 days), XYZ company will:

Swap

- **Example (Cont.)**

A. make a net payment of $16,250

B. receive a net payment of $32,500

C. make a net payment of $32,500

D. receive a net payment of $32,500

- Answer: C

Swap

- **Example (Cont.)**
- Fixed Rate Payment = (Swap Fixed Rate - $LIBOR_{t-1}$) * (# days in term / 360) * Notional Principal
- If the result is positive, the fixed-rate payer owes a net payment and if the result is negative, then the fixed-rate payer receives a net inflow. Note: We are assuming a 360 day year.
- Fixed Rate Payment = (0.085 - 0.072) * (180 / 360) * 5,000,000 = $32,500. Since the result is positive, XYZ owes this amount to the dealer, who will remit to SSP.

Swap

Example

- Which of the following statements is most accurate? Currency swap markets consist of transactions in:

  A. both spot and forward contracts.

  B. spot markets only.

  C. bond and stock markets.

  D. bond markets only.

Swap

- Answer: A

  The counterparties exchange the full notional principal at the onset of the swap. Then, on each settlement date, one party pays a fixed rate of interest on the foreign currency received, and the other party pays a floating rate on the dollars received. Interest payments are not netted. At the conclusion of the swap, the notional currencies are again exchanged. Thus, currency swaps involved transactions in both the spot and forward (future) markets. A fixed-for-fixed currency swap is equivalent to a portfolio of foreign exchange forward contracts (both parties need to deliver currency in the future).

Summary

- ✓ Swap
  - Terminology
  - Characteristics
  - Plain Vanilla Interest Swap
  - Currency Swap
- ✓ Exam Tips
  - 本章目的在于理解swap和forward的关系
  - Swap value的计算

Practice 1

- FRM EXAM 2005—QUESTION 51
  You are given the following information about an interest rate swap: two year term, semiannual payment, fixed rate = 6%, floating rate = LIBOR + 50 bps, notional USD 10 million. Calculate the net coupon exchange for the first period if LIBOR is 5% at the beginning of the period and 5.5% at the end of the period.
  A. Fixed-rate payer pays USD 0
  B. Fixed-rate payer pays USD 25,000
  C. Fixed-rate payer pays USD 50,000
  D. Fixed-rate payer receives USD 25,000

Practice 1

- Answer : B

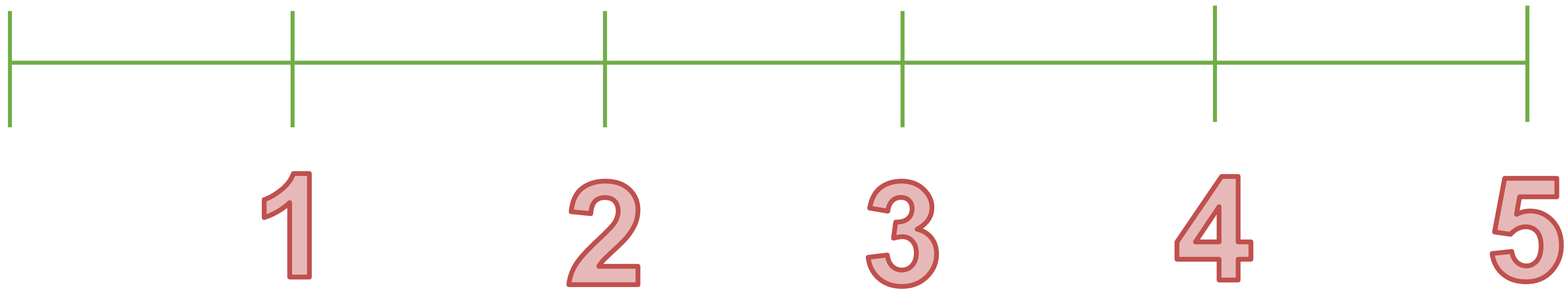
$$\frac{[6\% - (5\% + 50bps)] \times 10,000,000}{2} = 25,000$$

Practice 2

- **FRM EXAM 2000—QUESTION 55**
  Bank One enters into a five-year swap contract with Mervin Co. to pay LIBOR in return for a fixed 8% rate on a principal of \$100 million. Two years from now, the market rate on three-year swaps at LIBOR is 7%. At this time Mervin Co. declares bankruptcy and defaults on its swap obligation. Assume that the net payment is made only at the end of each year for the swap contract period. What is the market value of the loss incurred by Bank One as a result of the default?
  A. \$1.927 million
  B. \$2.245 million
  C. \$2.624 million
  D. \$3.011 million

Practice 2

- Answer : C



Principal	exp(-r*T)	Result	Principal	1/(1+r)^T	Result
1000000	0.93239382	932393.8199	1000000	0.934579439	934579.4393
1000000	0.869358235	869358.2354	1000000	0.873438728	873438.7283
1000000	0.810584246	810584.246	1000000	0.816297877	816297.8769
		2612336.301			2624316.044

Practice 3

- Determine the value of the swap to the floating rate payer using the bond methodology. Assume we are at the floating rate reset date.
  - ✓ $1 million notional value, semiannual, 18-month maturity.
  - ✓ Spot LIBOR rates: 6 months, 2.6%; 12 months, 2.65%; 18 months, 2.75%.
  - ✓ The fixed rate is 2.8%, with semiannual payments.

A. $66

B. $476

C. $3,425

D. $5,077

Practice 3

- Answer 3: B

$$1,000,000\times\frac{2.8\%}{2}=14,000$$

$$B_{fix}=14,000e^{-2.6\%\times0.5}+14,000e^{-2.65\%\times1}$$
$$+(1,000,000+14,000)e^{-2.75\%\times1.5}$$
$$=1,000,476$$

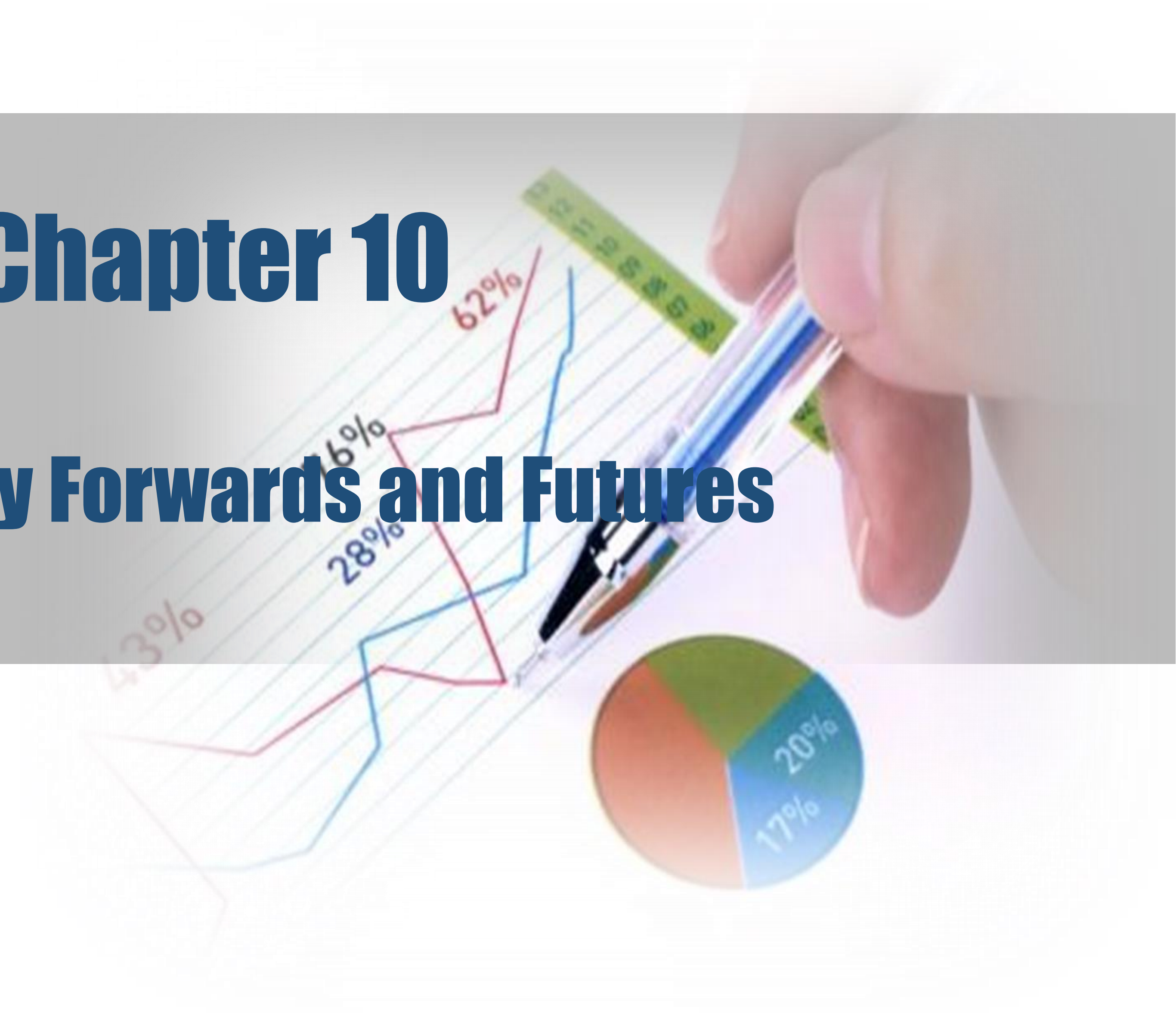
✓ Because we are at a reset date, the floating rate portion has a value equal to the nominal amount.

$$V_{swap}=B_{fix}-B_{floating}=1,000,476-1,000,000=476$$

Contents

Chapter 10

Commodity Forwards and Futures



Learning Objectives

- ✓ Apply commodity concepts such as storage costs, carry markets, lease rate, and convenience yield.
- ✓ Explain the basic equilibrium formula for pricing commodity forwards.
- ✓ Describe an arbitrage transaction in commodity forwards, and compute the potential arbitrage profit.
- ✓ Define the lease rate and explain how it determines the no-arbitrage values for commodity forwards and futures.
- ✓ Define carry markets, and illustrate the impact of storage costs and convenience yields on commodity forward prices and no-arbitrage bounds.
- ✓ Compute the forward price of a commodity with storage costs.
- ✓ Compare the lease rate with the convenience yield.

Learning Objectives

- ✓ Identify factors that impact gold, corn, electricity, natural gas, and oil forward prices.
- ✓ Compute a commodity spread.
- ✓ Explain how basis risk can occur when hedging commodity price exposure.
- ✓ Evaluate the differences between a strip hedge and a stack hedge and explain how these differences impact risk management.
- ✓ Provide examples of cross-hedging, specifically the process of hedging jet fuel with crude oil and using weather derivatives.
- ✓ Explain how to create a synthetic commodity position, and use it to explain the relationship between the forward

Commodity Markets

- Risk involved with commodity spot transaction:
  - Price risk
  - Transportation risk
  - Delivery risk
  - Credit risk

Commodity Markets

Basis Risk

- **Basis** is the difference between the cash or spot price of a commodity and the price of a futures contract on the same commodity at any given time.
- **Basis risk** is the volatility of the basis over time and as a result is usually represented as the variance of the basis:

$$\sigma^2_{S(t)-F(t)} = \sigma^2_{S(t)} + \sigma^2_{F(t)} - 2\sigma_{S(t)}\sigma_{F(t)}\rho_{S,F}$$

Commodity Markets

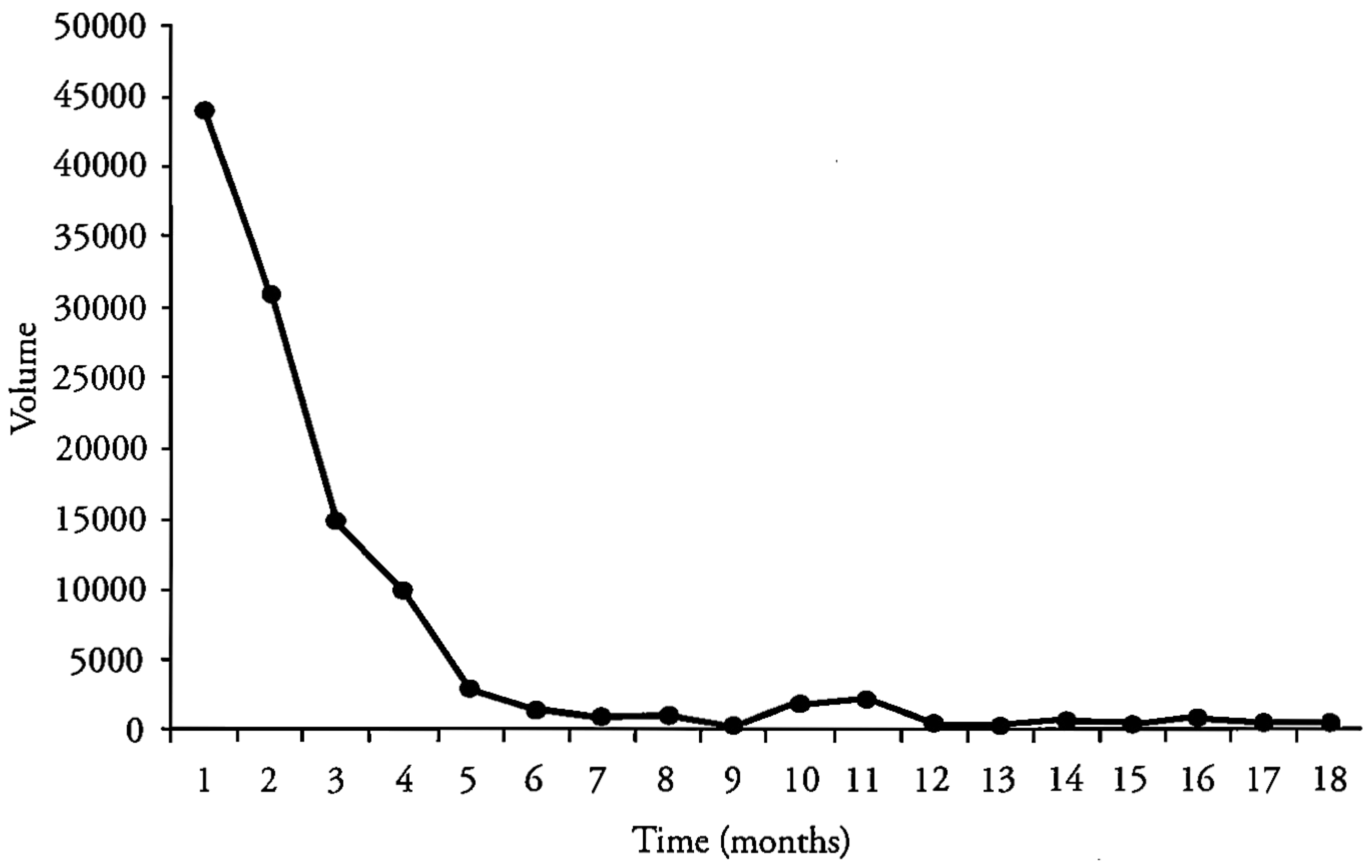
Market depth

- **Market depth** can be discovered by measuring how many units traders can sell or buy at the current bid or ask price without moving the price.

LO 45.1: Apply (☆)

Commodity Markets

Figure 2: Futures Liquidity Over Time



Commodity Markets

- Commodity Pricing

$$F_0=S_0e^{(r-\delta+\mu)T}$$

- F_0: commodity future/forward price at time t=0
- S_0: commodity spot price at time t=0
- r: risk-free rate
- δ: convenience yield continuously compounded
- μ: carrying cost continuously compounded
- T: the maturity of the future contracts.

Commodity Markets

Commodity arbitrage ($F_0 > S_0 e^{(r-\delta)T}$)

- **Cash-and-carry arbitrage** consist of buying the commodity, storing/holding the commodity, and selling the commodity at the future price when the contract expires.
- At the initiation of contract:
  - Borrow money for the term of the contract at market interest rates
  - Buy the underlying commodity at the spot price
  - Sell a futures contract at the current futures price
- At contract expiration:
  - Deliver the commodity and receive the futures contract price
  - Repay the loan plus interest

Commodity Markets

Cash-and-Carry Arbitrage	Cash Flow	
Transaction	Time 0	Time T
Short Futures @ $F_{0,T}$	0	$F_{0,T} - S_T$
Buy $e^{-\delta T}$ Commodity Units and Lend @δ	$-S_0 e^{-\delta T}$	S_T
Borrow @r	$S_0 e^{-\delta T}$	$-S_0 e^{(r-\delta)T}$
Total	0	$F_{0,T} - S_0 e^{(r-\delta)T}$

- * δ : continuously dividend(or other income) yield of the asset, no other carrying cost

Commodity Markets

Commodity arbitrage ($F_0 < S_0 e^{(r-\delta)T}$)

- Reverse cash-and-carry arbitrage has the following steps:
- At the initiation of contract:
  - Sell commodity short
  - Lend short sale proceeds at market interest rates
  - Buy futures contract at market price
- At contract expiration:
  - Collect loan proceeds
  - Take delivery of the commodity for the futures price and cover the short sale commitment

Commodity Markets

Reserve Cash-and-Carry Arbitrage	Cash Flow	
Transaction	Time 0	Time T
Long Futures @ $F_{0,T}$	0	S_T-$F_{0,T}$
Short $e^{-\delta T}$ Commodity Units with lease rate δ	$+S_0e^{-\delta T}$	$-S_T$
Lend @r	-$S_0e^{-\delta T}$	$S_0e^{(r-\delta)T}$
Total	0	$S_0e^{(r-\delta)T}$-$F_{0,T}$

- *δ: continuously dividend(or other income) yield of the asset, no other carrying cost.

Commodity Markets

Commodity characteristics

- Corn: seasonality
- Crude oil: long term price less volatile
- Natural gas: regional, costly to store, seasonal
- Electricity: demand not constant, none storability
- Gold: gold mine is assumed to operate, synthetic gold better

Commodity Markets

Commodity Spread

- Crush spread and Crack spread
  - Soybean (5) vs. Soybean meal (4) and soybean oil (1)
  - Crude oil (3) vs. gasoline (2) or heating oil (1)

Commodity Markets

Commodity hedge

- Strip hedge and Stack hedge
  - Strip hedge means that hedging a stream of obligations by offsetting each individual obligation with a futures contract matching the maturity and quantity of the obligation.
  - Stack hedge means that hedging using futures with single maturity to offset changes in the present value of the future obligations.

Question Example

Question:

- Each of the following are major risks involved with commodity spot transactions except:

  A. price risk

  B. transportation risk

  C. delivery risk

  D. ex-pit risk

- **Answer: D**

  Price risk, transportation risk, and delivery risk are forms or risk faced by spot contract holder.

Summary

- ✓ Commodity Forward
  - Cash-and-carry trade
  - Commodity hedge
  - Commodity spread
  - Commodity arbitrage
- ✓ Exam Tips
  - Crack spread和Crush spread计算
  - Cash-and-carry trade的理解和计算

Contents

Chapter 8

Mechanics of Futures Markets

Learning Objectives

- ✓ Describe the types, position variations, and typical underlying assets of options.
- ✓ Explain the specification of exchange-traded stock option contracts, including that of nonstandard products.
- ✓ Describe how trading, commissions, margin requirements, and exercise typically work for exchange-traded options.

Mechanics of Futures Markets

Characteristics specified in a 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 250X)
  - Eurodollar futures contract has a face value of $1 million
  - Delivery Arrangement
- Delivery Months
- Price Quotes
- Price limits and position limits

The Introduction of Futures

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

The Introduction of Futures

Underlying Index	CSI 300 Index
Contract Multiplier	CNY 300
Unit	Index point
Tick Size	0.2 point
Contract Months	Monthly: current month, next month, next two calendar quarters (four total)
Trading Hours	09:15 am - 11:30 am, 01:00 pm - 03:15 pm
Trading Hours on Last Trading Day	09:15 am - 11:30 am, 01:00 pm - 03:00 pm
Limit Up/Down	+/-10% of settlement price on the previous trading day
Margin Requirement	8% of the contract value
Last Trading Day	Third Friday of the contract month, postponed to the next business day if it falls on a public holiday
Delivery Day	Third Friday, same as "Last Trading Day"
Settlement Method	Cash Settlement
Transaction Code	IF
Exchange	China Financial Futures Exchange

The Introduction of Futures

合约标的	沪深300指数
合约乘数	每点300元
报价单位	指数点
最小变动价位	0.2点
合约月份	当月、下月及随后两个季月
交易时间	上午：9:15-11:30，下午：13:00-15:15
最后交易日交易时间	上午：9:15-11:30，下午：13:00-15:00
每日价格最大波动限制	上一个交易日结算价的±10%
最低交易保证金	合约价值的12%
最后交易日	合约到期月份的第三个周五，遇国家法定假日顺延
交割日期	同最后交易日
交割方式	现金交割
交易代码	IF
上市交易所	中国金融期货交易所

The Introduction of Futures

Underlying Bond	Nominal medium-term treasury bond with face value of RMB1 million and coupon rate of 3%
Deliverable Bond	Treasury coupon bond with the remaining term of 4-5.25 years after the first day of the expiry month
Quotation	RMB100 net price
Tick Size	RMB0.005
Contract Months	Three recent quarterly months (a cycle of three recent quarterly months among March, June, September and December)
Trading Hours	09:15 am - 11:30 am, 01:00 pm - 03:15 pm
Trading Hours on Last Trading Day	09:15 am - 11:30 am
Limit Up/Down	+/-1.2% of settlement price on the previous trading day
Minimum Margin Requirement	1% of the contract value
Last Trading Day	The second Friday of the expiry month of the contract
Last Delivery Day	The third trading day after the last trading day
Delivery Method	Physical delivery
Transaction Code	TF
Exchange	China Financial Futures Exchange

Subjects of Futures Market

- **Clearing** is the process by which trades in futures and options are processed, guaranteed, and settled by an entity known as a clearing house.
- A complete clearing house acts as the central counterparty to and guarantor of all trades that it has accepted for clearing from its clearing members.
- The clearinghouse manages margin accounts, and it could reduce credit risk and provide liquidity.

Subjects of Futures Market

- Brokerage Firm
  - Brokerage firm, or simply brokerage, refers to a lawfully established, accept customers' authorization, according to the customer's instructions, in its own name for the client to futures trading fee and intermediary organizations.
- Traders
  - Individuals and Institutions

Forwards vs. Futures

Forwards	Futures
OTC	Exchange-traded
Unique customized contracts	Standardized contracts
Default risk is present	Guaranteed by clearinghouse
Little or no regulation	Regulated
No margin deposit required	Margin required and adjusted
Settlement at maturity	Daily settlement (mark to market)
Delivery usually happens	Closed out before maturity

Clearinghouse & Collateralization

- Clearinghouse in Futures Transactions
  - Each exchange has a clearinghouse.
  - The clearinghouse guarantees that traders in the futures market will honor their obligations.
  - The clearinghouse manage the margin account.
- 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.

Mechanics of Futures Markets

- **Margin trading**
- **Initial margin**: It 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.

Mechanics of Futures Markets

- **Margin trading: (Cont.)**
- Variation margin: Extra funds deposited by the investor after receiving a margin call.
  - **Variation margin = initial margin – margin account balance**

Margin Required and Adjusted

Example

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

Margin Required and Adjusted

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	

Daily Price Limit

- The exchange has the right to impose a limit on the daily price movement of a futures contract from the previous day's closing price.
- A daily price limit set the minimum and maximum price at which the futures contract may trade that day.
- When a daily price limit is reached, trading does not stop but rather continues at a price that does not violate the minimum or maximum price.

The Role of Daily Price Limit

- Pros
  - Increasing the stability of market when new information approaches, and decreasing the fluctuations of futures price.
  - Supplying more time to market participants to analyze new information, and reducing the irrational trading.
- Cons
  - Enhancing the time of value discovery.

Types of Orders

- Market Order
  - It is a request that a trade be carried out immediately at the best price available in the market.
- Limit Order
  - It specifies a particular price, The order can be executed only at this price or at one more favorable to the investor.

Types of Orders

- Stop Order/Stop-Loss Order
  - It 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. In effect, a stop order becomes a market order as soon as the specified price has been hit.
- Stop-Limit Order
  - It is a combination of a stop order and a limit order. The order becomes a limit order as soon as a bid or offer is made at a price equal to or less favorable than the stop price.

Ways to Terminate a Futures Contract

- Physical delivery
  - A short can terminate the contract by delivering the goods. When the long accepts this delivery, he pays the contract price to the short.
- Cash settlement
- Reverse trading
  - If the investor make an exact opposite trade(maturity, quantity and good) to your current position.

Ways to Terminate a Futures Contract

- Exchange for physicals
  - You can find a trade with an opposite position to your own and deliver the goods and settle up between yourselves, off the floor of the exchange. Then you must contact the clearinghouse and tell them what happened.

Summary

✓ 这章以了解概念为主

Practice 1

- An investor enters into a long position in a gold-futures contract with the following characteristics:
  - The initial margin is $3,000
  - The futures price is $993.60
  - The maintenance margin is $2,250
  - Each contract controls 100 troy ounces.
- If the price drops to $991.00 at the end of the first day and $985.00 at the end of the second day, which of the following is closest to the variation margin required at the end of the second day?

  A. $0 B.$260 C.$600 D.$860

Practice 1

- Answer 1: D

✓ 991-993.6=-2.6 so after the first day -2.6*100=-260 loss would incur, and the balance is 3000-260=2740, which is larger than 2250.

✓ 985-991=-6 so after the second day -6*100=-600 loss would incur, and the balance is 2740-600=2140, which is smaller than 2250.

✓ However, the most crucial point is that it would increase its balance to its initial margin account, so it would be 860.

Practice 2

- **FRM EXAM 2004—QUESTION 66**

  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.

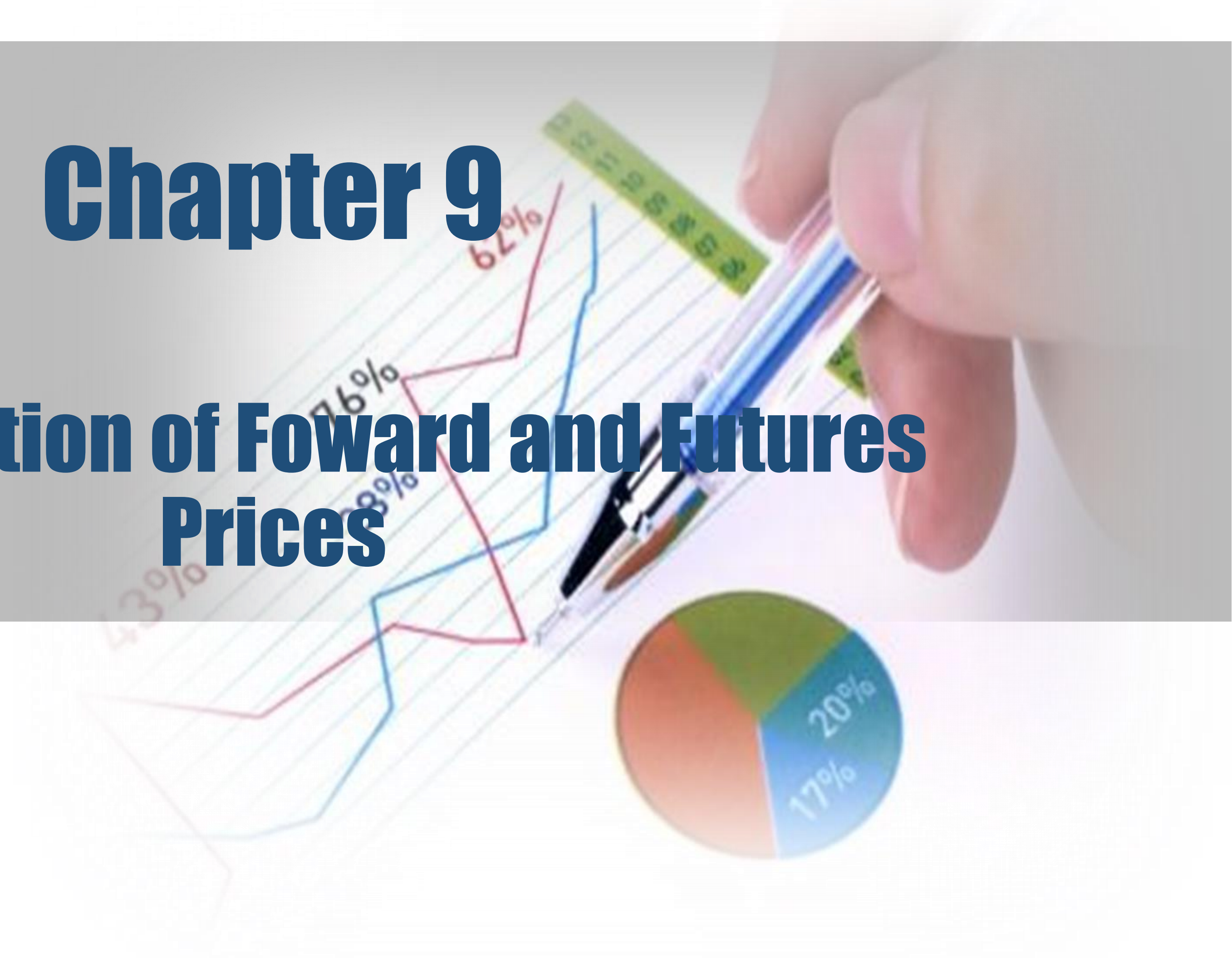
  D. A margin call will be issued only if the investor’s margin account balance becomes negative.

- Answer: D

Contents

Chapter 9

Determination of Foward and Futures Prices



Learning Objectives

- ✓ Differentiate between investment and consumption assets.
- ✓ Define short-selling and calculate the net profit of a short sale of a dividend-paying stock.
- ✓ Describe the differences between forward and futures contracts and explain the relationship between forward and spot prices.
- ✓ Calculate the forward price given the underlying asset’s spot price, and describe an arbitrage argument between spot and forward prices.
- ✓ Explain the relationship between forward and futures prices.
- ✓ Calculate a forward foreign exchange rate using the interest rate parity relationship.

Learning Objectives

- ✓ Define income, storage costs, and convenience yield.
- ✓ Calculate the futures price on commodities incorporating income/storage costs and/or convenience yields.
- ✓ Calculate, using the cost-of-carry model, forward prices where the underlying asset either does or does not have interim cash flows.
- ✓ Describe the various delivery options available in the futures markets and how they can influence futures prices.
- ✓ Explain the relationship between current futures prices and expected future spot prices, including the impact of systematic and nonsystematic risk.
- ✓ Define and interpret contango and backwardation, and explain how they relate to the cost-of-carry model.

Introduction

- Investment Assets vs. Consumption Assets
  - An investment asset is an asset that is held for investment purposes by significant numbers of investors.
  - A consumption asset is an asset that is held primarily for consumption. It is not usually held for investment.
- Short Selling vs. Short Squeeze
  - Short selling are orders to sell securities that the seller does not own.
  - Short squeeze: 指股价(或汇价等)急速上升，迫使先前沽空的投资者(short seller)平仓，这会进一步加速升势，有可能令其它不愿平仓的投资者亦要平仓

Forward & Rate Future Price

Forward price

- $F_0 = S_0 e^{rT}$
  - Wherein:

    T = time to maturity (in years) of the forward contract

    S_0= underlying asset price at t=0

    F_0= forward price today

    r= continuously compounded risk-free annual rate

Forward & Rate Future Price

- **Assumption:**
  - No transaction cost or short sale restrictions, no other carrying cost of benefits
  - Same tax rates on all net profits
  - Borrowing and lending at the risk free rate
  - Arbitrage opportunities are exploited as they arise

Forward & Rate Future Price

Forward price with carrying cost and benefits

- $F_0 = (S_0 \pm I)e^{rT}$
  - Wherein:

    I = present value of the cash flows over T years

    T = time to maturity (in years) of the forward contract

    S_0= underlying asset price at t=0

    F_0= forward price today

    r= continuously compounded risk-free annual rate

Forward & Rate Future Price

Forward price with a known dividend

- $F_0 = S_0 e^{(r-q)T}$
  - Wherein:

    q = continuously compounded dividend yield paid by the underlying asset expressed on a per annum basis

    T = time to maturity (in years) of the forward contract

    S_0= underlying asset price at t=0

    F_0= forward price today

    r= continuously compounded risk-free annual rate

Forward & Rate Future Price

Forward price with storage cost

- $F_0 = (S_0 + U)e^{rT}$ or $F_0 = S_0 e^{(r+u)T}$
  - Wherein:

    U: the present value of know storage cost over the life of the forward contract

    u: storage costs in terms of a continuous yield

Forward & Rate Future Price

Forward price with storage cost and convenience yield

- $F_0 = S_0 e^{(r+u-y)T}$
  - Wherein:

    u: storage costs in terms of a continuous yield

    y: convenience yield

Forward & Rate Future Price

- Forward foreign exchange rate
- $F_0 = S_0 e^{(r - r_f)T}$
  - Where in:

    F_0: forward foreign exchange rate (domestic/foreign currency)

    S_0: spot foreign exchange rate (domestic/foreign currency)

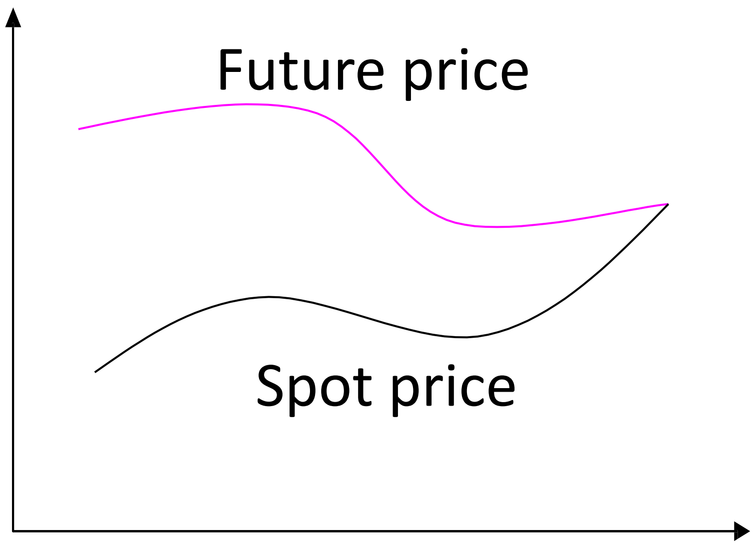
    r: domestic currency interest rate

    r_f: foreign currency interest rate

LO 38.8: Define (☆)

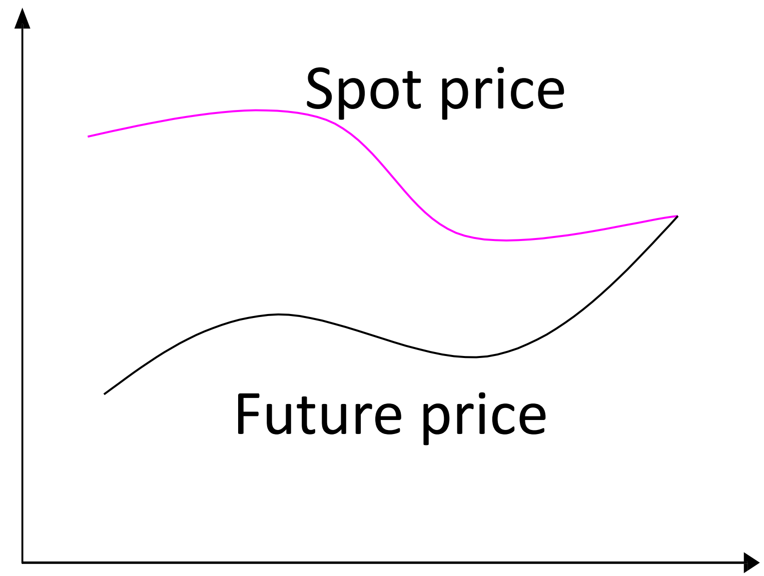
Forward & Rate Future Price

- **Contango and backwardation**



Contango

Future price > Spot price



Backwardation

Future price < Spot price

Forward & Rate Future Price

Delivery option

- Some futures contracts give the short positions right to determine where, when, and what to deliver.
- c > y: short position to deliver early
- c < y: short position to deliver late

Forward & Rate Future Price

Question:

- An Investor has an asset that is currently worth \$500. The continuously compounded risk-free rate at all maturities is 3%. If the asset pays a continuous dividend of 2%, which of the following is the closest to the no arbitrage price of a 3-month forward contract?

  A. \$494.24 B. \$498.75

  C. \$501.25 D. \$506.29

- **Answer: C**

  Forward price = $500 * e^{(0.03-0.02)0.25} = 501.25$

Summary

- ✓ Pricing Forward and Futures
  - Pricing principle
  - No arbitrage price
  - Pricing model
  - Pricing FRA
  - Pricing Swap
  - Swap value
- ✓ Exam Tips
  - 理解carry cost、convenience yield
  - Futures和forward的理论price计算
  - 理论价格和实际价格发生偏差时的套利交易
  - Contango和Backwardation定义

Practice 1

- Three month 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 cost. 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

Practice 1

- Answer 1: B

✓ The value per ounce= $(1050-1000)e^{-0.04\times 0.75}$

✓ The value of the forward contract= $100\times(1050-1000)e^{-0.04\times 0.75}=4852$

Practice 2

- Backwardation refers to a situation where:
  A. spot prices are above futures price.
  B. spot prices are below futures price.
  C. expected futures spot prices are above futures prices.
  D. expected futures spot prices are below futures prices.
- Answer 2: A

✓ Backwardation refers to a situation where spot prices are higher than futures prices. Significant monetary benefits of the asset or a relatively high convenience yield can lead to this result.

Practice 3

- **FRM EXAM 2002—QUESTION 56**

  Consider a forward contract on a stock market index. Identify the *false* statement. Everything else being constant,

  A. The forward price depends directly upon the level of the stock market index.

  B. The forward price will fall if underlying stocks increase the level of dividend payments over the life of the contract.

  C. The forward price will rise if time to maturity is increased.

  D. The forward price will fall if the interest rate is raised.

Practice 3

- Answer 3: D

✓ When the underlying asset pays a dividend, q, we assume that the dividend is paid continuously:

$$F = S_0 e^{(r-q)T}$$

Practice 4

- FRM EXAM 2007—QUESTION 119

  A three-month futures contract on an equity index is currently priced at USD 1,000. The underlying index stocks are valued at USD 990 and pay dividends at a continuously compounded rate of 2%. The current continuously compounded risk-free rate is 4%. The potential arbitrage profit per contract, given this set of data, is closest to

  A. USD 10.00

  B. USD 7.50

  C. USD 5.00

  D. USD 1.50

Practice 4

- Answer 4: C
- ✓ Based on the equation below, the price of the futures should be:

$$F = S_0 e^{(r-q)T}$$

$$F = 990e^{(4\%-2\%)\times 0.25} = 990e^{0.5\%} = 994.96$$

$$\text{Or, } S = \frac{F}{e^{(r-q)T}} = \frac{1000}{e^{0.5\%}} = 995.0125$$

Potential Profit=995.0125-990=5.0125

- ✓ So a good strategy should buy the current asset and short the futures contracts. The potential profit would be 1000-994.96, nearly 5 dollars.

Practice 5

- The owner of 300,000 bushels of corn wishes to hedge his position for a sale in 150 days. The current price of corn is $1.50/bushel and the contract size is 5,000 bushels. The interest rate is 7%, compounded daily. The storage cost for the corn is $18/day. Assume the cost of the storage as a percentage of the contract per year is 1.46%. The price for the appropriate futures contract used to hedge the position is closest to:

  A. USD 6,635
  B. USD 7,248
  C. USD 7,656
  D. USD 7,765

Practice 5

- Answer 5: D

✓ Both the interest and the storage costs compound on a daily basis, a continuous time model is appropriate.

✓ The cost of storage as a percentage of the contract per year is

$$U = 365 \times \frac{18}{1.5 \times 300,000} = 0.0146$$

$$F_0 = S_0 e^{(r+u)T} \times 5,000 = 1.5e^{(0.07+0.0146)\frac{150}{365}} \times 5,000$$

$$= 1.553 \times 5,000 = 7765.34$$

Practice 6

- What is the 3-month forward price for a bushel of corn if the current spot price for corn is $3/bushel, the effective monthly interest rate is 1.5%, and the monthly storage costs are $0.03/bushel?

A. USD 3.18

B. USD 3.23

C. USD 3.29

D. USD 3.31

Practice 6

- Answer 6: B

✓ Because the effective monthly interest rate is 1.5%, so the compounded interest rate would be

$$R = 12 \times \ln(1+1.5\%) = 0.178663$$

Compounded storage cost as a percentage of the contract per year

$$=12 \times \frac{0.03}{3} = 12\% = 0.12$$

$$F = 3e^{(0.178663+0.12)\times 0.25} = 3.232572$$

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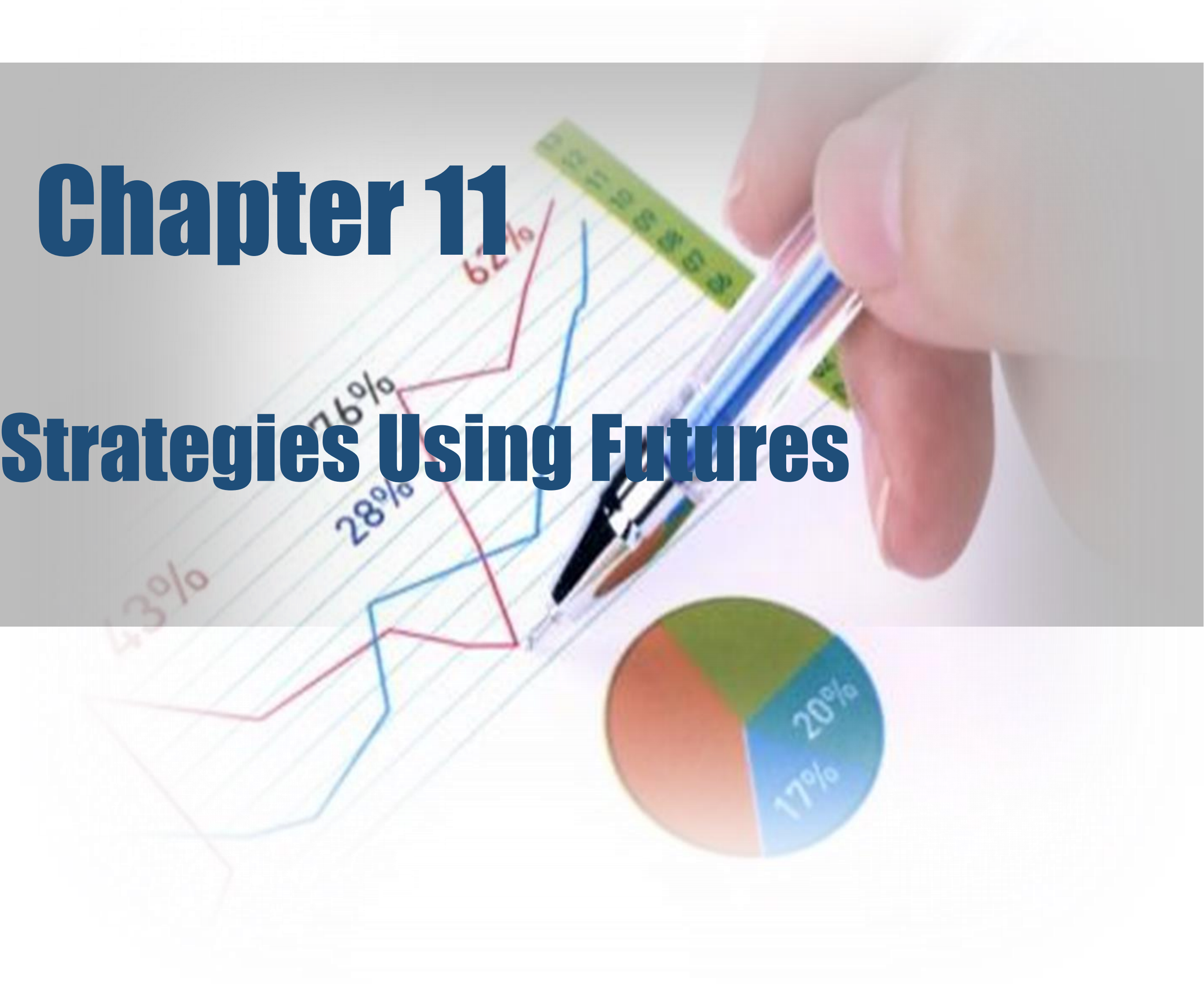
Chapter 11

Hedging Strategies Using Futures



Learning Objectives

- ✓ Define and differentiate between short and long hedges and identify their appropriate uses.
- ✓ Describe the arguments for and against hedging and the potential impact of hedging on firm profitability.
- ✓ Define the basis and explain the various sources of basis risk, and explain how basis risks arise when hedging with futures.
- ✓ Define cross hedging, and compute and interpret the minimum variance hedge ratio and hedge effectiveness.

Learning Objectives

- ✓ Compute the optimal number of futures contracts needed to hedge an exposure, and explain and calculate the "tailing the hedge" adjustment.
- ✓ Explain how to use stock index futures contracts to change a stock portfolio's beta.
- ✓ Explain the term "rolling the hedge forward" and describe some of the risks that arise from this strategy.

Hedging Strategies Using Future

Short Hedge and Long Hedge

- A short hedge occurs when the hedger shorts (sells) a futures contract to hedge against a price decrease in the existing long position.
- A long hedge occurs when the hedger buys a futures contract to hedge against an increase in the value of the asset that underlies a short position.

Hedging Strategies Using Future

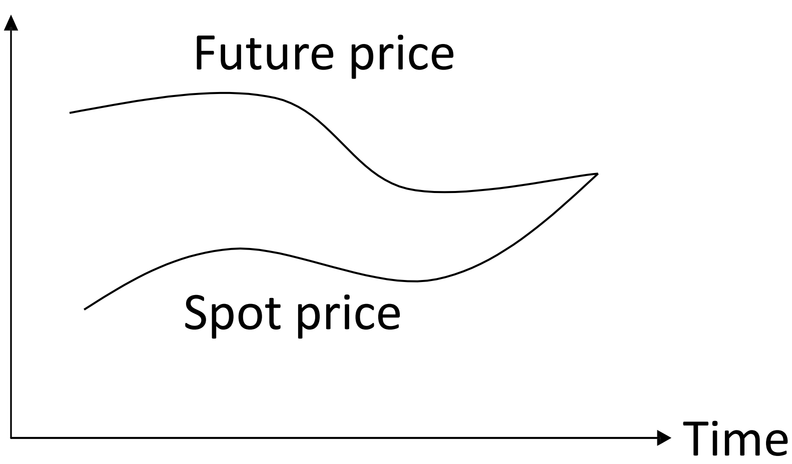
Arguments for & against hedging

- Reduce price risk
- Less impact on the company
- Less profitability

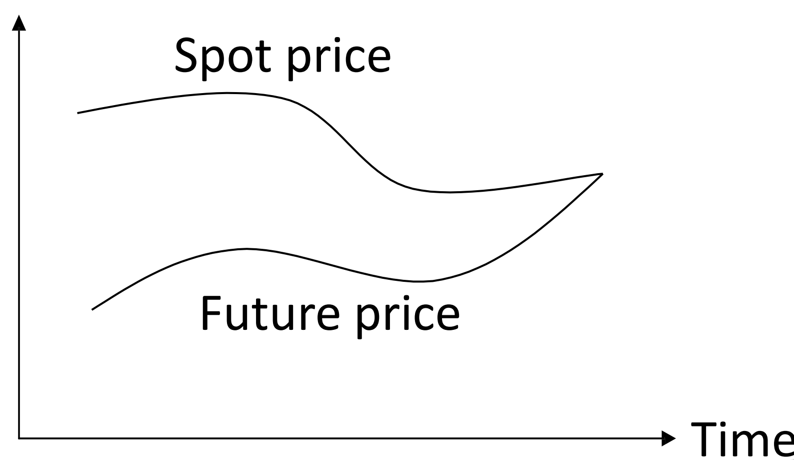
Hedging Strategies Using Future

Convergence of futures and spot prices

- **Basis = spot price – future price**
- As the maturity date nears, the basis converges toward zero.



(a) Future price > Spot price



(b) Spot price > Future price

Hedging Strategies Using Future

Perfect hedging

- All of the existing position characteristics (asset, horizon) match perfectly with those of the future contract specifications.

Hedging Strategies Using Future

Basis risk

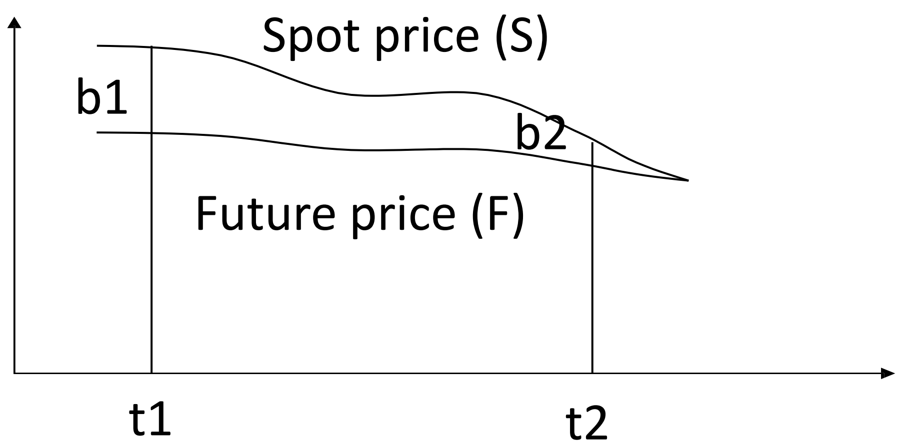
- The asset in the existing position is often not the same as that underlying the futures.
  - e.g. hedging a corporate bond portfolio with a future contract on a U.S Treasury bond
- The hedging horizon may not match perfectly with the maturity.
- So, different asset, different maturity, and the requirement of futures closing out before delivery month are the three reasons of basis risk.

Hedging Strategies Using Future

Basis risk

- For example, an investor enter a future contract at t_1 which mature at t_3 , but he need the underlying asset at t_2 (no future mature at t_2),

  the effective price = $F_1 + (S_2 – F_2) = F_1 + b_2$



Basis: b1 = S1 − F1
b2 = S2 − F2

Hedging Strategies Using Future

Cross hedging

- Cross hedging occurs when the assets underlying the futures contract and the asset whose price is being hedged are different.
  - An airline that is concerned about the futures price of jet fuel. Because there is no futures contract on jet fuel, it might choose to use heating oil futures contracts to hedge its exposure.

Hedging Strategies Using Future

Optimum hedge ratio

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

ΔS: Change in spot price, S, during a period of time equal to the life of the hedge

ΔF: Change in futures price, F, during a period of time equal to the life of the hedge

σ_s : Standard deviation of ΔS

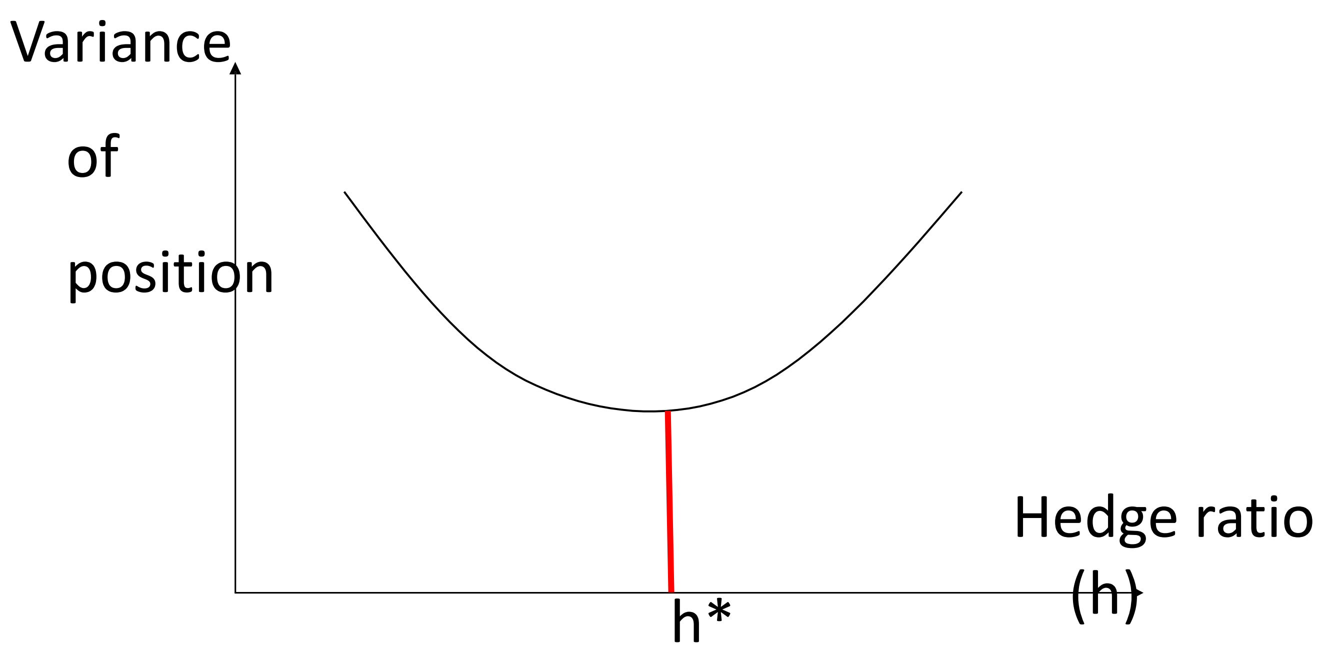
σ_F: Standard deviation of ΔF

ρ: Coefficient of correlation between ΔS and ΔF

h^* : Hedge ratio that minimizes the variance of the hedger's position

Hedging Strategies Using Future

- **Optimal hedge ratio**

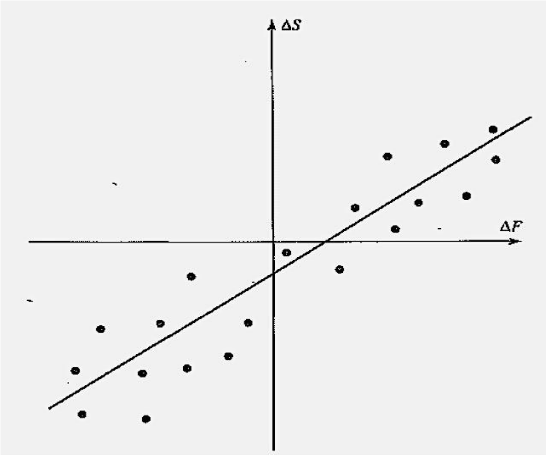


Dependent of variance of hedger's position on the hedge ratio.

Hedging Strategies Using Future

Optimal hedge ratio

- The optimal hedge ratio, h*, is the slope of the best fit line when ΔS is regressed against ΔF.
- **The hedge Effectiveness can be defined as the proportion of the variance that is eliminated by hedging**. This is ρ^2 ,or $R^2 = h^{*2}\frac{\sigma_F^2}{\sigma_S^2}$
- Note: the parameters ρ,σ_F, σ_S, are usually estimated from historical data on ΔS and ΔF.



Hedging Strategies Using Future

Optimum number of contract

- The futures contracts used should have a face value of h^*N_A, the number of futures contracts required is therefore given by:

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

Wherein:

N_A: Size of position being hedged (units)

Q_F: Size of one futures contract (units)

N^*: Optimal number of futures contracts for hedging

Hedging Strategies Using Future

Stock index future

- Stock index futures can be used to hedge an equity portfolio.
- Define:

P: Current value of the portfolio.

A: Current value of the stocks underlying one futures contract.

the appropriate number of futures is:

$$N^{*} = \beta \times \frac{P}{A}$$

β is the slope of the best fit line obtained when excess return on the portfolio over the risk-free rate is regressed against the excess return of the market over the risk-free rate.

Hedging Strategies Using Future

Adjusting the portfolio's beta

- In general, to change the beta of the portfolio from β to β* , the number of contracts required is:

$$(\beta^{*}-\beta)\times\frac{P}{A}$$

- Negative result indicates that selling futures to decrease systematic risk.
- Positive result indicates that buying futures to increase systematic risk.

Hedging Strategies Using Future

Rolling a hedge forward

- When the hedging horizon is long relative to the maturity of the futures used in the hedging strategy, hedges have to be rolled forward as the futures contracts in the hedge come to maturity or expiration.
- Typically, as a maturity date approaches, the hedger must close out the existing position and replace it with another contract with a later maturity. This is called **rolling the hedge forward**.

Hedging Strategies Using Future

- When rolling a hedge forward, hedgers are not only exposed to the basis risk of the original hedge, they are also exposed to the basis risk of a new position each time the hedge is rolled forward. This is referred to as rollover basis risk, or simply **rollover risk**.

Question Example

Question:

- The standard deviation of price change in a wheat futures contract is 0.9, while the standard deviation of changes in the price of wheat is 0.8. The covariance between the spot price changes and the future price changes is 0.36. Which of the following is closest to the optimal hedge ratio?

  A. 0.50

  B. 0.85

  C. 1.07

  D. 0.44

Question Example

- **Answer: D**
- ρ = CovS,F / (σ_S*σ_F) = 0.36/(0.9*0.8) = 0.5

  Optimal hedge ratio = 0.5*(0.8/0.9) = 1.0625

Question Example

Question:

- A large-cap value equity manager has a $6,500,000 equity portfolio with a beta of 0.92. An S&P 500 futures contract is available with a current value of 1,175 and a multiplier of 250. What position should the manager take to completely hedge the portfolio's market risk?

  A. short 20 contracts

  B. short 22 contracts

  C. long 22 contracts

  D. long 20 contracts

Question Example

- **Answer: A**

Because the manager has a long position in the market, she will want to take a short position in the future.

Contract number = $0.92 \times 6{,}500{,}000/(1{,}175 \times 250) \approx 20$

Summary

- ✓ Hedging Strategies
  - Long hedge
  - Short hedge
  - Convergence of futures and spot prices
  - Cross hedging
  - Optimal hedging ratio
- ✓ Exam Tips
  - Future hedging strategy
  - 什么是basis risk
  - Optimal hedging ratio

Practice 1

- **FRM EXAM 2007—QUESTION 99**

✓ 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

Practice 1

- Answer : C
- ✓ There is mainly basis risk for positions that are both long and short either different months or contracts.
- ✓ Position II is long twice the same contract and thus has no basis risk (but a lot of directional risk).

Practice 2

- **FRM EXAM 2007—QUESTION 125**

✓ A firm is going to buy 10,000 barrels of West Texas Intermediate Crude Oil. It plans to hedge the purchase using the Brent Crude Oil futures contract. The correlation between the spot and futures prices is 0.72. The volatility of the spot price is 0.35 per year. The volatility of the Brent Crude Oil futures price is 0.27 per year. What is the hedge ratio for the firm?

A. 0.9333

B. 0.5554

C. 0.8198

D. 1.2099

Practice 2

- Answer 2: A
  - ✓ $0.72*0.35/0.27=0.9333$

Practice 3

- **FRM EXAM 2003—QUESTION 14**

✓ A bronze producer will sell 1,000 mt (metric tons) of bronze in three months at the prevailing market price at that time. The standard deviation of the price of bronze over a three-month period is 2.6%. The company decides to use three-month futures on copper to hedge. The copper futures contract is for 25 mt of copper. The standard deviation of the futures price is 3.2%. The correlation between three-month changes in the futures price and the price of bronze is 0.77. To hedge its price exposure, how many futures contracts should the company buy/sell?

A. Sell 38 futures

B. Buy 25 futures

C. Buy 63 futures

D. Sell 25 futures

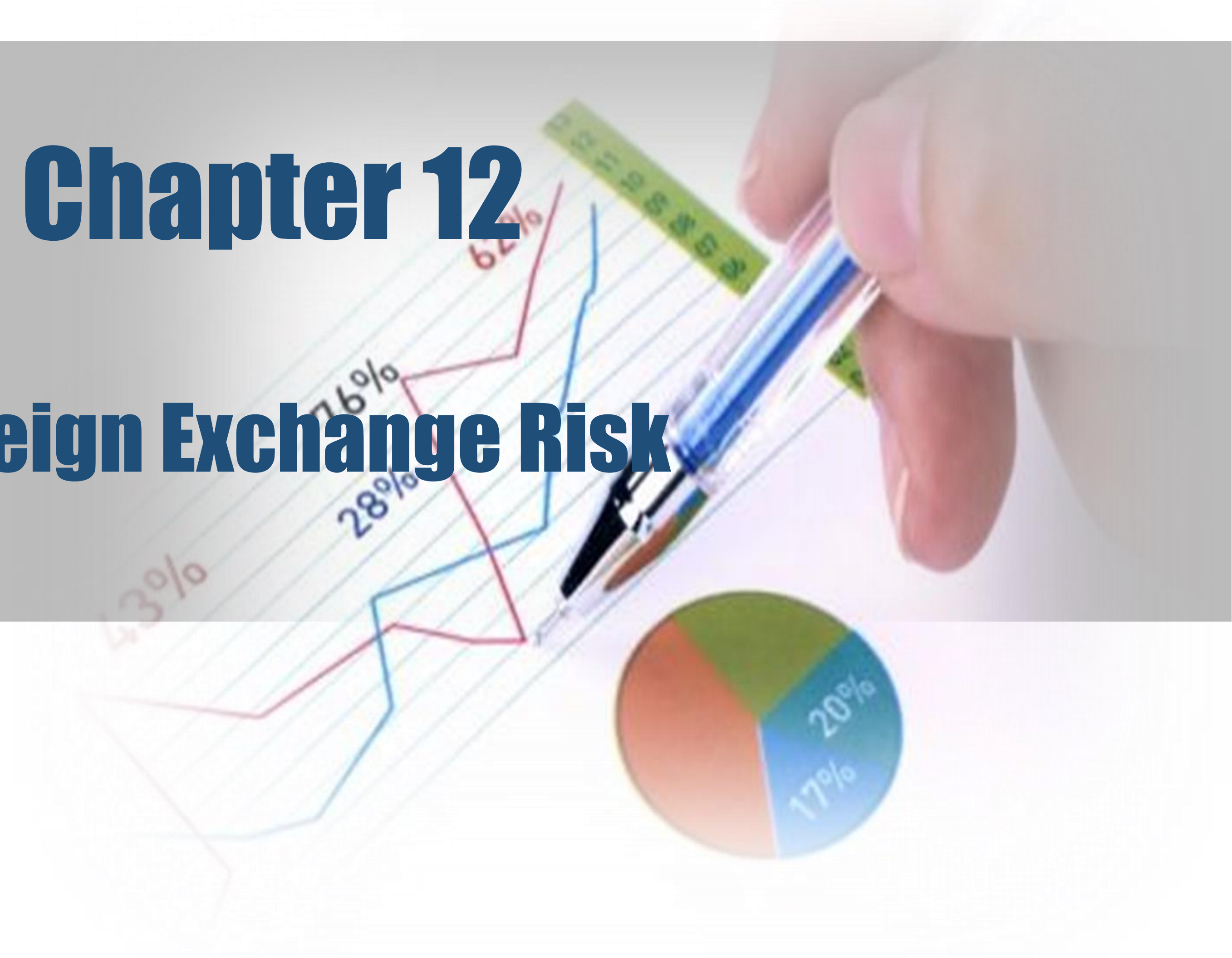
Practice 3

- Answer 3: D
- ✓ $h=\rho*\sigma_s/\sigma_f=0.77*2.6\%/3.2\%=0.625625$
- ✓ $N=h*NA/Q=0.625625*1000/25=25$

Contents

Chapter 12

Foreign Exchange Risk



Learning Objectives

- ✓ Calculate a financial institution’s potential dollar gain or loss exposure to a particular currency.
- ✓ Identify and describe the different types of foreign exchange trading activities.
- ✓ Identify the sources of foreign exchange trading gains and losses.
- ✓ Calculate the potential gain or loss from a foreign currency denominated investment.
- ✓ Explain balance-sheet hedging with forwards.

Learning Objectives

- ✓ Describe how a non-arbitrage assumption in the foreign exchange markets leads to the interest rate parity theorem, and use this theorem to calculate forward foreign exchange rates.
- ✓ Describe the relationship between nominal and real interest rates.

Foreign Exchange Risk

- **Foreign Exchange Risk**
- The risk that an investor will have to close out a long or short position in a foreign currency at a loss due to an adverse movement in exchange rates. It is also known as "currency risk" or "exchange-rate risk".
- A positive net exposure position means net long in a currency, while negative net exposure position means net short in a currency.

LO 49.2: Explain (☆☆)

Foreign Exchange Risk: CHY vs USD

Foreign Exchange Risk

Interest rate parity

- The risk that an investor will have to close out a long or short position in a foreign currency at a loss due to an adverse movement in exchange rates. Also known as "currency risk" or "exchange-rate risk".
- $forward = spot\left[\frac{(1+r_{DC})}{(1+r_{FC})}\right]^T$ (Direct Quote: DC/FC)

$$\frac{F}{(1+r_{DC})^T} = \frac{S}{(1+r_{FC})^T}$$

Where:

r_{DC}=domestic currency rate

r_{FC}=foreign currency rate

Foreign Exchange Risk

- IRP can also be stated using continuously compounded rates as follows:

$$forward = spot \times e^{(r_{DC}-r_{FC})T}$$

Foreign Exchange Risk

Balance sheet hedging

- On balance sheet hedging
  - On-Balance-Sheet Hedging is achieved when a financial institution has a matched maturity and currency foreign asset-liability book.
- Off balance sheet hedging
  - Rather than matching foreign assets with foreign liabilities, we may choose to remain un-hedged on the balance sheet, and hedge off-balance-sheet by taking a position in the forward market.

Question Example

- Century Bank issues USD20 million in U.S. CDs to fund its loan portfolio. The following characteristics pertain to the asset-liability position of the bank:
  - A promised 1-year rate on the CDs of 7%.
  - It invests 50% of its USD20 million in 1-year U.K. loans at 12% (loans made in GBP).
  - The bank invests the other 50% in U.S. loans at 8% for one year.
  - At the beginning of the year, the bank sells USD 10million for GBP in the spot currency markets at an exchange rate of USD1.42/GBP.

Question Example (Cont.)

- If the spot foreign exchange rate does not change over the year, the USD proceeds from the U.K. investment will be:

A. USD7,040,000

B. USD7,890,000

C. USD11,200,000

D. USD12,000,000

- Answer： C
- USD10 million = USD10,000,000/1.42 = GBP7,042,254
- One year later： GBP7,042,254 ×(1+0.12) = GBP7,887,324
- GBP7,887,324×1.42 = USD11,200,000

Question Example (Cont.)

- If the exchange rate falls to USD1.38/GBP, what is the weighted return on the bank's asset portfolio?

A. 1.41%

B. 2.82%

C. 5.41%

D. 8.42%

- Answer: D
- GBP7,887,324 × 1.38 = USD10,884,507
- (USD 10,884,507 - USD10, 000,000) / 10,000,000 = 0.08845 = 8.845%
- (0.5)(0.08) + (0.5)(0.08845) = 8.42%

Question Example (Cont.)

- If the bank hedges its GBP loan in the forward market with USD1.40/GBP, what is the return on the bank's loan portfolio?

A. 8.37%

B. 9.21%

C. 9.79%

D. 10.11%

- Answer: B
- GBP7,887,324 × 1.40 = USD 11,042,254
- (11,042,254 - 10,000,000) / 10,000,000= 10.42%;
- (0.5) (0.08) + (0.5) (0.1042) = 9.21%

Nominal Interest Rate

- **Nominal interest rate** equals the compounded sum of the real interest rate and the expected rate of inflation over an estimation period.
- $R_{nominal} = (1 + R_{real})(1 + Inflation\,rate) - 1$
  - $R_{nominal} \approx R_{real} + Inflation\,rate$

Summary

✓ Foreign Currency Risk

- Balance sheet hedging
- Off balance sheet hedging
- Interest rate parity

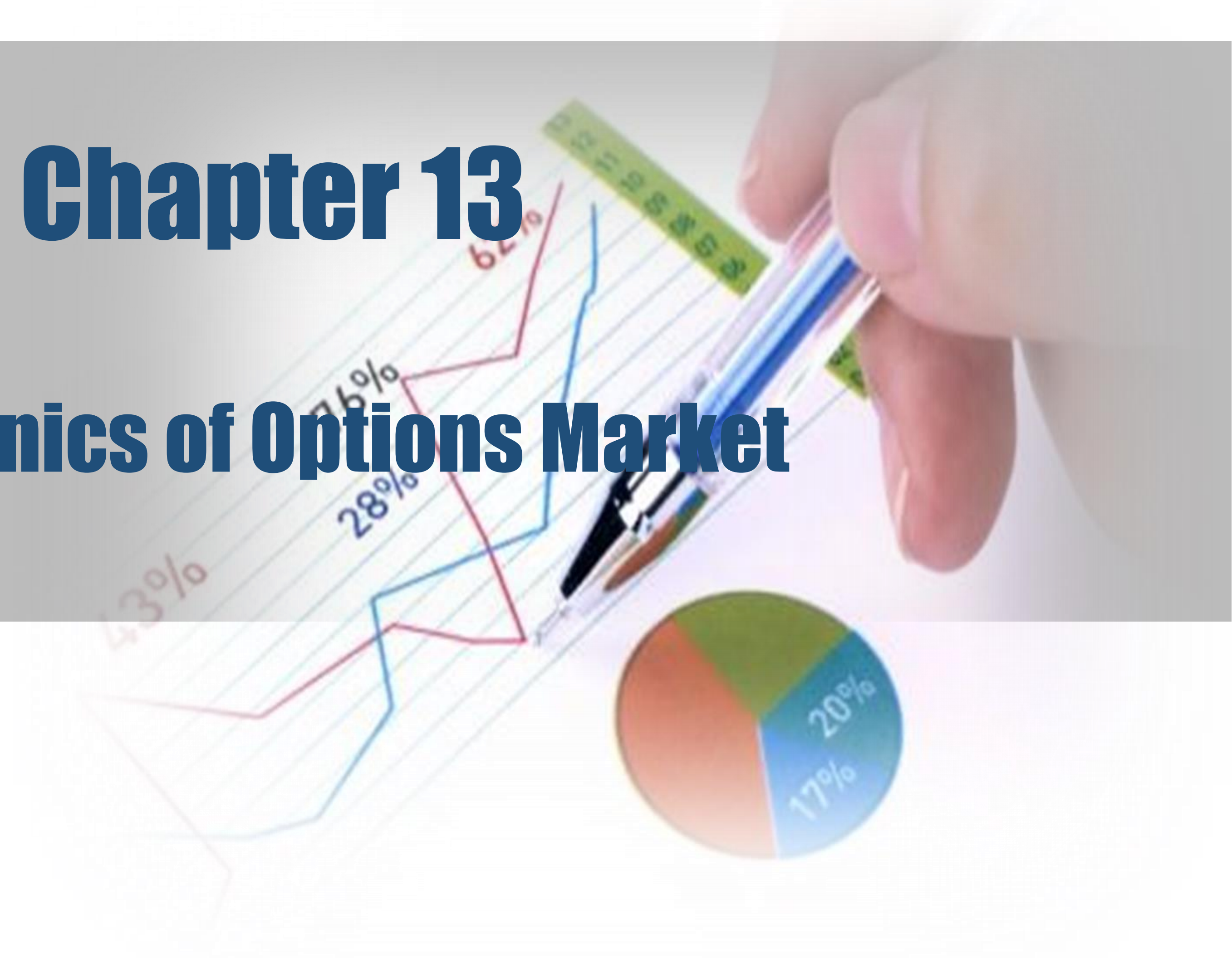
✓ Exam Tips

- 重点在于理解和计算IRP

Contents

Chapter 13

Mechanics of Options Market



Learning Objectives

- ✓ Describe the types, position variations, and typical underlying assets of options.
- ✓ Explain the specification of exchange-traded stock option contracts, including that of nonstandard products.
- ✓ Describe how trading, commissions, margin requirements, and exercise typically work for exchange-traded options.

Types of Options

There are two types of options:

- A **call option** gives the holder the right to buy an asset by a certain date for a certain price.
- A **put option** gives the holder the right to sell an asset by a certain date for a certain price.

Types of Options

Options can be either American or European:

- **European options** can be exercised only on the expiration date itself.
- **American options** can be exercised at any time up to the expiration date.

Option Positions

There are four types of option positions:

- A long position in a call option: right to buy
- A long position in a put option: right to sell
- A short position in a call option: obligation to sell
- A short position in a put option: obligation to buy

Basic Concepts

- **Strike Price**
  - represents the exercise price specified in the contract.
- **Premium**
  - option premium paid by the buyer of option;
  - Initial cost (or initial investment or up-front cost)
- **Expiration date**
  - The date after which an option is void is called the expiration date or maturity date.

Option Positions

- Payoff from a long position in a European call option is Max(S_T-X, 0);
  - Profit $\prod$ = Max(0, S_T - X) - c_0
- Payoff from a long position in a European put option is Max(X-S_T,0;
  - Profit $\prod$ = Max(0, X - S_T) - p_0

Properties of Stock Options

- 分类方法一：按交割时间分：
- American option美式期权: allow the owner to exercise the option at any time before or at expiration
- European options欧式期权: can only be exercised at expiration.
- Price of American option>= price of European options due to more flexibility.

Properties of Stock Options

- 分类方法二：按交易场所分：
- Exchanged-traded: regulated, standardized, liquid;
- OTC options： customized, primarily for institutional buyers.

Properties of Stock Options

- 分类方法三： 按标的物类型分：(Cont.)
- Financial options: include equity options and other options based on stock indexes, interest rates, and currencies.
- Bond Options: most are OTC options that can be deliverable or settle in cash.
- Index Options: settle in cash, nothing is delivered.
- Options on futures: sometimes called futures options, give the holder the right to buy or sell a specified futures contract on or before a given date at a given futures price, the strike price.

Properties of Stock Options

- 分类方法三： 按标的物类型分：(Cont.)
- Commodity options: give the holder the right to either buy or sell a fixed quantity of some physical asset at a fixed (strike) price.

Properties of Stock Options

- Moneyness（价值状态）:定性看long是否赚钱
  - **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**

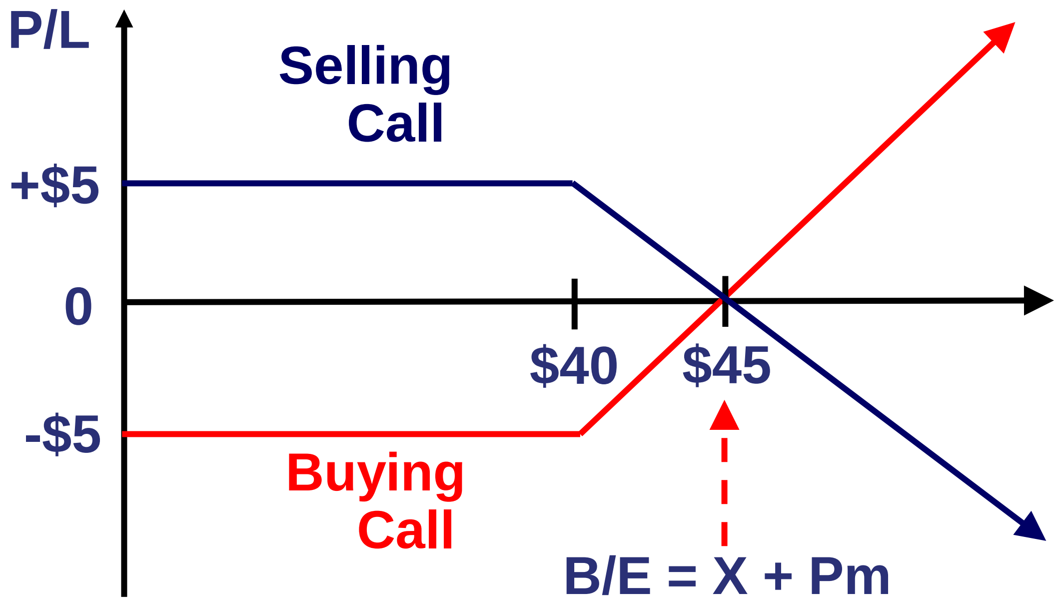
Moneyness	Call option	Put Option
In-the-money	S>X	S<X
At-the-money	S＝X	S＝X
Out-the-money	S<X	S>X

Call Option

- Profit of buying = intrinsic value at expiration - premium
- Profit of selling = - (profit of buying)
- Breakeven underlying price = X + premium

Call Option

- Example: call option with X = $40 and premium = $5



- Max. profit: unlimited
- Max. loss: premium

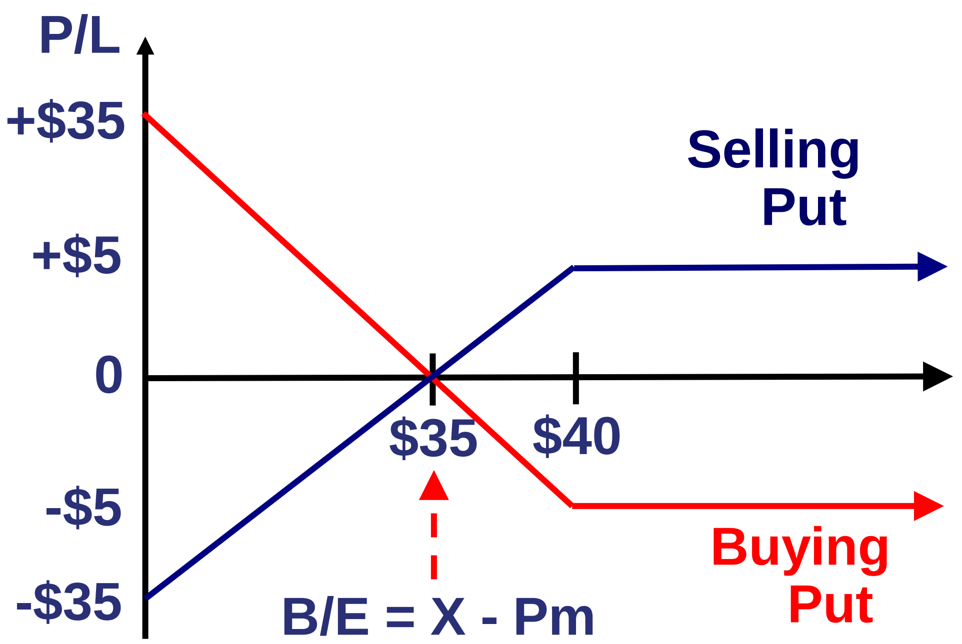
- Max. profit: premium
- Max. loss: unlimited

Put Option

- Profit of buying = intrinsic value at expiration - premium
- Payoff of selling = - (profit of buying)
- Breakeven underlying price = X - premium

Put Option

- Example: put option with X = $40 and premium = $5



- Max. profit: premium
- Max. loss: X - premium

- Max. profit: X - premium
- Max. loss: premium

Option Positions

	Long call	Short call	Long put	Short put
Payoff at T	$Max(S_T - X,0)$	$-Max(S_T - X,0)$	$Max(X - S_T ,0)$	$-Max(X -S_T ,0)$
P/L at T	$Max(S_T - X,0) - Pm$	$-Max(S_T-X,0) + Pm$	$Max(X-S_T ,0) - Pm$	$-Max(X - S_T ,0) + Pm$
Max. profit	Unlimited	Pm	X - Pm	Pm
Max. loss	Pm	Unlimited	Pm	X - Pm
Breakeven	X + Pm	X + Pm	X - Pm	X - Pm

Underlying Assets

- Stock Options
- Foreign Currency Options
- Index Options
- Futures Options

Nonstandard Products

The CBOE trades a number of other nonstandard products

- **Options on exchange-traded funds**
- **Weeklys:** these are options that are created on a Thursday and expire on Friday of the following week.
- **Binary options:** it includes cash-or-nothing option and asset-or-nothing option.

Other Nonstandard Products

- **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.
- **Effect of Dividends and Stock Splits:** Options are adjusted for stock splits. If a stock experience b-for-a stock split, the strike price become a/b and shares underlying become b/a

How Trading Works for Exchange-traded Options?

- **Market Makers**, who 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 asked is the price at which the market maker is prepared to sell.
  - Ensures buy and sell orders be executed without any delays.
  - Add liquidity to the market.
  - Make their profits from the bid–offer spread.

How Trading Works for Exchange-traded Options?

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.
- An investor who has written options can close out the position by issuing an offsetting order to buy the same number of options.

How Commissions Works for Exchange-traded Options?

- For a retail investor, commissions vary significantly from broker to broker.

Sample commission schedule for a discount broker.

Dollar annount 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% dollar amount

- A hidden cost in option trading (and in stock trading) is the market maker's bid-ask spread.

How Margin Requirements Works for Exchange-traded Options?

- When shares are purchased in the United States, an investor can borrow up to 50% of the price from the broker. This is known as **buying on margin**.
- When call and put options with maturities less than 9 months are purchased, the option price must be **paid in full**.
- For options with maturities greater than 9 months investors can buy on margin, borrowing up to **25%** of the option value.

Writing Naked Options

- **A naked option** is an option that is not combined with an offsetting position in the underlying stock. The size of the initial and maintenance margin for naked option is equal to the option premium plus a percentage of the underlying share price.
- Writing **covered calls** is far less risk. (Selling a call option on a stock that is owned by the seller of the option)

How Exercise Works for Exchange-traded Options?

- The **Options Clearing Corporation (OCC)** performs the same function for options markets as the clearing house does for futures markets. It guarantees that options writers will fulfill their obligations under the terms of options contracts and keeps a record of all long and short positions.
- When an investor instructs a broker to exercise an option, the broker notifies the OCC member that clears its trades.
- This member then places an exercise order with the OCC.

Other Option-like Securities

- Warrants
- Employee Stock Option
- Convertible Bond

Summary

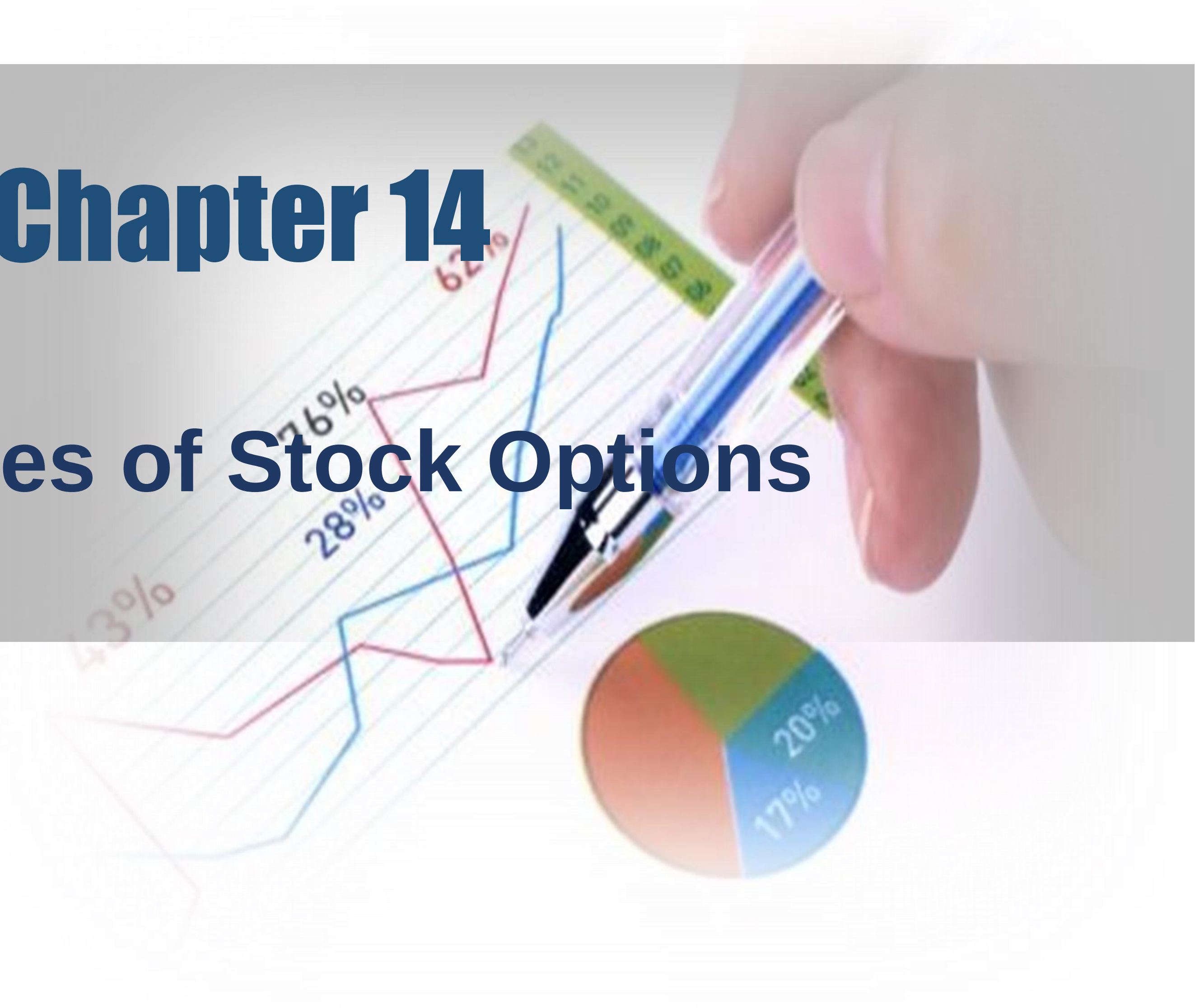
- ✓ Mechanics of Option
  - Call
  - Put
  - Payoff

- ✓ Exam Tips
  - 明确call和put的区别
  - American option和European option的区别

Contents

Chapter 14

Properties of Stock Options



Learning Objectives

- ✓ Identify the six factors that affect an option's price and describe how these six factors affect the price for both European and American options.
- ✓ Identify and compute upper and lower bounds for option prices on non-dividend and dividend paying stocks.
- ✓ Explain put-call parity and apply it to the valuation of European and American stock options.
- ✓ Explain the early exercise features of American call and put options.

Properties of Stock Option

- Six factors that affect option prices
  - S_0 = current stock price
  - X = strike price of the option
  - T = time to expiration of the option
  - r= short-term risk-free interest rate over T
  - D = present value of the dividend of the underlying stock
  - σ = expected volatility of stock prices over T
- When evaluating a change in any one of the factors, hold the other factors constant.

Properties of Stock Option

- **Six factors that affect option prices**

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

Properties of Stock Option

No dividend Vs. With dividend

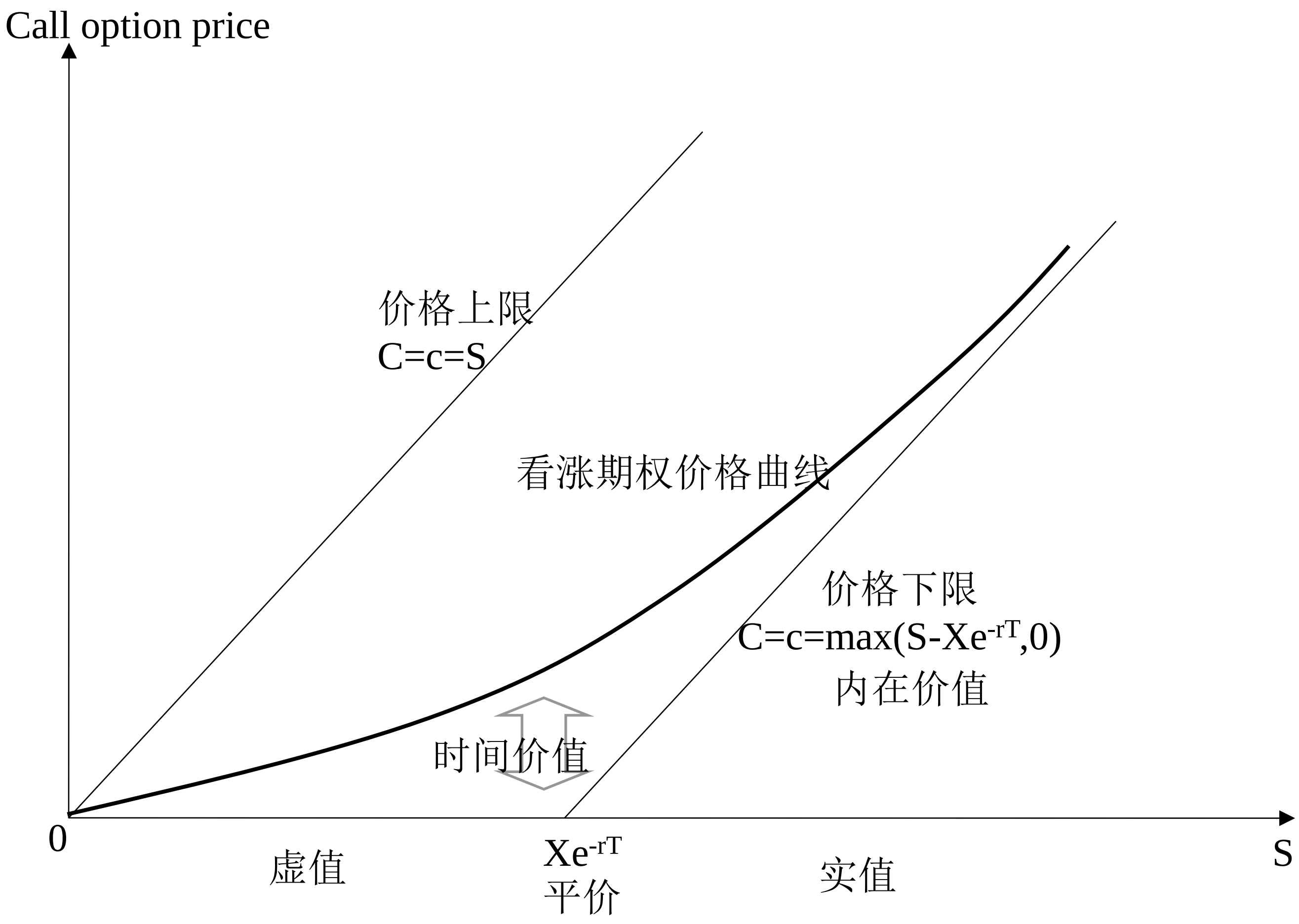
- No dividend
  - American call options = European call options
    - never exercise early
  - American put options can be delivered early,
    - if X—S is large and interest rate is high
- With dividend
  - Both American call and put options can be delivered early
- Remember: whether to early exercise is determined by the cash flow and risk-free interest rate.

Properties of Stock Option

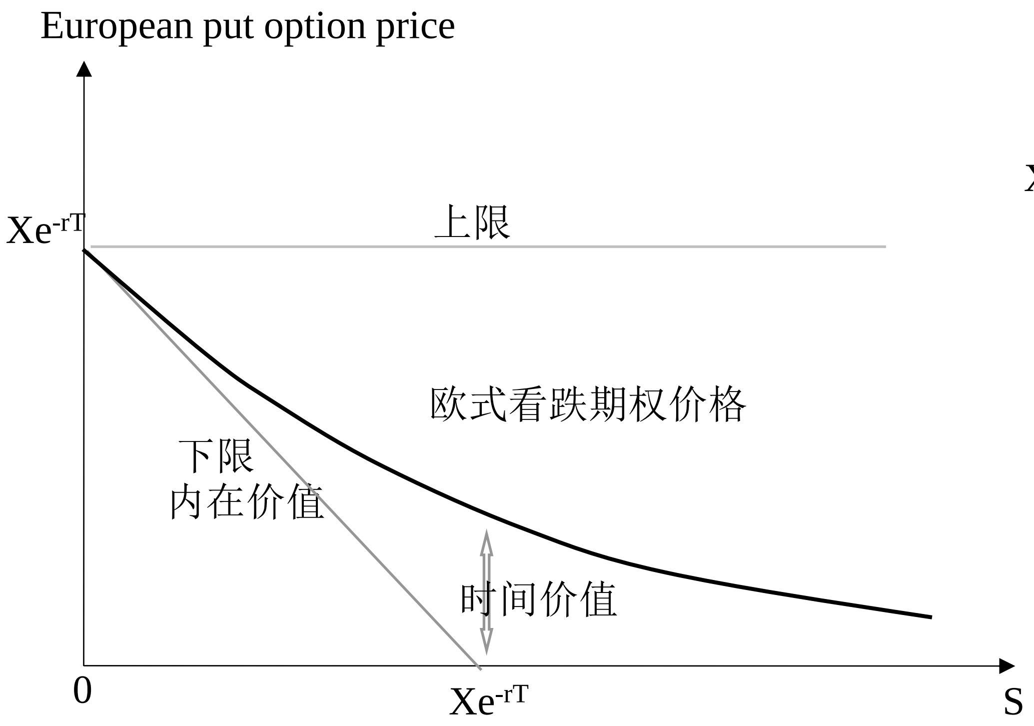
- **Upper and lower pricing bounds**

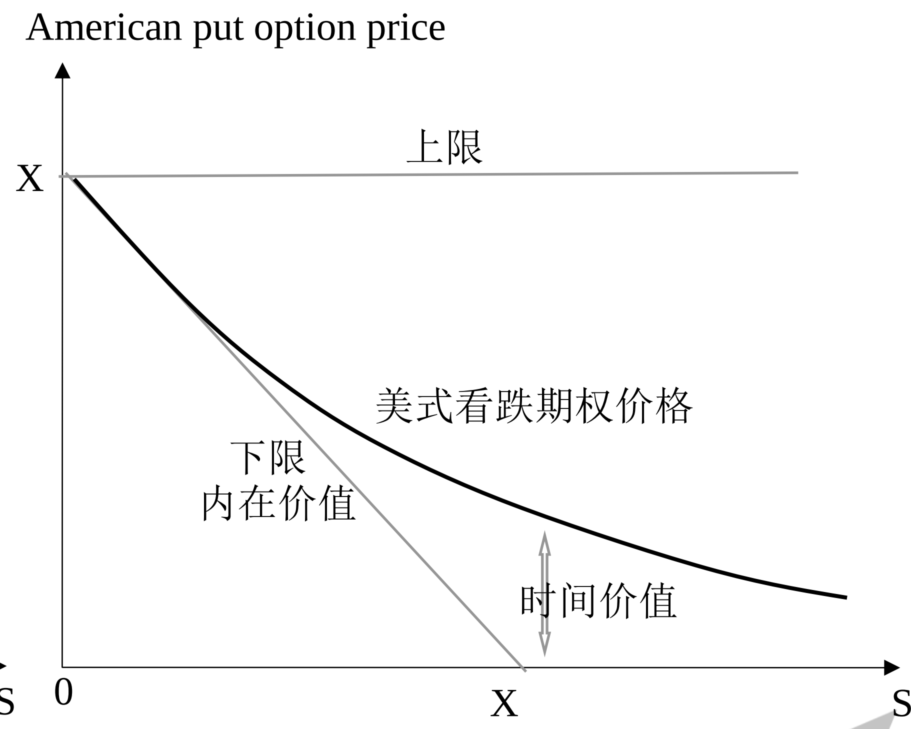
Option	**proxy**	**Min Value**	**Max Value**
European call	c	max $(0, S_0 - Xe^{-rT})$	S_0
American call	C	max $(0, S_0 - Xe^{-rT})$	S_0
European put	p	max $(0, Xe^{-rT} - S_0)$	Xe^{-rT}
American put	P	max $(0, X - S_0)$	X

Properties of Stock Option



Properties of Stock Option





Properties of Stock Option

Upper and lower pricing bounds

- Example1: Compute the lowest possible price for 4-month American and European 75 puts on a stock that is trading at 73 when the risk-free rate is 5%.
- Answer:

  $P>max(0, X-S_0)=max(0, 75-73)=\$2$

  $p>max(0, Xe^{-rT} -S_0)=max(0, 75\ e^{-5\%/3} -73)=\$0.76$

Properties of Stock Option

- Example 2: Compute the lowest possible price for 3-month American and European 73 calls on a stock that is trading at 75 when the risk-free rate is 5%.
- Answer:

$C > \max(0, S_0 - Xe^{-rT}) = \max(0, 75 - 73e^{-5\%/4}) = \$2.91$

$c > \max(0, S_0 - Xe^{-rT}) = \max(0, 75 - 73e^{-5\%/4}) = \$2.91$

Properties of Stock Option

Put-call parity

- Portfolio A: a European call option and an amount of cash equals to Xe^{-rT}

  Portfolio B: a European put option and one share

- Then: $p + S = c + Xe^{-rT}$

  $p = c + Xe^{-rT} - S$ $\quad\quad$ $c = p - Xe^{-rT} + S$

  $p - c = Xe^{-rT} - S$

- With dividend:

  $p + S - D = c + Xe^{-rT}$

- For American option:

  $S - X \leq C - P \leq S - Xe^{-rT}$

Summary

- ✓ Property of Options
  - Put-Call Parity
  - Value bound of Options
- ✓ Exam Tips
  - 各个要素对期权价格的影响
  - 期权价值的上下限
  - 期权平价公式的计算

Practice 1

- **FRM EXAM 2007—QUESTION 84**

According to put–call parity, buying a put option on a stock is equivalent to

A. Buying a call option and buying the stock with funds borrowed at the risk-free rate

B. Selling a call option and buying the stock with funds borrowed at the risk-free rate

C. Buying a call option, selling the stock, and investing the proceeds at the risk-free rate

D. Selling a call option, selling the stock, and investing the proceeds at the risk-free rate

Practice 1

- Answer : C

$$p + S = c + Xe^{-rT}$$

Practice 2

- FRM EXAM 2005—QUESTION 72

  A one-year European put option on a non-dividend-paying stock with strike at EUR 25 currently trades at EUR 3.19. The current stock price is EUR 23 and its annual volatility is 30%. The annual risk-free interest rate is 5%. What is the price of a European call option on the same stock with the same parameters as that of the above put option? Assume continuous compounding.

  A. EUR 1.19

  B. EUR 3.97

  C. EUR 2.41

  D. Cannot be determined with the data provided

Practice 2

- Answer 2: C

$$p + S = c + Xe^{-rT}$$

$$c = p + S - Xe^{-rt} = 3.19 + 23 - 25e^{-5\%} = 2.4092$$

Practice 3

- The price of a non-dividend-paying stock is $20. A six-month European call option with a strike price of $18 sells for $4. A European put option on the same stock, with the same strike price and maturity, sells for $1.47. The continuously compounded risk-free interest rate is 6% per annum. Are these three securities (the stock and the two options) consistently priced?

  A. No, there is an arbitrage opportunity worth $2.00.

  B. No, there is an arbitrage opportunity worth $2.53.

  C. No, there is an arbitrage opportunity worth $14.00.

  D. Yes.

Practice 3

- Answer : D

$$p + S = c + Xe^{-rT}$$

$$c + Xe^{-rT} = 4 + 18e^{-6\% \times 0.5} = 21.47$$

$$p + S = 1.47 + 20 = 21.47$$

Practice 4

- Which of the following will cause a decrease in the value of a European call option position on XYZ stock?

  I. XYZ declares a 3-for-1 stock split.

  II. XYZ raises its quarterly dividend from $0.15 per share to $0.17 per share.

  III. The Federal Reserve lowers interest rate by 0.25% in an effort to stimulate the economy.

  IV. Investors believe the volatility of XYZ stock has declined.

  A. I and II

  B. I and III

  C. II and IV

  D. II, III, and IV

Practice 4

- Answer : D

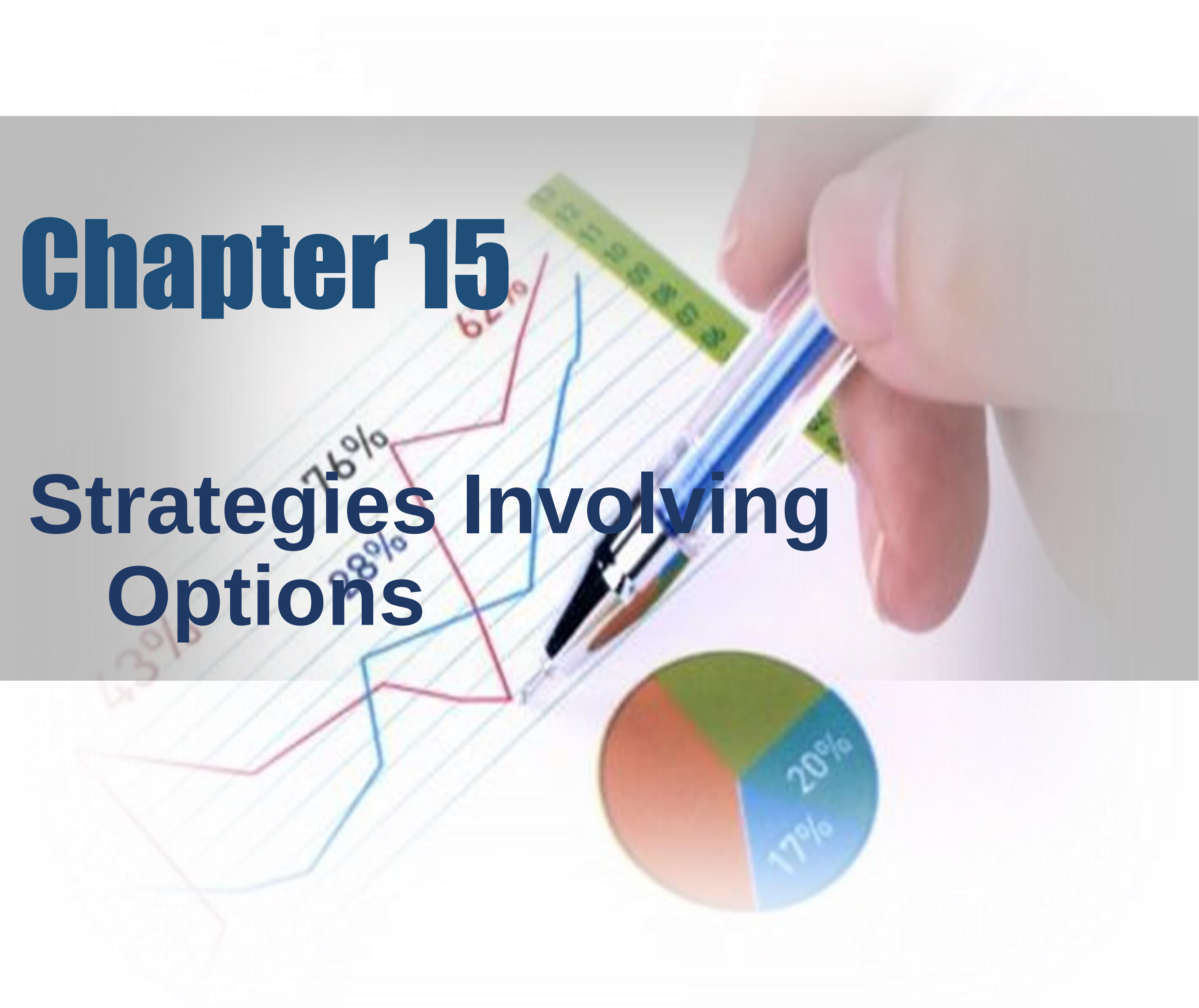
Factor	*European call*	*Situation*
S	+	
X	—	
T	?	
σ	+	IV
r	+	III
D	—	II

After a stock split, both the price of the stock and the strike price of the option will be adjusted, so the value of the option position will be the same.

Contents

Chapter 15

Trading Strategies Involving Options

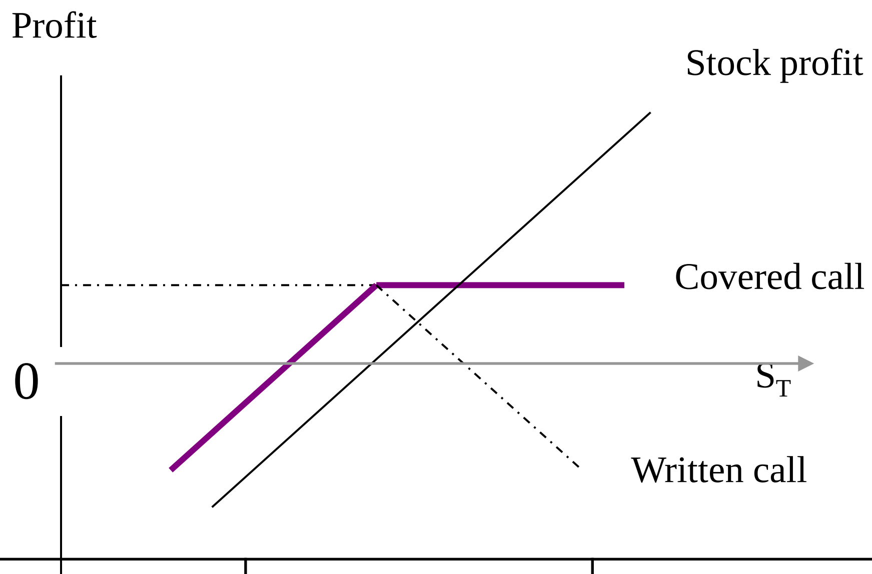


Learning Objectives

- ✓ Explain the motivation to initiate a covered call or a protective put strategy.
- ✓ Describe the use and calculate the payoffs of various spread strategies.
- ✓ Describe the use and explain the payoff functions of combination strategies.

Trading Strategies Involving Options

- **Covered call (short one call, long one share)** covered call$=-c+S$

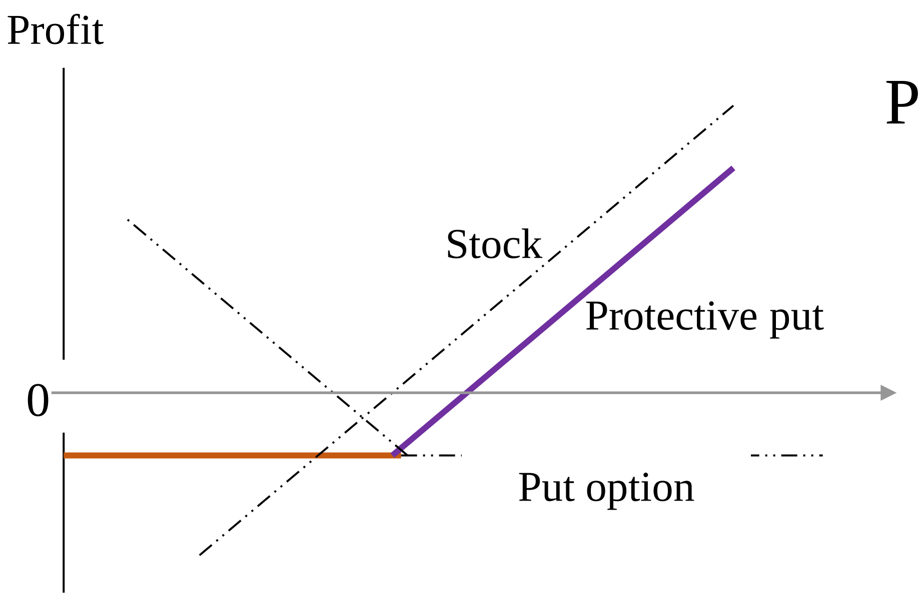


	$S_T<X$	$S_T \geq X$
Short call	C	$C-(S_T-X)$
Long stock	S_T-S_0	S_T-S_0
合计	$C+S_T-S_0$	$C+X-S_0$

- **Why do we need this combination?**
  - ✓ The market does not have a similar put option
  - ✓ The put option market is illiquid
  - ✓ If the S decrease, the premium can reduce the loss

Trading Strategies Involving Options

- **Protective put (long one put, long one stock)**



Protective Put=S+p

	$S_T \geq X$	$S_T < X$
Long put	$-P$	$(X-S_T)-P$
Long stock	S_T-S_0	S_T-S_0
合计	S_T-S_0-P	$X-S_0-P$

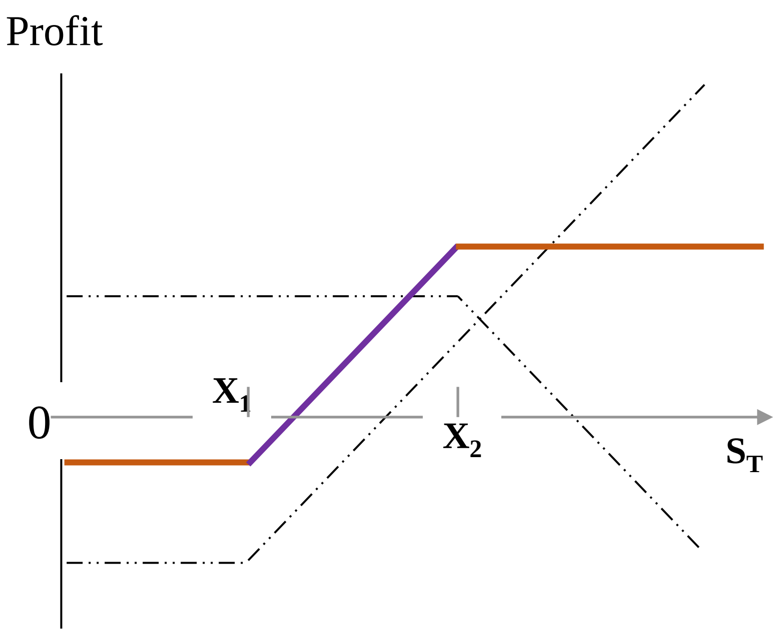
Trading Strategies Involving Options

Spread strategy

- 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).
- Several spread strategies exist. These strategies combine options positions to create a desired payoff profile. The differences between the options are either the strike prices and/or the time to expiration.
- We will discuss bull and bear spreads, butterfly spreads, calendar spreads, diagonal spreads.

Trading Strategies Involving Options

- **Bull call spread(long one call at X_1, short one call at X_2, $X_1<X_2$)**



	$S_T<X_1$	$X_1 \le S_T<X_2$	$S_T \ge X_2$
Long C(T, X_1)	$-C_1$	$S_T-X_1-C_1$	$S_T-X_1-C_1$
Short C(T, X_2)	C_2	C_2	$C_2-(S_T-X_2)$
合计	$C_2-C_1<0$	$S_T-X_1+C_2-C_1$	$X_2-X_1+C_2-C_1$

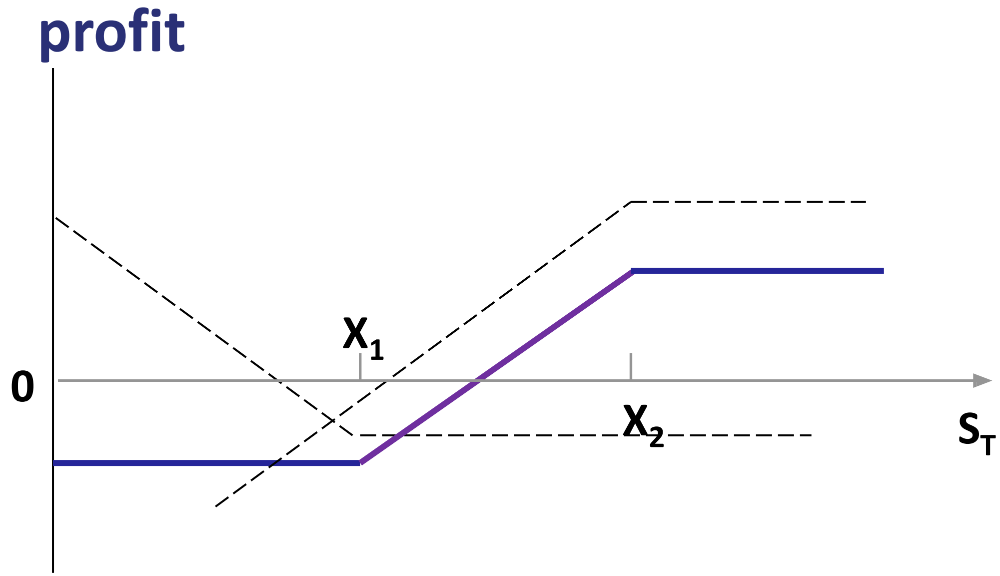
Trading Strategies Involving Options

Example

- An investor purchases a call for C1=$2.00 with a strike if X=$35 and sells a call for C2=$0.50 with a strike price of $55. Compute the payoff of a bull call spread strategy when the price of the stock is at $50.
- **Answer**
- For C1: Profit=(50-35)-2=13
- For C2: Profit=0.5
- Total=13+0.5=13.5

Trading Strategies Involving Options

- **Bull put spread （long one put at X_1, short one put at X_2, $X_1<X_2$）**



	$S_T<X_1$	$X_1 \le S_T<X_2$	$S_T \ge X_2$
Long P(T, X_1)	$X_1-S_T-P_1$	$-P_1$	$-P_1$
Short P(T, X_2)	$P_2-(X_2-S_T)$	$P_2-(X_2-S_T)$	P_2
合计	$P_2-P_1+X_1-X_2$	$P_2-P_1-(X_2-S_T)$	P_2-P_1

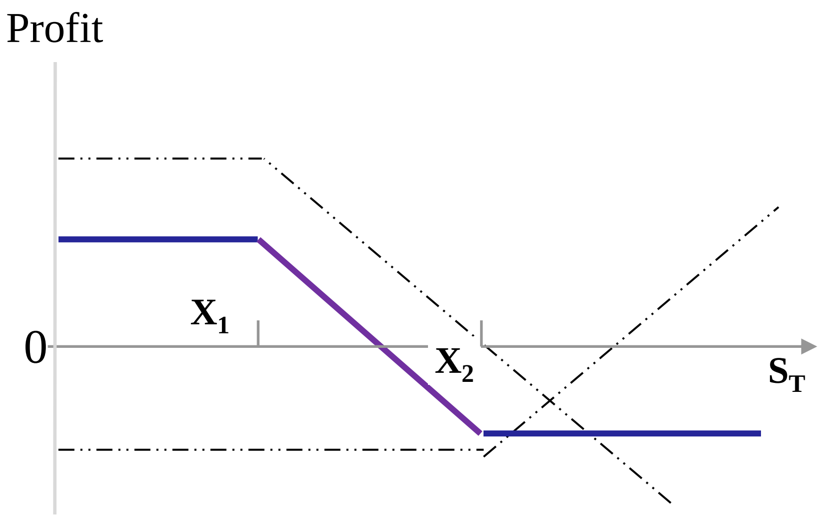
Trading Strategies Involving Options

Example:

- An investor purchases a put for P1=$1.50 with a strike if X=$50 and sells a put for P2=$8.50 with a strike price of $70. Compute the payoff of a bull put spread strategy when the price of the stock is at $60.
- Answer
- For P1: Profit=-1.5
- For P2: Profit=8.5-(70-60)=-1.5
- Total=-1.5-1.5=-3

Trading Strategies Involving Options

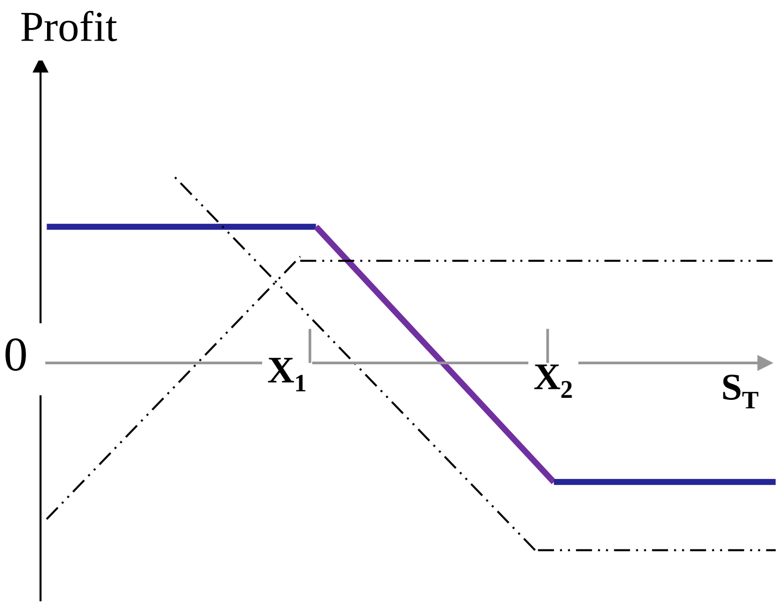
- **Bear call spread(short one call at X_1, long one call at X_2,X_1<X_2)**



	$S_T<X_1$	$X_1 \le S_T < X_2$	$S_T \ge X_2$
short C(T, X_1)	C_1	$C_1-(S_T-X_1)$	$C_1-(S_T-X_1)$
long C(T, X_2)	$-C_2$	$-C_2$	$(S_T-X_2)-C_2$
合计	C_1-C_2	$C_1-(S_T-X_1)-C_2$	$X_1-X_2+C_1-C_2$

Trading Strategies Involving Options

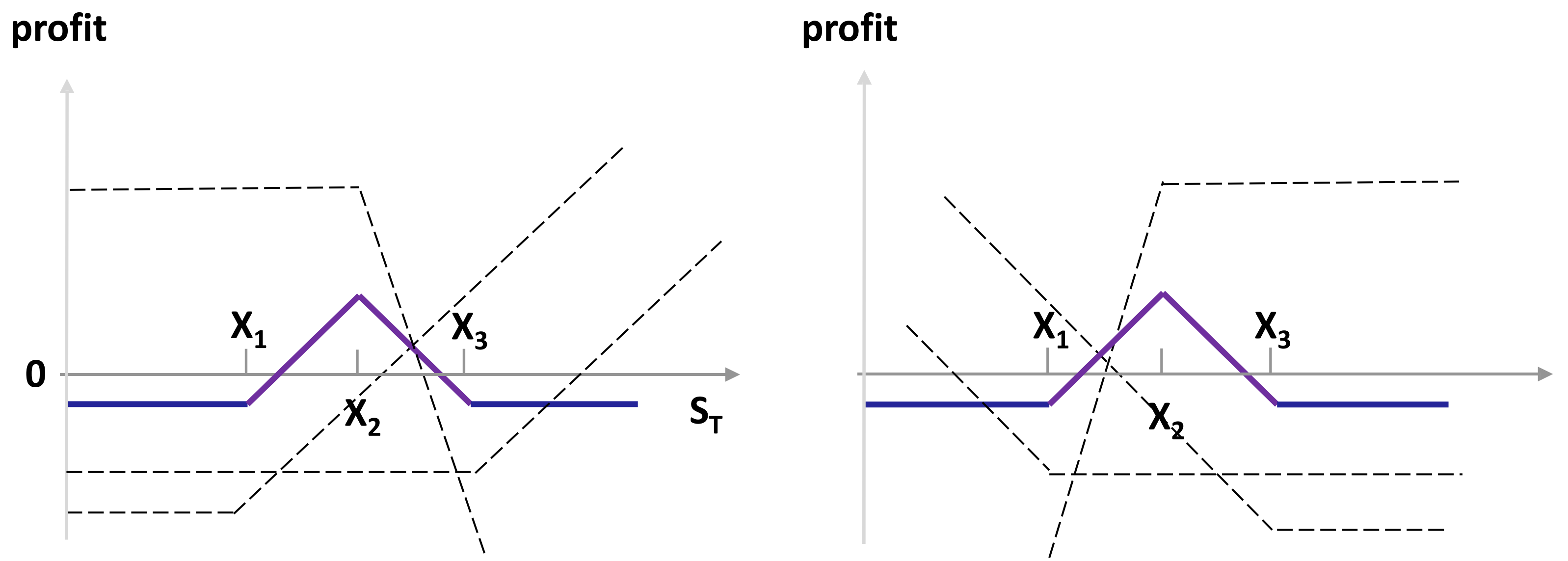
- **Bear put spread (short one put at X_1, long one put at X_2)**



	$S_T<X_1$	$X_1 \le S_T<X_2$	$S_T \ge X_2$
short $P(T, X_1)$	$P_1-(X_1-S_T)$	P_1	P_1
long $P(T, X_2)$	$(X_2-S_T)-P_2$	$(X_2-S_T)-P_2$	$-P_2$
合计	$P_1-P_2+X_2-X_1$	$P_1-P_2+(X_2-S_T)$	P_1-P_2

高顿财经 GOLDEN FINANCE

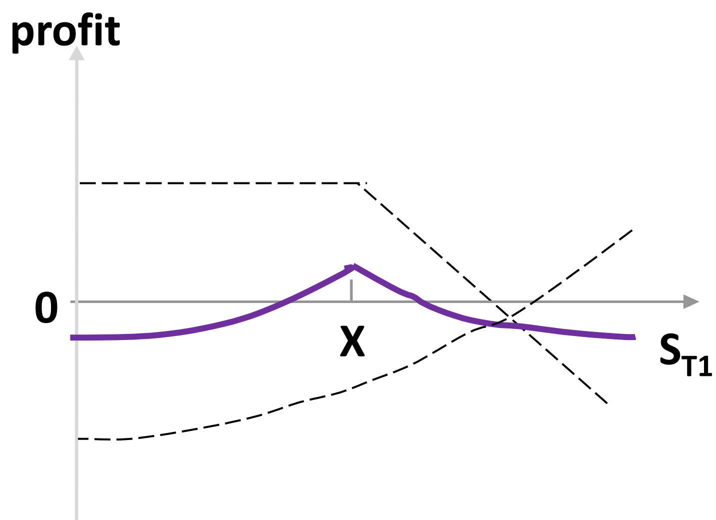
Trading Strategies Involving Options

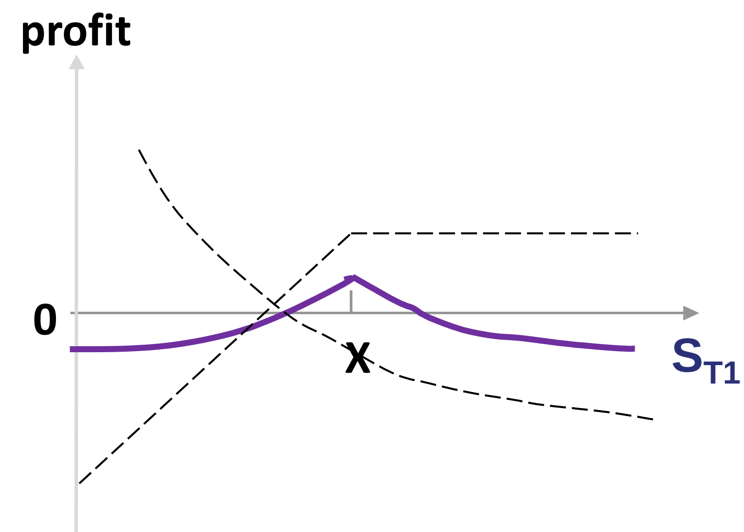


	$S_T<X_1$	$X_1 \le S_T<X_2$	$X_2 \le S_T<X_3$	$S_T \ge X_3$
Long P(T, X_1)	$X_1-S_T-P_1$	$-P_1$	$-P_1$	$-P_1$
Short P(T, X_2)	$2P_2-2(X_2-S_T)$	$2P_2-2(X_2-S_T)$	$2P_2$	$2P_2$
Long P(T, X_3)	$X_3-S_T-P_3$	$X_3-S_T-P_3$	$X_3-S_T-P_3$	$-P_3$
Total	$2P_2-P_1-P_3$	$S_T+X_3-2X_2-P_1+2P_2-P_3$	$X_3-S_T-P_1+2P_2-P_3$	$2P_2-P_1-P_3$

Trading Strategies Involving Options

- Calendar spreads（short one call at T_1, long one call at T_2）



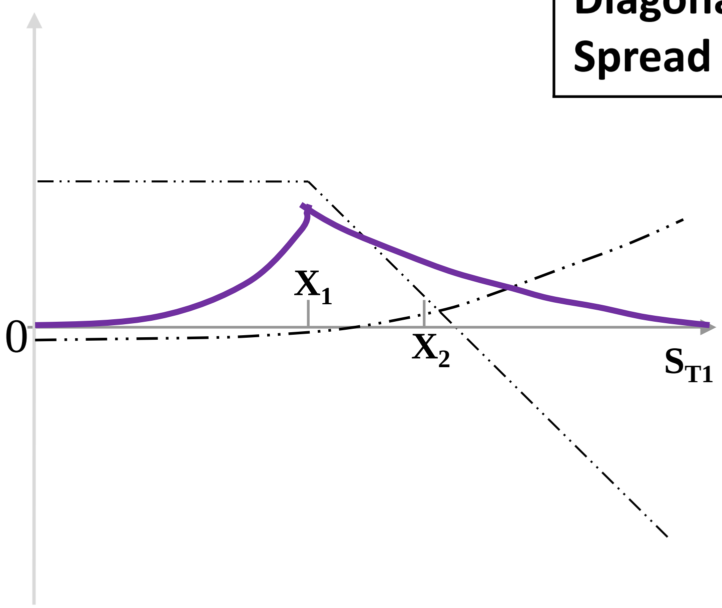


	$S_{T1}\to 0$	$S_T \approx X$	$S_{T1}\to\infty$
Short C(T_1, X)	C_1	C_1	$C_1-(S_{T1}-X)$
Long C(T_2, X)	$-C_2$+ TV	$-C_2$+ TV	$(S_{T1}-X)-C_2$+ TV
Total	$\to C_1-C_2$	C_1-C_2+ larger TV	$\to C_1-C_2$

Trading Strategies Involving Options

- **Diagonal strategies**

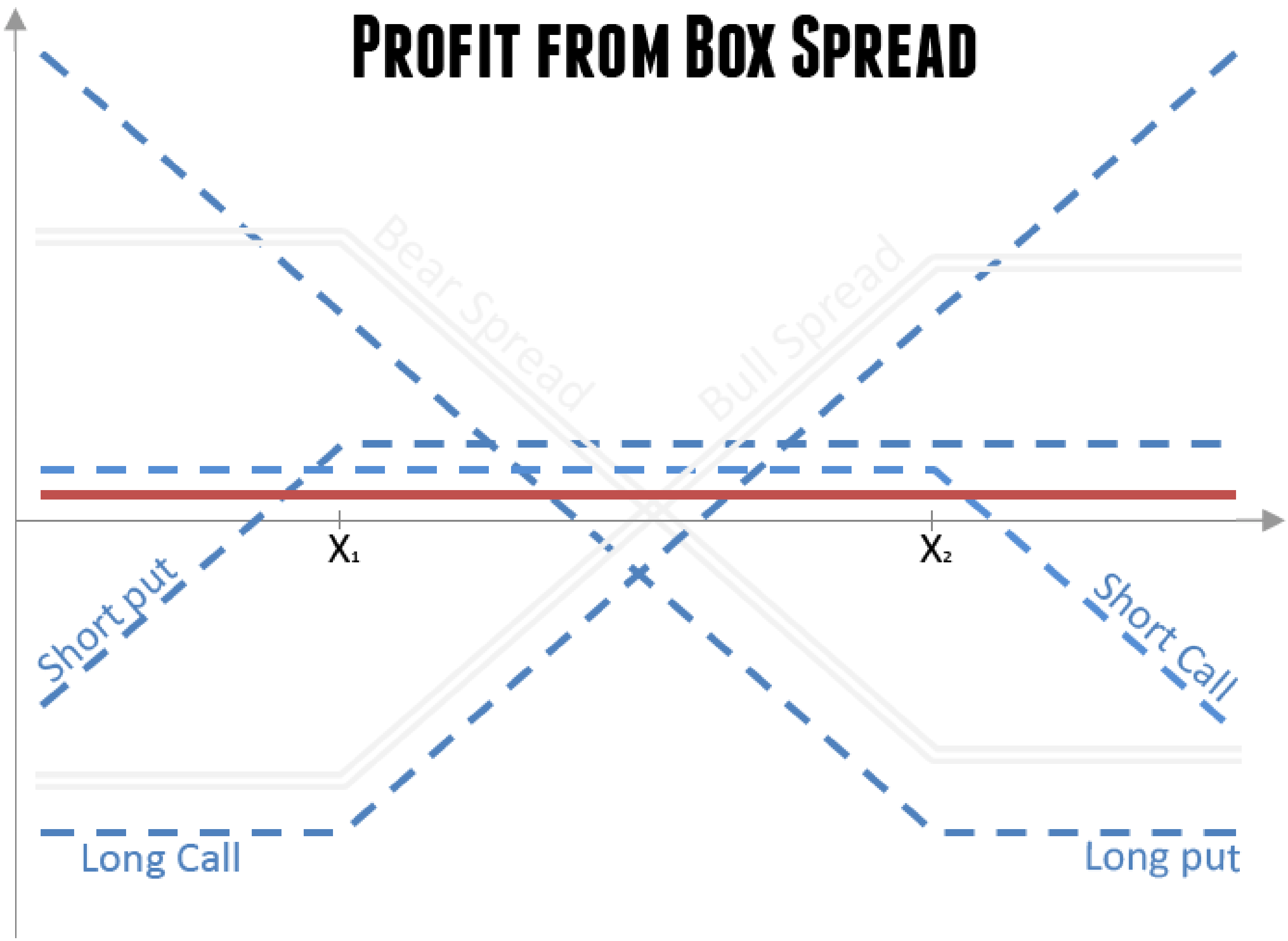
	Strike Price	**Expiration**
Calendar Spread	Same	Different
Diagonal Spread	Different	Different



Trading Strategies Involving Options

- **Box Spread**
- A combination of a bull call spread and a bear put spread on the same asset.
- Under a no arbitrage assumption, the present value of the payoff will equal the net premium paid.
  - **Profit will equal zero.**
- Box spread arbitrage is only successful with European options.

Trading Strategies Involving Options



Trading Strategies Involving Options

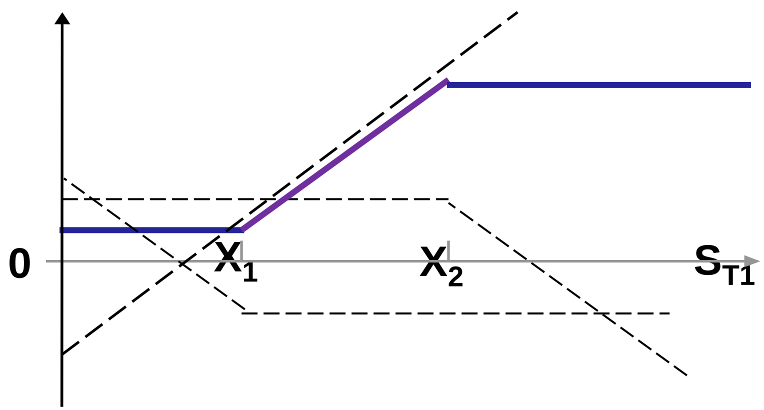
Combination strategy

- A combination is an option trading strategy that involves taking a position in both calls and puts on the same stock.
- It contains collar, straddles, strangles, strips and straps.

Trading Strategies Involving Options

Collar（short on call at X_2, long put at X_1, long 1 share, $X_1<X_2$）

- A collar is created with long stock, long put and short call, with different strike prices.

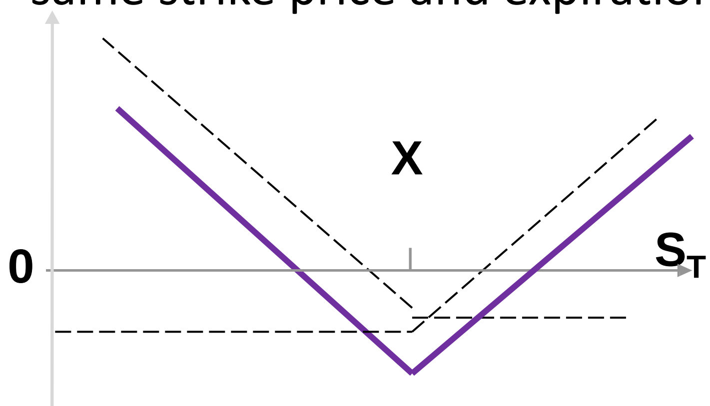


	$S_T<X_1$	$X_1 \le S_T < X_2$	$S_T \ge X_2$
Short C(T, X_2)	C	C	C－(S_T－X_2)
Long P(T, X_1)	(X_1－S_T) －P	－P	－P
Long asset	S_T－S_0	S_T－S_0	S_T－S_0
Total	C－P+X_1－S_0	C－P+S_T－S_0	C－P+X_2－S_0

Trading Strategies Involving Options

Long straddle（long one call, long one put）

- A long straddle is created by purchasing a call and a put with the same strike price and expiration. This strategy bets on volatility.

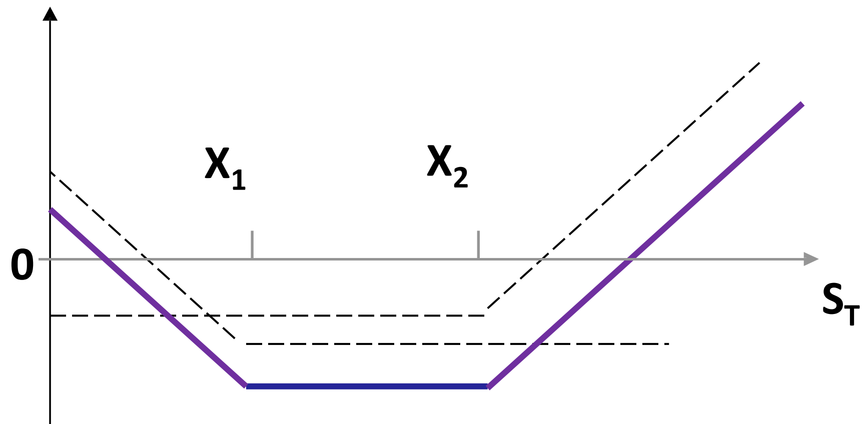


	S_T<X	S_T≥X
Long C(T, K)	−C	(S_T−X)−C
Long P(T, K)	(X−S_T)−P	−P
Total	X−C−P−S_T	S_T− X −C−P

Trading Strategies Involving Options

Strangle（long one call at X_2, long one put at X_1）

- A strangle (or bottom vertical combination) is created by purchasing a call and a put with the same expiration but different strike price.

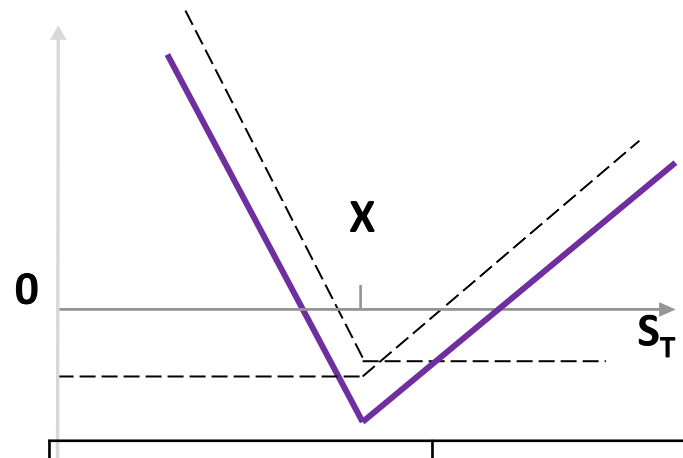


	$S_T<X_1$	$X_1 \le S_T < X_2$	$S_T \ge X_2$
Long C(T, X_2)	$-C$	$-C$	$(S_T-X_2)-C$
Long P(T, X_1)	$(X_1-S_T)-P$	$-P$	$-P$
Total	$(X_1-S_T)-P-C$	$-P-C$	$(S_T-X_2)-C-P$

Trading Strategies Involving Options

Strip（long one call, long two put）

- A strip involves purchasing two puts and one call with the same strike price and expiration.

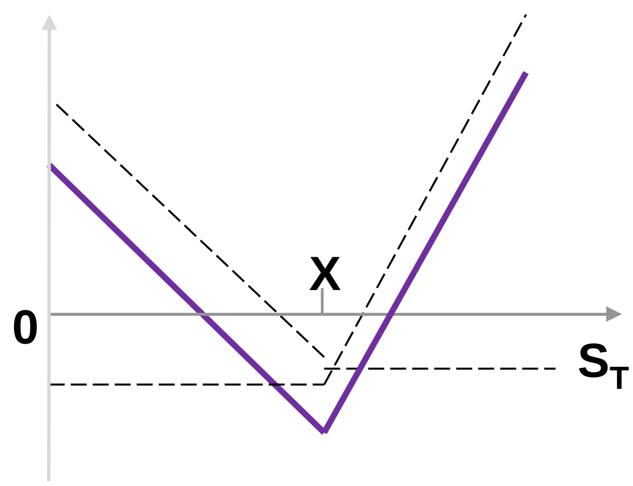


	$S_T<X$	$S_T \geq X$
Long C(T, K)	$-C$	$(S_T-X)-C$
Long 2P(T, K)	$2(X-S_T)-2P$	$-2P$
Total	$2X-C-2P-2S_T$	$S_T-X-C-2P$

Trading Strategies Involving Options

Strap（long two call, long one put）

- A strap involves purchasing two calls and one put with the same strike price and expiration.
- A strap is betting on volatility but is more bullish since it pays off more on the upside.

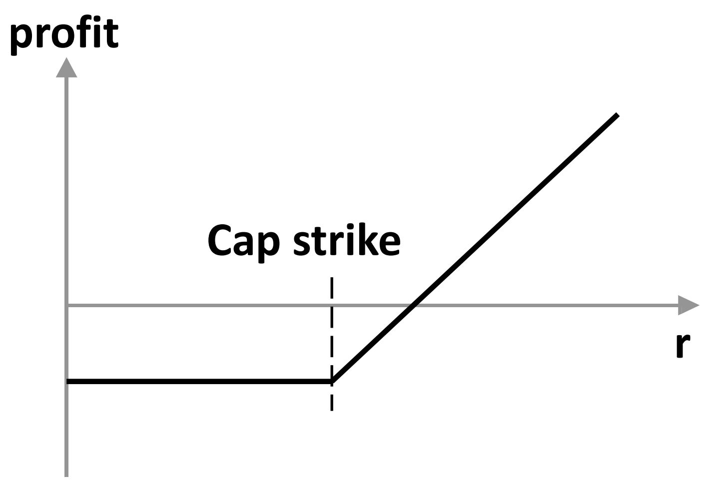


	S_T<X	S_T≥X
Long 2 C(T, K)	—2C	2 (S —X)—2C
Long P(T, K)	(X—S_T)—P	—P
Total	X—2C—P—S_T	2S_T—2X—2C—P

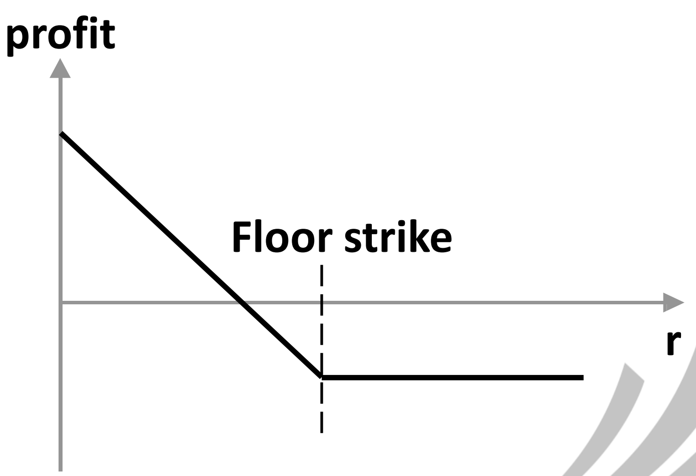
Trading Strategies Involving Options

Interest rate cap and floor

- A long cap is equivalent to a portfolio of long put options on fixed-income security prices.
- A long floor is equivalent to a portfolio of long call options on fixed-income security prices.



Long cap



Long floor

Example 1

- FRM EXAM 2001—QUESTION 90

  Which of the following is the riskiest form of speculation using option contracts?

  A. Setting up a spread using call options

  B. Buying put options

  C. Writing naked call options

  D. Writing naked put options

- Answer 1: C

✓ Writing naked put option may suffer a great amount of , but limited, loss. However, Writing naked call option make it possible to suffer an unlimited loss.

Example 2

- FRMEXAM2007—QUESTION103

  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

Example 2

- Answer 2: D
- ✓ A rise in stock price incur a positive result in the strategy means that it is a bull spread.
- ✓ Maximum loss is the difference between premium received and paid, 5-3=2.
- ✓ Maximum revenue earned is 45-40=5. At this time the cost is the difference between premium received and paid, 5-3=2. Generally, maximum profit would be 5-2=3.

Example 3

- FRM EXAM 2006—QUESTION 45

A portfolio manager wants to hedge his bond portfolio against changes in interest rates. He intends to buy a put option with a strike price below the portfolio’s current price in order to protect against rising interest rates. He also wants to sell a call option with a strike price above the portfolio’s current price in order to reduce the cost of buying the put option. What strategy is the manager using?

A. Bear spread

B. Strangle

C. Collar

D. Straddle

Example 3

- Answer 3: C

✓ Protecting the downside risk at the expense of rising potential, it is a strategy called collar.

Example 4

- **FRM EXAM 2002—QUESTION 42**

  Consider a bearish option strategy of buying one \$50 strike put for \$7, selling two \$42 strike puts for \$4 each, and buying one \$37 put for \$2. All options have the same maturity. Calculate the final profit (P/L) per share of the strategy if the underlying is trading at \$33 at expiration.

  A. \$1 per share

  B. \$2 per share

  C. \$3 per share

  D. \$4 per share

Example 4

- Answer 4: B
- ✓ Buying one \$50 strike put for \$7, exercise, earning 50-33=17, cost 7, profit=17-7=10;
- ✓ Selling two \$42 strike puts for \$4 each, exercise, losing 2*(42-33)=18, receiving 2*4=8, profit=-(18-8)=-10;
- ✓ Buying one \$37 put for \$2, exercise, earn 37-33=4, profit=4-2=2.
- ✓ Total profit=10-10+2=2

Example 5

- **FRM EXAM 2003—QUESTION 72**

Which of the following regarding option strategies is/are *not* correct?

I. A long strangle involves buying a call and a put with equal strike prices.

II. A *short* bull spread involves selling a call at lower strike price and buying another call at higher strike price.

III. Vertical spreads are formed by options with different maturities.

IV. A long butterfly spread is formed by buying two options at two different strike prices and selling another two options at the same strike price.

A. I only

B. I and III only

C. I and II only

D. III and IV only

Example 5

- Answer 5: B

  I. A long strangle involves buying a call and a put with equal strike prices.

  ✓ Same expiration but different strike price.

  II. A *short* bull spread involves selling a call at lower strike price and buying another call at higher strike price.√

  III. Vertical spreads are formed by options with different maturities.

  ✓ Bottom vertical combination is strangle, it is formed with same maturities but different exercise price (both the two are slightly out-of-the-money option)

  IV. A long butterfly spread is formed by buying two options at two different strike prices and selling another two options at the same strike price.√

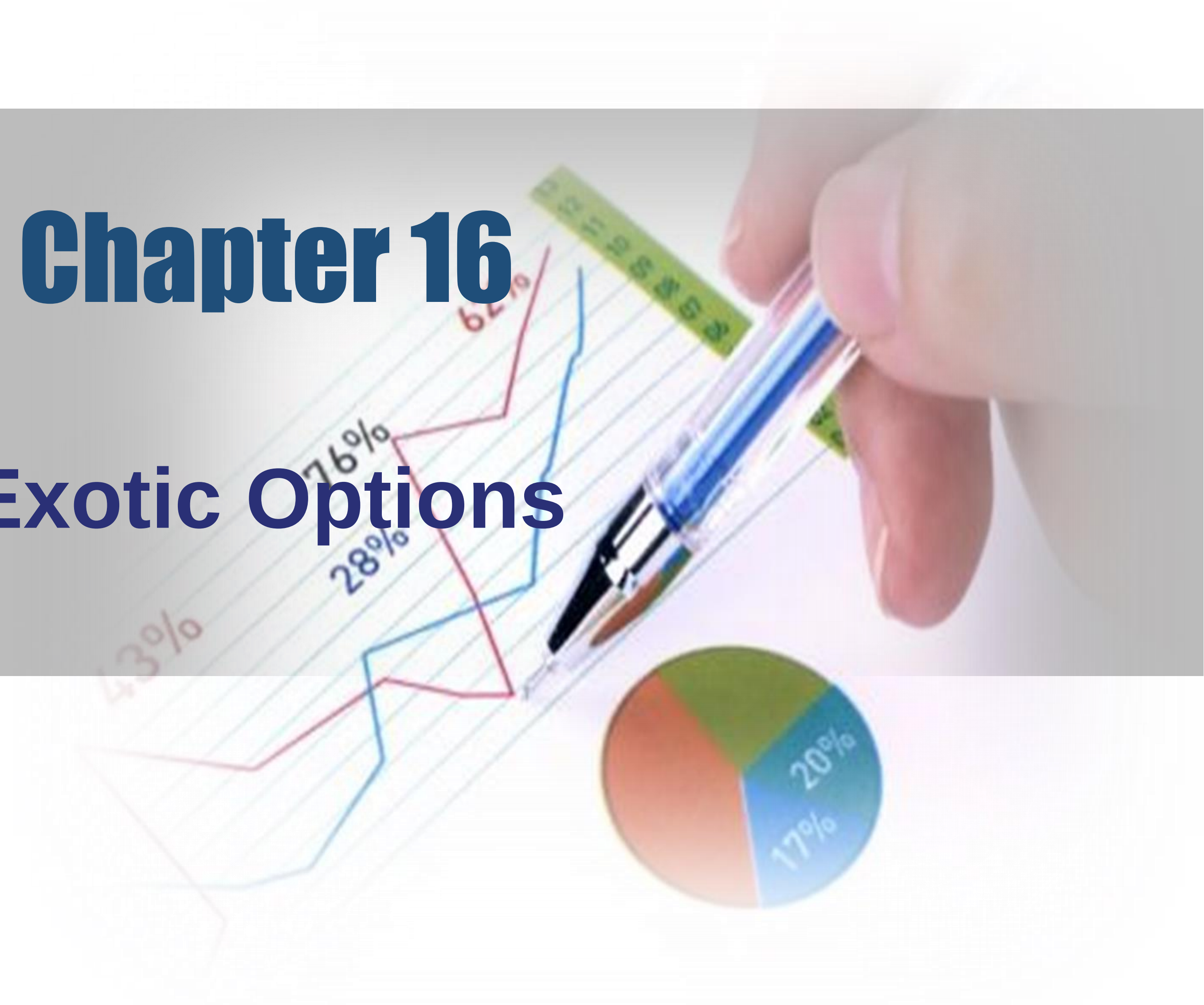
Summary

- ✓ Option trading strategy
  - Covered call
  - Protective put
  - Bull spread
  - Bear spread
  - Calendar spread
  - Butterfly spread
  - Strip/Strap
  - Straddle/strangle
  - Collar
- ✓ Exam Tips
  - 各个strategy的payoff，尤其是protective put，covered call和spread strategy

Contents

Chapter 16

Exotic Options



Learning Objectives

- ✓ Define and contrast exotic derivatives and plain vanilla derivatives.
- ✓ Describe some of the factors that drive the development of exotic products.
- ✓ Explain how any derivative can be converted into a zero-cost product.
- ✓ Describe how standard American options can be transformed into nonstandard American options.
- ✓ Identify and describe the characteristics and pay-off structure of the following exotic options: gap, forward start, compound, chooser, barrier, binary, lookback, shout, Asian, exchange, rainbow, and basket options.
- ✓ Describe and contrast volatility and variance swaps.
- ✓ Explain the basic premise of static option replication and how it can be applied to hedging exotic options.

Exotic Options

Exotic option Vs. plain vanilla derivative

- Plain-vanilla
  - European/American call and put options
  - Standardized (vs. OTC)
  - Trade actively
- Exotics
  - Tailored hedging need (sometimes)
  - Take advantage of accounting, tax, regulatory
  - Customized and illiquid

Exotic Options

- **Packages (一揽子组合期权)**
- A package is a portfolio consisting of standard European calls, standard European puts, forward contract, cash, and the underling asset itself.
  - Example: bull spreads, bear spreads, butterfly spreads, calendar spreads, straddles, strangles, and so on.
  - A package is often structured by traders so that it has zero cost initially.

Exotic Options

Transformation of American options

- Standard American option has a fixed (constant) exercise price & can be exercised at any time during option's life.
- Nonstandard options make exceptions:
  - Early exercise may be restricted to certain dates: Bermuda option
  - Early exercise may be somehow restricted: initial lockout period
  - Strike price may change during the life of an option: The warrants issued by corporations on their own stock often have some or all of these features.

Exotic Options

- **Gap option (缺口期权)**
- This option has two strike prices, X_1 is the real exercise (price to buy or sell), X_2 is the trigger price.
  - If $X_1=X_2$, gap option equals an ordinary European option.
- For a gap call, if $X_2>X_1$:
  - If $S_T>X_2$, payoff=S_T-X_1;
  - If $S_T\leq X_2$, payoff=0.
- For a gap put, if $X_2<X_1$:
  - If $S_T<X_2$, payoff=X_1-S_T;
  - If $S_T\geq X_2$, payoff=0.

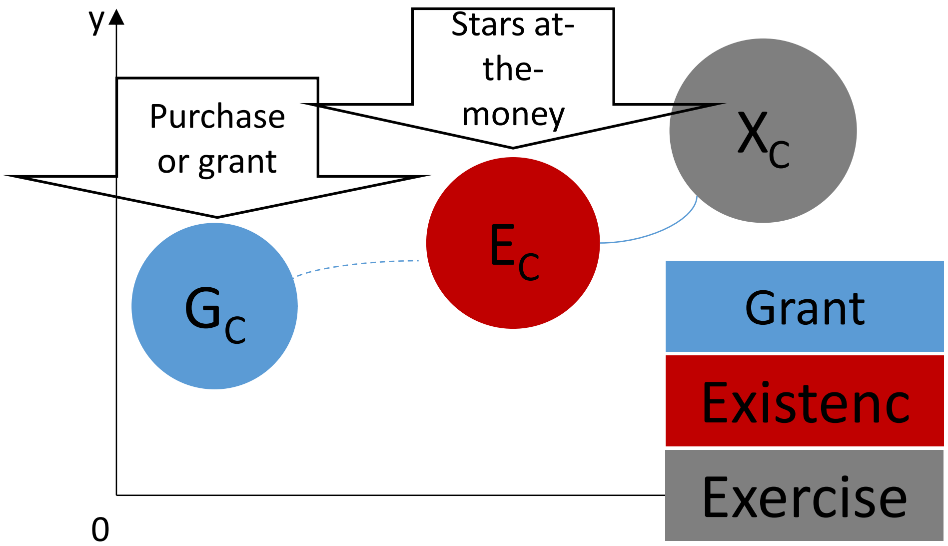
Exotic Options

- **Forward start options (远期生效期权)**
- Forward start options are options that being their existence at some time in the future.
  - For example, today an investor may purchase a 3-month call option that will not come into existence until six months from today.
- Employee incentive plans (员工股权激励计划) commonly incorporate forward start options in which at the money options will be created after some period of employment has passed.

Exotic Options

Forward start options

- Company commits to a grant in the future. Value of forward start option on non-dividend paying stock is same as value (c) on option with same life.

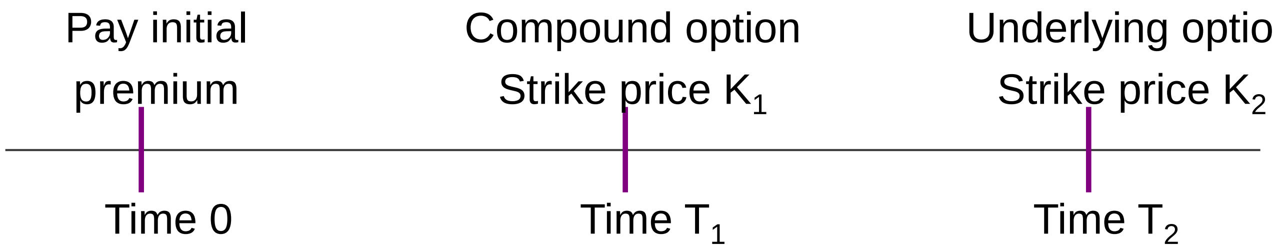


Exotic Options

- **Compound options (复合期权)**
- Four main types of compound options:
  - A call on a call gives the investor the right to buy a call option at a set price for a set period of time.
  - A call on a put gives the investor the right to buy a put option at a set price for a set period of time.
  - A put on a call gives the investor the right to sell a call option at a set price for a set period of time.
  - A put on a put gives the investor the right to sell a put option at a set price for a set period of time.

Exotic Options

- **Compound options**
- Compound options have two strike prices and two exercise dates.



Exotic Options

- **Compound options**
- Compound Option means option of option.
- Usually 2 layers.
- The same logic as the FOF or MOM.

Exotic Options

- **Compound options**

		S_1	S_2
0		T_1	T_2
	Call $_1$	Call $_2$	
	K $_1$	K $_2$	

由Call 2 的预期价值决定

比较K1 与Call 2 的premium，决定是否行权

行权

支付K1，购买协议价为K2的Call 2

不行权

不进入Call 2

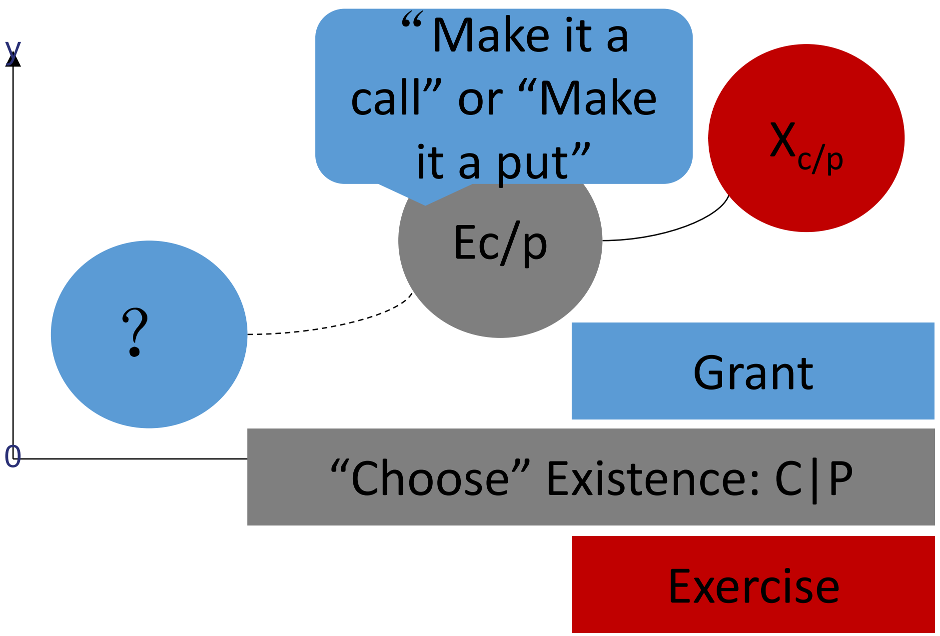
Exotic Options

- **Example**
- There is a compound option on a stock, if the stock price rises, how can we expect the effect of the four kinds of compound options?
- **Answer**
- Stock price rises, so call rises and put drops.
- So, call on call rises, put on put rises, call on put drops, and put on call drops.

Exotic Options

Chooser options (任选期权)

- Gives the holder, after a specified period of time, the right to choose whether the option is a call or put. The value of the chooser option at this point is MAX(c,p).



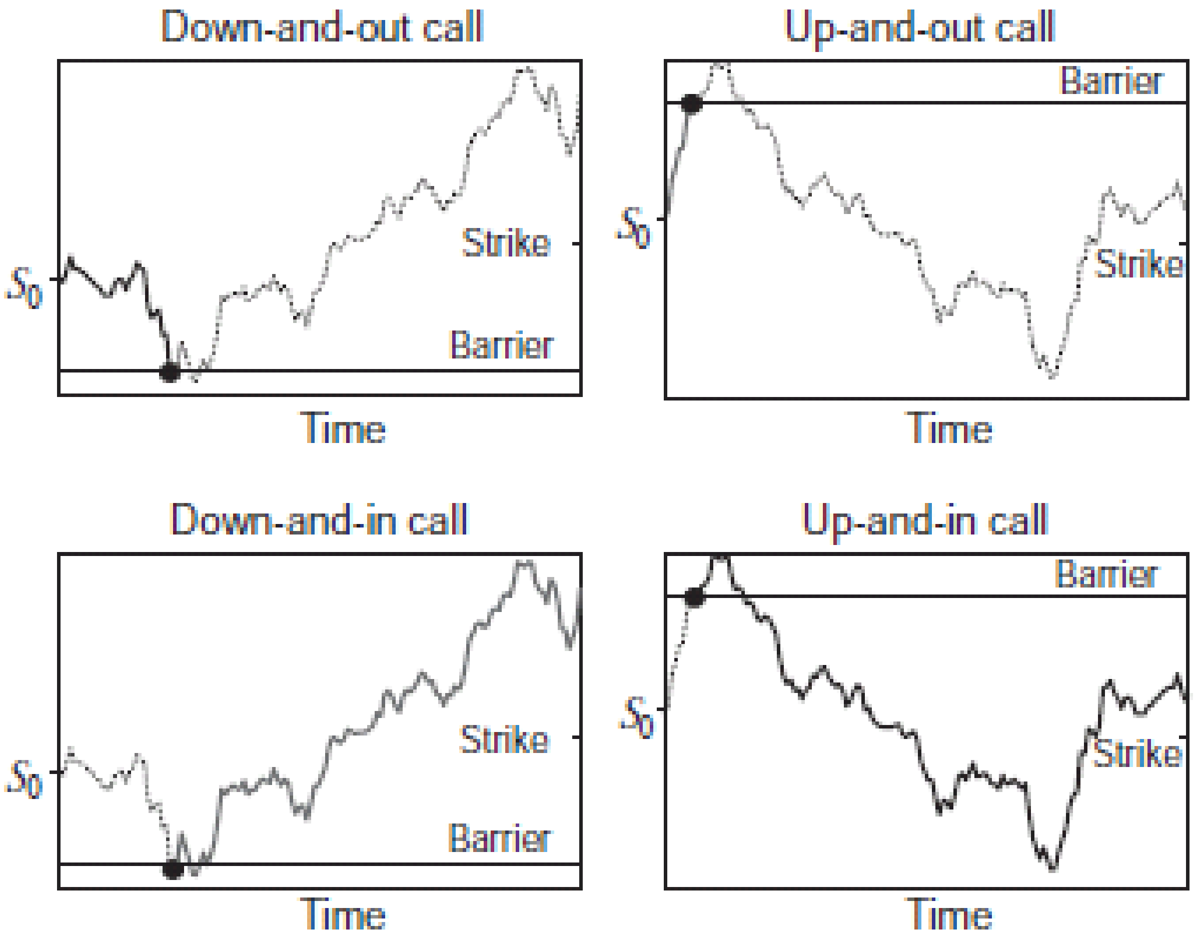
Exotic Options

- **Barrier options (障碍期权)**
- **Barrier options** are options where the payoff depends on whether the underlying asset's price reaches a certain level during a certain period of time.

Exotic Options

- **Knock-out options**
- It ceases to exist when the underlying asset price reaches a certain barrier.
  - Down-and out call / Up-and out call
  - Down-and out put / Up-and out put
- **Knock-in options**
- It comes into existence only when the underlying asset price reaches a certain barrier.
  - Down-and in call / Up-and in call
  - Down-and in put / Up-and in put

Exotic Options



Paths for Knock-Out and Knock-In Call Options

Exotic Options

- **Binary options (两值期权）**
- Binary options, also called digital options are options with discontinuous payoffs.
  - **Cash-or-nothing call**
  - **The payoff nothing if the asset price ends up below the strike price at time T and pays a fixed amount, Q, if it ends up above the strike price.**
  - **The value of a cash-or-nothing call is** $\boxed{Qe^{-rT}N(d_2)}$

Exotic Options

- **Binary options (两值期权）(Cont.)**
  - Asset-or-nothing call
  - The payoff nothing if the asset price ends up below the strike price and pays an amount equal to the asset price itself if it ends up above the strike price.
- The value of a asset-or-nothing call is $\boxed{S_0 e^{-qT} N(d_1)}$
- Notes: 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. $c = S_0 e^{-qT} N(d_1) - K e^{-rT} N(d_2)$

Exotic Options

- **Example**
- A cash-or-nothing call (also known as a digital call) pays a fixed amount to the buyer if the asset finishes above the strike price. Assume that at the end of a 1-year investment horizon, the stock is equal to \$50, the fixed payment amount is equal to \$45, and N(d1) and N(d2) from the Black-Scholes-Merton model are equal to 0.9767 and 0.9732, respectively. The value of this cash-or-nothing call when the risk-free rate equals 3% is closest to:

Exotic Options

- **Example (Cont.)**

A. $5

B. $42

C. $44

D. $47

- Answer: B
- The value of cash-or-nothing call is:

$$V = Qe^{-rT}N(d_2) = 45\times e^{-3\%\times 1}\times 0.9732 = 42.50$$

Exotic Options

- **Lookback Options (回望期权)**
- Lookback options have payoffs that depend on the extreme values of S over the option's life.
- Define S_{MAX} as the maximum and S_{MIN} as the minimum during the life.
- These options are even more expensive than regular options.

Exotic Options

- A good solution to memory for call option:
  - For European call option: $V=\max(0, S_T - X)$
  - For fixed lookback call option: $V=\max(0, S_{MAX} - K)$
  - For floating lookback call option: $V=\max(0, S_T - S_{MIN})$
- Memory for put option:
  - For European put option: $V=\max(0, X - S_T)$
  - For fixed lookback put option: $V=\max(0, K - S_{MIN})$
  - For floating lookback put option: $V=\max(0, S_{MAX} - S_T)$

Exotic Options

- **Example**
- Trader A purchased a 3-month floating lookback call option on ABA stock three months ago. Trader B purchased a 3-month fixed lookback call option on the same stock during the same time period as Trader A. ABA stock finished at $50 at the end of the three-month option term, and the initial strike price was equal to $40. The minimum stock price over the investment horizon was $35, and the maximum stock price over the investment horizon was $53. The payoff difference between the floating lookback call and the fixed lookback call is closest to: (   )

Exotic Options

- **Example (Cont.)**

A. $2

B. $3

C. $8

D. $10

- **Answer**: A
- Value of floating call option= $S_T - S_{MIN}$=50-35=15
- Value of fixed call option= $S_{MAX} - K$ =53-40=13
- The difference=15-13=2

Exotic Options

- **Shout Options (喊叫期权/呼叫期权/叫停期权)**
- 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.

Exotic Options

- **Example**
- Strike price is $50 and the holder of a call shouts when the price of the underlying asset is $60. If the final asset price is less than $60, the holder receives a payoff of $10. If it is greater than $60, the holder receives the excess of the asset price over $50.
- It shares a part feature with lookback option, but a bit less expensive.

Exotic Options

- **Asian options**, or average rate options, generate payoffs that depend on the average value of the underlying spot price during the life of the option, instead of the ending value.
- Define this as SAVE (t, T). The final payoff for a call is:

$$c_T = Max(S_{AVE}(t, T) - K, 0)$$

- NOTE: Because an average is less variable than the final value at the end of the same period, such options are "cheaper" than regular options due to lower volatility.
- It also could be used as the pricing mechanics for restricted employee shadow stock.

Exotic Options

- **Exchange options** are options to exchange one asset for another.
  - An option to buy yen with Australian dollars is, from the point of view of a US investor, and option to exchange one foreign currency asset for another foreign currency asset.
  - A stock tender offer (收购要约) is an option to exchange shares in one stock for shares in another stock.

Exotic Options

- **Basket options** are simply options to purchase or sell baskets of securities. These baskets may be defined specifically for the individual investor and may be composed of specific stocks, indices, or currencies.

Exotic Options

- The benefits are
  - Leverage (gearing) increases: compared with investing directly in stocks, options have higher leverage ratio.
  - Tax avoidance: higher tax rate would be levied on short-term investment, and the TERM for OTC options is defined as the expiration term for options, instead of the holding period for individual investor.
  - Flexibility: easily reverse part or all the position exposure with reverse position on individual stock, indices futures, one stock options and other active exchange derivatives.

Exotic Options

- **Rainbow Options (彩虹期权)**
- Rainbow option is a derivative exposed to two or more sources of uncertainty, as opposed to a simple option that is exposed to one source of uncertainty, such as the price of underlying asset.
- Rainbow options are usually calls or puts on the best or worst of n underlying assets, or options which pay the best or worst of n assets.
- The number of assets underlying the option is called the number of colors of the rainbow.
- The options are often considered a correlation trade since the value of the option is sensitive to the correlation between the various basket components.

Exotic Options

- **Rainbow Options**
- One example is the T-bond futures contract traded on the CBOT. The party with the short position is allowed to choose between a large number of different bonds when making delivery.
- The right for the short position to pick up the most appropriate bond to deliver is a kind of rainbow options, and the value of the right (option) depends on the current price for all the bonds which are allowed to be delivered.
- The number of the bonds are multiple, so we will find the number of colors in this rainbow options are numerous. In other word, it is a colorful and elegant rainbow for the option to pick up the most appropriate bond to deliver.

Exotic Options

- **Volatility and Variance Swaps**
- A volatility swap involves the exchange of volatility based on a notional principal. One side of the swap pays based on a pre-specified fixed volatility while the other side pays based on realized volatility.
- Much like a volatility swap, a variance swap involves exchanging a pre-specified fixed variance rate for a realized variance rate.
- However, unlike volatility swaps, variance swaps are easier to price and hedge since they can be replicated using a collection of call and put options.

Exotic Options

Hedging exotic option

- It is simpler to hedge using exotic options than plain vanilla ones.
- Dynamic option replication requires frequent adjustments, so it is costly.
- Static option replication may be used to construct once, it is cheaper.

Practice 1

- FRM EXAM 2003—QUESTION 34

  Which of the following options is strongly path-dependent?

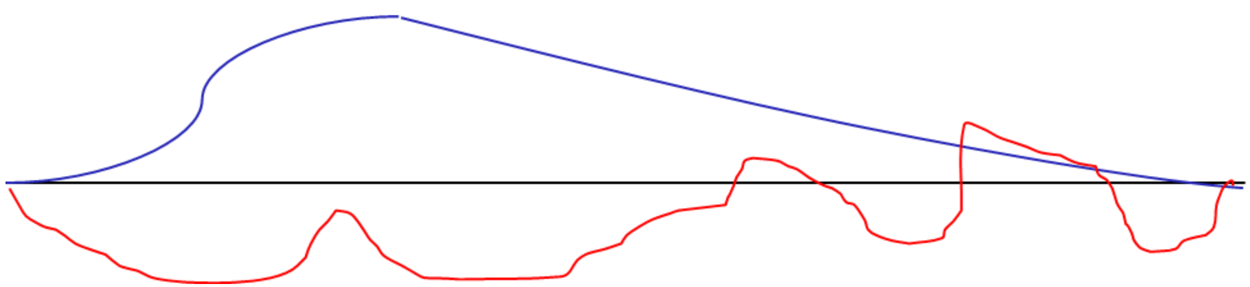
  A. An Asian option

  B. A binary option

  C. An American option

  D. A European call option

- Answer : A



Practice 2

- FRM EXAM 2002—QUESTION 19

  Of the following options, which one does not benefit from an increase in the stock price when the current stock price is \$100 and the barrier has not yet been crossed:

  A. A down-and-out call with out barrier at \$90 and strike at \$110

  B. A down-and-in call with in barrier at \$90 and strike at \$110

  C. An up-and-in put with barrier at \$110 and strike at \$100

  D. An up-and-in call with barrier at \$110 and strike at \$100

Practice 2

- Answer : B
- ✓ A down-and-in call comes alive only when the barrier is touched; so an increase in S brings it away from the barrier. This is not favorable, so B is the correct answer.
- ✓ A down-and-out call (A) where the barrier has not been touched is still alive and hence benefits from an increase in S.
- ✓ An up-and-in put (C) would benefit from an increase in S as this would bring it closer to the barrier of $110.
- ✓ Finally, an up-and-in call (D) would also benefit if S gets closer to the barrier.

高顿财经 GOLDEN FINANCE

Practice 3

- FRM EXAM 2006—QUESTION 59

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

Practice 3

- Answer : B
- ✓ Lookback options use the maximum stock price over the period, which must be more than the value at the end. Hence they must be more valuable than regular European options.
- ✓ Chooser options involve an additional choice during the life of the option, and as a result are more valuable than regular options.
- ✓ Asian options involve the average, which is less volatile than the final price, so must be less expensive than regular options.
- ✓ Finally, barrier options can be structured so that the sum of two barrier options is equal to a regular option. Because each premium is positive, a barrier option must be less valuable than regular options.

Practice 4

- 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

Practice 4

- Answer : D

✓ Bermudan options would set some restriction on early exercise. Compared with American options, Bermudan options have less profitable potentials.

Practice 5

- You believe that a stock will increase in price and would like to buy a call option. You would like to choose the date during the option’s term when the option payoff is determined. However, if the option payoff is greater at the option’s maturity, you want to be paid this value. What type of option should you buy?
  A. Chooser option
  B. Compound option
  C. Shout option
  D. Asian option

Practice 5

- Answer : C
- ✓ If you want to benefit the larger one between the option payoff at chosen date and the option payoff at the maturity, shout options are the appropriate kind.

Summary

✓ Options

- Gap options
- Forward start options
- Compound options
- Chooser options
- Barrier options
- Binary options
- Lookback options
- Shout options
- Asian options
- Exchange options
- Basket options
- Rainbow options
- Volatility swaps

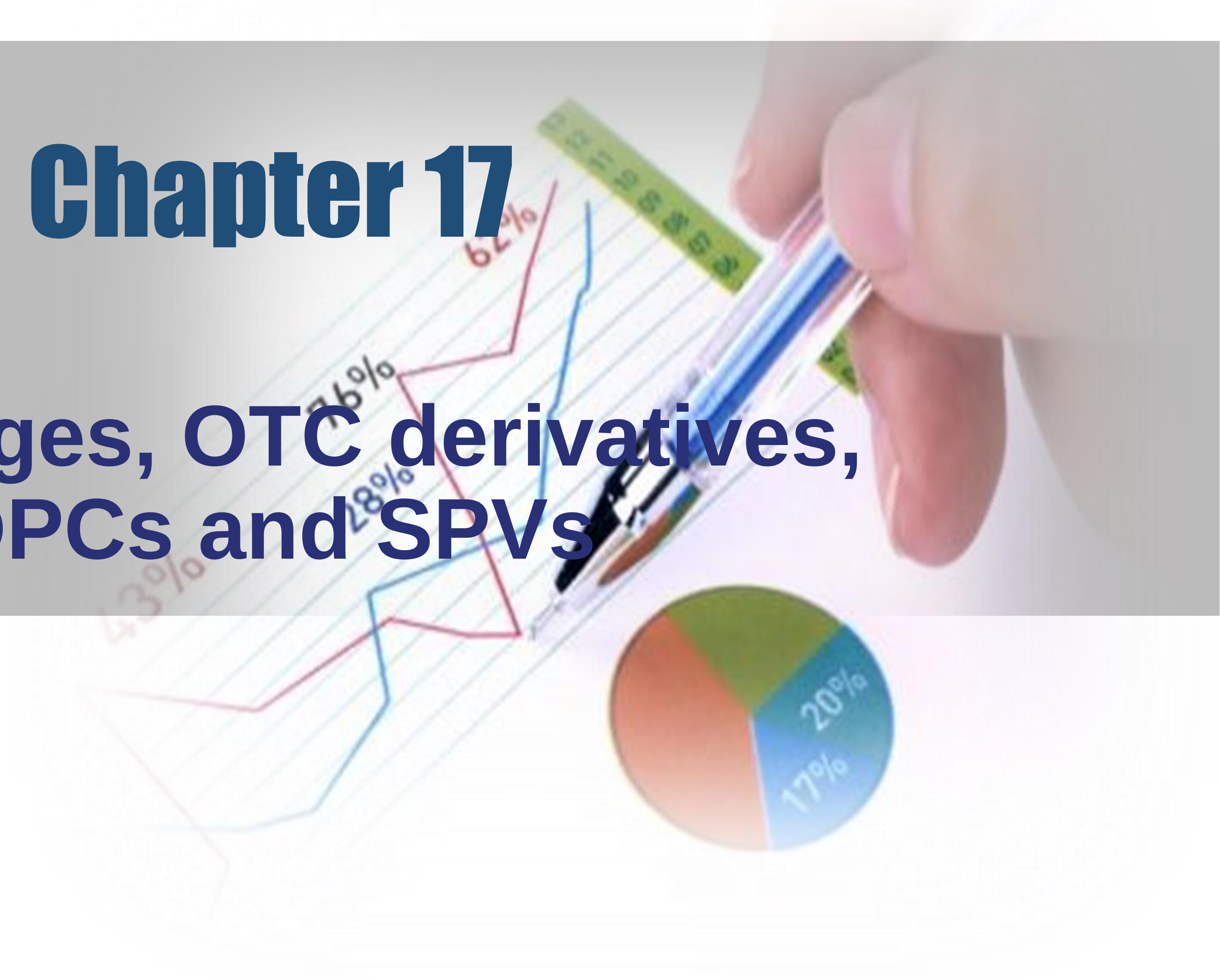
✓ Exam Tips

- 了解各个奇异期权的payoff

Contents

Chapter 17

Exchanges, OTC derivatives, DPCs and SPVs



Learning Objectives

- ✓ Describe how exchanges can be used to alleviate counterparty risk.
- ✓ Explain the developments in clearing that reduce risk.
- ✓ Compare exchange-traded and OTC markets and describe their uses.
- ✓ Identify the classes of derivative securities and explain the risk associated with them.
- ✓ Identify risks associated with OTC markets and explain how these risks can be mitigated.

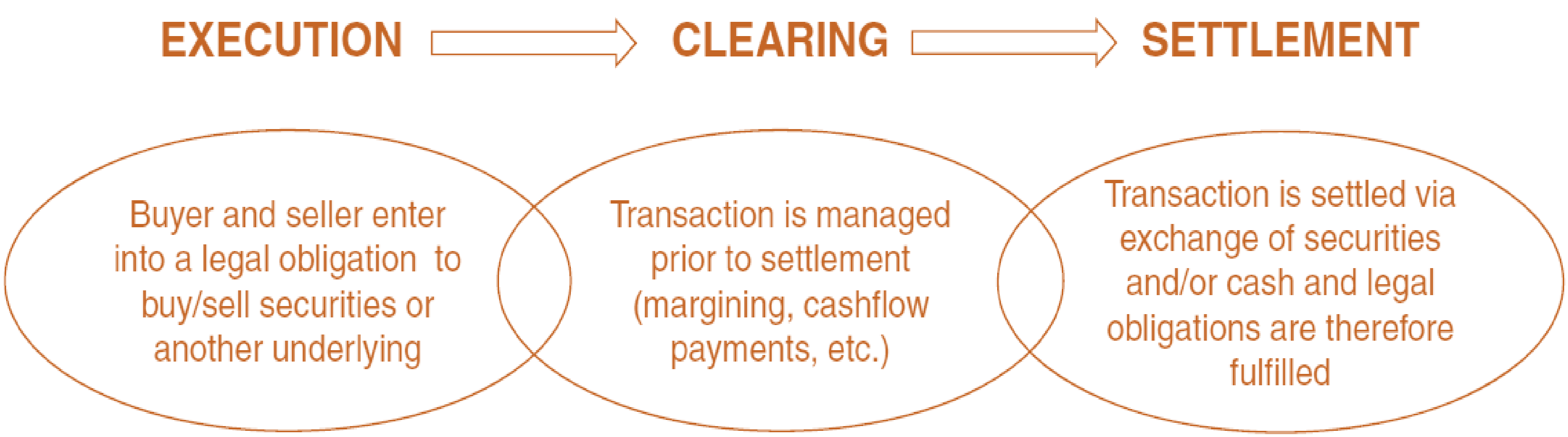
Functions of Exchange

Functions of Exchange

- It would alleviate counterparty risk.
  - Product standardization
  - Trading venue
    - Providing an opportunity for price discovery.
  - Reporting services
    - Creating a greater transparency of prices.

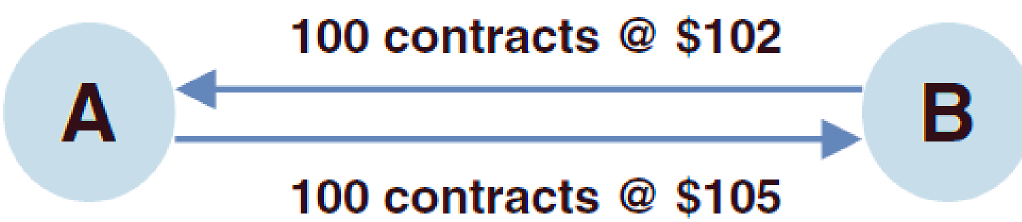
Development of Clearing

- **Clearing** is the term that describes the reconciling and resolving of contracts between counterparties, and takes place between trade execution and trade settlement (when all legal obligations have been made). It includes 3 forms.



Three Forms of Clearing

- **Direct clearing** refers to a bilateral reconciliation of commitments between the original two counterparties.

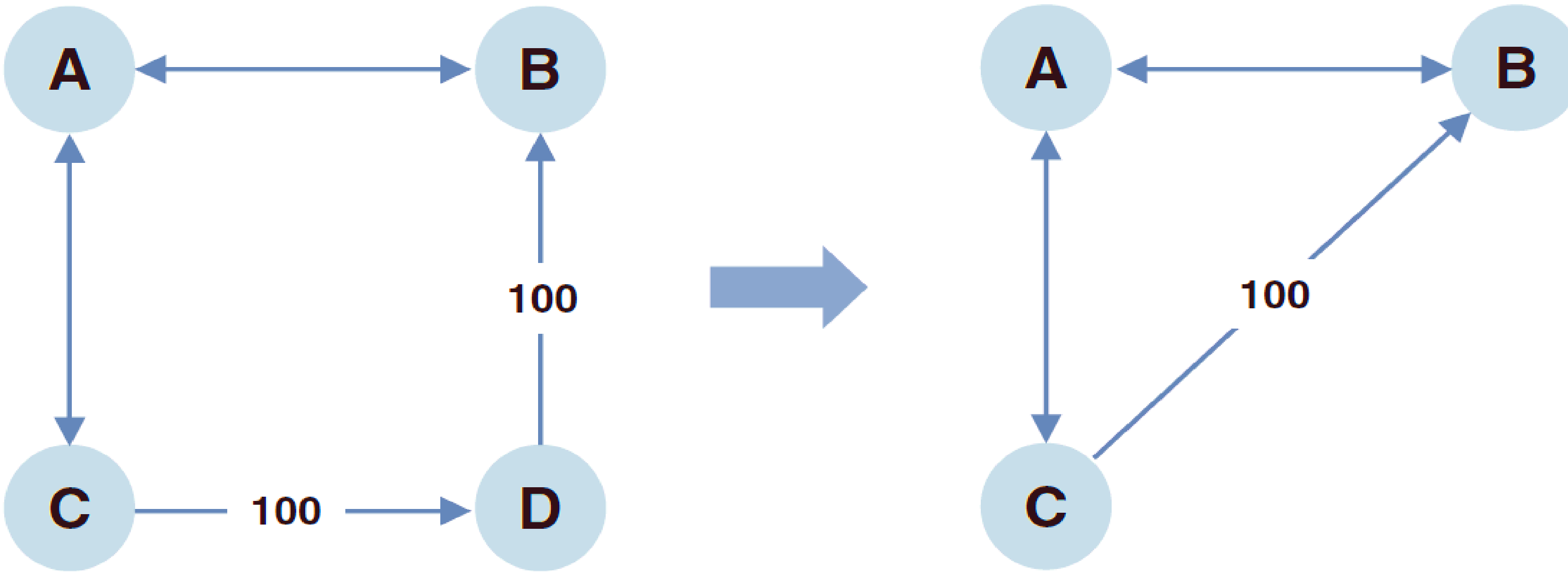


Three Forms of Clearing

- **Clearing Rings**
- To achieve the benefits of 'ringing', participants in the ring had to be willing to accept substitutes for their original counterparties.
- It is an informal means of reducing exposure (counterparty risk) and enhancing liquidity.
- A ring, whilst offering a collective benefit, is unlikely to be seen as beneficial by all participants.

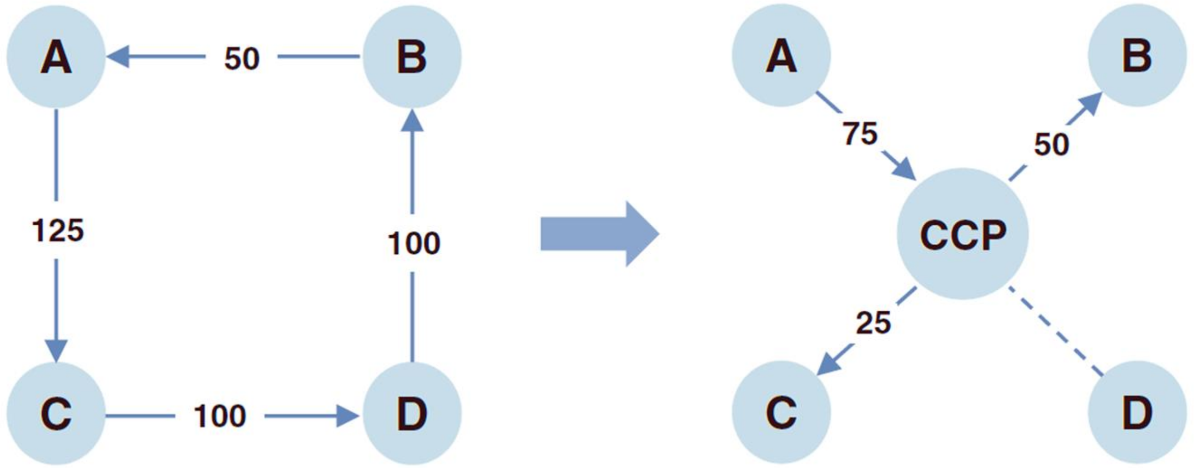
Three Forms of Clearing

- **Clearing Rings**



Three Forms of Clearing

- **Complete Clearing**
- A CCP or clearinghouse becomes counterparty to all transactions.
- By interposing itself between two counterparties, which are clearing members, a CCP assumes all such contractual rights and responsibilities.



Central Counterparty

- Distinct mechanisms for clearing and settlement:
  - **bilateral for OTC derivatives**
  - **central for exchange-traded structures.**

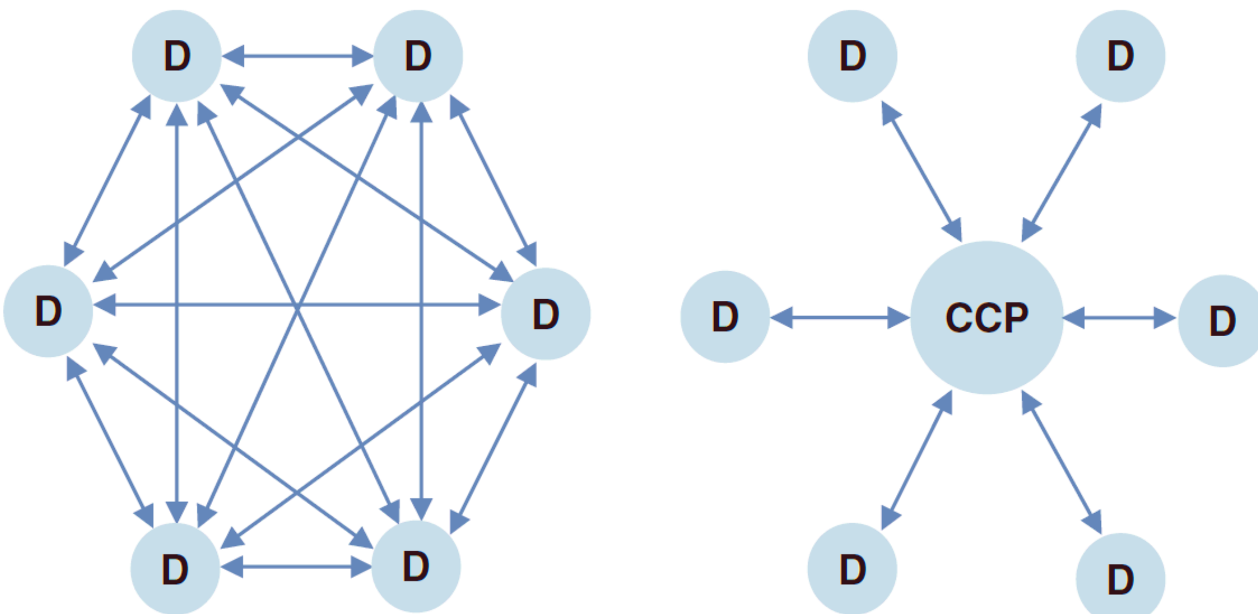


Illustration of bilateral markets (left) compared to centrally cleared markets (right).

Exchange-Traded Markets vs. OTC Markets

	Exchange-Traded Market	Over-the-Counter (OTC)
Terms of contract maturity	• Standardized (maturity, size, strike, etc.) • Standard maturities, typically at most a few months	• Flexible and negotiable • Negotiable and non-standard • Often many years
liquidity	Very good	Limited and sometimes very poor for non-standard or complex products
Credit risk	Guaranteed by CCP	Bilateral

Class of Derivatives Securities

- OTC derivatives include 5 broad classes: interest rate (dominate one with 84% of total OTC derivatives), foreign exchange, equity, commodity and credit derivatives.
- Counterparty risk is particularly important for foreign exchange derivatives.

Risk Mitigation in OTC Markets

- **Special Purpose Vehicles (SPVs)**
  - A legal entity created typically to isolate a firm from financial risk.
  - Change bankruptcy rules so that, if a derivative counterparty is insolvent, a client can still receive their full investment prior to any other claims being paid out.(bankruptcy-remote)
  - SPVs aim to shift priorities so that in a bankruptcy, certain parties can receive a favorable treatment.
  - Transforms counterparty risk into legal risk. The obvious legal risk is that of consolidation.

Risk Mitigation in OTC Markets

- **Derivatives Product Companies (DPCs)**
  - Generally it is a triple-A rated entity set up by one or more banks as a bankruptcy-remote subsidiary of a major dealer.
  - It provides external counterparties with a degree of protection against counterparty risk by protecting against the failure of the DPC parent.
  - How the resulting workout process would work.
  - The reality is that DPC is inextricably link with their parents, so it becomes an obsolete mechanism.

Risk Mitigation in OTC Markets

- **Derivatives Product Companies (DPCs) (Cont.)**
- The triple-A rating of a DPC typically depends on
  - Minimizing market risk
  - Support from a parent
  - Credit risk management and operational guidelines (limits, margin terms, etc.)

Risk Mitigation in OTC Markets

- **Monolines**
- Monoline insurance companies were financial guarantee companies with strong credit ratings that they utilized to provide ‘credit wraps’ which are financial guarantees.
    - Monolines began providing credit wraps for other areas but then entered the single name CDS and structured finance arena to achieve diversification and better returns.

Risk Mitigation in OTC Markets

- **Credit derivative product companies (CDPCs)**
- CDPCs were an extension of the DPC concept that had business models similar to those of monolines.

LO 46.5: Identify & Explain (☆ ☆)

Risk Mitigation in OTC Markets

- **Monolines and CDPCs**
- In order to achieve good ratings (e.g. triple-A), monolines/CDPCs had capital requirements driven by the possible losses on the structures they provide protection on.
- Monolines and CDPCs typically did not have to post margin (at least in normal times) against a decline in the mark-to-market value of their contracts (due to their excellent credit rating).

Summary

- ✓ Exchanges, OTC derivatives, DPCs and SPVs
  - OTC and Exchange
  - Clearing
  - Special Purpose Vehicles (SPVs)
  - Derivatives Product Companies (DPCs)
  - Monolines and CDPCs (Credit DPCs)
- ✓ Exam Tips
  - Risk Mitigation in OTC
  - Bankruptcy-remote

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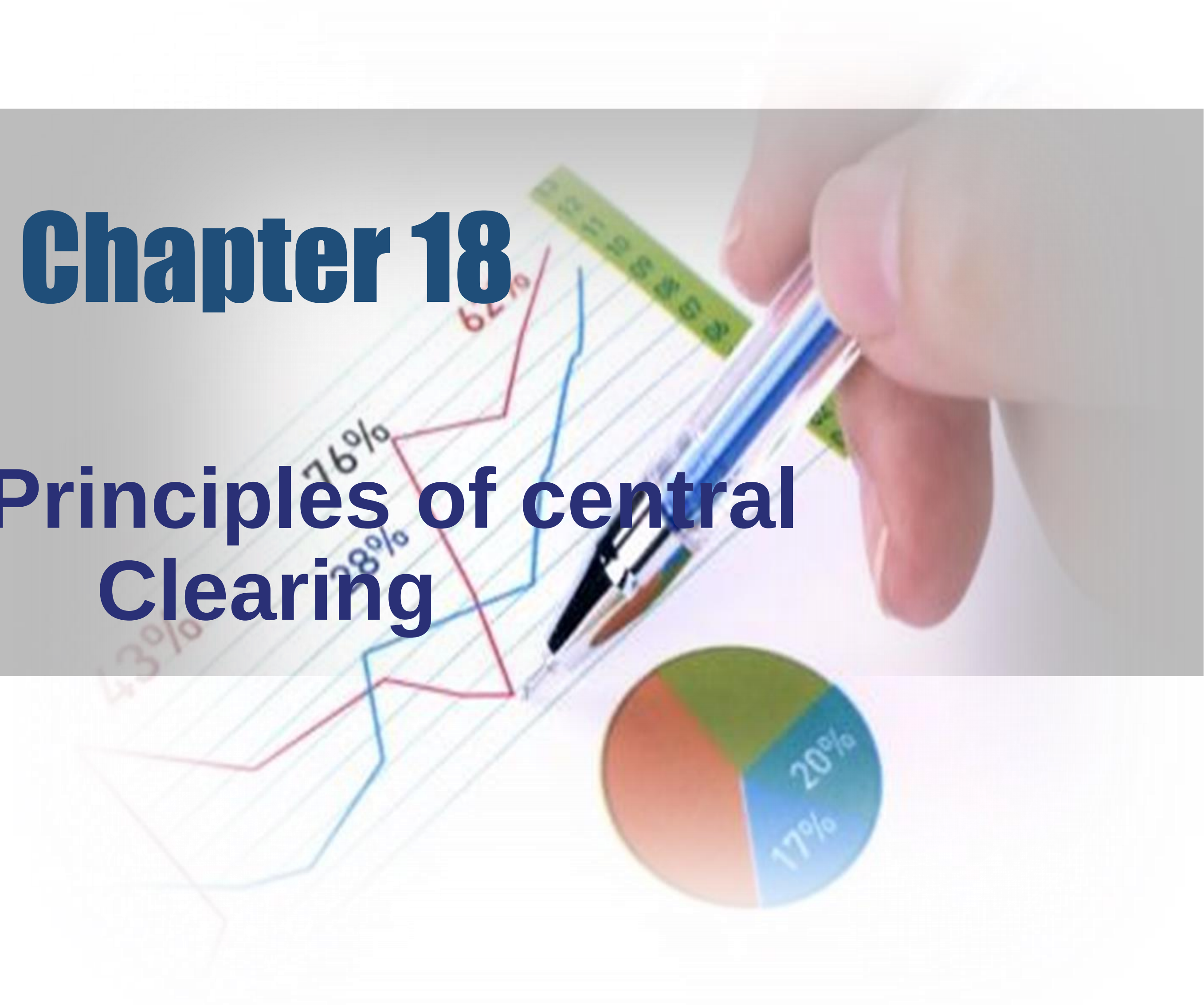
Chapter 18

Basic Principles of central Clearing



Learning Objectives

- ✓ Provide examples of the mechanics of a central counterparty (CCP).
- ✓ Describe advantages and disadvantages of central clearing of OTC derivatives.
- ✓ Compare margin requirements in centrally cleared and bilateral markets, and explain how margin can mitigate risk.
- ✓ Compare and contrast bilateral markets to the use of novation and netting.
- ✓ Assess the impact of central clearing on the broader financial markets.

Mechanics of CCPs

Mechanics of CCPs

- Clearing and settlement
- Auctions
  - Auctioning the defaulted members’ positions amongst the other members.
- Margining
- Novation and Netting
  - CCP is interposed between seller and buyer.
- Loss Mutualization
  - Losses above the resources contributed by the defaulter are shared between CCP members.

Advantages and Disadvantages of Central Clearing in OTC Derivatives

Advantages of Central Clearing in OTC Derivatives

- Transparency
  - offer a more transparent, safer market
- Offsetting
  - increases flexibility
  - reduces costs
- Loss mutualisation
  - losses are distributed throughout the CCP members

Advantages and Disadvantages of Central Clearing in OTC Derivatives

- **Advantages of Central Clearing in OTC Derivatives (Cont.)**
- Legal and operational efficiency
  - increase operational efficiency and reduce costs
  - reduce legal risks
- Liquidity
  - improve market liquidity
- Default management
  - smaller price disruptions

Advantages and Disadvantages of Central Clearing in OTC Derivatives

- **Disadvantages of CCPs**
- Moral hazard
  - Institutions have little incentive to monitor each other's credit quality and act appropriately because a third party is taking most of the risk.
- Adverse selection
  - firms may selectively pass these more risky products to CCPs due to information asymmetry.

Advantages and Disadvantages of Central Clearing in OTC Derivatives

- **Disadvantages of CCPs (Cont.)**
- Bifurcations(分岔)
  - The requirement to clear standard products may create unfortunate bifurcations between cleared and non-cleared trades.
  - It results in highly volatile cash flows for customers, and mismatches (of margin requirements) for seemingly hedged positions.
- Procyclicality(亲周期性)
  - positive dependence with the state of the economy

Margin Requirements of Central Clearing

- Margin Requirements by CCPs are in general much stricter than in bilateral derivative markets
- **Initial Margin**
  - It is charged at trade inception, and is designed to cover the worst-case close out costs (due to the need to find replacement transactions) in the event a member defaults.
- **Variation Margin**
  - It covers the net change in market value of the member's positions.

Margin Requirements of Central Clearing

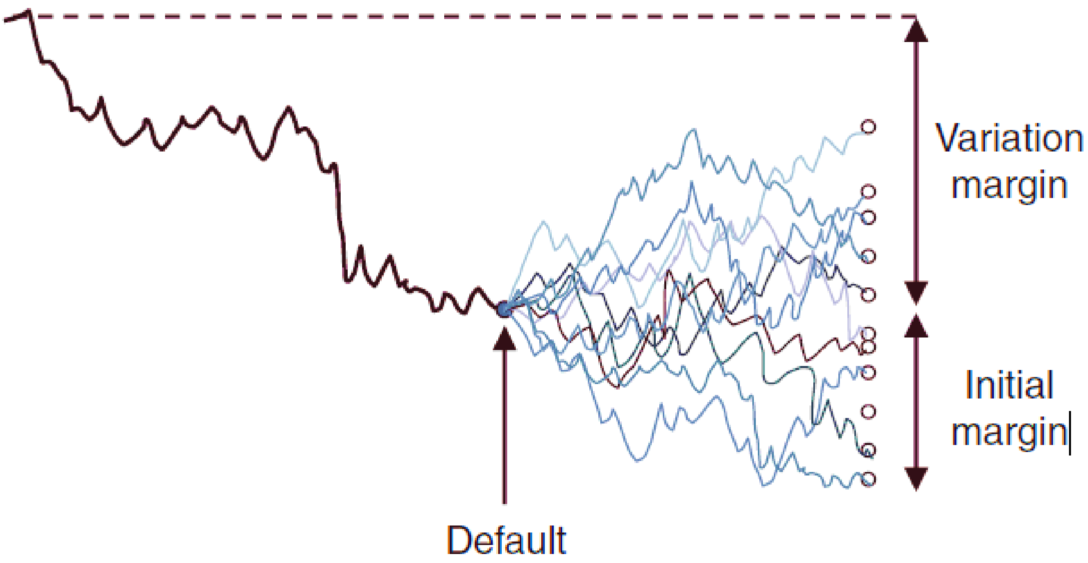
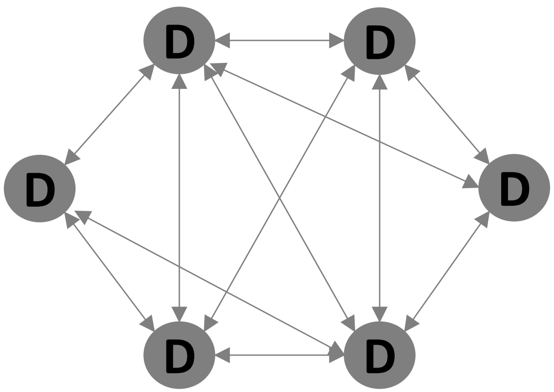
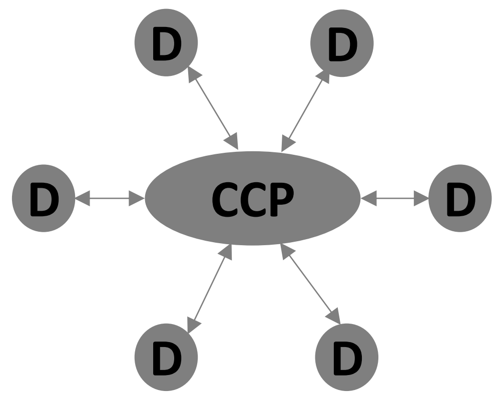


Figure 3.4 Illustration of the role of initial and variation margins. Variation margin tracks the value prior to default and initial margin provides a cushion against potential losses after default (e.g. close out costs).

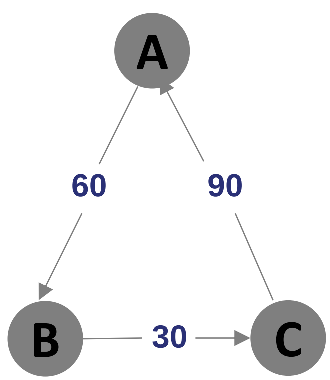
Bilateral Markets vs. Novation & Netting

- **Bilateral Markets vs. Novation & Netting in CCPs**

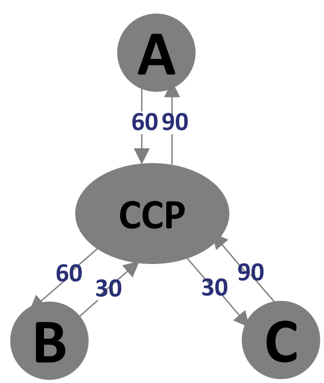




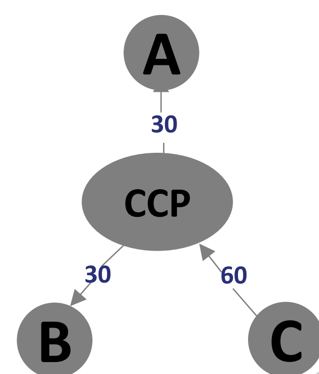
Bilateral market



Novation to CCP



CCP netting



Impacts of Central Clearing on Financial Markets

Impacts of Central Clearing on Financial Markets

- It provides greater transparency, offsetting positions and dealing with a large default in an effective way, but also have the potential to increase systemic risk.
- It will not so much reduce counterparty risk but rather distribute it and convert it into different forms such as liquidity, operational and legal risks.

Impacts of Central Clearing on Financial Markets

Impacts of Central Clearing on Financial Markets (cont.)

- Netting and margining, protect OTC derivative counterparties at the expense of other creditors.
- It cannot be extrapolated to imply that CCPs will definitely enhance financial market stability in general.

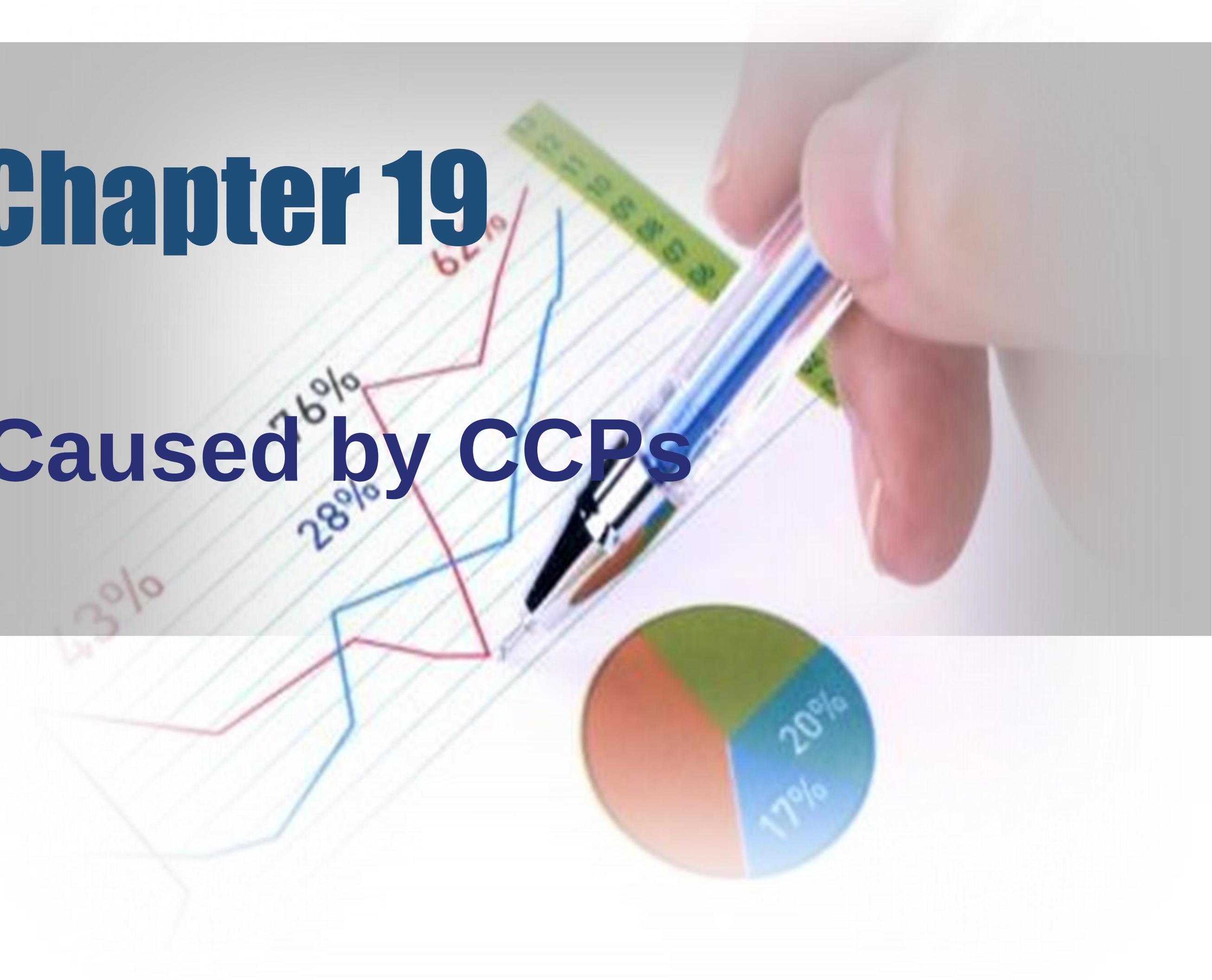
Summary

- ✓ CCP
  - ✓ **Mechanics**
  - ✓ **Advantages and disadvantages**
- ✓ Exam Tips
  - **Advantages and disadvantages**

Contents

Chapter 19

Risk Caused by CCPs



Learning Objectives

- ✓ Identify and explain the types of risks faced by CCPs.
- ✓ Identify and distinguish between the risks to clearing members as well as non-members.
- ✓ Identify and evaluate lessons learned from prior CCP failures.

Risks Faced by CCPs

- Default risk
- Non-default loss events
- Model risk
- Liquidity risk
- Operational and legal risk
- Other risks

Risks Faced by CCPs: Default Risks

- **Default or distress of other clearing members**
  - default correlation would be high and defaults unlikely to be idiosyncratic events.
- **Failed auctions**
  - If the CCP does not receive reasonable economic bids in an auction, then it faces imposing significant losses of its member via rights of assessment and/or alternative loss allocation methods.
  - Imposing losses on other clearing members will potentially catalyze financial distress of these members, even possibly leading to further defaults.

Risks Faced by CCPs: Default Risks (Cont.)

- **Resignations**
  - clearing members leave a CCP
  - since initial margins and default funds would need to be returned to a resigning clearing member, their loss could be felt in real terms as well as the potential negative reputational impact it may cause with respect to other members.

Risks Faced by CCPs: Default Risks (Cont.)

- **Reputational**
  - Remedying a clearing member default may involve relatively extreme loss allocation methods.
  - Methods such as VMGH and tear-ups may be viewed as imposing losses on them simply because they have winning positions.
    - These positions may not of course be winning overall as they may be balanced by other transactions (bilateral or at a different CCP).

Risks Faced by CCPs: Non-default

- Fraud
  - Internal or external fraud.
- Operational
  - Business disruption linked to aspects such as systems failures.
- Legal
  - Litigation or legal claims including the risk that the law in a given jurisdiction does not support the rules of the CCP.
- Investment
  - Losses from investments of cash and securities held as margin and other financial resources within the investment policy, or due to a deviation from this policy (e.g. a rogue trader).

Risks Faced by CCPs: Non-default (Cont.)

- CCPs have significant exposure to **model risk** through margining approaches.
  - CCPs are probably most exposed to model risk via their initial margin approaches.
  - Another important feature of models is that they generally impose linearity.

Risks Faced by CCPs: Non-default (Cont.)

- 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.
  - optimize investment of some of the financial resources they hold, without taking excessive credit and liquidity risk (e.g. by using short-term investments such as deposits, repos and reverse repos)
  - optimize credit and liquidity risk
    - Although CCPs will clearly invest cautiously over the short term, with liquidity and credit risk very much in mind, there is also the danger that the underlying investments they hold must be readily available and convertible into cash.

Risks Faced by CCPs: Non-default (Cont.)

- **Operational risk**
  - systems failures and fraud
- **Legal risk**
  - aspects such as segregation and the movement of margin and positions through a CCP, can be subject to legal risk from laws in different jurisdictions.

Risks Faced by CCPs: Non-default (Cont.)

- Settlement and payment risk
- Foreign currency (FX) risk
- Custody risk
- Sovereign risk
- Concentration risk
  - Due to having clearing members and/or margins exposed to a single region.
- Wrong-way risk
  - Due to unfavorable dependencies, such as between the value of margin held and creditworthiness of clearing members.

Too Big to Fail

- The failure of a large and complex CCP would represent an event potentially worse than the failure of financial institutions such as Lehman Brothers.
- A bailout of a CCP could be a more complex and sizable task than even bailouts of banks and financial institutions such as Bear Stearns and AIG.
- CCPs must maintain financial resources, such as initial margins and default funds, to absorb losses in all but extreme situations.

Risks for Clearing Members and Non-members

- Risks of CCP failure through initial margins
- Risks of distress of CCP may result in:
  - Loss of default fund contribution
  - Potential additional exposure arising
  - Variation margin gains haircutting
- Risk for non-members is the exposure from CCPs, clearing members and other non-members.

Lessons Learned from CCP Failures

Five key lessons

- Operational risk must be controlled as much as possible.
- Variation margins should be recalculated often and collected quickly (i.e., multiple times a day).
- Initial margins and default funds must be posted sufficiently.
- CCPs must actively monitor positions and penalize concentration.
- Availability to external liquidity sources.

Summary

- ✓ Risk caused by CCP
  - Default risk
  - Model risk
  - Liquidity risk
  - Operational and legal risk

- ✓ Exam Tips
  - 了解概念为主

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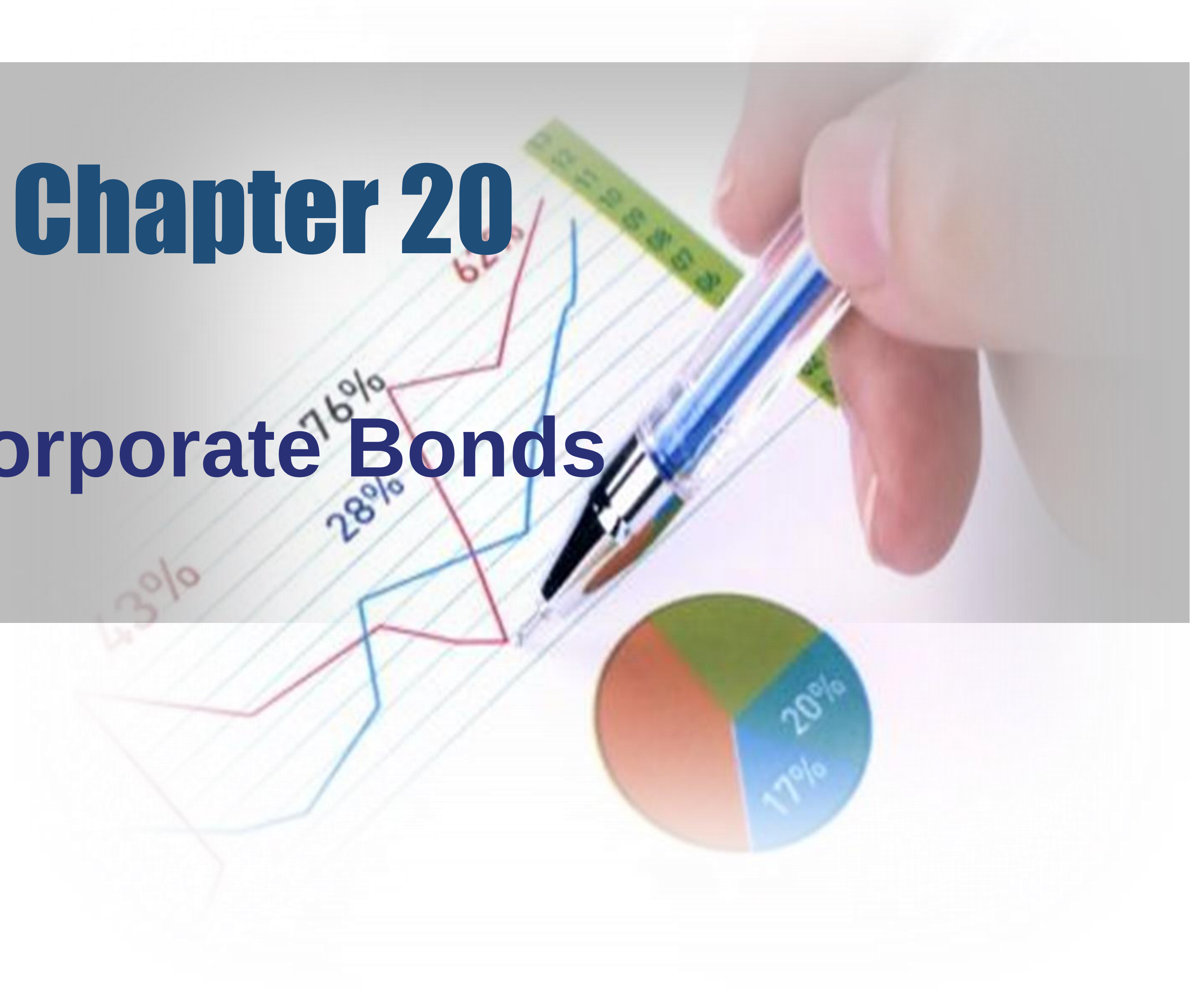
Chapter 20

Corporate Bonds



Learning Objectives

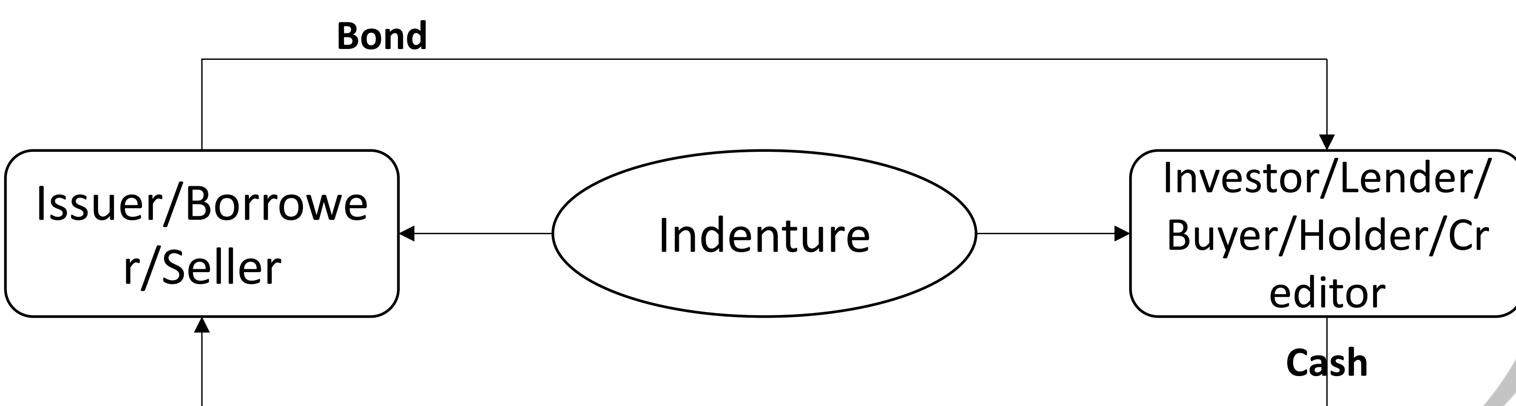
- ✓ Describe a bond indenture and explain the role of the corporate trustee in a bond indenture.
- ✓ Explain a bond's maturity date and how it impacts bond retirements.
- ✓ Describe the main types of interest payment classifications.
- ✓ Describe zero-coupon bonds and explain the relationship between original-issue discount and reinvestment risk.
- ✓ Distinguish among the following security types relevant for corporate bonds: mortgage bonds, collateral trust bonds, equipment trust certificates, subordinated and convertible debenture bonds, and guaranteed bonds.
- ✓ Describe the mechanisms by which corporate bonds can be retired before maturity.

Learning Objectives

- ✓ Differentiate between credit default risk and credit spread risk.
- ✓ Describe event risk and explain what may cause it in corporate bonds.
- ✓ Define high-yield bonds, and describe types of high-yield bond issuers and some of the payment features unique to high yield bonds.
- ✓ Define and differentiate between an issuer default rate and a dollar default rate.
- ✓ Define recovery rates and describe the relationship between recovery rates and seniority.

Corporate Bonds

- The promises of corporate bond issuers and the rights of investors who buy them are set forth in great detail in contracts generally called **indentures**.
- Roles of the corporate trustee includes interpreting this language and representing the interests of the bondholders



Corporate Bonds

- Maturity date: 债券到期日
- Issuers must pay the principal and interests or accrued interests at maturity.
  - The longer the maturity of the bond, the more time a company has to retire the bond issue.

Corporate Bonds

- **Types of corporate bonds**
- Main types include straight-coupon bond, floating-rate bond, and zero-coupon bonds.

Name	Another name	Interest
Straight-coupon bonds	fixed-rate bonds	fixed
Floating-rate bonds	variable rate bonds	floating

Corporate Bonds

- **Zero-coupon bonds** pay the face value or principal at maturity.
- Most zero-coupons issued today share a host of other features such as being convertible, callable, and putable.
- A zero-coupon bond's interest rate is determined by the original issue discount (OID): original-issue discount (OID) = face value - offering price
- No reinvestment risk for zero-coupon bond.

Corporate Bond Types

- Mortgage bonds
- Collateral trust bonds
- Equipment trust certificates
- Debenture bonds
- Guaranteed bonds

Corporate Bond Types

- **Mortgage bonds**
- A bond secured by a mortgage on one or more assets. These bonds are typically backed by real estate holdings and/or real property such as equipment. In a default situation, mortgage bondholders have a claim to the underlying property and could sell it off to compensate for the default.

Corporate Bond Types

- **Collateral trust bonds**
- A bond that is secured by a financial asset - such as stock or other bonds - that is deposited and held by a trustee for the holders of the bond.
- Collateral includes issuer's preferred stock, common stock, and other issuer's bond or stock.

Corporate Bond Types

- **Equipment trust certificates**
- A debt instrument that allows a company to take possession of an asset and pay for it over time.
- The debt issue is secured by the equipment or physical assets, as the title for the equipment is held in trust for the holders of the issue.
- When the debt is paid off, the equipment becomes the property of the issuer, as the title is transferred to the company.
- It shares the similar logic with financing lease.

Corporate Bond Types

- **Debenture bonds (including subordinated and convertible debentures)**
- A type of debt instrument that is not secured by physical assets or collateral.
- Debentures are backed only by the general creditworthiness and reputation of the issuer.
- Both corporations and governments frequently issue this type of bond in order to secure capital. Like other types of bonds, debentures are documented in an indenture.

Corporate Bond Types

- An example of a government debenture would be any government-issued Treasury bond (T-bond) or Treasury bill (T-bill). T-bonds and T-bills are generally considered risk free because governments, at worst, can print off more money or raise taxes to pay these type of debts.
- In the case of default, creditors with subordinated debt wouldn't get paid out until after the senior debt holders were paid in full. Therefore, subordinated debt is more risky than unsubordinated debt.
- Convertible debenture is a type of bond issued by a company that can be converted into stock of the issuer. By adding the convertibility option the issuer pays a lower interest rate on the loan compared to if there was no option to convert.

Corporate Bond Types

- **Guaranteed bonds**
- A debt security that offers a secondary guarantee that interest and principal payment will be made by a third party, should the issuer default due to reasons such as insolvency or bankruptcy.
- A guaranteed bond can be municipal or corporate, backed by a bond insurer, a fund or group entity, or a government authority.

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Corporate Bond Types

- Bonds have an inherent risk of default that could mean a bondholder never gets the principal back upon maturity and loses out on periodic interest payments.
- A guaranteed bond removes this risk by creating a back-up payer in the event that the issuer is unable to fulfill its obligation.
- Because of this lowered risk, guaranteed bonds generally have a lower interest rate than non-guaranteed bonds.
- What is worth mentioning is that this kind of obligations are not free of default risk.

Callable and Putable

- Embedded-option bond can be viewed as a pure bond plus an option, the value of the embedded-option bond is also the sum of the pure bond and the option.
  - An investment in a callable bond can be analytically decomposed into: Long position in a non-callable bond and a short position in a call option.
  - An investment in a puttable bond can be analytically decomposed into: Long position in a non-callable bond and a long position in a put option.

Callable and Putable (Cont.)

- Value of a callable bond=value of an option-free bond – value of the call.
- Value of a putable bond=value of an option-free bond + value of the put.

Retirement before Maturity

- The mechanisms by which corporate bonds can be retired before maturity, including:
  - Call provisions
  - Sinking-fund provisions
  - Maintenance and replacement funds
  - Redemption through the sale of assets and other means
  - Tender offers

Retirement before Maturity

- **Call provisions**
- Many corporate bonds contain an embedded option that gives the issuer the right to buy the bonds back at a fixed price either in whole or in part prior to maturity.
- Call provisions items give the corporations the right to retire their debt prior to maturity to take advantage of declining borrowing rates.
- Corporations would substitute new, lower-cost debt for older, higher-cost issues.

Retirement before Maturity

- **Sinking-fund provisions**
- Traditionally, it means that the issuer accumulates a fund in cash, or in assets readily sold for cash, that is used to pay bonds at maturity.
- It had that meaning many years ago, but too often the money supposed to be in a sinking fund was not all there when it was needed.
- In modern practice, no fund in pool but there is some periodical redemption on bonds outstanding before maturity.

Retirement before Maturity

- **Maintenance and replacement funds**
- It is used in utility industry, from the regulation by SEC to convention.
- Property is subject to economic depreciation, and the replacement fund ostensibly helps to maintain the integrity of the property securing the bonds.
- M&R only helps to maintain the value of the security backing the debt, whereas a sinking fund is designed to improve the security backing the debt.

LO 50.6: Describe(☆ ☆)

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Retirement before Maturity

农村中小学校舍维修改造资金绩效考评体系的基本构想

THE ESSENTIAL THOUGHTS ABOUT THE PERFORMANCE ASSESSMENT SYSTEM FOR THE MAINTENANCE AND REPLACEMENT FUNDS OF THE PRIMARY AND MIDDLE SCHOOL BUILDINGS IN RURAL AREAS

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doi: 10.3969/j.issn.1674-5132.2009.05.028

摘要： 我国农村中小学校舍维修改造资金长效保障机制已经建立,建立校舍维修改造资金绩效考评体系既是落实科学发展观、提高义务教育保障能力的必然要求,也是深化义务教育支出改革,完善义务教育支出监督机制的重要手段.本文提出按照适效性、时序型、强制性、经济性的原则建立校舍维修改造资金的绩效考评体系,对纳入中小学校舍维修改造,使用中央、省和省以下资金的所有项目按照单体项目资金绩效评价和整体综合项目资金绩效评价两种指标体系设计的指标来分别进行考评.

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Retirement before Maturity

- **Redemption through the sale of assets and other means**
- Mortgage bonds are secured by property, bondholders want the integrity of the collateral to be maintained.
- Bondholders would not want a company to sell a plant (which has been pledged as collateral) and then to use the proceeds for a distribution to shareholders.
- Release-of-property and substitution-of-property clauses are found in most secured bond indentures.

Retirement before Maturity

- **Tender offers**
- A firm may execute a tender offer and announce its desire to buy back specified debt issues. Firms employ tender offers to eliminate restrictive covenants or to refund debt.
- Tender offer is for “any and all” of the targeted issue, but it also can be for a fixed dollar amount that is less than the outstanding face value.
- In recent years, tender offers have been executed using a fixed spread as opposed to a fixed price.

Credit Risk

- Credit risk includes credit default risk and credit spread risk.
  - Credit default risk is the uncertainty concerning the issuer making timely payments of interest and principal as prescribed by the bond's indenture.
  - **Main rating agencies in the United States:**
- Fitch Ratings　　Moody's　　Standard & Poor's

FitchRatings　　Intertek　MOODY INTERNATIONAL　　STANDARD & POOR'S RATINGS SERVICES

- The agencies assign a symbol associated with the rating (e.g., AAA or Aaa for the corporate debt with the least credit default risk).

Credit Risk (Cont.)

- Credit risk includes credit default risk and credit spread risk.
  - Credit spread risk focuses on the difference between a corporate bond’s yield and the yield on a comparable-maturity benchmark Treasury security. This difference is known as the credit spread.

Event Risk

- **Event risk** addresses the adverse consequences from possible events such as mergers, recapitalizations, restructurings, acquisitions, leveraged buyouts, and share repurchases, which may escape being included in the indenture.

High-yield Bonds

- **High-yield bonds** (a.k.a. junk bonds) are those bonds rated below investment grade by ratings agencies. This includes a broad range of ratings below the cutoff, (e.g., BB to default).
  - Original issuers: Young, growing issuers with a story projecting future financial strength.
  - Fallen angels: Companies with investment-grade-rated debt with deteriorating balance

High-yield Bonds (Cont.)

- Restructurings and leveraged buyouts: Companies deliberately increase their debt burden with a view toward maximizing shareholder value.
- Reset bonds: Capitalizing adjustable discount rate to reflect the change of market rate, make the price of the bond equals to its par value.
- Deferred-coupon structures: These bonds sell at deep discount and do not pay interest for an initial period, typically from 3 to 7 years.

Event Risk

- **Businessman's risk** refers to bonds with a rating at the bottom rung of the investment-grade category (Baa and BBB) or at the top end of the speculative-grade category (Ba and BB)
- Over long periods of time, high-yield bonds should offer higher average returns, However, over shorter periods, the returns will be volatile where large losses are possible.

Default Rate & Recovery Rate

- **An Issuer default rate and a dollar default rate**
  - The issuer default rate is the number of issuers that defaulted over a year divided by the total number of issuers at the beginning of the year.
  - The dollar default rate is the par value of all bonds that defaulted in a given calendar year divided by the total par value of all bonds outstanding during the year.

Default Rate & Recovery Rate

- **Recovery Rate**
  - The recovery rate is the amount received as a proportion of the total obligation after a bond defaults. Measuring this can be complicated because the value of the total obligation requires computing the present value of the remaining cash flows at the time of the default.

Summary

- ✓ Corporate Bond
  - Risk
  - Method of retiring bond
  - Bond types
  - Ratings

- ✓ Exam Tips

  了解债券的概念及分类

Practice 1

- Which of the following responsibilities is least likely to be part of the role of a corporate trustee in a bond issue?
  A. Interpret the language of the indenture.
  B. Determine the interest rate on a reset bond.
  C. Keep track of the amount of bonds issued by the corporation.
  D. Monitor the corporation’s activities to make sure the corporation abides by the indenture’s covenants.

Practice 1

- Answer : B

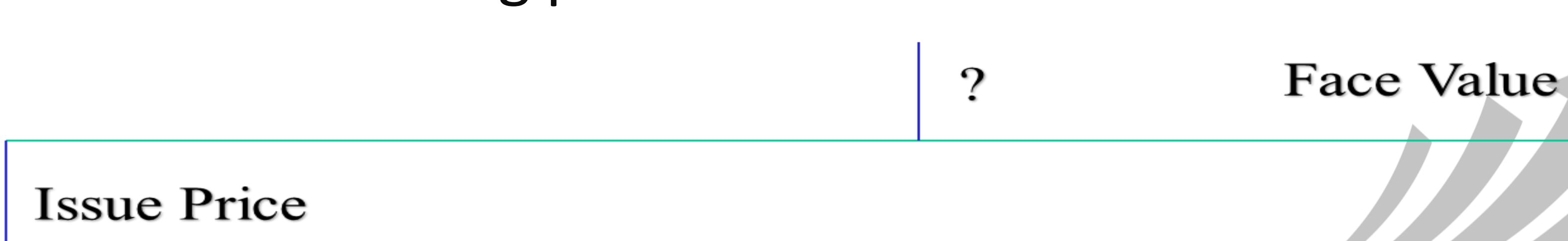
A corporate trustee is an independent supervisor of:

- ✓ managed funds - such as KiwiSaver schemes, superannuation schemes and unit trusts
- ✓ retirement villages
- ✓ debt securities
- ✓ custodial services
- ✓ securitization of assets.

Practice 2

- In bankruptcy, the holder of a zero-coupon bond obligation of the bankrupt corporation would have a claim equal to:
  - **A.** the face value of the bond only.
  - B. the issuing price of the bond only.
  - C. the issuing price plus accrued interest.
  - D. nothing, since zeros are always unsecured.
- Answer : C

✓ Face Value= issuing price +all interest rate



Practice 3

- All other things being equal, which of the following types of bond instruments would have the lowest interest rate?
  A. Equipment trust certificates.
  B. Mortgage bonds.
  C. Junior debentures.
  D. Senior debentures.

Practice 3

- Answer : A
  - ✓ Senior & Junior debentures are general credit tools, and backed by the whole creditworthy of the company.
  - ✓ Mortgage bonds are bonds secured by mortgage, mortgage means the assets are the property owners are the bonds issuers. In other words, if the bonds default, the bondholders have to sue and claim the right of the mortgage.
  - ✓ The title for the equipment is held in trust for the holders of the issue.

Practice 4

- Which of the following methods for retiring bonds before maturity is generally considered the most detrimental for the bondholders?
  A. Tender offers.
  B. Call provision.
  C. Sinking fund provision.
  D. Maintenance and replacement funds.

Practice 4

- Answer : B
  - ✓ Tender offer is a kind of advance redemption, it always supplies favor terms for bondholders.
  - ✓ Call provision would decline the financial cost for the issuers, so it would detriment the interest of the bondholders.
  - ✓ Sinking funds and M&R funds are more secured mechanics for the smoothness of the cash flow.

Practice 5

- An investment in a callable bond can be analytically decomposed into a:

  A. Long position in a non-callable bond and a short position in a put option.

  B. Short position in a non-callable bond and a long position in a call option.

  C. Long position in a non-callable bond and a long position in a call option.

  D. Long position in a non-callable bond and a short position in a call option.

Practice 5

- Answer : D
  - ✓ A callable bond includes an embedded option for the issuer to call the bond at a stated redemption or call price. If the issuer is long the call option, then the holder of a callable bond is short the call option.

Practice 6

- Which of the following statements regarding a puttable bond is true?

  A. A puttable bond has more market risk than a similar non-puttable bond.

  B. A puttable bond has more credit risk than a similar non-puttable bond.

  C. Both A and B.

  D. Neither A nor B.

Practice 6

- Answer 6: B
  - ✓ The holder of a puttable bond has the right to sell the bond to the issuer at its face value. This has the effect of reducing the market risk and increasing the credit risk of the bond.

Contents

Chapter 21

Mortgages and Mortgage-Backed Securities

Learning Objectives

- ✓ Describe the various types of residential mortgage products.
- ✓ Calculate a fixed rate mortgage payment, and its principal and interest components.
- ✓ Describe the mortgage prepayment option and the factors that influence prepayments.
- ✓ Summarize the securitization process of mortgage backed securities (MBS), particularly formation of mortgage pools including specific pools and TBAs.
- ✓ Calculate weighted average coupon, weighted average maturity, and conditional prepayment rate (CPR) for a mortgage pool.

Learning Objectives

- ✓ Describe a dollar roll transaction and how to value a dollar roll.
- ✓ Explain prepayment modeling and its four components: refinancing, turnover, defaults, and curtailments.
- ✓ Describe the steps in valuing an MBS using Monte Carlo Simulation.
- ✓ Define Option Adjusted Spread (OAS), and explain its challenges and its uses.

为何资产证券化？

中期来看存贷息差下降已成共识

杠杆率受到约束

贷款期限大于客户存款→资产证券化

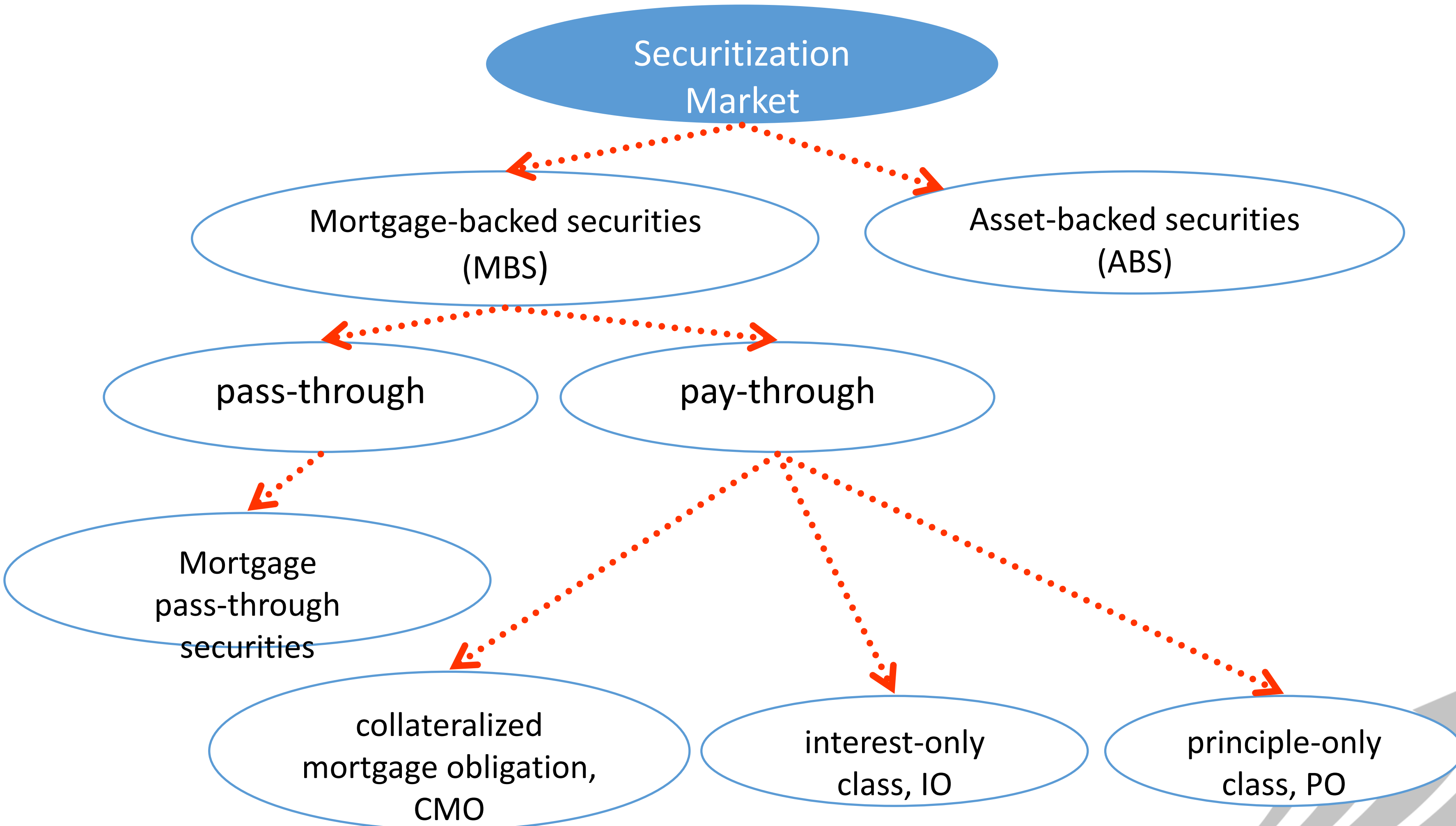
商业银行的资本回报率 = $\underbrace{\text{存贷息差} \times \text{资产周转率} \times \text{杠杆率}}_{\text{为了维持高资本回报率唯一可以依仗的只剩加快资产周转率}}$

- 实行资产证券化不仅可以改善资本充足率，还能够帮助其转变经营模式，提高中间业务收入。
- 我国银行理财产品的影子银行特征最为明显。对银行来说：

• 银行理财产品资金通过投向信托公司、券商资管等通道，实现负债端的表外化；

• 信托等通道投向票据、信贷资产，实现了资产端的表外化。

Types of Securities



Residential Mortgage Products

- **Lien status**
  - First lien could grant debt holders the first right to receive proceeds on liquidity.
- **Original loan term**
  - Mortgage terms of 10-30 years are common, but the most popular one in U.S is 30-year product.

Residential Mortgage Products

- **Credit classification**
- Classifying loans between prime and subprime is determined mainly by credit score (i.e., Fair Isaac Corporation or FICO model).
- Prime (A-grade) loans constitute most of the outstanding loans. They have low rates of delinquency and default as a result of low loan-to-value (LTV) ratios (i.e., far less than 95%).
- Subprime (B-grade) loans have higher rates of delinquency and default compared to prime loans.
- Alternative-A loans are the loans in between prime and subprime.

Residential Mortgage Products

- **Interest rate type**
- Fixed-rate mortgages: rate of interest is fixed
- Adjustable-rate mortgages (ARMs): similar with floating rate bonds
  - It is usually based on "base rate + spread".
  - For example, LIBOR+250bps

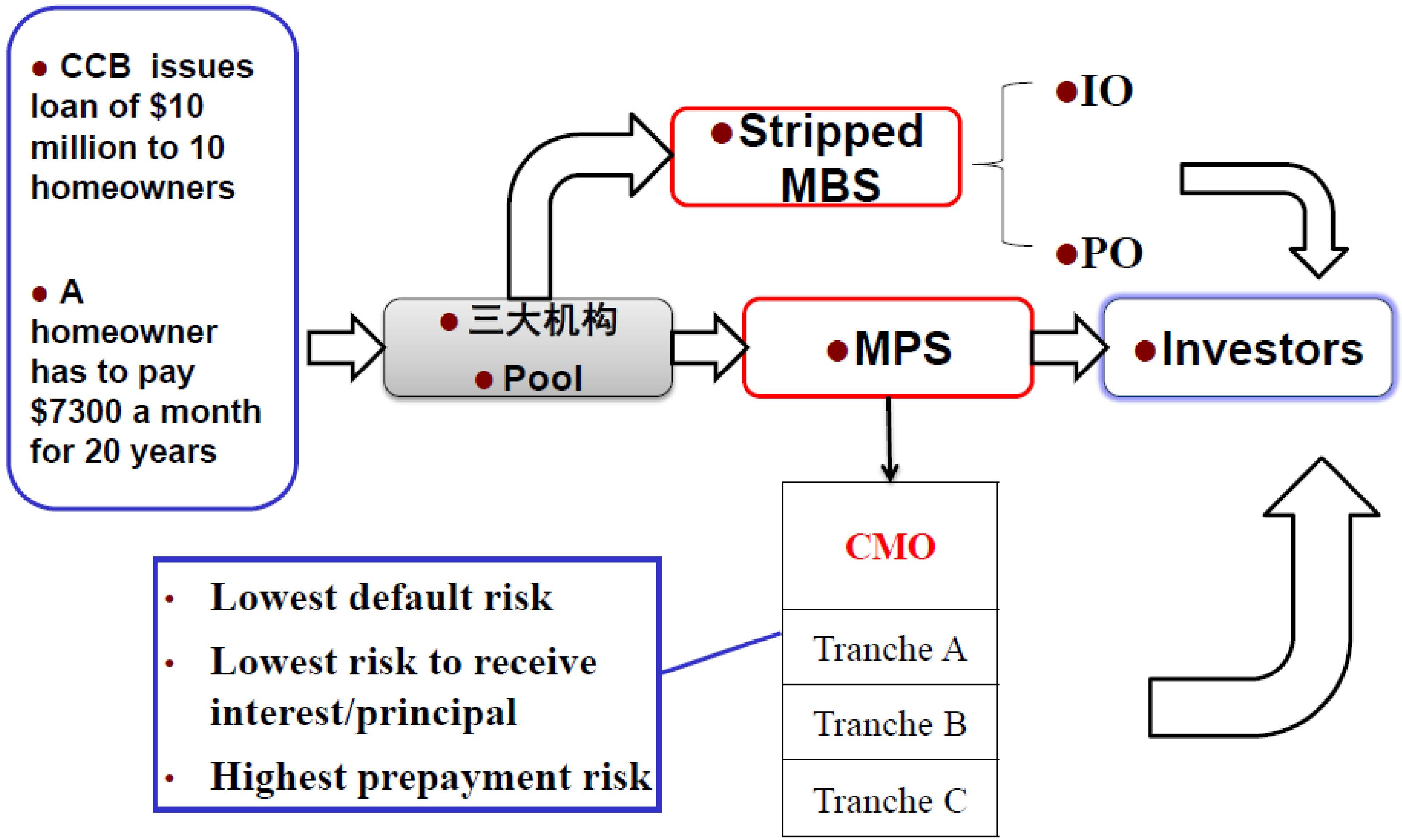
Residential Mortgage Products

- **Prepayments and prepayment penalties**
- Prepayments reduce the mortgage balance and amortization period.
- Three reasons to prepay earlier
  - Selling house
  - Refinancing at lower rates
  - Partial prepayment
- Sometimes penalties on prepayment exist.

Residential Mortgage Products

- **Credit guarantee**
- Government loans are those that are backed by federal government agencies (Government National Mortgage Association, GNMA).
- Conventional loans could be securitized by either government-sponsored enterprises: Federal Home Loan Mortgage Corporation (FHLMC) or Federal National Mortgage Association (FNMA).
- Agency (or conforming) MBSs are those that are guaranteed by any of three government-sponsored entities: GNMA, FNMA, and FHLMC.
- Private label securitizations

Process of MBS



Monthly Payments

- **Example**
- Bennett Bank extends a 5% APR (annual percentage rate) USD 100,000 30-year mortgage requiring monthly payments. If the mortgage is structured so that it requires interest-only payments for the first 5 years, after which point it becomes a self-amortizing mortgage, what would be the portion of the monthly payment applied to the principal in the 61st month?
- A. USD 167.92
- B. USD 174.60
- C. USD 584.59
- D. USD 591.27

Monthly Payments

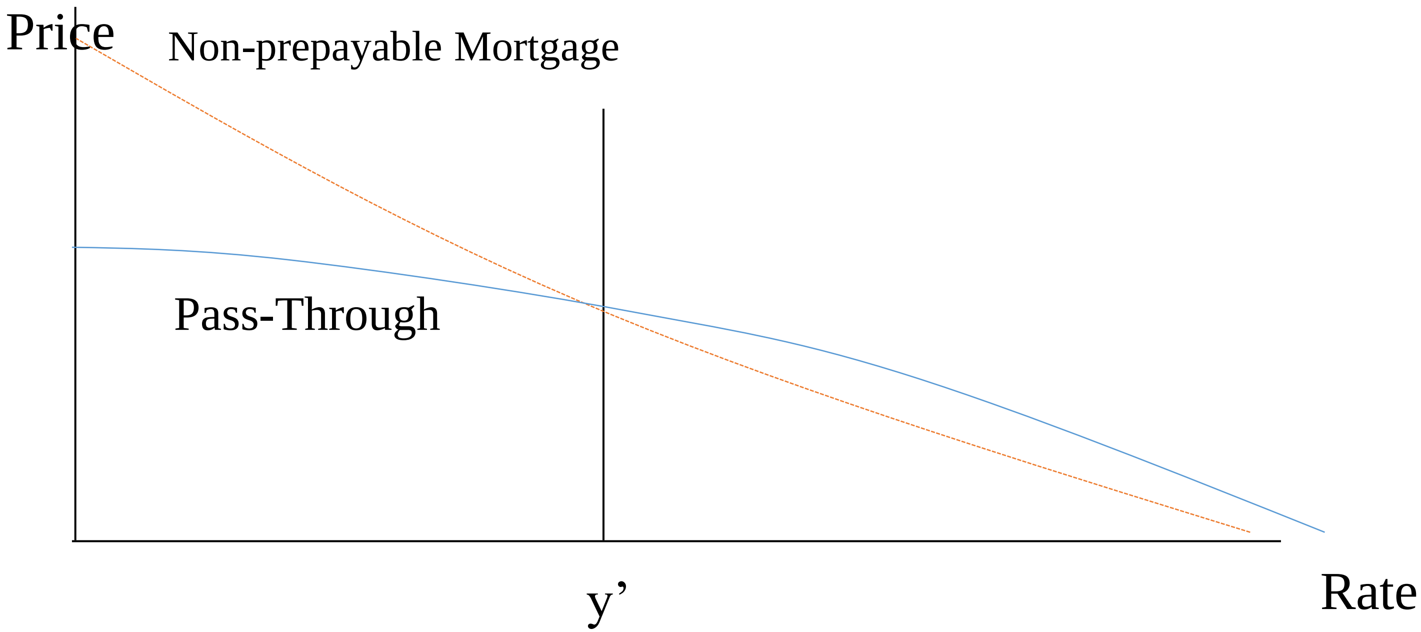
- **Answer: A**
- It is the same as a 25-year self-amortized loan.
- N=25*12, PV=100,000, FV=0, I/Y=5%/12, CPT PMT=-584.59
- Interest in 61^{st} month=100,000*5%/12=416.67
- Principal paid=584.59-416.67=167.92

Prepayment Risk and Factors Affecting Prepayment

- The borrower in a mortgage is very similar to the issuer of a callable bond. The lender has prepayment risk.
- The main factors that affect prepayments:
  - prevailing mortgage rates (当前的利率水平)
    - Spread between the current mortgage rate and the original mortgage rate.
    - Path of mortgage rates
    - Level of mortgage rates
  - The characteristics of the underlying mortgage loans (抵押贷款的本身特点)
  - Seasonal factors (季节因素)
  - General economic activity (一般经济因素)

Price-Rate Curve of a Mortgage Pass-Through Security

Price-Rate Curve of a Mortgage Pass-Through Security



- Contraction risk
  - ✓ Negative convexity
  - ✓ Reinvestment risk
- Extension risk

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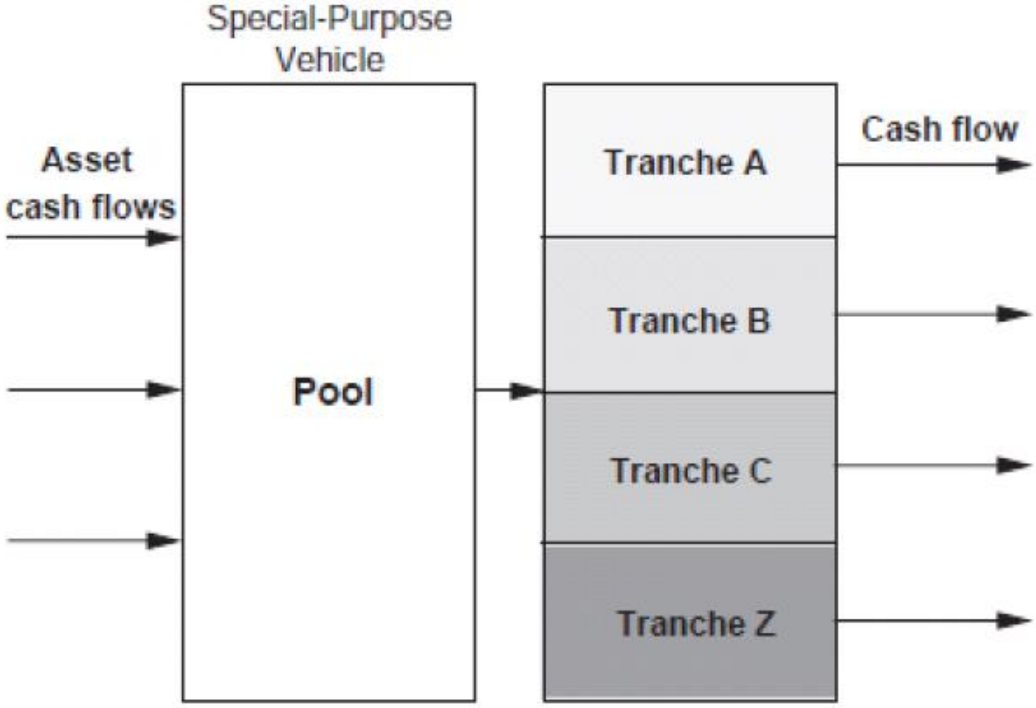
CMO

Collateralized Mortgage Obligations, CMO



Contraction risk	Extension risk
HIGH	LOW
↓	↓
LOW	HIGH

Tranching

Principal pay down window

PAC

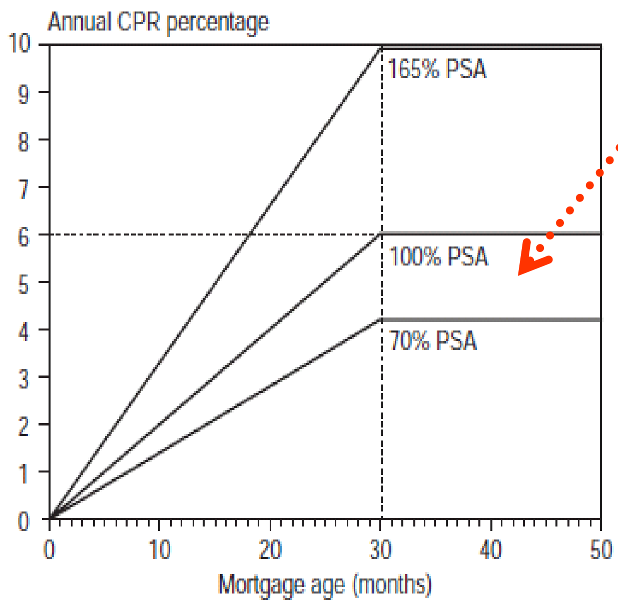
- PAC means planned amortization class tranches
- The most common type of CMO today is the planned amortization class (PAC).

<table>
<tr><th colspan="2">Tranche</th><th>Prepayment risk</th></tr>
<tr><td rowspan="3">PAC Tranches</td><td>A</td><td rowspan="4">LOW
↓
HIGH</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td></tr>
<tr><td colspan="2">Support tranche
(may lead to broken or busted PAC)</td></tr>
</table>

Measuring Prepayment Speeds

- Indictors of prepayment risk-prepayment rates
- Single monthly mortality rate (SMM):
  - The percentage by which prepayments reduce the month-end principal balance, compared to what it would have been with only scheduled principal payments (with no prepayments).
- Conditional prepayment rate (CPR)
  - An annualized measure of prepayments.

Measuring Prepayment Speeds



Prepayment Pattern

Public Security Association(PSA)

Conditional Prepayment Rate (年化提前还款率)

$$CPR = \text{Min}[6\% \times (t/30),\ 6\%]$$

Single Monthly Mortality Rate

$$SMM = 1 - (1 - CPR)^{1/12}$$

- Notes:
  - ✓ An SMM of 10% implies that 10% of a pool's beginning of month outstanding balance, less scheduled payments, will be prepaid during the month.

Measuring Prepayment Speeds

- The PSA prepayment benchmark assumes that the monthly prepayment rate for a mortgage pool increases as it ages or becomes seasoned. The PSA benchmark is expressed as a monthly series of CPRs.
- The PSA standard benchmark is referred to as 100% PSA (or just 100 PSA). 100 PSA assumes the following graduated CPRs for 30-year mortgages:
- CPR = 0.2% for the first month after origination, increasing by 0.2% per month up to 30 months. For example, the CPR in month 14 is 14(0.2%) = 2.8%.
- CPR = 6% for months 30 to 360.

Measuring Prepayment Speeds

- Compute the CPR and SMM for the 5th and 25th months, assuming 100 PSA and 150 PSA.
- Assuming 100 PSA:
- CPR(month 5) = 5 x 0.2% = 1%
    - 100 PSA = 1 x 0.01 = 0.01
    - SMM = $1 - (1 - 0.01)^{1/12} = 0.000837$
- CPR (month 25) = 25 x 0.2% = 5%
    - 100 PSA = 1 x 0.05 = 0.05
    - SMM = $1 - (1 - 0.05)^{1/12} = 0.004265$

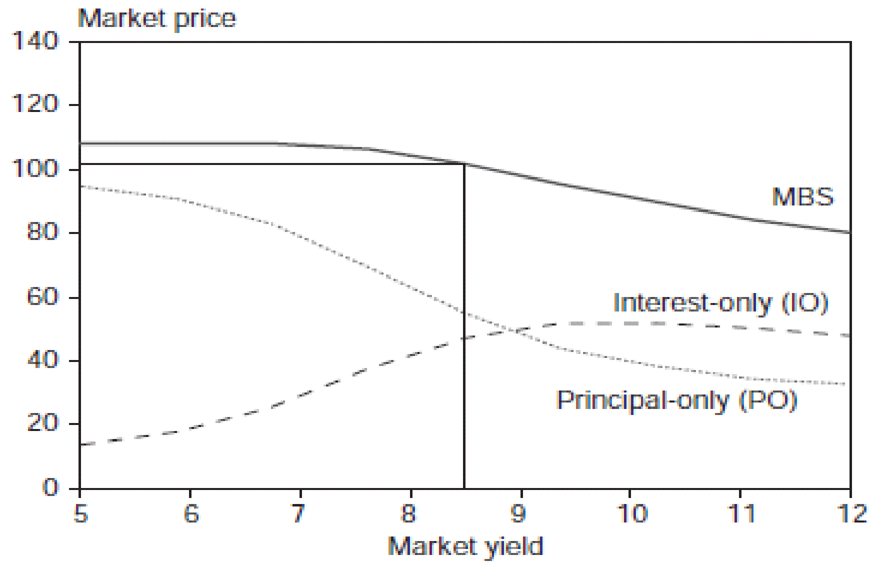
Trading Pass-Through Securities

- Fixed rate pass-through securities trade in one of the following ways:
  - Specified pools: The specified pools market identifies the number and balances of the pools prior to a trade. As a result, the characteristics of a given pool will influence the price of a trade.
  - To Be Announced (TBA): The TBA market, which is more liquid than specified pools, involves identifying the security and establishing the price in a forward market. However, there is a pool allocation process whereby the actual pools are not revealed to the seller until immediately before settlement. The characteristics of the pools that can be used for TBA trades are regulated to ensure reasonable consistency.

Stripped MBS

- Principal-only strips (PO)
- Interest-only strips (IO)

Investment Characteristics of IO and PO

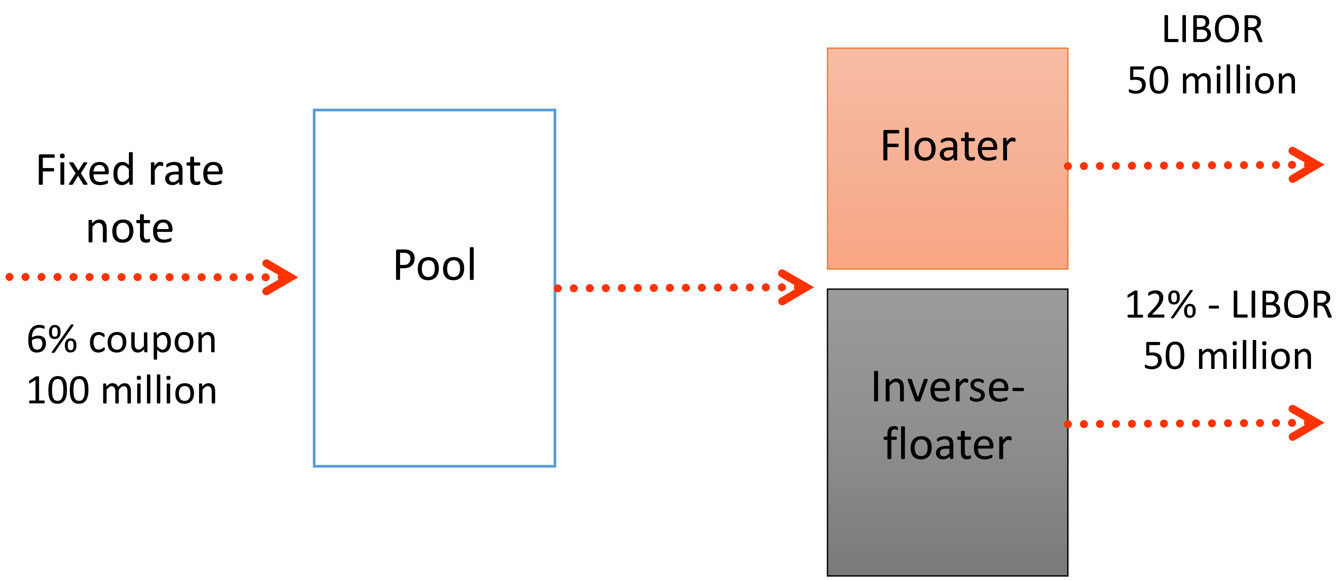


Creating an IO and PO from an MBS

Characteristics for IO and PO

- The underlying MBS exhibits significant negative convexity.
- The PO exhibits some negative convexity at low rates.
- The IO price is positively related to market rate at low current rates, so it have negative duration.
- The PO and IO prices are more volatile than the underlying.

Tranching: Inverse Floaters



COUPON :100 × 6% = 6 = 50 × (LIBOR) + 50 × (12% - LIBOR)

Prepayment Modeling

- The most common practice identifies four components of prepayments:
  - Refinancing
  - Turnover
  - Defaults
  - Curtailments

Dynamic Valuation

- Binomial model is only applicable for securities where the decision to exercise a call option is not dependent on how interest rates evolve over time.
- Monte Carlo methodology is a simulation approach for valuing MBSs.
- Best guess approach uses the expected value of each variable to estimate the value of the MBS. Unfortunately, this method is highly inaccurate.

Dynamic Valuation

Monte Carlo methodology

- A process of steps rather than a specific model

Step 1: Simulate the interest rate path and refinancing path

⇩

Step 2: Project cash flow for each interest rate path

⇩

Step 3: Calculate the present value of cash flows for each interest rate path

⇩

Step 4: Calculate the theoretical value of the mortgage security

Option-adjusted Spread

- The **zero-volatility spread** (z-spread, 零波动率利差) is a spread measure that an investor realizes over the entire Treasury spot rate curve, assuming the mortgage security is held to maturity.
- The **option-adjusted spread (OAS)** is defined as the spread, K, that, when added to all the spot rates of all the interest rate paths, will make the average present value of the paths equal to the market price.

Option-adjusted Spread

- There are four important limitations to consider when using OAS:
  - Modeling risk associated with Monte Carlo simulations.
  - Required adjustments to interest rate paths.
  - An underlying assumption of a constant OAS over time in the model.
  - The dependency of the underlying prepayment model.

Summary

✓ MBS

- Mortgages
- Prepayment
- Prepayment risk modeling

✓ Exam Tips

- Prepayment risk
- CPR and SMM
- CPR的计算模型不要求掌握

Practice 1

- **FRM EXAM 1999—QUESTION 51**

✓ Suppose the annual prepayment rate CPR for a mortgage-backed security is 6%. What is the corresponding single-monthly mortality rate SMM?

A. 0.514%

B. 0.334%

C. 0.5%

D. 1.355%

- Answer : A

✓ Using $(1 - 6\%) = (1 - SMM)^{12}$, we find SMM = 0.51%.

Practice 2

- **FRM EXAM 2000—QUESTION 3**
- How would you describe the typical price behavior of a low premium mortgage pass-through security?
  - A. It is similar to a U.S. Treasury bond.
  - B. It is similar to a plain-vanilla corporate bond.
  - C. When interest rates fall, its price increase would exceed that of a comparable duration U.S. Treasury bond.
  - D. When interest rates fall, its price increase would lag that of a comparable duration U.S. Treasury bond.

- Answer : D
- ✓ MBSs are unlike regular bonds, Treasuries, or corporates, because of their negative convexity. When rates fall, homeowners prepay early, which means that the price appreciation is less than that of comparable-duration regular bonds.

Practice 3

- **FRM EXAM 2004—QUESTION 45**

  As the CRO of a firm specializing in MBSs, you have been asked to explain how interest-only (IO) strips and principal-only (PO) strips would react if interest rates change. Which of the following is *true?*

  A. When interest rates fall, both PO and IO strips will increase in value.

  B. When interest rates fall, POs will increase in value, IOs decrease in value.

  C. When interest rates rise, POs will increase in value, IOs decrease in value.

  D. When interest rates rise, both PO and IO strips will increase in value.

- Answer 3: B

✓ POs have positive duration, IOs negative. Hence they react in opposite directions to falls in interest rates.

You're a Champion!

Thanks for staying with us. You have finished this chapter.